



Northdonning Heedwell
Presents:

Bellevistat

Sayre School
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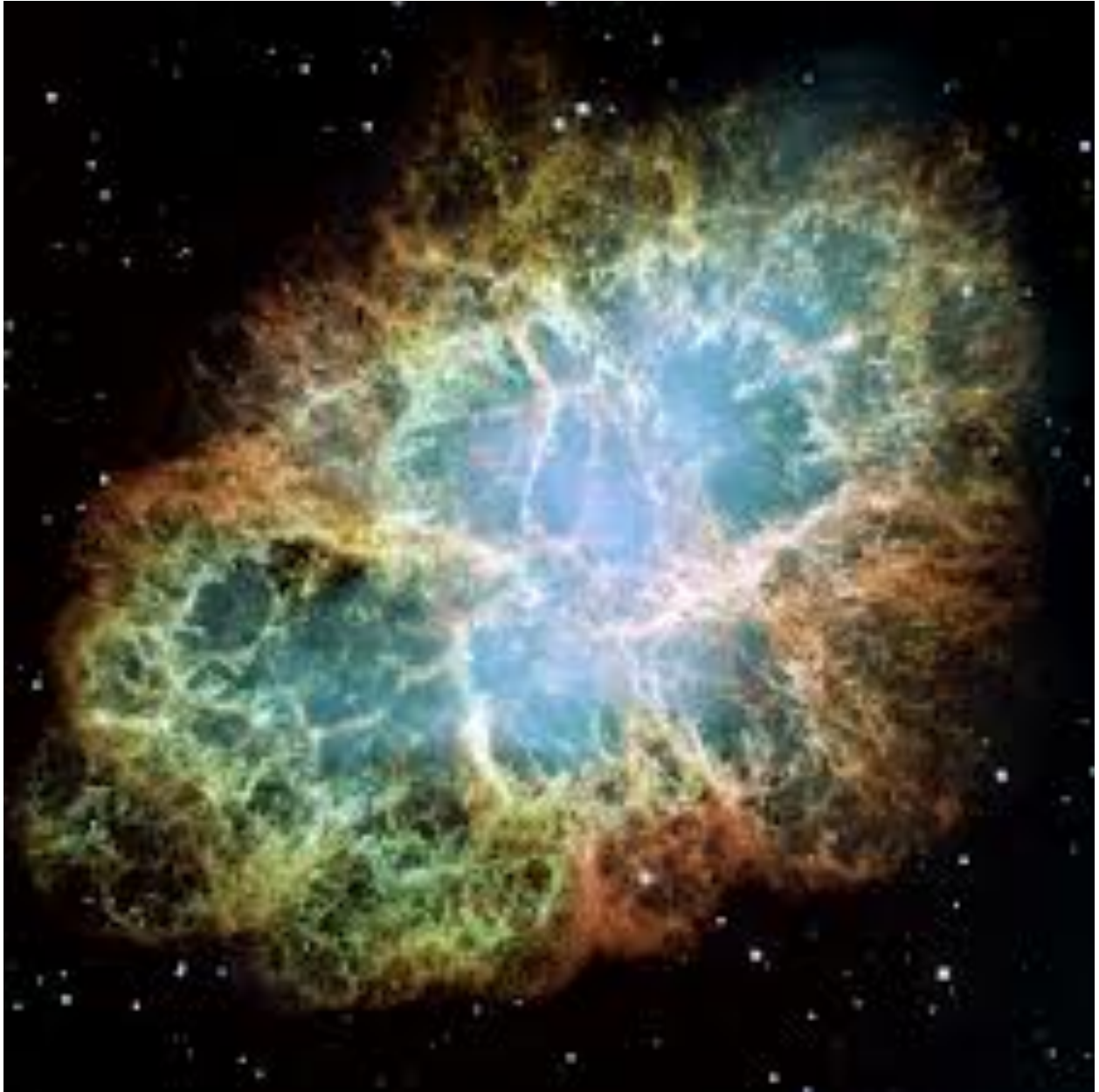


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1. Executive Summary



“Earth is the cradle of humanity, but one cannot live in a cradle forever”

- Konstantin Eduardovich Tsiolkovsky



1.0 Executive summary

Since the Apollo program in the 1960's Northdonning Aviation and Heedwell Grummietta have been an integral part of every major US project in space exploration. Now, 27 years after our merger, Northdonning Heedwell is proud to yet again propose an alliance with the Foundation society for the creation of Bellevistat.

Located in L4, Bellevistat will become the central location for manufacturing in space, utilizing the asset of microgravity for processes. Areas are allocated for .25g manufacturing of the unique material buckeyestructures, and 0g manufacturing. Under these unique conditions, Bellevistat will have the ability to build ships, and airlocks in our dry docks and perfectly cylindrical/spherical cross sections for aerospace applications (these conditions will be used to eliminate corners where cracks can occur) out of titanium taken from ilmenite on the moon in our 0g manufacturing, giving the Foundation Society a monopoly on unique products that can be crafted only in space. The large manufacturing areas have taken into account the space needed for businesses to rent out the areas insuring the Foundation Society a cost effective business plan. In addition to its manufacturing facilities, Bellevistat features a 1g torus and connected areas providing .8g and .5 g. All of these are combined with the option for 1atm, .8 atm, and .6 atm to prevent residents from needing to sacrifice the traditional comforts of Earth, and also experience the unique features of space. Further emphasis has been given to this idea throughout technical sections.

In order to provide a safe, comfortable and smoothly running station, operations have been designed to create a self-sustaining system MELiSSA (Micro-Ecological Life Support System Alternative); a system designed to give Bellevistat its own ecosystem providing for management and reuse of everything in the system. Great thought has gone into the utilization of materials, giving way to great use of lunar materials and bamboo in much of Bellevistat's building and production.

Community designs have been strategically made to give long views and natural light giving homage to Bellevistat's name: "beautiful view". Considerations have been given for future expansion and the need for large green areas providing parks and recreation reminiscent of elements from all over earth creating a unique blend of home, and the final frontier. Designs allow for integration of the transient population built directly into the lay out of the community, and expanded upon with welcoming features and integration into Bellevistat's residents main source of personal computing; the Smartband-Duo, allowing them the full experience of Bellevistat while enjoying their stay. Other features include designs to allow safe operations in 0g, most impressively, the new Mechanical Counter Pressure Suit which will replace the standard EVA unit.

The Alliance Automation Division of Northdonning Heedwell has continued to create innovative designs to increase efficiency and productivity in its design of the robotic and computing systems in Bellevistat. Systems for construction utilize a specialized magnetic nanorobotic positioning gel, capable of giving a magnetic quality to any surface. Artificial intelligence has been used to supplement operations on Bellevistat by giving antivirus systems the ability to learn like an immune system, give robots the ability to learn basic vocal commands in addition to taking kinesthetic based commands from the Smartband-Duo, and give systems the ability to become more efficient in their processing over time.

When faced with the challenge of building the first Cislunar docking facility, Northdonning Heedwell created plans for a pioneering automated docking system, located in Bellevistat's "Hestia Cislunar Docking Bay", which has adjustable positioning rings to accommodate for ships in a large range of shapes and sizes. Pressurized umbilical cords and elevators are available to take visitors up to Hestia's welcoming center where they will enjoy their first experience of Bellevistat as their ship is refueled or taken to a separate docking facility for servicing.

As a contractor for the Foundation Society, Northdonning Heedwell is confident that we will meet and surpass the expectations laid out for the designing and running of Bellevistat and provide a fully functioning settlement by the year 2046. As our collaboration continues with our long standing partner, we will successfully advance the space industry to heights no longer impossible. It is with great pleasure that we present to the Foundation Society Bellevistat. (For an introductory video please visit the home page at www.bellevistat.com)

2. Structures



“For the wise man looks into space and he knows there is no limited dimensions.”

- Lao Tzu



Structures

2.0 Structural Design

Bellevistat will provide a safe, productive, and ergonomic design, for its large manufacturing purpose and the comfort of its 11,000 residents and 500 transient guests. The station will provide a well balanced design taking into account the benefit of manufacturing in different gravities, as well as providing the foundation for wellness of its residents with long ranges sight, and natural light. Bellevistat will also finally provide long needed cislunar architecture with the Hesta Docking Bay innovative automated systems capable of adjusting to different ships for refueling, and a separate dry dock for repair.

2.1 External Features

The basic structure of Bellevistat is divided into a manufacturing area, and a habitability torus. Its features provide for several gravities, as well as a 0g manufacturing area and buckystructures specific areas.

The major features of Bellevistat's structure are:

Solar Panels that provide the station with electrical power for all of its various functions

A **Port Area** that facilitates the on-loading and off-loading of cargo and personnel as well as appropriate areas to support the logistical operations.

Zero G Manufacturing which is jointly shared between Buckystructures manufacturing and standard zero g manufacturing.

0.25 G Manufacturing which is dedicated to Buckystructures manufacturing.

The **Agriculture and Residential** torus is dedicated these functions and is the heart of the station. It will provide a majority of the living space nutrition for the residents of Bellvistat.

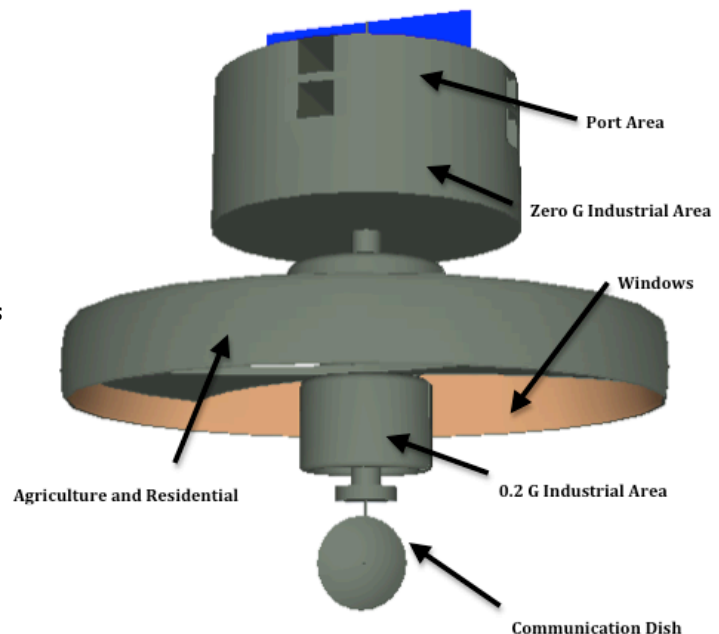
Windows which are Bellvistats portals to the greater universe. The windows are made of glass synthesis on the moon and coated with gold to control radiation.

Connection Struts connect the central axis to the Torus. This area also contains storage, living quarters and areas for operations.

0.2 G Manufacturing is dedicated to a variety of manufacturing activities where tjis level of Micro Gravity is required.

Communication Dish facilitates all communications external to the station.

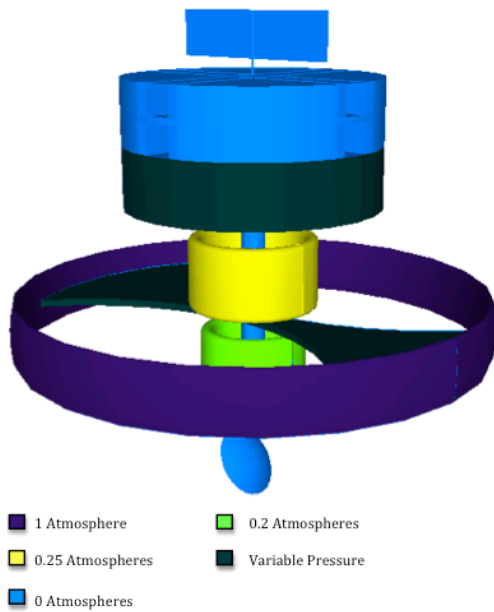
Shielding will consist of a several layers. From the outside, there will be layers of polyethylene, titanium, regolith, and a second layer of titanium.



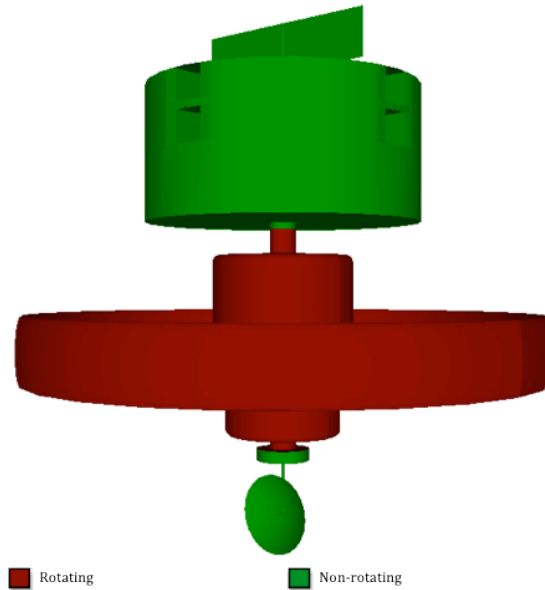


Structures

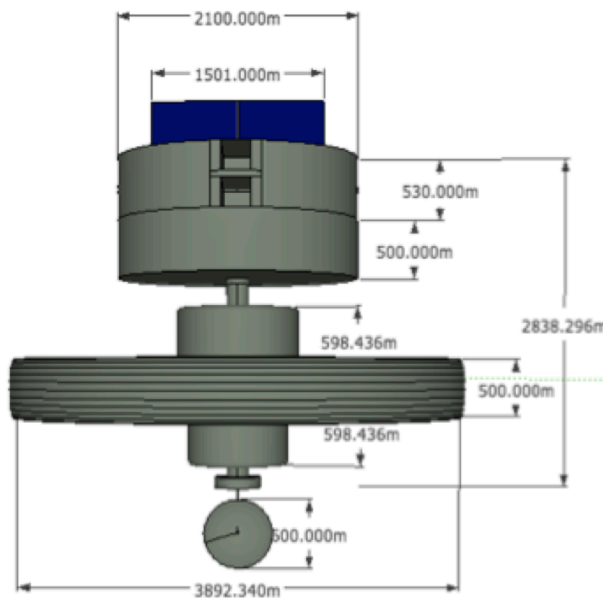
Various Pressures of the Station:



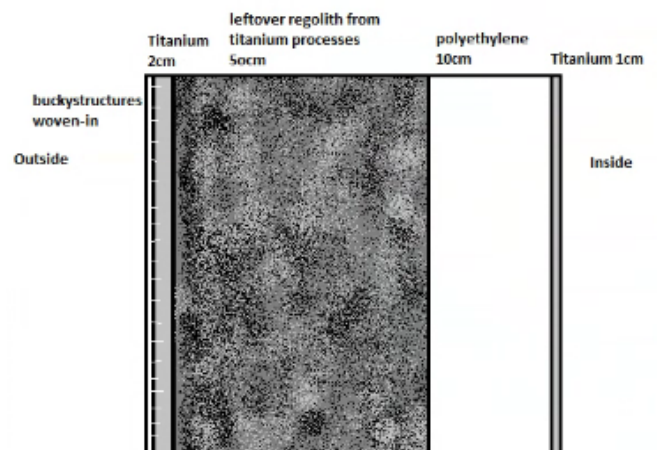
Rotating Sections of the Station:



Station Dimensions:



Shielding:



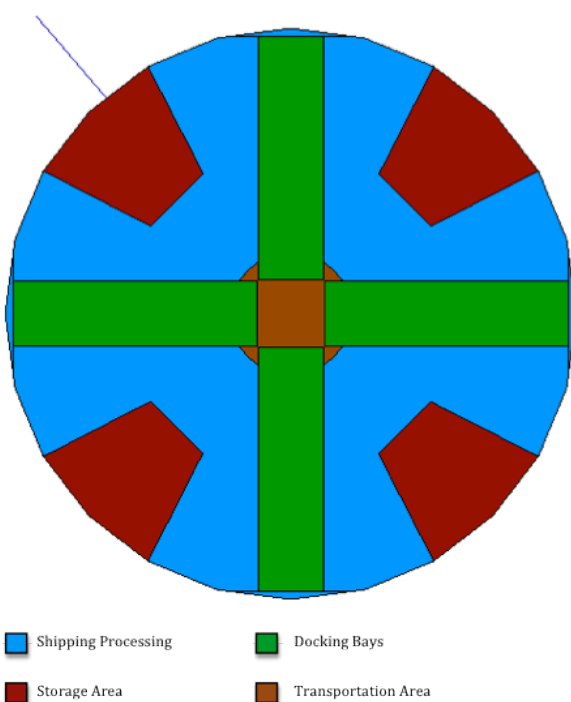
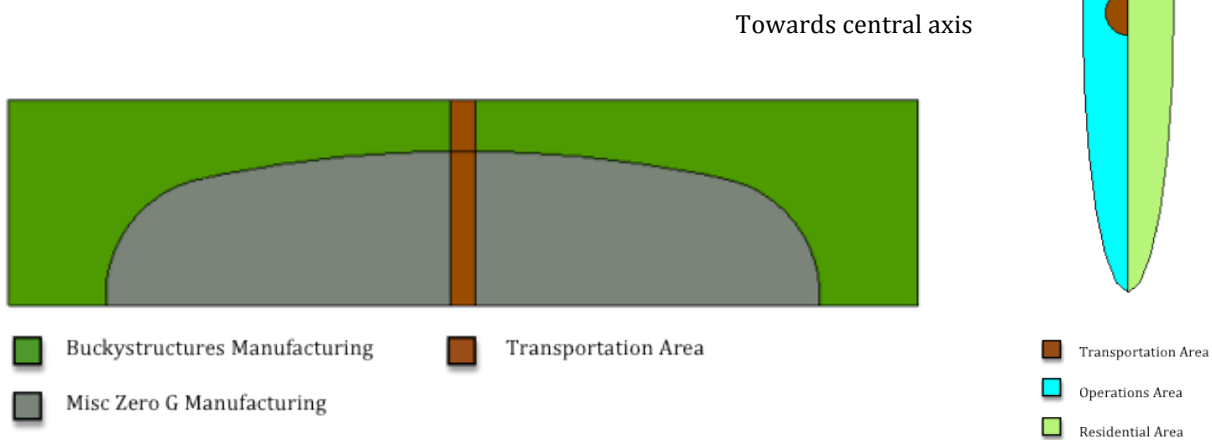


Structures

2.2 Interior Features

The interior of Belvostat is optimized to allow for maximum comfort and productivity.

