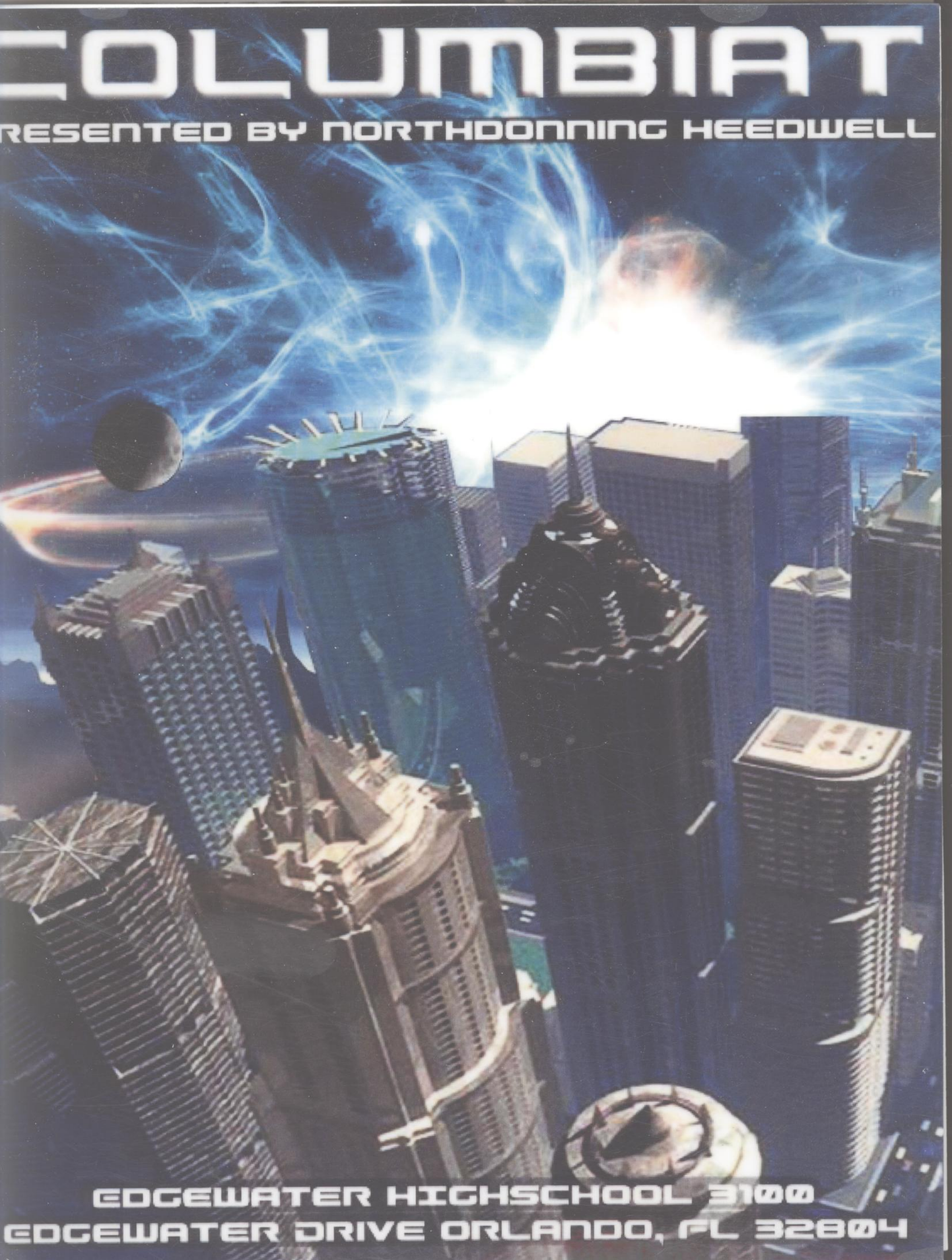
COLUMBIAT

RESENTED BY NORTHDONNING HEEDWELL



EDGEWATER HIGHSCHOOL 3100
EDGEWATER DRIVE ORLANDO, FL 32804

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1.0. Executive Summary

As humanity and technology continue their rapid progression, we must look to the stars for the next and final frontier. With Bellevistat established as the first extraterrestrial manufacturing center, Columbiat will be the nervous system of The Foundation's Society's quest, the next step in taming the majestic wilderness of space. Northdonning Heedwell has designed Columbiat to be the next advancement to the Foundation Society's goals – combining a highly-efficient, commerce suitable design with cutting-edge technologies that will define a new age of humanity.

Columbiat's design will make it the summit of commercial trade and business ventures, providing maximum convenience for transient businessmen, residents and tourists alike. From the initial moment of arrival, visitors will enjoy a prompt docking process, made efficient by four separate levels with the capacity of simultaneously docking up to eight ships. Time consumed for transportation will be minimized by the Elesphere, a spherical elevator that will safely transport large groups at high speeds anywhere around the station by means of the fifteen storage struts.

Columbiat will produce energy to match its reputation as a "city that never sleeps", utilizing a high efficiency thorium nuclear reactor to produce massive amounts of energy with minimal input material. This energy production will be compounded by black silicon solar satellite farms and Power Paths, a system that harnesses energy produced by pedestrians. For residents' ease of mobility, scooters capable of traveling in single and multi-unit configurations will be available at the convenience of travelers for navigating throughout the station. For high speed transit, Rapid-rail trains will run throughout the settlement, routing residents directly to their place of business.

In order to create the most enjoyable, efficient lives for the residents of Columbiat, the station will meld technologies of the future with conventional wisdom. To create the most relaxing, personable environment possible, citizens will have the opportunity to choose one of four base floor plans and have the option to customize the architectural style to suit their particular tastes. For any person who may find themselves working in the extraterrestrial environment, Columbiat will provide innovative, customized spacesuits. Each spacesuit will be fitted using 3D body scans, ensuring that the suit will be comfortable for the wearer and that issues associated with mechanical counter pressure system will be prevented.

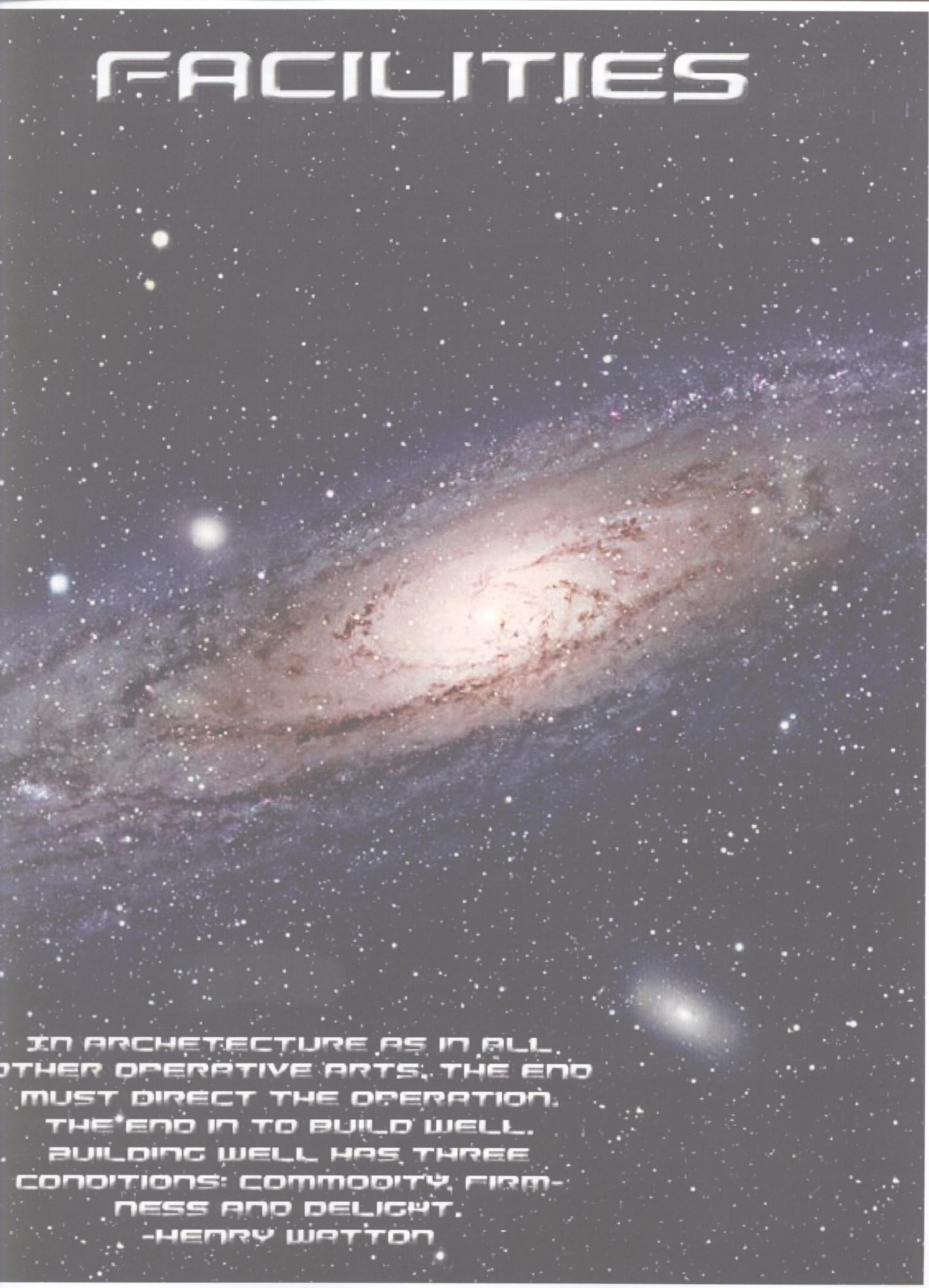
For the residents' benefit, automated systems will take care of many aspects of daily life. Robotic systems throughout Columbiat will work to maximize human comfort by working towards the best and most efficient solution for any situation. All robotic systems will be linked to EVO Centers, stations where robots will be carefully analyzed for efficiency and upgraded based on the findings. While external systems will be handling tedious tasks, making additional time available for residents, the AR-Eye will provide simplified interaction with their environment, ushering in a new age of computer-human interface.

Located at the L2 Lagrange point, Columbiat will act as an epicenter of travel and trade, offering the Foundation Society both a source of endless profitable investments and starting point for future space colonization. The commercial sectors will contain office space featuring automated moving walls to offer infinite configurations. The Foundation Society itself will have a spacious, state-of-the-art facility for its own headquarters, permitting effective monitoring, maintenance, and upgrading of the station.

Columbiat will become fully functional just 15 years after construction commences. Within 13 years of becoming operational, the station's varied enterprises will repay the Foundation Society's investment, becoming a self-sufficient, profitable settlement.

Now that humans have reached their limitations on our home planet of Earth, it is time to begin the refinement of space. Columbiat will serve as a multi-purpose commerce hub for the current and future settlements. Northdonning Heedwell with the Foundation Society will construct the commerce center of the future, the first thriving metropolis beyond the Earth.

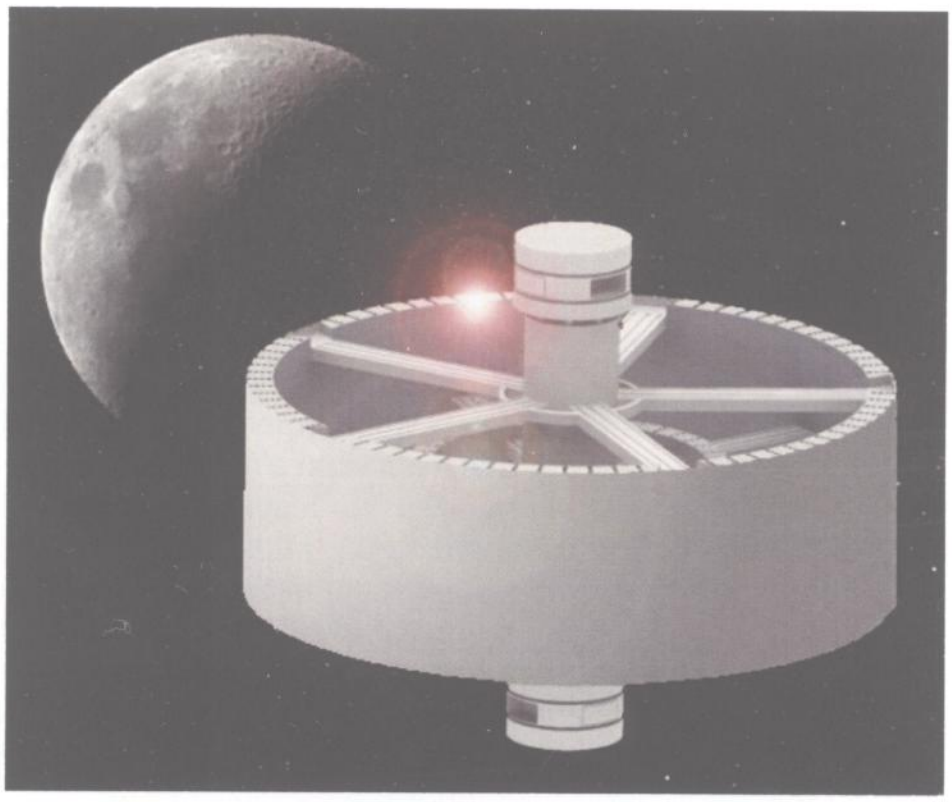
FACILITIES



IN ARCHETECTURE AS IN ALL OTHER OPERATIVE ARTS, THE END MUST DIRECT THE OPERATION. THE END IN TO BUILD WELL. BUILDING WELL HAS THREE CONDITIONS: COMMODITY, FIRMNESS AND DELIGHT.
-HENRY WATTON

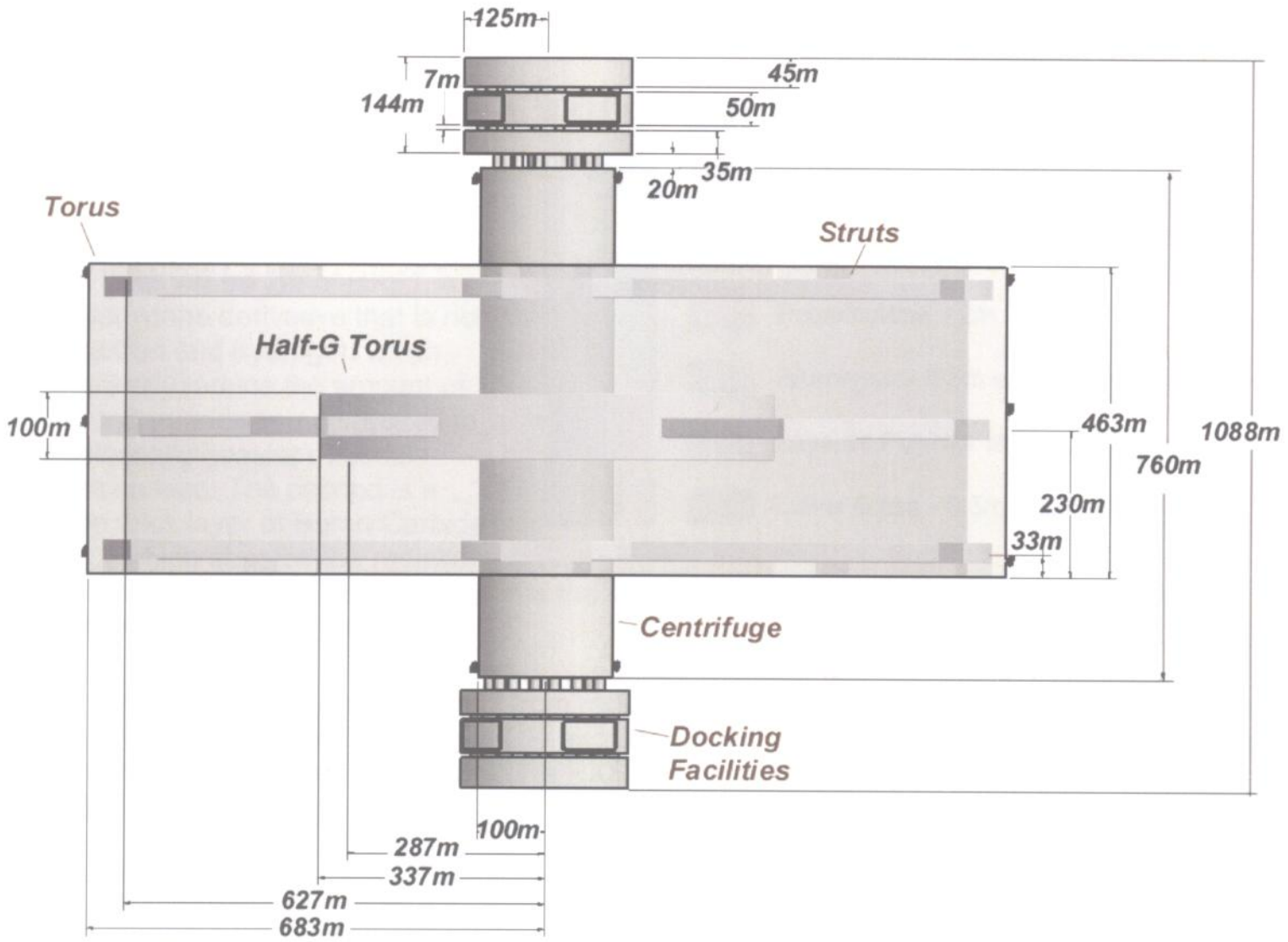
2.0. Facilities

2.0.1. Population and Natural Views



Columbiat will provide a home to 22,000 permanent residents as well as a home away from home for up to 5,000 transient businessmen and workers. An array of silicon carbide mirrors will be placed on the surface of the moon and on communication satellites orbiting synchronously with Columbiat in order to reflect views of Earth to the station. The reflected images will be combined and corrected to provide a non-distorted view of Earth to the population through the station's layered polymer nanocomposite windows. All mirrors will automatically adjust themselves to provide the best view of Earth and prevent unnecessary interference, such as glare from sunlight.

2.1. Exterior Design



2.1.1.Construction Materials

Material	Description
Aluminum	Aluminum will be used as the skin for the station.
Titanium	Titanium is a light weight metal that is corrosion-resistant and very strong. It will be used to secure the the hull.
Martensitic-hardened Steel	Martensitic-hardened steel is an enhanced version of steel that can withstand corrosion and extreme heat. These grades are mainly used where hardness, strength and wear resistance are required. This type of steel contains chromium and nitrogen.
Silicon Carbide	Silicon Carbide is a unique compound that will be used for reflecting visible light to reflect the Earth's natural views.
RXF1	This polymer is an effective shield for radiation because of its low production of secondary radiation. When the radiation hits the RXF1 small reactions happen and block the radiation. It is very strong and improve the structural integrity of the hull.
Ultrastrong and Stiff Layered Polymer Nanocomposites	This polymer will be used for the windows on the station because of the strength due to the layers of nanocomposites stacked on top of each other similar to bricks.
Lunar Glass	Lunar glass will be used as a radiation protection shield. The lunar glass will be put on both sides of the Ultrastrong and Stiff Layered Polymer Nanocomposites to ensure maximum protection from radiation.
Boron Carbide	Boron carbide will be used for radiation protection because of its high resistance to radiation.

Columbiat's radiation protection will consist of two separate layers placed near to the outside of the hull in order to minimize secondary radiation created by the metal framing. The first layer will be 2m of RXF1, a polyethylene derivative that is rich in carbon and hydrogen which drastically reduce the amount of secondary radiation compared to traditionally heavier materials such as lead. The second is a 1.5m thick layer of Boron Carbide (B_4C) which absorbs the radiation that penetrates the RXF1 and absorbs the neutrons from the small amounts of secondary radiation produced by the RXF1.

While these materials protect from radiation, when combined with the metal alloys used in the station's construction, they provide excellent debris protection. Boron Carbide is the fifth hardest material known to man and the RXF1 provides the desirable ballistics protection for small meteor strikes.

2.1.2.Volumes

Volumes by Pressure:

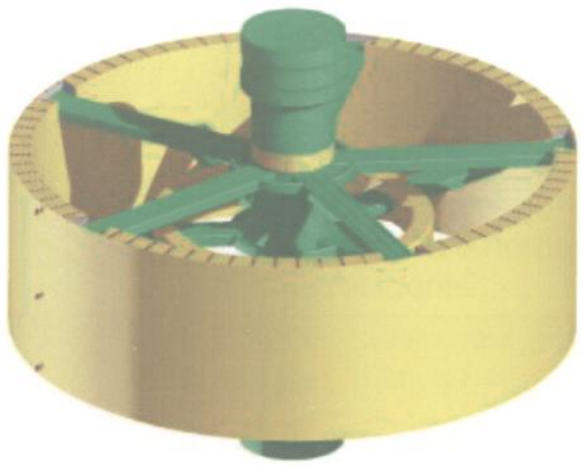
Category	Location/s	Volume	Purpose
Pressurized	Main Torus, Elevators, Docking, Centrifuge segments, Half-G Torus	130,198,469m^3	Furnishes a habitable environment for residents
Unpressurized	Basement, Centrifuge segments, Struts	48,970,380m^3	Conserves resources such as air and energy

Pressurized and Unpressurized Volumes

Pressurized

Unpressurized

Rotating Volumes



Clockwise Rotation

Counter-clockwise Rotation

Volumes by Rotational Direction:

Category	Location/s	Volume	Purpose
Counter-clockwise rotation	Docking, Zero-G Section of Centrifuge	15,747,233.2m^3	To create an artificial zero gravity environment
Clockwise rotation	Torus, Centrifuge, Half-G Torus,	163,421,616m^3	Generate an environment with artificial gravity

2.1.3.Artificial Gravity

Artificial gravity will be provided by the centrifugal force resultant from spinning the station at 1.15 revolutions per minute. 1.15 RPM is near the ideal rate of 1 RPM and will provide a comfortable environment for humans without any negative Coriolis side effects.

High-powered helicon thrusters will be attached to the side of the torus. If there is any deviation from the rotation rate, one of Columbiat's computers will calculate the amount of thrust needed to correct the problem. The thrusters will then provide propulsion to ameliorate the complication and provide a rotation rate of 1.15 RPM.

Electromagnets built into the centrifuge will pull the centrifuge and docking facilities opposite the torus. The centrifuge will rotate opposite the torus in order to generate a zero-G environment in order to make docking facilities stationary relative to space, and to provide for Zero-G facilities.

