
BELLEVISTAT
JP
Stevens
2013
BELLEVISTAT


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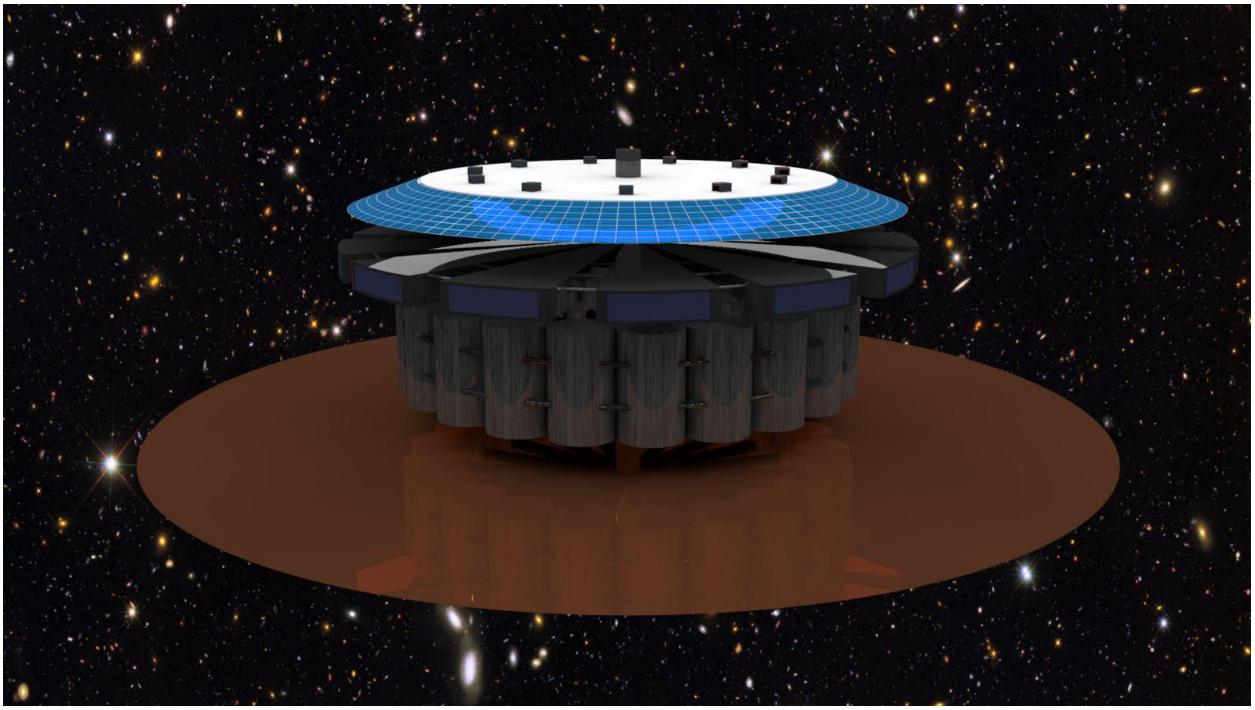
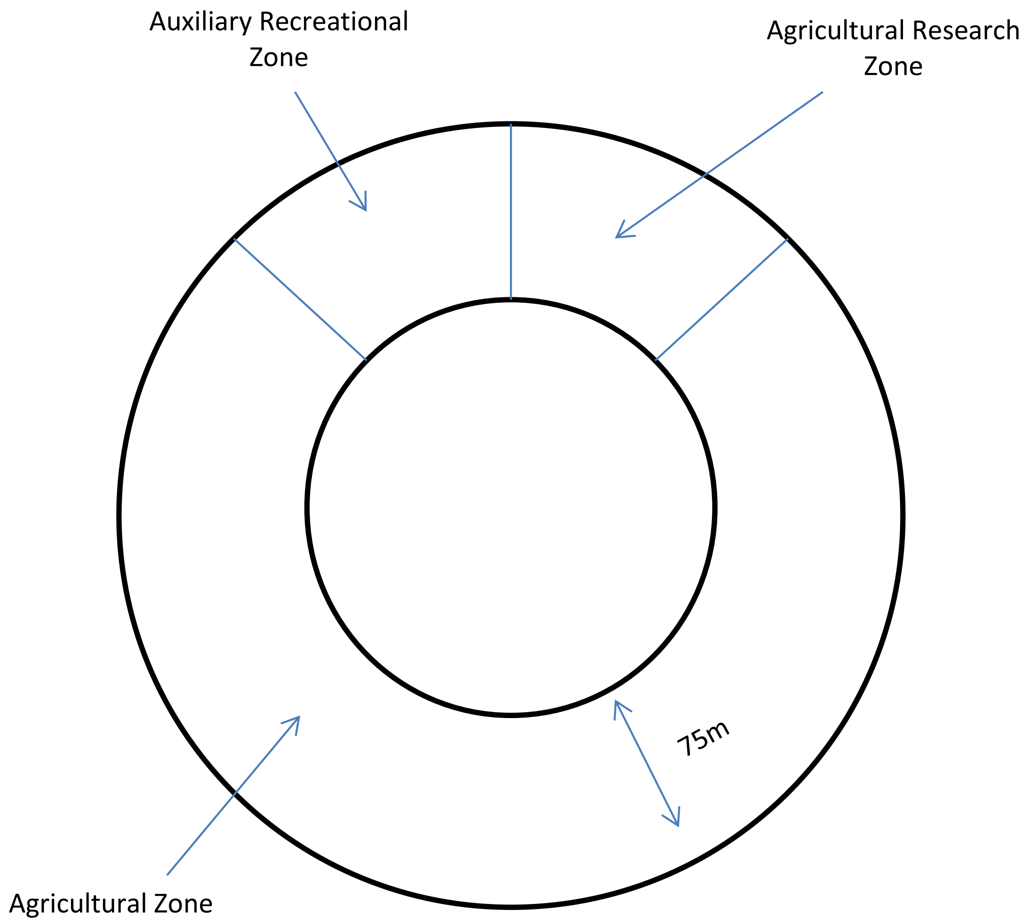


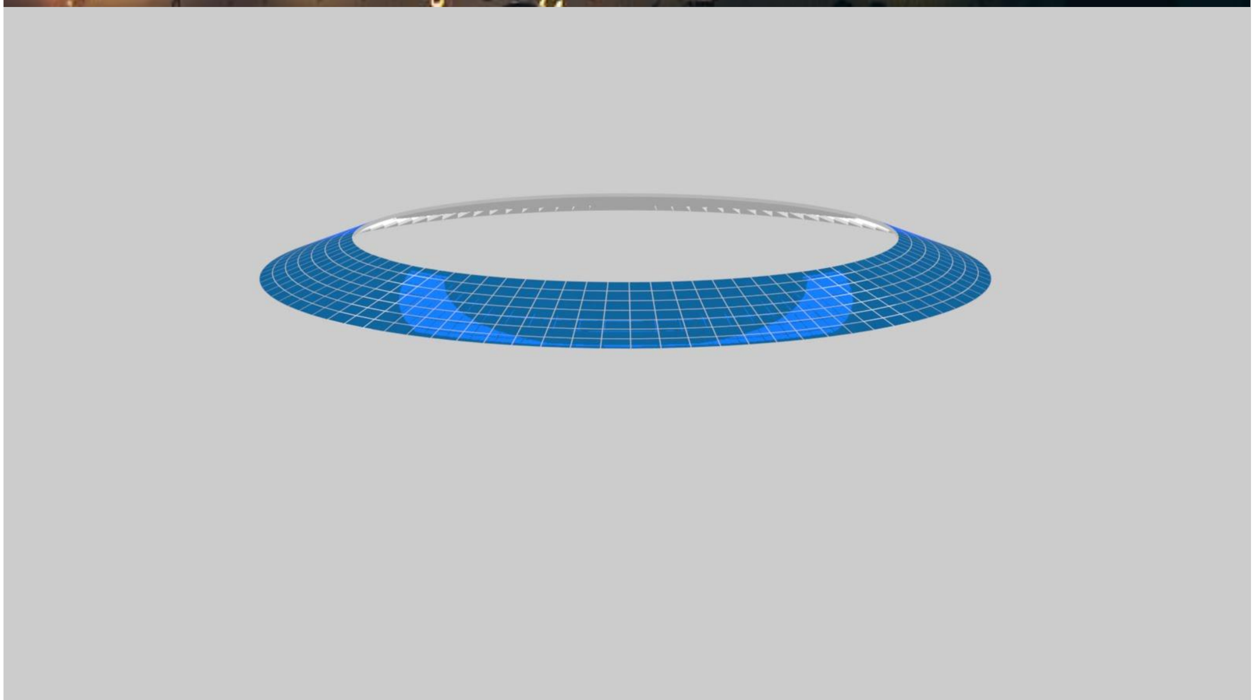
**Structural Overview:**

Bellavistat is organized in three segments, the local level, and the group level, and the overall structure. A local level of the structure is the individual partitions that divide the structure; The group level are the broad strokes areas that are in the structure, and the overall structure is, as stipulated, the entire Bellavistat infrastructure. This way in which the entire structure has been partitioned is for a dual purpose: construction and logistical ease, and emergency procedure expediency.