The cross section at left of the residential section is a large “flattened” torus and shows the primary distribution of volume. The central axis of this rotating portion of the station is to the right so as to achieve the desired simulated gravity level on the surface separating the operations and residential areas.

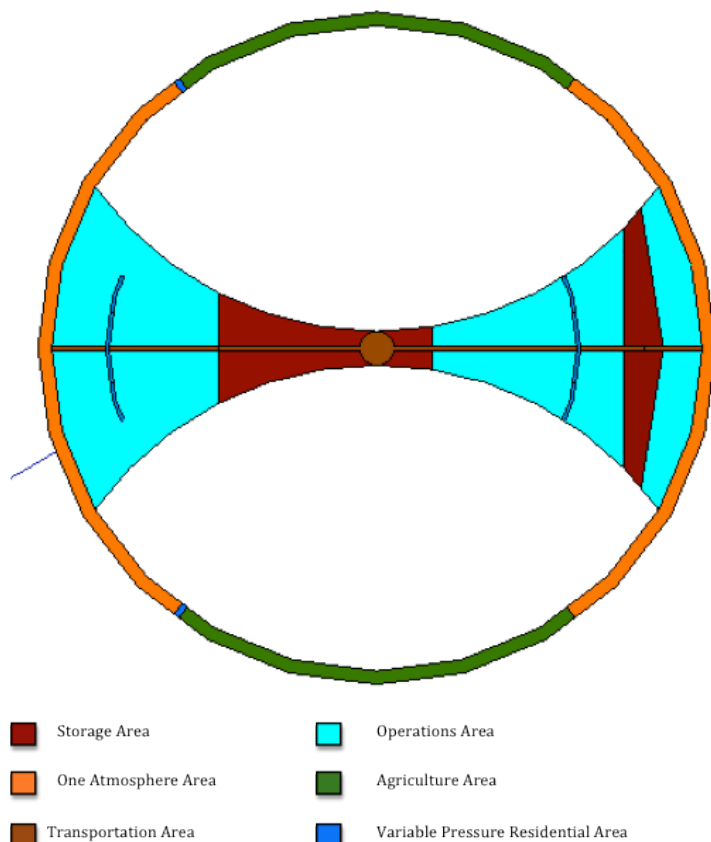


This cross section of the Zero G Manufacturing area details the allocation of volume between Buckystructures and other Zero G manufacturing. The orientation of this section is such that the primary axis of the station is aligned with the long dimension of the transportation area, and runs top-to-bottom.

The Port Area shown here details the distribution of Shipping, Docking, Storage, and Transportation functions. This cross section is oriented with the center of the transportation section aligned with the station's primary axis which comes out of the page.



Structures



This cross section of the main torus and the connection struts showing the allocation of volume between essential functions and detailing the presence of variable pressure environments. This cross section is oriented with the center of the transportation section aligned with the station's primary axis which comes out of the page. Cross sections of the 0.25 G and 0.2 G manufacturing areas do not require cross section drawings because their entire area is dedicated to their single purpose. The variable pressures labeled in the areas in 0.8 g and 0.5 g will be divided evenly between 1, 0.8, 0.6 times atmospheric pressures. The 1g areas will be designated for mostly 1atm while residents will also have the option for living areas in .8 and .6 times Earth sea level atmospheric pressure. The orange 1g areas are divided further into 2 sections in case of depressurization or other emergency, giving a total of four standard 1g-1atmosphere communities and a total of six 1g communities.

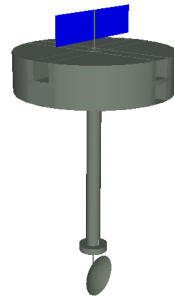

2.3 Construction Sequence

Before the station is capable of housing life, humans will reside on the moon and will be shuttled to the station for short periods of time to help facilitate the construction.

Phase One
<p>In this phase a resource-gathering base will be assembled on the moon. This station will both harvest resources and create prefabricated sections of the station. This base will consist of manufacturing facilities, mining facilities and a mass driver to facilitate the launch of material into lunar orbit. Construction of the base will be awarded to a private contractor.</p> <p>Build Time: 12 months</p>



Structures

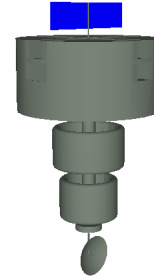
Phase Two	
<p>In this phase the moon base will gather resources and fabricate the interior sections of the station. Material will be accumulated in position until sufficient parts are available for the construction of Belvestat to commence.</p> <p>Build Time: 12 months</p>	
Phase Three	
<p>In the first phase of construction the Central Axis, Primary and Secondary Docking Facilities, Communications Dish, and the Solar Power Facility will be constructed. With this infrastructure in place the station will be operating at its full logistical capacity. This will allow for the acceleration of the transportation of material to the station expediting the building process.</p> <p>Build Time: 12 months</p>	
	
Phase Four	
<p>In this phase the, Zero G Industrial Facility below the docking area will be constructed and brought online. This will allow for the activation of automated manufacturing in this area. By initiating industry at this stage, further construction can be financed by profits made from these industries.</p> <p>Build Time: 6 months</p>	
	
Phase Five	



Structures

In this fifth phase, the Low G manufacturing areas will be constructed and brought online. Rotation will be initiated in the area below the Zero G Manufacturing and above the Secondary Docking Area. This will allow for the activation of Bucky Structure manufacturing, generating additional revenues.

Build Time: 12 months



Phase Six

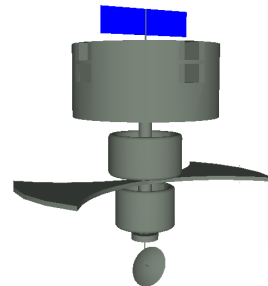
In this phase of construction Bucky structures are woven into the exterior of the station using the Pappenheimer external repair bots. This action improves the durability and robustness of the structure against space debris up to 2 inches in diameter. All future parts will come pre-woven.

Build Time: 14 months total with 4 of these months serial with other activities and the remaining 10 months in parallel with other operations.

Phase Seven

In this phase, the struts connecting the residential torus to the station will be built. The struts will be aligned near but not attached to the rotating area.

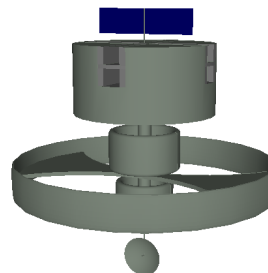
Build time: 8 months



Phase Eight

In this phase, the habitation torus will be constructed on to the struts. These will be accelerated up to the speed of the other rotating sections and will be connected to the central axis. After this is online the entire station will be online and operational.

Build Time: 24 months

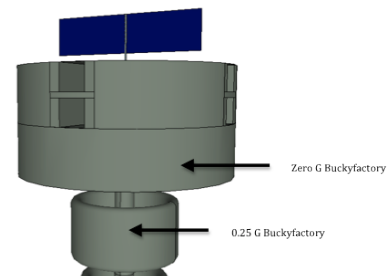




Phase Nine
Interior spaces will be constructed out of prefabricated parts produced on the moon base. This phase of construction will put in place all of the interior systems for agriculture and prepare the station for its community to settle in.
Build Time: 6 months
Phase Ten
In this phase Business's will be allowed to move into the inside of the structure and begin to set up shop. The Agricultural section will be set up to start producing food. When all businesses are ready and an appropriate food stockpile is in place, the populace can begin to move in.
Build Time: 4 months

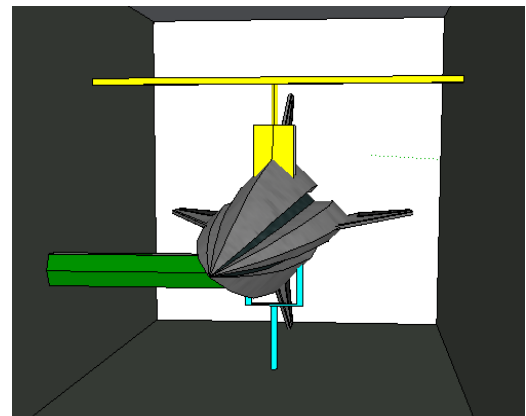
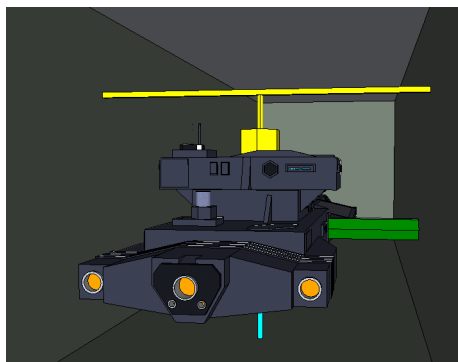
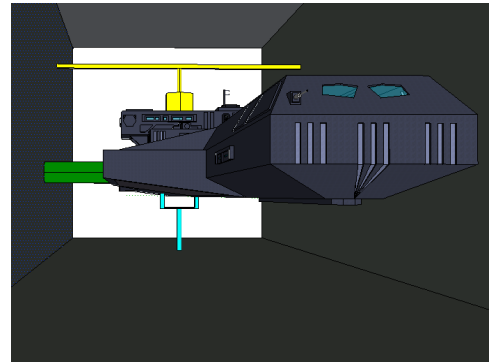
2.4 Bucky Structures Manufacturing

Bucky Structure manufacturing is located in part of both the Zero G manufacturing area and in the 0.25 G manufacturing areas (see diagram). The Zero G area has of volume 62,620,955,100 ft³ and a clearance of 10ft. The 0.25 G area will have a volume 6,876,413,211 ft³ and clearance of 30 ft. Materials and products will be moved via the internal Maglev system.



2.5 Docking

Docking within the station will take place in two steps. Initially a ship will attach to one of many in the docking ports of the Transition Station located near Bellevistat. Referring to the associated sketches showing this structure and two representative ship designs, once the ship is inside the docking port the connection struts (Cyan) will attach to the ship via magnets. The fueling boom (Yellow) will then extend and attach to fueling the top of the spacecraft to add additional stability. An auxiliary fueling boom may also attach to front of the craft. Finally the cargo and crew umbilical (Green) will telescope out and attach to the ship via magnets. This will facilitate the movement of cargo and personnel off the ship and into the Transition Station. Material management processing systems will then schedule the movement of cargo and personnel from the Transition Station to Bellevistat.



3. Operations



““Any sufficiently advanced technology is indistinguishable from magic.”

- Arthur C. Clarke



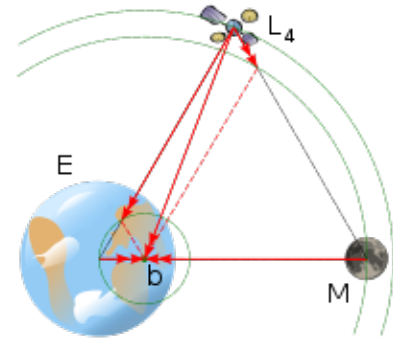
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3: Operation and Infrastructure

Bellevistat will be designed to maximum both efficiency and safety. After the initial building period, the station will not require supplies sent from Earth. Bellevistat will provide clean and plentiful air, water, and various foods, along with communication to Earth and industrial capabilities. It will provide redundant facilities, so that it can run smoothly at all times. The station will also be able to provide fuel and repair to other spaceships traveling to or returning from locations beyond Bellevistat. Bellevistat will be a symbol of humanity's technological achievement and drive to explore and colonize the unknown.

3.1 - Location and Material Sources

The station will be located at Lagrange Point 4. This is at the same distance from the moon (238,900 miles) and 60° ahead of it, relative to the Earth. Lagrange Point 4 is in stable equilibria with both the Earth and the moon.



Materials for construction, primarily titanium dioxide and silicon, will be mined from lunar sources to overcome the shortage of these materials on Earth, to minimize environmental effects, and to reduce the weight needed to be delivered from Earth. The Kroll Process will be used to separate Titanium and Oxygen. Other materials, which may be used for internal design and agricultural purposes, will be shipped from Earth. This includes fiber optic cables, laser equipment, and spacesuits. Plastics will be initially shipped from Earth; however, once the agricultural sector is running, soybeans will be used to produce the necessary plastic. Fabrics will be developed using both soybeans and bamboo, which will be produced on the station. Research will be conducted to determine whether or not there is enough water in craters on the moon to provide for the station. If so, water in the form of ice will be taken from Water will be obtained from comets.

Materials	Use	Source	Mass
Titanium dioxide	Construction	Moon	75,000,000 kg
Silicon	Construction	Moon	5,000,000 kg
Helium	Atmosphere	Moon	500,000 kg
Water	Consumption, Agriculture, Industry	Moon if found, comets otherwise	1,550,000 kg
Plastics	Internal Use	Earth (from soybeans)	50,000 kg
Plant Seeds	Agriculture	Earth	250 kg
Animal Stem Cells	Agriculture	Earth	250 kg
Miscellaneous Materials	Internal Use	Earth	50,000 kg
Carbon Dioxide	Agriculture	Earth	30,000 kg
Oxygen	Atmosphere	Titanium dioxide (from moon)	1,000,000 kg

3.2 - Community Infrastructure

3.2.1 Atmosphere

The starting atmosphere will be composed of 80% helium gas and 20% oxygen gas. A small amount of carbon dioxide will be shipped to allow farming to begin. The oxygen level is approximately the same as found on Earth, and helium will be used as an inert gas to maintain a proportional pressure. Air quality and levels will be monitored and held constant by the Freyr Climate Control System (see 5.2.1) in order to ensure safe levels to residents. To convert carbon dioxide exhaled by residents into breathable



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oxygen, air will freely be cycled through a vent containing algae genetically engineered to convert carbon dioxide to oxygen gas as quickly as possible. Air will then flow through a filtration system, which will remove airborne particles. Excess oxygen will be stored to be released in case of a disease or other issue with the algae.

Bellevistat will provide varying pressures in the station, at the levels of 1.0, 0.8, and 0.6 times the sea-level pressure on Earth. These levels will be an option for all available gravitational levels. Airlocks will be created in various sizes to minimize both the energy used by the airlocks and the time residents will need to wait to pass between atmospheric zones. Public spaces in Bellevistat will maintain a temperature of 70°F and a relative humidity of 35%; however, residents will be able to vary these levels inside of their homes.

Gas	Percent of Atmosphere	Mass Needed
Oxygen	20 %	1,000,000 kg
Helium	80 %	500,000 kg
CO ₂	0.3 %	30,000 kg

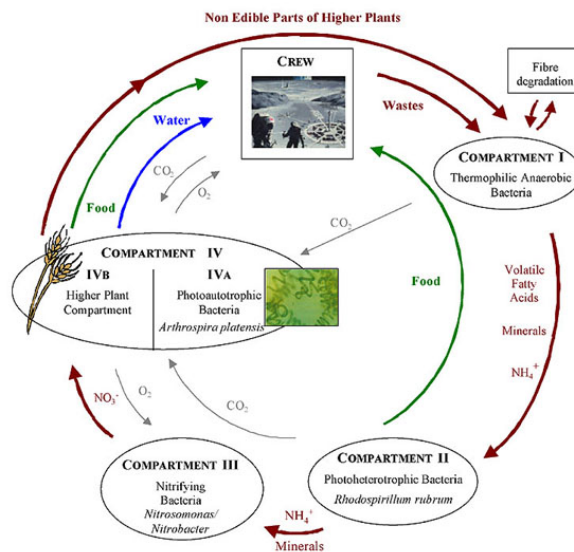
3.2.2 Automated Farming

Vertical farming will be used to minimize the space needed to grow the necessary crops and provide a wide range of food to its residents while not creating an unnecessary burdensome space need. Planting will be done in rows on square trays, which will be rotated by the automated farming system (AFS) to provide sufficient light. This system, which was originally designed in Belgium, has been remastered to be stackable (with layers being 1.5 meters tall) and work with an aeroponic system by connecting solution sprayers along the lengths of the trays, as opposed to the original system, which used hydroponics.