2.2. Interior Spaces

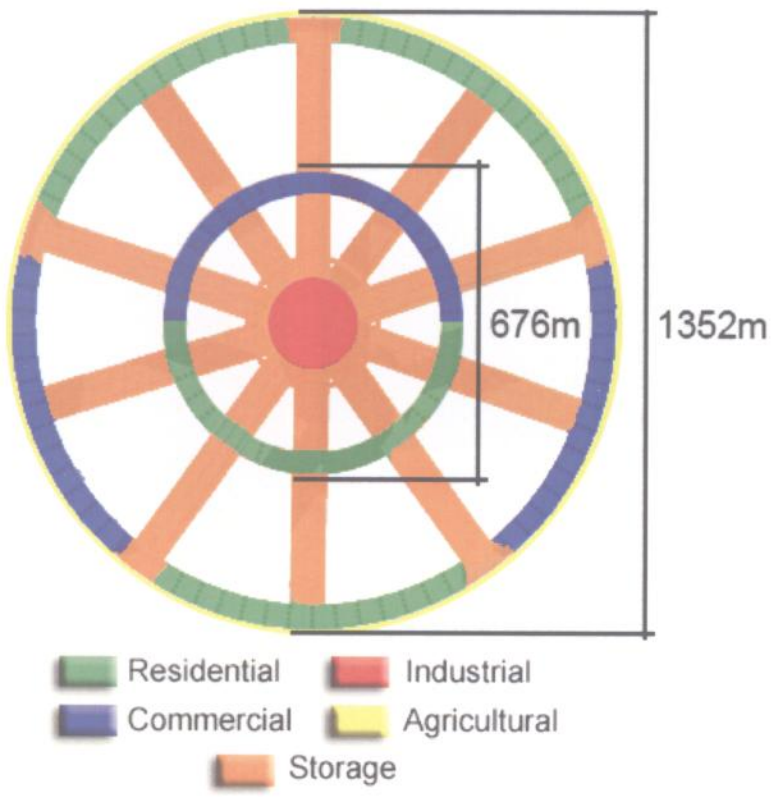
Columbiat's unpressurized volumes will be utilized for cargo storage, housing for agricultural and industrial systems, and for the station's background automated operations. Volumes with artificial micro-gravity will permit efficient handling and storage of cargo while also providing an area for low-gravity sports entertainment. Volumes with artificial zero gravity will be used both for further entertainment opportunities and as facilities to be rented by companies for research and development. Zero gravity volumes within the docking facilities serve to make docking easier and cargo handling more efficient.

(Standard Vertical Clearance)

Volumes by Gravity:

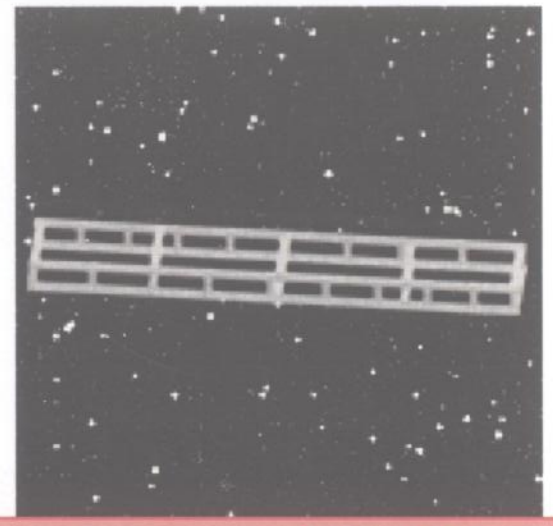
Category	Location/s	Volume	Purpose
Earth (1g) (artificial)	Main Torus	113,760,840 m^3	Will provide a healthy environment for humans to live and function in
Half Gravity (artificial)	Half-g Torus	9,833,185 m^3	A setting for visitor transitions and a home for elderly residents
Micro Gravity	Centrifuge	20,891,591 m^3	Efficient movement and storage of cargo
Zero Gravity (artificial)	Industrial centrifuge and docking	15,747,233 m^3	Allows easy manipulation of cargo, can be rented out for industrial endeavors, and entertainment
Variable Gravity	Spokes	18,936,000 m^3	Accommodates the transition from full to zero gravity

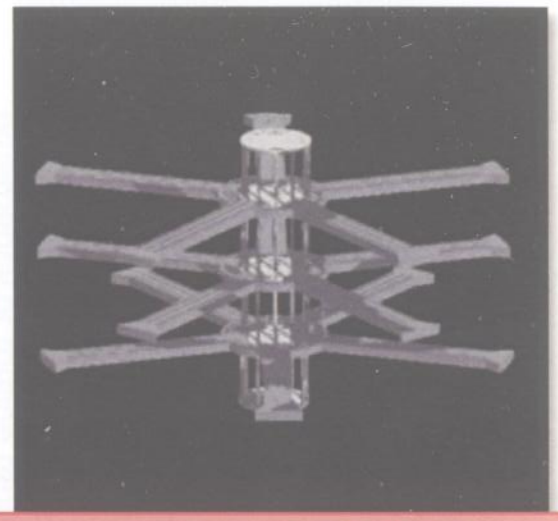
Interior Land Area Allocation



2.3. Construction Process

0. Kootenay – 05/44
Deliver material to L2 construction site

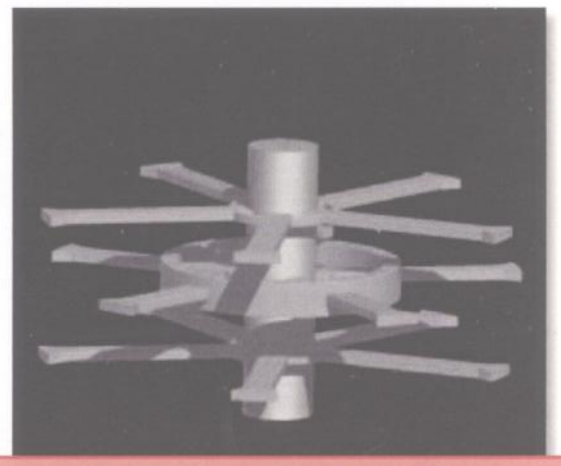


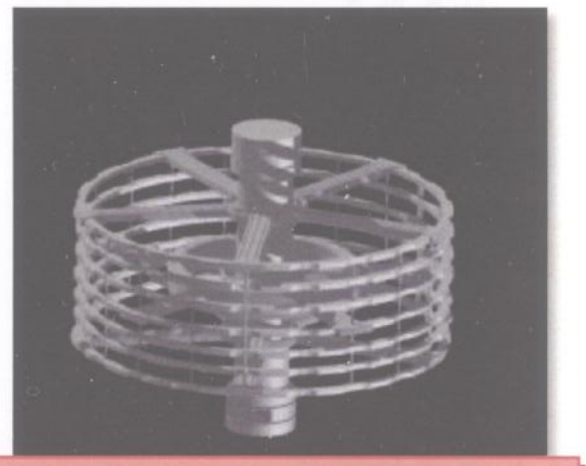


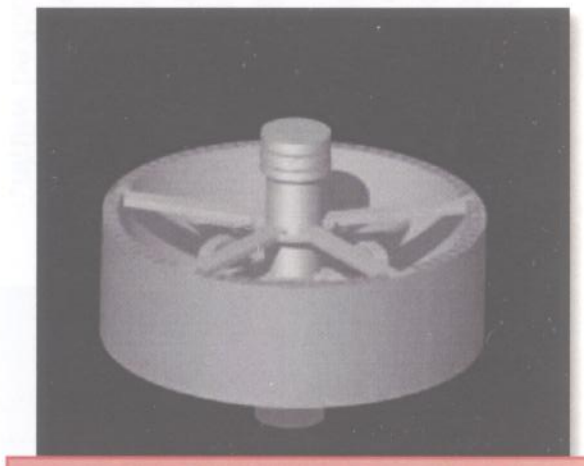
1. Wenatchee - 06/44- 12/46
Construct centrifuge frame with triangular struts produced by Bellevistat

2. Okanagan- 12/46-12/47
Construct 15 strut frames from triangular trusses

3. Spokane- 12/47-12/48
Provide paneling to the spokes and attach to the centrifuge frame







4. Yakima- 07/48-12/51
Begin construction of half-gravity torus around the spokes, attach exterior paneling to centrifuge

5. Deschutes- 12/51-12/54
Build torus frame and attach to the ends of the struts, construct docking

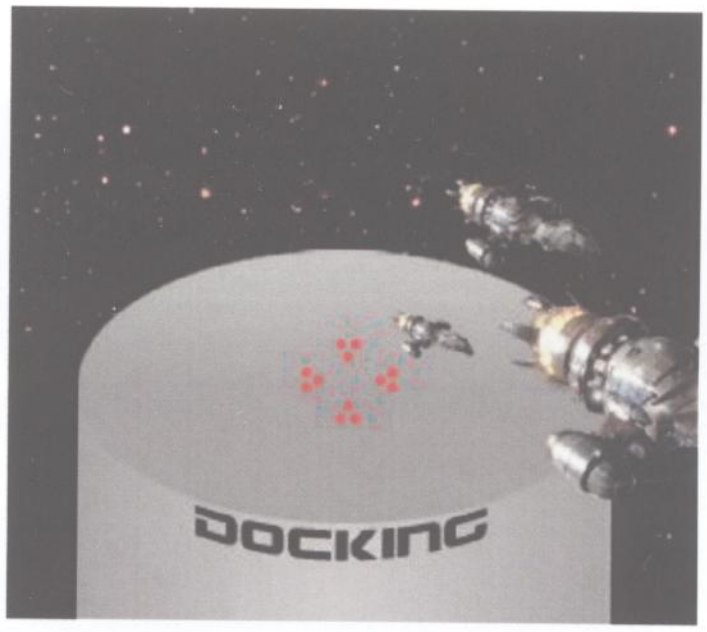
6. Willamette- 09/54-12/58
Attach exterior torus hull

7. Lewis - 12/56-07/59
Interior Construction and interior finishing: rooms, buildings, storage space, and infrastructure.

8. Cowlitz - 07/59
Columbiat is complete and fully operational.

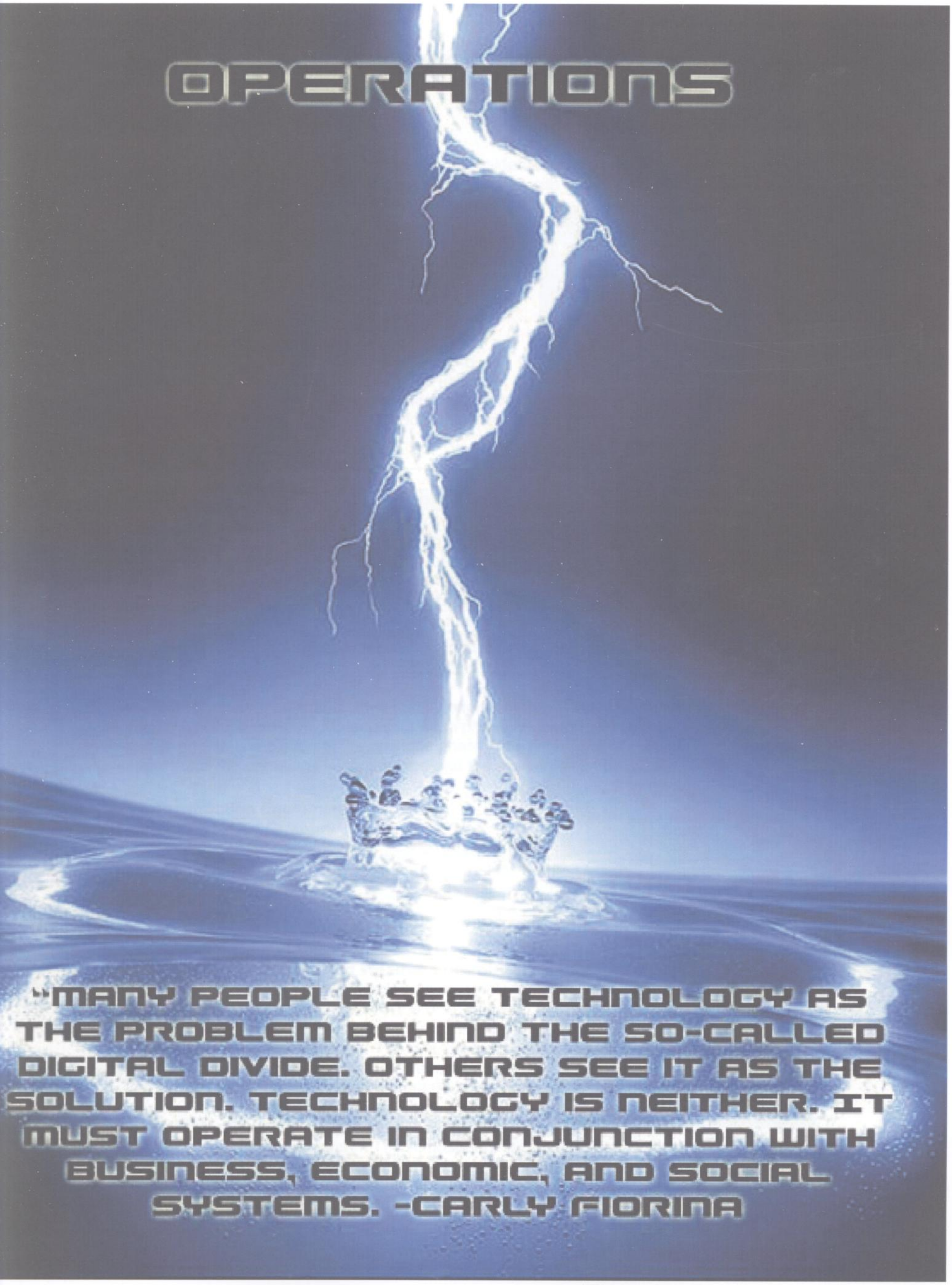
2.4. Port Facilities

Docking facilities consisting of two docking levels and two hangar levels will be constructed at both ends of the centrifuge. The entire docking facility will be spun by electromagnets in the opposite direction of the rest of the station in order to make the platform stationary relative to the docking ships. Two cargo ships can dock on the outermost platform of each docking facility, where they will be guided down into the hangar below. Cargo will be unloaded by Koniks and distributed through the station as needed. Two passenger ships can dock in the middle platform where their passengers will be unloaded into the Elesphere before the ships are guided into the lowest hangar level. Every hangar level is equipped with maintenance services to make emergency or routine repairs to ships docked within.



2.5. Low-gravity Accommodations

Columbiat will have a secondary torus designed to accommodate transients that have recently arrived on low-gravity transport ships, providing a half-gravity environment to help these transients acclimate. This secondary torus will be connected to the rest of the stations by way of the central cargo struts, allowing for efficient transportation to and from both the centrifuge and main torus, as well as keeping the secondary torus rotating at the same rate as the rest of the station. The secondary torus will be furnished with residential facilities for elderly permanent residents as well as commercial and entertainment facilities. For more on the method of rotation, see 2.1.3

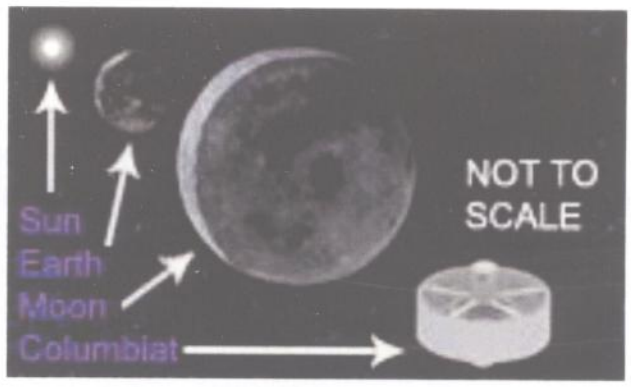

OPERATIONS
"MANY PEOPLE SEE TECHNOLOGY AS THE PROBLEM BEHIND THE SO-CALLED DIGITAL DIVIDE. OTHERS SEE IT AS THE SOLUTION. TECHNOLOGY IS NEITHER. IT MUST OPERATE IN CONJUNCTION WITH BUSINESS, ECONOMIC, AND SOCIAL SYSTEMS. -CARLY FIORINA

3.0. Operations

3.0.1. Conduct of Business

Operations on Columbiat will ensure that residents are provided with all the needs for a healthy and productive life while conserving resources with efficient system designs.

3.0.2. Accommodation for Ingoing and Outgoing Vehicles



Incoming vehicles will dock in facilities located on the ends of the centrifuge. Docking stations will be fully equipped to transport residents into the torus via the Elesphere. The ships will then undergo restocking and maintenance, as described in section 3.5.

3.1. Settlement Construction

Columbiat will be constructed at the L2 earth-moon libration point. This placement allows for easier radiation and thermal shielding of the station and requires minimal adjustments for station keeping. The location also acts an ideal location for a lunar elevator in the future.

3.1.1. Construction Materials

Material	Use	Source
Aluminum	Outside "skin" of the hull	Bellevistat
Titanium	Structural plating	Bellevistat
RXF1	Radiation protection	Earth
Boron Carbide	Debris and secondary radiation protection	Alexandriat
Martensitic-hardened Steel	Hull framework	Bellevistat
Polymer Nanocomposites	Windows/ Natural Views	Alexandriat/Bellevistat
Lunar Glass	Clear Radiation Protection	Alaskol
Silicon Carbide	Mirrored Natural Views	Alexandriat

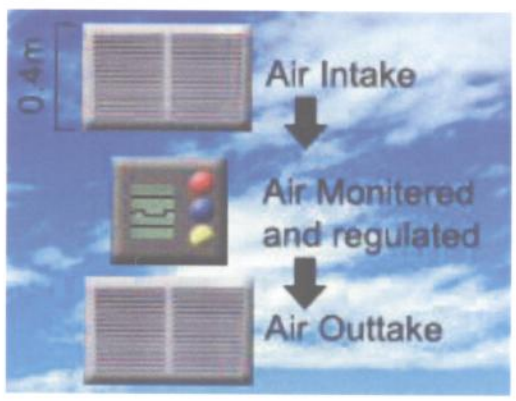
Construction materials for Columbiat will mainly originate from Bellevistat, while others will come from Alexandriat, Alaskol and Earth. Materials for each phase of construction will be shipped by Willamettes prior to completion of the previous phase. The first round of materials will be stored in the Williamettes until the centrifuge is constructed and the materials can be moved.

3.1.2. Construction Equipment

Equipment	Quantity	Use	Source
Triangular Trusses	300	Station framing	Bellevistat
Oxyacetylene Fuel	100,000 m^3	Fuel for welding robots	Earth
Tungsten-carbide Drills	1000	Replacement bits for drilling robots	Alaskol

3.2. Infrastructure for Operations

3.2.1. Atmosphere, Climate and Weather Control



The atmosphere on Columbiat will resemble that of earth's atmosphere in order to provide residents with a comfortable environment. The atmospheric pressure will be 101.3 kPa in the 1 G torus and 112 kPa to accomodate the elderly residents and transients in the half-G torus. The humidity will be kept between 40 and 60 and the temperature will vary from 20 – 27 degrees Celsius. A mild artificial wind will be generated to give residents a sense of being outdoors on earth. The Atmosphere will be regulated with an automated system for both security and safety. (See section 5.2 for more details.)

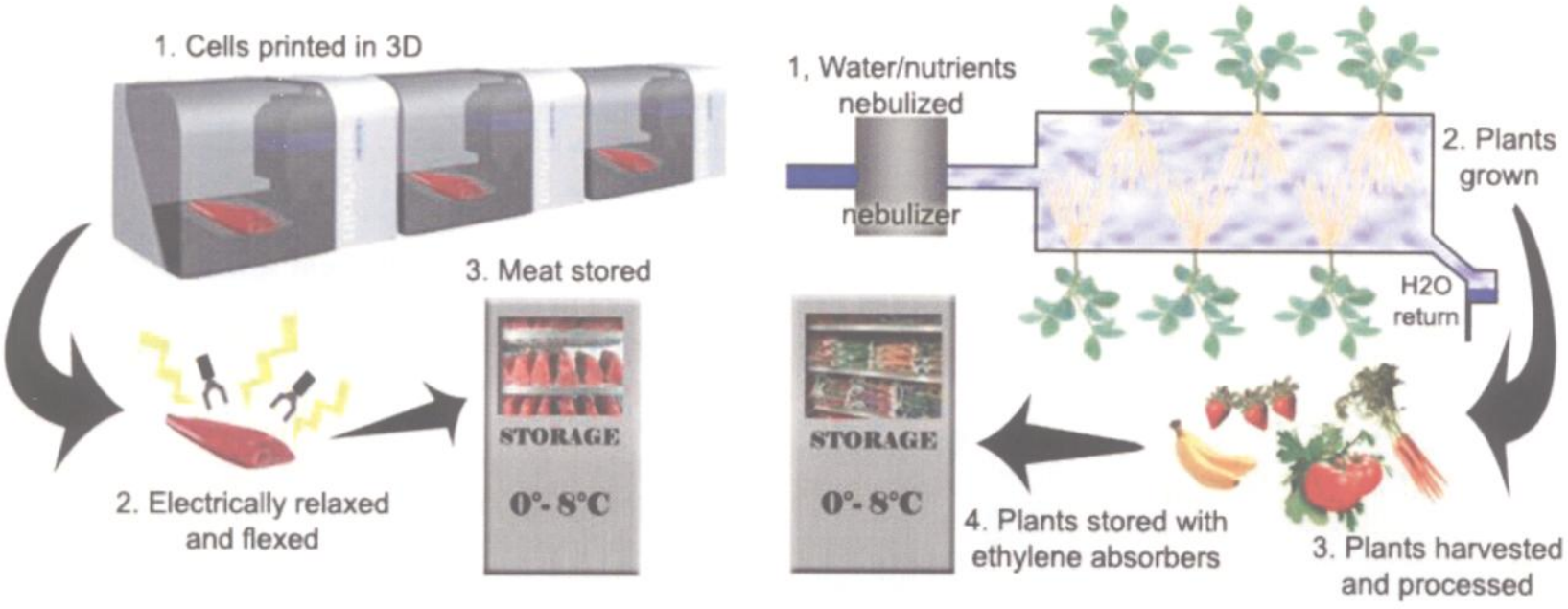
Component/Element	Volume
Nitrogen	78.08%
Oxygen	20.95%
Argon	0.93%
Carbon Dioxide	0.03%

3.2.2.Food Production

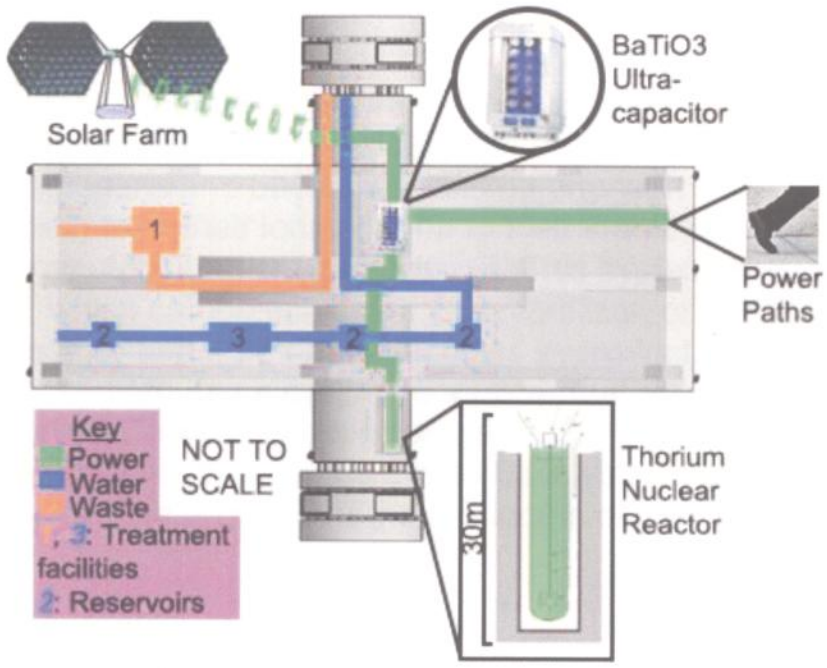
All plants on Columbiat will be grown using a nebulized aeroponics system. A solution of nutrients and water will be mixed and nebulized in a control center and pumped to plants through a series of pipes into aeroponic chambers. The vapor solution allows plants to more readily absorb water and nutrients, thus growing faster and healthier, while limiting equipment failure and flooding of roots. Plants will be grown in the basement and along walkways between the tops of buildings to provide a relaxing path for business goers.

