BELLEVISTA

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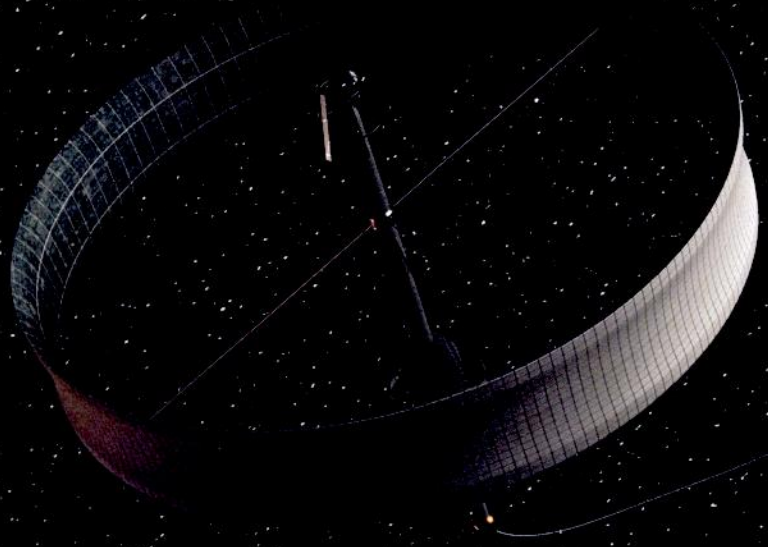

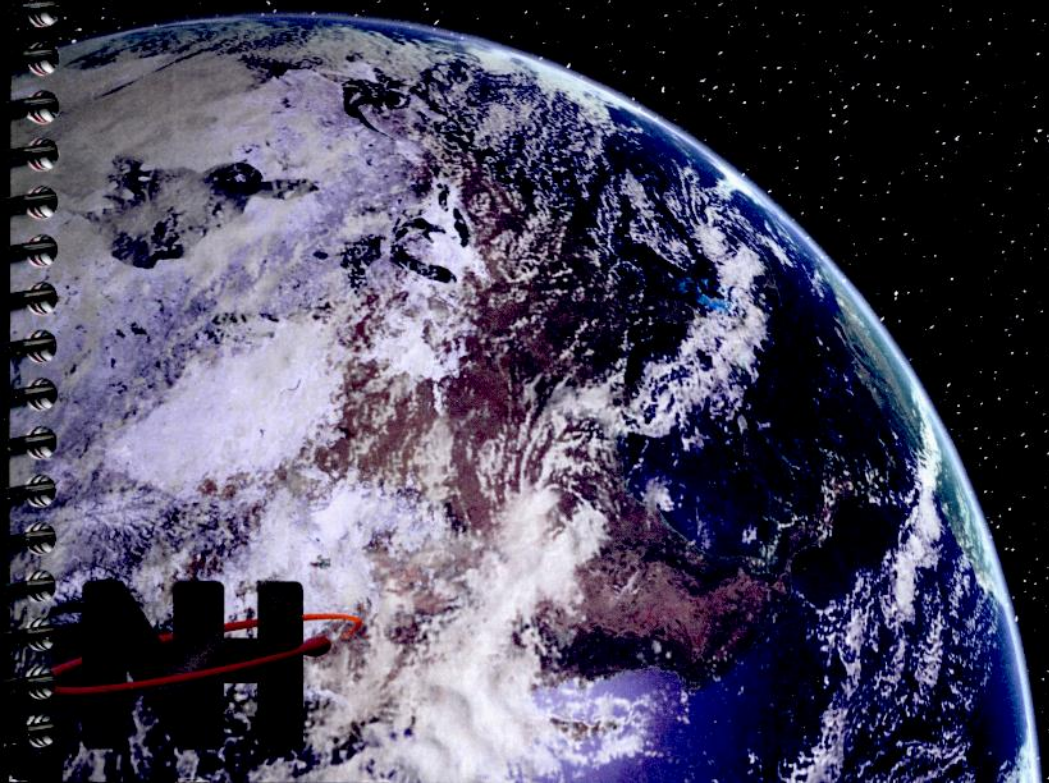

NORTHDONNING
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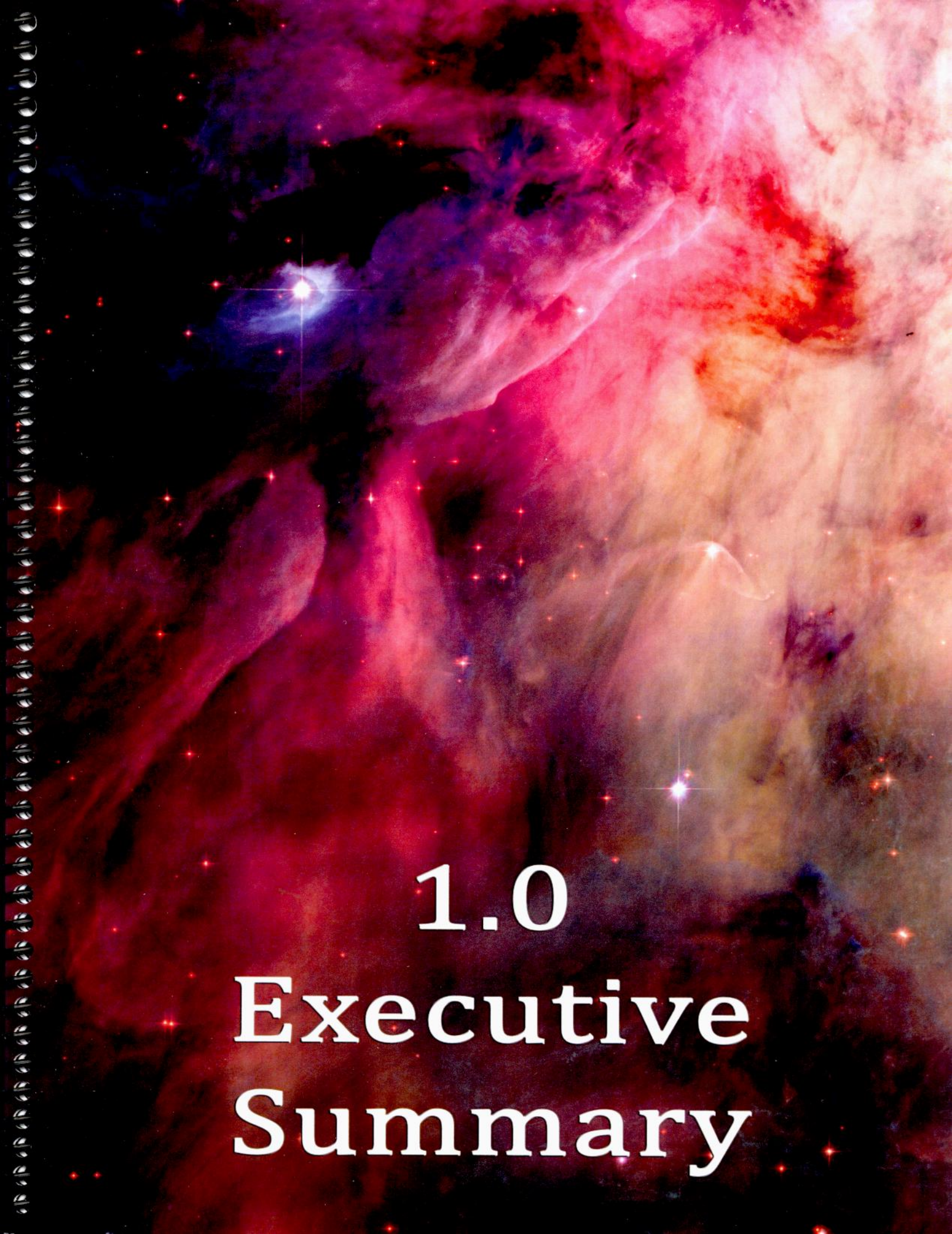
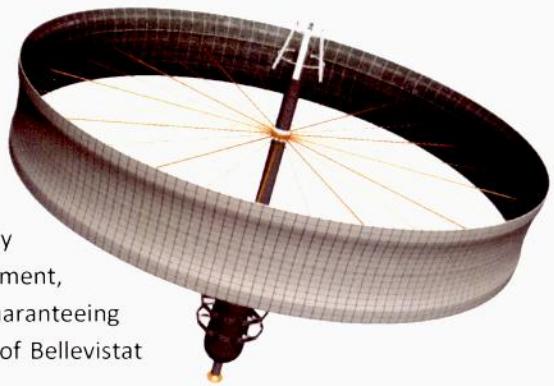

1.0
Executive
Summary

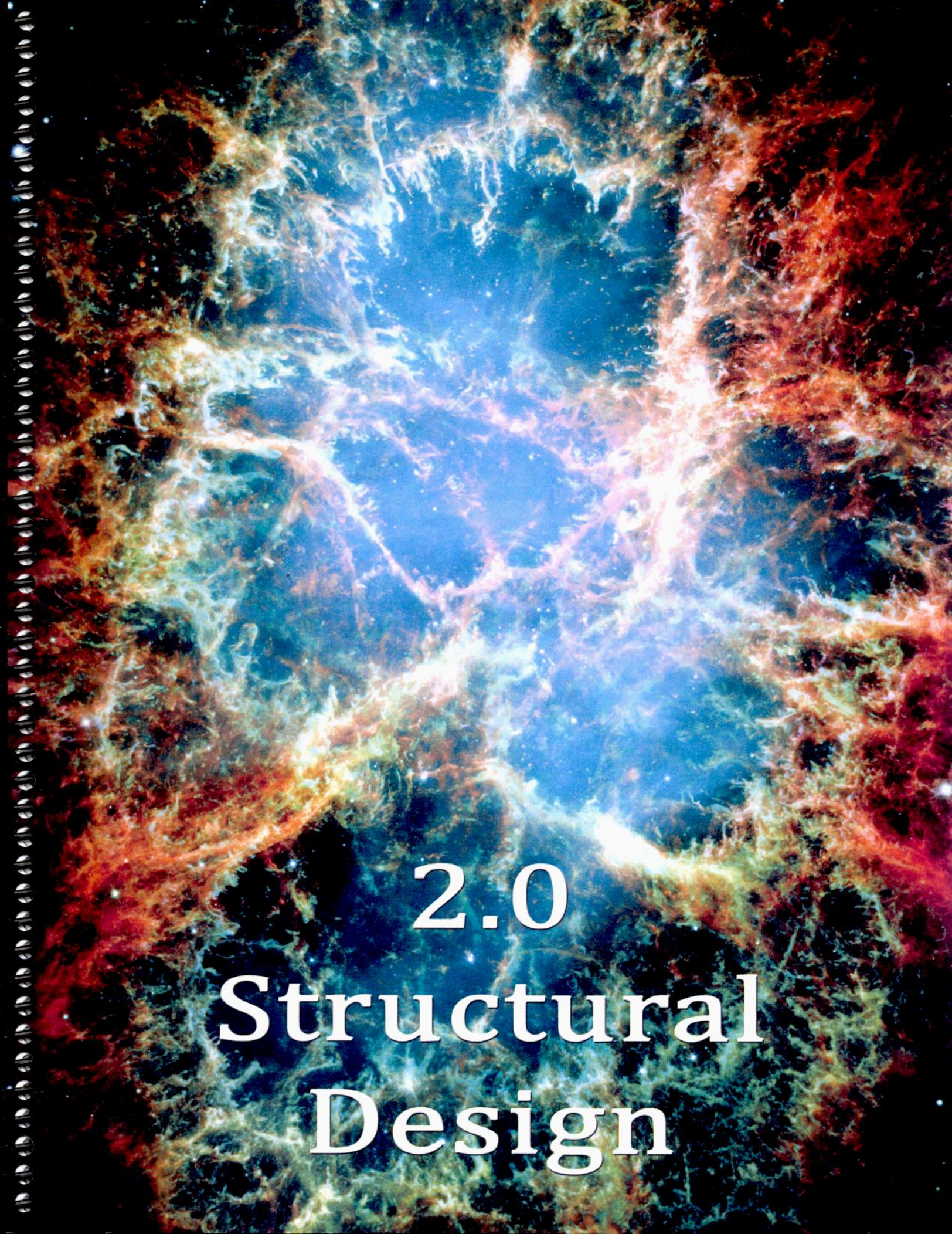
1.0- Executive Summary

We at Northdonning Heedwell in response to The Foundation Society's Request for Proposal, have designed Bellevistat, the perfect balance of luxurious living and economic prosperity. Bellevistat is the next great step towards galactic colonization, providing a foot-hold for all future endeavors in space. The well-designed features of the Bellevistat space settlement provide a platform in which development, prosperity, and profit can all be attained. The powerhouse behind the success of Bellevistat is the multi-functional industrial center that will lead the space based infrastructure for upcoming decades. Although the industrial center is the prominent feature, the settlement also provides its residents with a diverse community unparalleled by any other. To ensure the pristine living environment, Bellevistat's industrial center and residential area are separated, guaranteeing the safety of the thriving community. The unique design features of Bellevistat are a milestone in the development of human inhabitance in space.



- The Residential Ring has adopted a modified torus design with a terraced community layout to provide unobstructed views of space.
- The Manufacturing Center and the Residential Torus are separated to reduce vibrations caused by the mining and refining process.
- A combination of residential and agricultural areas effectively uses all available artificial gravity space.
- Numerous isolated docking facilities ensure the safety of Bellevistat and all surrounding space vehicles.
- A hybrid system of Nuclear Fission and Solar Electricity generate ample uninterrupted energy.
- Distribution of power through electricity, photonics, and pneumatics allows maximum efficiency.
- The use of cultured meat for consumption maximizes space efficiency.
- Simple and reusable materials are utilized for common items throughout the station.
- Fully automated houses eliminate mu+ndane tasks for residents.
- Robots are designed to be multi-purpose eliminating the need for an excessive reserve.
- Manufacturing and mining is fully autonomous eliminating risk of endangering humans.
- Housing designs and locations allow for the choice of urban or rural living.
- Ample entertainment options keep residents living a healthy and active lifestyle.
- Diverse manufacturing facilities allow for the production of numerous products easily and efficiently.
- Unique shipping techniques transport materials from Bellevistat to Alexandriat and Earth in a cost effective manor.
- Large profits generated from the numerous business strategies implemented by Bellevistat, reduces the time for investment return.

These features are among the many innovative designs implemented in the Bellevistat space settlement. By utilizing these innovations to their full extent, Northdonning Heedwell is poised to provide a safe, profitable environment for the Foundation Society. This settlement's proposal has been crafted around ideas that prove to be beneficial and thus make Bellevistat an economic investment for future generations to come. Bellevistat Engineers will look to this design for inspiration, as we move out of our orbit to Mars and beyond. We at Northdonning Heedwell proudly present Bellevistat.



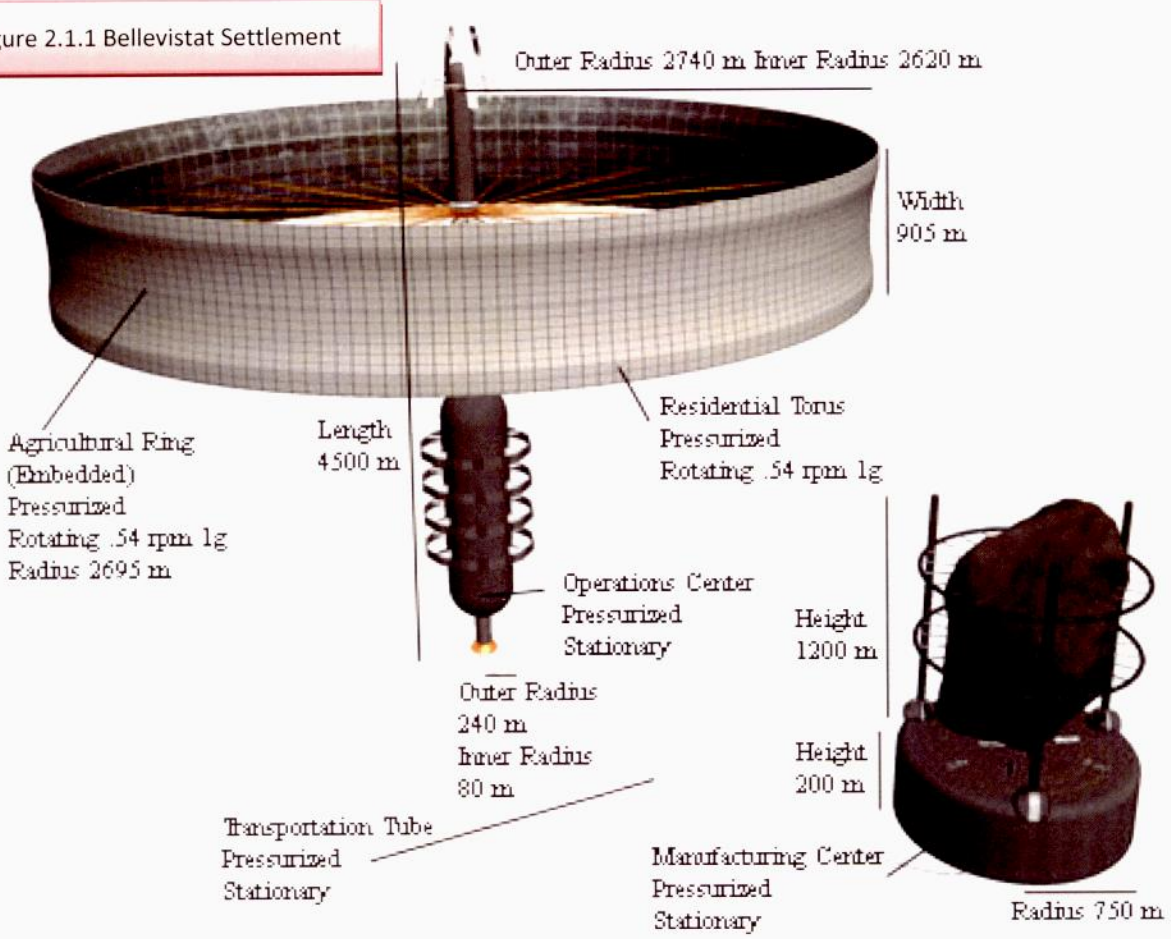
2.0 Structural Design

2.0- Structural Design

The station design for Bellevistat incorporates a unique combination of new and innovative concepts to create a pleasant living and working environment for the inhabitants. Bellevistat's exceptional design addresses all the previous problems discovered in the construction of Alexandriat including a new, safer docking system. The settlement's design also implements a unique terracing system that supplies plentiful views of natural space. The separation of operations into two distinct parts, the Manufacturing Center on the asteroid and the Operations Center on the freestanding station, increases operational efficiency. Overall, the station creates a comfortable, Earth-like home for the residential and transient population of Bellevistat.

2.1 Exterior Design

Figure 2.1.1 Bellevistat Settlement



Bellevistat is designed specifically to provide a safe living environment for all the residents, while creating an efficient and enjoyable working environment. Located in Earth's orbit, the mining settlement Bellevistat is divided up into two main parts: the free standing station and the **Manufacturing Center** (see figure 2.1.1). The freestanding station, which houses all residents, includes the residential, commercial, and agricultural portions of the settlement. These are combined into an indented torus rotating around a main central conduit, called the **Operations Center**. The settlement takes on the shape of an **indented torus** in order to conserve as much space and atmosphere as possible while still maintaining structural stability. The structural stability is maintained due to the unique design of a "**boomerang**" cross section without corners, which can become high-stress points. The

Structure	Function	Shape	Surface area	Volume	Height	Radius
Operations Center	Operations & Infrastructure	Central Conduit Cylinder	1,397,380 m^2	54,286,721 m^3	2700 m	80 m
Operations Center Continued	Operations & Infrastructure	Central Conduit Cylinder	3,076,247 m^2	32,572,032 m^3	1800 m	240 m
Manufacturing Center	Operations & Infrastructure	Cylinder (on Asteroid)	5,419,347 m^2	353,429,174 m^3	200 m	750 m
Transportation Tube	Operations & Infrastructure	Cylindrical Tube	76,812 m^2	565, 487 m^3	800 m	15 m
Residential Torus	Residential	Torus	31,408,968 m^2	867,826,250 m^3	905 m	2740 / 2620 m
Agricultural Ring	Agriculture	Ring Inside Residential Torus	25,823,892 m^2	8,607,964 m^3	10 m	2695 m

Figure 2.1.2 Main Exterior Structure Dimensions

Residential Torus has a large radius of 2740 meters to minimize the Coriolis Effect. The operational infrastructure of the station is divided into two separate components: the Operations Center and the Manufacturing Center. The Manufacturing Center is connected to the asteroid with the primary functions of mining and refining. The Operations Center is where docking facilities, main life support functions and storage are located (see section 3.2).

Dividing the operational infrastructure into two different sections allows all essential life support systems to be in direct contact with the residential and agricultural structure. In addition, it safely separates all heavy machinery and manufacturing, as well as the asteroid, from the free standing station, thus reducing hazards and inconveniences to the residents. Swift transportation between the Manufacturing and Operations Centers is conducted through a flexible transportation tube containing a dual pneumatic rail system that transfers people and materials (See section 2.4 and 3.2.4). Finally, docking on the settlement is divided into three separate docking facilities specifically engineered to eliminate danger to the residents without reducing the efficiency of its processes (See section 2.5).

2.1.2 Construction Materials

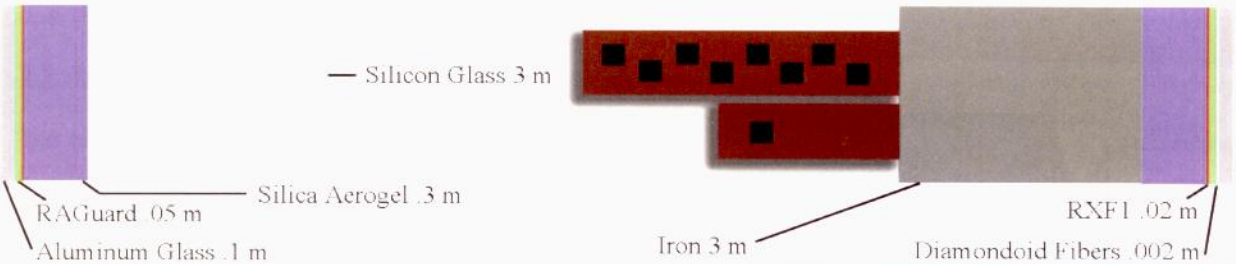


Figure 2.1.3 Construction Materials order

Materials used in construction, are one of the more costly investments for the station. In order to greatly reduce this cost, the majority of the materials are obtained through mining operations on the moon and the captured asteroid. The raw materials that are obtained from these two sources consist of silicon, aluminum, iron, titanium, and carbon (see section 3.1.2). The few remaining materials that cannot be obtained from these two sources are imported from Earth. The mined materials are transported to the manufacturing center where they are refined into the specific composites used for the main hull components. All materials used in the in the hull ceiling are transparent allowing residents veiws of natural space at all times from any position throughout the station.

