Bellevistat

The Foundation Society

NORTHDONNING HEEDWELL

DURANGO HIGH SCHOOL
DURANGO, COLORADO, USA

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1.0 EXECUTIVE SUMMARY

1.0 Executive Summary

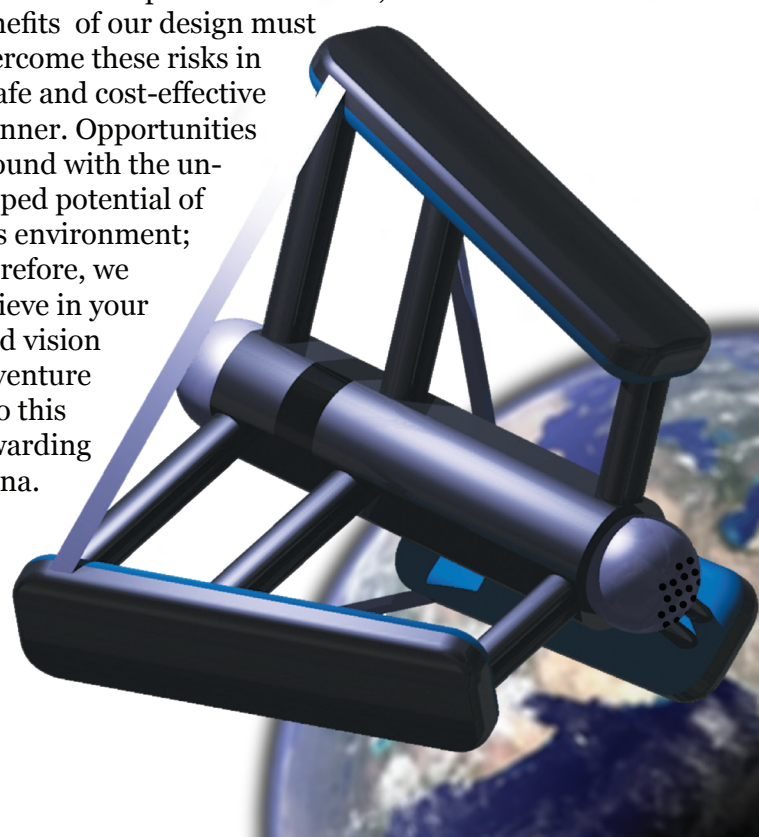
As a settlement on the verge of a new and unprecedented frontier, Bellevistat has the intensity of those brave enough to push the bounds of exploration and innovation. The dangers present at the Lagrangian point show no mercy, therefore we designed Bellevistat with versatility and variety in mind to meet the ever-changing challenges inherent in our new endeavor with exceptional safety measures. Converging on this new challenge, Northdonning Heedwell created Bellevistat to embody the adaptability and safety features necessary to secure the abiding success of your investment.

Through new technology and our location, Bellevistat utilizes the surrounding asteroids, the moon, and the properties of space to capitalize on the promising market of rare earth metals and buckystructures. Catering to the booming demand for buckystructures and rare earth metals we embrace our role as a refinery and manufacturing facility through which we can push the boundaries of innovation wth new and refined materials. With new materials Bellevistat allows for future generations to push the boundaries of space exploration.

Our most notable examples of this forward-thinking practicality and innovation appear in all design disciplines:

- Our strategic community layout and terracing system enables extensive lines of sight that increase both comfort and variety in views. Incorporating foliage and open space into our layout, we emphasize the beauty within our settlement.
- The revolutionary Li-Fi technology promotes exemplary internal communication through personal Holocom devices. Li-Fi enables the transfer of information through light emission, which supplies incredible connection speeds throughout our settlement.
- The Recreational Space Jacket has state-of-the-art sensors and body monitors and utilizes a high definition display to ensure safety for all residents inside our operations core. This innovation in spacesuit technology supplies our residents with extreme safety throughout Bellevistat.
- Innovative and versatile Autofy robotics transform Bellevistat into an efficient and refined settlement. The extremely redundant design of Autofy robotics allow for ease of repair and create a state of absolute safety around Bellevistat. With Bellevistat reaching new heights through our robotic systems we can render a higher value for your investment.
- Our extensive silicon buckystructure production facility takes full advantage the versatility of this material and the wide variety of its potential applications. Our leading position in this extremely profitable market quickly defrays the cost of settlement construction.

Northdonning Heedwell recognizes the significance of your investment in selecting us to move forward with you to make Bellevistat a reality. Understanding the myriad risks inherent to the space environment, we know the benefits of our design must overcome these risks in a safe and cost-effective manner. Opportunities abound with the untapped potential of this environment; therefore, we believe in your bold vision to venture into this rewarding arena.



2.0 STRUCTURAL DESIGN

NORTHDONNING HEEDWELL

2.0 Structural Design

We at Northdonning Heedwell envision Bellevistat as a safe, stable community with versatile features to carry it into the future and enough variety to suit all of its residents. Our structural design embodies this goal with myraid safety features such as the buckystructure band which works with the spokes to create multiple load paths and three residential wings that allow residents to choose their preferred atmospheric pressure level and gravity level. Our 0.9g terrace level houses most commercial and community regions, drawing residents together to work and socialize and preventing the isolation that would otherwise be created by the many varied living options.

2.1 External Configuration

Bellevistat's non-rotating operations core and rotating operations shell provide ideal industrial space for your current and future industrial pursuits because they are available in a variety of pressures and two gravity levels, 0g and 0.25g. Three residential wings exemplify comfort with our terracing system that creates exceptionally long lines of sight at 1513m.

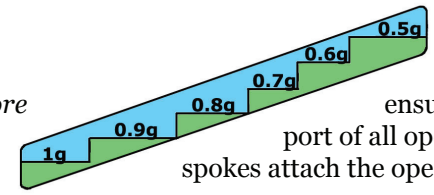


Image 2.1.1 Bellevistat's terracing system increases lines of sight for varied views

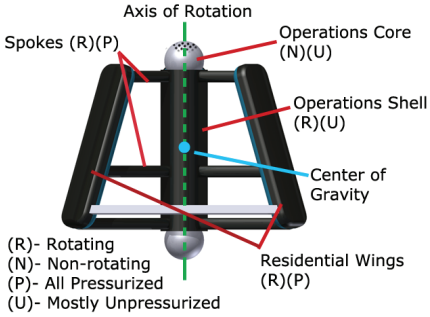


Image 2.1.2 Three residential wings give residents a choice of atmospheric pressure levels.

2.1.1 Overall External Configuration

Bellevistat features strategically-terraced residential wings, optimizing views of space and maximizing lines of sight within the settlement to 1513m (see Image 2.1.1). The centrally-located operations shell and core ensure easy and efficient transport of all operation processes. Since our spokes attach the operations shell to the residential wings for a structurally sound connection, they double as a reliable means of transport (see Image 2.1.2). Each residential wing is pressurized to a different level, allowing residents to choose between 0.6 atm, 0.8 atm, and 1.0 atm. To combat stresses generated by the rotating Bellevistat wings, Northdonning Heedwell envisions a buckystructure band with supreme tensile strength encompassing the residential wings. The band, in concert with the spokes, increases safety by creating multiple load paths.

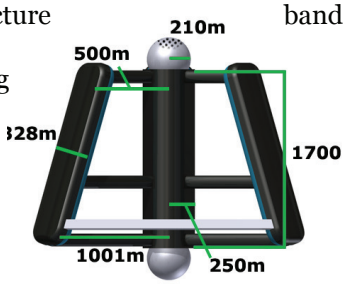


Image 2.1.3 Bellevistat's large radius increases rotation rate and therefore comfort.

2.1.2 Large Enclosed Volume Allocation

Bellevistat's operations regions stabilize the settlement's weight distribution and increase efficiency (see Image 2.1.4). Residents can easily access versatile business and commercial volumes, available for rent in a variety of pressures and sizes, through the

Table 2.1.1 Bellevistat's design provides ample space in every region with a mind towards versatility and the future

Component	Volume One (m3)	Volume All (m3)	Surface Area One (m2)	Surface Area All (m2)
Residential Wing	90,500,000	272,000,000	1,470,000	4,400,000
0.5g Spoke	76,300	229,000	20,300	60,900
0.8g Spoke	108,000	323,000	28,700	86,100
1.0g Spoke	156,000	467,000	41,500	125,000
Operations Shell	160,000,000		4,670,000	
Operations Core Endcap	26,600,000	53,300,000	363,000	725,000
Operations Core Cylinder	164,000,000		1,870,000	
TOTAL	650,000,000		11,900,000	

0.8g and 1.0g structural spokes. Also, the settlement operations region consolidates necessary functions in a central location. To stabilize Bellevistat's center of gravity, industrial storage is located in both endcaps of the operations core. Especially important with storage separated into two major facilities, our main transportation shaft running the length of the operations core effectively moves materials among all regions.

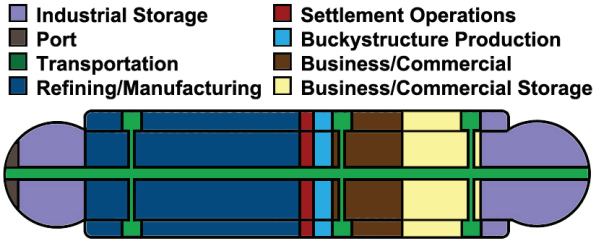
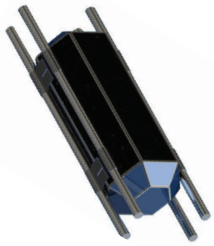


Image 2.1.4 Volume allocation within the operations regions facilitates easy transport of materials

2.1.3 Structural Interface

Because we at Northdonning Heedwell recognize dust as a major concern for all mechanical systems operating in space, we equipped Bellevistat with a structural interface coated with self-lubricating hard carbon thin-film coating to eliminate the dust-attraction problems associated with magnet-based interfaces. Three continuous rings situated at the junction between the rotating operations shell and the nonrotating operations connect the two volumes, and the hard carbon coating decreases friction along these rings. Our accelerating shuttle system facilitates easy and safe transportation of residents and materials between the operations core and the rotating portion of the settlement (see Image 2.1.5). Additionally, these three interface points, aligned with the spokes, allow for safe separation of materials heading for different destinations. One track transports residents, and the other two tracks transport industrial materials.