To see the Belgium system in action, please visit the automations section of our website.



The aeroponic system we will be using will help to utilize all parts of our lunar regolith processing by using leftover regolith for some of its iron, magnesium, and manganese in our aeroponics solution, while we will add in other necessary elements such as nitrogen, phosphorus, sulfur and potassium (mostly harvested from waste created in our micro farming processes). PH of aeroponic solution will be managed to be between 6.0 and 7.0 as preferred by most vegetables, and can be able to be varied to best fit the need of each specific plant. In order to assure our residents a constant supply of fresh vegetables, farming will be located in two separate agricultural units providing a backup for equipment failure or disease. Farming will also be done in rolling cycles, so food will not need to be stockpiled beyond standard cautionary measures.





Analysis of growth methods:

Geponics

Strengths: <ul style="list-style-type: none"> Traditional method of growing crops, greatest body of research available 	Weaknesses: <ul style="list-style-type: none"> Soil will cost much more to ship
Opportunities:	Threats: <ul style="list-style-type: none"> Not considered to be as clean as other methods leading to more disease

Hydroponics

Strengths: <ul style="list-style-type: none"> Very little or no soil is needed for plant growth Reduces the land needed to cultivate crops Reduces amount of water used Slightly cheaper than aeroponics 	Weaknesses: <ul style="list-style-type: none"> Nutrients need to be constantly replaced. Will require more water than other growth methods
Opportunities: <ul style="list-style-type: none"> Plants tend to thrive more in this type of system than in geponic systems, leading to a larger crop yield 	Threats: <ul style="list-style-type: none"> Has been shown to lead to more diseases than aeroponics

Aeroponics (selected for use)

Strengths: <ul style="list-style-type: none"> Eliminates the need for soil Nearly does away with having to use water Minimizes the area needed to grow crops Cleaner than other types of growth methods 	Weaknesses: <ul style="list-style-type: none"> Slightly more expensive than hydroponics
Opportunities: <ul style="list-style-type: none"> Reduce water usage Plants tend to thrive more in this type of system than in geponic and hydroponic systems, leading to a larger crop yield 	Threats: <ul style="list-style-type: none"> If the equipment to maintain the plants malfunctions the roots will rapidly dry up

3.2.3 Meat production

Meat production will primarily be used through in vitro stem cell growth. Stem cells will be brought from Earth, and new ones will be able to be created on the station. Bellevistat will comply with laws forbidding the use of these technologies on humans. In vitro growth will allow for a wide range of meat and fish options, and eliminates the risk of a disease. For a larger image of the in vitro meat

Habitants who have moral or other objections to the use of stem cell growth will still be able to consume meat. There will be micro farming provided on a small scale to provide chickens, rabbit, goats,

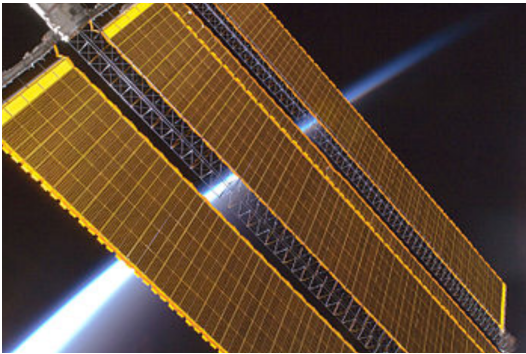


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geese, and sheep for a higher cost. Waste will be used combined with human waste to harvest nitrogen, phosphorous and potassium to supplement aeroponic systems.

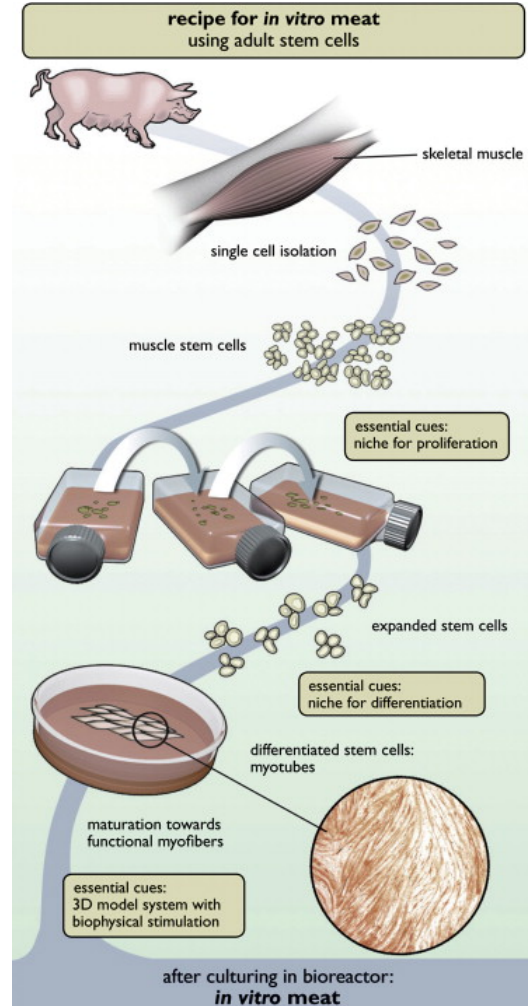
3.2.4 Food Distribution

Food will be harvested or grown using automated methods. After this is finished, the food will be transported from the agriculture sectors of the station to the various residential zones. There, the food will be given to the grocers and restaurants that will use it. Because of the rolling growth schedule, storage may be kept at a minimum. An emergency stockpile will be created that will contain enough food for two weeks. These stockpiles will be in each of the residential areas, and will contain standard refrigerated and non-refrigerated storage. To prevent changes from what is eaten on Earth, no significant changes will be made to the storage procedures in space.



3.2.5 Electrical Power Generation

Solar power will be used to provide electricity. Silicate asteroids will be mined to provide the materials necessary to construct the solar panels. Panels will be able to rotate so that light from the sun will hit the panels perpendicularly, which is most efficient. Because of the station's orbit, which is similar to the moon, power will not be available when the sun, the earth, and the station are aligned, which will happen with the same frequency and duration of lunar eclipses, or about twice per year lasting no longer than four hours. Power will be stored through hydrogen fuel cells for these times, and other periods of high use.



Power use per person	20,000W
Maximum population (including guests)	11,500 people
Total power use:	230 MW
Solar panel efficiency	400 W/m ²
Total Necessary Solar Panel Area	800,000m ²



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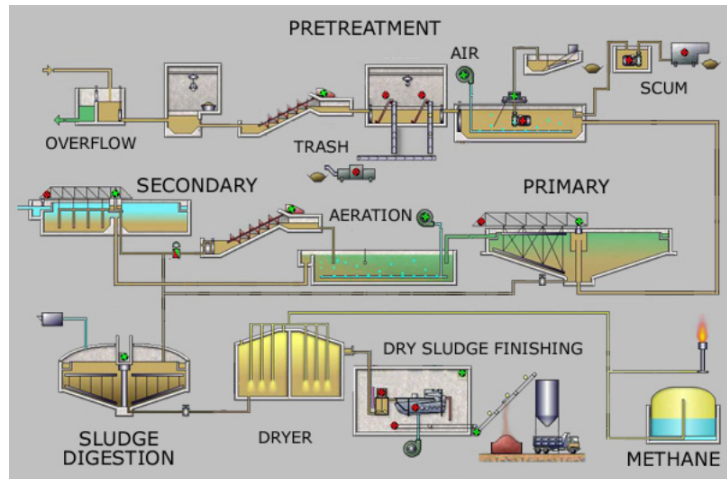
3.2.6 Water Management

Wastewater will undergo a rigorous filtration and treatment before it will be released for human consumption or used for agricultural purposes. Water will first be filtered to remove all large particles. Smaller contaminants will then be removed through reverse osmosis. Finally, a UV filter will eliminate the risk of biological contamination. Water for human and industrial use will be separated from water being recycled for use in hydrogen fuel cells for visiting space ships; however, it may be consumed if the need arises in emergency situations.

Water use per person	Population	Total Water necessary
100 liters	15,500 people	1,550,000 liters

3.2.7 Household and Industrial Solid Waste Management

Bellevistat will minimize the amount of waste produced by the station to limit the necessary shipments to the station. Liquids and gasses will first be removed from the waste, and are sent to their respective waste treatment areas. Paper and other recyclables will then be removed, sorted, and sent to their respective recycling centers. Using techniques pioneered by Sweden, most non-biological waste will be able to be recycled. Remaining waste be used for their minerals to aid with agriculture.



3.2.8 Internal and External Communication Systems

Community Wi-Fi will be offered to all residents in Bellevistat. Wi-Fi will be used for both internal and external communications. Commonly used data intensive services, such as video streaming, will be cached in a central server on the station. Other communications will be relayed to and from multiple uplink stations on the Earth using X-rays. These uplink stations will not only provide the infrastructure necessary to communicate with Bellevistat, but also all other populated space stations orbiting Earth.

3.2.9 Day/Night Cycle Provisions

To keep calendars aligned with Earth, 24-hour days will be used on Bellevistat. The station will be kept at Coordinated Universal Time (GMT). To simulate the sunrise and sunset, lights in public places will be brightened and dimmed over a two-hour period, from 6:00 AM to 8:00 AM and 8:30 PM to 10:30 PM respectively. For safety reasons, lights will never be completely turned off. Daylight savings will not be observed, as it would provide no additional energy savings. The agricultural section will be in constant daylight.





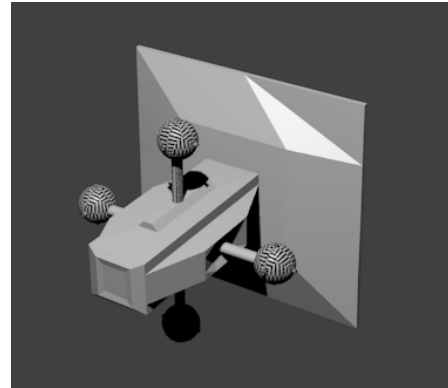
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3.2.9 Storage

Food storage will be distributed in each of the residential zones, to prevent the risk that disease could damage all crops. Each stockpile will be large enough to contain enough food for the residents in the respective area for two weeks. The storage areas will contain standard refrigerated and non-refrigerated storage. To prevent changes from what is eaten on Earth, no significant changes will be made to the storage procedures in space. After a month, food not consumed will be removed from the storage area to prevent the risk of disease developing.

3.3 - Construction Machinery

Machinery for constructing the station falls into two types: internal construction robots and external construction robots. The hull and large-scale internal structures such as floors and walls will be constructed using the external construction robots, as detailed in 5.1.1.2. Smaller scale internal structures that require more precision, such as lighting and interior design, will be constructed using the internal construction robots, as detailed in 5.1.1.3. Highly precise components, such as computer systems, will be constructed using the Versatile Repair Bots.



3.4 - Paper Production

Bamboo will be used as a substitute for full-grown trees on the station. It will be grown in the agricultural sectors, alongside other plants being grown. After the bamboo has been grown, it will be transported to the industrial sector, where it will be chipped into small pieces, steamed into a pulp, pressed into paper, and dyed for commercial use. Multiple sizes of paper will be able to be manufactured. Paper waste will be recycled by mixing it with water and combining it with the paper being newly produced before pressing it into new paper, in the same way that standard recycling procedures operate on Earth. Bamboo will also be utilized to create fabrics and internal reconfigurable walls called shoji screens.



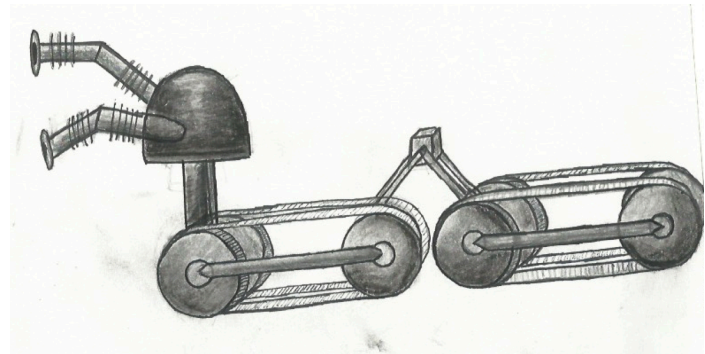
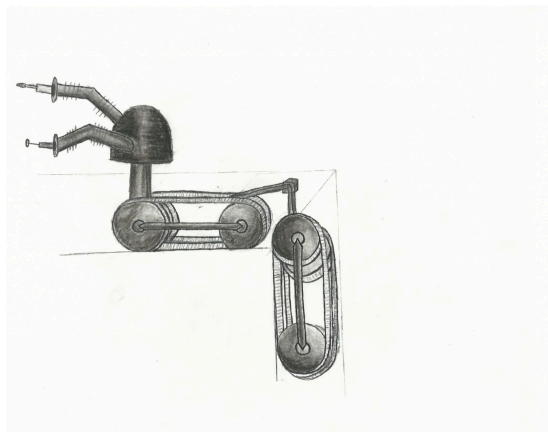
Bamboo Growth per Day	Paper Production per Day	Paper Recycled per Day	Total Paper per Day	Paper per Day per Person
2000 lbs per day	1030 lbs per day	520 lbs per day	1550 lbs	0.1 lbs



3.5 - Spaceship Repair

Bellevistat will provide both refueling and repair to visiting spaceships. Spaceships can be powered using hydrogen fuel cells. The station will allow visiting spaceships to deposit wastewater, which will be converted to hydrogen gas and oxygen gas, which may be used as fuel for other spaceships. Initial oxygen and hydrogen will be obtained through lunar mining.

Repairs will be completely automated using the Versatile Repair Bot. Both internal issues, such as engine repair, and external issues, such as hull damage, will be able to be rectified. Nanobots will be used for more precise repairs. Specific replacement parts will be provided using 3D printing, so that there will be no need for storing a large number of diverse parts and adaptability will be available for future spaceships. Ports that will supply repairs will have Versatile Repair Bots on hand, as opposed to standard docking ports.



4. Human Factors



“I really believe that if the political leaders of the world could see their planet from a distance of, lets say, 100,000 miles, their outlook would be fundamentally changed”

- Michael Collins

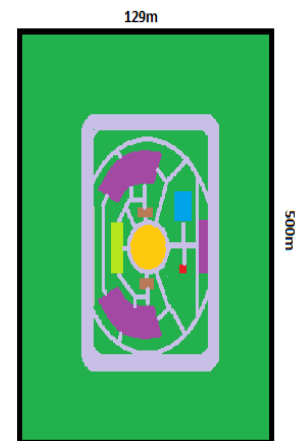
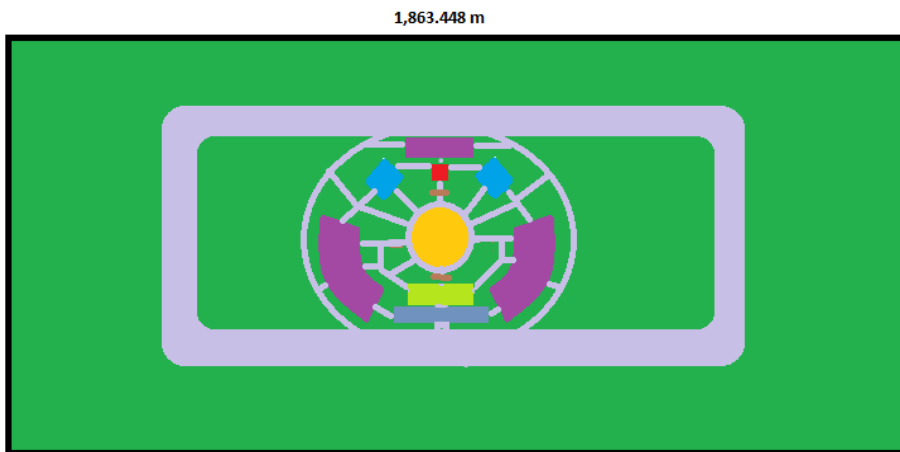
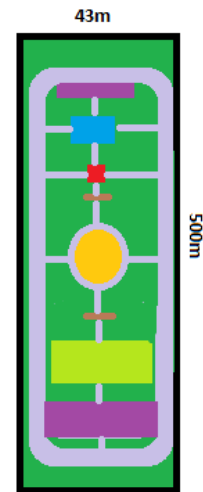


4.0 Human Factors

In designing Bellevistat, Northdonning Heedwell has worked to achieve balance between the quality of life desired by the residents and owners of the station and the limitations imposed by the expense and complexities of life in space. Energy demands, required physical volume, life support and supporting the psychological needs of the population are all counter to the engineering and business advantages of minimalist design. Innovative designs and efficient construction processes have allowed for the creation of comfortable living spaces meant to meet physical and psychological needs for residents, the transient population, and those taking advantage of Bellevistat's unique cislunar docking system. Attention has also been paid to systems for not only safety, but comfort and efficiency in 1g and requirements for living areas in .5 and .8 g. The following descriptions outline the final human factors designs for Bellevistat that satisfies both the requirements of the design and the need for a beautiful and comfortable living environment for its population in a cost-effective manner.