Material	Function	Thickness
Aluminum Glass	Exterior protection from meteorite penetration.	.1 m
Diamondoid Fibers	Backup support and protection for exterior of the station. Laid out in a super strong mesh layer that is 100 times stronger than steel.	.002 m
RAGuard	Primary radiation protection for the station. Prevents against alpha, beta, gamma, ionic, and neutron radiation. Polarizes for day/night cycles.	.05 m
RXF1	Protects station from radiation specifically solar flares and cosmic rays.	.02 m
Silica Aerogel	Hull insulation that prevents heat escaping from station.	.3 m
Silicon Glass	Main portion of the transparent hull designated for structural integrity.	3 m
Titanium	Lattice structure supports that maintain structural integrity of hull.	.3 m
Iron	Main portion of opaque hull provided for main structural integrity	3 m

Figure 2.1.4 Construction Materials and Function

2.1.3 Artificial Gravity

Artificial gravity is supplied to the residents and agriculture by the **rotation of the Residential Torus**. The settlement is specifically rotated at a rate of **.54 rpm** to create a 1g-environment making reacclimatizing unnecessary for residents and visitors coming from Earth. The Agricultural Ring is held within the Residential Torus creating a **gravitational growth constant** equivalent to Earth's. The presence of terracing on the station (See section 2.2) has a negligible effect on the gravity of the station and only creates an imbalance of .16 m/s^2 between the lowest terrace and the highest. To start the torus's rotation, chemical thrusters are placed around the exterior of the torus that will slowly accelerate the entire structure around the stationary central conduit until the proper rotational velocity is reached. The thrusters will also be used in order to maintain the 1g-environment in the event of any rotational velocity fluctuations. The two operational infrastructure volumes are not supplied with artificial gravity, as gravity is a hindrance to the mining, refining, and storage capabilities of Bellevistat.

Structure	Gravity	Pressurized or non pressurized	Rotations per Minute
Residential Torus	1 g	Pressurized	.54
Agricultural Ring	1g	Pressurized	.54
Operations Center	Zero	Pressurized	N/A
Manufacturing Center	Zero	Pressurized	N/A

Figure 2.1.5 Artificial Gravity supply

2.2 Utilization of Interior Space

2.2.1Residential and Commercial Area

The primary objective on Bellevistat is to provide a safe and pleasant living and working environment for the residents. To accomplish this task, many new and innovative ideas have been incorporated into the interior design. To start off, the residential torus, which makes up the majority of the pressurized internal down area, has a new and unique "**boomerang**" cross-section (see figure 2.2.1). This is done so to optimize the usage of interior space and reduce the waste of unneeded atmosphere. The residential torus encompasses a series of **7 gently sloping terraces**, arranged to form a hill. This beautiful prominence is covered with foliage and greenery to promote a comfortable and soothing

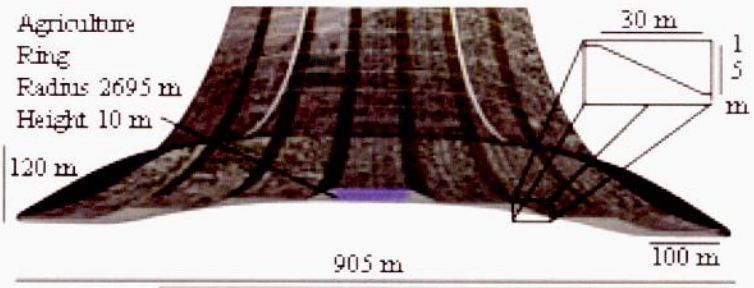
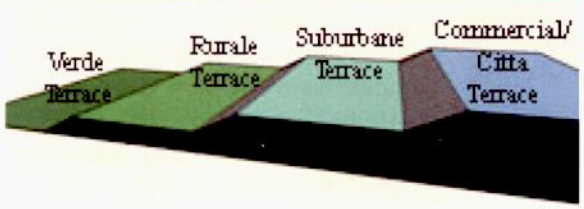


Figure 2.2.1 Cross section of Residential Torus showing Agricultural and Commercial areas

Figure 2.2.2 Cross section of terracing



environment for the residents. Each terrace steadily slopes down to the next, while also being intercepted periodically by verdant pathways. This hill also allows for **optimal uninhibited views of space and Earth** (Figure 2.2.2). The lower outer-most Verde terraces are sparsely populated agricultural areas. Then, slowly progressing up the terraces, the landscape changes from a rural community to a bustling urban/ commercial environment on the center, uppermost Citta terrace. The main commercial area is located on the center terrace. This area includes entertainment venues as well as shops and boutiques for the residents to enjoy (see section 4.0 Human Factors). The residential torus also contains space under the terraces for agriculture, livestock and essential infrastructure. The gravity supplied to the residential torus is 1g, however, the gravitational force in the station varies depending on the terrace. This gravity change is extremely minimal due to the massive radius of the torus and therefore, does not create an inconvenience to the inhabitants (refer to section 2.1 for specific magnitudes).

Figure 2.2.3 Cross-section of Operations Center

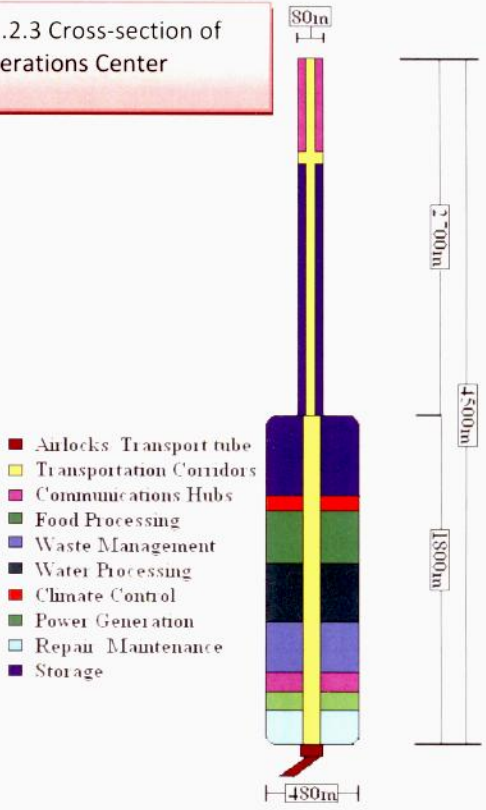
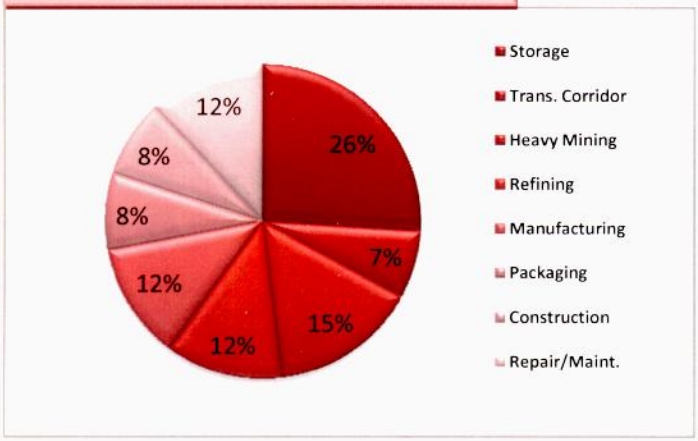


Figure 2.2.4 Operations Center Allocations



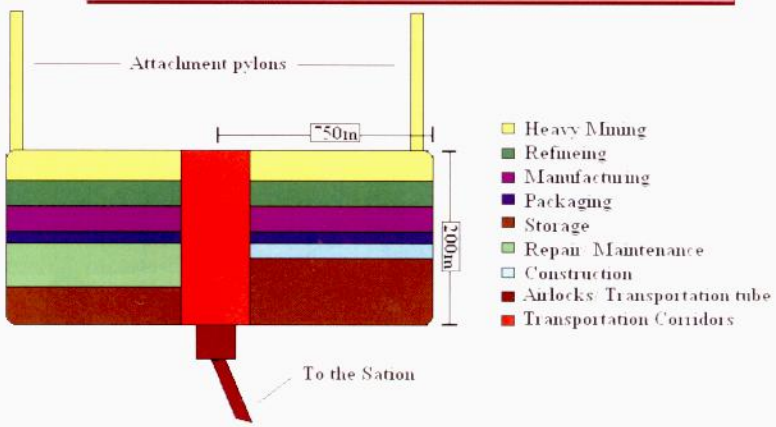
2.2.2 Agriculture

One of the largest concerns when living in space is obtaining a consistent and reliable food supply. Fortunately, Bellevistat's residents will never have to worry about acquiring this vital necessity. Bellevistat's food supply is grown and harvested in the ample space under the residential terraces (see figure 2.2.1). This area incorporates livestock, aero-ponic, and cultured-meat engineering to maximize space, efficiency, and overall yield (see section 3.2). The agricultural space is large enough to produce a steady supply of provisions for the residents in addition to maintaining a surplus for times of crisis. The residents are also able to grow their own fresh vegetables and food supply in their community and personal gardens.

2.2.3Industrial/ Micro-Gravity Areas

Bellevistat's extensive operating requirements call for a large industrial area, thus the station's operations are split into two separate parts: the **Manufacturing Center** and the **Operations Center**. The Manufacturing Center, located on the asteroid away from the main station, contains all of the industrial operations. This is where the heavy mining, refining, and manufacturing

Figure 2.2.5 Cross-section of Manufacturing Center



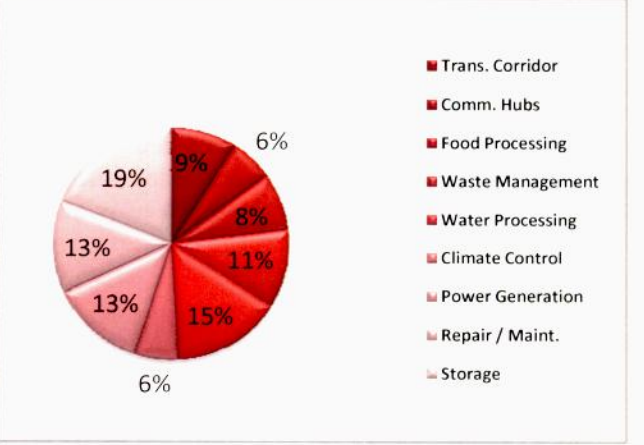
Section	Down Area
Agriculture	$3.4975 \times 10^6 m^2$
Residential	$6.7566 \times 10^6 m^2$
Commercial	$2.1127 \times 10^6 m^2$
Operations	$1.5552 \times 10^7 m^3$

Figure 2.2.6 Table of Down Areas

Operations Center, located within the main station, houses the remainder of the operations/ infrastructure needed to maintain Bellevistat (see figure 2.2.3 and 2.2.5). This is where the life support and other necessary systems are held. To connect the two operation areas together, there is a flexible transportation tube (see section 2.4). The industrial areas and docking are zero gravity to maximize mining operations and transportation capabilities (for docking see section 2.5).

occurs. This is done so to reduce vibrations and other inconveniences to the residents. The Manufacturing Center also supplies plentiful storage and additional docking ports. The

Figure 2.2.7 Manufacturing Center Allocations



2.3 Construction Sequence

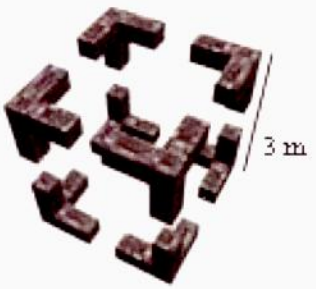


Figure 2.3.1 Phase 1 – DSPS surveys location and construction begins (1 years)

Figure 2.3.2 Phase 2 – Manufacturing Center construction (5 years)

Figure 2.3.3 Phase 3 – Operations Center construction (3 years)

To make such an immense project manageable, Bellevistat is constructed in a series of phases. In the first phase, the **Construction Command Ship** (CCS) is produced by the Alexandriat space settlement and sent for initial construction and assembly. Also during this time, a scout ship departs from Earth to survey the construction site of

Figure 2.3.4 Phase 4 – Docking added (1 year)

Figure 2.3.5 Phase 5 – Residential and Agricultural Torus added (8 years)

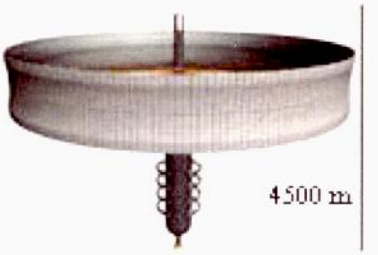


Figure 2.3.6 Phase 6 – Residential Torus pressurized and fully operational (3 years)

the future Bellevistat. This survey ship deploys the **Directional Space Positioning System** (DSPS) thus making the fabrication process as easy and efficient as possible (see section 5.1.1 or Figure 2.3.1) Just before construction begins, automation construction robots arrive along with the CCS to install temporary docking ports and agricultural/ housing areas, supplying food and shelter to the workers. (See section 5.1 for automation construction process). The second phase of construction begins with the assembly of the Manufacturing Center. This is done so to establish infrastructure needed for creating materials that are used later in the construction process (Figure 2.3.2). Once the mining and refining processes have commenced, the third phase, the construction of the Operations Center / central conduit, begins (Figure 2.3.3). A transportation tube is also created at this time to speed up the process of transporting construction materials to the rest of the station. The Operations Center is produced prior to the Residential Torus to provide an anchor for subsequent phases. Next, the docking is added to the Operations Center, which marks the completion of the fourth phase (Figure 2.3.4). In the fifth and largest phase, the Residential/Agricultural Torus is built (Figure 2.3.5). The sixth and final phase of construction consists of pressurization; interior finishing, infrastructure routing, and final system inspections (Figure 2.3.6). Also during the sixth phase, the agricultural processes are established to provide a surplus of provisions for the arrival of Bellevistat's residents. The sixth phase concludes the construction process and Bellevistat becomes fully operational after a mere 21 years.

Section 2.4 Asteroid Incorporation

2.4.1 Attachment to Asteroid

Figure 2.4.1 Manufacturing Center connection to Asteroid

In order to fasten the asteroid to the Manufacturing Center, three long structural towers that span the asteroids length are constructed. Each tower uses numerous pylons to securely link the asteroid to the Manufacturing Center (figure 2.4.1). Once the asteroid is captured and brought to Bellevistat, a system of harnessing attaches the asteroid to the manufacturing center. Three towers 1200m long rotate on a hinge from the base mounted to the manufacturing center (figure 2.3.2). Each tower has a quarter portion of a ring that when combined encircle the asteroid with pylons that drill and imbed themselves deep into the surface of the asteroid to secure it in place. The encircling rings then draw the asteroid toward the manufacturing center, traveling along the towers. Once the attached asteroid is depleted of materials, a replacement can be secured.

To accomplish an efficient mining operation, the transportation between the Operations Center and Manufacturing Center is essential. This system, however, also needs to be safe as it includes human transport. In order to accomplish this, a **flexible tube attached to each structure** is used. The tube is hollow, incorporating a pneumatic tram transport system for the rapid movement of materials and workers from station to the Manufacturing Center (section 3.2.4). The tube has 3 disconnection points. These points will seal off and detach if the force pulling against them reaches a predetermined stress point. The detach points are implemented to prevent elastic tension that could harm and change the rotational axis of the freestanding station. Disconnection points are located at the connection point between the manufacturing center and the operations center, and also in the middle of the tube. In addition to the detachment, both Bellevistat and the asteroid contain thrusters that can change their orbital path. To fasten the tube to the Operations and Manufacturing Centers, clamps from the structure fasten into corresponding indentations in the tube. A

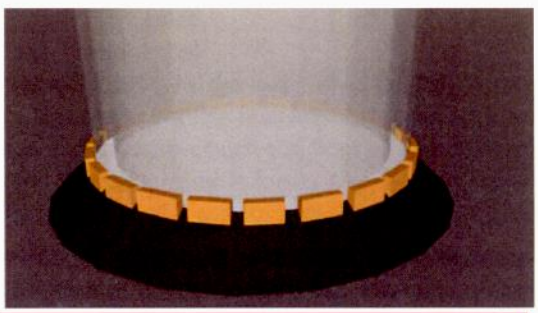


Figure 2.4.2 Clamping System to secure Transportation Tube

seal then slides down over the clamp to fasten them into place (figure 2.4.2). To release, the seal simply slides off of the clamps.

2.4.2 Dust Control

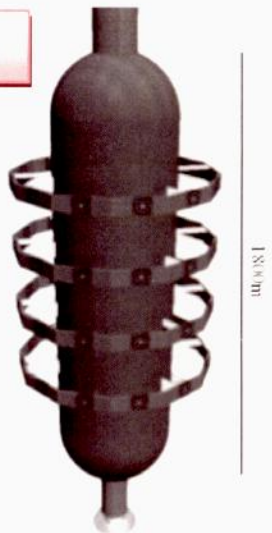
Controlling dust around the Manufacturing Center is key to retaining the functionality of the equipment and the station as a whole. To help stop the dust at the source, **electro-static dust collection bars** will be used to gather dust floating out from the drill heads. These circular bars wrap around the asteroid near the mining heads collecting stray dust. The electro-static charge of the collection bars are both positive and negative to attract the majority of statically charged dust that is created during the mining process. Because the mining process statically charges the dust particles, the use of an electrostatic attraction system most effectively controls the dust factor around Bellevistat. In order to protect the interior of Bellevistat, an airlock system is in place. The **airlock system** incorporates a combination of pressurized air and water to remove dust that may have attached to any persons or objects reentering Bellevistat. The single room airlock involves a three stage cleaning method: 1) Pressurized water cleans the person or object of all dust 2) vacuums drain the airlock of the remaining solvent 3) water is filtered and reintroduced for later use.

2.4.3 Refinement Areas

Bellevistat mines raw materials from the asteroid, which are then transported to designated refinement areas (see section 5.5.1). Initially, the raw materials are collected and refined in the upper levels of the Manufacturing Center (see section 2.2.3). After primary refinement, the processed materials are moved down to the manufacturing levels. This is to allow for easy handling, and to avoid having to transport ore to the station. This also reduces the probability of damage that accidents in manufacturing or refining can cause to Bellevistat.

2.5 Docking

Figure 2.5.1 Primary Docking



2.5.1 Primary Docking Ports

Docking for space vehicles traveling to and from the Bellevistat Space Settlement is provided in three separate areas in order to ensure safety and efficiency. **Primary Docking** for passenger traffic and delivery goods to the settlement is located in the four rings surrounding the Operations Center. The 16 docking airlocks in the Primary Docking are located on the outer side of the rings. Passenger and cargo loading concourses are located inside of the rings and are accessed through transport elevators leading from the Operations Center. The large distance between the docking rings and the Operations Center creates a "buffer zone" in order to avoid damage due to errant navigation. **Backup Docking** is located on the opposite end of the Operations Center as the Primary Docking. This docking structure is an arrangement of six external concourses, distanced from the central conduit in order to ensure maximum safety. This docking area is used mainly for small vehicle traffic but is also capable of supporting full station vehicle traffic in the case of a failure of the Primary Docking system. This area contains twelve docking airlocks. In the event of an evacuation of the station, both the Primary and Backup Docking would be utilized. **Cargo Docking** is located on the opposite side of the manufacturing center as the asteroid/mining functions and provides 30 docking airlocks for cargo vehicles to access the Manufacturing Center. The loading concourses for the Cargo Docking are located on the inside of the Manufacturing Center.

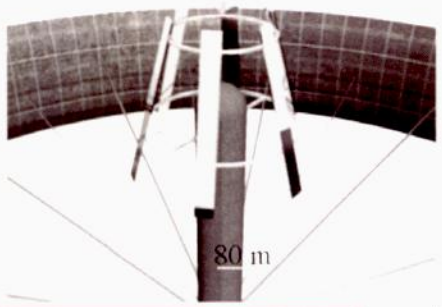
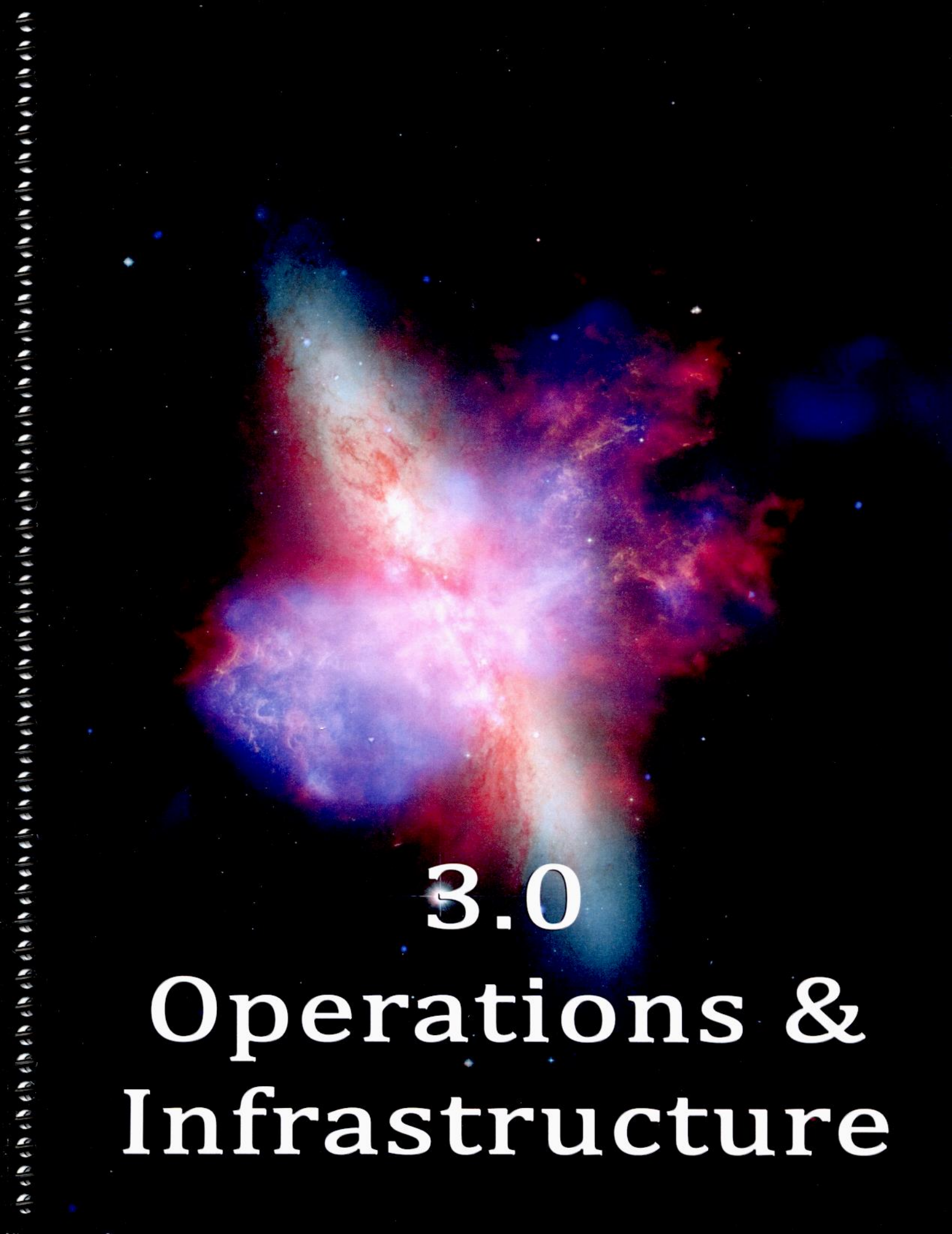


Figure 2.5.3 Backup Docking



3.0 Operations & Infrastructure

3.0- Operations and Infrastructure

Orbiting at more than 350,000 km above the surface of the Earth, Bellevistat is in many ways a better place to live than the blue planet below. Efficiency, advancement, and innovation are the ideals that the station is based upon. Everything from recycling silicon to transporting humans swiftly around the station, Bellevistat has redesigned all aspects of station operations and infrastructure to be not only similar to those on Earth, but far superior. Redundancy and stability are furthermore key aspects of the station, making sure that all foundation members are safe inside the station. Bellevistat is not only a space station, but a marvel of engineering where new inspiring technologies make life simple and enjoyable in the newest frontier.