Image 2.1.5 Our accelerating rail and pod system moves residents and materials safely between rotating and non-rotating volumes



2.1.4 Hull Composition

We recognize the need for a hull with fracture-toughness, radiation shielding, and thermal insulation. Thus, we at Northdonning Heedwell designed Bellevistat's hull composition to employ an array of tested, trusted materials and innovative methods like silicon buckystructures and negatively thermal expanding crystals to ensure the very best available materials technologies work together to protect and support your residents and your investment. Silica aerogel, with its low density and transparent qualities, insulates and absorbs shock from micrometeoroid impacts. A combination of amorphous polycarbonate and leaded laminated acrylic glass improves upon standard bulletproofing technology, with the added benefits of total clarity and radiation shielding (see Table 2.1.2). Our uniquely redundant and diverse system of lead in the acrylic, coupled with the high hydrogen content of polycarbonate shields residents from a wide spectrum of dangerous radiation. Our opaque hull components utilise the same hydrogen-rich properties of high-density polyethylene to shield residents from solar and cosmic radiation. Unlike liquid water, our solid radiation shielding methods maintain their form even in the event of a micrometeoroid impact, rather than complicating matters and increasing your recovery costs by flowing out of the exposed region. Penetration-resistant buckystructure fabric completely shields against micrometeoroid impact, especially when backed up by the shock absorption of silica aerogel and the fracture toughness of our ferronickel alloy. This ferronickel alloy also aids in settlement structural integrity by curing membrane stresses induced by interior atmospheric pressures. The lunar surface contains myriad iron resources along with titanium and niobium, and Near Earth

Table 2.1.2 Polycarbonate and leaded laminated acrylic glass protect residents from radiation and micrometeoroid impacts.

Material	Thickness	Purpose
EXTERIOR	*EXTERIOR*	*EXTERIOR*
Amorphous polycarbonate	0.2m	impact resistant, radiation protection
Leaded laminated acrylic glass	0.2m	impact resistant, radiation protection
Amorphous polycarbonate	0.15m	impact resistant, radiation protection
Silica aerogel	0.2m	thermal insulation, shock absorption
Amorphous polycarbonate	0.2m	radiation protection, impact resistant
INTERIOR	*INTERIOR*	*INTERIOR*

Material	Thickness	Purpose
EXTERIOR	*EXTERIOR*	*EXTERIOR*
Buckystructure fabric	4 layers	penetration resistant
High-density polyethylene	0.3m	radiation protection
Silica Aerogel	0.2m	thermal insulation, shock absorption
Chlorinated polyvinyl chloride	0.05m	thermal expansion
Negatively thermal expanding crystals	0.1m	thermal expansion
Ferronickel alloy	0.3m	Fracture toughness
INTERIOR	*INTERIOR*	*INTERIOR*

Table 2.1.3 Polyethylene protects residents from radiation, and silica aerogel insulates the settlement

Asteroids provide ample nickel; these materials compose the key components of our refined ferronickel alloy. In using locally-sourced materials for this alloy, we create a more cost-efficient hull. Furthermore, polyethylene's strength gives it the ability to deflect micrometeorites and take the impact of larger objects (see Table 2.1.3). Chlorinated polyvinyl chloride balances with negatively thermal expanding crystals, a new breakthrough in materials technology, to combat the thermal expansion created by Bellevistat moving in and out of the Earth's shadow. These also expand to block hull breaches (see Section A.1).

2.1.5 Volume Isolation

In case of an emergency, Bellevistat's system of bulkhead-creating nets isolate damaged or dangerous settlement regions. Within the habitable residential wings, the ceilings hold buckystructure nets rolled up at intervals above each terrace interface; these nets deploy down onto residential areas when an emergency arises (see Image 2.1.6). There they attach via electromagnets to permanent airtight and insulated safe buildings that have airlocks in place of doors. During normal settlement operations, these safe buildings function as entertainment facilities, assembly halls, and hospitals. Two nets deploy on either side of the safe buildings, providing four nets for total isolation of each residential area. Electrorheological nanofluid (ER fluid) disperses downwards on both sides of the net, flowing from flexible plastic tubing woven into the nets for complete coverage (see Image 2.1.7). A minor electrical charge then runs through this viscous fluid, creating a solid wall 2.5cm thick (see Section A.1). With all four nets combined, the barrier is 10cm thick. All electrical power used in the ER Fluid walls comes a small generator separate from the rest of the electrical infrastructure on the settlement, ensuring safe, reliable operation in emergency situations. The buckystructure net inside provides thermal insulation and tension strength, while the ER fluid ensures a complete airtight seal in case of air contamination or depressurization. Unlike other bulky isolation systems, the fluid nets are space efficient and unobtrusive when not in use because they are rolled up for storage.

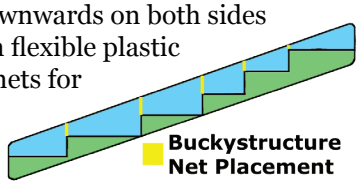


Image 2.1.6 Buckystructure nets can separate each terrace in each residential wing, effectively containing dangerous situations for maximum safety

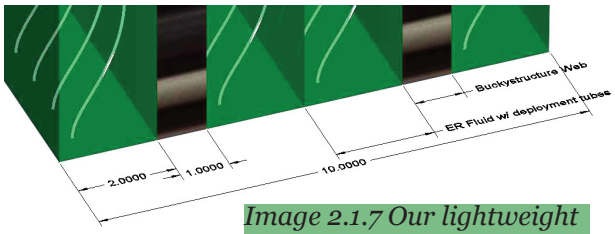


Image 2.1.7 Our lightweight isolation system protects residents in any emergency

2.1.6 Artificial Gravity

Bellevistat rotates with a period of 63.5 seconds to provide gravity in the residential wings, spokes, and operations shell. Placed around the exterior of the residential wings, 30 Multifunctional Interplanetary Propulsion Rockets fueled by hydrogen propellent initiate rotation. To reduce your wait time and total cost for spin-up, we selected these thrusters which accelerate the settlement in one month and use locally-mined hydrogen from Near Earth Asteroids as propellent. After the initial acceleration, magnetoplasmadynamic thrusters, with their continuous burn, maintain settlement rotation. By placing an electron-emitting cathode panel downstream of the charged particles expelled from the magnetoplasmadynamic thrusters, we neutralize the positive charge of the ion exhaust beam, enabling our settlement to remain neutrally charged. In placing thrusters also on upper and

lower portions of the operations core, we equip it to maintain its stationary, non-rotating position. Because these thrusters are situated on all major directional faces of the settlement, they can also accomplish any necessary orbital correction to keep Bellevistat at L4 or stabilize the settlement's rotation in case of disruption by micrometeoroid impact.

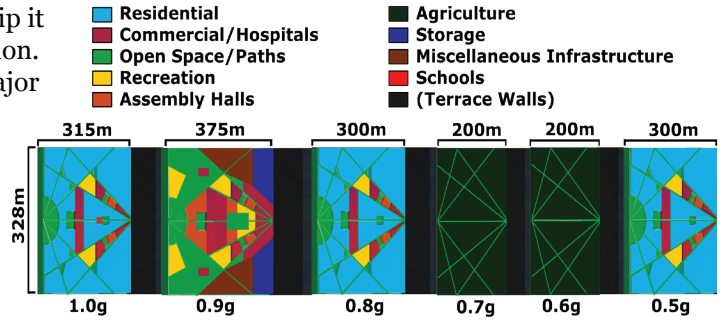


Image 2.2.1 Open space interspersed throughout the residential terrace levels promotes community

2.2 Down Area Allocation

We at Northdonning Heedwell understand that Bellevistat residents desire comfort and variety. Thus, we have designed our unique down area allocation to provide both of these. Plentiful open space provides regions for community interaction and psychologically-pleasing variety in residential regions.

Our unique double-sunburst layout allows residents to take best advantage of the varied gravity living options provided by our terracing system (see Image 2.2.1). Close to the rising terrace faces, taller buildings and more dense residential and commercial regions do not obstruct views. Near the terrace edges, open space facilitates the lines of sight so integral to Bellevistat's design, creating a more comfortable residential region with the reduction of the Coriolis effect. Since we value the health and safety of your residents, we have placed all schools and educational facilities in the 1g regions to promote healthy childhood bone mass development. Integration of small amounts of commercial area into the residential terrace levels increases convenience. We acknowledge that strategic community layout can ward off isolation and, moreover, bring the community together. Therefore, we place the majority of commercial, community, recreational, and

Table 2.2.1 Bellevistat's down area allocation creates an inclusive and efficient community layout

Function	Percentage of 0.5g and 0.8g	Percentage of 0.6g and 0.7g	Percentage of 0.9g	Percentage of 1g	Overall Per Resident (m^2)	Overall Percentage
Residential	63.72%	0	0	62.69%	49	32.89%
Open Space	13%	0	31.21%	12.79%	20	13.42%
Hospitals	0.78%	0	0.63%	0.77%	0.8	0.54%
Assembly Halls	1.95%	0	4.68%	1.92%	3	2.02%
Recreation	3.90%	0	6.37%	3.84%	5.04	3.38%
Commercial	4.95%	0	10.3%	4.86%	12.54	8.43%
Storage	0	0	15.6%	0	5	3.35%
Miscellaneous Infrastructure	0	0	21.85%	0	7	4.70%
Transportation	11.7%	0	9.36%	11.52%	12	8.05%
Schools	0	0	0	1.61%	0.42	0.28%
Agriculture	0	100%	0	0	34.18	22.94%
Total	100%	100%	100%	100%	148.98	100%

Table 2.2.2 Wide terraces and high vertical clearances increase lines of sight for more comfortable residential areas

Level	Down Area (m^2)	Radius (m)	Width (m)	Max. Vertical Clearance (m)	Min. Vertical Clearance (m)	Max. Clearance Under Terrace (m)	Min. Clearance Under Terrace (m)
1.0g	310,000	1001	315	172	70	128	27
0.9g	368,000	901	375	194	72	27	5
0.8g	295,000	801	300	192	94	8	5
0.7g	197,000	701	200	157	92	43	8
0.6g	197,000	601	200	122	57	78	43
0.5g	295,000	500	300	119	22	79	78
0.25g	2,660,000	250	1690	70	70	N/A	N/A

open space areas in the 0.9g gravity regions so that all residents of one residential wing come together to work and socialize (see Table 2.2.1). Relegating main agricultural areas to 0.6g and 0.7g minimizes risk of contaminations since these areas are separated from residential and commercial areas. Most residential down area is located at the 0.5g, 0.8g, and 1g levels, but our Terrace Apartments provide more variety for residents who wish to live closer to other gravity levels (see Section 4.2.9).