Meat production will take place in "Printing Centers". Bio-printers will print a gel-like medium, creating a 3D tissue structure. Nutrients are added and harmful fats will be replaced with other substances. The meat is electronically flexed and relaxed, giving it a natural texture. Bio-printers will produce beef, chicken, pork, fish, giving many healthy options to residents without the resources needed for livestock.

Meat will be vacuum sealed and refrigerated or frozen, depending on the length they are required to be stored. Plants will be harvested and processed using an automated system that will seal permeable bags that allow ethylene to escape and keep them at a reasonable temperature. Food will be delivered to residents utilizing both a series of specialized tubes and the cargo portions of the Rapid Rail cabins. Goods will be delivered to either the residents' homes or to a local neighborhood depot for pick up.



3.2.3.Power Generation

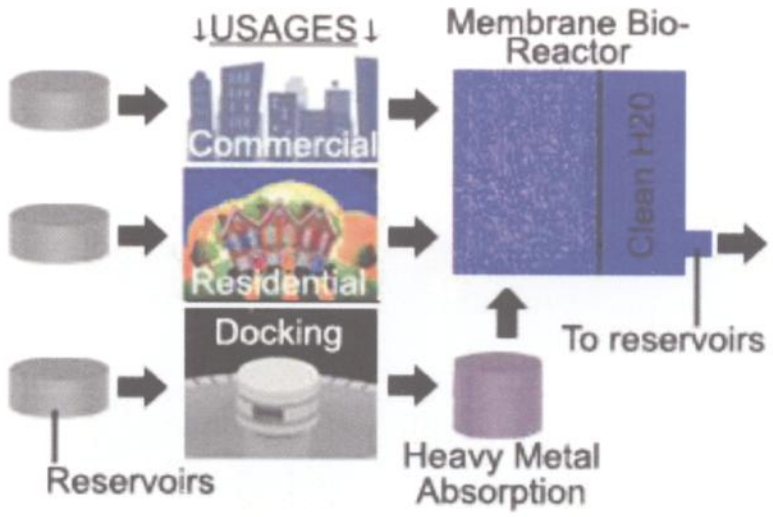


Power will be generated through black silicon solar panels, harvested from other systems, and a Thorium nuclear reactor. Solar panels made of black silicon absorb a larger range of light, increasing their efficiency. The panels will be a part of a solar satellite farm and will produce 350 MW per hour. Power Paths will also provide some energy that will be harvested as they run (see section 3.2.6). Power Paths will generate 4 MW per hour. A thorium reactor will be used to provide an additional 490 MW per hour. Thorium reactors allow for more efficient and safer nuclear energy production. It will also self-feeding, as a product of the reaction is Uranium, which can provide for further energy production. This system produces less waste than other reactors. Electricity will be distributed through super conducting wires that will be placed on the outside of the station for optimal efficiency due to the low temperature. Power will be stored using a BaTiO3 ultra super capacitor. Uses and totals can be found in the chart below.

Use	Amount allocated
Residents	40 MW
Commercial	45 MV
Life Support	750 MW
Robots	20 MW

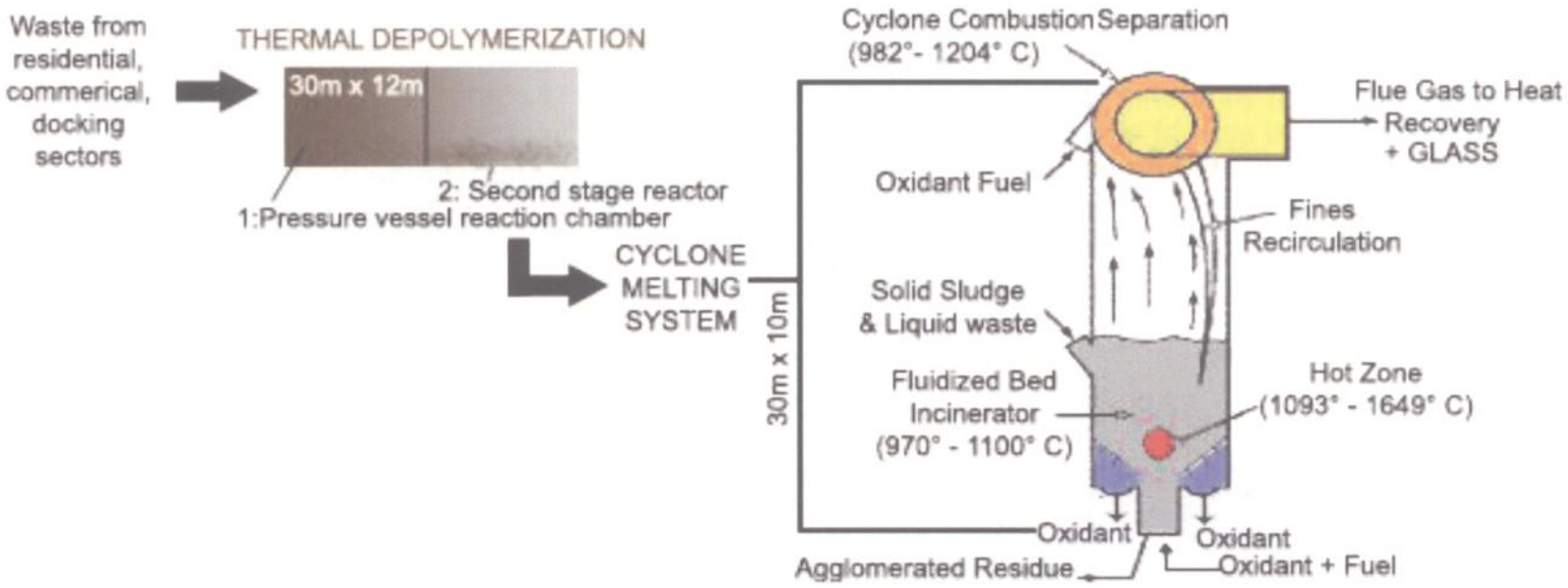
3.2.4.Water Management

Columbiat's water supply will be managed to provide the best quality water for residents. Water is stored in 3 reservoirs: one for residential, commercial, and docking. A total of 8414000 liters of water will be provided for residents, transients and visiting ships (see section 3.5).Once used in the appropriate system, water is pumped through ductile iron pipes to the processing plant. Residential and commercial wastewater will be purified using a membrane bioreactor system, while water from incoming ships will additionally treated with heavy metal absorption. Heavy metal absorption using nanostructured silica will remove contaminates such as lead, mercury, and zinc. The membrane bioreactor system uses Desulfitobacterium, which digests and breaks down a large range of organic and inorganic materials. After being treated by the bacteria, the water is forced through a membrane, leaving any non-digested pollutants as well as the desulfitobacterium behind. The water containing the bacteria will be monitored, and treated using a neutralization system, ensuring that the bacteria continue to work at full capacity.



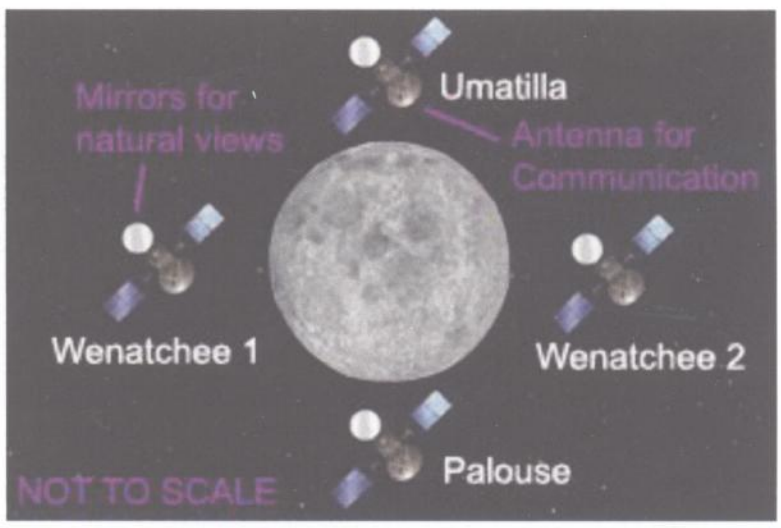
3.2.5.Waste Management

Waste will be treated with two systems, a thermal depolymerization system for organic waste and a cyclone melting system for inorganic waste. Thermal depolymerization breaks down the molecular shape of molecules, killing pathogens and bacteria, including prions. It also helps separate inorganic molecules, converting them from their ionized form to their stable oxides, which can then be harvested for re-use in manufacturing or sold for profit. This system also produces activated and fixed carbon solids, which can be used as a filter, fertilizer, or fuel. The cyclone melting system treats inorganic waste by turning them into a glass byproduct. Streams of inorganic waste are ground to a fine powder and fed into a cyclone container that acts as a combustion chamber operating at 1590 degrees Celsius. The high temperature fuses the components of the powder and produces waste fuels that can be cycled back into the system to generate power. The resulting glass can be purified and sold to the producers of items such as highly reflective mirrors and fiber optics.



3.2.6.Communication System

Columbiat will utilize both wireless and wired means of communication to maintain connectivity with both interior and exterior sources. Fiber optics cables are used for networking critical infrastructure systems within the station. Free Space Orbital Communications will be used to transmit information between Columbiat, other stations, and Earth. The FSOC uses 4 satellites in total that can transmit information at 1.2 Terabytes/sec. Multiple relay stations will be located on Earth to mitigate the signal reduction produced by Earth's atmosphere. The station's primary internal networking will

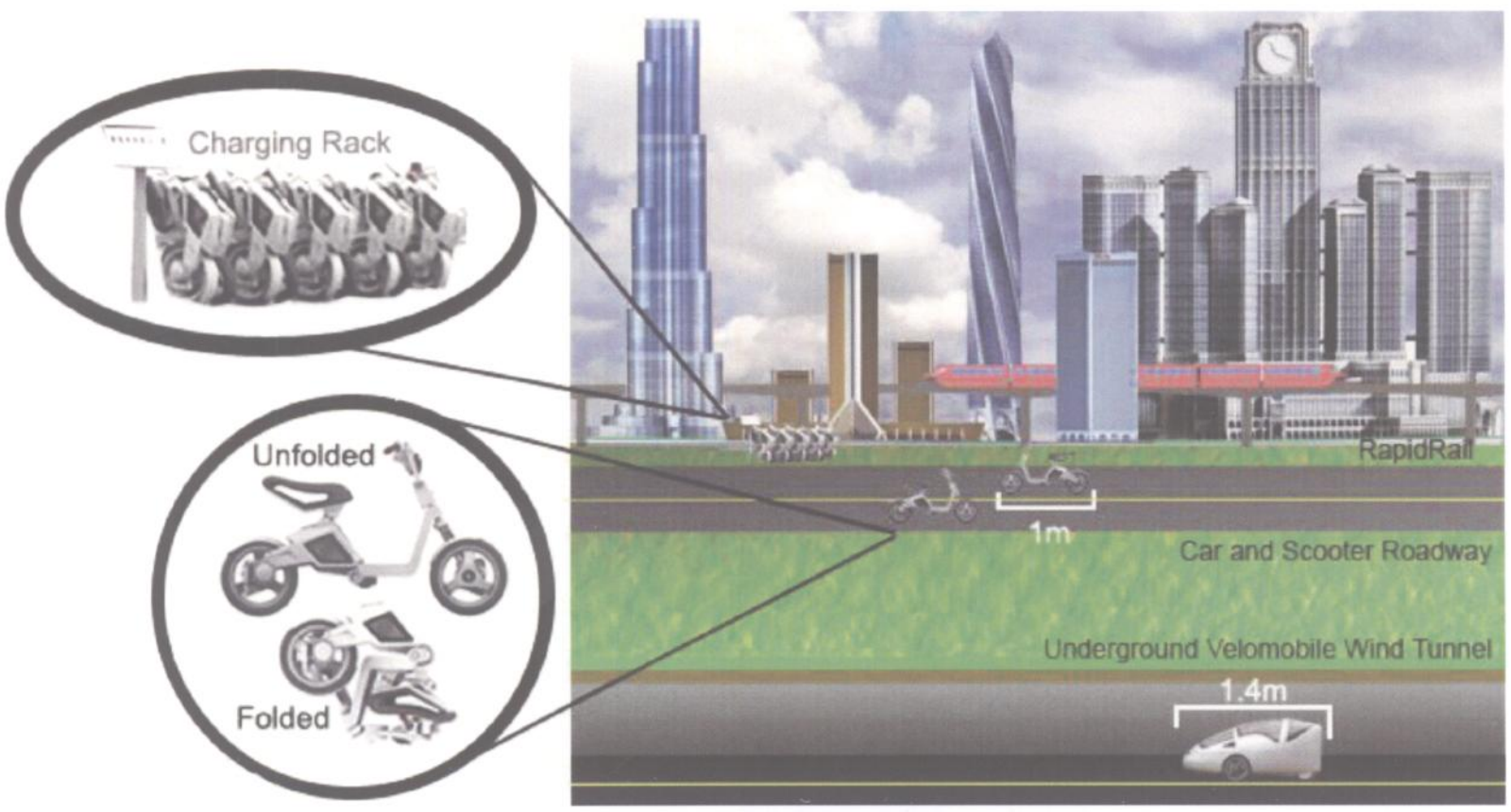


consist of two mesh networks. (See 5.3 for more detailed information) One such network is located only within the boundaries of the station and is meant solely for personal and commercial use. The second covers the interior and the immediate exterior of the station, serving as a dedicated network for automated systems. In addition, a very short ranged wireless network known as a Skin-Tenn will be used to network small devices on a residents' person. It will connect the electronics in their clothing, the AR-I and the Bluetooth. This system will have personalized firewalls and protection for each person. (See 5.3)

3.2.7.Internal Transportation

Personal transportation on Columbiat will consist of Velomobiles, Scooters, and cars made of scooters. Velomobiles, covered bikes, will be ridden in "wind tunnels" that use large fans to pull air and create less air resistance, allowing the rider to move more efficiently. The scooters can either be ridden in a single person configuration or can be used to create a "scooter car". Residents go to charging station, and choose the number of seats their vehicle should have, if riders need more than one seat, the scooters combine to create a 2 or 4 seat vehicle. The riders program in their location and the self-contained robotic wheels of the scooters transport the residents to their destination. Upon arrival to the nearest scooter charging rack, the scooters separate, fold and then return to their racks for charging. As residents travel, PowerPaths that make up the sidewalk and the roads will generate energy for the scooter charging stations. All scooters and bicycles will also be equipped with regenerative shock absorbers that use the bumps in the road to create power while simultaneously making the ride smoother. Any excess power will be routed into the station's power grid for use in critical systems.

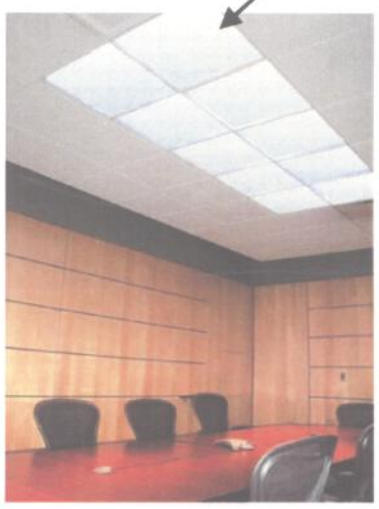
A Maglev rapid-rail train will also serve as the station's main method of mass transportation. It will be elevated above the ground, running through the middle of commercial buildings in the Cape Falcon section of the torus. This orientation will facilitate efficiency by allowing business people to stop directly in their buildings instead of dealing with the inconvenience of walking from a train stop.



Type	Number of People	Number of Vehicles
Velomobiles	1	2,830
Scooters	1	5,680
Rapid-rail	5,700	2

3.2.8. Day/Night Cycle

Light will be created on Columbiat through the use of hybrid LEDs. Quantum dots (luminescent inorganic nanocrystals) are embedded in organic LED structures. The hybrid LEDs are made of a carbon-based designer molecule that emits light when a current is passed through it. They are highly efficient, self-luminous, don't require a backlight, can be printed on flexible plastic, and are inexpensive to make. The quantum dots embedded in the structure allow the lights to emit a full spectrum, thus providing residents with a more "pure" light. Light emitted by hybrid LEDs is distributed more evenly than traditional LEDs, and closely resembles natural sunlight. The daily time schedule will be similar to that on earth, with 12 hours "on" and 12 hours "off".



(Hybrid LEDs light a conference room)

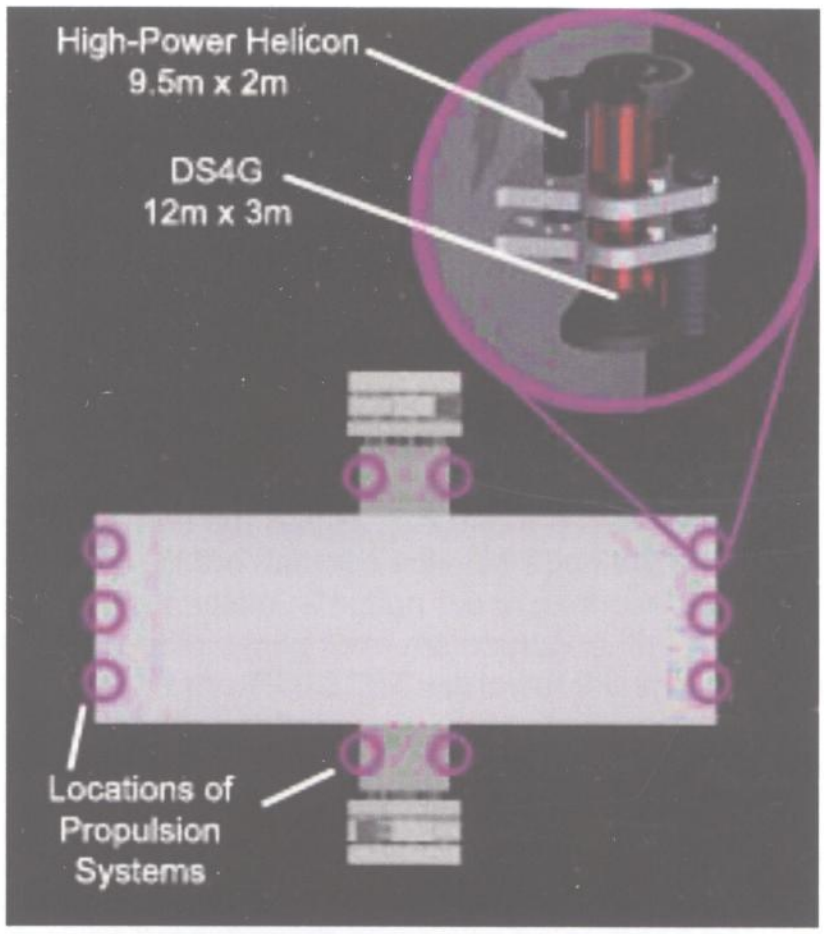
3.3. On-Orbit Infrastructure

Columbiat's role as the epicenter of business in space makes the role of ships imperative for the transportation of cargo and people. Columbiat must accommodate three types of travel: Earth /Columbiat, Other Stations/ Columbiat, and Moon/ Columbiat. Columbiat will utilize various ships to transport all types of cargo and multiple payloads of people to most cost effectively trade. (See next page for Vehicle Chart)

Name	Company	Purpose	Payload	Dimensions LWH	Fleet Size	Crew Size	Mission Duration
Auguilar	Northdonning Heedwell	Earth/Columbiat travel	10,200 kg 75 passengers **	30m x 11.25m x 15m	10	4	2 weeks
Anian	Northdonning Heedwell	Earth/Columbiat travel	34,000 kg 200 passengers**	80m x 30m x 40m *	4	8	2 weeks
Deschutes	Lockheed Martin	Small cargo between Alexandriat or Bellevistat	15,000 kg	50m x 22.5m x 7m	24	3	3 days
Hezeta	Northdonning Heedwell	People to Alexandriat or Bellevistat	110 passengers, approximately**	67m x 10.7m x 9.2m	10	4	3 days
Willamette	Lockheed Martin	Large cargo between Alexandriat or Bellevistat	30,000 kg	80m x 13m x 11m	12	8	3 days
Celilo	Vulture Aviation	Between Columbiat and Alaskol	17680 kg 130 passengers**	67m x 10.7m x 9.2m	10	4	3 days
Selkirk	Boeing	Rescue passengers on a broken ship, deploy repairbots and drag the ship to docking	100 people per ship, 50 Cimmaron robots	30m x 15m x 15m	2	4	10 minutes

3.4. Propulsion System

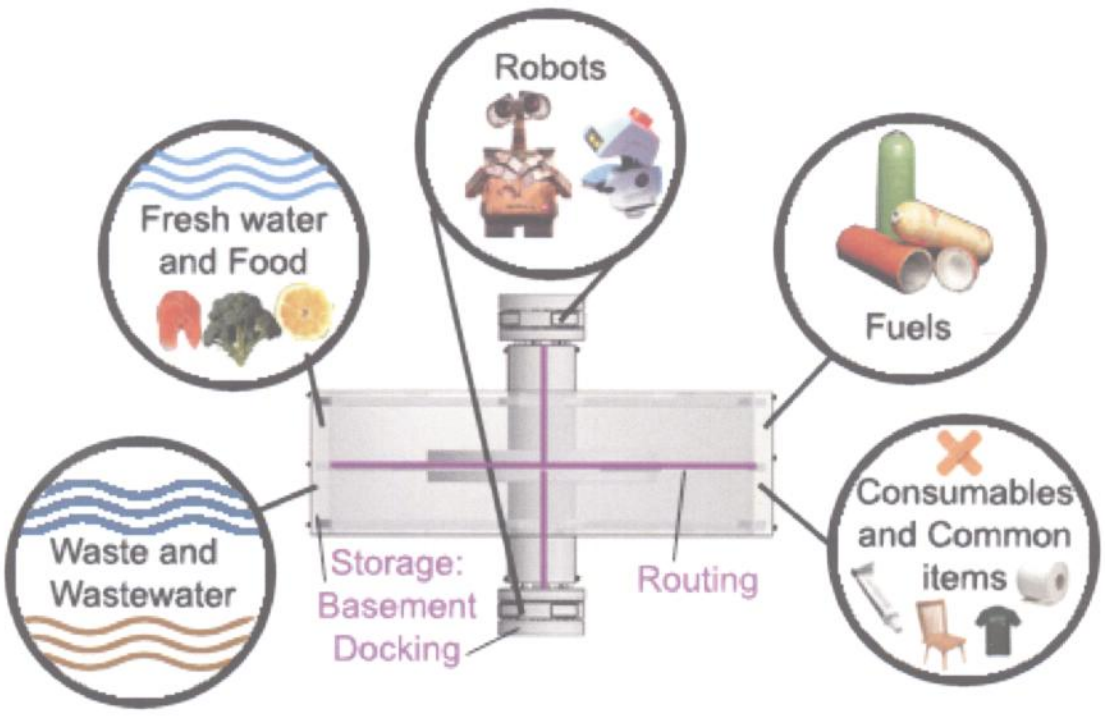
The main propulsion system will be a high-power helicon. This system does not use an electrode for thrust unlike other ion propulsion systems, and thus does not erode over time, so it theoretically never needs to be replaced. This makes it optimal for continuous use. High powered radio waves accelerate xenon ions for thrust. The system is small and flexible in operation, so it can adjust to the station's needs easily. The station's location in Earth/Moon L2 orbit requires periodic maintenance for its direction and course. For quick re-adjustment, a DS4G system will be employed. This system is four times faster than traditional ion thruster systems, and is very compact. The xenon propellant used for the DS4G is stored in the basement and the system will be located in strategic locations around the outside of the torus.