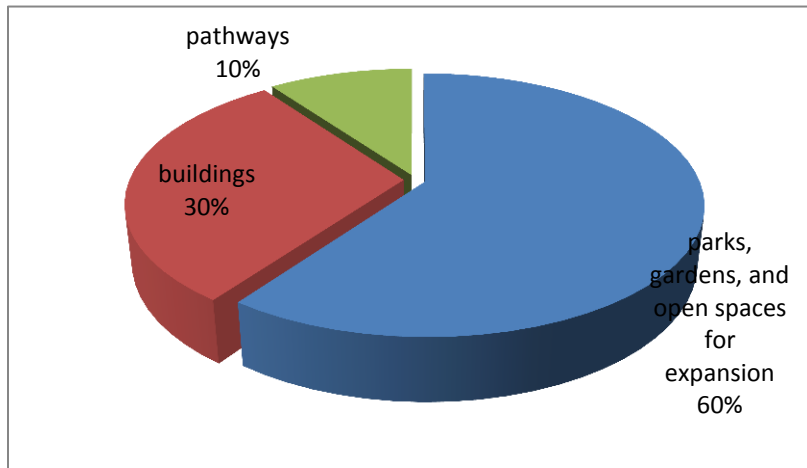
4.1 Community Design

Bellevistat offers both the urban and suburban lifestyles by allocating residential areas to places surrounding Civic Centers, shopping malls, restaurants, and grocery stores and creating more wide open spaces further out. In essence, community designs have replicated the idea of having a bustling downtown which fades out into a quieter area filled with green, and room for expansion. Exercise facilities are also strategically placed in Civic Centers and are specially designed to meet the unique needs of the various gravity and pressure environments. For those who prefer more traditional exercise, running tracks that weave from the Civic Center to the residential homes beyond are provided. Signs to direct runners and walkers on new paths to take on a day by day basis are incorporated to help add route variety to avoid boredom. Large research facilities have been provided within the communities for the convenience of researchers in the areas and so that they may take advantage of different atmospheric pressures and gravities. Apart from exercise, the civic centers will be at the heart of every community, providing places of worship, areas for school, adjustable rooms (equipped with holographic tables, projectors, screens, and other supplies) for business meetings), small clinics, tech departments, community computer/resources, small cafes and boutiques, bulletin boards displaying community events to help visitors become involved, a theatre, and a viewing space at the top providing members of the population with a beautiful view of the entire community.





4.1.1 Land Allocations



4.1.2 Housing

Housing on Belvestat is conveniently located near a main grocery/ convenience store. A total of six reasonably priced housing options are available to those residents who are single, married, married with children or for those preferring a flat mate styled option (please see section 4.2).

4.1.3 Education

On Belvestat, Children of residents will be provided with not only state of the art education, but will also be able to take advantage of a well rounded and customizable schedule. Educational programs will run from pre-k through high school level. Afterwards, students will be encouraged to attend university through online programs that will be arranged with universities back on earth, or continue their education outside Belvestat, with intentions of keeping a highly educated and socially aware population.

Individual programs include an extensive language education beyond the stations lingua-franca English. These programs will start at an early age to increase fluency in several major languages, shown to aid cognitive functioning and student success. This will not only serve to preserve the unique mixture of cultures found on earth, but will also help to integrate the transient population by removing language barriers and providing elements of home.

4.1.3.1 A chart depicting available classes

	Math	Science	English	Foreign Language (choice)	History	Creative and Performing Arts
Daycare Services	-Learning numbers	- Experiments and interactive activities	-Learning alphabet -educational story time	Choice by Parent -Intro to French Spanish Mandarin Arabic	-educational story time	Art
Lower School	-Course 1-5 Math	Intro to: - biology -chemistry -physics -earth-space	-Course 1-5 English -Eng as 2nd lang	Choice by Parent French Spanish Mandarin	-Course 1-5 Hist.	Choice -Drama -Art -Choir



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		-Computers		Arabic		
Middle School	Placing -Pre-alg. -Alg. -Geo. -Alg. II	-Biology -Physics -Chemistry -Computer labs	-Course 6-8 English/ Eng as 2nd lang	-Course 6-8 same lang.	-Ancient -Euro -World	Choice -Drama -Art -Choir
High School	Placing -Stats -Alg. II -Precalc -Precalc (adv.) -Calc 1 -Calc 1(adv.) -Calc 2 -Mult. var. Calc	Placing -Bio -Chem -Phys -Bio. (adv.) -Chem. (adv.) -Phys. (adv.) -Phys: calc-based (adv.) -Earth/Space Electives: -Astronomy -Comp sci -intro to engineering -intro to robotics	Placing -Eng. 9 -Eng. 10 -Eng. 10 (adv.) -Eng. 11 -Eng. 11 (adv.) -Eng. 12 -Eng. 12 (adv.) -English for non-native speakers (9, 10, 11, 12)	-Course 9-12 Same lang. Electives: -Latin -Greek	-Ancient -early common era - modern -World Govt's Electives: -world religions -art history -scientific history -comprehensive philosophy(eastern+western)	Choice -Economics (micro or macro) -art : 3d, 3d (adv), metals, metals (adv), 2d, 2d (adv), photography -public speaking -creative writing -non-fiction writing -Drama

Key:

Placing depends on student's proficiency level. requires admissions test.

Daycare- 1-4 year olds

Lower School- Grades 1-5

Middle School- Grades 6-8

High School- Grades 9-12

4.1.4 Consumables

Grocery stores (seen in community design) will be provided near the housing in each community. Furthermore, meal plans for the convenience of the residents will be provided at an extra cost to cater to specific needs. Individual meal plans will be shipped to housing by Automated Food Caddy after being prepared by local restaurants or selected from the grocery store.

4.1.4.1 Charts showing major consumables provided (see section 5.3 for computing systems availability)

Micro farming

Animal/breed	Food	Other
Goats (Saanens)	- Yogurt - Milk - Meat	



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Rabbits (New Zealand White)	- Meat	- Fur
Chickens (Plymouth Rocks)	- Eggs - Meat	
Geese (Emden)	- Meat - Eggs	- Down
Sheep (Columbias)	- Mutton	- Wool for clothing

Appliances

Appliances will be provided to both the permanent and transient population on Belvestat. They will be made using Belvestat's 3-D printing capability, used to produce all non-structural parts, facilities and fixtures.

4.2.4.3 Restaurants

Restaurants are going to be placed in areas in and surrounding the Civic Center with themes based off of the types of parks provided in that area. For instance, a community design with Japanese Cherry blossoms in its parks will encourage restaurants to move in that provide Japanese cuisine. Spaces will be available for restaurants on Earth to offer franchises. In order to promote diversity on Belvestat, there will be restaurants representing cuisines from all over the globe (e.g. Indian, Chinese, Italian, French, and African food). It is our hope that these features in different sections of the station help residents become integrated with one another by visiting attractions in each other's communities.

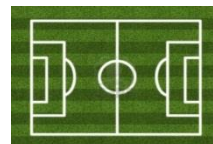
4.1.4.4 Clothing

While it is assumed that shopping areas will be populated with stores for the residents to buy desired clothing, arrangements have been made for convenient clothing options in the genesis of the settlement. Practically design flight suits have been made to provide comfort in all activities ranging from sleep to work. Residents will have 3 color combinations available to them from grey, soft blue, and muted red, all featuring pockets and a poly-cotton blend that is safe for use in the lab.



4.1.5 Hospitals and Clinics

On Belvestat, there will be two major hospitals located in the two largest 1g areas that will be used primarily for acute or intensive care. Clinics, conveniently located in the first level of the civic centers at the heart of the community, will provide check-up services and transportation to either of the major hospitals as required.



4.1.6 Entertainment

Parks and playing fields for adults and children alike will be located close to the home in order to provide healthier alternatives for entertainment. Park layout designs are inspired by elements of different countries from around the world to combine the elements of earth and the final frontier in a unique way only offered in the Belvestat community. Areas for sports from all around the world including soccer, American football, baseball, Cricket, Australian football, rugby, and more are provided for in the large green areas seen in the community design maps. Movie theaters, concert halls and live community theater are incorporated into the Civic Centers.





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These supplement the extensive library of eBooks, music, video and contemporary Television from Earth available in each apartment.

4.1.7 Assembly and Religion

All religions are embraced in the Belvestat community. In the event that any religious ceremonies or gatherings are requested to take place, spaces located in the first floor of the civic centers around Belvestat are open for use for these purposes.

4.2 Residential Design

Several housing options will be available for residents, which will be comfortable, but efficient in spacing. Apartments are built modularly (allowing for easy expansion), out of lunar materials in the outpost, and then be finished with an emphasis on the usage of bamboo. Residents will be able to take advantage of community gardens located at the top of buildings providing fresh vegetables and herbs and bonding with other residents.



4.2.1. Exterior Designs and descriptions of apartment buildings

Apartment buildings (shown right) house all permanent residents on Belvestat while hotels will house the transient members of the community. All apartment building will host a large central lobby on the floor level, and a laundry room containing waterless washers and dryers to save space in their apartments.

4.2.2. Housing Types and Numbers

4.2.2.1 A chart depicting housing types

*for the convenience of the foundation society, Imperial measurements have been provided

Type	Floor plan options available	Size	Description	Cost per month	number required of each
Married Adults	1 Apartment Design	1,150 sq ft	Married Adults are provided with the same basic necessities as the single population, however with account for more people providing a cozy but spacious atmosphere in the home.	\$800	300
Married w/ Children	2 Apartment Designs	1,400 sq ft	For those married and living with kids, two bedrooms along with a greater square footage in the home are provided to accommodate for the needs of the family.	\$900	1610
Flatmate style	1 Apartment Design	800 sq ft	For single residents desiring a cheaper alternative, housing designs have been made to accommodate those wishing to split the cost of a small apartment with another resident.	\$600	3300
Single	2 Apartment Designs	800 sq ft	For those wishing to live by themselves, residents will have an option between a cheaper studio apartment, and a slightly more luxurious one bedroom apartment featuring a wall with a built in bed and storage space.	1 st : \$500 2 nd : \$700	3300

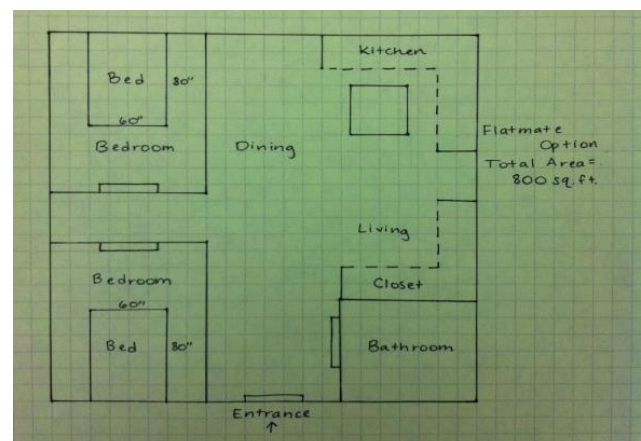
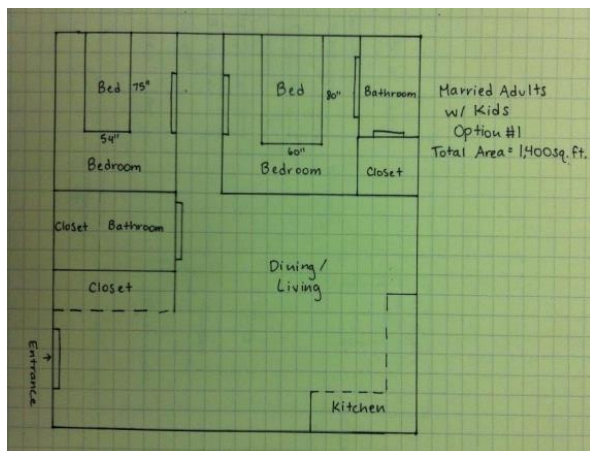
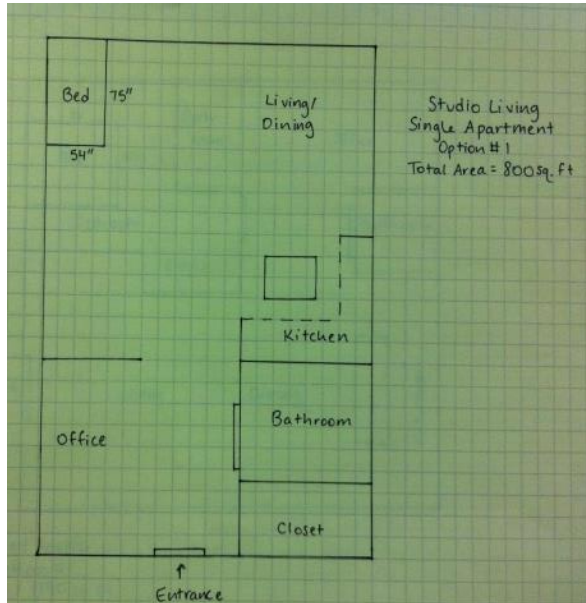
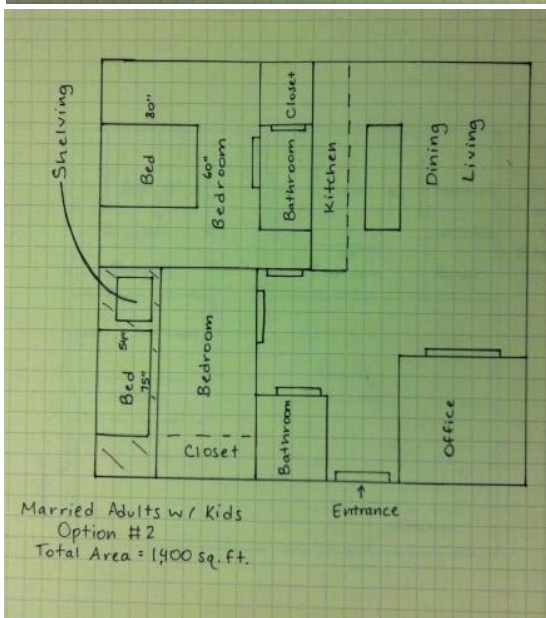
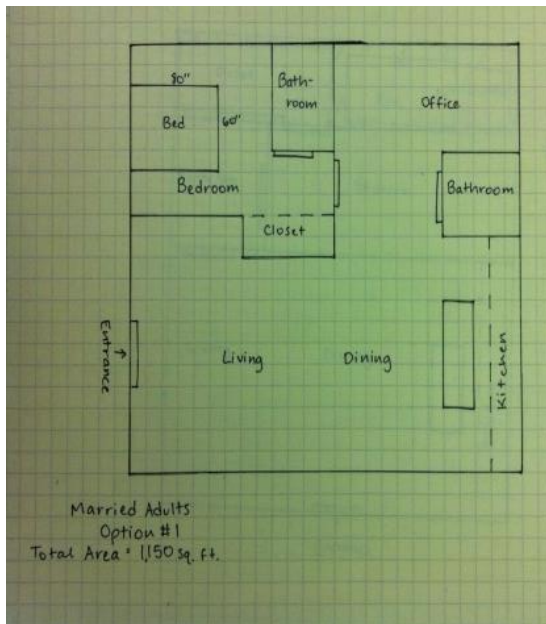


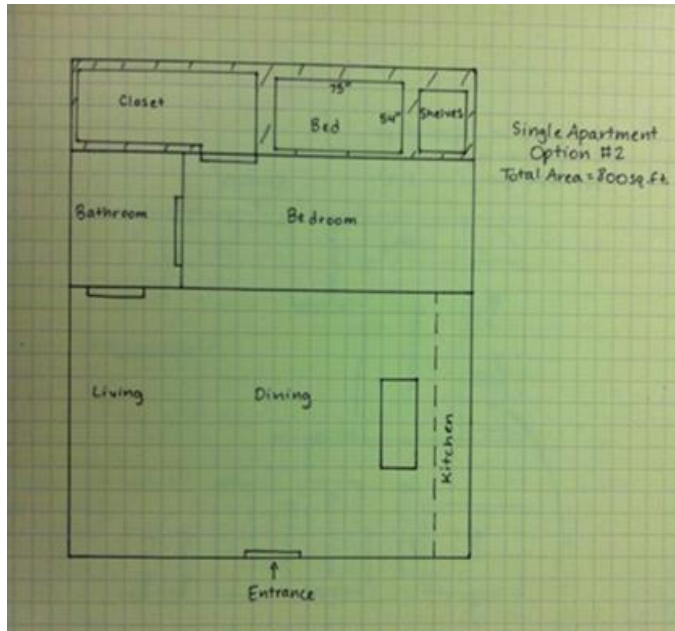
Human Factors

4.2.2.2 Interior floor plans

Plans have been made on the prediction that the largely single population will eventually marry and settle down. Thusly, arrangements have been made to accommodate a growing population whilst also giving single residents three options: 2 single and one flat share. Residents may also adjust their homes with movable bamboo walls which they may purchase upon arrival

*where closets and beds and shelves are surrounded by crisscrossed area, the space saving feature shown right is utilized





4.3 Enhancement of work environment

4.3.1 Extravehicular Activity Systems

In designing the space suit that will be used on Belvestat, designers have focused on these main points: provide pressurization, provide oxygen and remove carbon dioxide, maintain comfortable temperature despite strenuous work and movement, protect from micrometeoroids and radiation allow for seeing clearly, moving easily inside the space suit and outside of the spacecraft, and communicate with others (ground controllers, fellow astronauts), manage waste, and provide water

To do this, in the most efficient manner, Northdonning Heedwell has gone back to the drawing board, so to speak, to provide an innovative and efficient system.