Although our vertical clearances differ greatly due to the terracing of the residential wing floor, this straight-sloped ceiling provides ample clearance in all areas and increases structural integrity and therefore safety (see Table 2.2.2). Additionally, this system allows for unparalleled 1513m lines of sight, which decreases the negative impact of the Coriolis effect and makes residents more comfortable (see Image 2.2.2).

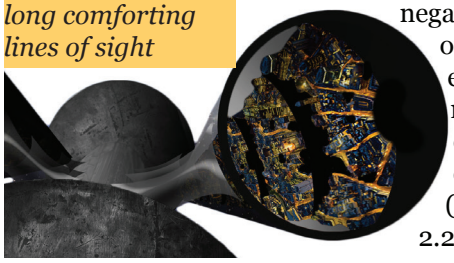


Image 2.2.2 Sloped ceilings and terraces create long comforting lines of sight

2.3 Construction Process

Our Autofy robots construct Bellevistat beginning with the non-rotating operations core and working outwards. Teams of Autofy robots work simultaneously on outer regions of the settlement construction such as the residential wings. In this way, we keep Bellevistat's center of gravity stable throughout the construction process, protecting your investment from the very beginning.

2.3.1 Means to Initiate Artificial Gravity

During the construction process, our innovative Multifunctional Interplanetary Propulsion Rockets accelerate the settlement and initiate rotation (see Image 2.3.11). Using an array of 30 thrusters stabilizes the roll axis, creating a safe one-month spin-up period and protecting your valuable investment. With the large mass of a fully-sustainable space settlement, chemical propulsion systems such as this are the only systems capable of generating sufficient thrust to initiate rotation. During spin-up, AutofyR robots (see Section 5.2) clean solar panels so that exhaust gases do not impede their power production. Hydrogen fuel reduces your construction costs because, just like the components of our refined ferronickel alloy, the raw materials are abundant locally (see Section 2.1.6).

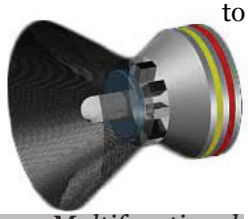


Image 2.3.11 Multifunctional Interplanetary Propulsion Rockets initiate rotation quickly and safely

2.3.2 Interior Construction

For interior construction, multi-layered interior walls create a universal and safe structure in bridging different gravities and supporting residential areas (see Table 2.3.2). Our heat fused lunar adobe, made from lunar regolith, composes the majority of our internal terracing infrastructure. Nickel, mined from Near Earth Asteroids and minimally refined, reinforces the lunar adobe and contributes fracture toughness and tensile strength. To preserve the longevity of the interior structure, a thin vapor barrier of high-density polyethylene on the exterior surfaces reduces atmospheric wear and prevents oxidation. Overall, the structure is rigid enough to keep its form but flexible enough that, when combined with pressure release valves (see Section A.2), it does not to break under great pressure differences, maximizing safety without sacrificing versatility.

2.4 Buckystructure Production Facility

Northdonning Heedwell envisions significant future expansion in the buckystructure market. Therefore, Bellevistat has ample space for current production, future production expansion, and continued research into this exciting technology.

Table 2.3.2 Heat-fused lunar adobe, composed entirely of lunar regolith, creates a strong internal structure

Layer	Material	Purpose	Width (cm)
1	High-Density Polyethylene	Membrane (Vapor Barrier)	0.05
2	Nickel	Fracture Toughness	5
3	Heat-fused Lunar Adobe	Strength, Insulation	25
4	Nickel	Fracture Toughness	5
5	High-Density Polyethylene	Membrane (Vapor Barrier)	0.05

Table 2.3.1 Construction begins with the arrival of the matriarch, reducing costs with in-situ construction.

Phase	Construction Phase Details
1	Matriarch arrives on site from Alexandriat. Matriarch, externally covered in solar panels for power and a port for docking with materials delivery vessels, carries 100 construction panels, several teams of Autofy robots (see Section 5.1), initial refining and manufacturing equipment, and additional stored solar panels. Begin assembling cylindrical portion of operations core (see Image 2.3.1).
2	Complete construction of cylindrical portion of operations core. Begin assembly of operations shell. Attach operations core to operations shell with temporary welds (see Image 2.3.2).
3	Construct first spherical end cap of operations core. Construct docking interface and port facilities (see Image 2.3.3).
4	Construct final spherical end cap of operations core. Prepare operations shell for construction of spokes (see Image 2.3.4).
5	Assemble transportation shafts and elevator shafts extending out to radius of residential wings (see Image 2.3.5).
6	Construct internal infrastructure in operations core and operations shell (see Image 2.3.6).
7	Construct spokes (see Image 2.3.7).
8	Construct residential wings (see Image 2.3.8).
9	Install of thruster arrays, fuel supply, and controlling mechanisms. Begin internal housing, agricultural, and industrial construction. Initiate artificial gravity (see Image 2.3.9).
10	Complete internal infrastructure. Final addition and construction of safety systems including sealing mechanisms and stabilizing buckystructure band (see Image 2.3.10). Residents may now begin process of moving in and inhabiting settlement. Thrusters continue to burn to compensate for the added mass of residents.

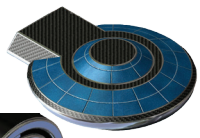


Image 2.3.1 The matriarch contains all necessary materials and equipment for starting efficient settlement construction

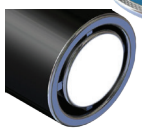


Image 2.3.2 Construction continues with the operations core and shell

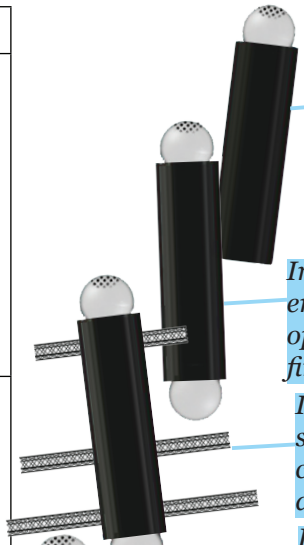


Image 2.3.3 With constuction of the first operation core endcap complete, the settlement has a fully operational port

Image 2.3.4 With both endcaps fully constructed, operations areas are finished

Image 2.3.5 Transport shafts prepare for stable construction of the spokes and residential wings

Image 2.3.6 Internal operations infrastructure equips Bellevistat to begin major refining and manufacturing

Image 2.3.7 Autofy robots construct spokes to support and connect the coming residential wings

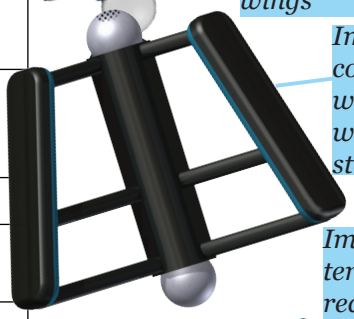
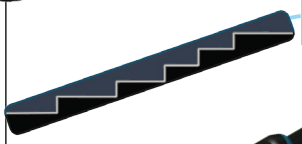


Image 2.3.8 By constructing residential wings at the same time, we keep the roll axis stable

Image 2.3.9 Interior terrace construction uses readily available lunar regolith to reduce costs



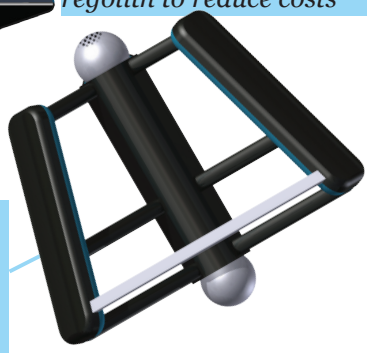
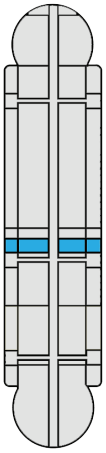


Image 2.3.10 Bellevistat, equipped with the secure buckystructure band, is now ready for residents

Image 2.4.1 The centrally-located buckystructure production facility accomodates both present and future manufacturing needs



Buckystructure production facilities are located within the operations core (0g) and operations shell (0.25g). Anticipating future expansion of this promising market, we have provided 10 times as much down area as the current market requires: 46,450m² with 70m vertical clearance each in the 0.25g operations shell and in the 0g operations core. (see Image 2.4.1). When not in use, this additional space doubles as storage. The production facilities have no specified pressure; instead they have sectionable rooms which can be pressurized to different levels. Optional pressure variety gives Bellevistat researchers the ability to explore new permutations of buckystructures produced under different conditions.

Solar panels and other technologies (see Section 3.2.3) provide 1 MW of continuous electric power for this facility, with nuclear generators in place as a redundant backup measure. To transport buckystructure products between the rotating and nonrotating production facilities, Bellevistat employs its versatile structural interface rail system (see Section 2.1.3), using pods accelerating on self-lubricating rails (see Image 2.4.2). An internal rail system transports buckystructures within the facilities (see Section 5.4.2), including using the convenient central transport shaft in the operations core to access shipping facilities. By tracking each batch through each phase of the production process, our system provides you with the constant information necessary to ensure quality and streamlined production (see Section 7.1.3).