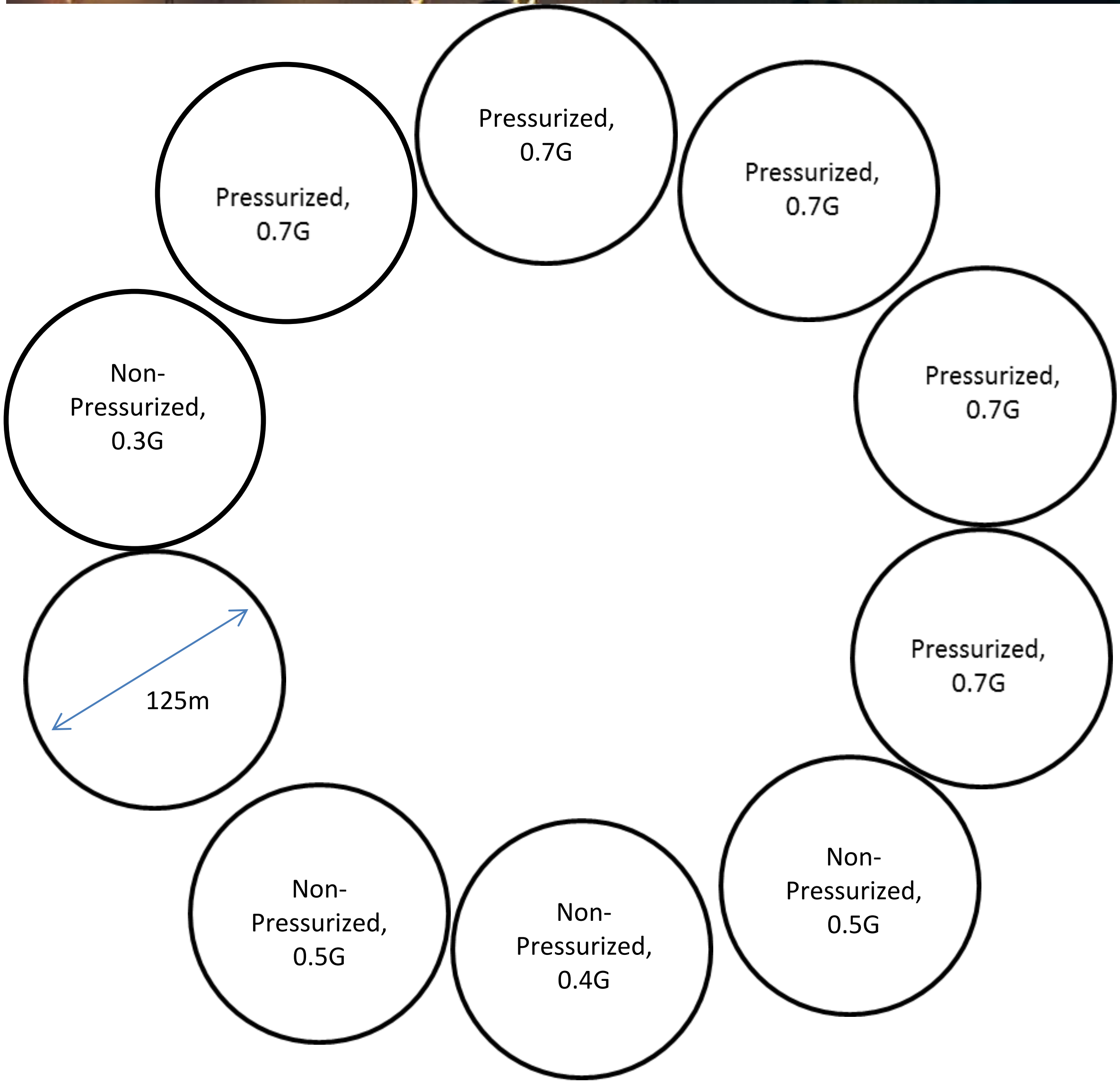
Each of the compartments, labeled with appropriate lettering, is semiautonomous in various areas, ranging from governance to resource allocation. However, perhaps the more vital aspect of this division is such that if an emergency is encountered, each section will be able to sustain itself for a short period of time despite the fact that an adjacent section has been damaged, thus saving the total structure from immediate danger.

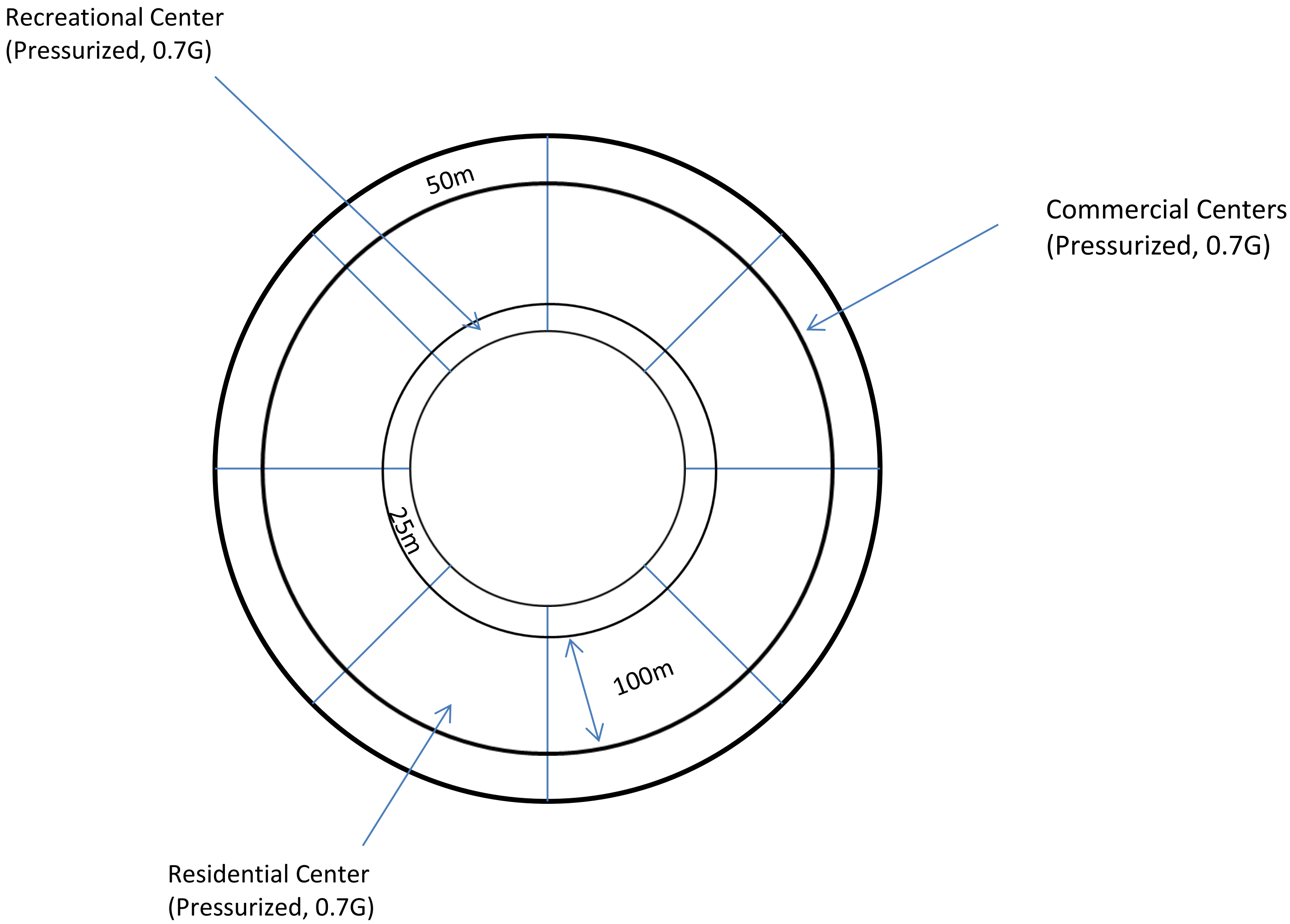
The Group level is organized into various groups, each preforming their own tasks. These groups have been given various names for the purpose of both expediency and ease of logistics. The torus that is pictured at the top is Columbus, or the agricultural sector. This sector is partially pressured (85% of torus at 1G) to ensure optimal growth in plants, however, sections of the structure are also non pressurized (15% at .5G)  in order to maintain research into various effects of space on plant life and growth. This section will make use of predominantly artificial light, so that the growing period for the plants is longer than it would be if under sunlight. The artificial lights in this section will be on for a stipulated 14 hours, allowing some time for the Calvin Cycle, or Dark Reactions, in the plant, to occur. The top of this torus will have small reinforced windows for better viewing into space; however, they are not large enough to supply full light to the entire structure. The structure will also have dual purpose as a park/recreational center; however, this will be a minimal section of the station.