Type	Propellant	Location of System	Storage Location of Propellant	Thrust
High Power Helicon	Radio waves & Argon	Torus, Centrifuge	Basement	160,000 N
Dual Stage 4 Grid	Xenon	Strategic locations on outside of Torus	Basement	40,000 N

3.5. Provisions for Visiting Ships

Food and Agriculture Replacement:
Using aeroponics and bio-printing in the station will allow us to maximize food production. This will allow for the station to additionally restock the food supplies of visiting ships. Also, seedlings will be available for ships possessing food growing capabilities.



- Livestock
Should the livestock on a visiting ship need veterinary care, a Pinto will be sent to the ship from the basement. The robot will scan any diseased animals using Full Body scanning, an effective and fast screening method. Information gained from the scan will be used assess vitals, discover sicknesses and determine an appropriate course of action for treatment. (see section 5.2.1) If a ship requests, livestock can be cloned to replace any injured or deceased livestock. It will remain up to the ship to raise the livestock cloned. Visiting ships may also purchase zygotes from our stock for their own cloning purposes.

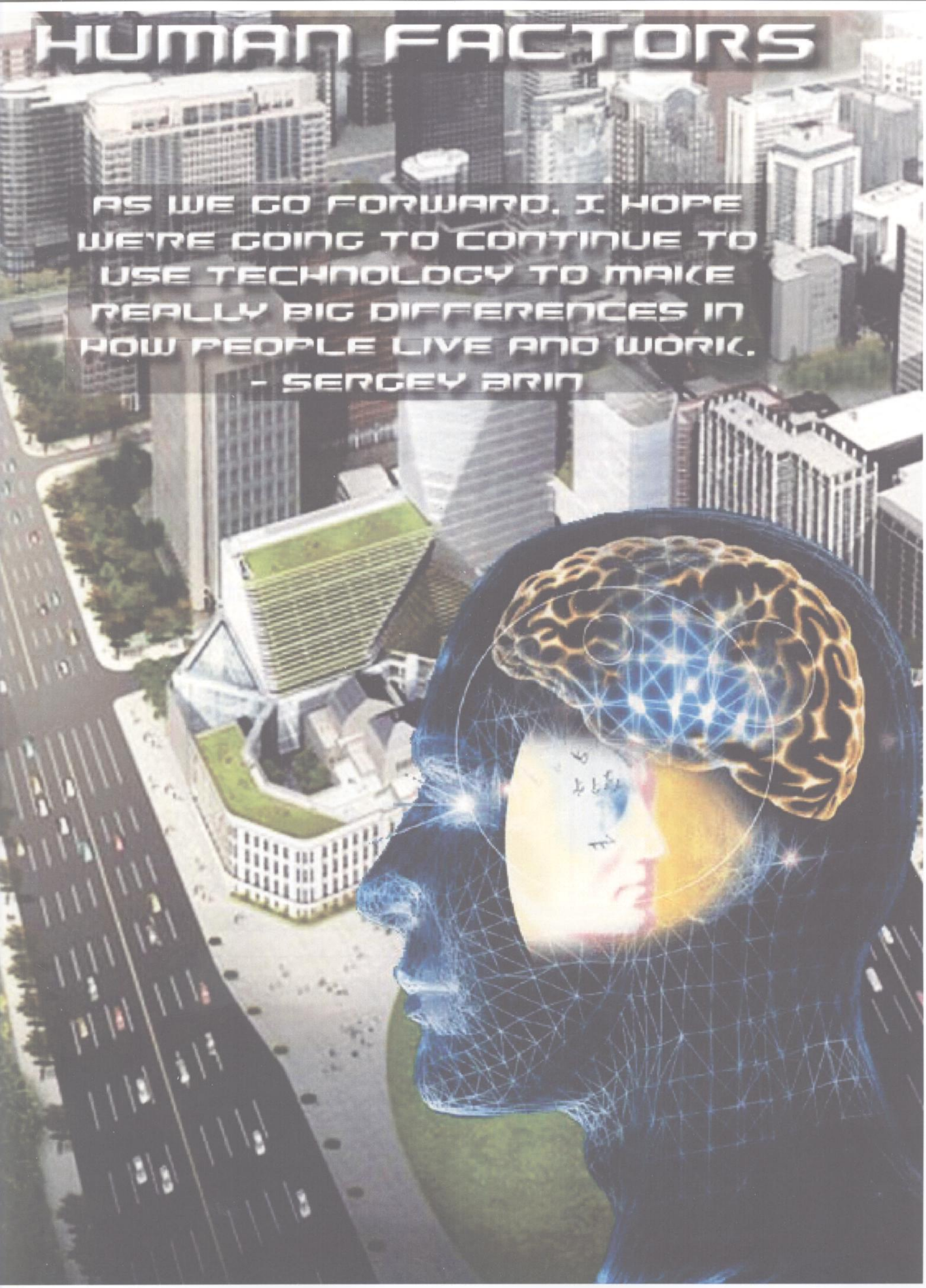
- Engine Maintenance
If a ship requires maintenance and is floating in free space, a Selkirk will be sent to the location of disabled ship and will unload the stranded passengers. When the Selkirk reaches the ship, it will also deploy a number of Cimarron robots based on the severity of the damage inflicted upon the ship. These robots will immediately focus on repairs requiring immediate attention (such as those that could prove to be potentially dangerous). If the ship still requires long term maintenance, the Selkirk will position the damaged ship over the docking stations and the TAMBTET will lower the ship into the emergency docking bay where it will be maintained by Cimarron robots.

- Fueling
Hydrazine, nitrogen titroxide, deuterium, and helium 3 will be imported from Earth and other space settlements. These fuel sources will be stored in the basement for the propulsion system or visiting ships. To supply ships, the fuel will flow up to the docking area through pipes and be pumped into ships using Studis.

- Waste Disposal
Waste from incoming ships will be transported to a treatment facility through a series of pipes into the basement. Here it will be processed by the main waste treatment system. If the systems is unable to handle the whole amount of the ship's waste at any point in time, then the excess will be stored in the treatment facility until it can be processed later.

Provision	Storage Area	System(s) Used
Food Restocking - For providing a visiting ship with food to restock its supply	Basement	Aeroponics - To grow plants, Bio-printing - To produce meat
Livestock Vet Services - For taking care of livestock, and replacing injured or dead ones	Docking Area Storage	Pinto - To scan using a Full Body scan and treat livestock, Cloning - To produce livestock
Ship and Engine Repair - For situations where a ship is unable to make it to a dock on its own	Docking Area Storage	Tug Ship - To move passengers and broken ships to Bellevistat, FIXXER robots - To fix ships
Fueling and Refueling - For providing fuel to a docked ship	Basement	Pipes - To move fuel to the ships, Fueler Robots - To fuel ships
Liquid/Solid Waste Treatment - For removing waste from a ship to treat it in our system	Treatment Facility	Pipes - To move waste to the treatment plant in the torus
Wastewater Treatment - For removing wastewater from a ship and treating it in our system	Treatment Facility	Pipes - To move wastewater to the treatment plant in the torus
Freshwater Restocking - For resupplying a ship's water supply	Reservoir	Pipes - To move freshwater to the ships

HUMAN FACTORS



AS WE GO FORWARD, I HOPE WE'RE GOING TO CONTINUE TO USE TECHNOLOGY TO MAKE REALLY BIG DIFFERENCES IN HOW PEOPLE LIVE AND WORK.
- SERGEY BRIN

4.0. Human Factors

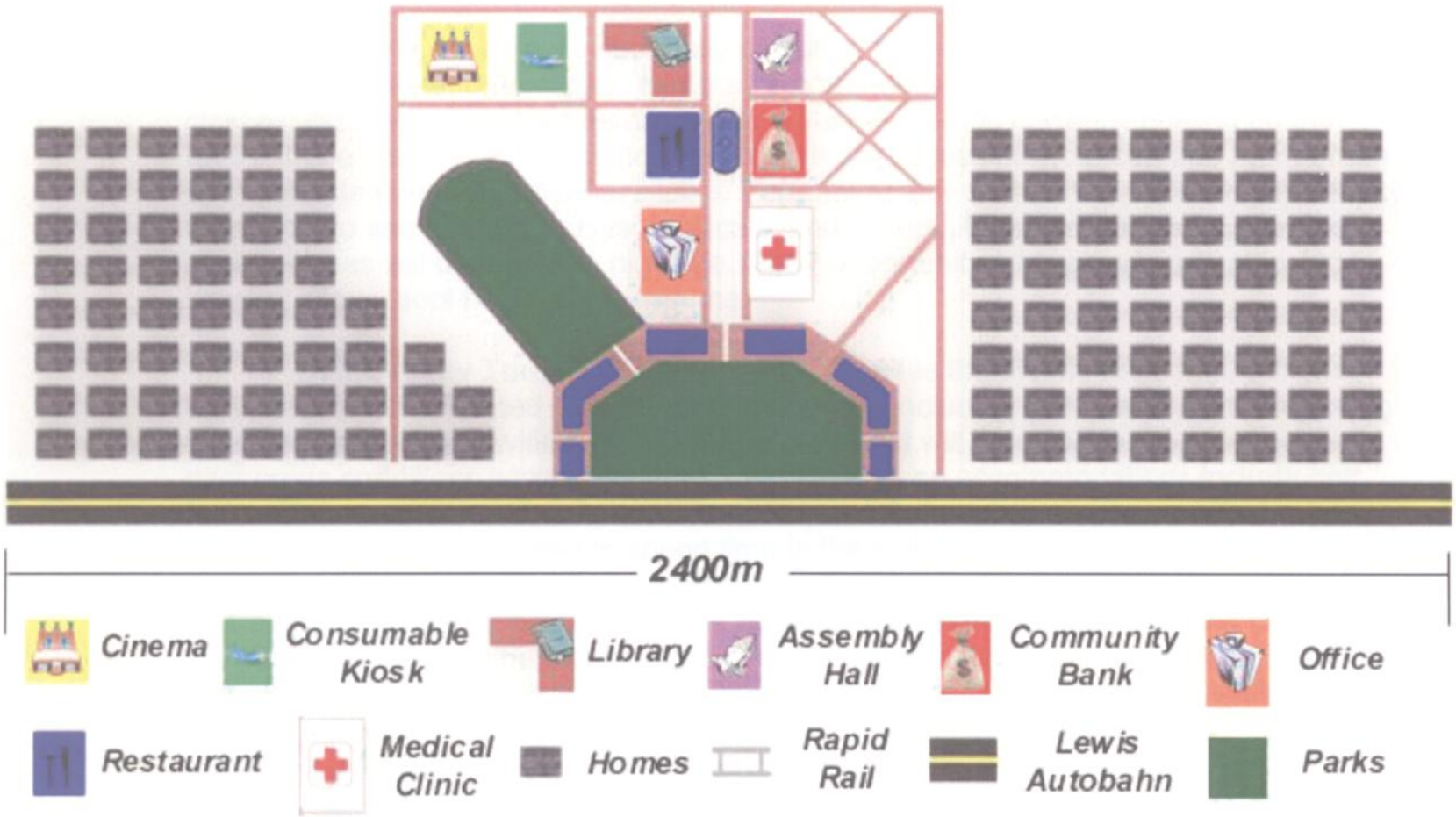
As an outpost amongst the stars, Columbiat will be a bustling metropolis. While commerce may be fast paced and highly efficient, suburban neighborhoods and active communities will provide an atmosphere of relaxation for residents. Exclusive entertainment options, high-class restaurants, and unique "spacer" venues--coupled with a wide array of facilities for recreation in normal, halved, lunar, and micro gravity--promote involvement in enriching activities. Columbiat will have features such as day and night cycles, a pleasant temperate climate, natural lighting, and artificial gravity to ease citizens into their new environment.

4.0.1.Natural Views

Panes of nano-composite glass will line the outer walls of the torus, offering projected views of the Earth via the natural view mirrors and outer space. Also, being positioned in L2, Columbiat will also maintain observatories for viewing deep space and the far side of the moon.

4.1. Columbiat Communities

The overall community will be divided into three subdivisions: Cape Falcon, Kennewick, Glenville. Cape Falcon will be designed to be a lively urban metropolis, consisting almost entirely of apartments, venues, restaurants, stores, banks, offices, and the Foundation Society Headquarters. Glenville, a suburban neighborhood planned to house most of the office and commercial workers, will be composed mostly of suburban houses, parks, and grocery stores. Kennewick will be comprised of two sections; one a tourist destination (consisting mostly of resorts, museums, and other attractions) and the other for housing working populations (consisting mostly of offices and houses). All of these communities will be linked by two superhighways called the Lewis and Clark autobahns.



Standard Community Design Map

4.1.1.Facilities for Services

Education - Taking into account the small number of children in the initial population though considering room for growth, Northdonning Heedwell has deemed that schooling will be, for the most part, virtual. Libraries will act as schools, in which students will use computers and other materials available for their classes. Library staff will serve as teachers while students take part in education at their own pace. Virtual schooling has been chosen because it poses the benefits of being unaffected by fluctuations in the child population, allowing students to learn at their own pace as well as offering individualized lesson plans.

Diet and Nutrition - The dietary options available to residents put an emphasis on pre-planned, and nutritionally sound meals based on the body's essential needs in space. Fruits such as citrus, kiwi, strawberry, banana and apple will provide vitamins A, the B family, C, calcium, magnesium, iron, and potassium. Vegetables such as avocado, broccoli, peas, carrots, mushrooms, sweet potatoes, onions, and spinach will contribute vitamins A, B3 and B5, C, calcium, copper, phosphorus, and selenium. The meat on Columbiat, beef, chicken, pork, and fish, provide zinc, iron, protein, phosphorus, and riboflavin. These minerals help to improve vision, bone strength, boost the immune system, prevent heart disease and cancer, and give skin and hair a healthy appearance. For those who work outside the station, vitamin A, beta-carotene and retinoid drugs are more heavily emphasized so as to decrease the amount of solar radiation absorbed through their skins.

Parks and Recreation - Leisure activities involving community interaction foster a productive and happy culture. Recreational centers will have four court halls, which can accommodate basketball, badminton, volleyball, netball, table tennis and other sports. Parks will include playgrounds for people to congregate at and exercise equipment for fitness.

Entertainment-

Torus-In the overall community design of the residential areas, there will be designated parks and recreation centers for community activities, such as sports and arts classes. Also, there will be cinemas which will show movies currently playing on the Earth. In the commercial areas however, parks will be less pronounced and more urban forms of entertainment will be available. Performing arts centers will offer the opportunity for people to see concerts, plays, musicals, and ballets. Also, comedy clubs, bars, and music venues will offer a lively night life. Other opportunities for entertainment include bowling alleys, pool halls, and museums.

Half-Gravity Torus - This torus, which houses the elderly residents, will offer activities found in planned retirement communities, including golf, tennis, and swimming. Due to the reduced gravities, the equipment required will be designed to prevent any dangerous conditions which may arise. Amongst these accommodations include golf balls with movable interior masses that enable the balls to have a more normal trajectory. Since transients are required to spend time in the half-G torus for adaptation from the space flights, a variety of entertainment will be provided. Transients can participate in inflatable, competitive obstacle courses against their fellow visitors which will make use of the half-gravity to provide more eventful and fun challenges. Engineers will be able to enjoy competitive robotics challenges that include building and competing against like-minded individuals. Business people amongst other visitors may try their wits at team-oriented, large-scale puzzles and logical challenges during their stay.

Centrifuge - The centrifuge will sport gravity approximately 1/6th of that which is on Earth, offering entertainment options similar to those available on the moon. Working with Alaskol and other lunar settlements, a lunar sports league could be developed, and a lunar Olympics held at one of the lunar settlements. Also, fields will be available to play

sports like rugby, soccer, football, and basketball in lower-g, which will allow for enhanced tactics which take advantage of the unique environment.

Assembly and Religion - Four assembly halls—two in Cape Falcon, one in Kennewick, and one in Glenville—and will serve as places where people can congregate for events, mostly for religious services, but also for other town/community functions.

4.1.2. Consumables and Means of Distribution of Consumables

Consumables will be distributed through the use of an automated system as described in section 5.3.1. Since Columbia's purpose will be to act as a center for commerce instead of as a producer, items such as medicine that are hard to produce will be imported from Bellevistat. Clothing will be produced by the Personal Clothes Remakers located in every resident's homes. The soy and bamboo fibers are initially imported from the byproducts of agriculture in Bellevistat, but will be procured from Columbiat's agriculture systems once they are operational.

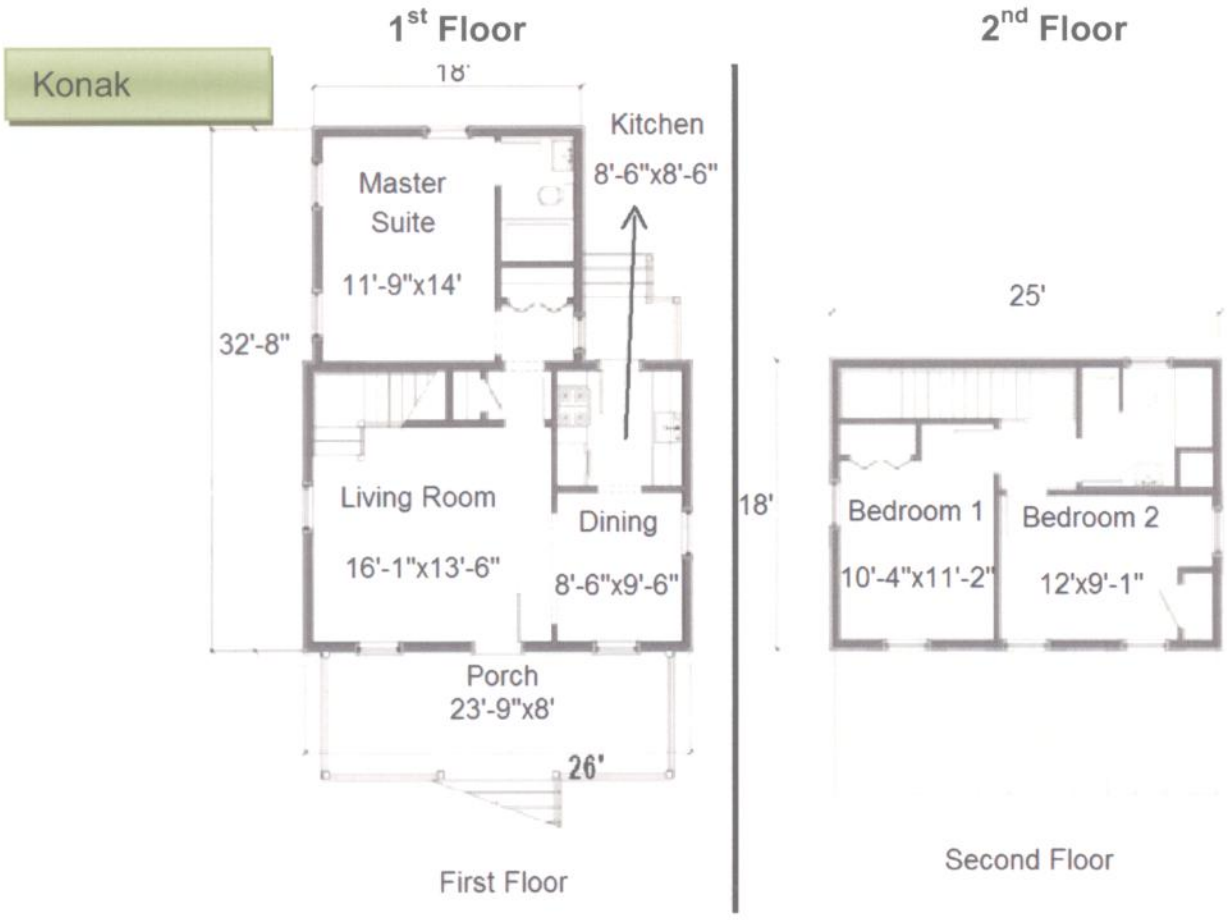
Category	Method of Production	Amount Produced
Food	Aeroponic systems and Bio-printing	431,000 kg
Cosmetics/Toiletries	Formulative Center	4,756,000 items
Medicine	Imported	1,540,000 medicinal products
Clothing	Original clothes produced by the Personal Clothes Remaker	7,925,000 products

4.1.3. Consideration of Psychological Factors

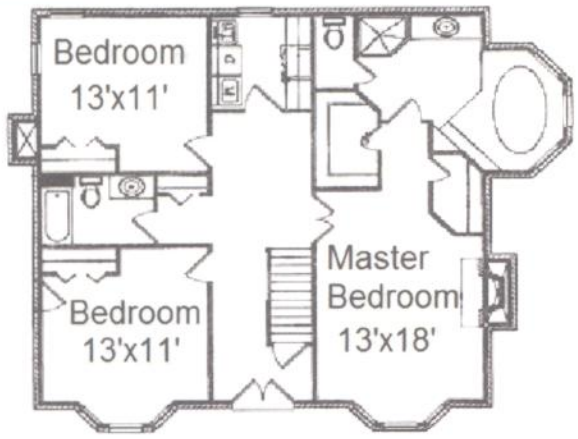
Human psychological problems in space all stem from intellectual isolation, activity limitation, and the surreal environment. Columbiat will maintain all the feasible, physical aspects of Earth as detailed in 4.0. Communal aspects, such as the diverse recreation and entertainment options labeled in the prior points, further maintain Earth like aspects by offering a large amount of amenities found upon it. The relative proximity to Earth ensures that there will be no delay in communication between the Earth and the station, thus eliminating the possibility for intellectual isolation.