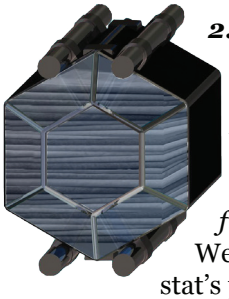


Image 2.4.2 Bellevistat's accelerating pod system efficiently transports buckystructures between rotating and non-rotating production facilities

2.5 Port Facilities

Bellevistat's port seamlessly integrates Northdonning Heedwell's versatile Buckminster Bay docking system to accommodate all current and future vessels.

We strategically designed Bellevistat's port facility to accommodate our Buckminster Bay universal docking system (see Section 5.5) which conforms to any port design. External docking systems allow Bellevistat to accommodate much larger vessels than interior drydock systems. Any craft up to 200m by 200m by 200m may dock with the Buckminster Bay system (see Table 2.5.1). Our continuously running magnetoplasmadynamic thrusters (see Section 2.1.6) stabilize the settlement during the docking process to eliminate disruption to normal operations. Additionally, we recognize that docking with any vessel would inherently shift our center of gravity; thus, a system of weights arranged around the operations core transportation shaft shift to adjust for the added mass and maintain a constant center of gravity. Larger ships orbit alongside Bellevistat. Our system of space tug vehicles (see Section 7.3) load and unload people and cargo from these large ships. This method greatly reduces disruptions to Bellevistat's rotation and orbit, thereby increasing safety for your residents and visitors alike. We have divided our port facility into two main but adjoining sections: residential for human use and industrial for cargo and ore use (see Image 2.5.1). With these sections next to each other, a vessel carrying both passengers and cargo can dock along the seam. This way, the craft can load and unload passengers and cargo simultaneously, but separately, for a safe and streamlined docking process.

Vessel size	Loading/Unloading Capacity	Storage Capacity
Over 200m by 200m by 200m	2 (space tug)	N/A (orbital storage)
Up to 200m by 200m by 200m	2 (Buckminster Bay)	N/A (orbital storage)
Up to 50m by 50m by 100m	10 (Buckminster Bay)	20

Table 2.5.1 Our docking facilities accomodate a multitude of vessel sizes for ultimate versatility

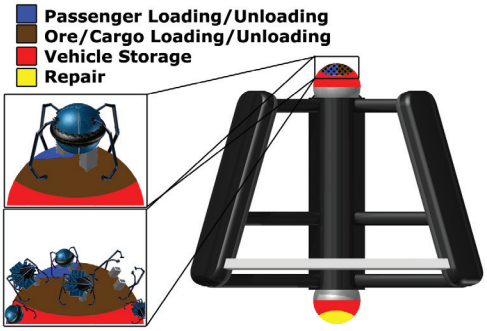


Image 2.5.1 Our innovative Buckminster Bay docking system accommodates a wide variety of vessels

3.0 OPERATIONS AND INFRASTRUCTURE

3.0 Operations and Infrastructure

By seamlessly integrating state of the art technologies with basic human needs, Bellevistat optimizes operations while minimizing disruptions of the normal flow of life within the settlement. A comprehensive system of basic infrastructure maximizes efficiency and productivity while ensuring variety for your residents. Capitalizing on redundancy and diversity, Aynah ensures the safety and well-being of our residents and your investments.

3.1 Construction Materials

Located at the L4 Libration point, Bellevistat is in the optimal position to receive materials from the moon, near Earth Asteroids, Alexandriat, and Earth. We utilize these materials to the fullest of their potential so as to make your settlement structurally secure at the lowest cost possible.

3.1.1 Construction Materials and Equipment

We at Northdonning Heedwell have established the ideal composition of materials to ensure the safety of your residents and to minimize costs. Most of our materials, including nickel, iron, titanium, silicates, cobalt, and carbon, are readily available on the moon and S type asteroids. The proximity of these material rich resources significantly reduces transportation and construction costs. The 2010 TK7 asteroid is one primary asteroid rich with the materials that would otherwise be transported from Earth. Orbiting in the Earth-moon L4 point, it is a nearby source of materials whose immediacy reduces the cost of fuel. From Earth we import only materials we cannot access from other sources, such as high density polyethylene. Alexandriat manufactures the buckystructures and ferronickel alloy needed in the initial construction of the hull. The matriarch transports preliminary construction equipment and materials from Alexandriat to our initial construction site (see Section 2.3.1). From there, Autofy C Robots begin the task of constructing the settlement (see Section 5.1).

Table 3.1.1 Our diverse materials come from a variety of sources, reducing transportation cost when compared to all materials costs

Material	Use	Quantity (m^3)	Source
High Density Polyethylene	nonclear hull	2,919,500	Earth
Silica Aerogel	windows and nonclear hull	2,386,300	S Asteroids Manufactured on Alexandriat
Ferronickel Alloy	nonclear hull	2,919,500	Asteroid
NTE Crystals	nonclear hull	973,200	Earth
Penetration Resistant Buckystructures	nonclear hull	48,700	S Asteroids
Amorphous Polycarbonate	windows	1,100,000	Earth
Leaded Laminated Acrylic Glass	windows	440,000	Moon Manufactured on Alexandriat

3.1.2 Construction Storage

The station matriarch arrives at the L4 orbital location containing solar arrays, Autofy robots, prefabricated construction panels, and a docking port for the delivery of future materials. After the construction of the non-rotating operation core, a specialized facility within the 0g environment provides specialized storage for hull components and miscellaneous materials. Clamping arms on the inner side of the operations core secure preliminary hull panels as they arrive at Bellevistat, containing them until their placement on the exterior of the settlement. Clamping arms also fasten down 20m by 10m by 10m bins for the storage smaller parts and other materials.

3.1.3 Materials Transportation

The Multifunctional Interplanetary Propulsion System Rocket transports all materials from Earth and the moon to our settlement. This revolutionary system significantly reduces fuel costs and materials needed in traditional transportation systems through a multimode unit. While in the Earth's atmosphere, the air-breathing mode eliminates the need for rocket propellant, cutting total

transportation costs and weight in half. Instead of traditional fuel, the air-breathing mode sucks in air, compressing it to about 140 atmospheres before injecting it into the combustion chamber. Once outside the atmosphere, the conventional rocket mode uses traditional liquid hydrogen propellant for propulsion to the settlement. This system can be used for lunar or asteroid transport as well. We can adjust the thrust output from these versatile Multifunctional Interplanetary Propulsion System Rockets dependent on the payload size, which allows us to launch payloads of up to 6m in diameter and 24m long from Earth and payloads up to 7m in diameter and 30m long or flat plates 30m by 15m from Alexandriat.

3.2 Internal Operations Systems

We at Northdonning Heedwell create the most comfortable and safe living environment while capitalizing on available space and resources. Bellevistat efficiently distributes its resources throughout its infrastructure to effectively accommodate basic residential requirements.

3.2.1 Atmosphere

To ensure the optimal comfort, health, and safety of our residents, Bellevistat maintains an air composition similar to that of Earth's, but without harmful gases (see Table 3.2.1). Elevated oxygen levels in the lower pressure zones maintain residential comfort while still mitigating the threats of excess oxygen (see Section 2.1.1). Zeolite molecular sieves filter and regulate gas levels within residential volumes Because of their ability to adapt; they are cleaner and more precise than traditional filtration systems. Excess carbon dioxide collected by our filtration system moves into the agricultural volumes to promote maximum plant growth. From there, a pump circulates the air through the filtration systems removing any harmful gases, and then into the residential areas once cleans. A system of readily exchangeable carbon loose-fill filters provides immediate redundancy for our primary air cleansing system. Synthetic diamond heat sinks, which retain more heat than traditional copper heat sinks, absorb any excess heat to ensure a favorable living temperature of 19 to 23 degrees Celsius. The decrease of temperature in the night hours creates

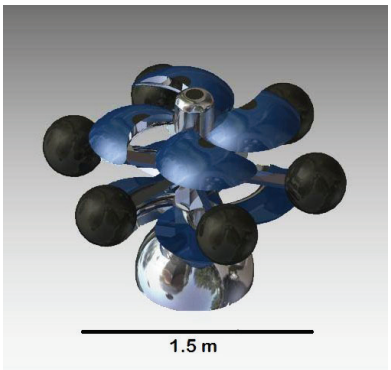


Image 3.2.1 The aesthetically pleasing Zeolite Molecular Sieves control the atmospheric composition

1 Atmosphere

Gas	Percent by Mass	Quantity (kg)
Oxygen	23.2	271,510,000
Nitrogen	75.47	882,430,000
Argon	1.28	15,020,000
Carbon Dioxide	0.046	530,000
Water Vapor	0.004	230,000

.8 Atmosphere

Gas	Percent by Mass	Quantity (kg)
Oxygen	24.42	217,210,000
Nitrogen	74.31	705,940,000
Argon	1.21	12,010,000
Carbon Dioxide	0.043	420,000
Water Vapor	0.017	190,000

.6 Atmosphere

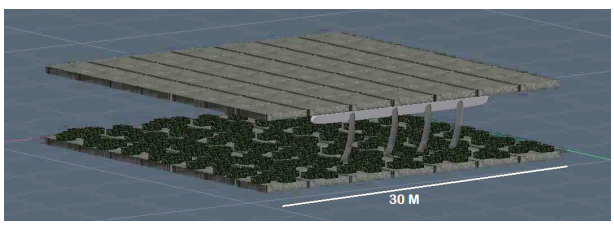
Gas	Percent by Mass	Quantity (kg)
Oxygen	25.48	162910000
Nitrogen	73.33	529460000
Argon	1.12	9010000
Carbon Dioxide	0.039	310000
Water Vapor	0.029	140000

Table 3.2.1 The air composition resembles that of Earth's atmosphere for maximum comfort and health.

a more earthlike feel and aids in sleep. Nine sections of compatible liquid gas tanks line the terrace walls, containing the optimal air compositions to rejuvenate air conditions in emergency situations.