SWOT charts explaining the decision making process:

Extravehicular Mobility Unit (EMU)

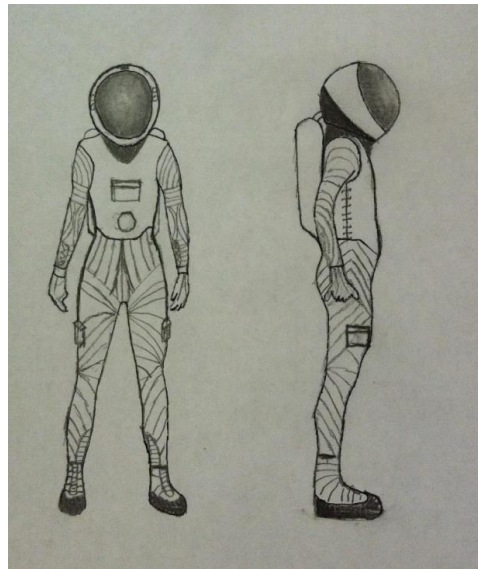
Strengths: <ul style="list-style-type: none"> provides all of the features listed above 	Weaknesses: <ul style="list-style-type: none"> heavy/ bulky balloon like atmosphere limit mobility
Opportunities	Threats

Mechanical Counter Pressure (MCP) Suit

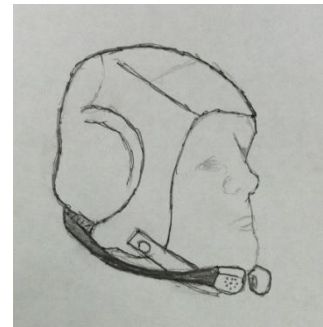
Strengths: <ul style="list-style-type: none"> provides a larger range of motion to Astronauts Is easily repaired using the specialized "tape" cloth in case of minor damage lightweight relatively easy to put on 	Weaknesses: <ul style="list-style-type: none"> must be made to custom fit owner thusly raising cost
Opportunities: <ul style="list-style-type: none"> It has been suggested that research and use of MCP's may lead to breakthroughs in medicine back on earth for those struggling with muscular health problems. 	Threats <ul style="list-style-type: none"> in case of major damage during transportation, the custom suit would have to be remade



For these reasons, we have decided to use a mechanical counter pressure suit. The MCP suit will be equipped to manage all of the points listed above. Major features include sensor grids that run along the fabric to ensure proper pressurization by the skin-tight suit, a gold-plated visor, a primary life support subsystem located in the back, a camera located at the top of the helmet, lights on the side of it, conveniently located pockets on the legs and chest, and a central hook to secure the



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astronaut to surfaces or attach extra bags. Images will be visible to the side of the helmet to provide necessary information. MCPs will be made with a silvered material to provide protection from radiation while thermal control will be taken care of with a material consisting of tubes manufactured out of buckeystructures with specialized thermal properties. Underneath, a superabsorbent material will whisk away perspiration to keep the astronaut cool and dry.

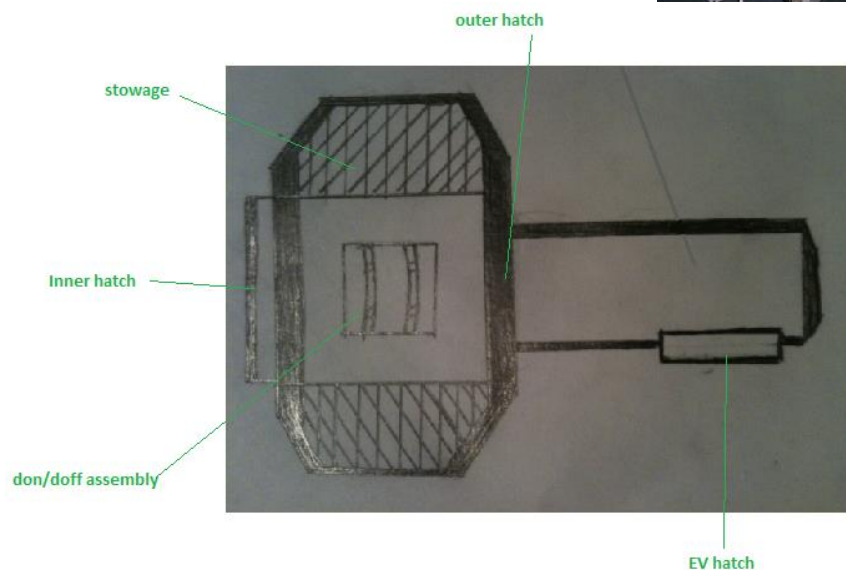
4.3.2 Vehicles

Astronauts will have the Manned Maneuvering Unit (MMU) and the Simplified Aid for EVA Rescue (SAFER) (depicted right) available to them for work in 0g.



4.3.3 Airlocks

Multiple sized of airlocks have been created for use on Bellevistat. The first size has been created for single person use. The second depicted is created for use of up to 10 people. While can easily be modified for use in going to 0g, the one depicted is specialized for our train system. While cabins will be pressurized at 1 atm, residents going from other pressures will need to be adjusted to the slight variation, while maintain the proper levels in both the cart and the community. For this, the larger air lock has the ability to seal with the train cart as it arrives, residents wishing to travel from one area to the other will have several of these located



in the train stops (shown in the community design). For efficiency lights on the entrance will signal shifts and allow the adjustments to occur before the cart has arrived as the entrances will be sealed (entrances open and close



Human Factors

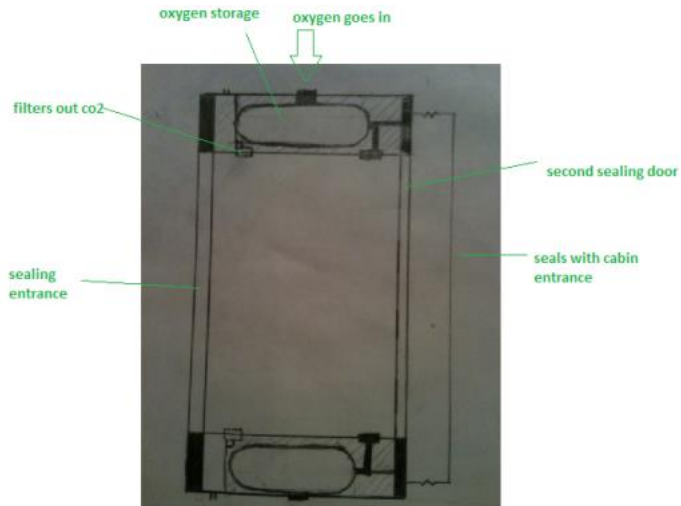
vertically). CO₂ will be filtered out and processed as the residents breath in pure oxygen (same as in the other air lock as well as in the MPCs). After the pressures are equal, the residents will be allowed into the train cart.

4.4 Considerations for transient population

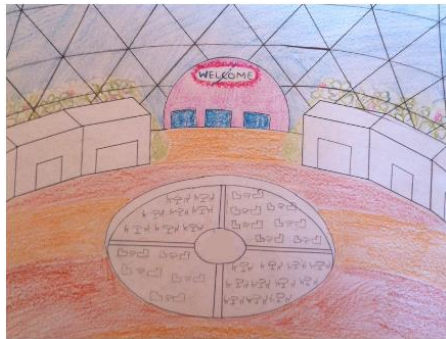


Integration of the transient population will be key for the enjoyment of their stay. Bellevistat will create a reputation of a welcoming atmosphere with several key features. Visitors are provided with comfortable

hotels to stay in while on Bellevistat which are located very near the housing units of permanent residents. This way, these members feel immersed in the day to day happenings around the settlement and do not feel secluded from the other members of the community. Hotels will have several options for rooms including suits, doubles, and singles. In addition, amenities will include soap, shampoo, conditioner, toothpaste, coffee/coffee pot, tea, and a complimentary breakfast located in the lobby. Residents will be provided a welcoming packet with maps showing where they are located and maps of each community complemented by pamphlets outlining exciting features such as popular shops and restaurants, locations of different themed gardens, and playing fields where they can join in a casual game of pick-up with the locals. Every member of the transient population will receive a Smartband-Duo (please see section 5.3) for security reasons, payment while on the station, and ease of computing while on the station. All transient members of the population are encouraged to take advantage of exercise facilities and the Healthtraker app on their Smartbands to create a specialized routine to lessen their transition to the environment should they elect to stay in areas that are on 1g 1atm.



4.5 Passenger receiving areas: the Hestia Cislunar Docking Bay

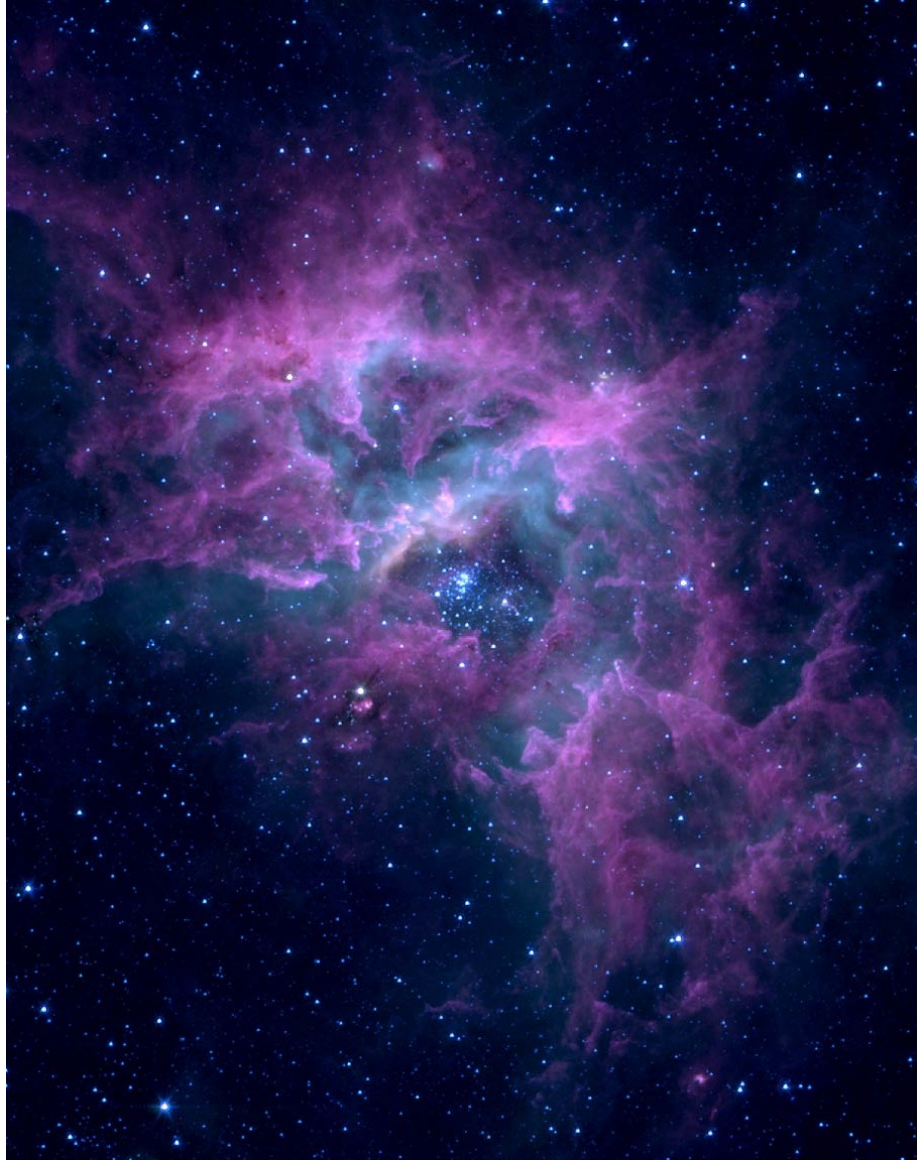


Passengers will be received in a geodesic dome with 360 degree views of Bellevistat, the Moon, the Earth and the outer space. The dome is constructed primarily of glass, which is acceptable as people will be using this area in a very temporary way, lowering the risks associated with radiation and loss-of-pressure events. The dome will contain a comfortable waiting area on the top floor for people congregate and adjust to their surroundings before being transported to Bellevistat or returning to their refueled ships. All fixtures and accommodations of the dome will be affixed using Velcro so as to both account for the 0G environment and to allow the configuration of the space can be adjusted

quickly and easily. Visitors to the dome will be supplied with Velcro gloves, booties and belts to allow them to move about the area and fix themselves to a particular location within the space, sit and relax. This will be the transient population's first view of Bellevistat, so it will be built to please the eye. Along the border of the dome are located small shops and kiosks providing people access to basic necessities.

Should they be tired, or require a longer stay due to ship disrepair, a quiet and darkened resting area will be located in the lower level (not displayed) provides specialized zero g cots with head straps and Velcro features so they may simply place it where ever they desire and sleep. For their comfort, vending machines will be located on this level to provide necessary toiletries such as dry shampoo, hand sanitizer, and cleansing wipes.

5. Automations



As technology advances, it reverses the characteristics of every situation again and again. The age of automation is going to be the age of 'do it yourself.'

- Marshall McLuhan



Automations

5.0 Automated Systems and Designs

With the challenge of Bellevistat, Northdonning Heedwell has created a generations of new technologies, capable of replacing humans in mundane or hazardous situations, generating efficiency, creating and maintaining the structure and its operations, and enhance the overall productivity and livability of the station. Automated systems and designs is not only a section in its own right, but also balances and enhances other design aspects in its incorporation of technologies for structural creation, generating smooth operations, increasing livability for humans, and being the backbone of manufacturing. Innovative designs include the usage of gecko feet nanostructures, weak AI, Claytronics, magnetic nanoparticle positioning gel, and electric impulse based wearable gestural interfaces. Without further ado, Northdonning Heedwell is proud to present Automated Systems and designs.

5.1 systems for construction, manufacturing, and transportation

5.1.1.1 Table showing all construction, manufacturing, and transportation robots

Name	Purpose	Dimensions	Location	Cost
MMPB	The precision angling of the different sections of the station that need to welded together	Sphere with a diameter of 18.288 m	Manufacturing plant when not in use	20,000 per unit
ASC	The welding of the separate sections of the station	2m X 10m X 14m	Exterior Hull	60,000 per unit
Belleviterrtrial Launcher	The transportation of people who desire to go from the planet to the station and back	The Mass Driver totals in at a length of 2 miles The ship containing people is at a length of 56.7 m x width x depth of 17 m Scramjet length at x width of x depth of	Mass Driver is stationed on Earth	900,000,000 per unit (note: one unit is used)
RETV	The transportation of people who desire to go from the station to the Spaceport and back		Hestia	300,000 per unit
Interior transit	The transportation of people who desire to travel in between sections of the station, separate atmospheres or otherwise		Interior Dead Space	7,000,000 per unit
Interior Finishing/3D Printing	The development of buildings, structures and base areas modularly. Creation of parts of appliances and furniture.		Lunar Outpost	50,000 a per unit and 60-80 per square foot in material costs/1,000 per unit



Automations

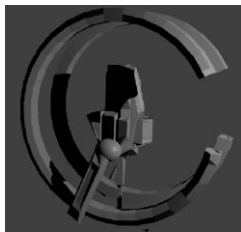
5.1.1.2 Exterior construction robots

For moving portions of the station into place multiple robots will be used.

The precise angling of the pieces of the station that will be welded together will be handled by the Multi-Purpose Magnetic Positioning Bot (MMPB). These robots are all part of a single unit (i.e. the sphere) which consists of three hundred twenty

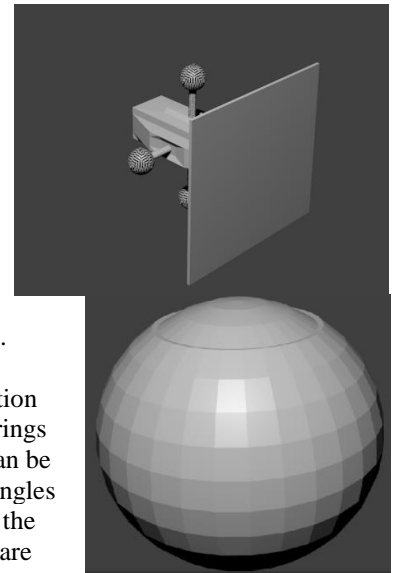
separate robots in average; width of 5 feet, a depth of 5 feet, and a length of 7 feet. The robots are filled with a gelatinous substance made of nanoparticles that allows the surface that the gel is applied to to become magnetic. The plate at the front of the robot can be magnetized and will then press against portions of the station and attach themselves magnetically. The spherical protrusions on its sides are ion drives used to precisely turn and move. Given the numerous robots available, three units will be used.