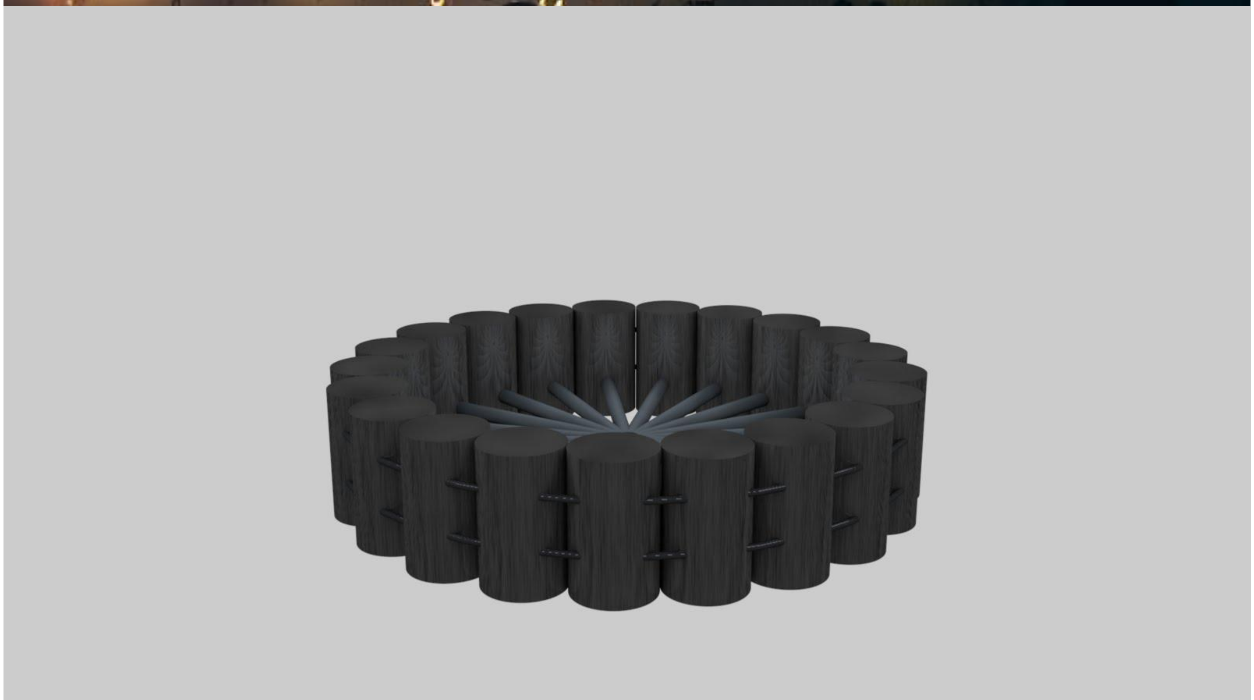


Group Level Two will be the level of residential and commercial area. This area will have the housing for the various residents, as well as their amenities. In order to facilitate this, these residential areas are each further dissected into individual centers, which will have the appropriate infrastructure necessary in order to sustain normal life. The majority of this level will be pressurized, with 96% of the level at 1G, however, 4% of total living space is unpressurized at various gravitational fields for recreation.


Pressurized, 0.7G
Pressurized, 0.7G
Pressurized, 0.7G
Pressurized, 0.7G
Pressurized, 0.7G
Non-Pressurized, 0.3G
125m
Non-Pressurized, 0.5G
Non-Pressurized, 0.4G
Non-Pressurized, 0.5G


Recreational Center
(Pressurized, 0.7G)
Commercial Centers
(Pressurized, 0.7G)
50m
25m
100m
Residential Center
(Pressurized, 0.7G)


Group Level Three is the industrial center; an area which is essentially feeds the entire system. This industrial center is kept at various gravities (refer to diagram), and in addition includes various industries.



**Hull Composition:**

The hull of Bellavistat will be made out of a combination of various materials, each selected for specific qualities:

Carbon Nanotubes, regolith, Fibrous Refractory Composite Insulation Tiles (FRCI), Flexible Insulation Blankets (FIB), water, Steel , Bucky Structures

**Construction:**

The Basis for all of the construction mechanisms for the Bellavistat Station are that the entire station can be assembles separately in pieces before it is taken together and combined as a whole. This process makes it such that the station can be made in large chunks on Earth or in remote areas in space, and then be attached to the overall space station infrastructure after individual construction.

The construction process will follow the following procedure:

The table below describes the broad strokes steps of construction:

| Phase | Step | Time Allotment | |
|---|---|---|---|
| 1 | Drago: The primary step that has to be taken in order to establish the space center is the construction of the main connection apparatus. This main Connection hosts power modules at its base, and the transport system that shuttles both personnel and materials throughout the station. This section will not have artificial gravity at this time. | 2 years | |
| 2 | Shale: A temporary command module will be connected to the base of the Drago apparatus. This will be a rotating module with 1 G artificial gravity, which temporarily houses workers and the resources necessary to sustain them. | 9 months-<br>1 year | |
| 3 | Pegasis: The next step of construction is the inclusion of the industrial center of the station. This center will have the entire industrial production center, and once online, it will be able to facilitate hastening of the construction of all of the other centers. | 3 years | |
| 4 | Falcon: This step will begin the creation of the residential area of the station. This area will take the longest; however, each section will be immediately pressurized once it is connected to the main structure. At this point, Shale will be removed, and all residents will be transferred to this area. Note: only 30% of the capacity of the station can be filled at this point, due to the lack of resources needed to sustain a full population. | 4 years | |
| 5 | Columbus: This will commence the last of the building stages, which will be the construction of the agricultural ring, or the Columbus ring. As the other torus will be open at this time, Columbus will be immediately pressurized and then further immediately ready for sowing seeds. However, it is important to note that prior to this point, residents are living on | 2 years | |

| | | | |
|---|---|---|---|
| | imported food resources. The remaining capacity of the station can now be filled. | | |
| 6 | Solar Shield: Until this point, the station has been running completely on its internal fuel cells for energy. Now, the solar cells can be added to the overall structure, thus finally making the entire structure self-sufficient. | 1 year | |

## Energy

In order to obtain energy for the space colony, we will use solar energy as it is abundant and easily acquired for use through various solar arrays throughout the exterior of the colony. For one section of our structure, we will have optimal gravity in which humans can live and perform everyday tasks, but for another section, we will use minimal gravity to support industry. Solar energy will be used to provide for agriculture and will be obtained directly with little interference as we are not using massive material on the outside as shielding, but using magnetic fields to protect against radiation. This will also allow solar energy to be easily used for industry and we can also use aluminum mirrors to create high temperatures.

In addition, electrical energy will be easily acquired through the use of a system that has a concentrating mirror, a boiler, a conventional turbogenerator and a radiator that discards waste heat to the cold of outer space. This energy can be used for everyday applications of the residents and approximately 2 Kw will be spent per person in a year, so each section of the colony that consists of 1000 people will be given 2000 Kw (2 Megawatts) of energy annually. Also, since a lot of energy will be produced from the solar arrays, energy can become a profitable export of the colony. The solar arrays that we will use in our space settlement will be on large wings that protrude outward and will generate large amounts of power for distribution through the settlement. Approximately 20 megawatts will be produced in a year which will be used to operate the systems of settlement as well as provide a source of energy for agriculture and the daily lives of the 10000 residents. In addition, these solar arrays will be positioned towards the sun and will be very large.

| Energy Distribution in the Settlement (Per year) | |
|---|---|
| Agriculture | 3.5 Megawatts |
| Transportation | 2.0 Megawatts |
| Water Management | 2.5 Megawatts |
| Automation | 5.0 Megawatts |
| Communication | 0.5 Megawatts |

| | |
|---|---|
| Waste Management | 1.5 Megawatts |
| Recreation | 0.5 Megawatts |
| Artificial Lighting | 1.5 Megawatts |
| Appliances/Daily Needs | 3.0 Megawatts |

http://settlement.arc.nasa.gov/CoEvolutionBook/TESTIM.HTML
http://www.spaceset.org/p.solar.mm

**2.3 Construction Process**

**2.4 Location of Buckystructure facilities**

**2.5 Docking System**

The docking system aboard the Bellevistat will essentially be a platform at the base of the settlement, with three different docking sizes for small (25-50 feet), medium (50-150 feet), and large (150-500 feet) incoming/outgoing spaceships.

**3.0 Operations and Infrastructure**

**3.1 Location and Materials Sources**

| |
|---|
| **Industry (moon and asteroids)** |
| **Transport To and From Earth and Alexandriat (shipping depots)** |
| **Materials for the building of the station** |

**Earth-Moon L4 Libration Point**

The space colony will be put into an irregular orbit at the Earth-Moon L4 libration point as this point will be a center of the region in which the colony will remain without the application of extensive stationkeeping forces. Since the L4 point requires very little energy, it is the most reasonable and effective place for the space colony to orbit. If the colony deviates from its orbit, forces will bring it back into the stable equilibrium at the L4 point. This point will be perfect in the 3 body system of the Sun, Earth, and Moon, as the colony will orbit at 60 degrees in front of the Moon’s path around the Earth. The L4 point has several other benefits to our space colony as it will allow industry to occur easier since objects will remain close to each other around this point. This will make the mining of materials from nearby asteroids easier as well as facilitate the acquisition of materials from Earth. A deep-space colony at this point will be protected from the human space junk that exists closer to the Earth and it will also benefit science experiments as it will contain both the Earth and the Moon within its view. Also, this region will be relative easy to reach and have a clean environment compared to the Moon which contains large amounts of lunar dust and is located far away from the Earth. Despite the multitude of benefits of this region, there is still a minor drawback to keeping a colony at orbit around the L4 because it will be outside the Earth's radiation belts and will be impacted by cosmic rays. However, we can add strong and thick covering to the space colony in order to prevent radiation from affecting the residents. This can be accomplished by using an active shield that consists of magnetic fields that deflect high energy galactic cosmic rays and are not severely harmful to humans. This will be more effective than passive shielding with massive material as it will create more inertia for the colony and it requires more energy for the thrusters. In addition, spacecrafts flying to the colony will be shielded from radiation with these fields as massive material is impractical for them.