To alleviate the threat of bacteria, fungi, viruses, and minor respiratory problems in our residents, humidifiers maintain a humidity level of 35%-37% at all times within the residential wings. This humidity level allows all automated systems to operate at optimal performance levels without the threat of electrostatic discharge or rust. Humidifiers and consecutive dehumidifiers maintain proper humidity levels within the residential communities. The dehumidifiers consist of water molecule modified molecular sieves. A pressure reactivation regenerates the molecular sieve when fully saturated, increasing the lifespan and significantly reducing cost due.

Image 3.2.2 Flexible harvesting arms gently gather produce, retaining food integrity and mitigating human error.



3.2.2 Food Production

A vertical fogponics system produces all crops and foodstuffs. This system optimizes nutrient absorption by the root hairs and the taproots to create a more efficient growing system while

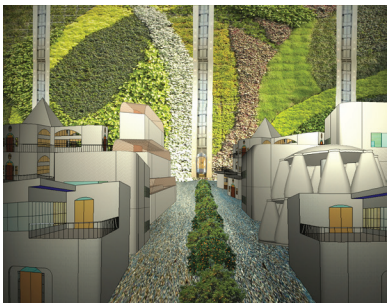


Image 3.2.3 Wall gardens on the rising terrace cliffs integrate nature into the daily lives of your residents and create an aesthetically pleasing environment.

conserving water and space. Within the residential terraces, fruit trees and other living green space grow through a second innovative system: zeoponics. Our zeoponics system conserves water and space through the minimal use of enhanced soil, while allowing healthy root and crop growth. Cultured meat and soy add protein into a vegan diet, while spirulina and chlorella supplements provide other necessary nutrients. Bioprinters within agricultural areas provide a cost effective and innovative alternative to livestock. These printers produce a nearly infinite array of meat to suit all tastes. An automated harvesting system of flexible arms gently gathers crops, retaining food integrity and mitigating human error. Once the robots harvest all food products, they move to large storage, processing, and distribution facilities. Optimal temperatures of 13-21 degrees Celsius maintain plant growth throughout the year while in short term storage; temperatures of 4.2-5.5 degrees Celsius aid nutrient retention before distribution. Sheets of buckystructures provide a light and strong packing material for long term storage, with better thermal performance and less gas absorption, which in turn extends shelf life and

Table 3.2.2 We provide a balanced, diverse diet to allow the residents to thrive.

	Cal/ Person/ day	Grams/ Person/ Day	Cal/11,500 people/2 weeks	Kilograms /11,500 People/2 weeks	Space Amounts (Meters Squared)	Space Allocation
Spirulina	13.5	3	21,73.5	483	40,900	7%
Wheat	202.5	45	32,602.5	7,245	62,000	10.60%
Rice	112.5	25	18,112.5	4,025	34,500	5.90%
Sorghum	270	60	43,470	9,660	57,200	14.90%
Soybeans	427.5	95	68,827.5	15,295	130,000	22.20%
Corn	45	10	7,245	1,610	14,000	2.40%
Vegetables	742.5	165	119,542.5	26,565	204,900	30%
Lagoons	450	50	72,450	8,050	30,100	5%
Fruit	540	120	86,940	19,320	58,500	10%
Total	2803.5	573	451,364	92,253	632,100	100%

minimizes transportation costs. Hemp and other plant byproducts provide a second source of packaging for shorter term needs. Once processed and packaged, pneumatic pipelines distribute food to commercial facilities and residents. Residential HoloCom devices enable the sale of agricultural products within the community. Containers for long-term storage maintain a drier, cooler climate to preserve food integrity and are located within the safe houses of each residential terrace. Each safe house contains food and water storage to sustain residents for a two week interruption. Temperature controlled storage facilities within the agricultural volumes provide versatile and expansive storage for daily food necessities and contingency supplies. In the event of blight or emergency, a central seed bank serves as a storage facility for a variety of cultivars capable of completely replenishing Bellevistat's crops while offering invaluable bio-medical research opportunities. A temperature of -18 degrees Celsius and low oxygen levels delay metabolic processes in the seeds, thus drastically slowing aging and deterioration. Community zeoponics, orchards, and wall gardens on the rising terrace cliffs minimize the negative psychological effects of living in space by providing abundant natural environments for residents and softening the residential area. All plants within residential areas self-pollinate or subsist by artificial pollination.

3.2.3 Electrical Power Generation

Our location within the L4 Libration point and consequent proximity to the Sun makes solar power the most practical and efficient energy source for our settlement. We use a non-traditional form of photovoltaic devices to provide your residents with abundant amounts of electricity (see Table 3.2.2). These devices, dubbed Solar Liners, resemble hollow half cylinders with a bar running through the middle. Light rays reflect from the cylinder onto the carbon-nanotube covered bar. To ensure maximum efficiency and redundancy in the protection of the Solar Liners, the innermost layer of the cylinder is a nickel-copper alloy composed with buckystructures fibers, directly encased in a layer of thermal-insulating buckystructures and all coated in light-refracting buckystructures. The residential wings and operations core receives electricity generated from the solar devices.

Image 3.2.3 The amount of energy each resident receives ensures they have enough power for their basic needs, and then some.

Amount of People	Kilowatt hours
Per Person/Day	10
Per 11500/Day	115,000
Per Residential Pressure Zone	28,750
Entire settlement use (Including one constant Gigawatt hour for manufacturing)	10,115,000

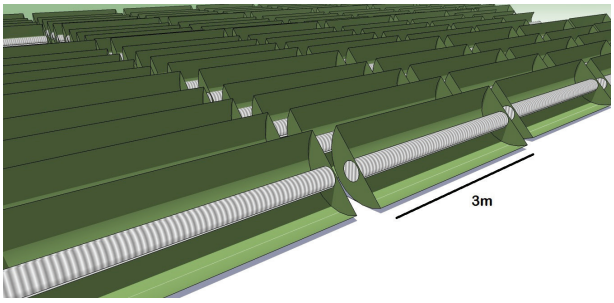


Image 3.2.4 Innovative photovoltaic solar collectors line the outside of our settelment.

Because the surface of Bellevistat cannot accommodate for the high power demands of 10,115,000 kW/h, we have chosen to use a Thorium-based Nuclear power generator as a secondary power system. Thorium is abundant on the Moon's surface making it an economical and efficient choice for you. Our nuclear reactor is located in the .2 gravity levels, a safe distance from the residence and is encased in similar structures as out hull, to serve as a redundant safety measure. Syngas fuel, a fuel able to power a small scale steam energy plant and derived from our waste management system, provides additional immediate redundancy in emergency power situations. All excess energy is storage in a nickel-hydrogen battery for later use. Bellevistat uses the Syngas fuel is the rare but predictable times when the shadow of the earth blocks us from the sun An additional energy system uses the excess heat from the settlement and stirling engines to transform heat into electricity, which can then be directly used within the settlement.

3.2.4 Water Management

To comfortably accommodate the 11,500 residents aboard the settlement at any given time, 19,684,000 liters of stored, circulated, and used water constantly goes through cleaning processes. This allocates 166 liters to the survival and comfort of each resident per day, including agriculture and manufacturing uses. Excess water functions as a

Allocation	Quantity
Industrial	4,412,000
Residential	1,909,000
Agricultural	7,636,000
Contingency Storage	5,727,000
Total	19,684,000

Table 3.2.4 Bellevistat provides plentiful water to fulfill all residential, agricultural, and industrial needs.

ballast system to assist in maintaining a constant center of mass (see Section 2.1.3). Northdonning Heedwell has ten main, independent, water processing plants, one in each residential terrace with a backup system within the operations core. Redundant processing guarantees that, in the unlikely circumstance of a system failure, the increased volume of water processing will not strain the processing in other residential areas.

Reverse osmosis, ultrafiltration, and evaporation filter the separated, liquid waste. Its .0001-micron filter size prevents almost all contaminants from passing through, whereas other filtration systems generally have .5-10 micron holes. If the reverse osmosis system fails, the secondary ultrafiltration system processes all the water until the main system is repaired. Because of the improbability of failure, ultrafiltration backs up reverse osmosis. Evaporation achieves the final distillation of water, after which nutrition and minerals are reintroduced into the water (see image 3.2.1). 20 tanks located within every other safe house store water not being pumped, filtered, or used. An extremely light and durable plastic makes up the exterior of the 1,000,000 liter tanks. The excess storage space allows each residential area to have extra water in the case of emergency. In the unlikely case that all of the filtration systems fail, the water stored within the tanks sustains the settlement with clean water for just over two weeks.

3.2.5 Waste Management

All waste travels to designated processing plants, where a system separates liquids and solids. Solid waste is then separated into organic and non-organic materials; non-organic materials are melted down into pure states and transported to the operations core to be used in manufacturing. Nutrients extracted from the settlement's organic waste travels to the agricultural volumes for use as fertilizer in our zeoponics system, and the remaining solid byproducts are gasified and made into Syngas.

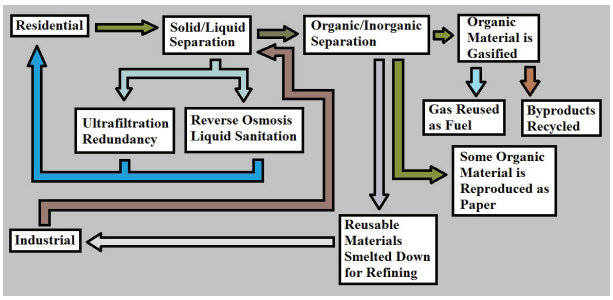


Image 3.2.5 Water is recycled with reverse osmosis and ultrafiltration for redundancy and efficiency. Solid waste is reused for.

Pneumatic pipelines collect solid household waste that is recyclable and transport it to the recycling station in the operations core. Separated non-recyclable organic waste then combines with the solid waste (see Section 3.2.4) to be gasified. This process creates a gas known as Syngas which serves as our energy source when Bellevistat does not have direct sunlight. A small percentage of waste, mostly compiled of industrial tailings, cannot be recycled, gasified, or reused in manufacturing, this waste is compacted into 1000 m^3 cubes and subcontracted onto empty ships that are bound for the moon and buried.