3.1 Construction Material Sources

3.1.1 Orbital Location

The Bellevistat Space Settlement is located in the **Earth-moon L4 orbit**, putting the station 384,400km from Earth while orbiting 60 degrees ahead of the moon. L4 is a stable orbital location for Bellevistat and the asteroid. This orbit was chosen due to gravitational characteristics that allow the station to orbit along-side the asteroid, and effortlessly correct the course of the station. L4 is in close proximity to the moon and Alexandriat providing convenient accessibility of resources.

3.1.2 Construction Material Sources

Equipment for construction of Bellevistat comes from the nearby space settlement, Alexandriat. Materials and construction equipment imported from Alexandriat are used to begin the construction process and utilized through final completion of the station. All equipment used for the station is stored on the CCS before being built into the station (Figure 3.1.3).

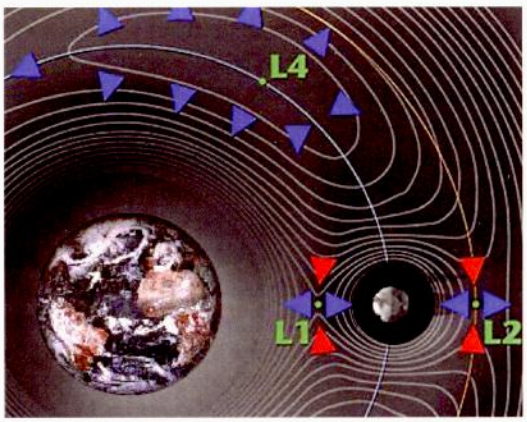


Figure 3.1.1 - Diagram of the Orbital Location of Bellevistat and Nearby Features

Materials for construction of the station are found and taken from three main sources: the moon, the Earh, and the subcontracted asteroid. Located less than 412,000km away from Bellevistat, the moon supplies the majority of resources used in the construction of the station (ex; iron, silicon, and aluminum). The moon also acts as a primary source of water and liquid oxygen. Bellevistat utilizes the On Moon Mining Bases' (OMMB) mass drivers for short-range transportation to the station. The asteroid that is attached to Bellevistat, is the main source silicon and carbon based materials. All materials that are not in immediate use are placed on-board the CCS until mass storage is available in the completed manufacturing center.

Item	Storage Area	Use	Quantity	Transportation
Robots	Manufacturing Area	Primary Construction	3,210	Brought via CCS
Robots	Operations Area	Primary Construction/repair	1,500	Brought via CCS
Iron	Manufacturing Area	Materials for Construction	N\A	OMMB Mass Driver
Aluminum	Manufacturing Area	Materials for Construction	N\A	OMMB Mass Driver
Silicon	Manufacturing Area	Materials for Construction	N\A	OMMB Mass Driver
Carbon	Manufacturing Area	Materials for Construction	N\A	Soft Transportation Tube
Titanium	Manufacturing Area	Materials for Construction	N\A	OMMB Mass Driver

Figure 3.1.2 - Materials and Equipment used in Construction and Storage

3.2 Community Infrastructure

3.2.1 Food Production

The main food source for the station is grown in the Agricultural Ring located beneath the Residential Torus (see section 2.2.2). Inside, crops, animals, and meats are grown for both human and livestock consumption. Crops are produced and grown using an **aeroponic system**, due to its efficient and compact nature. Aeroponics functions by spraying a nutrient-rich liquid onto the plants' exposed roots, therefore providing fast, efficient, and healthy plant growth. Aeroponics is used to produce the crops in a 3-D grid system to maximize space efficiency (Figure 3.2.1). The plants receive light via fiber optic lines designed to substitute natural sunlight. When fully developed, the crops are harvested by the agricultural robots and prepared for consumption (see section 5.3.4).

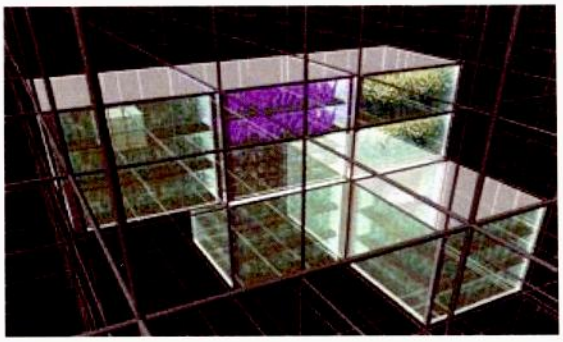


Figure 3.2.1 - 3-D Grid System for Agriculture

Meats are also produced in the Agricultural Ring. The majority of meat on Bellevistat is **cultured** however uncultured meat is also provided. Cultured meat is identical to naturally produced meat, except that it is grown in a laboratory environment rather than taken from a live animal. Cultured meat begins the growth process with stem cells and is then given bacteria. At this point the cells multiply to build Myrofibers, fibers of artificial meat, and grow until the desired amount of meat is produced. The Myrofibers are then harvested, producing cultured meat (Figure 3.2.2). Because it is not off a live animal, cultured meat can be grown in any shape and size, while not requiring the slaughtering of livestock. Cultured meat is space efficient, clean, quick to harvest, and cost effective. To satisfy residents who do not desire cultured meat, a small portion of the meat on the station is uncultured, and harvested from livestock. Fowl, rabbits, and a variety of marine life are raised in the agricultural area and offered to residents as an alternative to cultured products

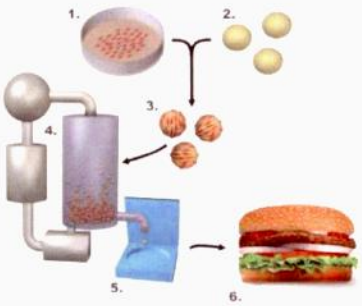


Figure 3.2.2 - Process Of Creating Cultured Meat

Once meats and crops have grown to full potential, they are robotically harvested and prepared for consumption. Uncooked food is then robotically refined and packaged in the operations center. Once the food has been packaged and cleared for human consumption, it is stored in the operations center until needed. Each day 42,000kg of food is produced to feed both full time and transient population. The Operations Center holds enough excess food for 28 days in case of emergency.

Food is delivered to residents by a rapid delivery system allowing residents to order meals from the comfort of their homes. Residents receive the packaged food in their own kitchen via a pneumatic delivery system, similar to that of a bank drive-through (Figure 3.2.3). The delivery system uses a series of pressurized tubes distributed throughout the station and installed into each residential kitchen. Food is ordered through the WatchComms, initiating food transportation from the operations center to the hungry resident. Upon arriving at the resident's house the packaged food is prepared and cooked as necessary through the automated food preparation device (See section 5.3.1).

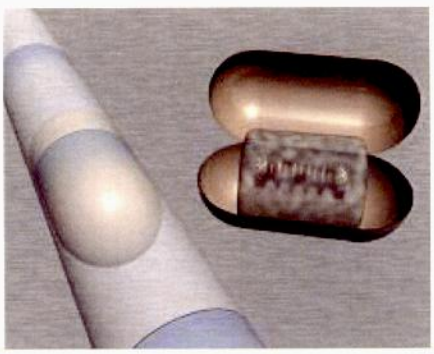


Figure 3.2.3 - Food Distribution Capsule

3.2.2 Power Generation and Distribution

Centered on mining and manufacturing, Bellevistat requires a large quantity of energy. This massive amount of energy is produced both by **nuclear fission** of **plutonium** and by **solar sheet technology** (Figure 3.2.4). Two nuclear reactors, one in both the Manufacturing and Operations

Center, are used for their capability to supply mass amounts of reliable power to these structures, while solar sheets supply power to the Residential Torus. Solar sheets efficiently supply photonic and electrical power for artificial light for crops and residents. Together the nuclear and solar power sources provide Bellevistat with 3.2 Giga-watts of power while only requiring 1.8 Giga-watts, leaving plenty of power left over for excess manufacturing or emergencies.

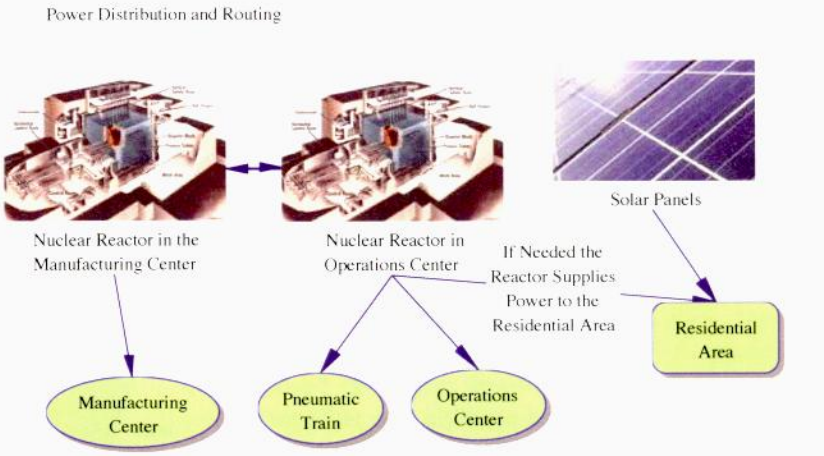


Figure 3.2.4 of Power Distribution

Power is distributed by **pneumatics**, **photonics**, and **electricity**. Pneumatics is used in moving equipment and powering mining in the Operations and Manufacturing Centers. Pneumatics is also capable of converting to hydraulic power when required. Electricity is used in the Residential Torus to power devices requiring mechanical energy. Photonics is used for computing, heating, and generating light throughout the entire station due to its fast, cost effective, reliable and efficient nature.

For redundancy and safety purposes the two nuclear reactors act as potential backups in case of an emergency. In the event that one reactor shuts down or is incapable of providing enough power, the other initiates to aid in the generation of power. The two reactors are connected with power lines, which run through the transportation tube. Power lines are also run to the Residential Torus preventing loss of power in the event that the solar sheets fail.

3.2.3 Communications

Communications throughout Bellevistat, to Earth and other stations are quick and efficient through the use of communication terminals, photonics, WatchComms and UV rays. Internal communications of Bellevistat utilize photonics, which is much faster and more efficient than traditional electronics. Residents use communication terminals which are placed throughout the station for contacting other residents, communication terminals, and Earth. For terminal-to-terminal communications, fiber optic cables are used to transport information. Residents also have personal devices called WatchComms (See section 5.3) that are used to communicate with the terminals and other WatchComms within the station. Communication to the masses on Bellevistat is achieved by a station wide intercom system. The system can broadcast over the entirety of the station, but can also be confined to smaller sections. For external communications, such as to Earth and other stations, Bellevistat uses microwaves, which can travel extreme distances and are a solid, trusted communication medium.

3.2.4 Internal Transportation

Transportation on Bellevistat allows for residents to quickly travel around the station (Figure 3.2.5). The main public transportation consists of 16 fast and efficient pneumatic powered monorail trains that run all the way around the Residential Torus. There are two monorails, each having 8 trains. The two monorails are set onto the second terrace,

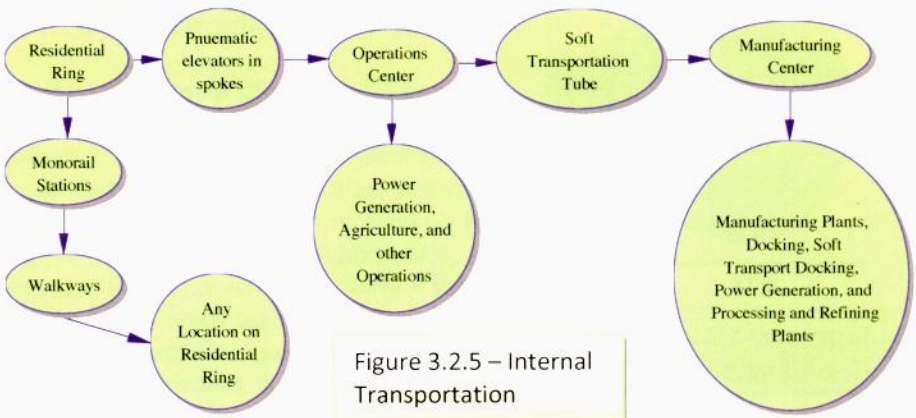


Figure 3.2.5 – Internal Transportation

one to each side of the Citta terrace, allowing for easy access to anywhere on the station. These trains stop at 16 evenly spaced stops around the station, allowing for one stop every 1.076 km. These 16 stops along with the 8 trains make it so that a train arrives at every station every two minutes, assuring minimal wait time. The monorails are set in a tunnel that is surrounded by a water tank filled with various forms of marine life for both aesthetic purposes and human consumption (Figure 3.2.6). The tunnel also masks the rushing monorail trains from those nearby as to not disrupt their daily activity. Each train has 4 cars on it each holding 150 people. This allows for 9,600 people to be on the rails at any given time. The trains rotate at 180km/h (.165rpm) in the opposite direction as the station, making it possible to reach the polar opposite of the station in under 7 minutes while still keeping 1/2 g on residents in transit.

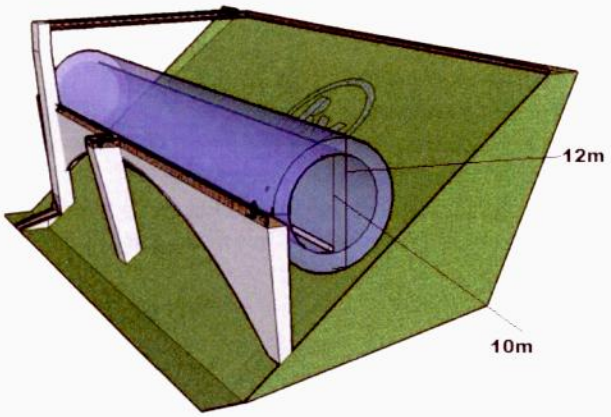


Figure 3.2.6 of Monorail Tunnel

If a resident does not wish to take the monorail there are a multitude of walkways on the station. These walkways are made of cement-like material composed of tailings from mining operations and held together with a silicate-based glue.

Transportation between terraces is accomplished via a combination of escalators, stairs, and funiculars placed around the station. Funiculars are a pair of pneumatically driven trams that travel diagonally along the slopes between terraces and carry both residents and cargo. As one tram ascends the rail, the other descends to counterbalance it. Funiculars, placed at every monorail stop, provide transit between each terrace. Stairs and escalators also provide transportation between terraces and are located at every block and every monorail stop.

Transportation from the residential ring to the central conduit takes place through the spokes that hold the ring in place. Two large pneumatic elevators in each spoke allow for both humans and goods to be transported back and forth. Elevator cars travel at different speeds based on cargo, traveling slowly with humans and faster with less gravity sensitive objects. While the elevators are in motion, goods and humans are held in place by seat belts and straps so they do not move about while in transit. Once in the central conduit, goods and humans are moved about via pneumatically powered multi-directional elevators. These transport cargo or human travelers to all the main points in the central conduit including the water and air refinery, power generators, places of manufacturing, and areas of food storage/processing. Transportation in the storage areas of the central conduit is achieved via a moving platform with x, y, and z-axis, giving the user complete movement to any place in the large storage area.

Transportation between the Manufacturing Center on the asteroid and the Operations Center on the station is provided by two cylinder-like trams that run in opposite directions through opposite halves of the **Soft Transportation Tube** (see section 2.4.1). Each tram is designed primarily for movement of cargo with minimal area for human transportation due to the small number of humans interacting directly with the Manufacturing Center (Figure 3.2.7).

Trams (Figure 3.2.8) are moved through the soft Transportation Tube via pneumatic pressure on either side of the tram. As one tram moves towards the Manufacturing Center, the air is pumped out from in front of it, creating a low-pressure zone and pulling the tram along the tube. The air that is pumped out is then pumped in behind the other tram, headed towards the Operations Center, creating a high-pressure behind it, and pushing it along the tube. This happens on both sides, so as each car is moving, it has a high-pressure and low-pressure area to move it through the tube quickly and efficiently. When the trams reach their respective places at opposite ends, the pumps are simply reversed and air is pumped the opposite way, pushing the multi-directional tram back the other direction.

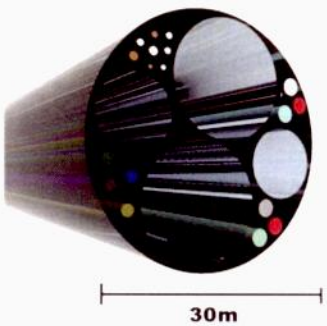


Figure 3.2.7 Cutaway of Transportation Tube

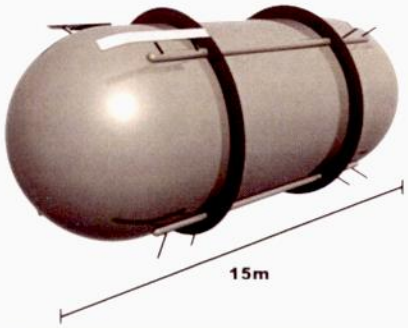


Figure 3.2.8 - Tram for Soft Transportation Tube

Sealant rings surround each tram on the front and back to ensure no leaks in pressure occur. These seals are on a pneumatic pressure system so that they can easily expand and contract to match the form of the Soft Transportation Tube. For example, when the tram comes to a small bend in the tube, as it passes through the rings will automatically expand and contract to fit the tube. This way, no pressure is lost and the trams can travel through small bends that may occur. This system makes transportation between the free floating station and the Manufacturing Center not only safe and reliable, but also very efficient.

3.2.5 Climate

Bellevistat's climate is similar to that of Earth, so that residents feel both at home and comfortable. The "outside" temperature is 22° C and humidity is 35%, but individual residents can adjust these within their own homes to their own preference. The atmospheric composition is that of Earth: 70% nitrogen, 28% oxygen, 1% argon, and 1% other. Atmospheric composition will not change because no foreign gases will be released into the station. Bellevistat has an atmospheric pressure of 101,000 pascals, the pressure at around 200 meters Earth elevation.

3.2.6 Solid Waste Management

Bellevistat is a very efficient station in the sense of its recycling systems for waste. All household waste is silicon based, and is therefore melted down and sent back to the operations area for refinement and then recycled back into the 3-D silicon replicators, creating very minimal waste. Organic material is disposed of via compost and aeroponics for agriculture. Human and animal waste is recycled back into the aeroponic system (Figure 3.2.9). To dispose of hazardous industrial waste, such as radioactive materials, Bellevistat propels it into the sun in secure rockets. Tailings from mining operations are disposed of by dumping them into lunar faults, jettisoning them into space, finely grinding them for furniture purposes, or mixing them with silicate based glues to make pathways on the station.

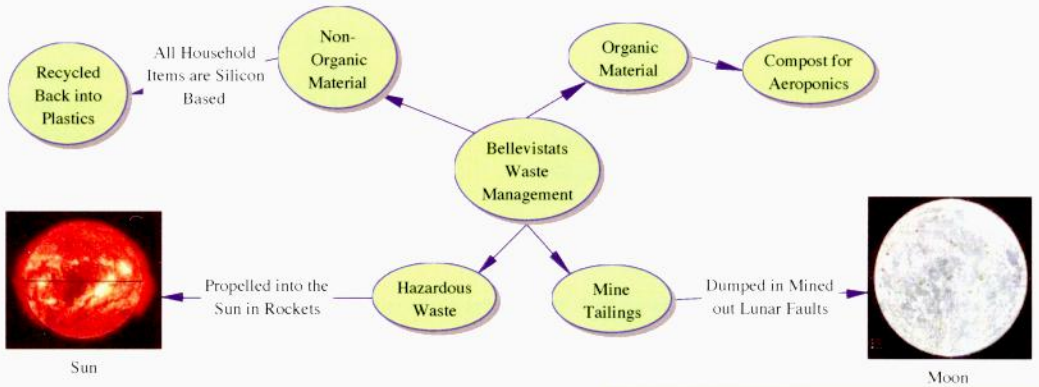


Figure 3.2.9 – Waste Management

3.2.7 Water Management

Water reaches all the residents on the station through a sanitary system. Water is distributed to residents through traditional pipelines. Once a resident uses the water it proceeds into the retrieval pipeline, and is sent to the water purification plant in the central conduit. There, water is sent through a large-scale filtration system to remove unwanted particles and suspended solids. The water is then sent through a reverse osmosis chamber to restore mineral balance and make sure that no unwanted chemicals are left. Finally, the water passes through a UV filter as it runs back into the piping system. Iron, alkaline chemicals, and other vitamins and minerals are added to the water as it passes through the residents tap (Figure 3.2.10). Water is stored in the Operations Center, and a 28-day water reserve is also kept in any event of contamination. This reserve is cycled every six days to prevent bacterial growth.

3.2.8 Day/Night Cycles

Day and night on Bellevistat are very similar to that on Earth. Light shines down upon the residents for 14 hours of the "day" followed by 10 hours of dark. Light is supplied in the form of natural sunlight through the windows or by fiber optics. To block out natural sunlight during "night" hours, an electric current is run through the RA Guard in the hull, darkening the windows, while solar panels slide across to make use of extra space for power generation.

3.2.9 Export movements

All materials that are mined, refined, and manufactured are available to other stations and Earth. Materials and equipment that are exported to Alexandriat are transported by means of cargo vehicles, while transportation to Earth is done with the re-entry vehicle (see section 3.3.2 and 7.1.3). The cargo vehicles that export to Alexandriat are loaded and unloaded in the docking facilities on the Manufacturing Center. The re-entry vehicles are loaded on the
Manufacturing Center and propelled toward Earth by the Magnetic Propulsion System (MPS). Import vehicles dock in the Manufacturing Center (see section 2.5) so as not to disrupt tourist docking in the Primary Docking Facility.