In order to get the space settlement into orbit at the L4 point, we will have to build it piece by piece with various construction methods involving automated machines and spacecraft. We will send these parts into space with rockets that have a high speed to escape the Earth's atmosphere, but not enough to be removed from orbit around the Earth. Then, the space settlement will be built at this point over the course of several years and the entire operation will be controlled from Earth. Since the L4 point is very stable, construction will be easier to accomplish and the space settlement will be able to be created without much difficulty.

http://www.21stcentech.com/space-update-nasa-choices-moon-mars/
http://www.permanent.com/space-transportation-earth-moon-libration-points.html
http://hyperphysics.phy-astr.gsu.edu/hbase/mechanics/lagpt.html
http://engineering.dartmouth.edu/~d76205x/research/Shielding/

**3.2 Community Infrastructure**

Agriculture:

1. Aeroponic Growth System for Crops

When establishing space settlement, soil tends to be very difficult to work with. First off, soil is very heavy. The sheer cost of transporting the necessary amount of soil to feed the population of 11,000 people would skyrocket, thus proving to be highly inefficient. Also, soil is very messy. With the low gravity of space, stray soil particles could get into staff member's eyes, pieces of equipment, and consequently pose threats to both safety and machinery. Lastly, soil also has many problems involving fertility. Once the soil has been fully exhausted of nutrients, the soil must be refortified in order to grow crops. The extra machinery needed for this process could cause budget problems as well as break time constraints.

A far better alternative to soil is Aeroponics. Aeroponics, meaning "growing in air", would be cheaper and much less problematic than soil. In aeroponic cultivation, plants are kept in a fully oxygenated and climate controlled environment. The soil is not needed because the plants absorb their nutrients through a water-nutrient mist mixture that will be sprayed on regularly.(include mixture)

The nutrients for growth will be provided through a hydro-atomized spray. This will include distilled water, growth hormones, and a mixture of nutrients essential for plant germination.

An artificial lighting system will be in place above all of the plants to mimic sunlight. These fluorescent lights will either be blue or red in color, because both of those produce high rates of photosynthesis. The blue lights (appx. 450nm wavelength) will be used for vegetative purposes; when the plant is in its main growing stages. The red light (appx 680nm wavelength) will be used for flowering or fruiting purposes, when reproduction of plants is needed. A small list of crops is provided below. The growth period is the time needed to grow the crop untill ripe, then cut it at the roots for regrowth.

| Crop | Growth Period(days) | Crop | Growth Period (days) |
|---|---|---|---|
| Carrot | 12 | Yam | 10 |
| Broccoli | 11 | Zucchini | 17 |
| Potato | 7 | Grapes | 32 |
| Lettuce | 10 | Onion | 14 |
| Zucchini | 7 | Eucalyptus | 10 |
| Wheat | 5 | Blueberry | 25 |

| | **Conventional Farming** | **Greenhouse Farming** | **Aeroponic Farming** |
|---|---|---|---|

| **Seasonality** | Seasonal | Extended season, but costly | Year Round |
|---|---|---|---|
| Water Use | High | Low | Low |
| Land Use | High and fairly inefficient | Medium | Very Low, 3-Dimensional |
| Yield/ Quality Predictability | Low | Medium | High |
| Pesticides Use | Very Often | On occasion | Never |
| Labor Conditions | Tedious, Painful | Very hot, humid | Climate Controlled |
| Weather Dependency | Very High | Medium- Some control | None |
| Food Safety | Difficult | Medium | Easy |
| Shelf life | 1 week | 2-3 weeks | 3-4 weeks |

2. Livestock Cultivation

Livestock cultivation on a space station poses many problems. Resources such as water, food, and medicine increase the cost of raising animals. Also, the animals themselves need space and sunlight to develop, neither of which will be adequately provided on the settlement.

In the agricultural ring, the alternative would be to produce *in - vitro* meat. In-vitro meat is meat produced by taking small amounts of animal muscle and applying a protein that would cause the muscle cells to proliferate, and thus producing the meat.

Initially, the healthy cells of animals such as chickens, fish, sheep, cows, pigs, buffaloes, horses, dolphins, lambs, etc. will be obtained and stored cryogenically aboard the torus. The cells are of full muscle fibers and fat cells. The muscle cells will be grown using a perfusion system that provides nutrients and removes waste. Also, the muscle cells will be genetically modified so that the highest quality of meat is ensured.

3. Water

Water is the fundamental resource for life, and the citizens will require an endless amount of it. Therefore, the torus will have a water cycle that constantly pumps and purifies water. Two colors of pipes will be used in the settlement: blue, which contains cleaned, drinking water, and red, which is dirty water that is headed for the purification chambers. The purification chamber is in the agricultural rin.

4. Packaging, Storing, Delivering,Selling

Once the food is ripe, it will immediately be shipped to supermarkets around the settlement for purchase and consumption. This not only prevents the food from rotting, but it will also be provided fresh for the citizens. The food will be placed into refrigerated containers and then be shipped by residential resource distributors to people who need it.

Bibliography:

http://www.aeroponics.com/aero20.htm
http://highrisefarming.northshoresolutions.com/wp-content/uploads/2011/03/Laboratory.pdf
http://www.synergyii.com/aeroponic/VAP.pdf
http://aerofarms.com/why/comparison/

Transportation:

A high speed magnetic levitation train(maglev) will run throughout the torus in a circular route. There will be two adjacent tracks, each with maglevs traveling in opposite directions(this is so that travelers do not have to circumvent the entire torus to get to an adjacent node). The maglevs will travel at 400mph (644km/h), stopping at stations located within each node for 1 minute allowing for embarkation/disembarkation. There will be a total of 5 maglevs running on each monorail, with a reserve in the event of a failure of another. Thus, in total, there will be 10 running monorails at any time, with two reserves. Each train will be approximately 65 feet long and 12 feet wide, with the ability to hold 110 passengers. The trains will hover 10 centimeters above the rail.

The maglev cars will hover by electrodynamic suspension(EMS). Here, the train will have c shaped arms that will hug the rail and produce a magnetic field that levitates the train. Using a feedback loop, any instability caused by passengers and luggage will be balanced by correcting the electromagnets and canceling the instability.

### 3.3 Construction Machinery

**Construction Robots**

There are three categories of Construction robots:

External Construction Robots (ECR):

The ECRs will be responsible for the building of the outside structure of Bellevistat. ECRs are about the size of a cylinder with a radius of 14 inches with a height of 8 inches and are battery operated. Once the settlement has been built, the ECRs will be made into EDDs (Refer to **5.0 Automation Design and Services),** where they will be able to scan the surface of the settlement for cracks or small damages. The ECRs use bucky structure-built arms to build the settlement in each of its parts, with approximately a thousand robots assigned to each section of the settlement, working simultaneously for its construction.

Infrastructure Construction Robots (ICR):

ICRs are robots that carry out the construction of the inner part of the ship. They are essentially tele-operated and controlled to build the infrastructure of the settlement, including residences, restaurants, parks, and so on. ICRs exist in different sizes: the size of a cylinder with a radius of 15 inches with a height of 8 inches and a cylinder with a radius of 22 with a height of 4 inches. Once the ship has been built, these ICR’s can be retired and turned into the large Internal Labor Robots (Refer to **5.0 Automation Design and Services)** .