For the sealing of portions of the station a mobile unit, named Automated Space Crane (ASC) will be used. The ASC is a fully automated unit used to grab portions of the station



with its exterior rings. These rings can be moved about. The rings are made of segmented portions and all portions of the ring can be moved independently allowing the machine to grab varying angles of the station as well as spherical rotation modules that allow the rings to be moved into varying angles as well. Also the rings are capable of moving along the attachment portion of the structure giving the unit a wide range of different methods of grabbing the different portions of the station. Then the unit has an extension for the purposes of welding the seams of the

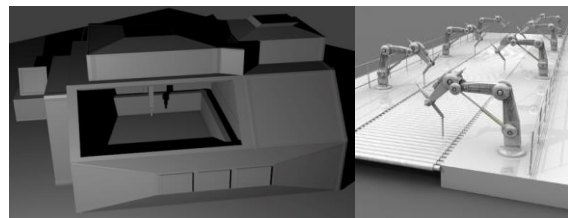
station's many parts. The extension remains stationary as the rings move so the ASC can control the movement of the station while continuing to weld the seams. For time saving construction of the settlement, a total of 15 ASC will be used with two on standby in case any should require maintenance or malfunctioning occur.



5.1.1.3 Interior construction robot for homes and interior finishing

The housing and base interior platforms will be built modularly. Sections are built preemptively in the lunar outpost and place prior to the station pressurization and rotation.

The modular buildings will be made using automated robotic arms. Preset designs will be put into the system and dictated how many of each design is desired. The arms will then craft the designs using the supplies gained from earth and lunar exploits. Once all pieces have been set the station will be pressurized and set in motion. Furniture will be crafted via 3D printing transported to their locations and assembled in their homes.





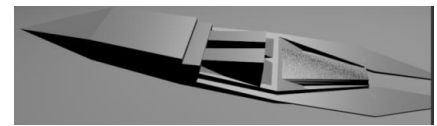
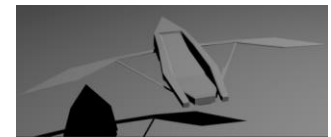
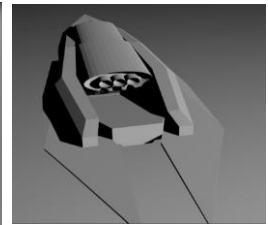
Automations

5.1.2 Automated transportation of materials

Bellevistat will be the home of three major types of external transportation, and an internal maglev system.

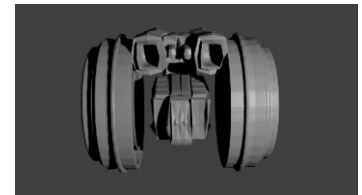
5.1.2.2 Launch Vehicles

For the convenience of travelers going from the planet to the station, an automated mass driver, the Belleviterrstrial Launcher, will be used to launch a ship capable of comfortably seating 250 people. The system's initial build results in a cost at almost double the cost of a current shuttle launch, however, utilizing the power gained from damming the Rio Chambo on the Ecuadorian mountain, Chimborazo, the cost of the actual launch is cut drastically. Also, due to the ease of each launch, the Belleviterrstrial Launcher is capable a single daily launch. The scramjet that the system uses will be released at Mach 10 off the side of the Ecuadorian mountain, allowing it to reach a max altitude of 200,000 feet above sea level before the ship containing the passengers ejects from the scramjet and lifts off into space. The scramjet then glides back down to the safety of earth where it will be retrieved and reset on to the Belleviterrstrial Launcher system. For landing, the ship containing passengers will approach earth and then use thrusters located at its underside to stop from reaching terminal velocity as the scramjet is launched at the ships insertion point to reconnect and land safely.



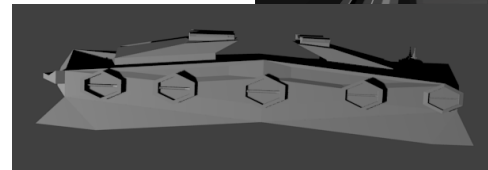
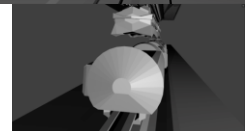
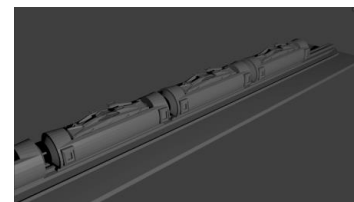
5.1.2.3. In-Orbit Vehicles

The transportation of civilians through the vacuum of space will be carried out by the automated Rotating Extraterrestrial Transportation Vehicle (RETV). The vehicle can be controlled by people but does not require them to operate. It will move from docks in the station to the Spaceport and back as well to and fro between the station and the moon. In total the RETV can comfortably carry a maximum of 50 people. In its exterior rings are miniature thrusters so that the vehicle can rotate itself in all angles available in zero G as well as main thrusters so that it may be used to thrust itself forward. It should be noticed that the can be used to propel the ship forward incase main thrusters fail. As such twelve RETV's into total will be functional where four will be on standby in case any require maintenance or are damaged.



5.1.2.4 Transit vehicles

As space conservation is a must for stations out in the vacuum of space a dual car maglev train will be used. The automated train cars come in two parts: The exterior car, which runs along a magnetic rail, and the interior car which sits upon four pistons inside the exterior car. The train system is entirely pressurized as it runs through a vacuum. The exterior car contains cargo (i.e. medical supplies, food, manufacturing supplies or tools) while the interior car contains people going from one section of the station to the next. When the train approaches a stop the interior cars will be shot up by the pistons and connect to a railing above where it will then pull up to and stop at an airlock to acclimatize if need be while the exterior car drops of supplies in a lower cargo site where they can then be distributed appropriately. Then both sets of cars (exterior and interior) will leave and as they move the interior car will be safely inserted back into the exterior car. In an atmospheric environment this system would not work due to friction caused by the air, however, because the system is in a vacuum the issue is not present and remains safe. For the convenience of the populace 4 train systems of 8 exterior and interior cars will be used.



5.2 - settlement maintenance, repair, and safety functions

5.2.1 A table showing maintenance related automated systems



Automations

System Name	Purpose	Location	Dimensions	population	Price per unit
Space Gyroscope	Interacts with one-another to measure the tilt of the settlement for a precise measurement. then signals for the thrusters to correct the settlement's alignment. If one of 3 fails, the 4 th system kicks in to recalculate the tilt, and the other system is shut down for repairs	center of settlement	N/A	3	\$2,000
Automated Farming System (AFS) *see 3.2	rotates crops for adequate lighting and can move to a conveyor belt for distribution. has sprayers on its edges along the agricultural trays to distribute the aeroponic solution.	Agricultural units	stackable units of 2mx1.5Mx2m	2 complete systems	\$600
Bee-Bot	These small "creatures" offer an alternative to traditional pollinating. simple in nature, the bee-bot will have the ability to fly, and carry pollen between plants in its synthetic bristles. They can be manufactured in large quantities fairly easily due to their very simple design/programming and self-folding capabilities which makes them extremely cheap individually. As opposed to regular bees and other pollinators, they do not pose a threat to humans, and less are needed to support a hive, as they don't also have to simultaneously produce their own food.	Agricultural units	3cmx1cmx2cm	10,000	hive of 5,000: \$2,000:
Bee-Bot Hive	The hive is where the bee-bots will be stored. they can return here when their battery is low and recharge through Bluetooth	Agricultural units	.5mx75m	2	\$150
AMCR Automated Maintenance and cleaning robot	A multi purpose system, the AMCRS can preform minor repairs using claytronics, but the majority of its memory is used to create cleaning tools. It carries a cleaning solution, has a vacuum on the bottom, and gecko feet nanostructures on treads located on its sides.	all areas	1.2 m tall cylindrical body Diameter of .31 m	30	\$300
Tlaloc Water Maintenance System	named after Aztec god of water, checks water quality before it is distributed to residents and controls operations in water purification	All areas	N/A	1	2,000
Freyr Climate	Monitors, temperature,climate and	All areas	N/A	1	2,000



Automations

Control System	atmosphere, named for the Norse god of good weather				
Étaín lighting control system	After the Irish sun Goddess, the Étaín Lighting control system will monitor day and night cycles by coordinating the opening/closing of windows and indoor lighting	All areas	N/A	1	2,000

5.2.2.1 A table showing automated systems for repair

System Name	Purpose	Location	Dimensions	population	Price per unit
Structure Nervous System (SNS)	The structure will have a grid of sensors built into it so that any damage will be immediately reported to the internal or external repair bots.	The Hull	N/A	1 system	\$6,000
Nanorobotic Salve	Distributed by maintenance and repair bots, the nanorobotic salve will “heal” damages on the molecular level and then be recollected for reuse.	N/A	N/A	3.14×10^7	\$200/Kg
claytronic solution	described by many as programmable matter, claytronic nanobots (individually called “catoms”) have the ability to “talk” to each other to form larger shapes via electromagnetic attraction and repulsion. while the possibilities are endless, we will be mostly using these to form tools.	N/A	N/A	5×10^7	\$200/Kg
Metamorphosis repair system: grounded	Robot utilizes gecko feet nanostructures on treads to operate in all areas and travel up and over any surface. It utilizes claytronics and will be used in all repairs including ship repairs as part of the cyclunar architecture (further information found in 5.5, 3.5, and operational scenarios)	All	.4mx.75m	300	900
Metamorphosis repair system: flying	A flying quadroter system that can be used in pressurized areas and benefits from supreme maneuverability. Uses claytronics. (see operational scenario for pictures of the metamorphosis system)	Pressurized areas	.25mx.4m	200	\$200



Automations

Pappenheimer External repair bot	Seals breached area with claytronic solution (elaborated on in operational scenario) It is also used in the construction phase to weave buckystructures onto the outside of the settlement, and later in repairs patch this layer.	outside of settlement	2mx10mx14m *tapered nozzle that can fit into 4.5 cm+	15	60,000
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5.2.3.1 A description of security measures

Residents will be fingerprinted upon arrival and other scans needed, will be taken at this point as well. The eye and fingerprint scanners log when each person enters secure area and when they leave.

For both retina and fingerprint scanner, an authorized password must be entered before scanning is allowed. Residents will be required to fill out a personal file with a basic physical description, picture, SSN, job description, and basic background

information. These will be uploaded to database before arrival on the settlement. At this point residents will set their basic access security password (needed to be scanned for entrance to secure areas) consisting of at least seven letters, two numbers, and one symbol. Residents will, of course, be encouraged to set different passwords for separate applications for added security. On the station, Bellevistat specific technology will utilize Security of personal data is further elaborated upon in section 5.3.

clearance level	Personel Type	Security Measure Taken			
		walk-through metal detector / x-ray scan of possessions	personal password and file made	Finger print	Retina scan
Red	Transient pop.	■	■	■	■
Orange	residents	■	■	■	■
Green	comercial	■	■	■	■
Silver	research engineer docking	■	■	■	■
Gold	Adminis-tration	■	■	■	■

5.2.3.1 Backup systems and contingency plans

Emergency	Response plan
Fire	Fire extinguishers will be located in all homes, shops, and major buildings. Basic training in firefighting and first aid will be required of adults before they are integrated into the Bellevistat community.
Water Leak	The Tlaloc Water Maintenance System will automatically sense the disturbance and temporarily cut off water flow to that area. Wet Dry vacuums will be used to recapture leaked water.
Solar Storm	all equipment has been made to withstand solar activity. the population will remain safe due to protection from radiation by the shielding described in structures, and the goldplating on the windows
Virus or Cyber Security Breach	The AVI-system (anti-virus intelligence system) will identify, analyze, and ultimately block the attack. AVI will take the experience, and “learn” from it much like a immune system, preventing further attacks. A Linux distribution has been created for use station wide that will be compatible with dominant operating systems, but bring the added security and flexibility of Linux.

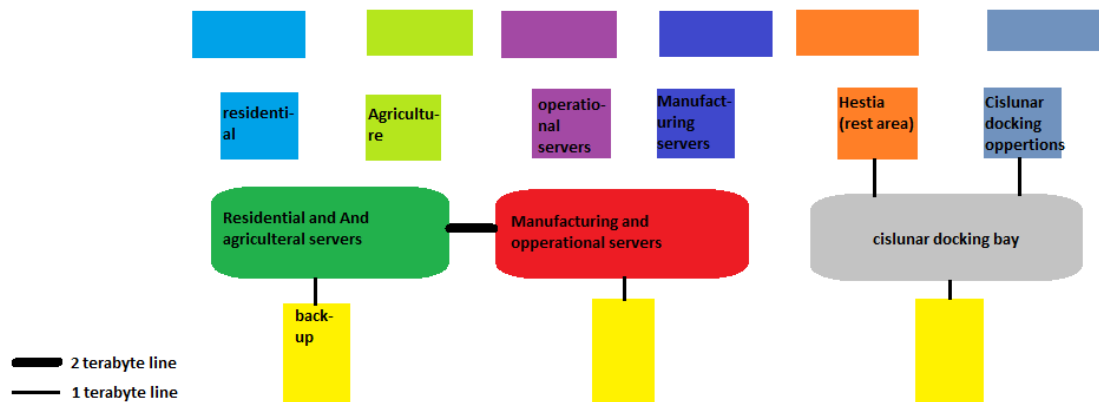


Automations

Security Breach	While security has been made extremely secure, should a breakin be attempted on a secure location, tasers will be released from hidden hatches next to entrances, stunning the criminal while security arrives.
Medical Emergency or Epidemic	Sections in the station can easily be quarantined in case of an epidemic. Doctors and nurses will be provided with protective masks and scrubs. In extreme cases, doctors and nurses will use the virtual interactive features of the medi-bot (see 5.3). Other procedures for individual medical emergencies are described under smartband-duo functions.
Internal Explosion	Please see operational scenario
Hull Breach	Please see operational scenario
Docking	For added safety, the Hestia Cislunar docking bay has been designed to be disconnected from the main structure in case of complications with refueling. Should an explosion occur, the automated systems on the main structure of Belvestat will be available to cut off the area and manage heat, and other such hazards. Should a docked ship pose a threat, it will be ejected from the site, and after a waiting period, if safe, it will be moved by designated systems to the repair site.
Equipment Failure	For added durability, solid state hardware will be used station wide. Should personal equipment fail, tech departments will be located in the civic center. Robots and other equipment will be repaired in a designated area in the 0g manufacturing sectors.

5.3 Habitability and Community Automations

5.3.1 Network and bandwidth requirements



The bandwidth for the station will be set at 7 gigabits. While this may be a considerably large quantity, we at Northdonning Heedwell, have put a premium on efficiency due to the many inconceivable situations that may arise in space. All systems will therefore be assured quick access without having to sacrifice connectivity in another area.

5.3.2 Personal computing devices



All residents and members of the transient population will have access to Smartband-Duo. This will constitute as the main computing device used while on Bellevistat. The Smartband-Duo hosts a variety of functions to improve the computing experience, health, and wellbeing. Firstly, the main band (displayed left) holds the smart chip which may be removed and put in a variety of other provided smartchip enabled devices (computers, tv's, tablets, phones, etc...) to easily transfer data. The microprojector will allow for displays to be shown on any surface for the wearer's convenience. For added security of personal information, applications will not only need personal passwords, smartchip enabled devices may only be turned on with voice activation or using the microcamera/projector to scan the retina. Along with the microprojector and smartchip, individual clearance levels will be denoted by a coloured bar. The secondary band will be responsible for controlling the device as well as commanding all automated systems. The secondary band can easily sync up with other devices (that one is authorized to use) and then uses electric impulses in the arm to read kinesthetic signals and transfer them into commands. A basic list of commands will be provided, but over time the device will "learn" preferences from the wearer and eventually be able to take their verbal commands as well. Residents will need to wear their smartband-duo for security clearance purposes, but it will also come in use for other activities such as shopping, where the resident need simply pass their arm over specialized scanners and then input their pass code to pay.

Residents will be able to adjust the Smartband-Duo to their preferences and suit their needs with apps made for it. All Smartband-duos come with the Healthtraker app. Functions of the

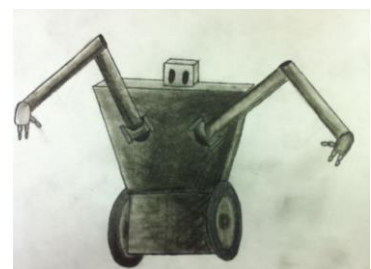
Healthtraker app include: a place to log mood; a sleep tracker that records sleep, can provide a silent alarm that is

optimal for their rem cycle or set by themselves to fit their schedule; track calories; set the best exercise routine based on age, weight, gravity living in, atms living in, and help the transient population adjust to space; provide a static alert that alerts user when one has not been active for too long; set appointments at the clinic through a calendar of their doctor's available dates and times with a personal reminder; sound emergency alarms based off of level off issue (yellow being non-lethal, red being lethal); monitor vitals such as blood-oxygen levels and heart rate and more. Should the resident elect to use this last option (recommended for the elderly and those with chronic conditions) alarms can be automatically sounded so that help can be immediately found.