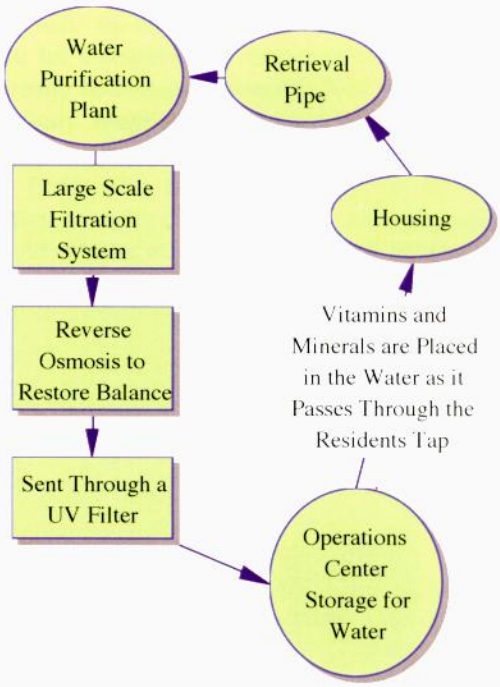


Figure 3.2.10 – Water Distribution

3.3 Space Infrastructure and Vehicles

3.3.1-Space Infrastructure

Bellevistat is the main processing and refining facility within the Earth orbit. Inside the Manufacturing Center ore is mined and refined. There is also a micro-g heavy manufacturing plant located within the Operations Center that produces equipment, new vehicles, and parts for repairs (see section 2.2.2). Satellites are located in Earth orbit and constantly monitor around the station for incoming projectiles and other such hazards. Vehicles are loaded, unloaded, and fueled in one of the three docking facilities on the station. For redundancy, in case of an emergency, there is also a backup docking facility. In the rare event of a collision of vehicles within one docking station, the other docking facilities can be utilized. Vehicles have designated routes to follow to avoid such collisions (see section 3.3.4). If needed, vehicles are brought into the docking centers for repairs and maintenance (see section 2.5).

3.3.2-Vehicles

Vehicles manufactured on Bellevistat are built with new, efficient, and cost-effective engines that transport humans and cargo to Alexandriat and Earth quickly. **Liquid Hydrogen** (LH2) and **Liquid Oxygen** (LOX) fuel the vehicles on Bellevistat. Compared to petroleum propellants, these two liquids combined create a very efficient and cheap fuel source for vehicles. Water is separated using electrolysis to create LH2 and LOX. Bellevistat obtains its water for fuels from the moon and Earth. The station is also currently researching cheaper and easier ways of obtaining water.

All of the following space vehicles (Figure 3.3.1) are manufactured and assembled on Bellevistat in the Operations Center. Many of these vehicles are produced for transportation of equipment from either Bellevistat en route to Earth or Bellevistat to Alexandriat. All vehicles are fully robotic. The Bellevistat station does not need to produce many cargo vehicles. Bellevistat utilizes Alexandriat's cargo fleet when needed and doesn't need to produce any more than the ten vehicles manufactured specifically for the stations use. Human transport vehicles allow humans to return to Earth or go to Alexandriat. These vehicles are supplied with food and personal belongings to make the

trip quick, easy, and as painless as possible. At all times there are at least 36 human transport vehicles on the station for emergency evacuations. Cargo vehicles are also available for evacuation as they can hold massive amounts of weight. Bellevistat utilizes these vehicles and has them ready to transport people off of the station immediately. The evacuation of the station takes approximately 2.5 hours. **Magnetic Propulsion Systems** (MPS) are used to transport materials to Earth with very little time and expense. These systems use giant magnets to propel one-way, disposable re-entry vehicles from Bellevistat to Earth. The MPS' are positioned on the Manufacturing Center and directed towards Earth. The re-entry vehicles, carrying cargo, are disposable one-way crafts that are propelled by the MPS towards Earth (see section 7.1.3). All vehicles made within the contract can be created outside of the original contract whenever requested.

Vehicle	Purpose	Fleet size	Flight Schedules	Minimum Requirement	Payload Size	Turnaround Time
Cargo Vehicle	Transports refined materials to Alexandriat and other stations	10	1 flight per week	In contract but can be created separately	10 passengers 31500kg of cargo	**2 days (1 to unload old cargo and 1 to load new cargo) leaving when ready**
Transport Vehicle	Transports people from Earth to the station and back.	60	10 flights per year to Earth and other stations.	In contract but can be created separately	500 passengers 10000kg of cargo	**1 hour to load and unload yet 2 days before departing**
Magnetic Propulsion System (MPS)	Propels re-entry vehicle to Earth.	2	N/A	In contract but can be created separately	N/A	**N/A**
Re-Entry Vehicles	**Transports finished materials to Earth**	**N/A**	**Whenever necessary**	**In contract**	**$202m^3$**	**N/A**

Figure 3.3.1 – Vehicle Chart

3.3.3 -Vehicle Designs

The human transport vehicle uses its innovative new design to encourage passengers to travel to Bellevistat (Figure 3.3.2). The cargo transport is a larger vehicle designed specifically for station to station transport (Figure 3.3.3). The re-entry vehicle looks similar to a rocket without fins. It has propellers that spring out and spin to slow down for landing (see section 7.1.3). All of the vehicles on Bellevistat are fully autonomous which eliminates the chances of human error.

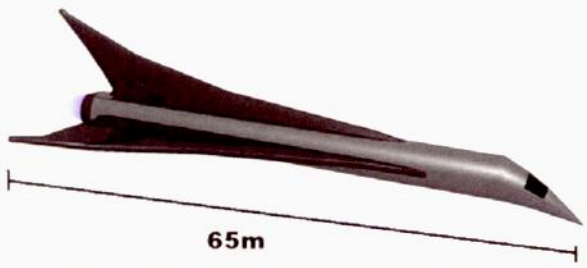


Figure 3.3.2 Human Transport Vehicle

3.3.4 -Transportation Vehicles And Rights-of-way

The human transportation vehicles transport humans and their personal cargo to Earth (see 3.3.2). Right-of-ways around the station are designed to keep vehicles at least 200 meters away from other vehicles except during docking procedures. When a vehicle comes within 200 meters of any object, it is stopped and redirected. All vehicles are run by a constant monitoring system that directs the vehicles where to go and the speed at which to travel. Cargo vehicles have the right-of-way over the

smaller human transport vehicles. If a vehicle has troubles or is in one place for too long then the normal rights-of-way will be momentarily changed. In times of emergency all vehicles are utilized to evacuate humans from the station.

3.3.5-Outside of Contract

The Operations Center contains factories to create new vehicles, parts to repair vehicles, new communications satellites, and any parts needed for the assembly of new stations or for the repair of existing stations. New infrastructure can be made at any time for any purpose. Factories located in the Operations Center create equipment outside of the original contract by request from other companies.

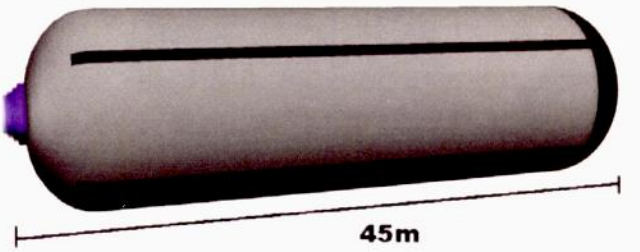


Figure 3.3.3 Cargo Vehicle

3.4 Agricultural Diversity

In order to help feed the residents on the station while making Bellevistat a comfortable and beautiful place to live, crops and plant life are not restricted to the Agriculture Ring. Growing of crops also takes place in the Residential Torus in both rural and urban areas. A multitude of small fields that produce wheat, barley, corn, and other such crops, are grown in the lower terraces of the station. In commercial areas towards the center of the station, trees and smaller vegetation occupy the open spaces alongside buildings. The plants grown in the Residential Torus are given nutrients via aeroponic systems to cut down on the maintenance costs of the plants and allow for nutrient rich growing. As they develop, crops are available to be picked by residents or the residential agricultural robot (see section 5.3.4)

Figure 3.4.1 Plants in the Urban Area

Although some agriculture is grown in the Residential torus, (figure 3.4.1) the majority of the crops are grown in the Agricultural Ring. Though minimal due to cultured meats, livestock and livestock feed is all grown in a separate section of the Agricultural Ring, away from the food being produced for human consumption.

Agriculture Diversity	Quantity grown in Agricultural Ring	Quantity grown in Residential Communities	Harvested by:	Nourished by:
Field Crops Ex. Wheat, barley	95%	5%	Residents or Agriculture Robots	Aeroponics
Orchard Crops Ex. Apples, oranges	80%	20%	Residents or Agriculture Robots	Aeroponics
Livestock Feed	100%	N/A	Agriculture Robots	Aeroponics

Figure 3.4.2 Table of Food Distribution around Station

3.5 New Materials

Many innovative materials allow for new types of furniture, kitchen materials, plumbing/utility lines, and other every day necessities (Figure 3.5.1) Furniture and simple every day necessities are made from silicon, and created in a silicon replicator. This allows for residents to design and create their ideal furniture to match their home, and

to make any every day necessity that they may need. Plumbing and utility lines are made from silicon as well, providing a light, yet very durable piping system.

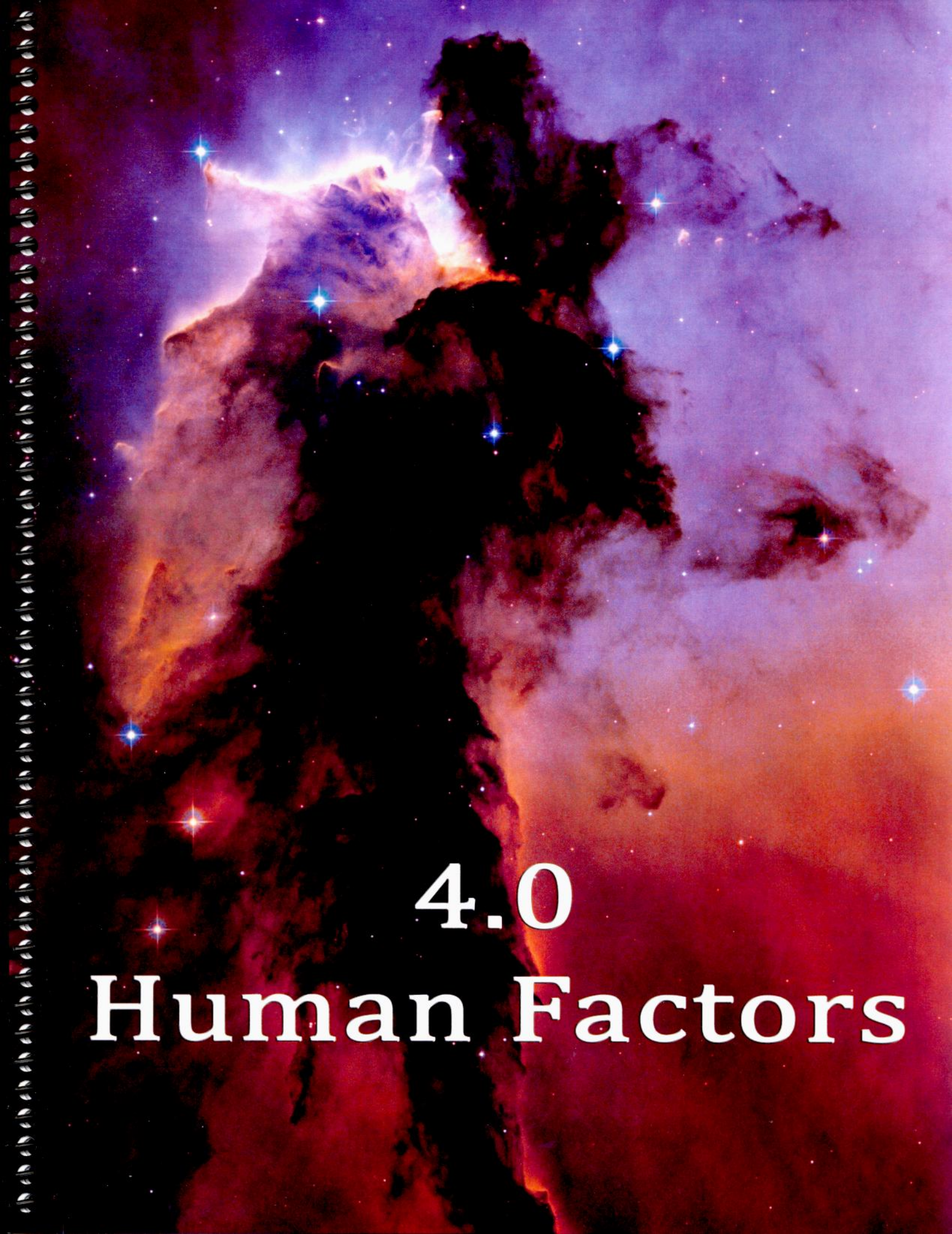
Silicon is also integrated into every day life through a silicon replicator, which prints three-dimensional objects from a silicon block to create household items(5.3.1). When an item from the household is no longer desired, the resident deposits it in a designated silicon collection facility. It is then sent to the Operations Center to be recycled, refined, and stored for later use by replicators. Silicon allows a recyclable element to be utilized that is easily obtained from the asteroid, while minimizing the need for storage or imports. By recycling silicon, costs and wastes of products are reduced. To reduce waste, Bellevistat reuses tailings from the mining operation. The tailings are collected and ground into dust, to put into moldable seat cushions and pillows, which allow for additional furniture customization.

Figure 3.5.1 Household object made from PEEK

Kitchen appliances that need to be heat resistant, such as automated food preparation devices, are made from polyetheretherketone, or **PEEK** (see section 5.3.3). PEEK is a highly heat and chemical-resistant compound that is lightweight and durable, therefore ideal for use in the kitchen. Household items such as silverware, furniture, faucets, and hard interior surfaces of residencies, are created out of silicon.

Item	Kitchen Ware	Furniture	Plumbing	Everyday Necessities
Material	Polyetheretherketone	Silicate Plastics Via Silicon Replicator	Silicate Plastics Via Silicon Replicator	Silicate Plastics Via Silicon Replicator

Figure 3.5.2 Table of Materials



4.0 Human Factors

4.0- Human Factors

On Bellevistat, residents, visitors, and foundation society members find themselves in the middle of not only a major manufacturing hub, but also a welcoming and comfortable environment that anyone would be proud to call home. Bellevistat provides a cornucopia of new ideas in education, medical care, and entertainment for all residents. The station is equipped with the newest, most advanced technology in all respects to provide an optimum living environment. Residents are also provided with entertainment that can be found on both earth and exclusively on Bellevistat. These forms of entertainment provide mental stability and stress relief for all. The differentiating environments from terrace to terrace allow residents to choose not only where they desire to live but also the ability to travel from a highly populated city environment (Citta Terrace) to an unpopulated serene setting with ample green space (Verde Terrace). Bellevistat's top of the line technology in education and medical care, abundance of entertainment, highly diverse living options, and ample views of earth and outside space makes it the perfect place for anyone who chooses to live there.

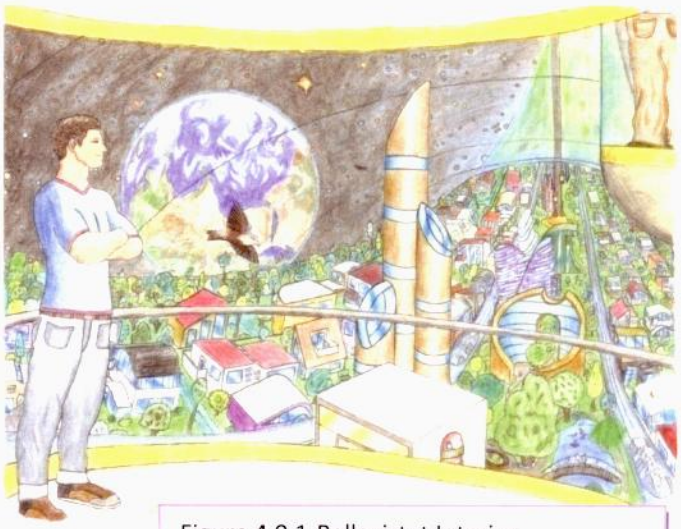


Figure 4.0.1-Bellevistat Interior

4.1 Community Design

Education

Two educational centers are located on Rurale Terrace. While attending these facilities students enjoy a constructive social learning environment provided through interaction with other students, although students are still allowed the luxury of learning at their own pace with the Automated Learning System. This system is accessible on computers and students can access lesson plans made by the teachers. The entire Automated Learning System is accessible through the use of any computer on the station including the Watch Comms (See Section 5.3.2). When the lesson plan provided on the computer is not enough for the students to thoroughly understand the material, teachers are always available to intercede for additional help.

Medical

For the safety and health of Bellevistat residents, **four medical facilities** are strategically placed around the station. Each facility's convenient location on Citta Terrace allows residents to access professional medical care with ease. Health care on Bellevistat is rapid and effective due to Medical Detection Nanobots (See Section 5.3.1) and First Aid Robots (See Section 5.2.1). Doctors are present to perform complicated operations and oversee minor operations.

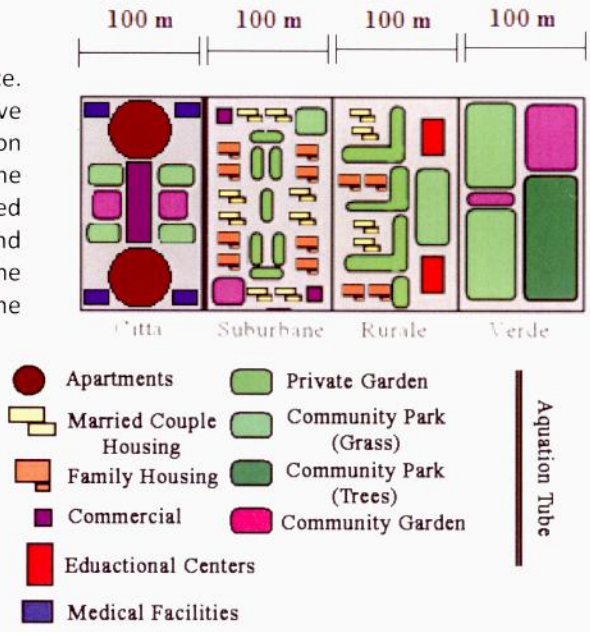


Figure 4.1.1 Community Layout

Religion

Bellevistat welcomes all peaceful religions. It is important that residents are welcome to practice their own religion to ensure moral stability and happiness throughout the station. Buildings are always available to spiritual leaders to request and provide religious services of any kind.

Open Space

In order to create a lively and tranquil environment for the residents, green space is a major asset of Bellevistat. These areas are mostly located on Verde Terrace and Rurale Terrace. There are additional parks and gardens located on Suburbane and Citta Terraces for residents who do not spend much time on the Rurale Terrace. The numerous green spaces on Bellevistat welcome everyone to enjoy a peaceful and serene atmosphere for rest and relaxation.

Commercial Areas

Residents are welcome to visit commercial areas of Bellevistat for shopping, fine dining, and exposure to any further city life similar to that on earth. The majority of the commercial areas are found on Citta Terrace while some can also be found on Suburbane Terrace. Visiting these commercial areas provides residents with an enjoyable, urban experience and gives them a sense of being home.

Paths and Walkways

Each of the seven terraces has a set grid system of pedestrian paths. Each terrace grid has three pathways that span the entire circumference and an interjecting pathway every 100 meters that spans between the 7 terraces. All pathways are 3 meters wide to prevent congealing of pedestrian traffic. The grid system of pathways for Bellevistat takes up 154,530 square meters meaning 1.25% of the total down area. **Residents use these pathways to access the mass transit systems on the station**. (See section 3.2.4)

Distribution, Quantity, and Variety of Consumables

Need	Item (how met)	Quantity per Month	Distribution
Food	-Food is grown in the agriculture ring, including: all plants grown by aeroponics, cultured meats, and live animals (See Section 3.2.1). -Marine life is raised in tanks around the Aquatation Tube. -Residents can grow their own plants in community and personal gardens.	425,520 kg	Products that are grown and raised by Bellevistat are distributed throughout the station by the pneumatic delivery system. They are sent uncooked and packaged from Operations Center straight to the individual's home.
Clothing	Clothing is made from materials produced in the Manufacturing Center.	540,000 clothing products	Clothing items are sold throughout Citta and Suburbane Terrace.
Toiletries	Synthetically or organically made toiletry products are produced in the Operations Center.	324,000 toiletry items	Toiletry products are readily available in the Citta and Suburbane Terrace.
Medicine	Medicinal products are created synthetically or organically in the Operations Center.	90,000 medicinal products	Medicinal products are delivered to medical facilities and stores around the station.
Appliances	Appliances are initially made in the silicone replicators located throughout the station. Appliances that require any amount of heat are made from PEEK and created in the Manufacturing Center. (See section 3.5)	360,000 appliances	The needed appliances are gathered from silicone replicating centers.

Figure 4.1.2-Table describing distribution of consumables

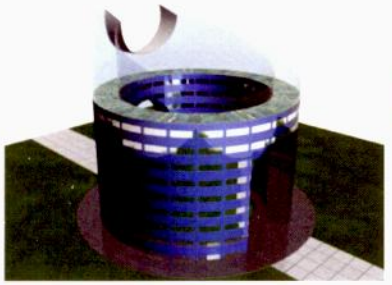
4.2 Residential Designs

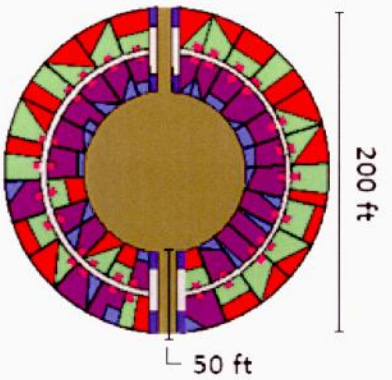
4.2.1 Housing Designs

Three main types of housing are available on the station: apartments, married adult housing, and family housing. The option of living in the **Rurale (rural), Suburbane (suburban), or Citta (urban)** Terraces is made available to the residents (See section 4.4).

Apartments are located on the Citta Terrace of Bellevistat. Many exterior designs for apartments are utilized on the station to make several architectural styles available to the residents. All the rooms within the apartment complexes vary between each apartment to provide variety. Apartment rooms are generally built to suit one or two persons' needs, so they are supplied with one bathroom, one bedroom, one kitchen, and one living room (Figure 4.2.1).