Construction Aid Robots (CAR):

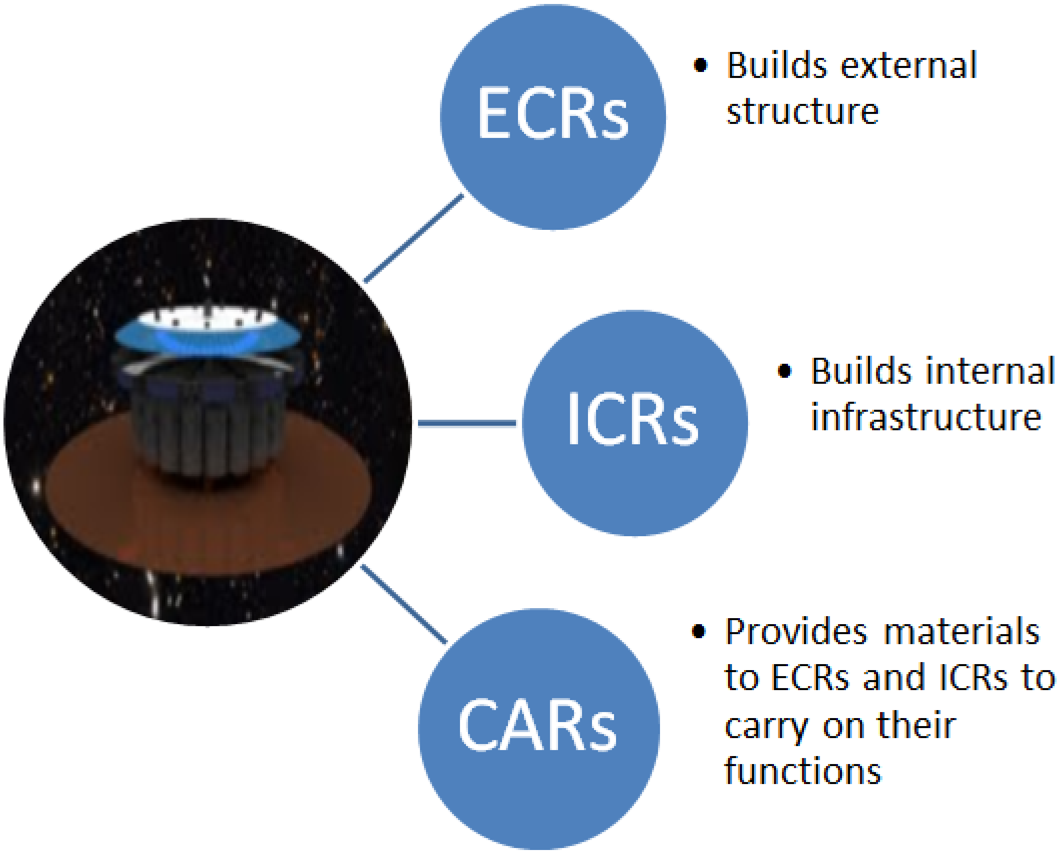
CARs are characterized by their large size and their ability to carry large amounts of heavy material. CARs are essentially large robots about 5 feet wide and 6 feet tall, and with a large cavity to hold large amounts of construction materials. They also have 4 wheels located under each corner, so that they can move around from one area of the settlement-in-progress and supply the materials that the other construction robots need to build the settlement. They are automatically operated by placing homing devices on the warehouse where the materials are kept and on each subsequent robot that the materials need to be delivered to. CARs retired into Residential Resource Distributors (RRDs, Refer to 4.2-Residential Housing). Once retired, the now RRDs will have the responsibility of distributing materials among the Internal Labor Robots if any new housing/construction projects are undertaken in the settlement.

The robots are made of carbon nanotube to achieve maximum rigidity and minimum density. The outer surface layer of the robot will be covered in a thin layer of graphene for protection when functioning on the outer surface of the ship. Heavy Internal Robots operate with 3 pairs of wheels.

When inactive, the robots get into sleep mode. In sleep mode, the robots do not shut down but achieve a state of minimum power usage, which helps the robots recharge much faster. Sleep mode has an advantage over shutting down, for the latter requires the robot more time to start and activate. Robots can get into sleep mode on the spot, without having to dock, as charging is done wirelessly. When finished their task the robots move to their docking position unless ordered not to do so. Robots on the external surface of the ship enter through a special vent. Robots dock when inactive.

The robots are provided with simple software. The software enables complete control of the robot. The software can also provided with applications for certain tasks.


Robots communicate with a central computer to report errors or for debugging.




**3.4 Paper Production**

Kenaf and banana peels will substitute tree-based paper on Bellavistat. Kenaf plants are tall, thin stalks averaging 14 to 18 feet in height; they generally lack branches and grow in dense plots, and therefore require less space than tree forests do. Kenaf is safer and more manageable to harvesters because of its smaller size.

Kenaf Size

In addition, Kenaf is adaptable to a range of environmental conditions, thriving best in warmer temperatures (above 50°F), and fully develops within 6 months. Kenaf makes a promising paper source because of its highly fibrous content - Kenaf fibers are both longer and stronger than tree fibers, and therefore Kenaf paper can endure many more recycling cycles than can tree paper.

Kenaf Fibers

Moreover, Kenaf paper is a clean white that is comparable to tree paper. One acre plots, with complementary fiber mills, will be apportioned to the production of Kenaf on Bellavistat; each acre will contain 75,000 to 100,000 plants and is expected to produce approximately 10 tons of fiber annually. In the absence of soil, Kenaf will be grown by hydroponics.

The alternative to kenaf paper is banana peel paper. Making banana peel paper, however, requires boiling, blending, and drying banana peel pulp, and yields a coarse final paper product. Thus, banana peel paper is less preferable than kenaf paper and will be reserved for emergencies.

Five recycling centers, 60,000 square feet each, will be established in each district. Trucks will collect recyclables once a week. At the recycling plant, Kenaf paper will be treated with water and chemicals to break it down into fibers. If necessary, new Kenaf fibers will be introduced to the pulp to strengthen the final product. The resulting pulp will be screened to remove contaminants, de-inked by flotation, bleached using environmentally-friendly hydrogen peroxide, and dehydrated to produce recycled paper.

**3.5 Visiting Ship Repairs**

Because of the variability of the visting ships, problems can be foreseen with conducting on site repairs. However, the engineers at Belevistat will be able to easily eradicate the problem of a visiting ships variability by have a special software system in place that allows for the repair robots to recieve the information necessary to conduct repairs on visiting vessels.

This software system will consist of a set of protocalls that ship owners will have to abide by when docking their ship. To be able to dock with Bellevistat, the incoming vessel will have to upload a series of documents with very detailed information concerning the parts, materials, and repair protocols that their ship has. This information will have to be structured and formatted in a certain way so that it can be immediately uploaded to and understood by the stations repair robots. Bellevistat's robots will then interpret this information and immediately begin using it to diagnose and alleviate any problems with the ship.

**4.0 Human Factors and Safety**

**4.1 Community Design**

# Communication In space:

## Internal:

All internal communications will be run on a network within the station that resembles a metropolitan area network (MAN). This is a computer network that is most efficient for use in a large city. A metropolitan area network functions by providing a link between numerous smaller scale networks such as local area networks (LANs - 1 per housing unit) through either physical or wireless connections through the use of data transfer technology. In the case of the space station, a technology that incorporates lasers in a system that somewhat resembles fiber optics will be used.

This system of data transfer will utilize one laser per core of cable that emits short pulses containing 325 separate colors of light. Each individual color will carry its own information and through the use of optical and mathematical techniques such as fast Fourier transformations, this information can be rapidly decoded and reconstructed into usable information. In current test by students under Professor Wolfgang Freude at the Karlsruhe Institute of Technology (KIT) the technology has reached speeds of 26 terabits per second. With minor optimization of the optical technology and techniques, an even more efficient network can be achieved.

This system's utilization of a single core and laser make it simple to transport, easy to install, simple to repair, less likely to fail, and most of all cheap to implement. This optimal speed and usability makes this method of Laser Fiber Optics Data Transmission (LFODT) the most efficient means of connecting both the systems and inhabitants of the station.

As well as this new innovative physical aspect of data, we will be implementing the onboard use of a new Fujitsu Laboratories data transmission protocol. This breakthrough in data transmission has made transport of data much more reliable through significantly decreased latency and packet (information) loss.

### External:

Due to obvious restrictions resulting from the nature of the space station, a wireless network (as opposed to the physical one shown above) must be established between the earth and station to adequately and efficiently connect the inhabitants of the space station to the rest of the world. The metropolitan area network of the space station will be integrated with a "super-server" based on the earth that will act as a proxy which would properly encode, efficiently package, monitor for security threats, and "re-serve" the data through the data transfer protocol previously mentioned that computers on the station would be able to interpret. The most significant challenge associated with this venture would be the connection between the station and the earth server. This would be overcome through the use of multiple satellite uplinks through stations around the world and numerous receiver dishes on the station. To overcome the issues with speed, dedicated supercomputers would be designated at both sides of the transfer to significantly compress and decompress data with the utmost efficiency and speed.