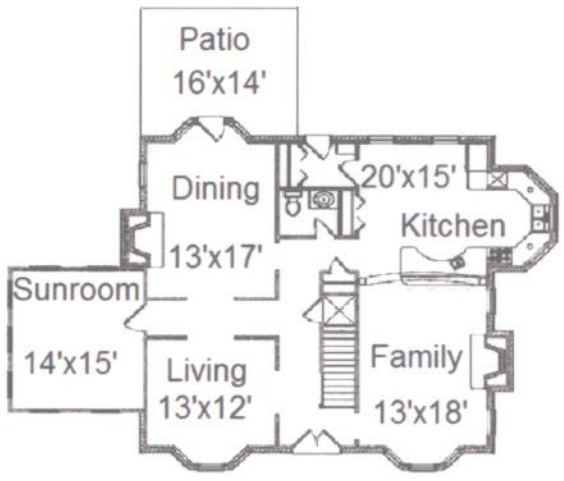
4.2. Residential Design

4.2.1. Interior Floor Plans and Exterior Designs

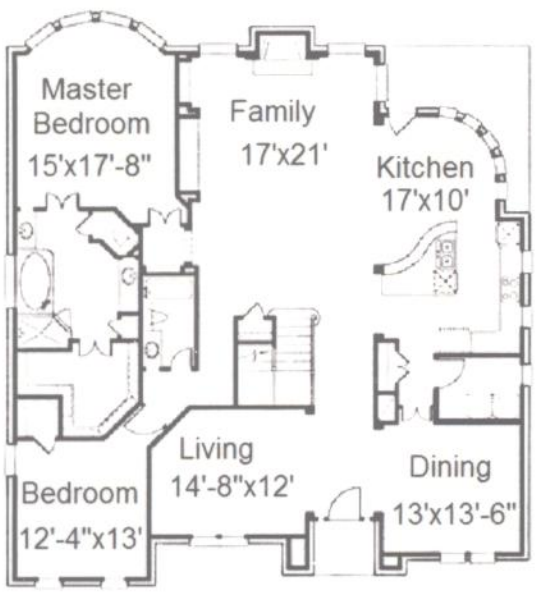


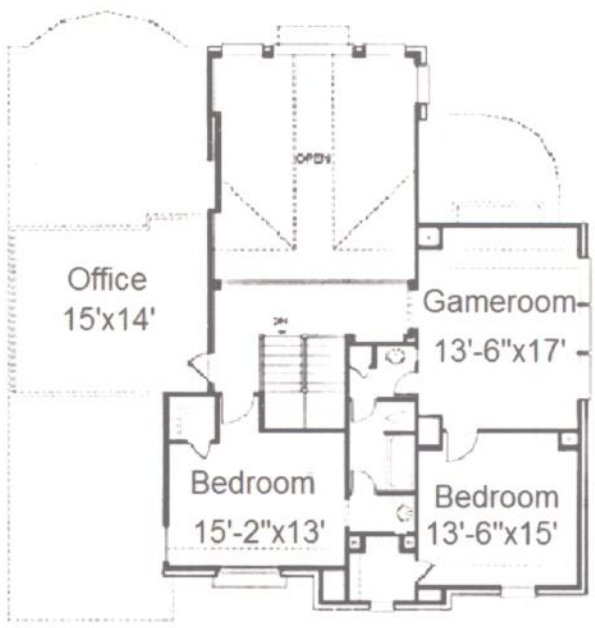
Prairie House



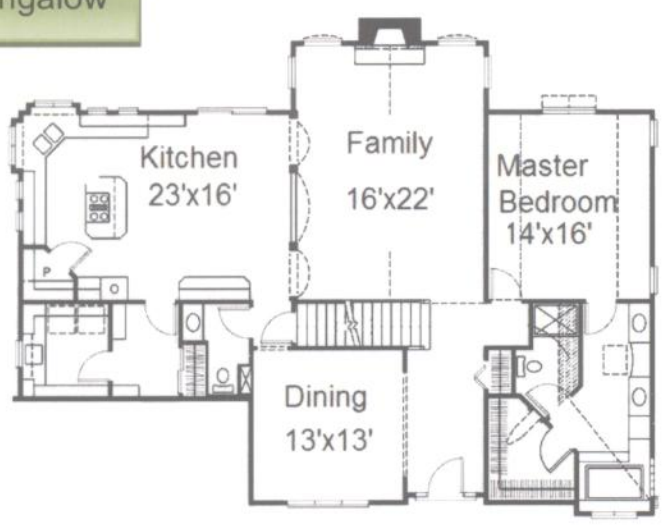


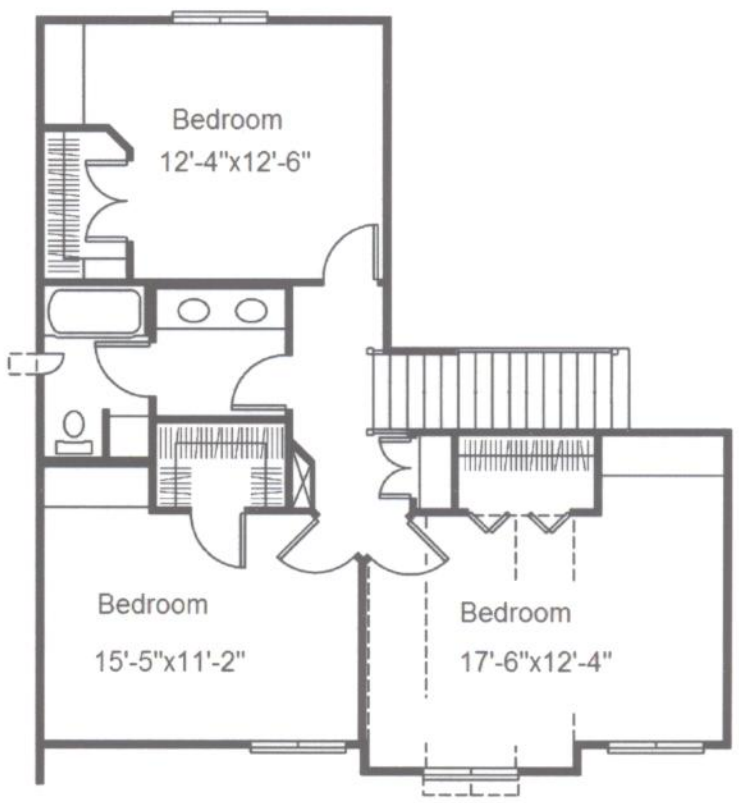
Mansard





Bungalow





Konak

Prairie House

Mansard

Bungalow

4.2.2.Housing Types and Numbers

Floor Plan Name	Living Area (m^2)	Quantity
Konak	$93m^2$	5500
Prairie House	$208m^2$	275
Mansard	$224m^2$	550
Bungalow	$186m^2$	6875

4.2.3.Architecture

To offer residents more diversity in their choice of homes, Columbiat offers the following add-on features to modify the four base floor plans to be more distinctive and unique.

Style	Features
Spanish Mission	· Smooth stucco siding · Roof parapets · Large square pillars · Twisted columns · Arcaded entry porch · Round or quatrefoil window · Red tile roof
Ranch	· Low pitched gable roof · Deep-set eaves · Large windows: double-hung, sliding, and picture · Sliding glass doors leading out to patio · Looks to be made of natural material: woods and brick exterior · Lacks decorative detailing, aside from decorative shutters
Bungalow	· Low-pitched roof and horizontal shape · Living room at the center · Connecting rooms without hallways · Built-in cabinets, shelves, and seats
Prairie	· Low-pitched roof · Overhanging eaves · Horizontal lines · Central chimney

	· Open floor plan · Clerestory windows

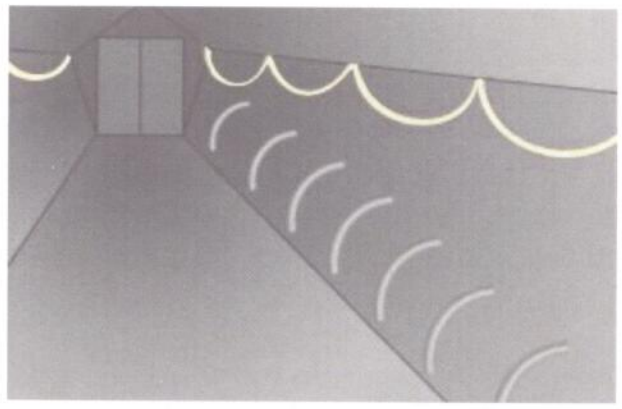
4.2.4.Furniture

During the construction of Alexandriat, it took a longer than expected amount of time to bring in the interior furnishings. This design flaw was corrected with Bellevistat, giving it the capability to create its own interior furnishings. Alexandriat recently underwent construction to convert the old facilitites that designed the solar shield to become light manufactoring centers. All furninishings will come from these two pre-existing stations--most of them from Alexandriat, as Bellevistat is currently operating at capacity

4.3. Low Gravity Locomotion

4.3.1.Safety in Low Gravity Environments

In order to ensure that people can move safely and effectively through low gravity facilities, padded walls and handholds will line these volumes. As a means of increasing friction so as to prevent people from reaching dangerous speeds, the floors will be rough and people will wear Gecko Shoes (shoes with carbon nanotubes for dry adhesion), allowing them to stick to the ground but still flexibly move. In the centrifuge, the ceilings will be padded to prevent potential head injuries.



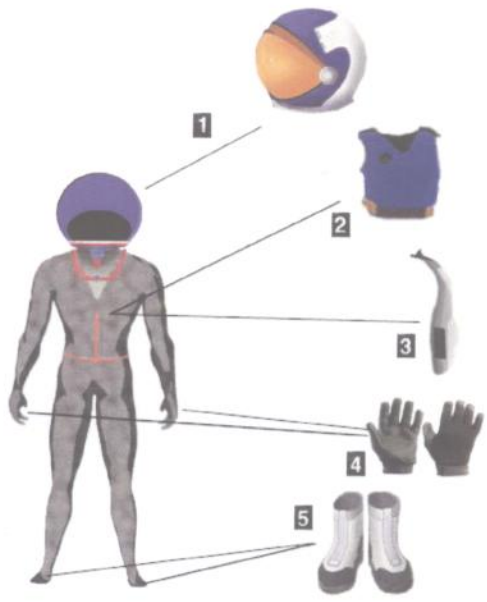
(Example of tethers and handholds in low gravity environments)

4.3.2.Moving Between Differing Gravity Environments

The movement will be facilitated by a series of elevators. In these elevators, people will have to wear harnesses to ensure the changing gravity doesn't cause them to move about the cabin. Also, computerized gyroscopes and accelerometers ensure that orientation remains constant during travel, preventing nausea among individuals.

4.4. Space Suit Design

For work outside pressurized environments, Northdonning Heedwell has designed a mechanical counterpressure (MCP) space suit. The design of the suit will integrate bio-nano machines to increase mobility and lessen the amount of energy required to move while possessing self-repairing layers.



Fitting the suit to a subject will be greatly simplified with the use of full-body, 3-D laser scans and digital image correlation techniques. These technologies ensure that pressure is always kept constant across the body so the suit will not experience any problems with maintaining the appropriate fit to the body. When mapping these deformations, a series of lines which run across the subject's body are produced so that the fitting process may account for them.

The suit will be built around elastic cords placed along each of these lines. Since these cords will not be stretched, the amount of pressure they provide will remain constant. This will allow the pressure to be accurately and easily controlled. The remainder of the suit consists of spandex placed in-between each of these cords, resulting in a single layer suit that will act as a second skin. Maintaining a constant MCP on smaller joints like the fingers and feet is difficult to do without sacrifice mobility. Thus, a pressurized helmet and gas-filled pressurized boots and gloves will be included in the design.

Though the suit can sustain tears of up to 1mm^2 in size, the bio-nano-machines will have the ability to repair damages. Bio-nano-machines will be programmed to form a self-healing layer for the space suit. These on site repairs will be particularly useful for the MCP design, since tears in the suit will not lead to depressurization or prevent space goers from completing tasks.

4.4.1.Donning and Doffing Process

After donning the comfortable, elastic Bio-Suit layer (1), the hard torso shell (2) is donned next and seals with couplings at the hips. The portable life support system (3) attaches mechanically to the hard torso shell, providing gas counter pressure to the helmet (1) and down through tubes on the elastic bio-suit layer to the gloves(4) and boots (5).

4.4.2.Airlock Designs

Columbiat's airlocks are designed to minimize the amount of air lost by using timed closures, altered opening speed, and the normal depressurization processes. By programming the exact times the airlocks open and close, the amount of the air lost is reduced. People are accelerated out of the airlock by a plunger-like device. The airlock consists of a chamber with air masks that people enter. Once people are in the chamber, they don the masks, which slowly acclimate them to the entirely oxygenated environment of the spacesuit. Once adapted, the person will be prepared to be launched out of the airlock.

Keeping air loss minimal is essential. This can be done by timed closures. A program of a series of openings and closures of the lock to prevent losing too much air while allowing multiple people through. Multiple entrances will also help reduce air loss. Altered opening speeds, quickly open and reseal doors also help in keeping air loss low. The direction the doors would open would be vertical, opening down into the station.

Once the doors open from the exterior people will enter. The exterior door will close, sealing them off from space. The second air lock door will then open and people will enter the next chamber, while the door they just passed through closes. The second chamber will then be pressurized, while people doff the spacesuits. While the doffing process occurs, the first chamber actively pulls any of the escaping air from the first chamber out, ensuring that there is minimal air loss to space. While these precautions are taken, there is still a negligible air loss of 1 x 10^{-6} m^3 per process.

4.5. Visitation and Security

Visitors will be monitored via the scooter, velomobile, and Rapid Rail Systems. Residents will scan their knuckles to obtain permission to the transportation methods. This will track the locations of the scooters, the checkout point of the velomobiles, and train routes. The hotels will monitor where the residents walk once inside using pressure sensors located below the floors. This information will be anonymously sent to a computer to check for suspicious activity. If none is found then the information will be permanently deleted for the sake of security. Incoming visitors must take a Quick Full

Body Scan before entering the Elesphere. If health problems are detected by the scanning computers, the transients will be transported to the nearest hospital and placed in quarantine facilities until a full medical evaluation can be completed. Communications/computer usage will also be scanned for potential security risks.

4.5.1. Anticipated Security Risks and Responses

If a transient is deemed a security risk, the authorities will be alerted to his or her whereabouts—which are being monitored at all times—and all modes of transport cease to be operable by the transient until he or she is apprehended, detained, and/or deported.

Security Risk	Response
Criminal Activity	Transients are tracked down, apprehended, and dealt with accordingly.
Unauthorized Entry	Authorities are alerted of break in location, those who entered, and the offenders are dealt with accordingly
Contamination	Transients are screened for foreign contaminants before they enter the Elesphere.
Epidemic	Checkpoints will be set up and manned by medical teams to prevent the disease from spreading further. Infected individuals will be quarantined until all cases are cured to help contain the disease.

"WE LIVE IN A TIME WHEN AUTOMATION IS USHERING IN A SECOND INDUSTRIAL REVOLUTION"
- ADLAI E. STEVENSON

AUTOMATION

5.0. Automation Designs and Services

5.0.1. Unique Robot Design

The inability for robots to adapt to their task is a key drawback to the complete automation of most tasks. Columbiat will utilize a system that essentially evolves the designs of the robots. All robots will be equipped with LIDAR, potentiometers, object sensing cameras, and ultrasonic sensors that measure inputs from the environment to collect data on how effectively the robot is working. The data from each robot will be collated in a central computer and dynamic modeling simulations will be run to find the best configuration of the robot to most efficiently complete its tasks. That data will then be checked by a computer monitored genetic algorithm to determine the best way to create the new design. The outputs will then update the base CAD drawing of the robot and send the new plans to the EVO Centers. When a robot requires maintenance or stops work for recharging, it is moved to the EVO Centers located in the basement. The robots can then be equipped with universal parts to fulfill the model created by the system (examples include adding more wheels or extending the gripper). This process cycles over periods of months until the most efficient robot design is reached.

5.0.2. Computer Hardware and System Requirements

All computers will be equipped with memristor technology for storage. Each memristor chip can store up to a TB of memory with little space wasted. Instead of the normal bootup time that computers require, memristors will allow computers and servers to instantaneously startup because they do not lose information like traditional RAM does. All computer chips are to be printed using plasmonic nanolithography onto stretchable semi-conductor materials, creating small flexible electronics. These can withstand the abuse that normal chips cannot while being 100 times denser than the average computer chip.

5.1. Automation of Construction Process

5.1.1. Material and Equipment Delivery

Material necessary from earth will be shipped using the most economically viable solution, while equipment and materials from other station such as Bellevistat will be delivered by space tugs.

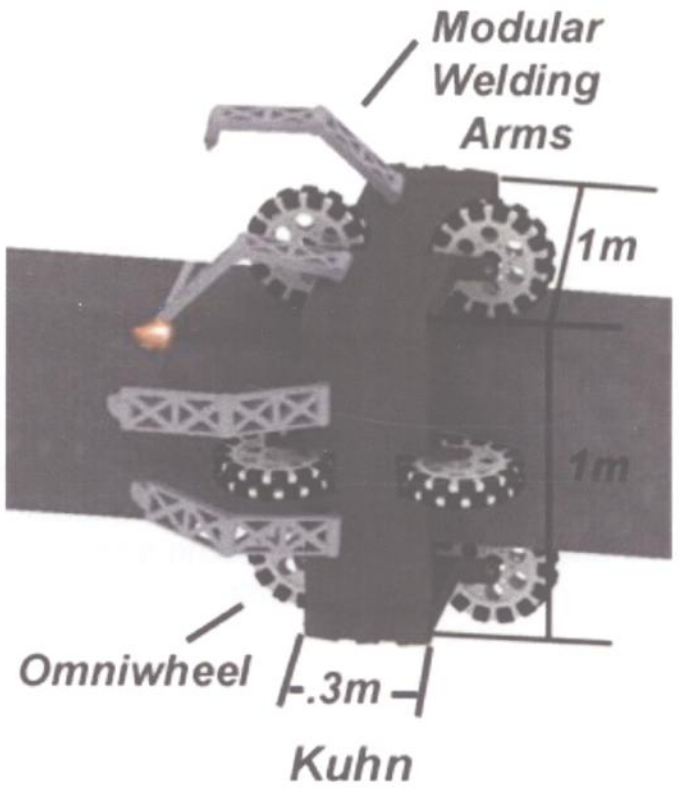
5.1.2. Settlement Assembly

Exterior Robots for Construction	Purpose	Dimensions	Quantity	Cost
Kuhn	Welding	1m x 1m x .3m	1500	$27000
Welara	Robots used for moving items and holding items for welding	4x2x1	3000	$22000
Pottok	Large vehicle with interior system to build walls, paint, and install pre-made electrical connections	4m x 4m x 8m	800	$75000
Breton	Will do final interior finishing and inspect all final installations	.75m x .75m x .5m	1500	$19000

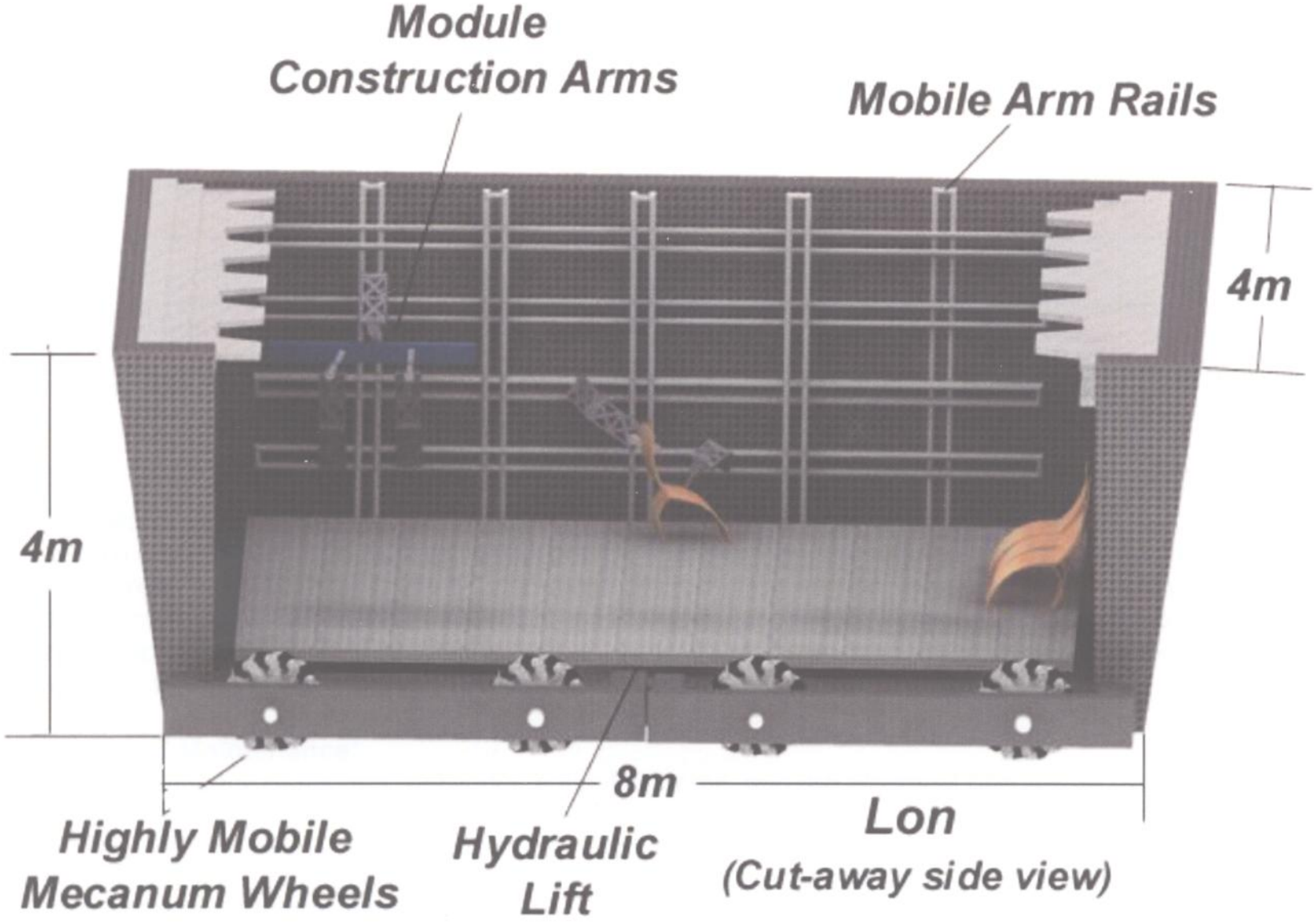
Exterior/Interior:

Columbiat will be primarily constructed from the inside outwards. When structures such as the centrifuge or torus are being constructed, all of the inside supporting beams will be placed first in order to circumvent the problems that robots face when trying to construct from the exterior inwards (movement within the interior and difficulties with maintaining more detailed construction constraints). Before construction begins, 10 EVO centers with the capacity to hold 250 robots each will be brought in on Williamettes. These floating stations will be utilized throughout the construction process to both optimize the robot designs as well as reconfigure them for the different jobs they may perform.