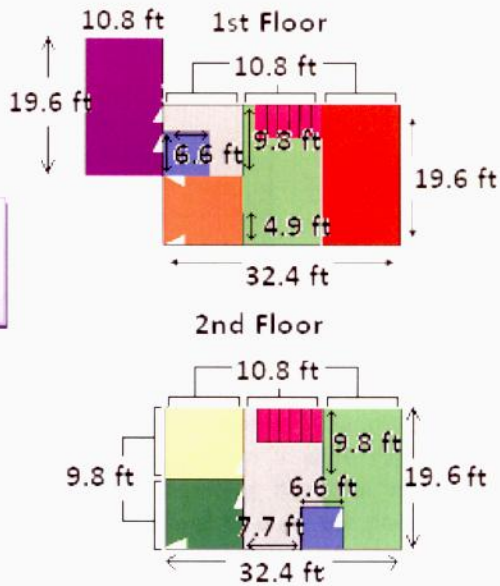
Figure 4.2.1-Diagrams depicting apartment complex



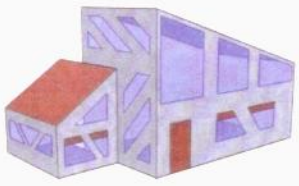


Married adult housing and family housing are found on Suburbane and Rurale Terraces. There are several exterior designs of the family houses and married couple houses with **suburban and rural designs of each**. Exterior design of the housing differs between the Rurale and Suburbane Terraces in order to relate housing style to the environment where the house is placed. These modifications include window shape, variations on color scheme, and house texture. A Suburbane house looks more modern and metallic while the Rurale residences have a cabin, wood-like appearance to them. There are multiple floor plans used in the houses on Bellevistat so each resident can have a unique living environment (Figure 4.2.2 and Figure 4.2.3). Housing differs between married and whole family households, which results in family housing being larger than married couple housing. Even though each housing design is suited to fit a certain group of people, residents on Bellevistat have complete control over their living environment.

Figure 4.2.2-Diagrams representing married adult housing



Rural Exterior Design



Suburban Exterior Design

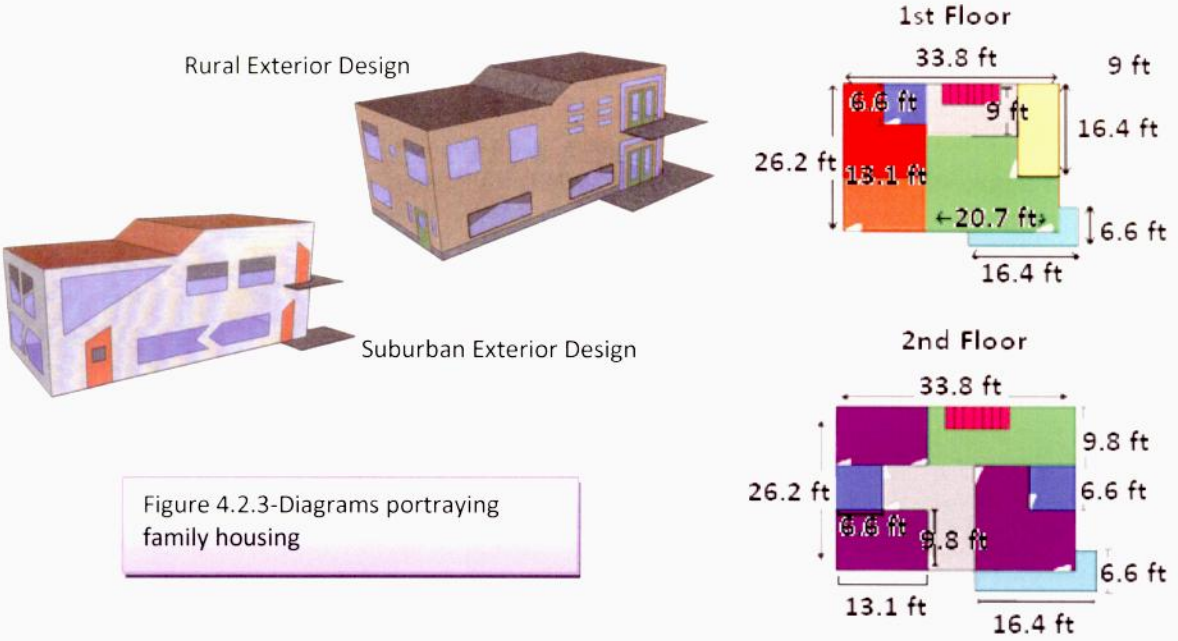


Figure 4.2.3-Diagrams portraying family housing

4.2.2 Demographics

Resident type	Design type	Number of residents in type	Percentage of total population of resident type	Number of individual houses and apartments rooms	Total area of each residence
Married Couple	House	4,860	27%	2,700	1481.73 sq ft
Family	House	1,080	6%	180	1901.14 sq ft
Single Male	Apartment	6,660	37 %	6,660	981.75 sq ft
Single Female	Apartment	5,400	30%	5,400	981.75 sq ft

4.3 Working Environments

4.3.1Devices, Systems, and Vehicles for Human Use

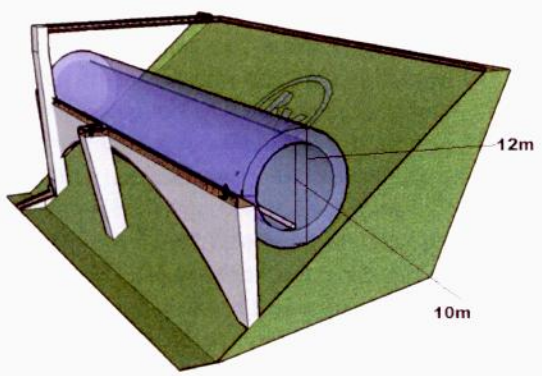


Figure 4.3.1-Exterior view of a cross section of the Aquatation Tube

For convenience of the residents, walkways are available around the residential ring (See section 4.1). An additional monorail system, the **Aquatation Tube is located on each side of the Citta Terrace.** The Aquatation Tube provides the main transport for residents throughout the residential torus. Two concentric tubes contain a wide variety of aquatic plants and animals providing beautiful views of marine life as the residents travel through the pneumatic monorail system located inside. Walkways are located on

either side of the Aquatation Tube to provide residents with additional means of transportation. Escalators, stairs, and funiculars are located consecutively along the walkways so residents can travel easily from terrace to terrace (See section 3.2.4).

4.3.2 Devices, Systems, and Vehicles to Enhance Productivity

Workers participating in a variety of occupations on Bellevistat have a number of new technologies to better enhance the productivity of work.

Figure 4.3.2-Table depicting occupations and the devices used to enhance productivity

Occupation	Device	Function
Teacher/Educational Faculty	· Automated Learning System (ALS) (See Section 5.3.1)	Each learning system includes a series of lesson plans prepared by teachers. It is accessible on computers and Watch Comms. This particular device creates convenient learning environments, which allow students to learn at their own pace.
Doctor/Medical Detection	· Medical Detection Sensors · Medical Transportation Robot (MTR) · First Aid Robot (See Section 5.2.1)	Medical Detection Sensors are placed in the patient's body and examine suspected area producing readings in a matter of minutes. MTRs transport injured residents to the nearest medical facility.
Interior Maintenance Worker/Plumber	· Interior Repair Robot (IRR) · ODTR-Circuitry repairs	(See specifications in section 5.2.1)
Exterior Maintenance Worker	· Multifunctional Construction Robot (MCR) (See Section 5.2.1)	Each robot uses a coordinate system to reach points of weakness on the station and is prepared with welding equipment to repair any damages.
Janitor/Custodian	Multifunctional Construction Robot (MCR) that has been refitted for janitorial work (See Section 5.2.1)	Refitted MCRs provide janitorial services and patrol public areas and collect all non-organic waste to provide a clean and pleasant atmosphere.
Security/Law Enforcement	· Station Security Robot (SSR)	SSRs provide the reassurance of safety. (See specifications in section 5.2.1)

4.3.3 Spacesuit Design

Spacesuits are designed for maximum comfort and safety and allow residents to move about comfortably in a low-g environment if need be. Each suit is built using a wide variety of durable materials that provide **solar radiation protection, micrometeoroid impact prevention, and water and dust resistance**. Tanks of oxygen are attached to the back of the suit to provide residents with a life support of nine hours. Each suit includes a one-piece body suit that covers from the worker's neck to feet, which can be custom fit. Helmets with visors are designed for vision and protection of the occupant. Each joint is covered in a flexible **microfilament dust filtering fabric** that prevents dust from entering or damaging the suit. Each suit can be attached to a removable exoskeleton that uses mechanical parts to enhance the worker's strength. Every exoskeleton is connected to the suit with a series of straps made of a durable thermoplastic.

Figure 4.3.3-Exterior view of spacesuit with removable exoskeleton

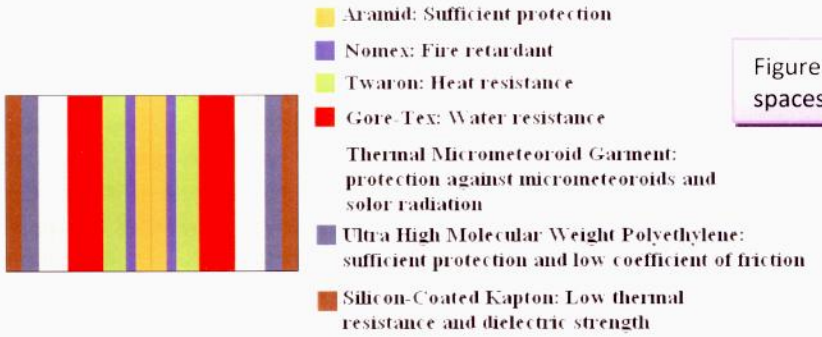


Figure 4.3.4-Diagram portraying spacesuit layers and materials

4.4 Neighborhoods

To differentiate rural and urban areas, three different neighborhood styles are present. These styles of houses consist of Rurale, Suburbane, and Citta style architectural designs, which correlate to the different terraces present on the station. The appearance of each residence and the amount of space between each house varies from terrace to terrace (See section 4.2.1).

Figure 4.4.1-Locations and sizes of Different Neighborhoods

The Rurale architecture, located on the Rurale Terrace, is aimed towards people who want to be further away from the hustle and bustle of urban areas. Each of these houses is surrounded by plenty of open space to give the residents the **capability of growing personal gardens.** Because of their location on the Rurale Terrace, these houses are given a more rustic look to fit into the land surrounding them.

Figure 4.4.2-Picture depicting architecture on Rurale Terrace

The Suburbane style buildings, located on the Suburbane Terrace, focus on a more modern architecture style for an attractive and pleasant look that fits into the land around them. The contemporary style of this architecture achieves a resemblance of the buildings of suburban areas that thrived in the early twenty-first century.

Figure 4.4.3-Picture depicting architecture on Suburbane Terrace

The Citta style buildings are located on the innermost terrace known as the Citta Terrace. This type of architecture incorporates a sufficient amount of silicon glass as well as an attractive framework. The design of Citta architecture is much taller than Rurale and Suburbane. There are Commercial properties interspersed among the apartments of this terrace.

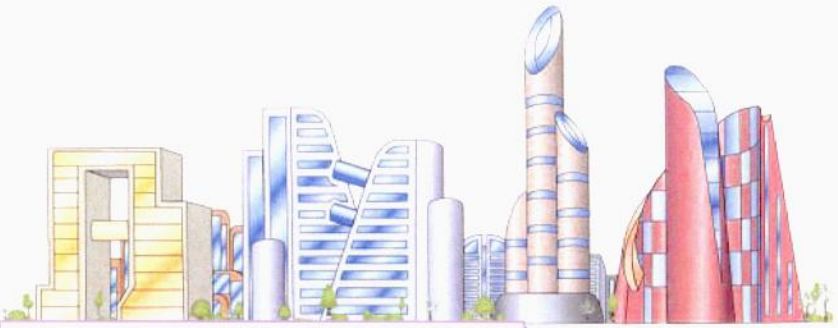


Figure 4.4.4-Picture depicting architecture on the Citta Terrace

4.5 Entertainment

Bellevistat offers a variety of activities and entertainment that allow residents to maintain mental stability and physical fitness while enjoying the lively atmosphere on the station., movie theatres, opera houses, and a plethora of urban attractions are readily available. Residents are also provided with means of physical recreation through the use of ice-skating rinks, rock climbing walls, gyms, swimming pools, bike paths, and outdoor recreational areas.

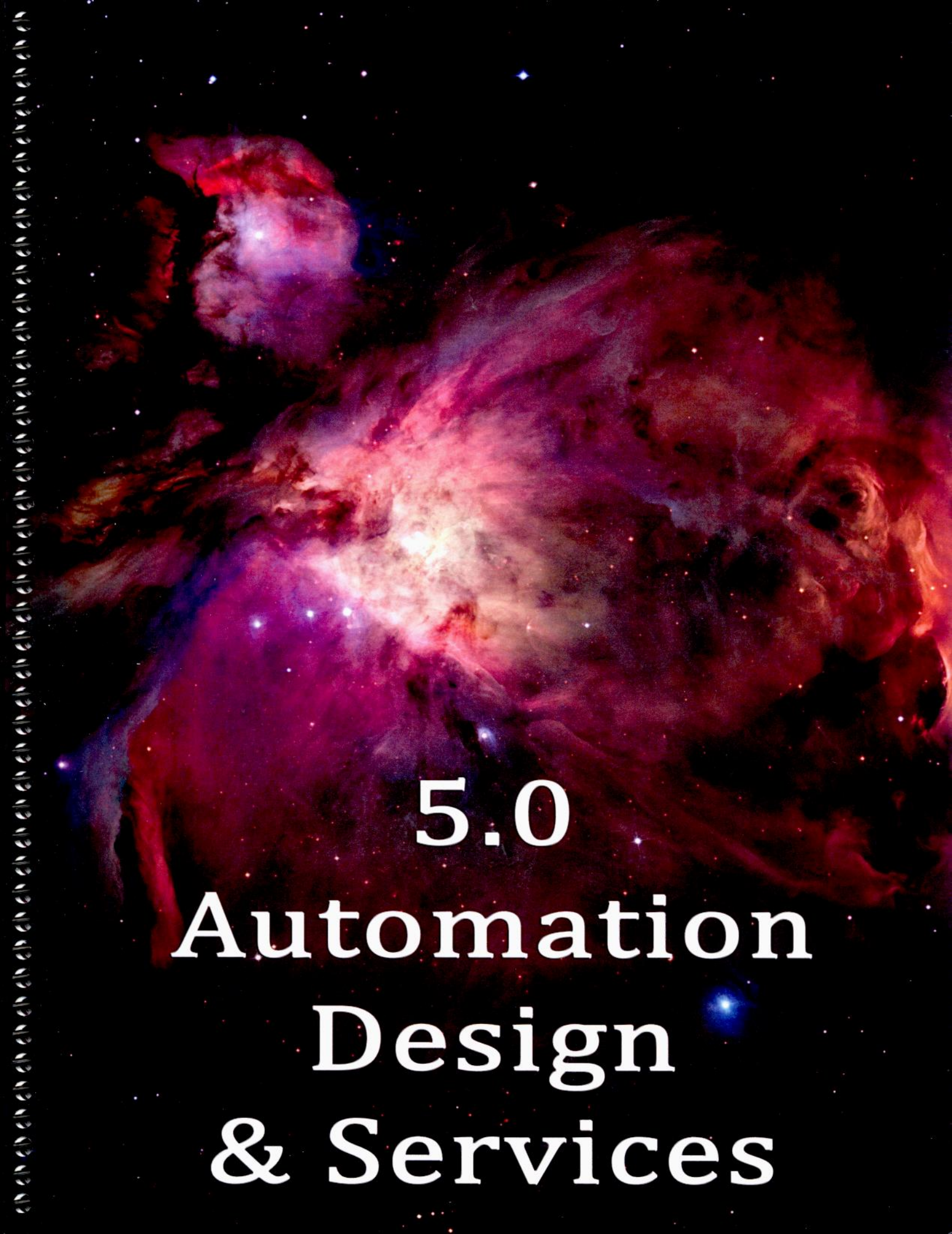
Figure 4.5.1-Downtown commercial area

Two low-g arenas allow Bellevistat residents to experience the wonders of micro-gravity while playing familiar sports. The entirety of each arena is 492.1 square feet and within, these facilities can be segregated into 6 smaller arenas if desired. These facilities are located in the operations center, safely separated from the bustle of the station's economic complex. **Injuries are easily avoided** in the arenas with the use of visco-elastic polyurethane foam coating on all walls. This lessens the negative effect of an incidental collision with any surrounding wall. Overcoming the challenging feat of playing a game with the effect of low gravity, Bellevistat residents are driven to give this game a try.

In order to insure **mental stability**, activities on Bellevistat not only provide mental and physical stimulating activities, but activities that allow residents to escape from reality for a short time as well. One of these activities is known as the IGS. The IGS (Interactive Gaming System) is a game in which residents can experience virtual reality. The IGS takes place in circular room 32.8 feet in diameter with a wide treadmill acting as the floor. The treadmill rotates in the same direction as the user is moving, automatically adjusting speed and angle to keep the user centered in the room. Images are projected on the wall and ceiling to simulate a virtual world for whomever desires to partake.

Figure 4.5.2-Interactive Gaming System

Physical fitness facilities and recreational centers are available on Bellevistat to provide the residents with **physically stimulating activities**, improving each person's everyday lifestyles and health. These facilities provide the same equipment as seen on earth, including treadmills, weight lifting machines, stationary bikes, and other such apparatus. Walkways and paths are also accessible throughout the station to enable residents to enjoy exercising in an outdoor like environment. These easily accessible means of physical recreation contribute to Bellevistat's overall mood and appearance.


5.0
Automation
Design
& Services

5.0- Automation Design and Services

Through the use of streamlined, unproblematic automation systems, Northdonning Heedwell ensures that the Bellevistat station is the pinnacle of modern technology. The use of interchangeable chassis for robots allows for high efficiency and cost-effectiveness, while making virtually all construction and maintenance processes fully autonomous. An embedded house CPU allows for the choice of autonomous completion of mundane household tasks. Utilization of all construction robots for interior finishing makes sure that house construction is completed within 72 hours, guaranteeing quick completion of the station. In order to generate maximum profit, an advanced mining system is utilized. The Bellevistat station requires everything to be in working order to run. Without the automation systems used by Northdonning Heedwell, this would not be possible.

5.1 Automation for Construction

Figure 5.1.1 – A table showing all the construction robots and their functions

Robot	Function	Stages (see 2.3)	Dimensions	Pop.	Storage Location	Storage size m^3
Directional Space Positioning System (DSPS)	Navigation and positioning of all robots during construction	1-4	3x3x3m	8	Space	N/A
Small Construction Ship (SCS)	Transports chassis and construction robots to specific construction locations	2-4	8x5x3m	200	Manufacturing Center	40,000
Universal Space Chassis	Moves individual attachable construction robots through space to build Bellevistat	2-3	2x1x1m	2,000	Manufacturing Center	4,000
Universal Interior Chassis	Moves individual attachable robots on and through the station during construction	2-4	2x2x1m	2,000	Operations Center	8,000
Multifunction Construction Robots (MCR)	Assembles the station and completes interior finishing	2-4	2x1x.2m	1,500	Operations Center	1,500
Liquid Applying Robots (LAR)	Applies liquids to surfaces of the station during station finishing	3-4	2x1x.2m	1,500	Manufacturing Center	1,500
Utility Laying Robot (ULR)	Places lengths of tubing and/or wires during interior finishing	3-4	2x1x1m	1,500	Manufacturing Center	1,500
On Moon Mining Base (OMMB)	Mines materials from the moon and refines them for use in construction	1-3	50x50x50m	3	Moon	N/A
Swarm Transportation Robots (STR)	Transports and positions objects in space	2-3	.1x.1x.1m	100,000	Manufacturing Center	100
Large Cargo Transporter (LCT)	Transports medium to large objects to the construction area	2-3	20x15x15m	10	Manufacturing Center	45,000

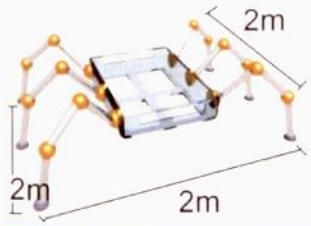


Figure 5.1.2 –An image displaying the interior chassis

5.1.1- Automation for Construction.

Construction of Bellevistat begins with the Construction Command Ship(see section 2.3), which houses a control center for initial construction, a plethora of construction robots and chassis, and a fleet of smaller ships to be used on a variety of tasks. The survey ship then deploys a Directional Space Positioning System (DSPS) which supplies dimensional coordinates for the construction area. This system is composed of eight sensor modules surrounding the entire construction site, creating a **3D grid used for the navigation of all construction device**s. After the construction process is complete the DSPS continues to operate as a navigational aide to all automations. Each DSPS module is spaced approximately 5000 meters apart. To initiate supply of materials for the construction process three solar powered On Moon Mining Bases (OMMBs) are used. This system functions through the employment of multiple telescoping arms that move around a central material collection depot. These arms are equipped with multiple drills and pry jacks to break up and collect material which is then transported back to the central depot for refining and packaging. The roughly refined material is then sent to the Bellevistat construction site via multiple electromagnetic mass drivers.

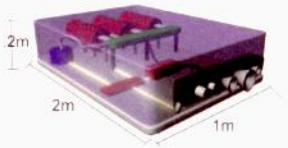


Figure 5.1.3- An image of the LAR

wo chassis are used for the implementation of construction robots. There are two main universal chassis. The first is a rocket propulsion system for external work and the second uses legs for on-station work. These universal chassis allow the robots to work in a variety of environments as well as providing **part interchangeability of joints**, the component most prone to wear. This also increases utilization of space because similar components can be packed more efficiently together. These chassis are mass produced from high strength silicon compounds to further ensure ease of manufacturing and are compatible with all of the primary construction robots. The Multifuntion Construction Robot (MCR) is the most general and commonly used of the many construction robots. The MCRs are designed for a wide variety of basic construction and assembly tasks, and are equipped with a wide array of attachable tools including grabbing arms, welders, and riveters. For laying utilities like plumbing and fiber optic cables, the Utility Laying Robot (ULR) operates using multiple, interchangeable spools of infrastructure material (See Figure 5.1.1). The Liquid Applying Robot (LAR) applies silicon paints and gels from interchangeable containers to internal or external station components (See Figure 5.1.1). The **initial stages of construction are fully automated**, requiring no human supervision.

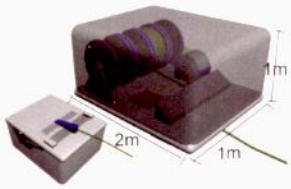


Figure 5.1.4- An image of the ULR

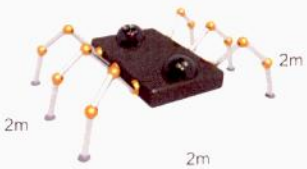


Figure 5.1.5 – MCR mounted on the Interior Chassis

5.1.2 – Transportation of Materials and Equipment.

Three distinct automated robotics systems are utilized for the transportation of materials and supplies around Bellevistat during its construction phases. Small Swarm Transportation Robots (STRs) position small to medium sized objects. STRs operate by linking together in swarms to maneuver cargo. STRs use miniature ion engines that are **highly efficient with low thrust**. Ion engines work by firing ions through an electromagnetic field. Small Construction Ships (SCSs) are self-contained transport vehicles which carry all the necessary equipment, including construction robots and chassis, to complete a wide variety of basic construction tasks. For the transportation of larger payloads of materials and equipment, Large Cargo Transporters (LCTs) are used. These robots are equipped with swarms of STRs for loading/unloading and positioning of the transported payloads.

Figure 5.1.6 – An image a STR with 2 linked together in the background

5.1.3 – Automation for Interior Finishing.