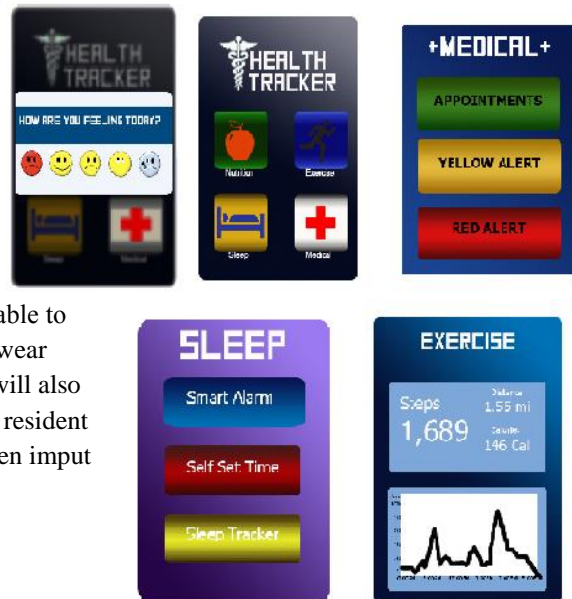
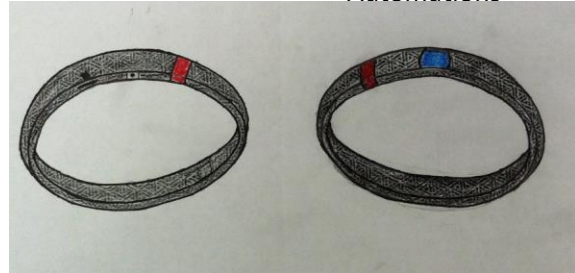
*all functions are optional and may only be legally viewed by the user, their doctors if given permission, and if station security has procured a search warrant.

5.3.3 Automations for Home

Residents will have access to a Butler-bot if they choose so. The Butler-bot has been designed to do basic tasks such as picking up clothes, doing laundry, cooking basic meals, bringing their owners much needed coffee, and other basic house hold tasks. Butler-bots receive commands through the Smart-band Duo, but



Automations



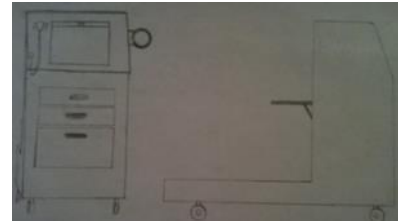


Automations

over time they learn basic voice commands. Residents who wish to supplement their experiments with these helpers, can teach them to do certain tasks, or upload functions (such as recipes, or schedules for dining) to increase efficiency.

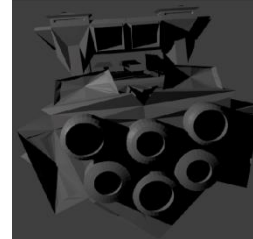
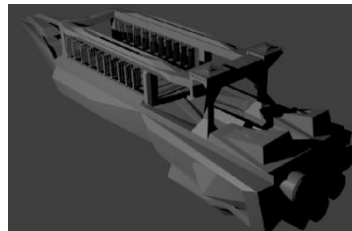
5.3.4 Medical robots

The Medi-bots designed for use on Bellevistat have many useful features for doctors, nurses, and residents. The design hosts a screen and webcam system for conversing, drawers for supplies, blood pressure cuff, thermometer, and a back with an extendable seat and reusable sides to be used for transportation of materials or people. The Medi-bot can easily be synced up with resident's Healthtraker apps to get full histories, show patients the way to rooms, and do basic tasks for doctors and nurses, saving time.

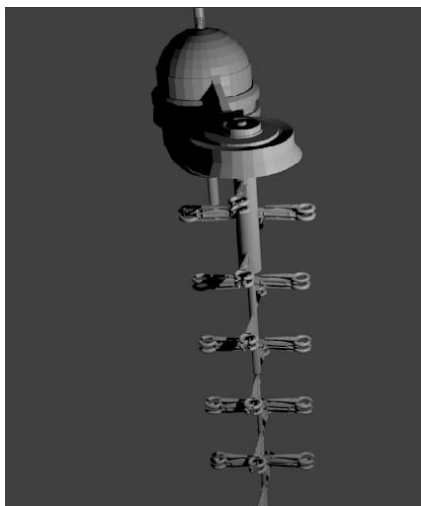


5.4 Automated systems to deliver ore to refining processes

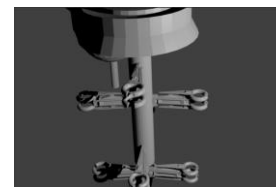
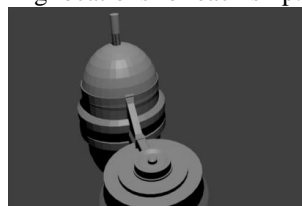
The transfer of materials from the moon to the station is handled by an automated space ship built for intensive cargo shipping named the Lunar Whale Carrier. This ship is capable of holding a total of 112 (15^2ft by 60ft) containers equating to a volume of 450860m^3 when maxed out. The ship is capable of holding and supporting a staff to monitor systems and materials carried but do not require them to operate. The arms are on multiple pivot points and can work in groups to grab and maneuver objects of non-standard shape/size into its cargo hold, but as for basic shipping, it takes one arm to place one container in the hold. There will be only two Lunar Whale Carriers due to their great mass, one in operation and one on standby during maintenance or in case of a malfunction. There are areas that can be pressurized should anyone desire to use a RETV to board the carrier in times of critical circumstances or unexpected indicators appearing in cargo.



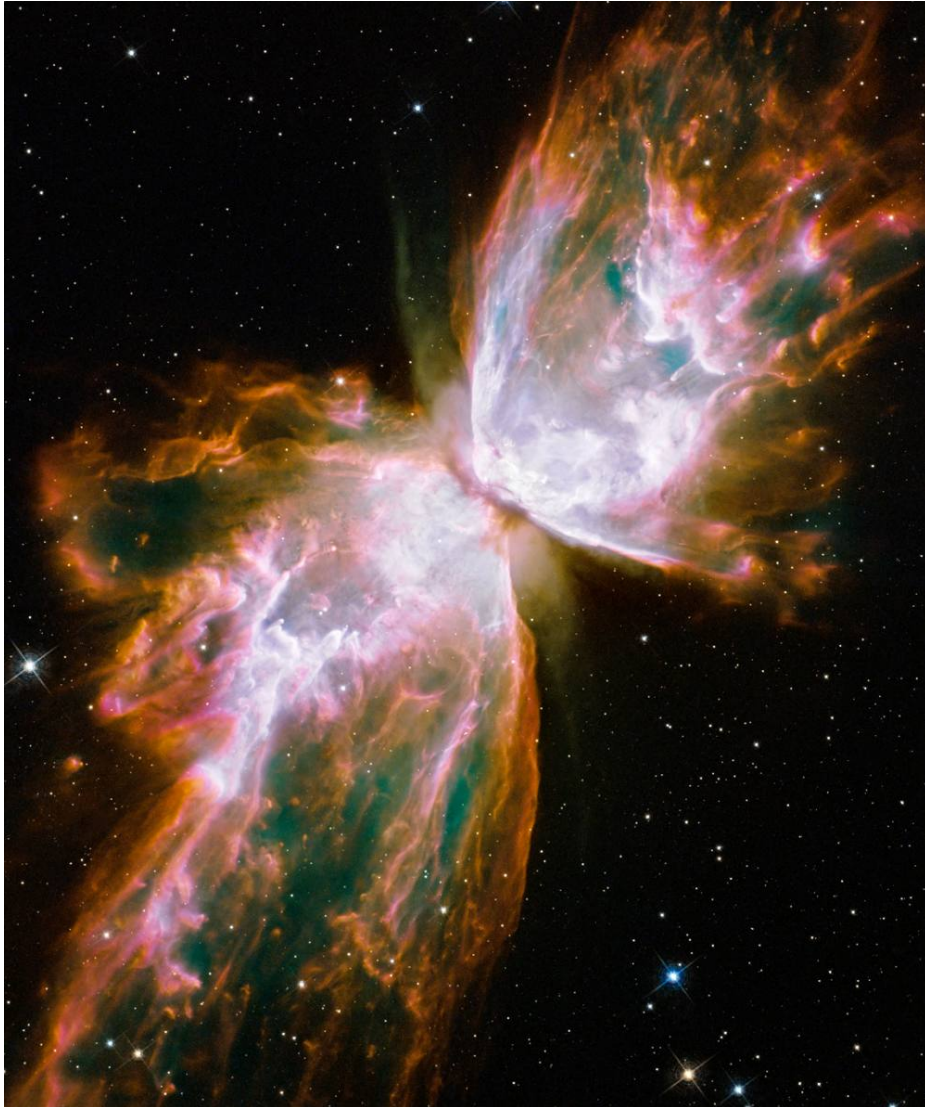
5.5 Ship docking and refueling system



For the docking and refueling of multiple RETVs as well as any ship from earth, be it coming from or going to, a secondary docking will be used. One that comes with automated docking procedures and pressurized umbilical cords for the admittance of travelers to their first impressions of Bellevistat. The cis-lunar docking bay, Hestia, consists of; a massive capsule which contains the hydrogen and oxygen meant for refueling ships, automated gripping protrusions which are rotating, segmented, inflatable rings capable of handling ships of varying angles and sizes, a two story habitable geodesic space for traveling individuals' convenience (i.e. resting areas, vending machines, kiosks), and an elevator which takes people between the different docks and the rest area. As with any fluid based refueling system, shifts in pressure will allow the fuel to be moved from the capsule to different docking locations for each ship.



6. Schedule and Cost



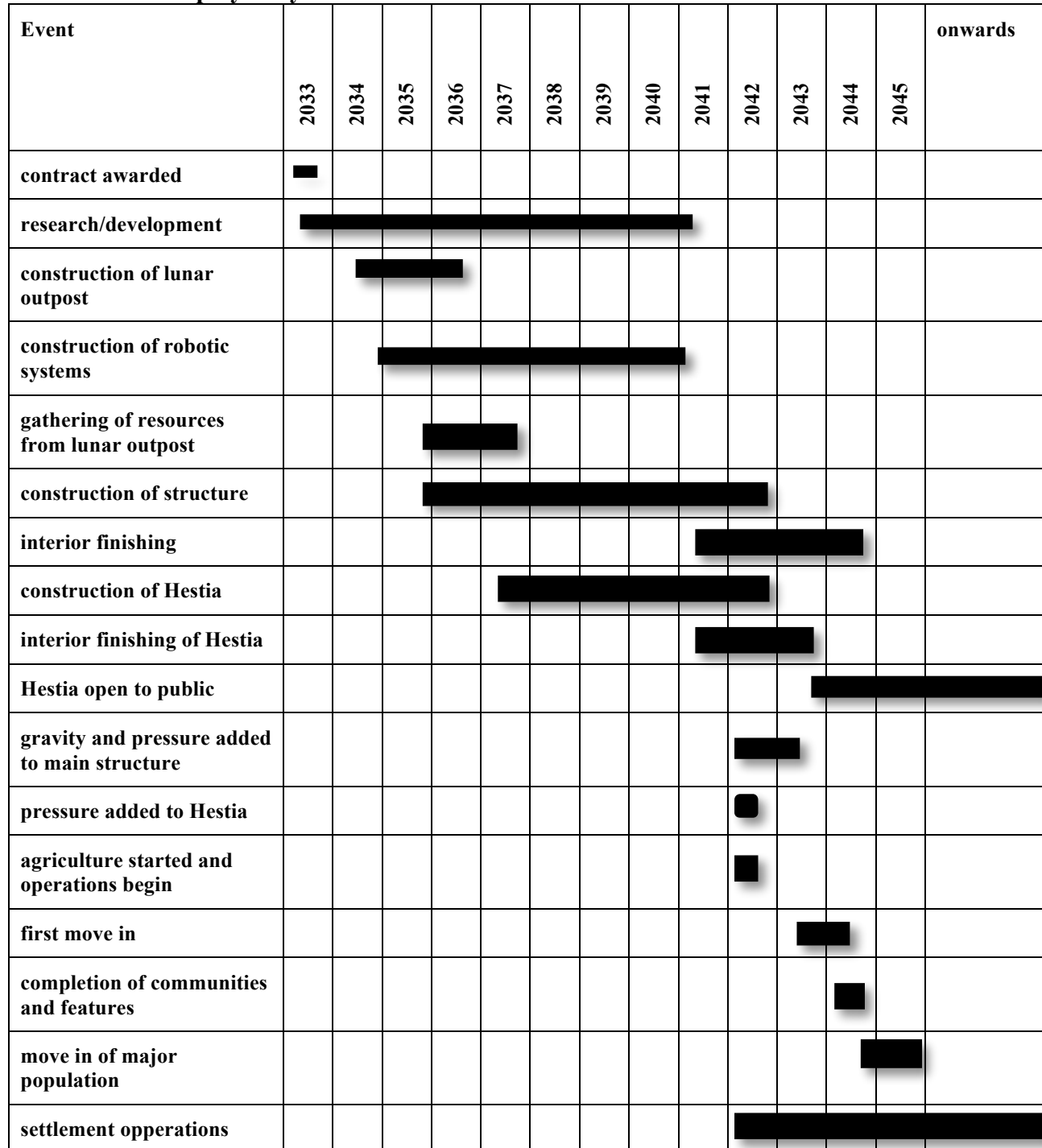
After one look at this planet any visitor from outer space would say 'I want to see the manager.'

- William S. Burroughs



6.0 Schedule and cost

6.1 Schedule displayed by Gantt chart

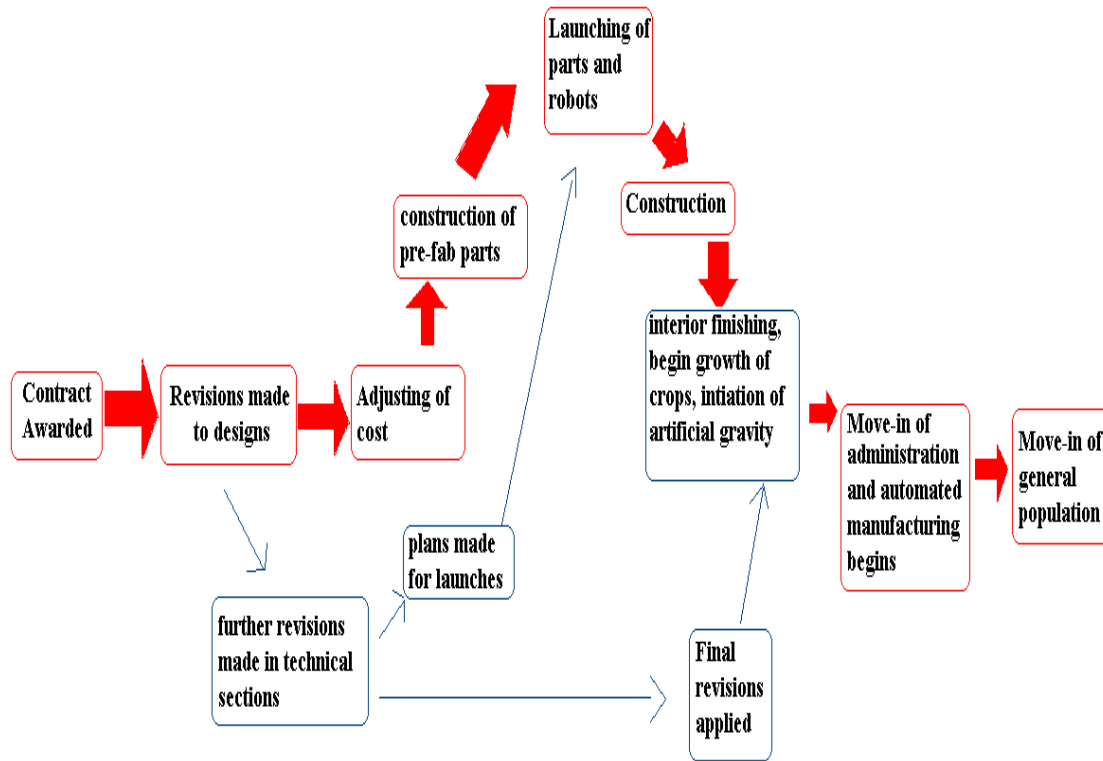




Schedule and Cost

6.1.2 by critical outlining

Schedule displayed
path schedule
major deadlines



6.2 costs

*given in us

dollars

Structures:

Item	Quantity	Cost per unit	Total
Titanium Girder	600,000,000	40\$	24,000,000,000\$
Glass Pane	5,669,810 m ²	32\$/m ²	179,513,920\$
Gold Tinting	5,669,810 m ²	100\$/ m ²	566,981,000\$
Prefabricated Interior parts	7,000,000	1000\$	7,000,000,000\$
Fueling Stations	4	100,000,000\$	400,000,000\$
Docking Infrastructure sets	8	10,000,000\$	80,000,000\$
Total			32,226,494,920\$

Operations:



Schedule and Cost

Item	Cost per Unit	Amount Needed	Total Cost
Freyr Climate Control System	200,000	1	200,000
etain water maintenance	200,000	1	200,000
Automated Farming System	\$600	1,000	600,000
space gyroscope	200,000	3	600,000
Bee Bots	\$0.4	10,000	4,000
Bee Bot Hive	\$150	2	300
Meat Growth Bioreactor	2,000	200	400,000
Solar Panels	261.6	2000	523,200
Electrical Power Grid	1,000,000	1	1,000,000
Tlaloc Water Maintenance System	200,000	1	200,000
Structure nervous system	600,000	1	600,000
Solid Waste Recycling System	400,000	1	400,000
Communications Uplink Station	750,000	1	750,000
Central Computing Server	200,000	1	200,000
Food Storage Center	10,000	12	120,000
Bamboo Growth Area	100,000	1	100,000
Paper Recycling and Production Machine	10,000	10	100,000
Hydrogen Fuel Cell Recharging Unit	10,000	48	480,000
Total Operations Cost:			64,477,500

Human factors:

Item	total cost
Parks/Gardens	400,000,000
community structures	3,500,000,000
air locks	3,280,000,000
Mechanical Counter Pressure suits	900,500,000



Schedule and Cost

medical facilities	650,000,000
research facilities	800,000,000
entertainment facilities	25,000,000
religious facilities	5,000,000
educational programs and facilities	10,000,000
Appliances	450,000,000
Furniture	10,000,000
total cost	

Automations:

Item	cost per unit	amount needed	total cost
fingerprint scanner	\$130	100	13,000
retina scanner	\$800	100	80,000
walk through metal detector	\$2000	25	50,000
X-ray baggage scanner	\$5000	25	125000
security cameras	\$70	1000	70000
automations for construction			9,105,060,000
automations for operations not yet listed			16,281,350,000
personal automations			4,540,000,000
Total			29,926,748,000

*specific prices of automated units are listed in their respective automations section

Salaries:

Category	Job	Annual salary	man-years	total
Engineers	mechanical	77,000	700	53,900,000
	Automation	87,000	700	60,900,000
	Operations	88,000	700	61,600,000
	structures	84,000	700	58,800,000
	systems	89,000	600	53,400,000
	biomedical	81,500	300	24,450,000



Schedule and Cost

	materials	86,800	300	26,040,000
	Aerospace	97,500	700	68,250,000
	electrical	87,800	600	52,680,000
Research and development	physicists	106,400	500	80,200,000
	biologist	70,000	300	21,000,000
	chemists	71,000	300	21,300,000
	societal	80,000	300	24,000,000
	medical	90,000	125	11,250,000
	other	70,000	20	1,400,000
Management	General	120,000	320	36,000,000
	Engineering	120,000	300	36,000,000
	public relations	120,000	100	12,000,000
Misc.	Astronauts	140,000	600	84,000,000
	communications	60,000	60	3,600,000
	Upkeep of facilities	30,000	100	3,000,000
	Aerospace technicians	35,000	500	17,500,000
Total				1,002,970,000

Shipping

Transportation of original population with 250 pound allowance	total cost
600,000	6,600,000,000

cost per pound to ship	estimated total cost of shipping
\$1000	\$50 B

Total cost of shipping	56.6 B
------------------------	--------

Total: \$226,155,690,400

7. Business Development



“The human brain now holds the key to our future. We have to recall the image of a planet from outer space. A single entity in which air, water, and continents are interconnected. That is our home.

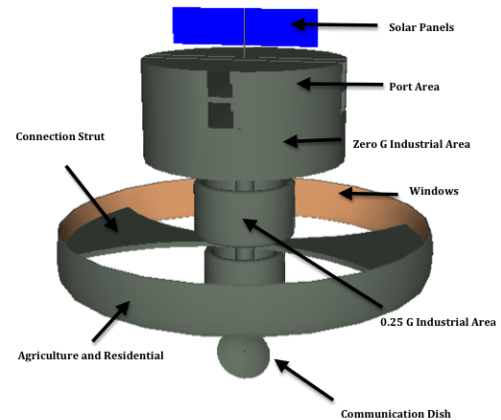
- David Suzuki



Business Development

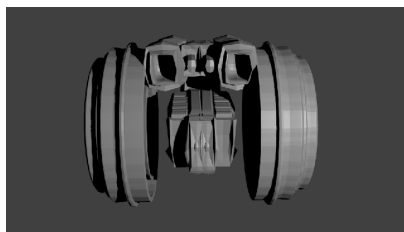
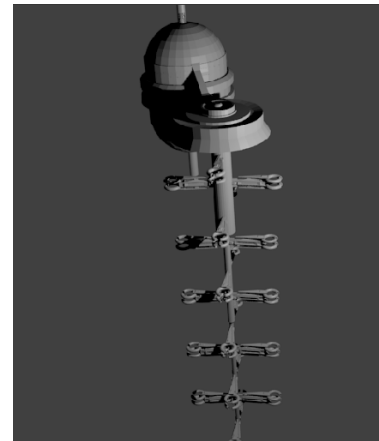
7.0 Business Development

Bellevistat will be the host of a wide range of industries. Lunar material and asteroids will be mined, and the materials will be sorted and refined to produce lunar regolith, Titanium, Helium-3, and Ilmenite. Raw and finished materials will be able to be shipped to and from the station, allowing trade to flourish with Earth. Capabilities exist to use these materials to produce space-faring equipment and design goods that cannot be created in standard Earth conditions, such as nearly perfectly spherical containers. Passengers and cargo may be able to leave their ships and step onto Bellevistat on either large, internal dry-docks or external ports. Both locations will allow for refueling, and have substantial features to protect the safety of both the visitors and residents of Bellevistat. The internal drydocks have the added ability of both repairing visiting ships and constructing new ships, and the docks have the capability of containing large space tugs.



7.1 Ports for receiving lunar and asteroid materials

Major shipments of ore and raw materials will be located in the port areas on the main structure. Most storage will remain in the 0g area for manufacturing while materials for bucky structures will be shipped to designated areas in the .25 g manufacturing section where it may also then be either stored or processed. Separations of these areas are available for customization during the construction phase of the schedule for the manufacturing areas for businesses to purchase. As resources are used up, the standard shipping containers will be used for exporting goods (if applicable) and then reused to bring in more raw materials. Once ships have arrived, automated systems with magnetic nanoparticle positioning capabilities will be able to unload ships efficiently onto conveyer belts (enclosed to account for microgravity preventing materials from flying off) which will take goods to be stored or processed. Afterwards, ships may be repaired in the same dry dock area, or continue on to the Hestia Cislunar docking bay for refueling.



Should materials need to be taken between Hestia and the main structure, RETV's will be available for transporting shipments between the two areas. If for some reason materials do not arrive in standard shipping containers, provisions have been made for them to be sorted, and placed in containers that will be kept on Bellevistat.

Separate docking facilities have been created for humans and cargo other than raw materials. Hestia will host several umbilical cords which may be pressurized and allow for going between ships and the elevator to be allowed entrance into the welcoming center. RETV's will then transport them to airlocks located on the main torus where they may enter the Bellevistat community and use the extensive maglev system for further transportation. At this point cargo and humans will be further subdivided (though they will already be transported in separate RETV's) as part of the layout for the maglev system (please see section 5.1). The maglev system will also be used for materials coming from the docking ports on the main structure to deliver nutrients left over from the regolith to agricultural units, and materials for use in the research facilities located in the community designs.

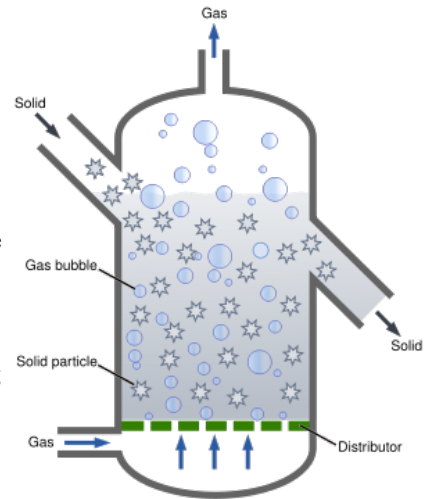


Business Development

7.2 Production of goods from manufactured areas

Lunar ore and asteroid materials will be sorted and refined before either being used for manufacturing aboard the station, or being shipped back to Earth or other Fondation Society Colonies. Overburden, essentially consisting of lunar regolith, will be separated from rarer and valuable materials such as Titanium Dioxide and Ilmenite. Through the Kroll process, raw material will be separated in a fluidized bed reactor. For the proper separation of materials to be successful, it is necessary that this occurs in at least .25 g and this will be located in the designated area along with bucky structures manufacturing.

Because of the many businesses that will be interested in having manufacturing facilities on Bellevistat, considerations have been made specifically for the manufacturing of large aerospace equipment such as spaceships, and airlocks, as well as the unique possibility to manufacture perfectly spherical cross section from processed titanium. These features would make resulting configurations extremely structurally sound due to the elimination of corners for the origins of cracks. Suggested uses could be for tanks made for gas or corrosive materials, against which, Titanium is extremely resistant.



Because Titanium is only ductile when free of oxygen, the station is afforded a unique opportunity to easily manufacture titanium wire. For this reason, claytronic enabled systems able to operate in non pressurized areas will be able to take advantage of this unique feature, and will be able to sell other businesses around the station Titanium wire. Pure titanium will also be sold for alloying with other metals such as Molybdenum, which may be used for a wide variety of industrial activities such as desalination plants on Earth.

7.3 Repair and restoration of ships and other space infrastructure elements

Bellevistat will provide both external ports for shipping and internal “drydocks”. External ports located on the Hestia Cislunar Bay will allow goods and people to enter and exit the visiting spaceship and into Bellevistat. After boarding RETVs. Additionally, the external ports will provide ships with the opportunity to have their hydrogen fuel cells be refueled through the use of the Hestia docking system. Internal drydocks will provide the same refueling and shipping capabilities as the external ports, but also allow ships to be repaired and for new ships and other devices, such as large-scale solar panels, to be manufactured. The internal drydocks are large enough that they can fit anything from small ships to large cargo tugs. There will be 8 internal drydocks and 21 external ports, yielding a total of 29 ports that may be used after initial construction. Bellevistat will be constructed such that additional external ports using the Hestia docking system may be constructed as the need arises.

In the case that a hazardous situation arises, the automated gripping protrusions which include rotating, segmented, inflatable rings capable of handling ships of varying angles and sizes that will be used to maneuver the ship in normal situations will be able to take evasive actions to softly bring the ship under control with minimal damage and risk to the ship and its passengers, as well as preventing damage to the docking system or other sections of Bellevistat. For added safety, the Hestia Cislunar docking bay has been designed to be disconnected from the main structure in case of complications with refueling. Should an explosion occur in either the external docking structure or the visiting ship, the automated systems on the main structure of Bellevistat will be available to cut off the area and manage heat, and other such hazards. Should a docked ship pose a threat, it will be ejected from the site after passengers aboard the ship have been evacuated, and after a waiting period, if safe, it will be moved by designated systems to the repair site. Internal drydocks will be given kevlar walls to prevent explosions or gas leaks from effecting the rest of the station. In extreme situations, the ship may be ejected after all passengers have been evacuated.

8. Appendices



Space is big. You just won't believe how vastly, hugely, mind-bogglingly big it is. I mean, you may think it's a long way down the road to the drug store, but that's just peanuts to space.

-Douglas Adams



Operational scenarios

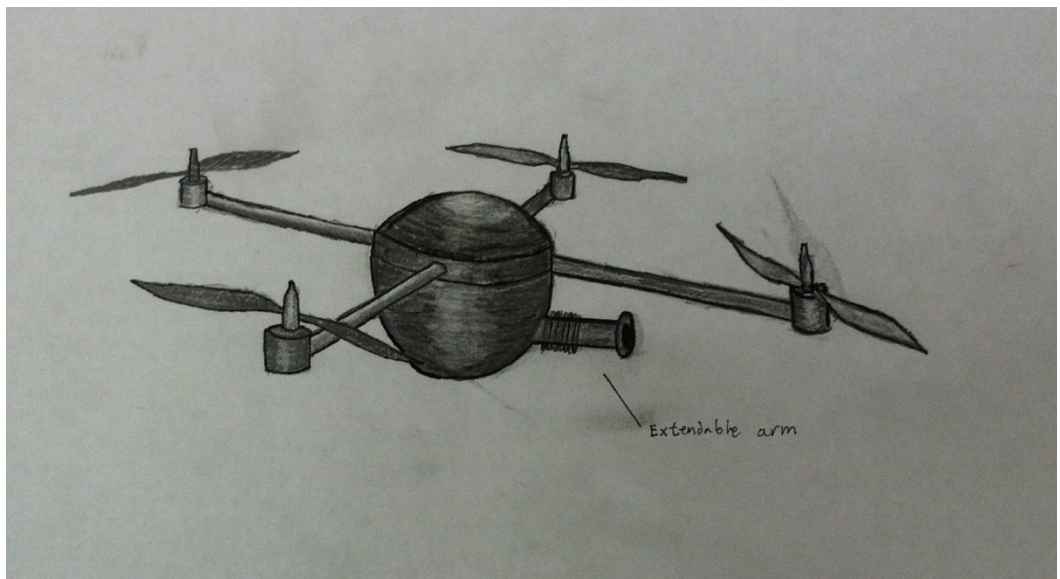
A. 1

Northdonning Heedwell has prepared for hull breaches with several key automated systems. Should a hole breach occur, the Station Nervous System will sense the disturbance and immediately sound alarms and call upon repair robots to assess and repair the surrounding area. The Pappenheimer repair robot will be dispatched and, once reaching the scene, insert its needle into the hull of the ship. Then it will shift the cylinders along the needle to the depth of the hole and release a micro plated gecko feet nanostructure tarp to cover the hole from the interior and exterior sides of the breach, sealing it. Then the Pappenheimer releases a nanorobotic salve to seal up any exposed piping, severed electrical wiring, or structural support damage. The station's automated nervous system SNS will then assess the damage while other specified systems for controlling settings will work to rebalance the area to its original state. Once the tarps have been placed it is safe to pressurize the breached area and have the necessary resources arrive and repair any leftover damage. The nano robotic salve can be withdrawn, which will be done slowly, and eventually completely returned to the storage in the Pappenheimer. After sufficient repairs are made both tarps will be retrieved and the Pappenheimer can leave the fully repaired area.



A. 2

In the event of an internal explosion, though not damaging the hull to the point of exposing the interior to the vacuum of space, one of two automated robots will be used as well as assistance from the Freyr climate control system will be required. The two separate robots (known in conjunction as the Metamorphosis Repair System) that serve the same



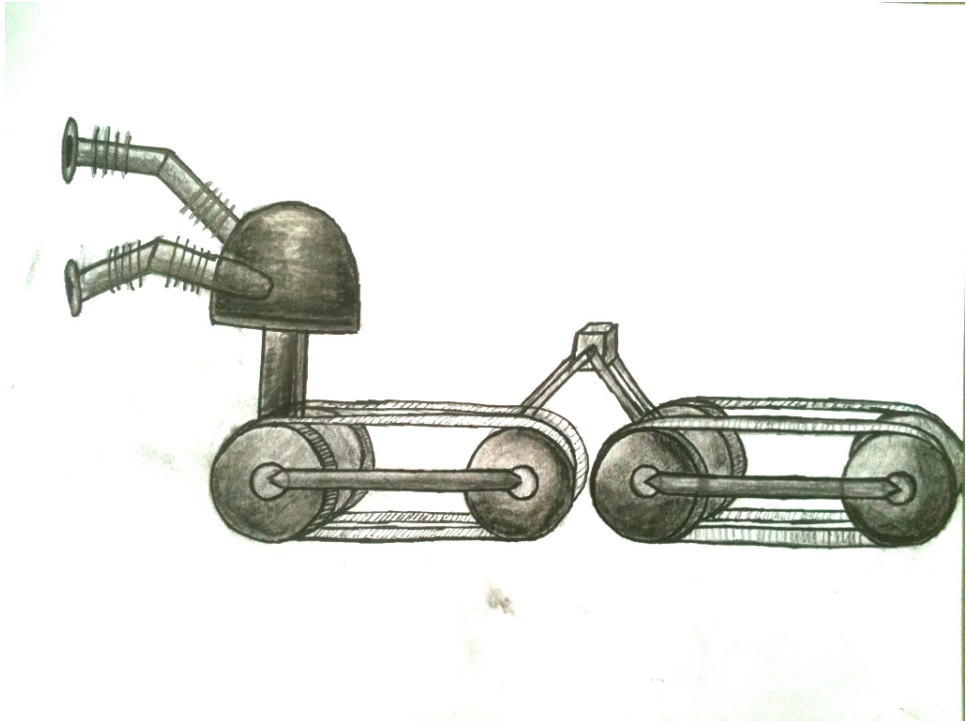
purpose and use the same tools to accomplish that purpose, however one is a quadrotor robot equipped with a port to utilize claytronic technology to be used in a pressurized location and the other is a robot that utilizes gecko feet nano structures placed as treads to travel in unpressurized locations using the same claytronic system. The Freyr climate



Appendices

control system will respond by immediately by calling on needed systems and venting any toxic gases that may be present after the explosion while either repair robot arrives in groups of about 4 at a time (number of groups will be determined by severity of explosion). There the robots will focus on the clearing of debris and containment of the origin of the explosion.

Once the area has been made safe and any volatile materials have been properly secured the robots will then move onto repairing any damage caused by the explosion.





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