During the "inside-out" construction, Pottoks will latch onto construction materials using arms equipped with flexible dry adhesion carbon nanotube arrays that allow the robot to quickly attach and detach from the materials and adapt to curved surfaces with no loss of grip. Using physiomimetic programming, a series of these robots will be able to arrange themselves in detailed lattice formations for optimal efficiency in construction. Once the Pottoks have arranged themselves in the desired shape,Kuhns will configure themselves to wrap around the frame members, traversing the component while scanning for places that need to be welded based upon their downloaded blueprints. For the attachment of plates and other flat surfaces, the Kuhns will restructure themselves to drive on the panels and place welds in the desired places.



Once the initial frame construction is finished, the Kuhn will be brought to one of the on site EVO centers and will be outfitted with tools such as power ratchets and rivet guns for use on non-metallic construction materials like polymers. The Pottoks will be utilized once again for the placement of materials, and the Kuhn will simply place fasteners in the material's pre-fabricated holes.



Interior:

The main working component of the interior construction process is the Pottok. Instead of implementing the process of placing walls, plumbing then, wiring them, and then painting them; all materials will be finished on their way to their final destination. The Pottoks will have the capacity to carry large sections of items such as walls. Inside of the Pottoks' cargo holds, there will essentially be mobile workshops that can build furniture, place plumbing and wiring in pre-fabricated walls, and even paint objects before they are delivered to their final stop. This will make units that contain electrical components, such as walls, "plug and play". During the interior construction process, the Pottoks and Kuhns used for the exterior construction will be sent to the EVO centers in order to be equipped with manipulators to facilitate in the interior construction. Pottoks will then move and place large segments similar to walls while Kuhns will assemble the pre-fabricated units delivered by Pottok.

After the interior placement is complete, the Bretons will connect the plumbing and electrical sections while checking for any material deficiencies. The Inspect Bots will also do final interior finishing such as laying roads and placing furniture. This construction process eliminates the need for multiple types of robots to complete individual tasks and instead increase efficiency through the use of pre-fabrication.

5.2. Facility Automation

Name	Description	Dimension	Quantity	Individual Price
Pinto	Performs full body scans on animals and cares for them	2m x 3m x 2m	150	$30000
Cimarron	General maintenance of ships	2m x 1m x 1m	200	$19000
Studi	Refuels visiting ships in the docking facility	1m x 1m x 30m	32	$30000
Pottok	Builds common items	4m x 4m x 8m'	800	$75000
Altai	Sticks to the martensitic steel hull to cover breach with bladder.	.5m x .5m x .25m	100	$5000
Cait	Fixes broken electrical connections	.025m x .025m x .025m	2000	$3000
Asturcon	Assesses problems	.25m x .25m x .25m	300	$3000
Iomud	Moves about the station and monitors atmosphere conditions	.25m x .5m x .1 m	1000	$12000

5.2.1.Maintenance

To reduce operations and materials needs, many of the common household objects will be highly recyclable. If items made of universal materials such as glass or metal are damaged, they will be obtained and replaced by the Bretons then converted back to their raw materials for future manufacturing uses. This allows the Bretons to optimize the time spent on mundane tasks as well as creating a "life-cycle" for every reusable material.

Electrical Maintenance:

Maintenance of servers, networks, critical systems, and the electrical grid will be executed by a subdivision of robots called Caits. Each Cait cluster utilizes physicomimetic programming to artificially simulate the forces acting on them, thus allowing the clusters to precisely organize themselves into efficient swarms. The Cait clusters can, diagnose, repair connections and replace faulty parts by moving from server to server through dedicated I/O ports. Wiring Caits

function similarly to their server counterparts, but instead will work in smaller groups within the station's conduit system.

Interior System Maintenance:

Robots will be maintained, repaired, and overhauled in the EVO centers placed in the middle of the storage struts so that the facilities may utilize the advantages of lower gravity while repairing the robots. EVO centers will also be located in the docking facilities to clean and maintain docking robots and robots from visiting ships. To maintain efficiency and cost effectiveness, the Kuhns and Bretons will be reused for interior maintenance. When something is reported broken, three Asturcons are dispatched to analyze the problem. The data is then sent back to the nearest EVO center and robots are equipped with the tools most effective for solving the problem. A version of the Kuhn or Breton will be sent based upon the actual magnitude and type of problem.

Ship Maintenance:

As the cargo is transported from the ship to the station, a designated Cimarron will take action to respond to any malfunctions and remedy them by rewiring, welding, or replacing parts and can also be adapted for any future complications on the ship. Animals that come in from ships will travel through the Pinto. The Pinto will be placed in hangers to allow easy access to animal carrying ships to test for any diseases and overall heath. The Pinto will be equipped with systems to analyze skin and hair in order to test for diseases along with tranquilizers to calm unruly animals. Studis will have a snake-like configuration that actually acts as the fuel line itself, so the robot can adapt to the location of any fuel port. If a problem is reported with a ship, the same process utilized for interior maintenance will be applied to the ships. A Cimarron will be fitted with the best tools to fix the problem in the nearest EVO center and will be dispatched the fix the problem.

Exterior System Maintenance:

To protect the electronic circuits and components of exterior maintenance systems, aluminium and lucite shield will be built into the structure of the robots. To be able to protect from high-intensity solar flares without adding extra weight, a Multilayer High Temperature Superconductor Protection System would be installed around the most delicate electronics of the systems and turned on whenever there is a threat of a solar flare. This would ensure that all exterior robots would be able to operate with no handicap during a solar flare.

Manufacturing Robot:

Instead of disposing with broken items, the materials will be reused. After construction is complete, Pottoks will be made stationary and act as manufacturing stations in the basements. The Bretons will pickup the broken materials and use the basement roadways to deliver the materials to the manufacturing station. The stations then use their internal workshops to create any common good out of raw broken materials

5.2.2.Contingency

Fire - Infrared heat sensors all throughout the station. if any temperatures reach 500 degrees Celsius, then robots will be transported, via systems located in the ceiling, to the area of the fire. Bretons will be appropriately equipped at the EVO centers and will put out the fire.

Flood - Moisture sensors are located just below the floor all around the station. When one of these sensors becomes saturated, a vacuum-drain, located below the floor near the sensors will turn on vacuuming away all unwanted water. If a drain starts to suck in air then it will shut off preventing it from sucking out all of the air. There will be pressure sensors in every water pipe so the at if there is a drop in pressure, the drainage systems will become more acute to moisture. all drain moisture is contained and recycled.

Atmosphere - The station will have robots called the Iomud that will patrol the station with that have sensors in order to test for a change in atmosphere. If a change is detected, the Iomud will

alert the station and an alarm will sound in the affected area. When the alarm goes off all humans will quickly be evacuated from the area and it will be locked down.

Gas leak - If the sensors in the air filters detect an abnormal composition in the air then an automated system will shut off all gas ducts in the area of the contamination. While the shut off is occurs citizens will be directed to a safe area and. All of the areas that are contaminated will then be locked down (once void of humans). Robots will be deployed and each will scan the air in order to find a high concentration of the unnatural gas. Once a high concentration has been found, the robots will determine the source of the gas via the schematics of any nearby gas-transferring ducts. The robots will then either patch the leak or replace the entire duct if necessary.

Hull Breach – If a pressure change is detected in the hull, Altais will be deployed. The Altais can use compressed air to propel themselves near the hull breach and will magnetically cover the hull with a steel and Kevlar reinforced bladder. A Kuhn will be deployed to fix the hull breach and the bladder will be removed.

Water contamination- All water is tested for contaminants before it is put into circulation and after it is recycled. During the water management process, it is filtered and upon public distribution, it will pass through a contaminant filter and then tested for contaminants one last time. If contaminants are found then the water distributor (ie water fountain, water faucet etc.) will shut off. Contaminated water will be pumped into holding tanks so that it can be tested for specific contaminants. Any contaminant that is found will then be filtered, removed physically, or removed chemically.

Solar Flare- In the event of the detection of a solar flare, all automated robots will be equipped Multilayer High Temperature Superconductor Protection System for protection against solar flares. This will allow the robots to continue working through the flare or move to a safe area.

Health - epidemic- All citizens of the station have their health monitored constantly via systems (toilet, shower, etc.) in the home and a tenna-tooth located in the mouth area. When a person becomes sick, they will have medication recommended to them automatically. If a person has a contagious disease that is possibly fatal, then they will be quarantined until they are no longer contagious. If multiple people have the same disease, then they will all be contained in the same area. As a person becomes non-contagious, they will be moved to a separate area, away from the contagious people, until they are no longer sick.

Space Communication Malfunction - Four satellites are used to route all communication to different base stations on earth. If these satellites fail, Columbiat will connect to any other station using a reserve Free Space Optical transmitter and receiver and will utilize that station's connection to earth for high priority and emergency communication.

Elesphere Malfunction - If a breach is made in the tube where the elevator travels or a malfunction with the elevator occurs, the elevator will stay put until robots can repair the damage to the elevator.

Power Failure – In the case of a power failure the station will run off of the stored power in the ultra super capacitor which will sustain the basic infrastructure for the maximum of 11 days that the bots need to repair the damage.

5.2.3.Security

Level	Personnel Access	Privileges	Security Measures
1st	Tourists	Allows minimum passage to transportation and hotels	Knuckle Scan
2nd	Residents/ Workers	Home entry and business related access	Knuckle Scan Tenna-teeth RFID
3rd	Managers	Admittance to higher level business areas and files	AR-I Iris Scan Tenna-teeth RFID
4th	CEOs and Engineers	Access to all station related plans, maintenance areas and highest level business files	AR-I Iris Scan Tenna-teeth RFID Dental Scan (non-invasive)
5th	Columbiat Administrators	Control of Columbiat's infrastructure and ability to	AR-I Scan Tenna-teeth RFID

		view all critical data	Dental Scan (non-invasive) Skintenna Network Identification

5.2.4.Automation for Operations

Operations Systems	Description
Power Grid Management	Repair broken/ interrupted circuits. Maintain nuclear reactor. Occasional repairs to the solar farm.
Water Management	Checks for contaminants and leaks along the system.
Atmospheric Control	The air's composition, temperature, and pressure are monitored by independent Iomud robots; any changes will be corrected by stored gases and scrubbers
Waste Management	Controls the flow of waste to the independent systems.
Transportation Systems	Monitors the flow of traffic of Rapid rails, velomobiles, and scooters

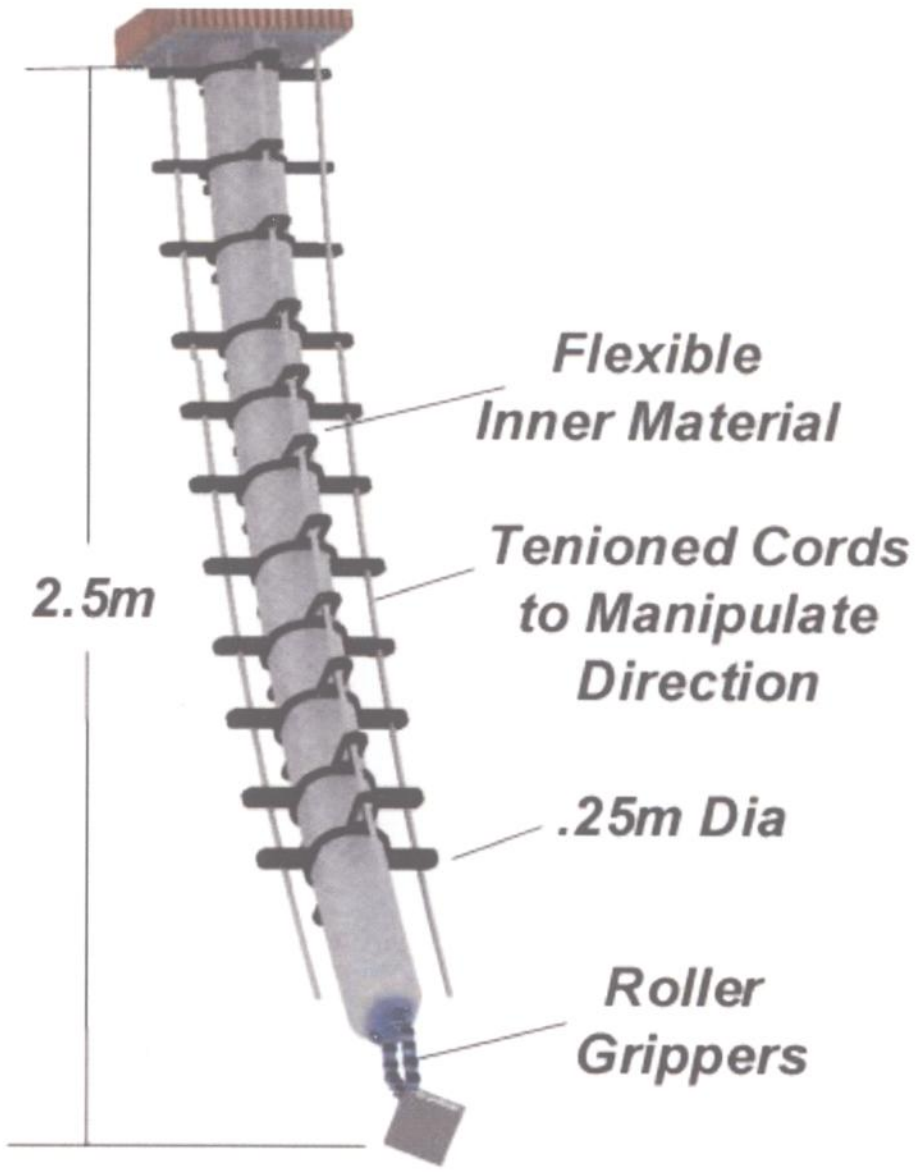
5.3. Automation of Settlement

5.3.1.Automation in Community

	Purpose	dimensions	quantity	cost
Meeko	Personal help robot in the home	.25m x .25m x 2.3m	26400	$30000
Fouta	Multi-purpose cleaning robot	.5m x .6m x . 25m	30000	$5000
Karbada	A system that cooks, cleans, and helps in the kitchen	N/A	13200	$1500
Personal Clothing Re-maker	Makes clothing to the specifications of the user	1m x 1m x .5m	13200	$20000
Hirzai	Picks up trash	.5m x .5m x. 25m	2000	$3000
Jutland	Delivers consumables	N/A	1	$2600000

Robots and Automated Systems:

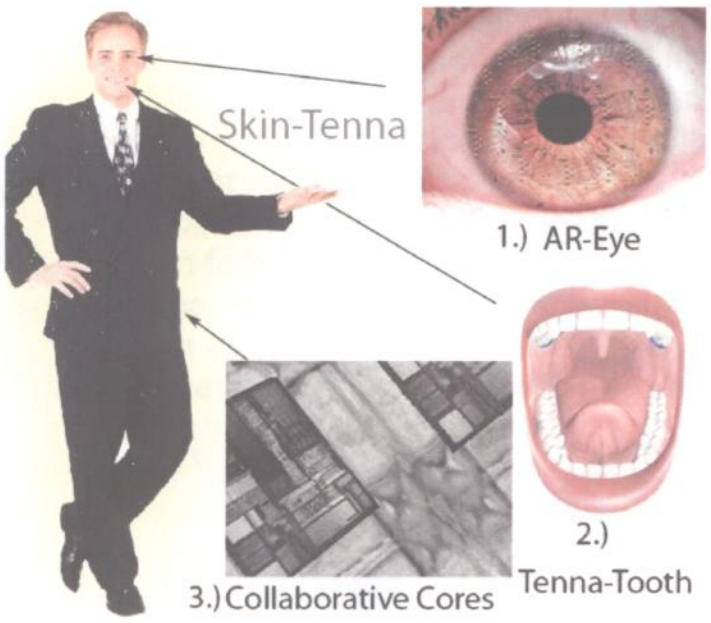
The Meeko system will consist of two infinite axis manipulators per house that extend from the ceiling to assist the residents. The manipulator can travel throughout the house using a complex system of rails inside the ceiling concealed by independently moving ceiling tiles. When the manipulator is not in use, it will be set aside in the space between the ceiling tiles and the ceiling framing of the house. Whenever the manipulator is in use, the ceiling tiles will shift and shuffle to create a path for the manipulator to go through. Each tile will be equipped with an LCD display to create lighting and entertainment such as a 'shifting tile puzzle' amongst other games. Users will be able to command the Meeko using the AR-I or voice commands to bring household items to them. The Meeko system can also analyze objects in a room and can put things back into place using the perspective technologies if the resident so desires.



For an efficient cleaning system
the bamboo floors will be coated with titanium dioxide. This coat will allow the particles to absorb ultraviolet light and in turn will give the particles cleaning quality stronger than that of bleach. These particles are able to destroy bacteria and compounds in addition to preventing water droplets from forming due to its' superhydrophilicity. This causes water to run straight off of the material and cleans the floor during the run off process. The BOB robots will pass over the floors with strong UV lights, activating the titanium dioxide while picking up debris and other foreign contaminants.

All clothing in the station will be made out of soy/bamboo fiber blends. This will enable the wearer to place the clothing article into the PCR where the clothing will be taken apart down to its core fibers and then re-threaded into any other type or design of clothing that the individual wishes for. New designs and logos can be bought using the AR-I interface. The machine will integrate a plethora of independent processor cores into each piece of clothing which it will remove when rethreading the clothes.

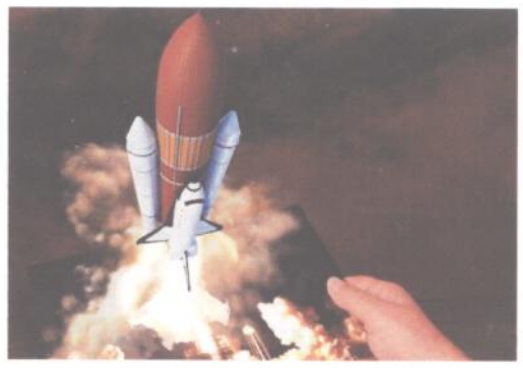
In order to ease the lives of the residents of Columbiat, consumables will be distributed via a system incorporating the transportation of Columbiat. Whenever an item is ordered, whether for personal or commercial use, it will be placed in a specialized container and put into an electromagnetic tube for transportation to the nearest Rapid-rail stop or scooter rack. The container will connect to the mesh network and determine which vehicle will be traveling nearest to its destination in the most time effective manner. The container will then attach to the mode of transportation and then detach itself when it reaches the nearest point to its destination. From there it is entered into the tubes again and is propelled to either a community consumable center or directly to a commercial building.



Computers:

The station's residents will be provided with an innovative and fully integrated solution for mobile computing. This solution does not consist of a single device but rather of a group of separate devices.

The user interface will be rendered and projected directly onto the users eye by the **(1) AR-Eye contact lenses**. The AR-eye will have an array of light sensors in order for the computer to analyze visual data to render required elements of the user interface. Embedded nano-LEDs will project light directly onto the retina to display any necessary graphics. This will allow the use of augmented reality and HUD user interfaces. Augmented reality is the rendering of additional virtual objects based on a person's perspective and surroundings. The AR-Eyes have the ability to analyze a person's perspective in the room. By doing this, the surroundings can be augmented and altered to suit the situation. The AR-Eyes renders virtual 3-D images using the information gathered about the person's location, perspective and movement.



(Shuttle is projected in from the paper in 3D using augmented reality)

The Tenna-Teeth are used for several identification purposes. The tooth piece contains an RFID chip that allows for the person to be identified in low security situations. Small speakers and microphones will be integrated within the tooth piece that send vibration through the jaw and enables the user to hear computer gene.

Collaborative Cores will be imbedded within clothing. The nano-sized cores are fully independent but will collaborate with each other to fully utilize the computing power and will incorporate memristor memory and processing. Extreme ultraviolet lithography will be used to manufacture these individual parts. All of the worn electronic will not have batteries but will use power directly transmitted through the wireless power field which uses magnetic resonance to transmit power at a 95% efficency.

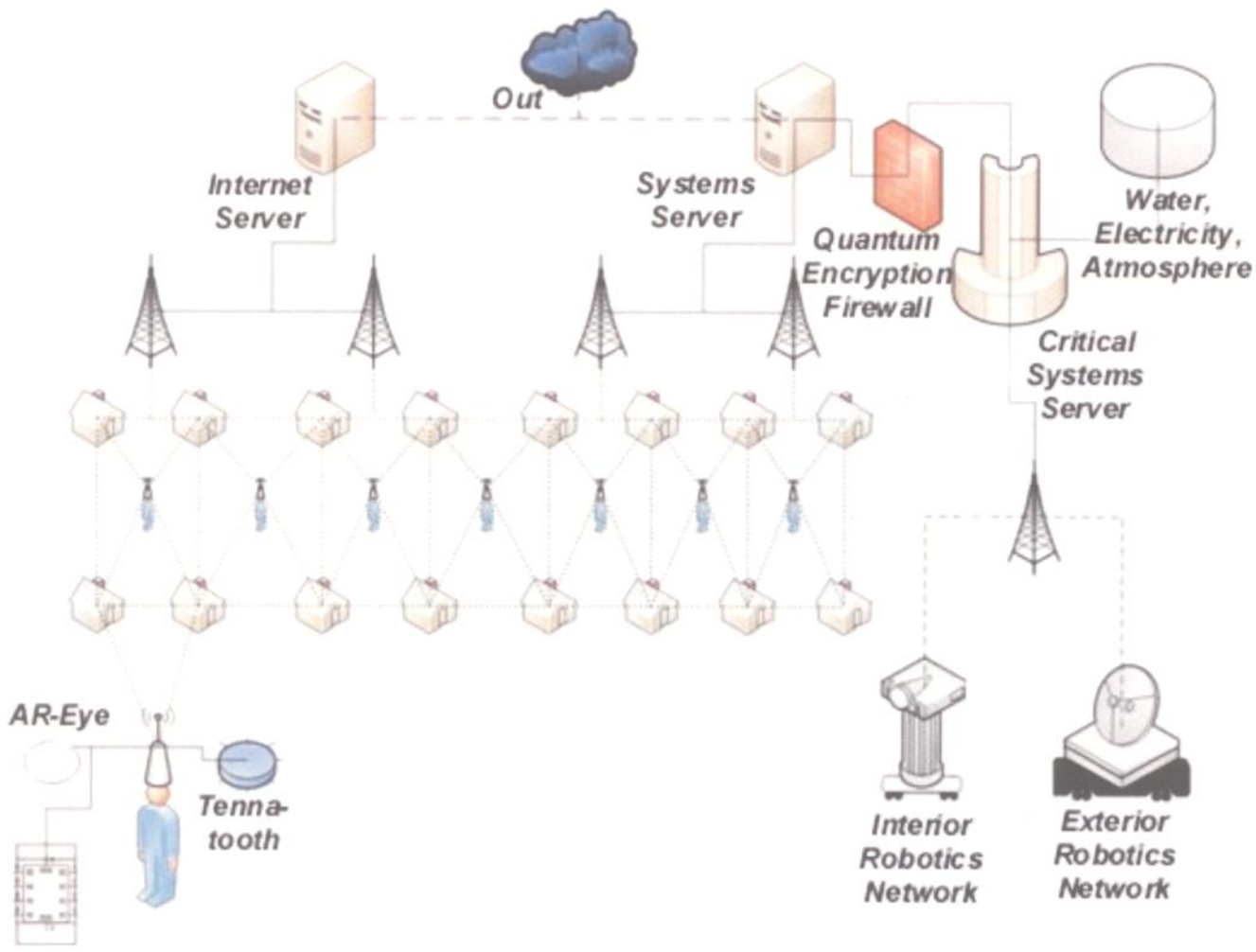
Home computing will use the AR-eye but the environment will be fully integrated in ways such as knowing were all objects are in the house and use of integrated displays speakers and health monitoring

5.3.2.Automation in Workplace

Since Columbiat is to be the epicenter of business in space, efficiency in the workplace will be extremely important. Workers will all make use of a Brain Computer Interface, a noninvasive 'helmet' that will be integrated into the seat. The user will be trained on how to efficiently use the BCI because a level of concentration is needed, but will greatly improve productivity in the end. Performing calculations amongst other activities will be exponentially quicker as no time will be wasted inputting data manually. The user can use the BCI at the same time as other standard interfaces; they can even decide to ignore the BCI if too stressed to use it.