All interior finishing tasks are completed by a combination of construction robots. For more information on this process, refer to section 5.4.

5.2 Facility Automations

Figure 5.2.1 – A table showing the automations requirements for station operation

	Automation System	Function	Storage	Pop.
SSR	Station Security Robot	Patrols all areas of the station to identify and neutralize threats to security.	.2x.25 x.15m	1,000
FAR	First Aid Robot	Stored in a First Aid Station, can provide basic first aid and assist in evacuation in an emergency. Maintains resident's health.	.3x.1x.03 m	4,300 units; 860 hubs
IRR	Internal/Interior Repair Robot	Repair or replace pipelines, circuits, or any other interior malfunction that could occur.	.02x.07x.0 3m	1,054
MCR	Multifunction Construction Robot	Focus on exterior and interior maintenance, and cleaning. Recycled from construction. Refer to 5.1.1.	2x1x.2m	1,500
	Internal Cleaning Robot	Cleans the residential area of the station as well as private residences	.35x.2x.1	1,500
	Medical Transportation Robot	Ambulance / Criminal Transportation	2x2x2m	200
	Residential Server	Stores all residents' ID Profiles (See Section 5.3.5) and personal data for access from any computer	2x2x2m	512; 256 Backup
	Operations Server	Stores all station critical data and runs all operational functions	4x4x4m	512; 256 Backup
	Agricultural Server	Runs all automated agricultural processes	4x4x4m	64; 32 Backup
	Manufacturing Server	Runs all mining and manufacturing precesses in the Manufacturing Center	4x4x4m	512; 256 Backup

5.2.1 Settlement Maintenance, Repair, and Safety Functions

Bellevistat is equipped with a variety of robots to ensure that the station is kept in optimum functioning order. All robots are equipped with a thin, 100 mbps bandwidth of network connectivity for battery conservation. Robots are capable of running diagnostics and relaying information to the Operations Center due to this connectivity, which is valuable to the overall functionality of the station. Bellevistat utilizes solar power combined with Double Layer Capacitors (DLCs) enhanced by carbon nanotubes for robot power.

Repair and maintenance is completely autonomous on Bellevistat, and demands little human interaction. The Internal Repair Robot (IRR) resides inside station infrastructure conducting repairs. They splice wires and seal pipelines with epoxy for quick repair, then switch to a more specific tool to ensure optimal refurbishment of station infrastructure. Two systems are in place amongst infrastructure lines to ensure immediate response in case of failure. Internal Repair robots work in conjunction with these systems. They receive pipeline leak data from a system using sectioned pipelines to detect depressurization, and circuitry damage data from an OTDR (Optical Time Domain Reflectometer) system, which locates severed circuitry by measuring distance through electrical pulses in

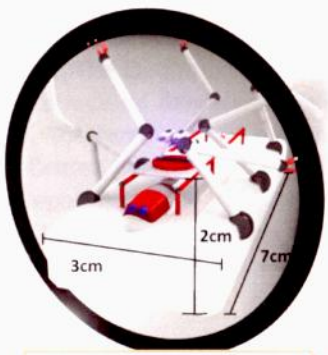


Figure 5.2.2 Image of IRR

station circuitry. The speed, reliability, and accuracy of these two systems allow IRRs to quickly and effectively locate and repair damage. For cleaning and basic maintenance of residential areas, the Internal Cleaning Robot is used. This robot is equipped with basic cleaning utilities and trash removal systems. It patrols residential systems and can be requested for personal residential cleaning.

MCRs (See section 5.1.1) from the construction process are reused for external maintenance purposes. They are supplemented with external hull sensors located at regular intervals across the station capable of detecting hull breaches and incongruity in structural integrity. If the sensors detect an anomaly within their range of examination, they notify the Operations Center, which sends MCRs to rectify the problem. Such systems are utilized to rapidly neutralize any threat to structural integrity.

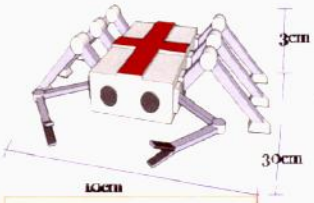


Figure 5.2.3 – FAR

First Aid Robots act as a first response to medical emergencies; 5 robots are located every 50 meters in the Residential Area in order to ensure rapid response to any size of medical emergency. First Aid Robots receive data from medical sensors that all residents imbibe (5.3.1). Using information from the sensors; the First Aid Robot can analyze and perform basic first aid procedures to stabilize any patient. After the resident is stabilized, the Medical Transportation Robot delivers patients to the nearest hospital.

Figure 5.2.4-SSR

In order to maintain a safe environment on Bellevistat, Multiple non-intrusive automation systems are implemented. A primary means of insuring station security is the automated scanning of all station imports. These scanning systems use x-ray detection as well as microbe analysis and RF-ID certification. Station Security Robots (SSRs) are employed for monitoring and on station security. SSR's are equipped with a taser and a hypodermic tranquilizer needle to ensure the incapacitation of any major infringement of resident's security.

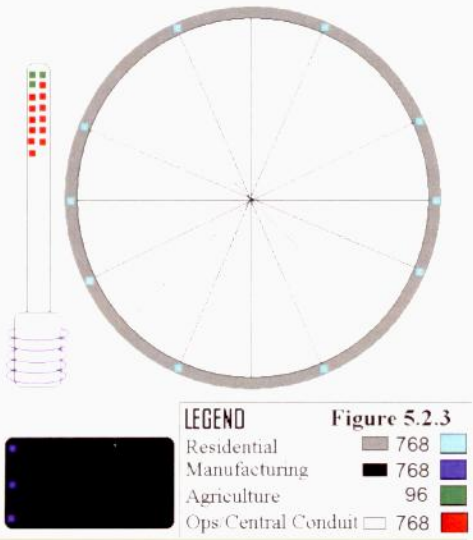


Figure 5.2.5-Location of Station Servers

5.2.2 Physical Locations of Automations

In order to ensure maximum operating efficiency servers are located in their task specific locations on the station. Four separate server banks run all residential, operations, manufacturing and agricultural tasks. All server data and functions are mirrored on backup servers to allow for extensive redundancy (See Section 5.2.5). Robots also have their own storing locations. FARs are found at their medic stations. SSRs remain idle around the station, until any security threat arises at which time the nearest group is ready to respond immediately. The Internal Cleaning Robots reside primarily at cleaning hubs around the residential areas of the station, when they are not operating. Thirty percent of the robots from the construction phase are stored in the Operations Center allowing for easy deployment in case of structural damage as well as simply for routine hull maintenance. The remainder of station robots are stored in the Manufacturing Center, placing them out of the way of station operations. Internal Repair Robots remain active and operate out of hubs directly inside the station's circuitry and infrastructure, allowing them to constantly monitor and repair data transmission systems.

5.2.3 Solar Flare Shielding for Automations

All robots and electronics are coated with a translucent nitrate salt-based solar shielding film known as **RAGuard**. RAGuard is a featherweight shielding film of radiation protection 10 microns thick that serves the same functions

as a 200-micron layer of lead. This provides electronics with extensive radiation protection without lead's excessive weight and allows robots to operate in any conditions.

5.2.4 Security for Access to Critical Data and Locations.

Although there are many vital portions of the station, the security and reliability of the stations functionality is at the forefront. In order to combat malicious programming and any intrusion attempts, extensive network encryption and anti-virus protocols are utilized. For access to secure areas, including server rooms and robotic storage locations, iris scans are used to ensure the integrity of the stations critical functions and allow access to authorized personnel. Administrative workers are admitted various levels of security clearance based on their rank within the station. This rank specifies the exact areas they may access, ensuring no security breaches in areas of critical functions. Requests for access to these areas are required, and are reviewed prior to the time that access is given to ensure no infractions of security. In case of an attempted break-in, SSR teams, equipped with tasers and hypodermic tranquilizers, are deployed to incapacitate the threat, after which medical transportation robots remove them to secure holding facilities.

5.2.5 Backup and Contingency Plans

In the highly unlikely event of system failure, a series of contingency plans are in place. In case of single robot corruption, the robot will be shut down and communications with the Operations Center will be terminated in order to avoid the spread of corrupted data, as our silicon-based robots are expendable. Robot operating software is periodically updated to minimize software malfunction. Servers are the central point at which all computers and robotics function, that is why extensive amounts of server backup is provided for the automations systems and residents of Bellevistat. During server failure, the responsibilities of the downed server are switched to the mirrored, partner server and a maintenance crew will fix the downed server. Should a server experience technical difficulties, the functioning, **mirrored servers supply an equal alternative without loss of data (For Number Specifics See Section 5.2.2).** This system ensures that server failure will not compromise computer data.

5.3 Automation for Enhanced Livability

5.3.1 Automatons for Livability in the Community

State-of-the-art technologies are used on Bellevistat to ensure luxury and ease of livability. To ensure medical safety of all residents, all residents ingest a pill, which releases micro-detectors in the residents' blood stream to monitor for foreign agents and anomalies. If something should go wrong with a resident's health, these medical sensors inform the nearest First Aid Station (See Section 5.2.1). For residential education, the ALS, an advanced interactive learning application is used on the Watch Comm in conjunction with the educational faculty of the station. For education and ALS protocol (see section 5.3.1)

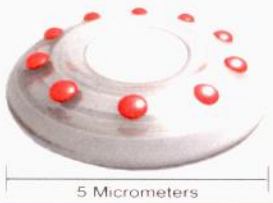


Figure 5.3.1 – Medical sensor

In order to make purchase of daily household goods easier, Bellevistat provides a means for its residents to do all their shopping from the comfort of their own home. Residents are able to log on to the station's main shopping network through their Watch Comms (see Section 5.3.2), where they are able to scroll through all available items. They simply select what they want and the quantity. The resident is then billed for the order. All food items are requisitioned from the station's food bank while **all conventional items are produced on demand through the use of silicon replicators**, which use a system of 3D printing and UV curable liquid silicon to construct various objects. These replicators use a virtual 3D model of an object and construct it by printing layer after layer of silicon until the three dimensional object takes shape. Residents can alter these objects through the Watch Comms making them to their specifications. However, all items used in a high temperature environment, i.e. ovens and cooking pans are made out of PEEK (See Section 3.5). Uncooked food and other items, including food packaged for use with the automated food preparation device (See Section 5.3.3) can be ordered through the shopping network and **delivered to residents' houses via a network of tubes** using pressurized air to send items throughout the station (See Section 3.2.1). This system ensures that the average delivery time is minimal. Ordered commodities are packaged into convenient parcels that allow for ease of transportation through the goods distribution network. For more conventional residents, traditional grocery stores are placed around the station.

5.3.2 Automaton for Productivity in the Workplace

In order to generate profit, work must be completed efficiently and effectively. Therefore, the Foundation Society provides residents on the station with **their own personal computer conveniently located in a wrist top device called the Watch Comm**. The devices are small photonic computers that interact using a 3D projected GUI operating system. This system uses an interactive holographic display, which allows for extensive ease of use and convenience. The **Watch Comms are the main method of computing** used on the station by residents. Users are able to access their personalized profiles, which are stored on the residential servers, from anywhere within the station.

5.3.2 – Watch Comm. Computer

Residents also use the Watch Comms as the main platform for conducting work. The Watch Comm is configured with applications specific to that person's job. Construction, mining, and other physical jobs are completed with the employee using his Watch Comm to control a robot and direct it to complete various processes. Watch Comms can also be used for communication. There is also a home computer that can be used for all the same functions as the Watch Comm. The same work can also be conducted on the stations public computer consoles (See section 5.3.6). For Watch Comm data storage protocol See section 5.3.6.

Because of the numerous professions present on the station, specialized automations equipment will be required. This specialized equipment can be produced at low cost in the Manufacturing Center of Bellevistat providing any profession with autonomous assistance.

5.3.3 Automation for Convenience in Residences

Every residence in the station is built as an intelligent, automated residence. The house controls and supervises all aspects of traditional household tasks from cleaning to cooking. The house functions through a central CPU that oversees all household chores. The physical actions the house actually completes are done by implementing the appropriate automated device for the task at hand. This can include both in house automations and the requisition of robots for tasks such as cleaning and maintenance. Many automation systems are implemented directly into the housing construction process. **Residents are able to schedule day-to-day tasks** such as cleaning the dishes or vacuuming. While they are at work, these are completed. Residents can also control house functions on the go from their Watch Comm. **Control is ultimately in the hands of the inhabitant.** For cleaning needs the residential computer can request an Internal Cleaning Robot (See 5.2.1) from the nearest cleaning hub to service the house. Another feature of the residences on Bellevistat is the automated food preparation device. This is a simple automated device that takes uncooked food packages from the food delivery system (See section 5.3.1) and prepares them in a familiar home-style meal.

5.3.4 Automation for Maintenance and Routine Tasks

In order to ensure residents ease of livability, Bellevistat has taken many steps to alleviate the need to complete boring or routine tasks as well as maintenance tasks concerning the human areas of the station. Most routine house needs can be completed through the automated home (See Section 5.3.3) and the Internal Cleaning Robot (See section 5.2.1). Other routine tasks can be completed through the use of the Watch Comm. A resident can contact the robotics database and request a robot (See section 5.3.6).

In order to reduce the need for manual labor in the agricultural process, Bellevistat uses a simple harvesting robot knows as the Agricultural Robot. It functions by sliding along the aeroponics rails in the agricultural area and harvests crops using a series of arms outfitted with basic agricultural implements. The robot then deposits the crops in the appropriate receptacles. A similar and much smaller legged version of this robot, known as the Residential Agricultural Robot is employed for harvesting and garden work in residential and commercial areas (See Section 3.4).

Maintenance of human inhabited areas is completed by the Internal Cleaning Robot (See section 52.1). These robots can not only remove trash but perform the basic maintenance most commonly required in the residential area. In the event of more extensive damage in the residential area, an MCR is dispatched to perform repairs.

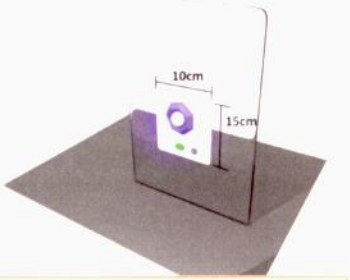


Figure 5.3.3 – A Personal computer performing an Iris Scan

5.3.5 Automation for Privacy and Control Systems

All personal data is stored on the residential server system which can be accessed with a personal ID. All personal computers such as the Watch Comms and house computers store all data on a resident's ID profile on the residential servers. In conjunction with the user name and password system, Iris Scans are used to access a resident's ID profile. **The chance of two irises being identical is 1 in 10^{78}**, ensuring flawless security. This system of centralized data storage ensures near unlimited storage space and a high level of data security. In order to ensure privacy of resident's personal data, administrative personnel are required to get a warrant before they are able to access a residents ID profile and personal data.

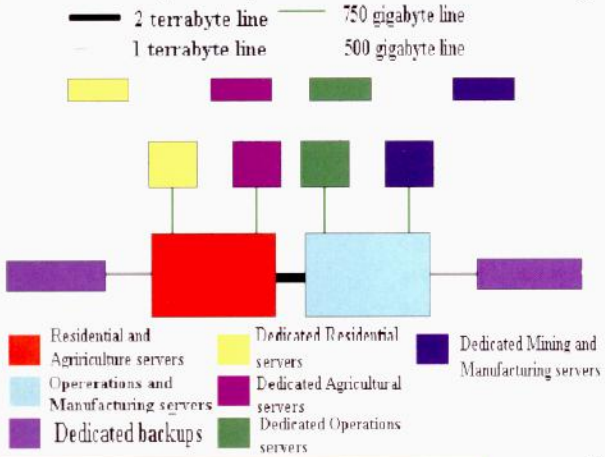


Figure 5.3.4-diagram of Server Bandwidths

5.3.6 Automation for Community Computing and Robot Access

All community computing is distributed across the many residential servers. All data storage requests are controlled through a central residential hub, which coordinates data storage. Storage space is allocated according to community location. **Community computing for each resident is accessible through the resident's Watch Comm allowing all personal data to be accessed from any location.** Computing power is distributed among all residents of the station. Each resident has a more than adequate share of computing power and data storage. In case a resident does not have their Watch Comm available, public computing consoles are distributed throughout the main areas of the station. All the same functions of the Watch Comms are available on these public computers. In order to access specialized robots residents may contact robotic resources through their ID profile on any station computer, including the Watch Comm.

5.4 Automation for Interior Finishing

5.4.1 Automation for Finishing of Buildings

Figure 5.4.1 – A table showing the robots involved with interior finishing

Robots Name	Function	How it Accomplishes Task
Multifunction Construction Robots (MCR)	Connect prefabricated building sections together	Uses tools such as welders or riveters to assemble buildings from prefabricated sections
Utility Laying Robot (ULR)	Run and install fiber optics, electrical, and plumbing utilities to all buildings.	Carries multiple spools of various utility cables used throughout the station
Liquid Applying Robot (LAR)	Spray silicon based paints and protective coatings on all interior surfaces.	Contains an assortment of fluid canisters to apply finishers to any object
Interior Finishing Transport, MCR	A robot similar to the SCS which places furniture and transports MCRs	Transports furniture; MCRs place furniture and installs various automated computer and homes systems.

For maximum efficiency, ease, and reduction of costs, all interior finishing and building is completed through the **implementation of robots from the original construction** of the station.

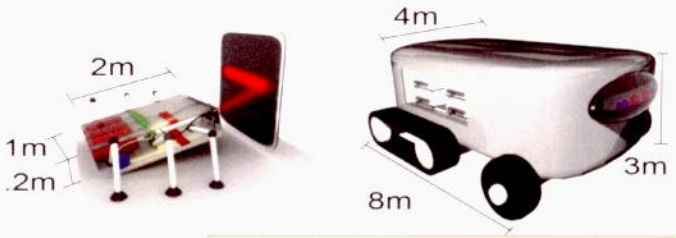


Figure 5.4.2 – The Interior Finishing Transport and LAR, two robots used in the interior construction process.

5.4.2 Estimated Interior Finishing Time

The estimated time to construct an entire home or building including framework, wiring, plumbing, and furniture placement is **forty-eight to seventy-two hours**, depending on whether the building is a home, apartment, business, etc. This construction time includes attachment of prefabricated sections, running of utility lines, painting and liquid coating, as well as placement and installation of furniture and automated home systems.

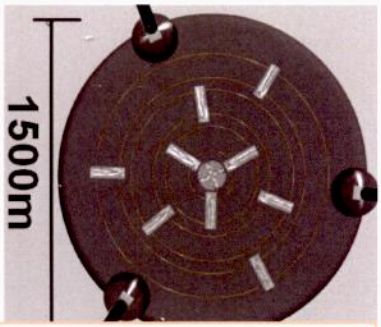


Figure 5.5.1 - Diagram of Manufacturing Center showing Mining Platforms

5.5 Automations for Mining

5.5.1 Automations for Material Harvesting

Bellevistat uses a large mass harvesting system to easily and efficiently collect large amounts of ore. The system is based entirely on the Manufacturing Center, allowing for minimal transportation distance and high efficiency. The asteroid is attached to the station by three towers that run along the Manufacturing Center. The asteroid is attached to the towers sing pneumatic spikes (See section 2.4.1).

The harvesting process begins by rotating nine mining platforms, which are attached to the bottom of the Manufacturing Center, around the bottom of the asteroid. The mining platforms are outfitted with **interchangeable pneumatic jackhammers and barrel rippers** for fast repair and grinding head replacement. The mining platforms rotate on tracks around the bottom of the Manufacturing Center to grind off layers of the asteroid. Slowly, as the platforms take away more and more ore, the attachment rings on the asteroid slide down the towers, pushing the asteroid into the mining platforms. As the asteroid is slowly pushed into the Manufacturing Center, the mining platforms continue grinding off one layer at a time until the entire asteroid has been collected. After it is torn away from the asteroid, ore is collected and transported (5.5.2) to the main refinement center where the breakdown process begins (7.1.1).

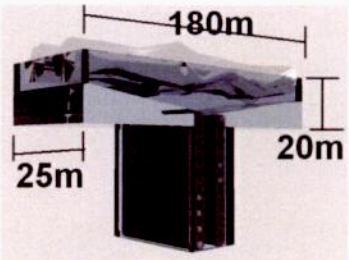


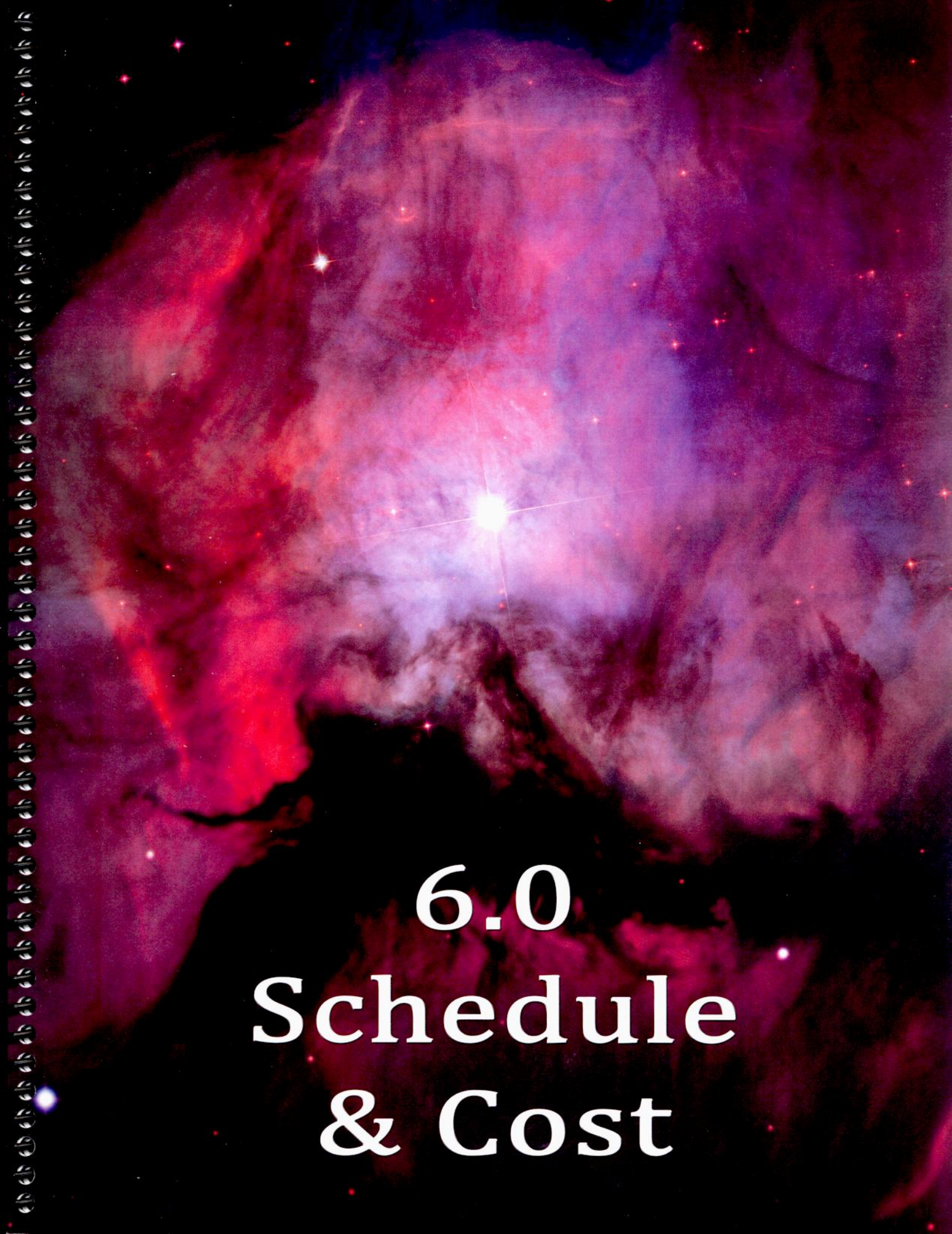
Figure 5.5.2 – Diagram of auger bits (top) funneling disintegrated ore into Ore Transportation.