3.2.6 Internal and External Communication Systems

A direct line of sight between Earth and our settlement allows for efficient laser communication. The rapid speed of communication with earth allows residents on Bellevistat to communicate almost instantly with friends and family on earth. Antennas on the exterior of the settlement receive UHF waves as well as emit them as a backup communication system if in the extremely unlikely event that the laser systems fail. Personal communication devices referred to as HoloComs provide person-to-person communication (see Section 5.3). Our settlement uses Light-Fidelity (LiFi) to connect HoloComs with each other and to the

Device	Quantity needed
Rollers	11,000 units
HoloCom	11,500 units
Laser Communication system	30 Units
UHF communication system	20 Units

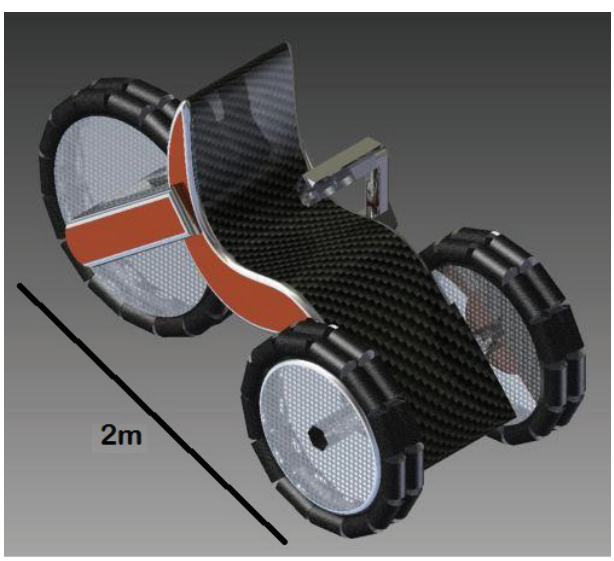
Table 3.2.5 Bellevistat has 500 Rollers less then the population because the communal transportation option reduces the required amount. Every citizen has a HoloCom.

settlement network. LiFi is tactfully integrated into the day and night cycle lighting system as well as residential lights. The unnoticeable, rapid flickering lights allowing data to be transferred at exceptional speeds. The HoloCom, when interfaced with LiFi, allows your residents to interact with their homes and communities instantly.

3.2.7 Internal Transportation

Bellevistat residents use Rollers to move within and between the residential wings (see Image 3.2.2). Rollers are personal transportation units with a large reclined seat, three omni rotational wheels, and a hard carbon coating at all junction points to eliminate friction. Rollers have a small rechargeable battery that charges when the user pedals and can assist the user for longer commutes, omni-rotational wheels allow easy movement around tight turns Rollers can be attached to each other so that families or injured residents can travel with other residents. When attached, the Rollers become more efficient and aerodynamic. Rollers are small in size and require very little additional infrastructure compared to any train or cars, allowing Bellevistat to have more open space, cultivating a community feelings. Rollers interface with HoloCom (see Section 5.3.1), allowing users to easily navigate throughout the settlement.
To move between gravity levels within the terraces, large transparent elevators provide spacious and comfortable travel to residents while encouraging a community feel and providing sweeping views of the settlement. The roomy 40m by 30m by 8m elevators can accommodate large quantities of people during rush hours as well as any Rollers that residents may have. The elevator are receded into the wall to create a sense of security for your residents who are not comfortable with heights.

Image 3.2.6 The Roller has a sturdy design and eases interface with Holocoms and the entire settlement.



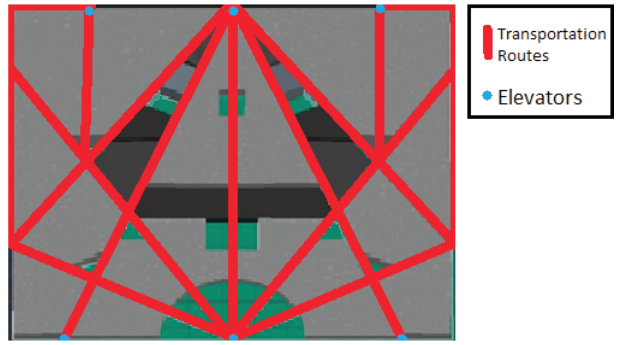


Image 3.2.7 Our conveniently located transportation routes and elevators create and efficient transport of goods and people.

Movement between pressure levels requires residents to travel to one of three spokes in each residential wing; from there, residents must move through an airlock into the rotating operations core (see Section 2.4). An allocated transportation route through the operations core separates humans from manufacturing and operation functions. Residents traveling between pressures have a two hour acclimation period (see Section 4.4).

3.2.8 Day/Night Cycle Provisions

On Bellevistat, we perpetuate the circadian cycles present on Earth by manipulating two variables: light and temperature. By modulating light intensities and temperature, we produce comfortable living and working spaces while retaining an aspect of the natural fluctuation present throughout a day on Earth. Dimmer-enabled Organic Light-Emitting Diode panels (OLEDs) provide the basic lighting infrastructure for Bellevistat and

Table 3.2.6 Our day and night cycles mimic the natural cycles of Earth, pleasing the residents.

General Day and Night Cycle Levels	Light Intensity	Temperature Control (°C)
10 pm-7 am	50%	20°
7 am-10am	80%	21°
10am-12:30pm	85%	22°
12:30pm-2:30pm	95%	23°
2:30pm-5:30pm	90%	22°
5:30pm-7pm	80%	21°
7pm-10pm	65%	19°

Image 3.2.8 OLED lights that are integrated into our hull create an earth-like sky while retaining the ability to become transparent.

adjust realistically throughout the day to create an earth-like feel. Not only are OLEDs very efficient and ultra-thin, but they also provide the wireless infrastructure needed for our LiFi networking systems (see Section 5.3.5). UV lights are integrated into the OLED display to simulate a more earthlike experience as well as give our residents extra required nutrients. Our windows are made up of photochromic, leaded limited acrylic glass which diffuses natural light. Our thermal control systems mimic the thermal fluctuation present on Earth. Predetermined schedules define exact levels for both temperature and thermal fluctuation (see Table 3.2.4). While predetermined schedules define the general default settings in community areas, your residents can control the light and temperature levels within their homes using their HoloCom devices (see Section 5.3).

3.3 Construction and Machinery

Northdonning Heedwell skillfully constructs the interior building and exterior hull using a versatile, multi-phase construction sequence. The Autofy robots enhance versatility and safety during the construction process and throughout our settlement.

3.3.1 Exterior Construction

To simplify the hull assembly process, the matriarch contains prefabricated exterior tiles of 15 by 30 meters via payloads from Alexandriat. Each tile of the hull is comprised of Buckystructure fabric high-density polyethylene, silica aerogel, chlorinated polyvinyl chloride; negatively thermal expanding crystals 0.1m, ferronickel alloy for structural integrity (see Section 2.1.4). Autofy C creates a structural frame of the operations core out of ferronickel alloy rods. The robots deliver tiles to their specified construction sites on the settlement hull. Additional Autofy C robots assemble the tiles by securing the tiles to the frame and then interlocking the tile together (see Image 3.3.1), systematically constructing the exterior of Bellevistat.

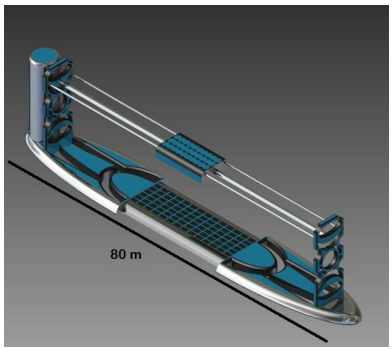
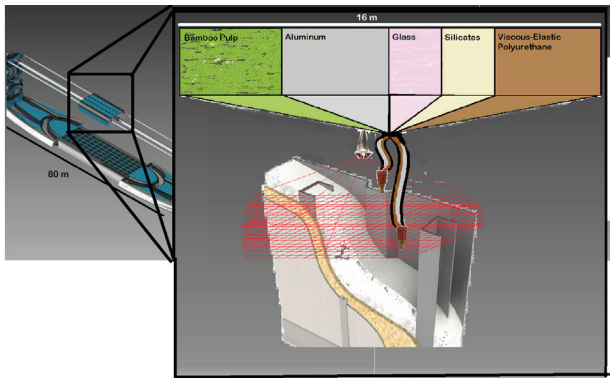


Image 3.3.1 Contour crafters quickly construct houses and other internal aspects of Bellevistat while using minimal materials.

3.3.2 Interior Construction

For the construction of interior structures and buildings, Northdonning Heedwell has designed an enhanced contour crafter technology that capitalizes on accuracy and efficiency. These contour crafters are analogous to 3D structural printers, and use a dual printer-head system to print each layer of the building with maximum efficiency (see Image 3.3.2). Laser grid guidance system ensures structural accuracy, as well as a pressurizing argon pump to propel the materials quicker and accelerate the construction process. Two layers of refined nickel and thin vapor barrier on either side of a heat-fused lunar adobe core compose the internal walls and floors to reduce costs without compromising strength (see Section 2.3.2). Internal structures employ materials including bamboo pulp, aluminum, glass, silicates, and viscous-elastic polyurethane, all materials are either produced on our settlement or imported from Earth or the moon.

Image 3.3.2 Contour Crafters systematically take the separate materials and seamlessly combine them into sturdy structures.



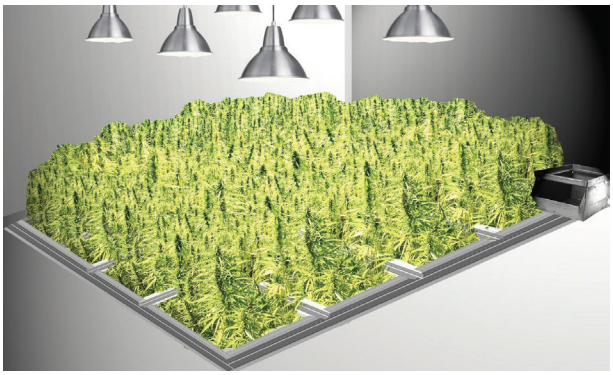


Image 3.4.1 Hemp is the most efficiently and easily recycled plant, making it ideal for paper products on Bellevistat.