5.3.3.Networking and Computer Access

Free space optical communication will be used for earth to satellite to settlement data communications. Throughput for each of these satellites will reach a maximum of 1.2 terabits per satellite. This will provide ample bandwidth for all necessary communications. The station will have a total of 1,500 servers including storage, backup, and communication servers. A set of 35 critical systems servers spread throughout the station (torus, ½ G, and centrifuge) will work to keep life support working and other critical tasks. These critical servers are all interconnected with fiber optics and are extremely superfluous meaning the station would operate normally if two thirds of them failed. The interior of the station will use a wireless Mesh network in the 1Ghz frequency range. Antennas throughout the station will provide the connection to the servers and internet while all each home and wireless device connects to one another creating a "Mesh" and extending the network so that if a tower were to go down, every home would still a network connection.



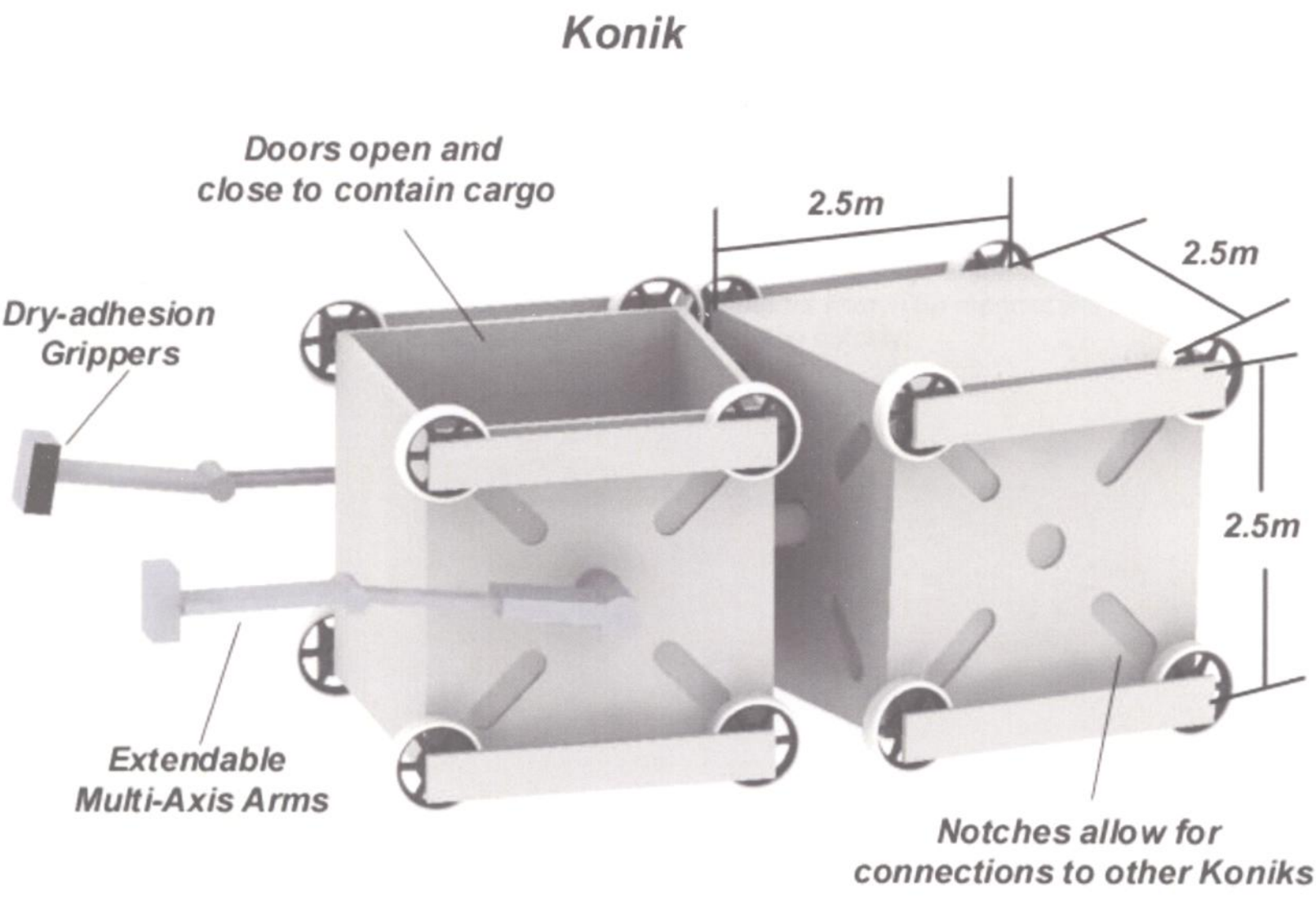
Residents of the station are equipped with Tenna-teeth which will directly connect to the mesh network and will recreate a personal area network, around 60Ghz, that uses the skin as a short range antenna for all of the worn devices, such as AR-eye contact lenses and collaborative cores.

Top administrative accounts or levels will include tasks like network address assignment, assignment of routing protocols and routing table configuration as well as configuration of authentication and authorization. Quantum cryptography is the most reliable and secure option out of the many out there in terms of networking security. The concept of quantum cryptography relies on the fact that quantum information cannot be measured without disturbing the data being transmitted. This is because, the user and system would automatically know when an intruder is attempting eavesdrop, providing ultimate control and security. Quantum cryptography will only be used to produce, encrypt and decrypt a key. The key will then be distributed using the One-Time-Pad encryption method. The One-Time-Pad cipher is unbreakable and cannot be cracked with brute force method.

5.4. Automation for Cargo Management

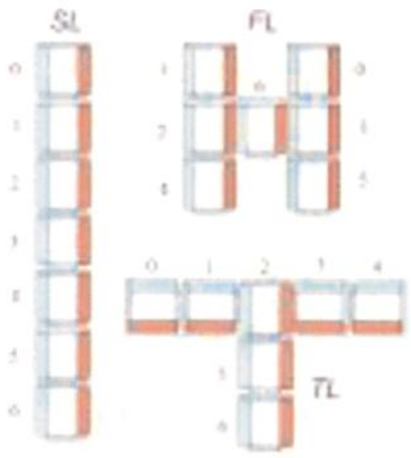
5.4.1.Cargo Handling System and Management

In order to transport cargo, self organizing robot boxes called Koniks will be equipped with two arms for unloading cargo from the standardized containers and magnetic wheels. Koniks essentially act as storage containers themselves, loading cargo into themselves and being able to arrange themselves in the most efficient manner. They are module robots which can be given unique node IDs, utilizing a centralized algorithm that uses eigenvalues (used to quantify inertia vectors) to provide accurate movement inside warehouse facilities. These Koniks can be loaded quickly and efficiently because the docking facility is operating in simulated zero g, allowing the cargo to be manipulated easy and efficiently. They will board the cargo ship and load themselves according to the ship's cargo manifest and the Konik's preset cargo subsets. Once the Koniks have been fully loaded, robots of the same subsets will release from the ground and maneuver via compressed air to form a "train" that will travel to their designated warehouse.



5.4.2.Cargo Storage Systems and Management

For inventory management, the Koniks will work with the mesh network to be able to communicate the locations of all the cargo. Cargo will be stored according to its categories and will receive and redistribute the signal to ensure all of the storage Koniks will receive it. By logging onto the network residents can use their AR-I to visually identify their cargo at any predetermined cargo station. Koniks can connect and disconnect with each other, moving to create formations that provide the most efficient processes to obtain any single piece of cargo at one time. When a



(Example of warehouse management strategies)

Konik is removed, the rest of the Koniks will instantly work over the mesh network to create the next most efficient layout based on their internal blue prints of the warehouse.

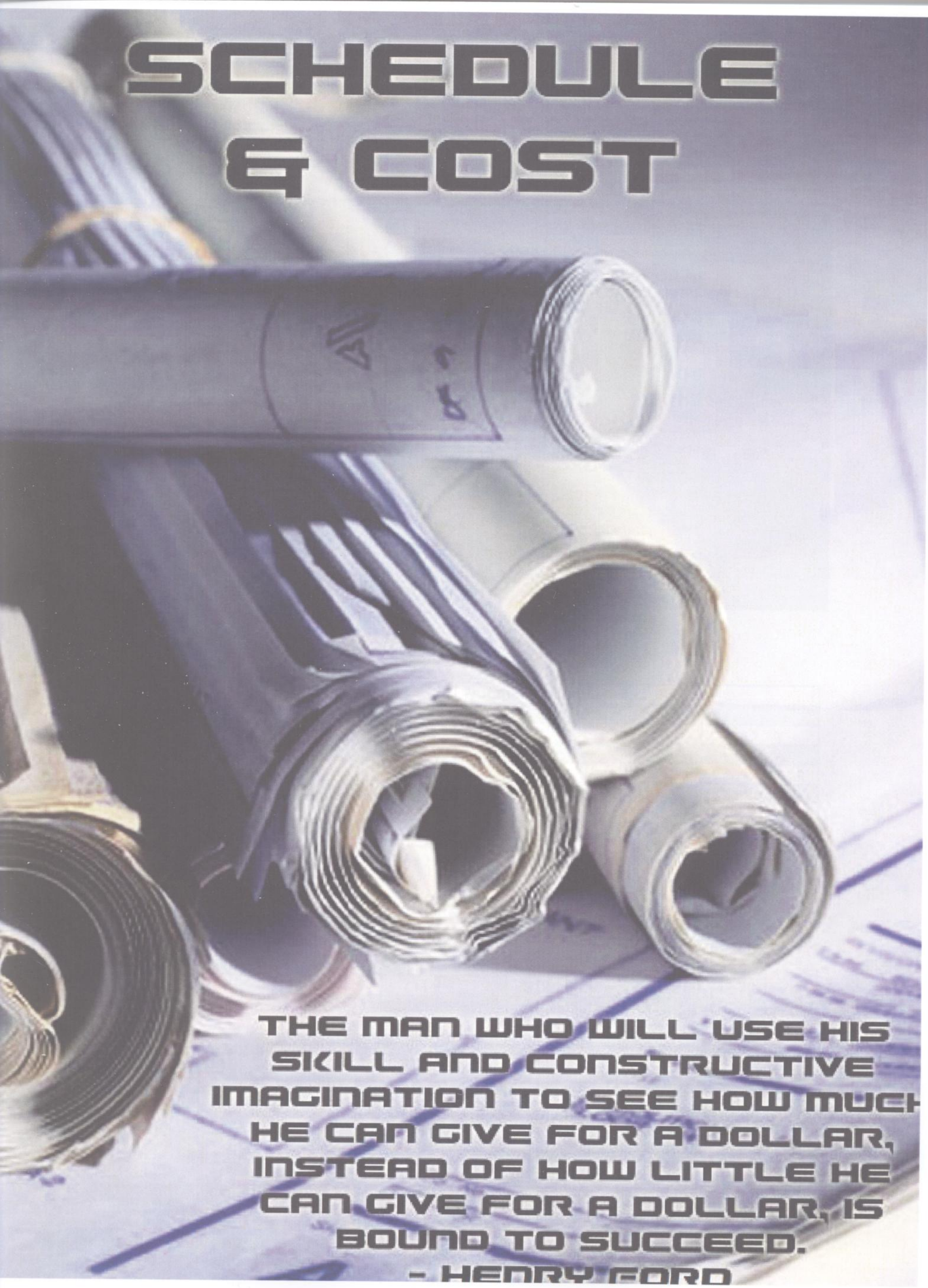
5.5. Automation for Foreign Robot Maintenance

All docking ports will have two maintenance stations located on opposite sides which will each contain Cimarron robots and an EVO Center. These robots will board ships to make any minor repairs or transport any disabled robots to the restoration system in the EVO Center. Before entering the EVO Center, all robots will endure a stringent cleaning and dust removal process. To protect the moving joints on robots that could potentially be clogged with electrostatic dust, each robot will be equipped with piezoelectric material in the joints. Whenever a joint on a robot moves, bending the piezoelectric material, the voltage produced from the deformation of the piezoelectric material will repel the electrostatic charge on the dust.

The exterior walls of the docking facilities will be shielded with Durable Dust Repellent Coating made of nano-phase oxide coatings. This coating prevents dust from either abrading or sticking to the surface of the docking facility. The EVO centers, decontamination stations, and robots will all use a liquid crystal membrane dust mitigation system that uses electrostatic repulsion and ultrasonic vibrations to repel dust from any surface. Visiting robots will be put through a process consisting of an air shower, UV treatment, safe brushing to remove any dust. Before it is put through the process, the dust will be analyzed to determine its type and the most effective way to remove it. The robots specifications will also be analyzed to ensure that no harm will be done to its structure and system during cleaning.

Air from the maintenance center will be constantly filtered using a multi-stage filtration system that uses permanent magnetic fields with high efficiency particulate air filter. The magnet will help collect the magnetically charged particles to avoid wearing out the filters too quickly.

SCHEDULE & COST

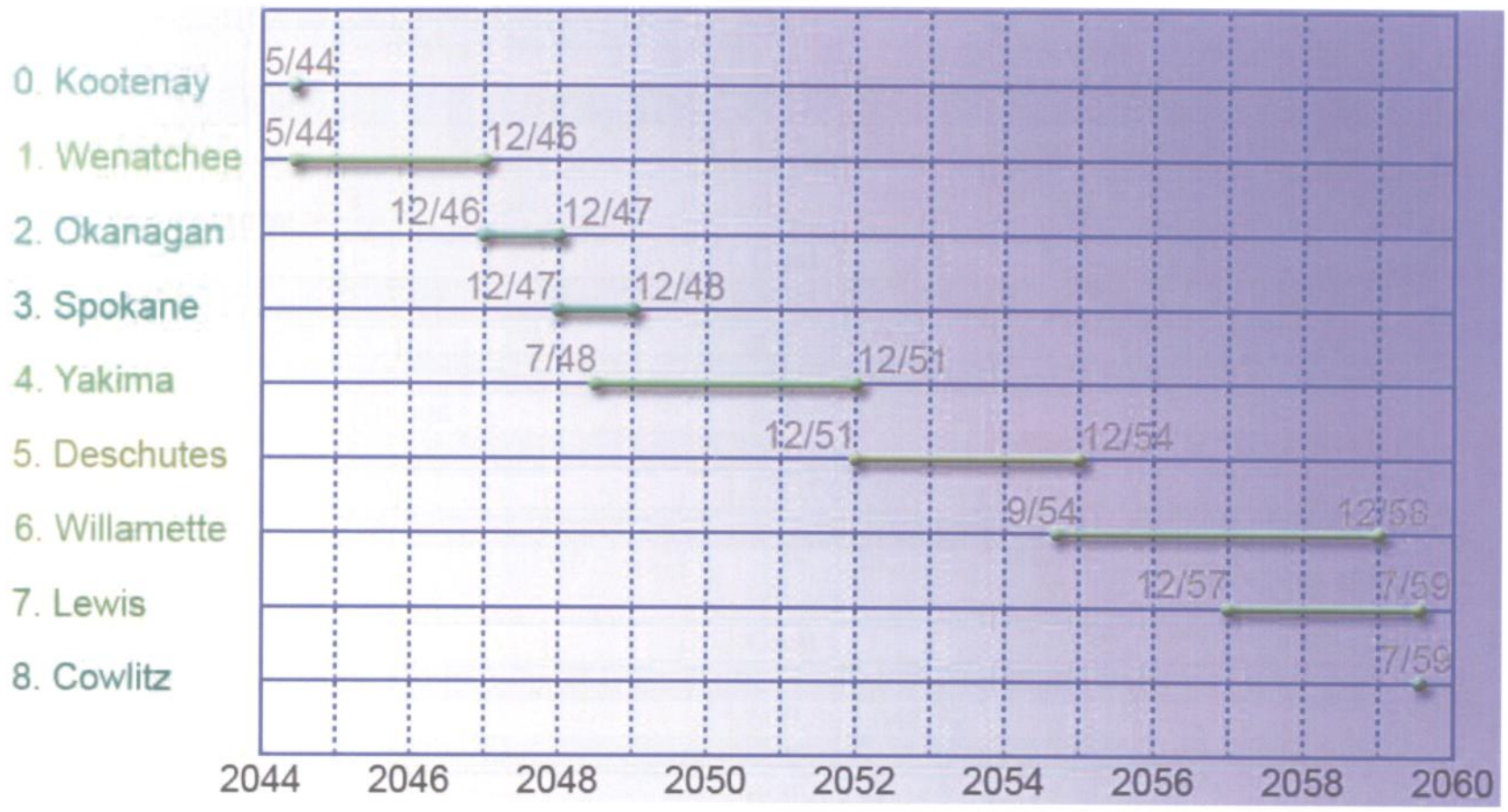


THE MAN WHO WILL USE HIS SKILL AND CONSTRUCTIVE IMAGINATION TO SEE HOW MUCH HE CAN GIVE FOR A DOLLAR, INSTEAD OF HOW LITTLE HE CAN GIVE FOR A DOLLAR, IS BOUND TO SUCCEED.

- HENRY FORD

6.0. Schedule and Cost

6.1. Design and Construction Schedule



6.2. Costs and Employees

6.2.1.Employee Numbers By Phase

Phase Name	Number of Employees
Wenatchee	300
Okanagan	250
Spokane	400
Yakima	450
Deschutes	560
Williamette	620
Lewis	225

6.2.2.Cost by Section

Facilities:

Material	Volume	Cost/Cubic Meter	Total Cost
Aluminum	975,039,007	$141.47	34,484,692,101.31
Titanium	60,998,311	$1570.45	95,194,899,365.05
Martensitic Steel	113,760,839	$286.04	$8135037654.09
Silicon Carbide	711	$194.56	$109,342.72
Polymer Nanocomposites	8,699,200	$207.22	$45,028,913.65
RXF1	766,941	$153.69	$29,467,802.35
Lunar Glass	869,867	$337.21	$73,332,024.3
Boron Carbide	9,209,775	$2235.78	$117,554,543,558.53
Total	1,169,344,651	N/A	$255,517,110,762

Operations:

Item	Cost
Vehicles	50,000,000,000
Propulsion	2,634,300,500
Utilities	1,330,000,000
Satellites	810,000,000
Consumables	55,200,000
Total	54,482,950,050

Human Factors:

Item	Cost
Education	150,000,000
Entertainment	815,250,000
Salaries	3,287,192,000
Homes and Furnishings	228,500,000
Transportation	14,785,026,000
Consumables	250,000,000
Total	19,516,000,000

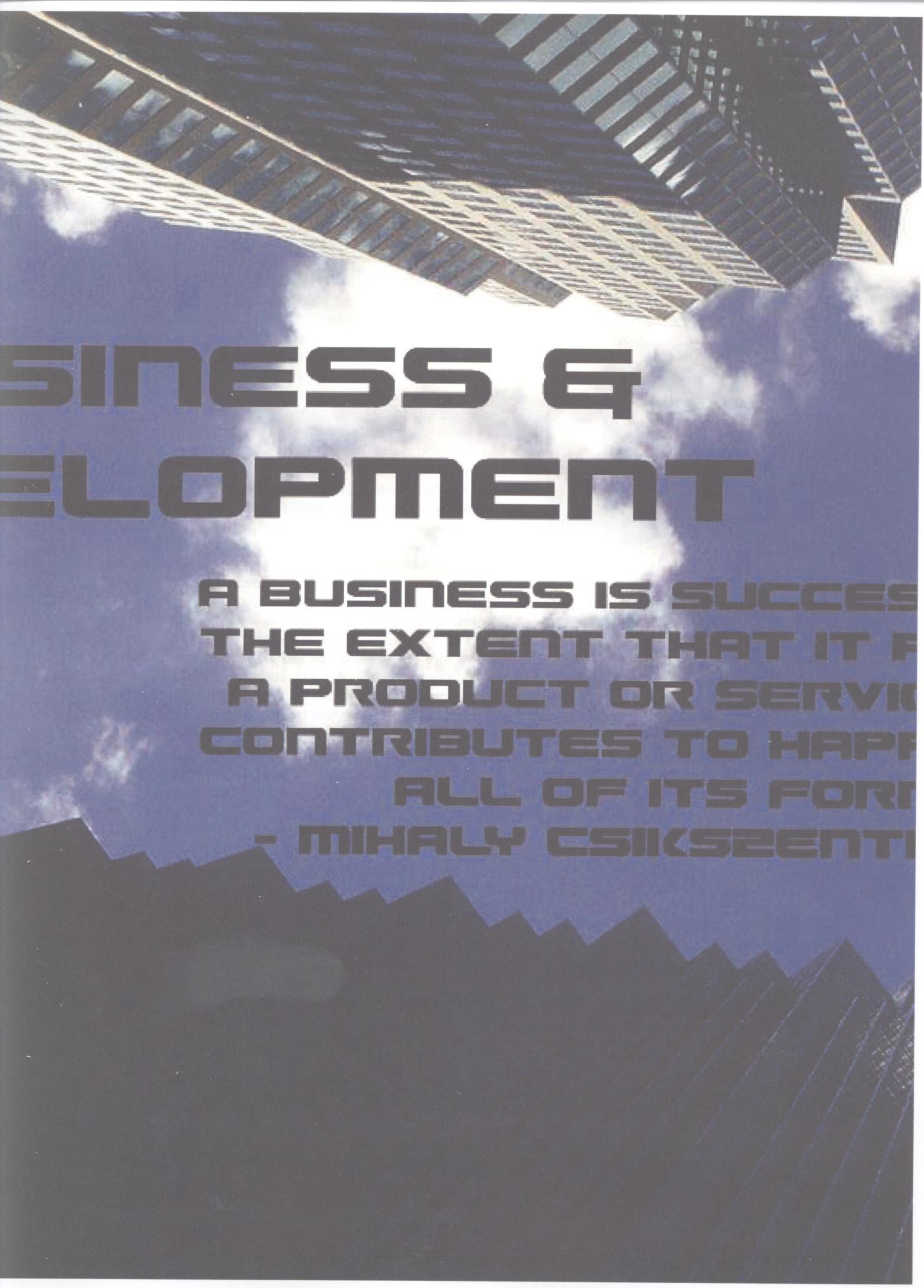
Automation:

Item	Cost
Finishing and Furnishing	225,324,639.23
Construction	568,391,648.72
Operations	8,326,461,213.31
Community	6,386,297,146.84
Networking	10,582,364.07
Total	15,517,057,010

Total Cost: 345,033,117,822 or 345 Billion

6.2.3. Cost By Phase

Phase Name	Cost	Associated Expenses
Kootenay	$262,157,625,520	All materials for construction and EVO centers delivered
Wenatchee	$125,526,320	Automation construction costs and salaries for two and a half years.
Okanagan	$62,892,598	Automation construction costs and salaries for one year
Spokane	$62,892,598	Automation construction costs and salaries for one year
Yakima	$265,734,945	Automation construction costs and salaries for three and a half years
Deschutes	$212,180,665	Automation construction costs and salaries for three years
Williamette	$283,421,250	Automation construction costs and salaries for four years
Lewis	$80,842,393,926	All infrastructure, operations, interior finishing, networking, transportation systems, automation construction costs for 2 years
Cowlitz	$1,020,450,000	Education, entertainment, consumables, and salaries
Total	$345,033,117,822	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ELOPMENT
A BUSINESS IS SUCCES
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ALL OF ITS FORM
- MIHALY CSIKSZENTI

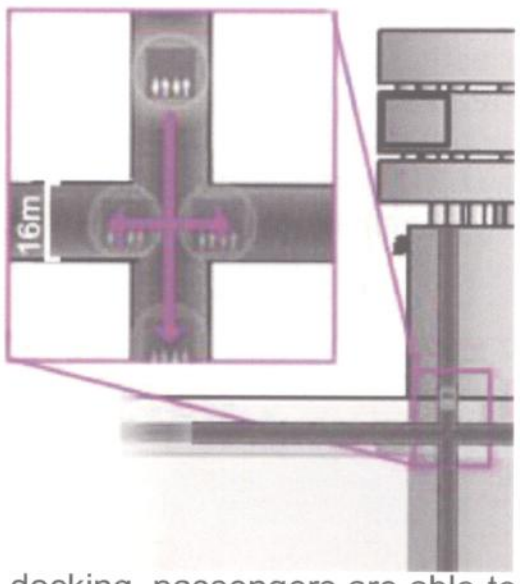
7.0. Business Development

Columbiat has been designed to host a wide variety of commercial and industrial enterprises, initially focusing on three pursuits with both short and long term potential: acting as a hub for transportation, a center for commerce, and a service station for visiting spacecrafts. Though the original configuration of the station will be heavily focused on these three ventures, Columbiat is flexibly designed to provide to any business seeking to invest in the unique opportunities of space. With the capability to house and maintain an endlessly diverse commercial population, Columbiat will maximize the Foundation Society's profits.