## Education:

Taking into account the fact that our station will be a permanent home for most of our population, we must make considerations for the public and universally available education of the youth of our inhabitants. Seeing as the creation of the space station will be based on the general ideology that seeking knowledge is beneficial for the progression of the human race, we must foster imagination and the will to learn among the students. Because of this, the teaching staff on the station would be put through more rigorous training and vetting than is used on Earth.

| Ages<br>Pre-School | | |
|---|---|---|
| 1-3 | Pre-School | Children are supervised and are taught basic functions. |
| | | |

| | | |
|---|---|---|
| Kindergarten | | |
| 3-4 | Kindergarten – Year 1 | Children are still constantly supervised and are able to experience basic social interactions. They are also taught basic arithmetic and are shown media to foster further interest in academic endeavors. |
| 4-5 | Kindergarten – Year 2 | |
| Primary Education | | |
| 5-6 | Primary – Year 1 | Students return to a more conventional education and are taught all the regular academic subjects. |
| 6-7 | Primary – Year 2 | |
| 7-8 | Primary – Year 3 | |
| 8-9 | Primary – Year 4 | |
| 9-10 | Primary – Year 5 | |
| Secondary Education | | |
| 10-11 | Secondary – Year 1 | Students enter a very rigorous STEM (Science Technology Energy and Mathematics) based education. They are also taught about Earth culture and history as well as station history and government. At this point students are encouraged to utilize the extensive educational and academic resources offered outside of the school. |
| 11-12 | Secondary – Year 2 | |
| 12-13 | Secondary – | |

| | | |
|---|---|---|
| | Year 3 | |
| 13-14 | Secondary – Year 4 | |
| 14-15 | Secondary – Year 5 | |
| 15-16 | Secondary – Year 6 | |
| 16-17 | Secondary – Year 7 | |
| Mid-Education | | |
| 17-18 | Deciding Period | Students are taught conventionally just as they were before; however students are also given an introduction to the fields offered in the higher education organizations and as occupations on the station. |
| Higher Focused Education | | |
| 18 and up | Higher Education | Students have chosen their field of focus and are taught especially for their future occupations. They are also encouraged to utilize the resources outside of their schools to become well-rounded individuals. |

## Governance:

The internal and external affairs regulating the Bellevistat will be supervised by a system of government, to ensure that the settlement does not descend into chaos and is able to successfully maintain functionality.

This government will comprise of a council of seven members, elected by the people. Every permanent resident the age of eighteen and over on board the Bellevistat will be allowed seven votes to elect their choice of Council members, one from each geographic continents on Earth (excluding Antarctica and with two from Asia due to its large population, thus spreading the Council members representing the populations on Earth more evenly). each Council member shall have the opportunity to hold his/her post for a period of two years, after which fresh elections will be carried out to replace the preceding Council as a whole. Each Council member shall be eligible to serve only for a maximum of two terms, after which the individual may/may not choose to return to a previous profession or lifestyle. To be eligible to run for Council, each individual must be at least 35 years of age, and must have at least five years of experience in the sector of public service, whether it be a local government job, supervising the operation of a Non-Profit Organization, or even holding the post of an international diplomat. In addition, each potential council member must not be the founder, owner, or an employee of a private business/ industry while running for Council (and even after being elected for and serving on the Council); in the event of such an occurrence, the individual must resign from his/her present post in order to be eligible for election. The individual running for a Council position must be a permanent resident on the Bellevistat, and must make a pledge upon choosing to run for a position, as well as upon being elected into the Council, to ensure that the candidate wishes to serve the members on board the settlement and supervise their safety without letting any ulterior motives and/or personal ambitions get in the way of logic, reason, and welfare.

In the event of a lack of candidates to represent a certain geographic population/ area/peoples on Earth, the additional number of necessary candidates may be appointed from any of the other regions representing those on Earth, as chosen by a way of five-sevenths majority by the preceding Council. the same procedure shall be followed in the event of the death/serious injury of any of the Council members, with the newly appointed Council inductee serving for the remainder of the said member's term, and still being eligible for a potential two terms after.

The obligation/duty of the Council is essentially the same as any governing body on Earth, namely the welfare of the people under it's jurisdiction. In order to carry out this responsibility, the Council will be provided with a number of powers:

1. The Council shall be given the power to make any laws 'necessary and proper' for the welfare of the people, each bill having to be passed by a case of five-sevenths majority in the Council, but only after a period of five days where the said bill must be reviewed and its consequential benefits/ harms be presented in front of the Council and argued upon. In the case of a bill failing to pass, it is rendered 'dead' and must be reintroduced into the Council in order to be considered. A bill may be introduced by any member of the Council, as well as any permanent resident onboard the Bellevistat who is able to receive the support of over four hundred people for the reviewing of the bill.
2. The Council shall also be in charge of maintaining stable relations with the governments and nations on Earth, to supervise and ensure the continuance of trade, and to allow for any diplomacy which may be required to negotiate agreements or develop a compromise in any necessary situation.
3. The Council will also be placed in charge of the supervision of any industries/businesses/private enterprises to ensure that the said enterprise follows all the rules concerning the operation of the business, payment of taxes, price maximums

and minimums. In case the enterprise fails to comply with the rules, the Council is granted the power to either:

a. Take control of the business and make it a state-run enterprise,

b. Remove the enterprise as legitimate onboard the settlement and replace it with an alternative private cooperative from Earth

4. The Council shall serve as the jury in case of any criminal case/ hearing and shall decide the verdict upon hearing the cases of the prosecution and the defense by simple majority.

In the event that the governing body, namely the Council, overextends its powers to the point of tyranny, and usurps the rights granted to all residents onboard the Bellevistat- the right to life, liberty, and property- the people have the right and duty to replace the Council with one more suitable to govern them. In such a case, if over seven thousand of the settlement's residents express written discontent over the present governance and vouch support for its replacement, the Council will be relieved of it's duties and public elections will be held to choose another, with the members of the overthrown council being made ineligible to ever run for the post again.

**Recreation**

The space station would be split up into a medieval like format, with the city, and most populated area in the middle of the space station with lots of buildings and apartments. This middle part of the station will mimic a real city on earth, with lots of entertainment, like plays, parks, stores, and restaurants. However, the city is also where all the bigger businesses are and where all the visitors usually are greeted first coming onto the station. Next, in a more outer section will be the suburban area, with individual houses, townhouses, and more much space than in the city. In another section, it shows the more intellectual side of people, with schools, museums, laboratories, zoos, hospitals, etc. The rest of the provinces will be for more recreational uses, with each part themed with a different type of location on Earth, as in beach, snowy mountains, rainforest, temperate forest, etc. Also, each part will have each of their own recreational activities. For example, there are mini amusement parks with no gravity and ski slopes that people can ski upside-down. Also, at night, no matter here on the settlement, the skies, or well, space actually will be shown, with a beautiful view of Earth, the moon, and the stars. Overall, each section of space station has their own use, and will serve its purpose day and night.

# Medicine:

The physical and mental well-being of passengers aboard the *Bellevistat* is one of the top priorities, and to that effect a complete system of healthcare will be set up on board. Medical research and drug production will be carried out by private corporations established on Earth, but with regulation from the governing body on the space settlement. All Food and Drug Administration Acts, whether it be mandatory labeling of all products and ingredients, or transparency with the government on modus operandi, will be effective aboard the settlement.

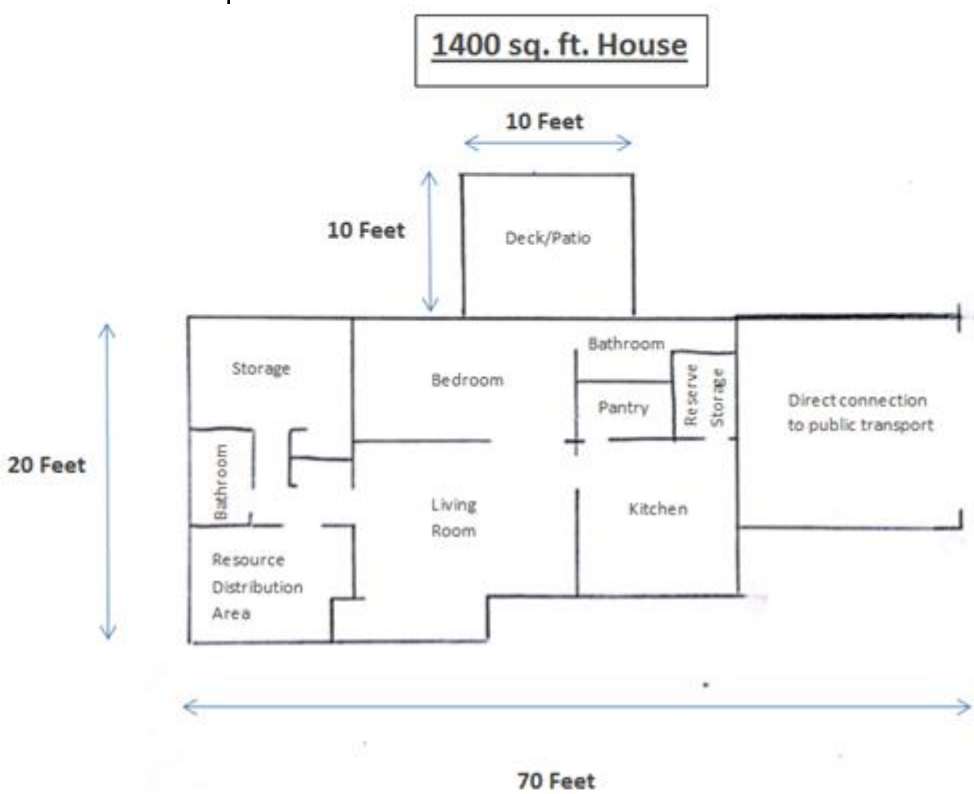
For the 11,000 total people on board, a system of three major hospitals and ten major clinics will be provided, with the doctors and medical staff rotating between clinic duty and hospital work. Each hospital can cater to a 3,000 patients at a time, and houses a staff of 125 doctors, 150 nurses, and 25 medical technicians.The medical staff will be selected from the top hospitals on Earth, and will have to pass a rigorous course testing the abilities of the medical staff to react in high pressure situations,  which would otherwise induce panic, such as a sudden epidemic on board. The course will also reaffirm and serve as a refresher of medical school, lasting for six months and placing doctors and staff in sample situations in areas of their expertise, and measuring their response. The 125 doctors per hospital will be divided as follows: 25 general physicians, 20 general surgeons, 10 specialized cardiac surgeons, 10 specialized neurosurgeons, 20 psychologists, 10 dentists, 15 orthopedic surgeons, 10 ear/nose/throat specialists, and 5 optometrists. The rotation between clinics and hospital will follow a pattern so as to allow 5 physicians, 3 psychologists, 2 ear/nose/throat specialists, and 2 dentists to be at each clinic at any one point of time, with four hour shifts operating for 24 hours every day 7 days a week. The clinics are the second line of defense against disease for relatively minor health problems, while the hospitals serve as the final frontier in the fight against major medical problems. The first barrier against any medical issues, however, are the citizens themselves, and each citizen will be required to learn basic CPR and first aid before they are taken aboard the space settlement, and each household will be provided with a comprehensive first aid kit containing bandages, valium, aspirin, penicillin, a 100cc bottle of pure oxygen, latex-free gloves, ice packs, a surgery scissor, and a pack of thread.