5.5.2 Automations for Ore Transportation to Refining Facilities

After the ore is harvested from the asteroid, it is collected and pushed into an automated compression conveyer belt. The conveyor belts are located below the mining platforms and transport the ore to a central collection system, where it is packaged in large reusable transportation bins. The ore is then taken to the refining facilities for further breakdown (7.1.1).

5.5.3 Human Involvement in Mining Operations

Mining of asteroids in space is dangerous work; therefore human involvement in the Bellevistat mining process is minimal. During mining and harvesting of the asteroid, there is **no human presence on the asteroid** itself. All human observation is conducted from the mining department based in the Operations Center on Bellevistat. A minimal number of 20 mining engineers are constantly present in these facilities, always overseeing the mining processes of the asteroid. This allows for the mining process to be done efficiently and with human control, but placing no humans in the direct line of danger that revolves around the mining process

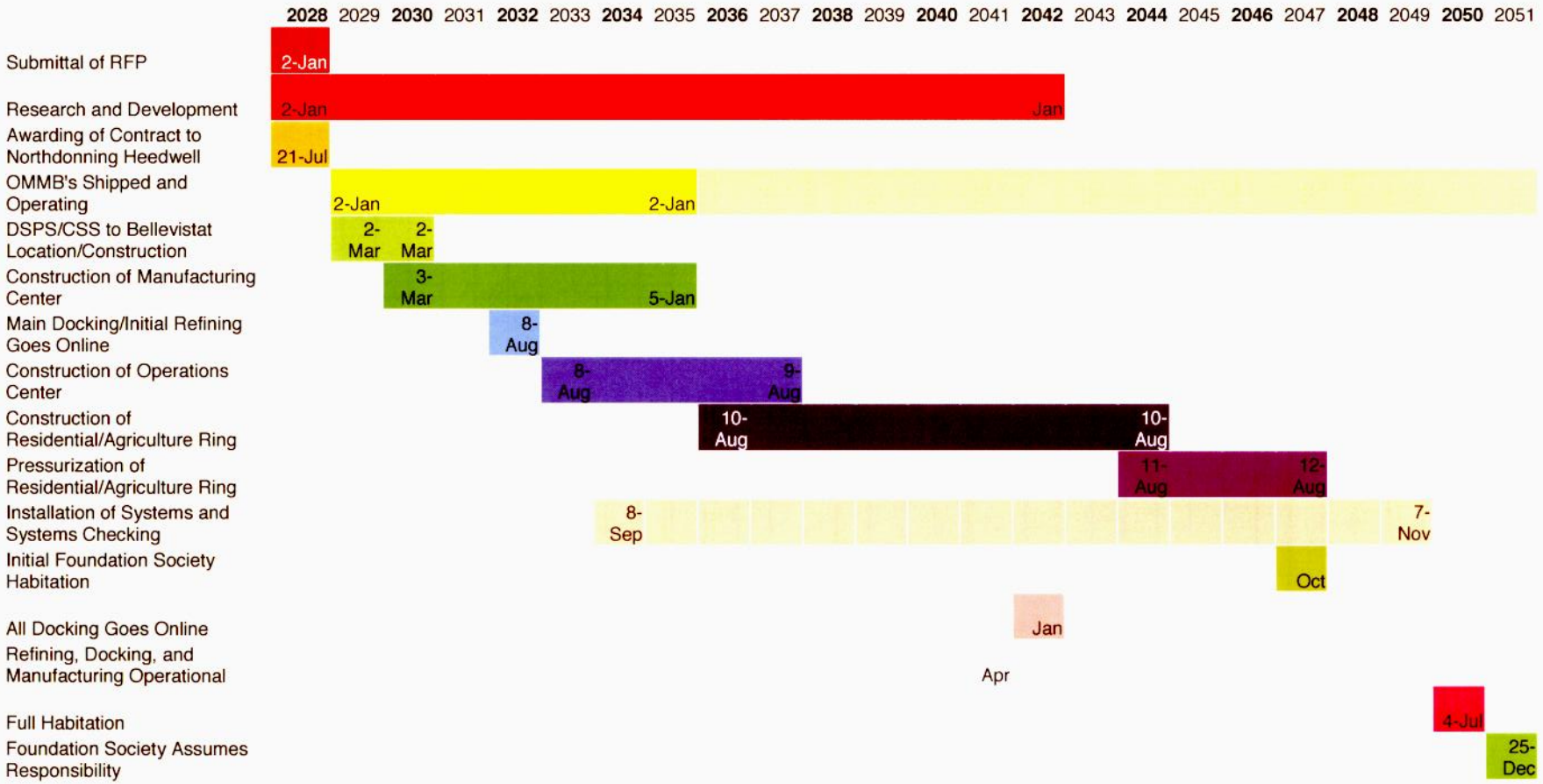


6.0 Schedule & Cost

6.0- Cost and Schedule

Bellevistat's cost and construction scheduling are just as well planned and designed as the station itself. Northdonning Heedwell has planned a reasonable timeframe for the construction of such an immense undertaking. To reduce The Foundation Society's investment cost, all aspects of Bellevistat have been designed in a cost-efficient manner. The end result of a well-planned schedule and cost-efficient construction will be a fully operational Bellevistat in 21 years at a total cost of 71 billion dollars.

6.1 Schedule



6.2 Cost

Structural Design Cost

Item	Quantity	Cost per Unit	Total Cost
Silicon Glass	116,648,000 m	$32/m	$3,732,736,000
Iron	116,648,000 m	$14/m	$1,633,072,000
Silica Aerogel	11,665,000 m	$31/m	$361,615,000
RAGuard	1,944,000 m	$50/m	$97,200,000
Aluminum Glass	3,888,000 m	$47/m	$182,736,000
RXF1	777,000 m	$186/m	$144,522,000
Diamondoid Fibers	38,800 m	$3420/m	$132,696,000
Titanium	972,000 m	$96/m	$93,312,000
Terracing	7	$7,234,000/T	$50,638,000
Research	N/A	N/A	$6,700,000,000
Total Cost	**N/A**	**N/A**	**$13,128,527,000**

Operations and Infrastructure Cost

Item	Quantity	Cost Per Unit	Total Cost
Research	N/A	N/A	$1,750,000,000
Docking Facilities	56	$32,500,000	$1,820,000,000
Construction Command Ship	1	$4,200,000,000	$4,200,000,000
Agricultural Infrastructure	N/A	N/A	$1,400,000,000
Nuclear Reactors	2	$340,000,000	$680,000,000
Solar Sheet Materials	N/A	N/A	$12,500,000
Water and Atmosphere	N/A	N/A	$320,000,000
Fiber Optic Lines	225km	$750/km	$168,750
Pneumatic Lines	660km	$675/km	$445,500
Utility Lines	1620km	$475/km	$769,500
Communication Satellites	N/A	N/A	$262,000,000
Transportation Systems	N/A	N/A	$2,400,000,000
Cargo Ships	10	$25,000,000	$250,000,000
Human Transportation Ships	60	$92,000,000	$5,520,000,000
Refinery Systems	N/A	N/A	$4,750,000,000
Manufacturing Center	N/A	N/A	$8,850,000,000
Soft Transportation Tube	1	$84,000,000	$84,000,000
Liquid Hydrogen and Liquid Oxygen	N/A	N/A	$12,000,000
Magnetic Propulsion Systems	N/A	N/A	$8,000,000
Silicone and PEEK	N/A	N/A	$9,500,000
Total Cost			**$32,329,383,750**

Human Factors Cost

Item	Total Cost
Married couple houses	$2,025,000,000
Family houses	$162,000,000
Apartments	$4,221,000,000
TOTAL for all housing	$6,408,000,000
Space suits	$5,000,000

Low g arenas	$460,000
IGS interactive gaming system	$600,000
Physical Fitness Facilities	$4,300,000
TOTAL for all entertainment	$5,360,000
Total Cost	**$6,418,360,000**

Automation Design and Services Cost

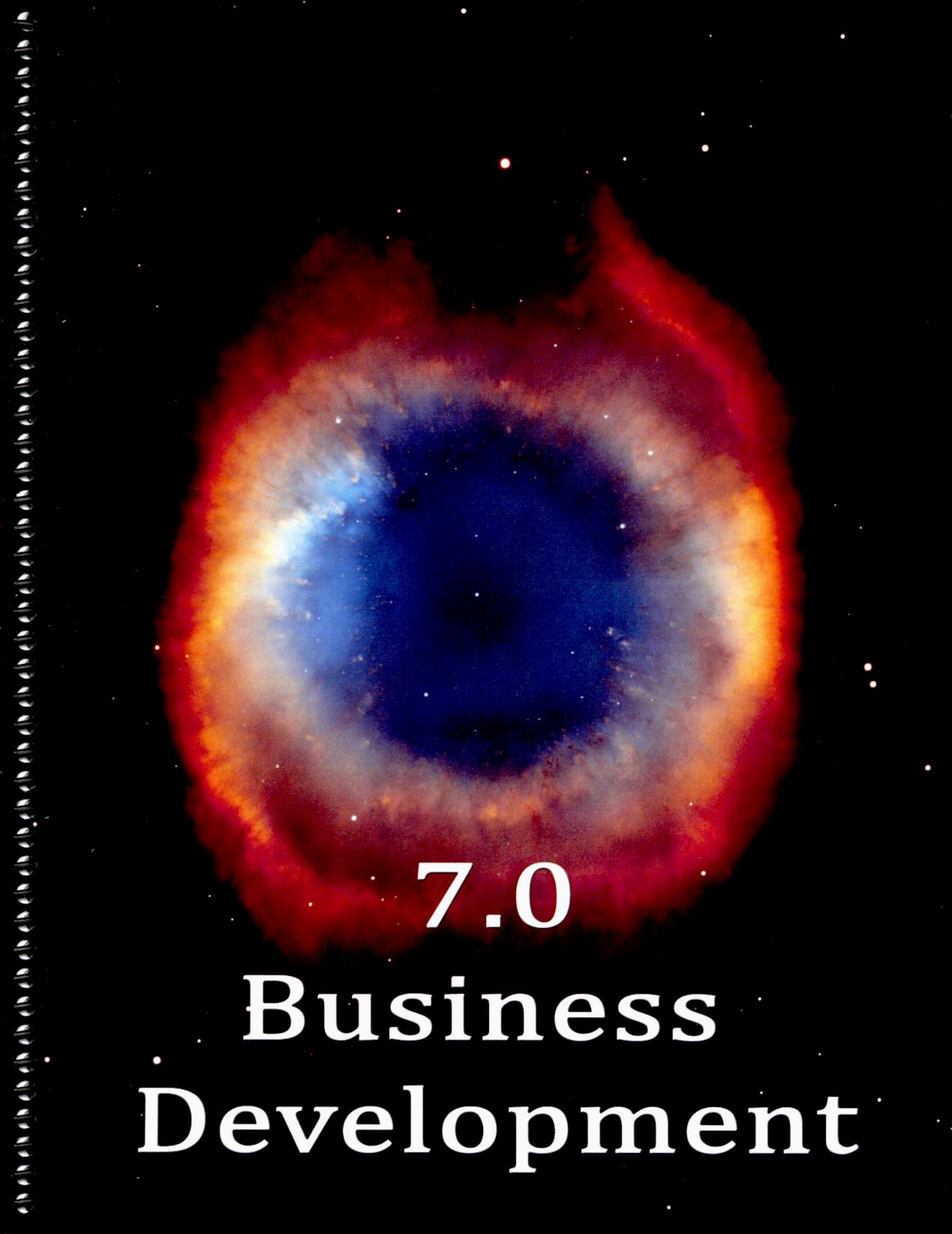
Item	Quantity	Cost Per Item ($)	Total Cost
DSPS	8	$80,000	$640,000
Construction Ships/Robots	4701	$287705	$1,352,500,000
Robot Chassis	4000	$24,000	$96,000,000
On Moon Mining Base	3	$80,000,000	$240,000,000
Swarm Transporters	100000	$1,500	$150,000,000
Large Cargo Transports	10	$4,000,000	$40,000,000
Internal Services Robots	32354	$1,865	$60,340,400
Station Computers	25,500	$1,600	$40,800,000
Server Banks	2106	$800,000	$1,684,800,000
Mining System	N/A	N/A	$91,000,000
In House Automations	14940	$30,000	$448,200,000
Robots Dealing with Food	23500	$3447	$81,000,000
Equipment Monitoring Robots	1000240	$1072	$1,072,000,000
Iris Scanners	25000	$1,000	$25,000,000
RAGuard	N/A	N/A	$5,000,000
Residential Replicators	150	$18,000	$2,700,000
Optical Time Domain Reflectometer System	N/A	N/A	$15,000,000
Interior Finishing Transport	300	$200,000	$60,000,000
Automations Research and Development			$3,550,000,000
Total Cost			**$9,014,980,400**

Business Development Cost

Item	Quantity	Cost Per Item ($)	Total Cost
Mass Refining Center	1	$8,500,000,000	$8,500,000,000
Manufacturing Lines	15	$8,000,000	$120,000,000
Magnetic Propulsion Systems	15	$500,000	$7,500,000
Liquid High Density Carbon Crystalline	10 m^3	$60/$m^3$	$600
Shipyards	2	$750,000,000	$1,500,000,000
Bellevistat Museum	1	$5,000,000	$5,000,000
Complementary Maps	20,000	$0.50	$10,000
Total Cost			**$10,142,510,600**

Total Cost of Bellevistat Space Settlement: **$71,033,761,750**

Phase of Construction (See Section 2.3)	Number of Personnel	Cost
Phase 1 - Surveying of Construction Site	50	$5,500,000,000
Phase 2 - Manufacturing Center Construction	350	$13,700,000,000
Phase 3 - Operations Center Construction	350	$15,200,000,000
Phase 4 - Primary Docking Construction	350	$2,500,000,000
Phase 5 - Residential/Agricultural Construction	725	$28,100,000,000
Phase 6 - Pressurization and Operation	725	$6,000,000,000
Operational Capacity	500	N/A


7.0
Business
Development

7.0- Business Development

The Business section of the Bellevistat proposal is the financial engine behind the operation of the Bellevistat heavy manufacturing center. Our revolutionary mining, transportation, and manufacturing systems provide raw and refined material for a variety of industrial purposes. Additionally, cornucopias of available tourist attractions exist on Bellevistat for visitor enjoyment. These factors combined, create the ideal economic center; one of enormous revenues generating high profits making Bellevistat a safe and thriving business environment.

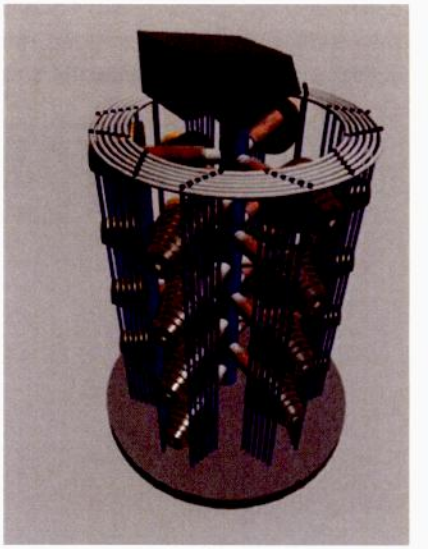


Figure 7.1.1 One Tower of the Refinery with Multiple Centripetal Material Separation Systems (CMSS).

7.1 Mining and Transportation

7.1.1 Harvesting and Refining Ore from the Asteroid

A mass mining and delivery system (see section 5.5) based in the manufacturing center collects raw ore from the asteroid. The manufacturing center on the asteroid is the base of asteroid operations and retains all the capabilities for: mining, refining, processing, ship construction, manufacturing, storage, and shipping. The mining system dumps the material in its tubs (see section 5.5) into one of six cylindrical **Centripetal Material Separation Systems** (CMSS) for refining. The CMSS's heat the ores and spin them, creating gravity and allowing ores to separate by density. Small outlets attached to delivery tubes move along the hull of the CMSS to allow different amounts of different materials to be collected. These transportation tubes take each of the individual materials in their density level. From the tubes, material flows into two smaller refineries that purify the ores. Once pure, rare and common ores or are shipped to different storage tanks for recall later. Materials that may only be found in small amounts in certain asteroids are run through a separate micro refinery that is easily cleaned allowing us to change its refining focus. These materials are stored in much smaller areas after purifying for recall later. Afterwards, materials are sold or processed into objects for sale, excess materials can also be sent back to Earth at the request of the Foundation Society.

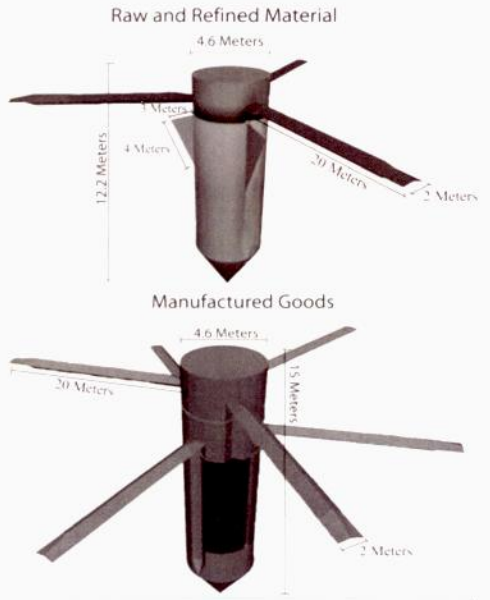


Figure 7.1.2 Images of one-way re-entry vehicles

7.1.2 Asteroid in Orbit Near the Settlement

Bellevistat is close enough to the asteroid to extend the transportation tube (see section 3.2.4) without putting any sort of stress directly on Bellevistat. This close distancing allows us to eliminate the need for ships to transport materials and personnel between Bellevistat and the asteroid, making the system contained and thus more efficient and cost effective. The manufacturing center also contains heavy transit shipping areas and Magnetic Propulsion Systems (MPS) to ship materials to customers in Space and on Earth (section 3.3.2) for some additional profits.

7.1.3-One-way Re-entry Vehicles

Two different types of **one-way re-entry vehicles** have been created to transport ores (at Foundation Society request) and manufactured goods to Earth's surface. A set of rotors peel off the

body at a specified altitude by an altimeter located in the nose cap, causing the rotors to catch the air and push them out into their extended telescoped position. These rotors act in the same manner that a helicopter seed does on Earth. Manufactured Goods capsules contain an additional set of rotors to slow the craft. Before being launched from orbit, both types of craft are coated in a carbon skin that, under extreme heat and pressure, rearranges its molecules into a high-density carbon crystalline structure. In the event that guidance systems inside the craft fail and the package is set for a burn-up re-entry, the carbon structures become stronger and more heat resistant as heat is added, preventing it from burning up in the atmosphere and allowing it to maintain a steady path to land at its projected site.

	Raw/Refined Ore Craft	Manufactured Products
Rotor Length	20 Meters	20 Meters
Rotor Width	2 Meters	2 Meters
# of Rotor Sets	1	2
Body Length	12.2 Meters	15 Meters
Body Diameter	4.6 Meters	4.6 Meters
Style of Containment	Ores are poured into the shell of the craft as though it is a mold	The interior is compartmentalized, items are put inside and secured
Landing Area	Ocean Water Landings	Ground Landings
Guidance	Altimeter, Cone Cap, Fins	Altimeter, Cone Cap, Geared Rotors
Launching Technique	Fired From MPS	Fired From MPS
Atmospheric Protection	High Density Carbon Skin	High Density Carbon Skin
Drop Interval	24.8 Hours	24.8 Hours

Figure 7.1.3 Table of the Features of Each One-Way Re-Entry Vehicle.

7.2 Space Manufacturing

7.2.1 Spacecraft Manufacturing Facilities

Bellevistat provides two automated 200x80x80 meter **shipyards for the manufacturing of spacecraft**. The spacecraft constructed will be sold to emerging space businesses to promote the new economic market in space. A variety of spacecraft are manufactured to suit different needs, primarily interplanetary exploration and lunar landings. Construction takes place in the Manufacturing Center where the shipyards can develop any variety of spacecraft. Each construction yard consists of multiple levels that reach from the walls into each bay. These floors provide construction versatility by means of retraction inside the bay walls to construct larger ships or extend to enclose a smaller area. Also contained within the floors are basic utilities, which can be accessed by a set of robotic construction arms that move about the construction yard and actually build the ships. For convenient access, the construction yards open through the docking areas on the Manufacturing Center. (see Figure 5.1.1)

7.2.2 Supply Components for Future Space Construction Projects

Bellevistat's manufacturing center is the key to its success. From their respective storage areas, materials are shipped to the necessary machinery inside the Manufacturing Center for creation and assembly. Multiple sets of machinery are in place inside the Manufacturing Center for the creation and assembly of final products. Although each different machine group is individual to its material type (one line for every major material that is collected from the asteroid), the changing out of plates and contact surfaces that work with the materials allows the changing over of machines from a major substance to any less common one. Major materials include Aluminum, Titanium, Silicon, Carbon, and Iron. The manufacturing lines in Bellivistat's Manufacturing Center include machinery for **every different walk of industry**, heavy or no. The heavy industry lines deal primarily with the construction and manufacturing of spacecraft and machinery use machinery for rolling, shearing, cutting, grinding, and welding metals to create the products. Other lighter industries including the manufacturing of pharmaceuticals, synthetic textiles, plastics, and electronics use circuit printing machines, smaller scale forges, automated looms, and bacteria farms. These in-place facilities allow the creation of any customer request, be it customized construction/manufacturing machinery, typical construction materials, new spacecraft, a new drug,

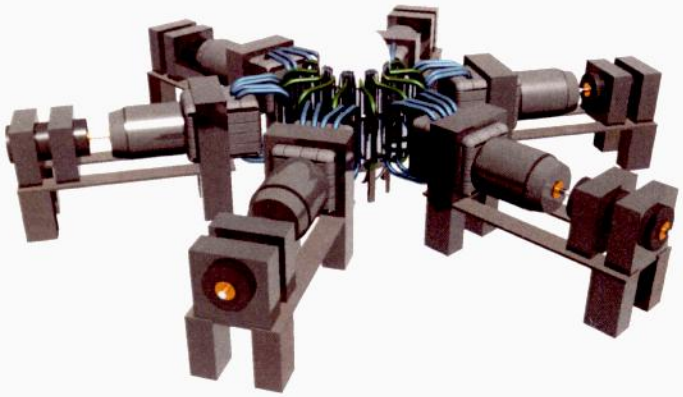


Figure 7.2.1 The Nuclear Reactor that Gives Power to the Manufacturing Center with Generators Attached.

power generation systems, communications devices, clothing, medicines, other textiles, computers systems, security robotics, or an alarm clock. Bellevistat's ability to quickly change its manufacturing focus and adapt to any type of customer request makes its versatility and manufacturing capability unmatched anywhere else.