7.1. Transportation Node and Point

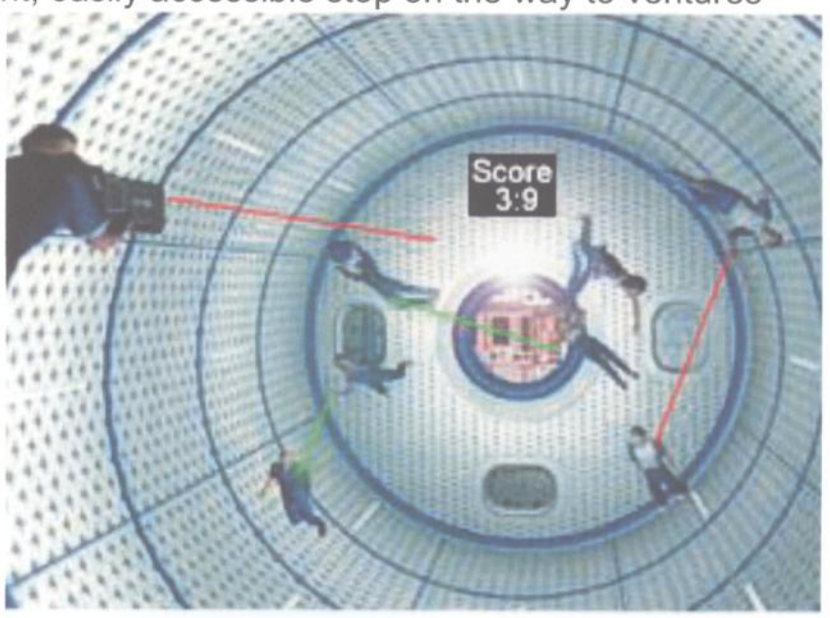
Located in one of the most accessible and central points near the Earth, Columbiat is in prime location for extraterrestrial journeys of varying distances. It will also act as a stepping-stone for future space exploration and travel opportunities.

7.1.1.Docking



Columbiat utilizes a revolutionary zero gravity four level docking system to allow more efficient simultaneous docking and to simplify the processes of managing cargo and passengers. With a zero gravity environment provided by electromagnetic counter-rotation of the docking facilities, cargo can be unloaded with exceptional efficiency by flexible, self-organizing Koniks in the facilities designed solely for the unloading, distribution, and loading of cargo. With the flat outermost level dedicated to docking only cargo ships, they are offered the ability to land in their optimal orientation, thus accommodating more paths of approach. Below the cargo ship hangar, passenger ships are able to dock directly and immediately unload passengers into waiting gyro-stabilized Elespheres. Due to the separation from cargo docking, passengers are able to bypass the hassle of waiting for cargo to be dealt with and are also provided with the most direct path to their final destination within the station.

Due to its L2 location, Columbiat is in the physical center of the current space community and the future of colonization, close to the important hubs of trade, travel, and expansion. As the ultimate waypoint, the ample storage space within the struts and centrifuge will provide a means to store cargo brought from any other station or Earth, while the self-organizing Koniks will transfer cargo onto ships dedicated to colonization, expansion, and development further in space. Columbiat's storage and distribution facilities are sufficient to house and transfer materials to initiate development of settlements on the surface of the Moon, Mars, and asteroids beyond. The station's proximity to the Moon makes Columbiat the best choice for material delivery for lunar-based projects. The station also offers a convenient, easily accessible stop on the way to ventures beyond the Earth-Moon system. Aside from its ideal location for expansion, Columbiat's position between the existing Foundation Society settlements will allow it to become a major trading center, within short distance of all other trading facilities.



7.1.2.Vacation Spot

Columbiat is not only a bustling commercial outpost, but also an attractive tourist destination. The station has a broad spectrum of entertainment activities, appealing to a diverse set of preferences and tastes.

Transients will commence their vacation in the secondary, lower gravity torus, which will be outfitted with sports areas featuring low-gravity tennis, golf, swimming, and more. A resort and spa will be the centerpiece of the commercial sector of the secondary torus, allowing all transients to enjoy a relaxing, entertaining stay while acclimating to higher levels of gravity. The main torus will feature a diverse selection of cultural entertainment choices, ranging from performing arts centers and cinemas to bowling alleys and pool halls. These venues will be complimented by the delicious cuisines found in the wide variety of restaurants that will be spread throughout the commercial sectors. To take advantage of the unique aspects of space living, there will be a section of the centrifuge, where visitors can take part in zero-g games, including Platform Jump, Puzzle Maze, Laser Tag, and Foundation Society Says.

In order to maintain a relaxed, entertaining environment, Columbiat will be fully prepared to deal with any medical emergencies. With two full size, fully equipped hospitals supported by two clinics the station capable of serving 1000 people at any given time, Columbiat will be ready for every medical eventuality. All medical facilities will use state of the art equipment, minimizing the length of stays to allow transients to enjoy more time on the station and get residents back to their normal life as quickly as possible. To reduce the risk of disease on the station, all transients will be scanned for infection when they enter the Elesphere from their ship. Any transients that are considered to be a risk to the health of the station will be seated in a separate section of the Elesphere and sent directly to the quarantine facilities at the nearest medical station. Columbiat's all-inclusive medical care will keep residents and transients healthy and capable to allow for an enjoyable and productive stay.

7.2. Commerce and Finance Center

With a multitude of flexible facilities, Columbiat will be prepared to become the financial center of space, providing for a wide variety of businesses and trade opportunities. The unique commodities made available by Columbiat's centralized location and state of the art facilities will enable tenant businesses to profit, as well as the Foundation Society.

7.2.1.Business Facilities

Columbiat will be malleably designed to accommodate the interests of any and all investors. The station houses an entire section of business offices within the Cape Falcon commercial sector, equipped with advanced, innovative moving walls, that be rearranged as needed by each business. With this flexibility, along with the extensive selection of office sizes to choose from, Columbiat will be equipped to deal with nearly any size business. With extra office space and zero-gravity volumes available for businesses to rent, the possibilities of research, development, and commercial pursuits are nearly endless.

Three of the largest office facilities will be constructed as banking centers, fully equipped to deal with the financial dealings of space companies using the station as storage, a trade hub, or a base of operations. These large bank facilities, in addition to two smaller banks in East Kennewick, will also provide financial services to both residents and transients, allowing them to deposit transfer credits for use on the station. This credit currency system will have set exchange rates with currency from Earth to provide a simplified, efficient means of carrying out transactions on the station.

The heart of the office section will be the headquarters of the Foundation Society itself - a luxurious office space equipped with four conference rooms, multiple research labs, and private offices for the 300 person staff. As the governing entity of the station, the Foundation Society will be provided with the height of technological control over its' own domain as

well as all-inclusive monitoring of station facilities. This feedback will be examined for the purpose of updating Columbiat and to improve designs of future settlements.

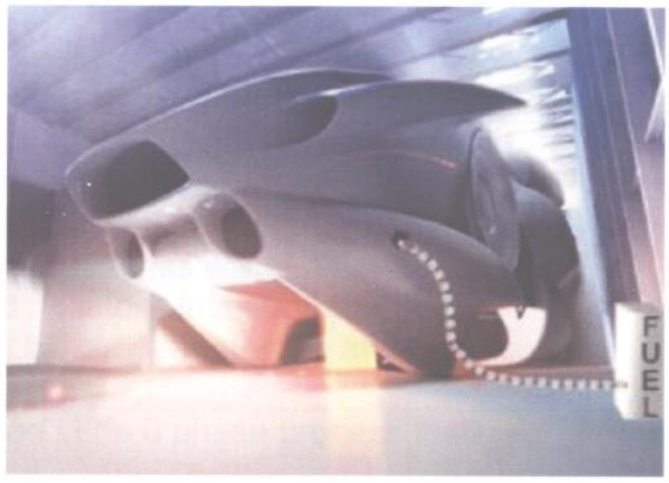
Each office building will be equipped with a closed fiber optics network. This system will not only provide the fastest available transfer speed, but will also be the most secure of all other systems. Separate computing centers that will be sectioned off for each company, will house secure servers that will provide the only optional means by which networks may open up. This system will promote security from both internal and external interference while still offering a viable means of transferring data to other networks.

7.3. Base for Visiting Spacecraft

As the most advanced, most accessible settlement in the current efforts to colonize space, Columbiat will be visited frequently by ships of all types and purposes. The station will be prepared to fully refuel, repair, and restock these ships, keeping business and exploration running at peak efficiency.

7.3.1.Fueling Services

Columbiat will actively procure excess fuel supplies from Earth, Bellevistat, and Alaskol for spacecrafts in need of refueling for longer journeys. This fuel surplus will be stored in secure, pressurized cooling facilities within the struts located at access points near the docking hangars. Helium-3 obtained from Alaskol as well as hydrazine, deuterium, and nitrogen titroxide obtained from Earth and Bellevistat will be the main fuels offered to spacecrafts, each selected for its efficiency. Spacecrafts docking with Columbiat will be automatically refueled if the parent company so desires.



7.3.2.Maintenance

Columbiat's docking hangars will be equipped with Cimarron robots to provide proper maintenance for all ships housed therein. Upon arrival, ships will be immediately thoroughly cleaned, keeping the docking facilities in good order and providing the ships' crews with a pleasant environment for future trips. As part of the cleaning service, the ship's waste will be emptied and processed with that of the station's, allowing for the recycling and disposing of waste as necessary. Not only will this provide a clean environment for the crew, but also any recyclable materials will be added to the station's store. The ships will undergo any necessary repairs (from simple scratches to major damages), to ensure that they will be in exceptional condition for their next voyage.

7.3.3.Excess Food

Columbiat's extensive, high-density agricultural network will produce a supply of consumable goods in excess of the station's population's needs. This extra food will be stored in cooling facilities spaced throughout the struts and in the centrifuge, keeping the food fresh and healthy. On average, the available oversupply will be sufficient to support the populous for one month. This excess may also be purchased by ships to restock their own supplies or be brought to other settlements in case of emergencies resulting in food shortages. All food, necessary or in excess, will endure rigorous screening and be appropriately packaged to ensure the highest quality products for residents, transients, and crews.

8. Compliance Matrix

1.0 Executive Summary	Details the design of Columbiat and the vision to fulfill the Foundation Society's quest.
2.0 Facilities	Columbiat will be at the L2 Lagrange point, located optimally for expansion and trade opportunities.
2.0.1 Population and Natural Views	Columbiat will support 22,000 permanent residents and an average of 2,500 transients, providing them with natural views of Earth by means of mirrors on satellites.
2.1 Exterior Design	The station will be one major torus and one smaller torus rotating around a centrifuge with docking facilities at either end.
2.1.1 Construction Materials	The station will be constructed from materials provided by Earth, Alaskol, and Bellevistat.
2.1.2 Volumes	The station will have unpressurized volumes dedicated to background operations and pressurized volumes wherever humans will be. All volumes will rotate clockwise except for the docking and zero-g sections of the centrifuge.
2.1.3 Artificial Gravity	The rotation of the station at 1.15 RPM will provide artificial gravity equal to that of Earth to the main torus and half that of Earth to the secondary torus.
2.2 Interior Spaces	Micro-gravity and zero-gravity volumes will be used for entertainment, storage, and business investments. Unpressurized volumes will be used for storage and automated operations.
2.3 Construction Process	Columbiat will be constructed in an 8 phase process lasting from May, 2044 to July, 2059.
2.4 Port Facilities	Two docking facilities will be able to simultaneously dock a total of eight ships at any given time and have up to sixteen in hangars. All docking hangars will have specialized repair facilities for emergency situations.
2.5 Low-gravity Accommodations	Columbiat will have a secondary torus with artificial half-g gravity to help transients accommodate to the station's gravity and to provide a permanent residence to the elderly.
3.0 Operations	Station operations provide an excellent, more terrestrial quality of life for residents.
3.0.1 Conduct of Business	Station operations ensure that residents and transients are provided with all the needs for a healthy life, while conserving resources with efficient system designs.
3.0.2 Accommodations for Ingoing and Outgoing Vehicles	Vehicles will land in docking centers located at both ends of the centrifuge, where they can be re-fueled and re-stocked.
3.1 Settlement Construction	Columbiat is built and located at L2, allowing for easier thermal and radiation shielding while being an ideal location for a lunar elevator in the future.
3.1.1 Construction Materials	Construction materials from Bellevistat, Alexandriat, and Earth include Aluminum, Titanium, Martensitic-hardened Steel, Silicon Carbide, RXF1, Ultrastrong and stiff layered Polymer Nanocomposites, Lunar glass, and Boron Carbide.

3.1.2 Construction Equipment	Equipment will include drills, oxyacetylene, and triangular trusses
3.2 Infrastructure for Operations	Infrastructure provides residents with life support systems.
3.2.1 Atmosphere, Climate and Weather Control	Columbiat's atmosphere will resemble that of Earth's atmosphere to provide a comfortable environment to residents. Air pressure, temperature, composition, and humidity will be monitored and controlled.
3.2.2 Food Production	Food will be grown in the Torus with aeroponics and bio-printing.
3.2.3 Power Generation	Power is generated with a solar farm, a thorium nuclear reactor, and Power Paths. Energy is stored in a BaTiO3 Ultra Capacitor.
3.2.4 Water Management	Water is stored the basement in 3 reservoirs for residential water, commercial water, and water allocated for incoming ships.
3.2.5 Waste Management	Waste is treated in the basement by thermal depolymerization and a Cyclone Melting System, resulting in useful Carbon compounds and glass.
3.2.6 Communication System	Four satellites located around the moon with transmit data to locations in space, while wireless "Skin-Tenna" networks and small cellular devices provide communication on a smaller scale.
3.2.7 Internal Transportation	The Rapid Rail Maglev, foldable Scooters and Scooter Cars, and Velomobiles will be available in addition to walking for transportation.
3.2.8 Day/Night Cycle	Columbiat is lit with Hybrid LEDs, providing a natural looking light allowing for a day-night cycle resembling that of Earth's.
3.3 On-Orbit Infrastructure	Satellites provide communication and solar energy while ships provide transportation to and from Columbiat.
3.4 Propulsion System	Propulsion with a High-Powered Helicon and a DS4G system will maintain the proper rotation rate, orbit and orientation of the station.
3.4.1 Station-Keeping	Propulsion systems maintain the proper placement of the station efficiently with a High Powered helicon and a DS4G system.
3.5 Provisions for Visiting Ships	Food stocks of visiting ships are easily replenished due to the use of aeroponics and Bio-printing. Livestock can receive veterinary care from a Pinto robot. A Selkirk can bring stranded ships to docking and Cimarrons do short term or long term maintenance. Fueling with fuels imported from Earth and other stations is accomplished by Studis. Waste and wastewater is taken to the basement via pipes where it will be processed in Columbiat's main waste/water treatment systems.

4.0 Human Factors	Columbiat will play host to both a commerce heavy environment and a relaxing residential area
4.0.1 Natural Views	Residents will be able to see space and earth through panes of nano-composite glass
4.1 Columbiat Communities	Columbiat will be divided into three areas, Cape Falcon, Kennewick and Glenville.
4.1.1 Facilities for Services	A wide variety of human friendly activities will be providing, including education, diet and nutrition plans, and entertainment options.
4.1.2 Consumables and Means of Distribution of Consumables	Consumables will be distributed through an automated system and will be obtained from many different locations.
4.1.3 Consideration of Psychological Factors	Will ensure that an earth-like atmosphere is present
4.2 Residential Design	Four separate floor plans are provided
4.2.1 Interior Floor Plan and Exterior Designs	Four floor plans and exterior views are shown in this section
4.2.2 Housing Types and Numbers	Details the living area and amount of each floor plan that are present in Columbiat
4.2.3 Architecture	Residents may choose from four different architectural styles for their houses
4.2.4 Furniture	Furnishings will come from Alexandriat and Bellevistat
4.3 Low Gravity Locomotion	Means to safely move in low gravity are provided
4.3.1 Safety in Low Gravity Environments	People can use gecko shoes and handholds to safely maneuver in low gravity
4.3.2 Moving Between Differing Gravity Environments	Residents can move through different gravities using elevator systems
4.4 Space Suit Design	Uses a mechanical counterpressure space suit with integrated bio-nano robots
4.4.1 Donning and Doffing Process	Provides a step by step process for donning and doffing
4.4.2 Airlock Designs	Airlocks are a multi-stepped process that let out approximately 1×10^{-6} m^3 of air per process
4.5 Visitation and Security	Visitors movements will be monitored via the transportation systems and the footsteps will be checked while they are in their hotel rooms.
4.5.1 Anticipated Security Risks and Responses	Criminal transients are apprehended if they cause a disturbance within Columbiat.
5.0 Automation Designs and Services	Automation will be used in Columbiat to enhance the lives of residents and produce more efficiency in the long run.
5.0.1 Unique Robot Designs	EVO Centers will continually upgrade robots based on sensory input to make the most efficient design possible
5.0.2 Computer Hardware and System Requirements	Memristors will be used for memory storage in computers and all chips will be made with plasmonic lithography and made flexible
5.1 Automation of Construction Process	The construction of Columbiat will be mainly accomplished by automated systems that will weld, bolt and place construction materials
5.1.1 Material and Equipment Delivery	Equipment will be delivered from Earth and other stations
5.1.2 Settlement Assembly	Construction will be done by Kuhn and Pottok robots that weld and bolt frame members into place.
5.2 Facility Automation	Robots will be used to maintain various aspects of the

	station.
5.2.1 Maintenance	Cait robots will maintain electrical systems – construction robots will be reused for maintenance.
5.2.2 Contingency	Columbiat will plan for any potential problems and will respond with automated systems.
5.2.3 Security	There are five possible levels that residents must go through
5.2.4 Automation for Operations	The power grid, water management, atmosphere, waste system and transportation systems will all be maintained with automated systems.
5.3 Automation of Settlement	Automation ensures that resident's lives will be happy and productive
5.3.1 Automation in the Community	The Meeko system provides a helping hand in the home and the AR-Eye contact lense provides a virtual environment for increased efficiency
5.3.2 Automation in the Workplace	The Brain Computer Interface in the workplace ensures that workers are able to be the most productive they can
5.3.3 Networking and Computer Access	Columbiat will use free space optical communication for earth to space connections. The mesh network for the interior of the station ensures that the network is always operational.
5.4 Automation for Cargo Management	Konik robots will act as moving storage boxes for cargo
5.4.1 Cargo Handling System and Management	Konik robots will be able to propel themselves with compressed air in the zero-G environment and will load themselves from the ships. They then move themselves to the designated warehouses.
5.4.2 Cargo Storage Systems and Management	Then Koniks will ensure efficient management of cargo by using the mesh network and organization algorithms to efficiently manage cargo.
5.5 Automation for Robot Maintenance	Robots will use piezoelectric material in their joints to repel electrostatic dust. The exterior walls of the docking facilities will be covered in dust repellent.
6.0 Schedule and Cost	Columbiat will be completed in 15 years and will cost 345 billion dollars
6.1 Design and Construction Schedule	The construction of Columbiat will be spread out over 15 years and 8 total phases with 6 intermediate steps.
6.2 Costs and Employees	Columbia will come to a total cost of 345,033,117,822
6.2.3 Cost by Phase	Breaks out Columbiat's cost by all eight phases
7.0 Business Development	Columbiat will host multiple commercial and industrial enterprises to make the highest possible profit
7.1 Transportation Node and Point	Prime location for any business venture in space
7.1.1 Docking	Columbiat will use a zero-gravity four level docking station to provide highly efficient docking opportunities.
7.1.2 Vacation Spot	Utilizes the various gravitational sections of the station for tourist opportunities.
7.2 Commerce and Finance Center	Columbiat will become the financial center of space
7.2.1 Business Facilities	Business facilities have moving walls to facilitate ergonometric office design
7.3 Base for Visiting Spacecraft	Coumbiat is prepared for any visiting spacecraft
7.3.1 Fueling Services	Fuels such as hydrazine, deuterium and nitrogen titroxide

	will be available for ships to use
7.3.2 Maintenance	Cimarron robots will keep ships in peak operating condition
7.3.3 Excess Food	Excess food will be kept in cooling facilities and sold to other stations.

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