The payment for these medical services will be provided for by the Bellevistat Care Services, a plan operating by way of a monthly deduction amounting to 10 percent of every earning member's income (approximately $600 on average per member for about 6000 working members), and also a payment collected amounting to an equal sum by the employers, in addition to the regularly paid taxes. Also, 20 percent of all additional taxes collected by the governance (approximately $2,500,000) in the settlement will be used to further fund the hospitals/clinics/medical expenses of the citizens aboard.

The hospitals and clinics aboard the *Bellevistat*, however, are not the first barrier of defense against disease and medical emergencies- that responsibility rests on the shoulders of the citizens aboard the space settlement. Each citizen aboard will be trained in basic Cardiopulmonary resuscitation techniques, as well as basic knowledge concerning the use of certain drugs in certain conditions; such as the functions and impacts of aspirin, tylenol, and penicillin on the human body, the specific situations in which they must be employed, and the side effects they can have on the human body.

**4.2 Residential Design**

Each housing module will consist of a series single purpose rooms. The modules will be 1400 square feet, and depending on the resident, the houses can have minor adjustments if their occupant's job or specific needs require it. Some rooms to take note of are the Deck/Patio. This area of the house is unique because it represents an iconic area of the classic Earth home that families can go and enjoy an evening together. On Bellevistat, this room will hold projectors and state of the art climate modules that can be used to simulate almost any environment on Earth. Another area of importance is the Research Distribution Area, or RDA. This area serves as a place where Residential Resource Distributors can deploy resources that have been ordered by the resident such as products, tools, or food. These houses are also very different from regular Earth houses in that they have a direct connection to public transportation. This facilitates ease of access and movement to all parts of the station.




**4.3 Safe Access**
**Spacesuits**

Despite the abundance of the stations repair robots that will surround it at all times and monitor the exterior of the ship, we must keep in mind that spacewalks will be necessary at one point or another.

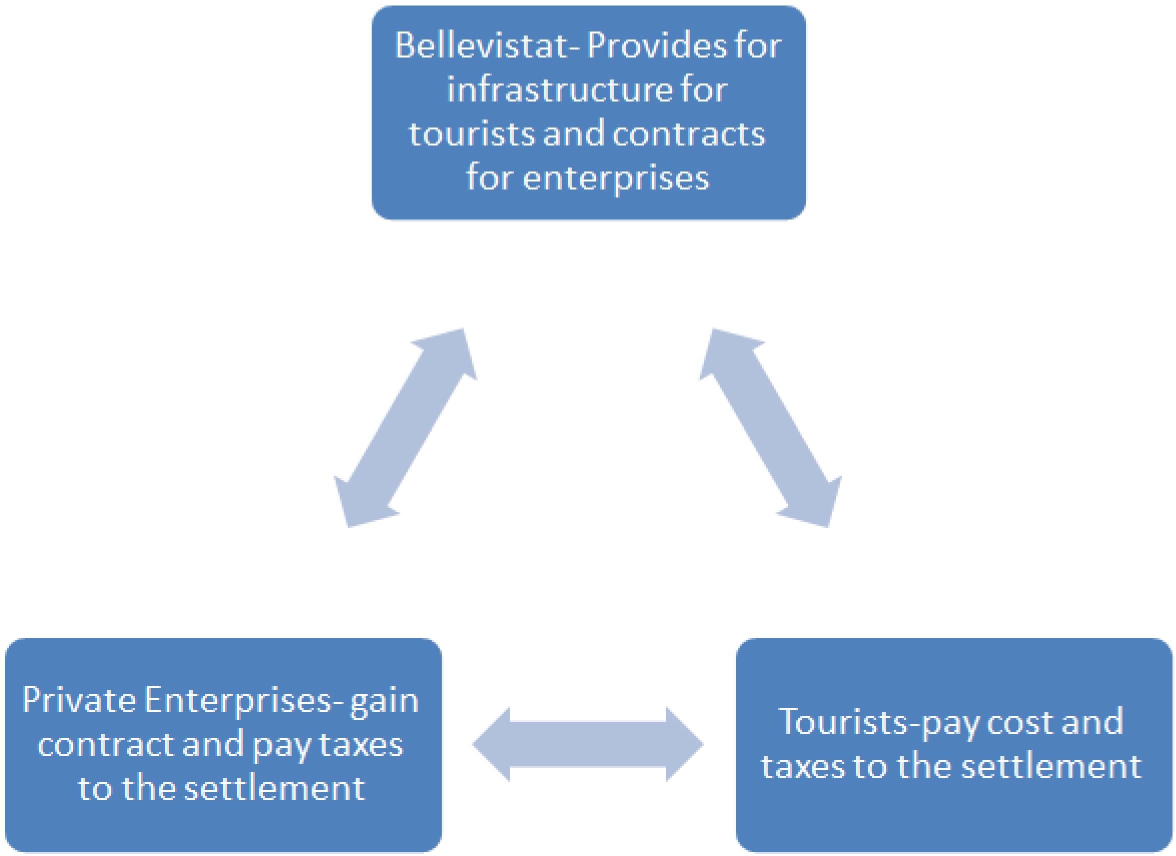
Because of this constant potential for a spacewalk to occur we must always have a state of the art spacesuit available on board for people to be able to use. The first problem that the space suit will have to address is that of pressure. The suits use of rigid components will stop the vacuum from destroying the suit and the and a component of the suits “backpack” will hold the job of keeping 101.3 kpa of pressure within the suit so the astronaut can survive. Another aspect the must be taken care of is range of movment. I previously mentioned that the suits exterior would be made of rigid components, however they would be segmented in a way that allows relatively fluid motion.The suit would also contain a miniature climate module that would regulate temperature, serve as a carbon dioxide scrubber, and provide oxygen to the wearer.

**4.4 and 4.5 corresponding to SOW paragraphs**

Tourism:

The Bellevistat, though primarily a space settlement for the numerous permanent residents, also caters to a number of tourists from earth, no more than five hundred at any one point of time. All tourism will be managed by private enterprises chosen from earth based on the amount of money they contribute and invest in the building of the settlement, as well as based on the enterprises’ environmental footprint, ethical reputation, and past recorded customer service (all of which shall be investigated by the Council before granting any contracts).

The tourism companies chosen will build temporary residences, restaurants, and itineraries to their discretion, to accommodate as many of the viewer attractions on board: including the parks, theatres, ‘city-life’ even in space, and not to mention the breathtaking views of the Earth, Moon, and space as a whole. An additional tax will be paid to the settlement in addition to the tourist enterprises on part of the tourists, in addition to the overall cost of the tours. This tax shall be placed at seven percent of the cost paid by the tourists to the private enterprises, in addition to the income tax paid by each of the private cooperatives to the settlement.




**5.0 Automation Design and Services [computer and robot systems]**

**Automation Design and Services:**
Spaceship repairs are handled by humans, robots, or both. Damages are either external such as outer ship surface, thrusting systems, etc or internal such as building damages. Ship surface damages are most likely caused by meteoroids varying in size, because unlike earth, the spaceship lacks an atmosphere. The lack of atmosphere adds another miniscule damage factor: meteoroid dust. Although small, the damage caused by the dust accumulate and can considerably damage the colony. Repairing the exterior surface of the colony manually will take considerable manpower and energy; therefore the maintenance of the exterior surface of the ship is carried by a set of robots teleoperated by a human operator from inside the space colony. There are two categories of exterior repair robots:

- External Damage Detectors (EDD):
  The EDDs will scan the exterior surface of the space colony every 3 months and

send a report to a central computer that is later reviewed manually. The EDDs are about the size of a cylinder with a radius of 12 inches with a height of 6 inches and are charged wirelessly. They attach to the exterior surface of the colony and scan it for cracks or small damages. The robots use laser scanners to find damages caused by meteoroid dust or even bigger meteoroids. These robots have the ability to move into narrow places such as jet engines. They create a report which is later transferred wirelessly inside the ship to a computer for analysis.