7.2.3 Specialized Equipment for Space and Lunar Construction

Because Bellevistat is the base for future space-based construction, supplying equipment for construction is a very profitable business. The opportunity for renting or buying earth-like mining equipment is available to any person or company. Equipment is much like earth based mining and construction equipment (cranes, bulldozers, dump trucks, jack hammers, explosives, bucket wheel excavator, tunnel boring machines, backhoes, excavators, road graters, pavers, etc.), however, they have more external protection from radiation and dust-particles and are completely enclosed vehicles. (See section 5.5) Individual parties can also order specialized equipment for more specific needs.

7.3 Tourism

7.3.1 Desire to See Bellevistat

Being that Bellevistat is only the second settlement in Earth orbit, it is a natural gravity well for tourist populations. Bellevistat expects up to 1,000 people in a transient population at any time, any number of which may be tourists, miners, vacationers, or business peoples. Viewing platforms at multiple different operational areas allow visitors to witness the operations and infrastructure below Bellevistat's surface, including in Manufacturing Center. A small human transportation system runs people between Bellevistat and the Manufacturing Center for viewing and equipment supervision. Of special interest are the **mining and manufacturing sections**, which both require guided tours due to the hazards, and the entertainment district. Bellevistat's mass transit system is open for transportation to each of these sections via the aquatation tube monorail (see section 3.2). Introductory guided or unguided tours of the entire station (only part of the station in the unguided case) are also offered where the tourist gets to view the operating parts of the station in addition to the entertainment district, different hotel options, restaurant options, the Bellevistat Museum, and the variety of entertainment options that exist on Bellevistat.

7.3.2 Hotel Locations and Visitor Amenities

Most hotels on Bellevistat are located in the urban areas on top of the highest tier along with restaurants, coffee shops, shopping centers and other commercial areas that are provided for tourists as well as the local population of Bellevistat. A few hotels are strategically placed in the residential areas to show what it is like to be a resident living in space. An additional guest feature on Bellevistat is the provision of access to robotic systems and secured computer access. (See section 5.3) These robotic provisions can be used as a guide to the station and for the upkeep of private living space. Computer access can be utilized to check email, view Bellevistat's system status and functionality in addition to any number of basic computing functions outlined in Automations, including word processing, music creation and storage, and other functions expected on a personal computer. (See section 5.3)

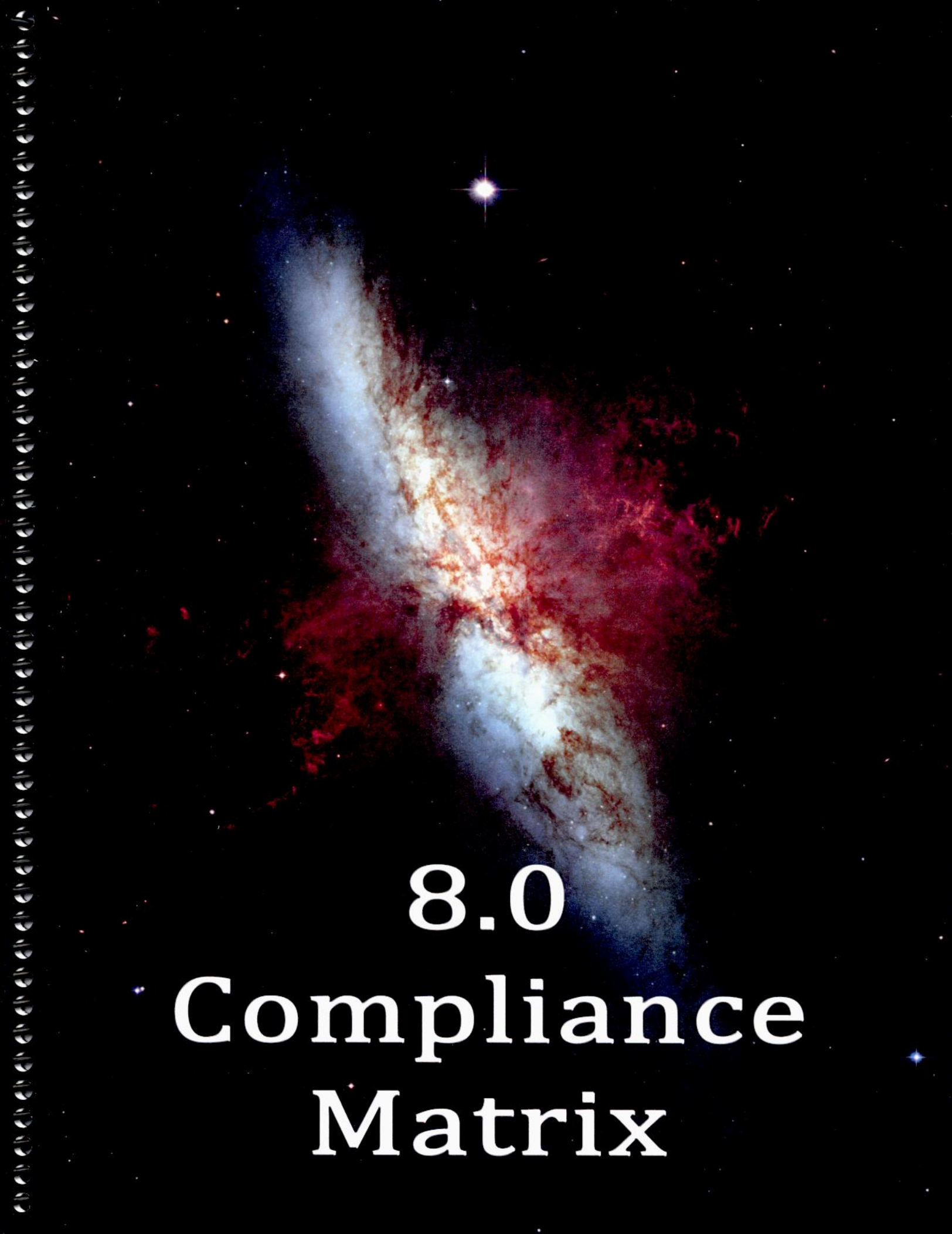
7.3.3 Major Tourism Locations

Major tourist attractions on Bellevistat include malls, hotels, the entertainment district, and restaurants are located primarily on the top terrace of the Residential Ring. The manufacturing, refining, and station workings are mostly contained in the Manufacturing Center and are a major attraction for the more entrepreneurial sort of guests. Incorporated with the tour in 7.3.1, maps are provided to all tourists showing areas where entertainment, dining, and lodging may be found as well as tourist attractions. Opportunities for private mining enterprises are provided at their company's own risk and expense. A museum is also available to the public describing the processes and history of Bellevistat. **Zero-g games** are optional on the tours, games such as (zero-g) laser tag, dodge ball, soccer, basketball, or any other sport (see section 4.5).

Figure 7.3.1 View From Observation Booth Into The Manufacturing Center

7.3.4 Opportunities for Tourists to View Mining, Refining, and Manufacturing

Opportunities to view the mining, refining, and manufacturing in the Manufacturing Center are provided via tours. The rail system in the transit corridor is also used to transport interested tourists and machinery supervisors to the Manufacturing Center (See section 3.2) A small viewing area is provided at the end of the conduit that looks directly into the Manufacturing Center where visitors can see the manufacturing, refining, and construction operations.



8.0 Compliance Matrix

8.0- Compliance Matrix

Requirement	Where Found	Page #
1.0 – The contractor will describe the design, development, and construction of the Belevistat space settlement in Earth orbit	Section 1.0	3
1.1 - The contractor will develop plans for operating and maintaining community	Section 1.0	3
2.0 – Provide safe and pleasant living and working environment for 18,000 residents and 1,000 transient	Section 2.0	5
2.0 – Design must enable residents to have views of space and earth	Section 2.0	5
2.1 – Identify large, enclosed volumes and their uses on exterior design drawings	Figure 2.1.1 and Section 2.1.1	5
2.1 – Show dimensions of major structural components and design features on exterior drawings	Figure 2.1.1	5
2.1 – Identify construction materials for major hull components	Section 2.1.2	6
2.1 – Specify volumes where artificial gravity will be maintained, means of maintaining it, and rational for selecting rotation rate and magnitude	Figure 2.1.5	7
2.1 – Identify volumes maintained in zero or low-G environments	Section 2.1.3	6
2.1 – Identify volumes maintained in pressurized or unpressurized environments	Figure 2.1.1	5
2.1 – Specify means for protection from radiation and debris penetration	Figure 2.1.4	7
2.1 Minimum Requirements		
An overall exterior view of the settlement with major visible features (solar arrays, antennas, telescopes, etc.)	Figure 2.1.1	5
Show rotating and nonrotating segments	Figure 2.1.5	7
Show pressurized and nonpressurized sections	Figure 2.1.1	5
Indicate functions inside of each volume	Section 2.1	5
2.2 – Specify allocation of interior down spaces with areas designated and dimensions labeled	Section 2.2.1	7,8
2.2 – Show residential, industrial, commercial, agricultural, and other zones	Figure 2.2.1 and Figure 2.2.2	7
2.2 – Specify volumes and state how microgravity and unpressurized facilities are utilized	Section 2.2.3	8,9
2.2 – Show orientation of down surfaces with respect to overall settlement design and vertical clearance for each area	Figure 2.2.6	9
2.2 Minimum Requirements		
Overall map or layout of interior area showing total down area inside artificial gravity volumes	Figure 2.2.1 and Figure 2.2.2	7
Show use of these areas	Section 2.2.1	7,8
Show dimensions of areas designated for specific uses	Figure 2.2.6	9
2.3 – Describe the process used to construct the settlement via sequence of major structural component assembly	Section 2.3	9
2.3 Minimum Requirements		
Drawings showing several intermediate stages of assembly	Figure 2.3.1-2.3.6	9
2.4 – Show structural attachment to and/or construction on captured asteroid for harvesting materials	Figure 2.4.2	10
2.4 – Include systems to minimize transfer of asteroidal surface material (dust) into areas of the settlement where they can do damage and adversely effect the quality of life	Section 2.4.2	11
2.4 – Identify locations in the settlement and/or on the asteroid where refining operations will be conducted	Section 2.4.3	11
2.4 Minimum Requirements		
Incorporate captured asteroid in overall exterior design and/or drawings of	Figure 2.1.1	5

structures on asteroid surface		
2.5 – Docking port facilities must be situated so that incoming vehicles are unlikely to damage pressurized volumes if they deviate from their approach paths	Section 2.5.1	11
2.5 – In the event of an accident provide three widely separate docking spaces	Section 2.5.1	11
2.5 Minimum Requirements		
Include multiple docking port facilities in exterior design drawings	Section 2.5.1	11
3.0 – Describe facilities and infrastructure necessary for building and operating the community	Section 3.0	14
3.0 – Include conduct of business and accommodations for incoming and outgoing space vehicles	Section 3.0	14
3.1 – Identify an orbital location for Belevistat and reason for it's location	Section 3.1.1 and Figure 3.1.1	14
3.1 – Identify sources of material and equipment to be used in construction and operations	Section 3.1.2	14
3.1 – Specify means for transporting materials to Belevistat location	Section 3.1.2	14
3.1 – Storage between arrival and use in the station of materials	Figure 3.1.2	14
3.1 Minimum Requirements		
Chart or table identifying materials and equipment required in construction process and from where and how the materials are shipped	Figure 3.1.2	14
3.2 – Show elements of basic infrastructure required for the activities of residents and customers of the station	Section 3.2	15
3.2 – Show food production (Including growing, harvesting, storing, packaging, delivering, and selling)	Section 3.2.1	15
3.2 – Electrical power generation (Specify Kilowatts) Distribution and allocation for specific uses	Section 3.2.2	15
3.2 – Specify internal and external communication systems	Section 3.2.3	16
3.2 – Specify internal transportation system	Section 3.2.4	16
3.2 – Show atmosphere, climate, and weather control (identify air composition, pressure, and quantity)	Section 3.2.5	18
3.2 – Specify household and industrial solid waste management	Section 3.2.6	18
3.2 – Specify water management (required water quantity and facilities)	Section 3.2.7	18
3.2 – Specify day and night cycle provisions	Section 3.2.8	19
3.2 – Define transportation corridors and means of access throughout and between facilities	Section 3.2.4	16
3.2 – Show designs of transportation vehicles for use in and around the station	Section 3.2.4	16
3.2 – Include a diagram and/or map to show movement of exports from sources to port facilities	Figure 3.2.10	19
3.2 – Drawings of transportation vehicles and rights of way	Figure 3.2.8	20
3.2 Minimum Requirements		
Specify dimension drawings showing systems which provide required infrastructure and as appropriate, their configurations	Section 3.2	15
3.3 – Identify existing or new on orbit infrastructure required to develop or sustain settlement operations	Section 3.3.1	19
3.3 – Provide concessions for the commercial development and operation of vehicles for transporting goods and personnel from Earth orbit to the Belivistat orbital location and/or for transporting construction materials from extraterrestrial sources	Section 3.3.2 and Figure 3.3.1	19,20
3.3 Minimum Requirements		
Chart or table describing space based infrastructure in vehicles required for settlement operation	Section 3.3.1	19
Include notation of which will be included in this contract and which will be developed commercially without Foundation Society investment	Section 3.3.4	20
3.4 – For efficient land use grow plants for human consumption in landscaping of residential and commercial areas	Section 3.4	21
3.4 – Growing of animals and animal feed must be conducted in separate areas	Section 3.4	21

3.4 Minimum Requirements		
Specify agricultural description and account separately for production of feed and housing for animals in drawings and tables	Section 3.4	21
3.5 – Develop innovative approaches for design and materials of furniture, interior finishing of residences, plumbing, and kitchen equipment	Section 3.5	21
3.5 Minimum Requirements		
Create a chart or table of material sources	Figure 3.5.2	22
Separately account for materials needed for residential, interiors, and amenities	Section 3.5	21
4.0 – Maintain the traditional comforts of Earth without the sacrifices normally associated with a frontier environment	Section 4.0	24
4.0 – Provide community attributes that citizens of Earth's large towns might enjoy (comfortable houses, fine food, access to entertainment, etc.)	Section 4.0	24
4.0 – Assure natural sunlight, views of space outside, and Earth below the settlement are readily available to residents	Section 4.0	24
4.1 – Provide facilities for services that residents could expect in a comfortable modern community environment (housing, education, entertainment, medical, parks and recreation, etc.)	Section 4.1	24
4.1 – Provide variety and quantity of consumables and other supplies	Section 4.1 Figure 4.1.2	24,25
4.1 – Provide public areas designed with open space and consideration of psychological factors	Section 4.1 Figure 4.1.1	24
4.1 – Depict/specify means of distributing consumables to residents	Section 4.1 Figure 4.1.2	24,25
4.1 Minimum Requirements		
Maps and/or illustrations depicting community design and location of amenities with dimensions/distance scale	Section 4.1 Figure 4.1.1	24
Identify percentage of land area allocated to roads and paths	Section 4.1	24
4.2 Provide designs of typical residential homes showing room sizes	Section 4.2 Figure 4.2.1-4.2.3	26
4.2 Minimum Requirements		
External drawing and interior floor plan of at least one home design with dimensions (sq ft) and required number	Section 4.2 Figure 4.2.1-4.2.3	26
4.3 – Designs of systems, devices, and vehicles used by humans inside and outside of settlement with sizes clearly indicated	Section 4.3.1 Figure 4.3.1	27
4.3 – Systems, devices, and vehicles will consider enhancement of productivity	Section 4.3.2 Figure 4.3.2	28
4.3 – Identify means for people to move about safely and in a predictable fashion in low gravity environments of the station	Section 4.3.3 Figure 4.3.3	28
4.3 – Provide spacesuit designs for work outside of pressurized settlement volumes	Section 4.3.3 Figure 4.3.3	28
4.3 Minimum Requirements		
Chart or table identifying major categories of work throughout the station and tools necessary to complete these tasks	Figure 4.3.2	28
4.4 – Offer residents neighborhoods with a variety of preferences of architectural design and lifestyle choices	Section 4.4 Figure 4.4.1-4.4.4	29,30
4.4 – Describe and show design style examples of at least three neighborhood choices	Section 4.4	29
4.4 Minimum Requirements		
Identify locations and sizes of different neighborhoods on interior map(s)	Section 4.4 Figure 4.4.1	29
4.5 – Provide a variety of activities, entertainment, and recreational options to encourage physical fitness and mental stimulation of residents	Section 4.5 Figure 4.5.2	30
4.5 Minimum Requirements		
Show/describe example of pastimes available for residents	Section 4.5	30

	Figure 4.5.2	
5.0 – Specify number and types of computers, servers, software, network devices, and robots required for Bellevistat's facility, community, and business operations	Figure 5.2.1	34
5.0 – Computer system descriptions include types and capacities of storage media, data collection,data distribution, and user access to networks	Section 5.3.6, Figure 5.2.1	34,38
5.0 – Show robot designs, clearly indicating dimensions and how they perform their tasks	Section 5.0	32
5.1 – Describe use of automation for construction	Section 5.1.1, Figure 5.1.1	32,33
5.1 – Consider transportation and delivery of materials and equipment, assembly of the settlement, and interior finishing	Section 5.1.2, Figure 5.1.1, Figure 5.1.6	32,33
5.1 Minimum Requirements		
Chart/table describing automated construction and assembly devices and purposes of each	Figure 5.1.1	32
5.2 – Specify automation systems for settlement maintenance, repair, and safety functions (backup systems and contingency plans for failures)	Section 5.2.1, Figure 5.2.1	34
5.2 – Define physical locations of computers, servers, and robots for critical functions	Section 5.2.2, Figure 5.2.5	35
5.2 – Emergency external repair robots must survive and accomplish tasks during solar flare activity	Section 5.2.3	35
5.2 – Describe means for authorized personnel to access critical data and command robot and computer systems	Section 5.2.4	36
5.2 – Describe security measures to assure only authorized personnel have access and only for authorized purposes	Section 5.2.4	36
5.2 Minimum Requirements		
Chart/table listing anticipated automation requirements for operation of settlement	Figure 5.2.1	34
Identify computers and robots to meet each automation need	Section 5.2	34
5.3 – Specify automation systems to enhance community living, productivity in work environments, and convenience in residences	Section 5.3.1-5.3.3	36,37
5.3 – Emphasize use of automation to perform maintenance and routine tasks and reduce need for manual labor	Section 5.3.4	37
5.3 – Provide privacy of personal data and control systems in private spaces	Section 5.3.5	38
5.3 – Describe access to community computing and the robot resources of individuals' home and work	Section 5.3.6	38
5.3 Minimum Requirements		
Drawings of robots and computers encountered in everyday life at Bellevistat	All Figures 5.3	36-38
Diagrams of networks and bandwidth requirements to enable computer connectivity	Figure 5.3.4	38
5.4 – Develop automated systems for finishing interior of residences and other buildings (plumbing, wiring, lighting, painting, floor installation, and furniture)	Section 5.4.1, Figure 5.4.1	38
5.4 Minimum Requirements		
Drawings of interior finishing systems in operation with estimated completion time of average building interior	Figure 5.4.2	39
5.5 – Develop automated systems for mining and transporting asteroid ores to refining facilities	Section 5.5.1, Section 5.5.2	39
5.5 Minimum Requirements		
Drawings of mining systems in operation with description of how many human controllers are required	Figure 5.5.1-5.5.2 Section 5.5.3	39
6.0 – Include a schedule for development and occupation of Bellevistat	Section 6.1	41
6.0 – Costs for design through construction phases of the schedule	Section 6.2	42
6.1 – Describe contractor tasks from time of contract award until the customer assumes responsibility for operations of completed settlement	Section 6.1	41
6.1 – Show schedule dates when Foundation Society members may move into their	Section 6.1	41

new homes and when original population will be established in the community		
6.1 Minimum Requirements		
List/chart/draw durations and completion dates of major design, construction, and occupation tasks	Section 6.1	41
6.2 – Specify costs of Bellevistat design through construction in US dollars without inflation	Section 6.2	42
6.2 – Estimate numbers of employees working during each phase of design and construction	Section 6.2	42
6.2 – Justifications for contract costs to design and build settlement	Section 6.2	42
6.2 Minimum Requirements		
Charts/tables listing separate costs associated with different phases of construction clearly showing total costs billed to Foundation Society	Section 6.2	42
7.0 – Provide opportunity to hose a variety of commercial and industrial ventures which may change	Section 7.0	45
7.0 – Include sufficient flexibility to add compatible business types with little configuration change	Section 7.0	45
7.0 – Original configuration must accommodate three major business pursuits	Section 7.0	45
7.1 – Bellevistat will harvest ores from a captured asteroid approximately one kilometer in diameter	Section 7.1.1, Figure 7.1.1	45
7.1 – The asteroid will be attached to the settlement or in orbit nearby (delivery of asteroid will be under separate contract)	Section 7.1.2	45
7.1 – Design "one way" re-entry vehicles, made from asteroid materials and recyclables to transport raw materials and manufactured products to Earth's surface	Section 7.1.3, Figure 7.1.2	45
7.2 – Provide facilities for manufacture and assembly of spacecraft for interplanetary and lunar landing applications	Section 7.2.1	46
7.2 – Bellevistat will serve as a supplier for future large space construction projects, providing components for solar power satellites, antennas, future space settlements, and other projects as requested by customers	Section 7.2.2	46
7.2 – The settlement will provide specialized equipment for large-scale space and lunar construction projects	Section 7.2.3	47
7.2 – Provide machines to perform tasks similar to Earth-based cranes, trucks, bulldozers, and mining equipment.	Section 7.2.3	47
7.3 – Anticipate tourist's desire to visit and explore Bellevistat	Section 7.3.1	47
7.3 – Show locations of hotels and describe amenities for visitors.	Section 7.3.2	47
7.3 – Show locations where tourists will be encouraged to go and what they will be encouraged to do on interior settlement maps	Section 7.3.3	48
7.3 – Provide opportunities for tourists to observe mining, refining, and manufacturing operations from safe vantage points	Section 7.3.4	48
7.3 – show and describe zero-g games that will appeal to visitors and residents	Section 7.3.3	48
7.3 – show and describe visitors' access to and use of Bellevistat's communications, computing, and robot resources	Section 7.3.2	47
7.3 – Include security to prevent unauthorized access	Section 7.3.2	47

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