3.4 Paper Alternatives

Bellevistat combines excess vegetable waste and enhanced hemp fibers to produce a reliable and recyclable paper substitute for conventional paper. Digital alternatives satisfy all industrial paper needs, while bidets and microfibers streamline domestic cleaning.

3.4.1 Paper Substitutes

While Bellevistat produces limited amounts of conventional paper for art and other conveniences, Northdonning Heedwell has created a number of paper alternatives to conserve water, energy, and to maximize reuse. Because businesses rely completely and seamlessly on digital devices and microfibers efficiently take care of all domestic cleaning paper usage is reduced. Bidets and air suction dryers, which generate a low pull vacuum pressure that collects excess water, replace hygienic paper products, greatly reducing the paper usage required for bodily cleansing. To satisfy packaging needs, flexible and self-adhesive buckystructures form a self-sealed covering, with optional thermally insulating buckystructures to protect temperature sensitive cargo.

Table 3.4.2 We use simple and readily available resources to manufacture paper products which mimic those of Earth.

Material	Amount per Batch	Use	Source
Plant fibers	136 kg	Fiber filler in paper	Left over materials in farming
Hemp pulp	105 kg	Strength and flexibility of paper	Hemp farm (grows in 90 days)
Hydrogen peroxide	18 kg	Whitening	Chemical labs by striking oxygen with ultra-violet rays in the presence of water

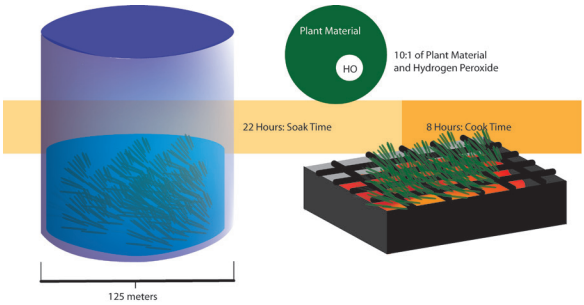


Image 3.4.2 We use hemp to fulfill paper needs on Bellevistat. The fibers are blended, soaked in water, heated and bleached with hydrogen peroxide.

3.4.2 Industrial Paper

For industrial facilities that require conventional paper products, we provide paper made of hemp fibers supplemented with recycled vegetable matter. Utilizing the farming leftovers as paper reduces the amount of overall vegetable waste. Not only does this versatile product produce fiber suitable for manufacturing clothing, textiles, and furniture for the settlement, but hemp also boasts a high recycling life (7-8 times), a high density growth rate, and 77% usable fiber, making it the optimal choice over products such as wood pulp. When the paper fibers become too short for adequate paper quality, the fibers are injected with nutrients. The nutrient rich, moisture holding material mixes with the soil in community gardens and green spaces to preserve plant health.

Hemp grows to maximum fiber potential in 90 day, therefore the hemp farm grows plants for paper eight times a year to have a constant crop growing or being harvested. The hemp production facility, located in the agriculture area, has a rectangular holding system contains the densely planted hemp and a fogponics system (see Section 3.2.3). Processing of the harvested hemp takes place in a 125 meter cylinder. Hemp plants and farming leftovers soak in water for 22 hours. The processing cylinder then weighs the drained material and adds 5 pounds hydrogen peroxide for every 50 pounds plant material. The plant fibers cook for 8 hours, and blend into a malleable mixture. Wide nozzles spray the mixture onto extremely fine mesh, on which

the mixture passes through a series of rollers. The first is felt-covered for squeezing out water, then the dry paper passes through metal cylinders filled with hot steam. Heavy cast iron plates then press the hemp paper to create smoothness and uniform thickness, then rotating blades slice the paper into desired sizes. In one year, we manufacture 198,000 m^2 of paper, or 1.5 m^2 per resident per month. In the same facilities as our hemp, Bellevistat produces a bamboo, a second diverse and quick growing product. Bamboo can be used for internal construction of residences and furniture, as well as options for textile production and clothing.

3.5 Repair Facilities and Processing

Bellivistat's innovative and effective docking system seamlessly integrates with the repair stations. We provide isolated, secure facilities to ensure the safety of any craft and eliminate contamination of our settlement while repairing foreign vessels.

3.5.1 Repair facilities

Bellevistat can repair foreign vessels of all variety and ensure the safety of everyone on board. In the event that the vessel cannot control its course or speed, Bellevistat administers the initial use of its tugs. The tugs slow the velocity of the potentially uncontrollable ship and assist them in the approach of the port. Telescoping, adhesive geco arms encompass the ship (see Section 5.5), ensuring the complete control and maneuverability of incoming ships needing repairs. Once the adhesive geco arms secure and pull the vessel near the hull, a secondary arm detaches from the gecko arms and retracts, encasing the injured vessel in a nextel aerospace fiber. The nextel aerospace fabric is then coated in ER fluids and an electrical current creates a more stable shape. The encasement for the ship creates a temporary pressurized hanger, facilitating versatile porting options for all types and sizes of ships (see Image 3.5.1). A main gangway then scans the docking area of the injured ship and Autofy Ds configure themselves to create a customized gangway to allow passengers and cargo to transfer to Bellevistat (see Section 5.5).

3.5.2 Repair Processes

Because of the varied and numerois hazards of space travel, we provide a number of repair options for injured vessels. Once the damaged craft is secured within the aerospace fabric shell, Autofy R robots can begin making repairs. Abundant space debris is a large issue for space vessels. If a vessel has any cracks or damaged hull or windows, Autofy's replace the damaged hull and halts cracks. Autofy's perform a standard check of all atmospheric gases and energy capabilities on all incoming ships to ensure safety.

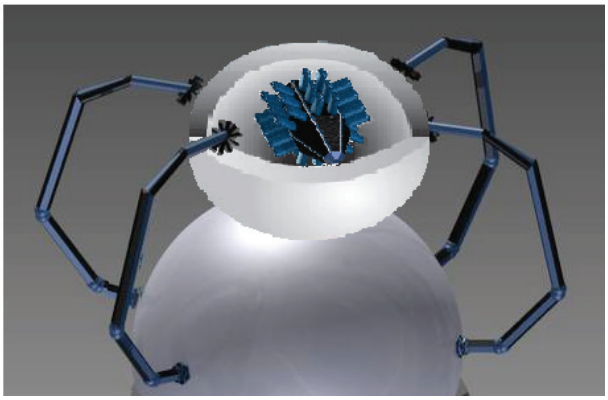


Image 3.5.1 Our innovative repair system can expand around any size ship while maintaining securely fastented to Bellevistat.

4.0 HUMAN FACTORS AND SAFETY

NORTHDONNING HEEDWELL

4.0 Human Factors and Safety

Here at Bellevistat, Northdonning Heedwell vitalizes the friendly, frontier community with organization and versatility paramount to the inefficiencies of Earth. Bellevistat assures residents a pleasant, safe, and fun environment with accommodations for all lifestyles. Elegance and sophistication line our settlement's community layout with patterned and differentiating structure levels and ergonomic designs. The culture embraces a plethora of entertainment options that encourages a healthy and vibrant environment for self expression. We rely heavily on comfortable and minimalistic housing designs to suit the demands of an opulent and diverse culture. Emphasizing safety, Northdonning Heedwell provides a beautiful view of space both in and out of the settlement with reliable spacesuits and an innovative exterior mobility device. Welcoming by design, Bellevistat graces each new resident with helpful Community Centers and the option of joining our Host Family Program to lighten the stress load of new residents.

4.1 Community Layout

Northdonning Heedwell satisfies all your service needs with Bellevistat's community layout which encourages complete interaction among all residents. We realize that in order for your vision of Bellevistat to remain viable for the long term, you'll need a vibrant, interactive and happy community. We believe your vision begins in community layout. Yet, we also support each resident with personalized entertainment to obtain the optimum mixture of individual prerogative and community involvement. State-of-the-art health monitoring systems as well as centralized hospital locations guarantee residents the best and most efficient medical treatment possible.

4.1.1 Residential

Bellevistat supplies a comfortable, modern living environment for all residents. The houses include long lines of sight, rounded corners, and comfortable open area. Too, hardwood trees and various genetically altered fruit trees increase the natural feel of the settlement.

4.1.2 Entertainment

On arrival to our settlement, each resident receives an individual entertainment and communication device, the HoloCom (see Section 5.3). These devices also provide educational functions in their home environment. Every HoloCom can instantly customize to each resident's aesthetic or virtual needs: size, placement of the cube, color, and programming options encourage expression of each individual. The HoloComs are perfect for watching movies, conducting business meetings or communicating with loved ones on Earth or Alexandriat. To augment the innovative feel of Bellevistat,we have incentivized our restaurant and bistro offerings to bring in some of the top restauranteurs and chefs on Earth. We know that they will love experimenting with low gravity cuisine. For fun, we also have designed a youth and adult level zero-gravity robotic demolition derby league and book-themes games like quiddich from Harry Potter and the ever-popular Ender's Game arena. For the truly courageous, we have micro-gravity "three-dimentional water polo" in which an olympic sized swimming pool's worth of water floats in a glob in the middle of a cylindrical arena. Participants equipped with a small tank navigate through the water to score goals floating in and around the 'glob.'

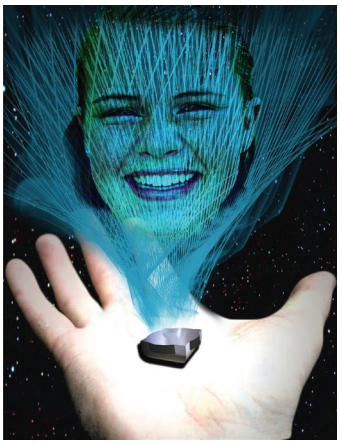


Image 4.1.1: HoloComs entertain all residents with relative ease and an intense virtual community.