- External Construction Robots (ELR):
  ELRs are robots that carry out the actual repairing of the ship. They can be given orders to carry out tasks or can be teleoperated. ELRs exist in different sizes: the size of a cylinder with a radius of 12 inches with a height of 6 inches and a cylinder with a radius of 24 with a height of 6 inches. Smaller robots carry out smaller tasks such as repairing damage caused by meteoroid dust, or welding existing clefts. While heavier robots are equipped with robotic arms capable of fine tasks. The robotic arms are capable of carrying tasks with excessive precision. Tasks such picking eggs mid air without breaking them or even human surgery are an easy feat for the robotic arms, although they are not meant to carry such tasks.

Internal damages inside the ship are handled manually and automatically. Internal damages are much harder to detect, and can have unlimited possibilities of damages. However, certain type of damages are detected by robots. Damages in water management systems, waste management systems, and power distribution systems that are concealed from the naked eye or somewhat unreachable to a human can be easily noticed by scanning robots and reached by maintenance robots. Like external repairs robots, there are two types of internal repair robots:

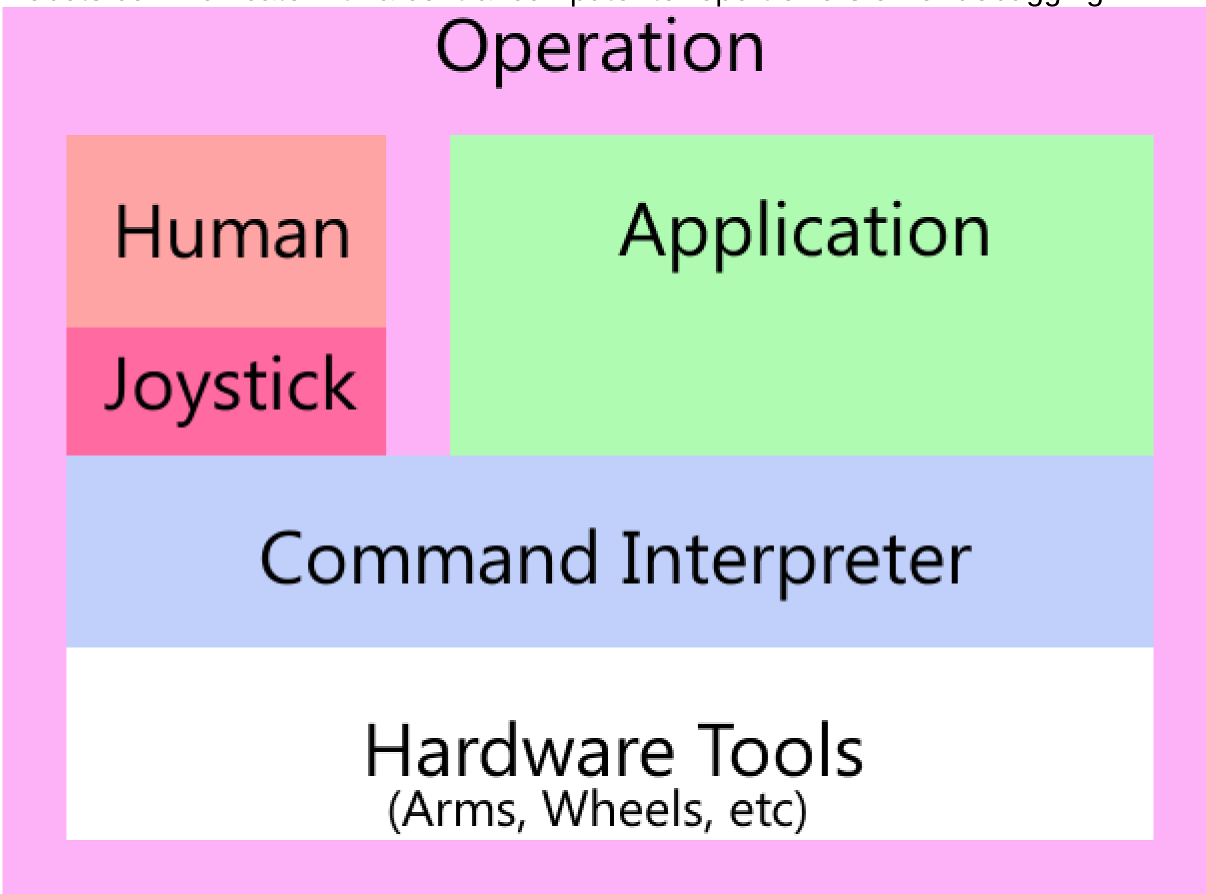
- Internal Damage Detector (IDD):
  IDDs are characterized by their small size and their ability to get into small spaces. They are about the size of a cylinder with a radius of 3 inches and a height of 3 inches. The robots are provided with insect-like legs to achieve mobility in unlikely places. The robots take photographs of locations with likely damages and send them to a human operator for analysis. The can take color, infrared, x-ray, or ultraviolet photographs to detect possible damages. They are also operated manually. These robots have a hardware structure similar to that of a smart phone.
- Internal Labor Robots (ILR):
  There are two types of labor robots, each with their unique task. The first type is the Heavy ILR. The HILRs handle big repair tasks such as ships, buildings, etc. The second type is Light ILR. LILRs are a little bigger than Internal Damage Detectors. The difference in size is for the carrying of material by which actual maintenance takes place. LILRs are also provided with a Carbon Dioxide laser for welding cracks. Both robots are operated manually.

Both external repair robots, External Damage Detectors and External Labor Robots, use the same mobility system to navigate on the surface of the ship. The robots attach to the surface of the space colony and navigate using 3 pairs of wheels. When in teleoperated mode, the ships communicate wirelessly with a computer on the ship which is controlled by a human operator. In autonomous mode, the robots, especially EDDs, communicate together to achieve maximum efficiency and avoid unnecessary collisions between robots. The robots can also cooperate to carry out laborious and arduous tasks such as repairing bigger damages caused by considerable meteoroids or other causes. The robots are made of carbon nanotube to achieve maximum rigidity and minimum density. The outer surface layer of the robot will be covered in a thin layer of graphene for protection when functioning on the outer surface of the ship. Internal repair robots are slightly different from external repair robots. For example, they don't have the outer layer of graphene. They also have a different mobility system. Internal Damage Detectors and Light Internal Labor robots have 3 pairs of insect like feet that enables them to easily attach to surfaces and defy gravitational pull. Heavy Internal Robots operate with 3 pairs of wheels.

When inactive, the robots get into sleep mode. In sleep mode, the robots do not shut down but achieve a state of minimum power usage, which helps the robots recharge much faster. Sleep mode has an advantage over shutting down, for the latter requires the robot more time to start and activate. Robots can get into sleep mode on the spot, without having to dock, as charging is done wirelessly. When finished their task the robots move to their docking position unless ordered not to do so. Robots on the external surface of the ship enter through a special vent. Robots dock when inactive.

The robots are provided with simple software. The software enables complete control of the robot. The software can also provided with applications for certain tasks.

Robots communicate with a central computer to report errors or for debugging.




**5.1 Automation of Construction Processes**
***same person as construction Process and Machinery***
**5.2 Facility Automation**

Space Colony Repairs

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**5.3 Habitability and Community Automation**

| |
|---|
| **Gadgets (refer to Aurora 4.2)** |
| **Law enforcement (like CCTV)** |

**Gadgets (refer to Aurora 4.2)**

Community automation of Bellevistat will rely on the entanglement of its residents with the technological infrastructure of the entire station. To assist with this, multi-purpose chips will be implanted into the residents forearm. Each resident of the station will also be granted a device known as a omni-tool, which will link to the implanted bio-link chip and provide the user with information about their own physical state and position within the station. The omnitool (as implied by its name) will also serve as a universal utility to access all parts of the station and will serve a similar purpose to modern Earth cellular devices.

Both of these devices will create a greater link between the individual and the environment around them. With this enhanced integration with the infrastructure of the station, people will have a more fluid access to communications, news, and overall be more in tune with the daily processes of Bellevistat.

**Law Enforcement:** In order to ensure that all residents aboard the settlement are safe throughout the period of their stay, a system of enforcement will be set up, provided by a tracking chip placed inside the forearm, enabling the tracking of all residents and ensuring that no criminal can remain on the run for long. The chip will also send an alarm in case of serious injury/medical problem of the individual who has the chip within him/her, prompting immediate medical and police responses.

The settlement will also contain ten police stations, each with a police force of 20 robots, chosen based their versatility and responses to pressure situations. Each police-robot will be armed only with non-lethal weapons (as only non-lethal weapons are allowed onboard the settlement), including flash grenades and rubber bullet guns. The police-robots are going to be composed of a strong titanium alloy reinforced with a steel "jacket" to protect against any lethal weapons that may have been smuggled on board. Each robot will also contain a homing device, in order to track any suspects and/or victims. All criminal cases and hearings will be presided over by the Council, who will act as the jury (refer to 4.1 Community Design).

**5.4 Automation of unloading shipments/5.5 Docking System**

**Shipment Unloading**

**Automation of Docking**

**6.0 Schedule and Cost *Needs to be done after everything else is complete***

**6.1 Design and Construction Schedule**

**6.2 Costs**