4.1.3 Medical

We know that your residents' health is your priority. We have made it ours as well. Northdonning Heedwell takes a multitude of precautions

to monitor and assure the health of our residents. HoloComs read the resident's finger, a security precaution, and then assesses the health of the resident. Additional health monitoring devices such as personal mirrors and toilets may be configured to check the residents' health in each residential home. These procedures monitor things such as weight, height, chemical balance of blood, body heat, and other minor health ailments. However, if residents have serious health issues, doctors are readily available at the local medical center.. We offer both automated and human options for surgeries. If a resident requires a speciality procedure, specialized doctors on Earth can perform surgeries on patients on Bellivistat via the utilization of Li-Fi and direct-feed monitors connected to a hologram system. Doctors can observe the automated surgery as the holographic image in front of the doctor changes as the surgery proceeds. However, if the resident doctor sees something awry with the procedure he can stop the surgery within milliseconds and manually takeover the surgery using highly accurate laser grid and holographic sensors. Arriving on our settlement, residents undergo medical examination and, if necessary, the residents are sent to a temporary yet luxurious quarantine; duration of stay directly correlates to the threat level derived from our diagnoses.We don't just want your residents to remain healthy, but we also want incoming residents and visitors to be pampered. Whether in quarantine or entering the settlement for the first time, our five-star spa services and orientation welcome them to your settlement.

Consumable	Product (or service) Available/Day/Item (entire community)	Replacement Frequency
Furniture	Bought during the first day of full-term residency	Need based replacement
Hygiene	450 products	Everyday
Residential Appliances/ Houseware	600 appliances	Every week
Clothing	1500 color or customization/article of clothing	Every 4 weeks+
Medicine	300 products	Every 2 weeks
Personal Upkeep	900 products	Every week
Luxury	100 renewals/cleansings	Every day
Food	34,500 meals	Every day
Water	107,000 gallons	Every 2 weeks

Table 4.1.1: Our delivery schedule for consumables provides sufficient products to all resident without overstocking our storage areas.

4.1.4 Variety and Quantity of Consumables

We envision Bellevistat as a place where an Earth-like marketplace meets immediate demand for all residences and businesses. Be it clothing, furniture, appliances or consumable goods, our production facilities are responsive to customer needs, plus a stable replacement schedule for each service and product guarantees individuals access to their desired item or service without hassle. Local storage units house these products and deliver them either via pneumatic tubes or by hand, depending on size.For food and smaller consumables, select pneumatic tubes deliver to communal kitchens or local stores. For a private, family dining option, we have fully functional kitchens in all apartments. Even though residents can get all their food through our delivery system, we also provide local markets to encourage the natural interaction people should have around community and food.

4.1.5 Distribution

Residents order the majority of consumables, such as food and clothing, via the HoloCom. Pneumatic tubes (see Section 3.2.2) deliver the consumables to the residents' community kitchens encouraging communal integration. Expanding in non-consumable efficiency, residents' clothing consisting of rayon fibers, change pigment color and morph into various colors and patterns with an easy switch in the voltage applied with nanogenerators. Local department stores provide non-consumables like furniture and other common household items available to pick up after consumers place an online order. Moreover, residents can efficiently in-

Type of Land	Percent Allocated
Residential	32.89%
Open Areas (Parks)	13.42%
Medical (hospitals)	.54%
Assembly Halls	2.02%
Recreation	3.38%
Business	8.43%
Storage	3.35%
Miscellaneous Infrastructure	4.70%
Transportation	8.05%
Educational Facility	.28%

Table 4.1.2: Even distribution of residential and commercial areas encourages both a more communal and relaxing environment on Bellevistat

terface with each other in an open marketplace and test various items prior to purchase at any waking hour.

4.1.6 Community Design

Bellevistat sustains a well-integrated community with restaurants, recreational centers, department stores, community parks, and open space nearby all residential areas (see Image 4.1.2). We designate 13.42% of land for open areas and parks while incorporating foliage and other plant life into the community for a peaceful and natural surrounding for all residents. Communal Parks and open areas provide a relaxing and inviting environment for our residents. Moreover, residents and visitors have the option of multiple gravity levels to satisfy their unique living requirements. Our residential communities surround main park areas to spur community interaction and livability through its centralized location. Moreover, Bellevistat apportions a hospital to each residential community and a safe house (see Section A.1) every 100 meters reassuring the safety and care of our residents. Pathways and public transportation encourages walking and, therefore, increased community interactions (see Section 3.2.7).

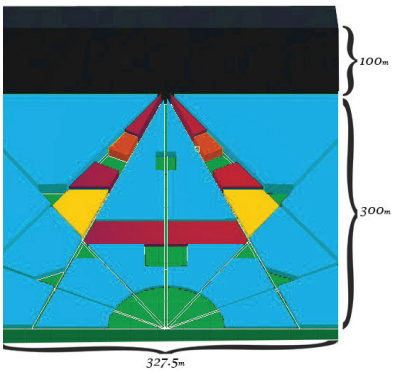


Image 4.1.2 An evenly distributed community capitalizes on lines of sight and cultural diversity.

4.2 Housing Designs

We encourage the individual to express themselves through our numerous housing options and outfitting designs. We offer a vast selection of personal items and capitalize on advancements in glass technology as a basis for customization. Additionally, an even distribution of housing designs across Bellevistat creates a tight-knit community to interact at every possible opportunity minimizing isolation of any kind.

4.2.1 Manufacturing of Furniture, Appliances, and Housing

We craft furniture items and appliances with materials including bamboo, visco-elastic polyurethane foam, and alkali-aluminosilicate and electrochromic glass. These materials comprise our furniture and appliance components due to the versatility, customization and recyclability aspects related to each material. These building materials help each individual shape their items to any specifications without restrictions, allowing for expression of individualism and personality. Retaining both a strong core and flexible exterior,

The Type of Housing Design	# of each Housing Design required (Each apartment/ condominium building holds up to 18 residents).	Square footage in each design (ft)
Expanding Singles Condominium	138	950’
Couples Apartment Residences	180	900’
Family Condominium	20	1250’
Transient Apartment Residences	27	800’
Informal Singles Condominium	90	1000’
Formal Singles Condominium	55	1200’
Terrace Apartment Residences	75	1400’
Total/Average	585	1071’

Table 4.2.1: An even distribution of different housing designs conserves both functionality and diversity.

bamboo supplies the basis of all your luxurious furniture and housing. Ensuring not only a light design, but also feasibility with contour crafting (see Section 5.1.2), pulped bamboo (see Section 3.4.3) excels in rapid growth with reduced costs. To comfort each resident, we employ visco-elastic polyurethane foam to fulfill the needs of cushions and other comforts. The visco-elastic polyurethane foam maintains heat-resistant and hypoallergenic qualities while containing the ability to transform densities with ease. An innovation on normal panes of glass, electrochromic glass allows users to control the amount of heat or light that passes through the glass at the ease of a switch, giving them the ability to regulate temperatures or create privacy also with relative ease. Coupled with a small core of alkali-aluminosilicate glass, our glass maintains structural balance while still providing unique characteristics such as temperature regulation.

4.2.2 Sources of Personal Items

An online cloud-like interface via each personal HoloCom grants individuals the ability to order personal items and clothing. Most pieces of apparel contain rayon fibers, hemp, and modacrylic fibers. Minuscule amounts of hemp fibers increase the durability and longevity of the product. Yet we have reenvisioned traditional textile technologies: each resident has the ability to change the texture, color, or granularity of any personal item. Microgenerators sewn into the fibers of clothing produce a sufficient amount of energy to charge the materials and change them upon desire. Residents can immediately change their clothing style without changing their wardrobe.

4.2.3 Expanding Singles Condominium

Our first premier structure specializes in demographic expansion. The pyramid design has a complex expansion system in which the outer walls expand and compress with population differentiation, its only limit being the dimensions of the base level. Each tier has accessible views above and below their apartments fulfilling a feeling of freedom and openness throughout the apartment. A great medium between sizes, our design averages to about 950 square feet for every condo.

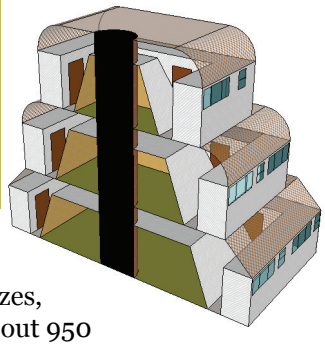


Image 4.2.1 The pyramid design maintains the ability to expand while still keeping an open area for community interaction.

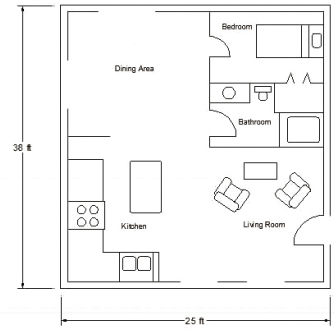


Image 4.2.2 Evenly-spaced condos give ample room and ensure luxurious lines of sight

4.2.4 Couples Apartment Residency

Our Couples Apartment Residency gets its design from the modified shape of the buckyball's atomic structure. However, large open areas with tables and greenery between each teardrop influence interaction between couples if they so desire.The couple's apartment design averages 900 square feet per apartment with 2 floors per every teardrop. An encased, spacious elevator in the center gives not only structural stability but easy access to each communal floor.

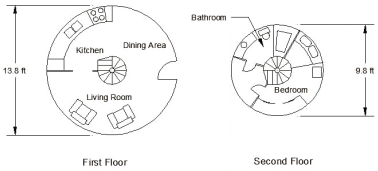


Image 4.2.4 The illusion of additional space with the additional story in each apartment helps each resident feel less constricted in our frontier environment.

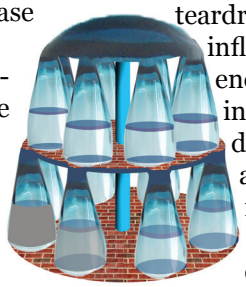


Image 4.2.3 The minimalistic design of the teardrop influences each resident of this housing to be more interactive within the community and their residential surroundings.

4.2.5 Deluxe Family Condominium

Our vibrant Family Condominium Design is perfect for all couples with children. The immense living area promotes family interaction and communication. Each condo contains a massive amount of down area totaling 1250 square feet, ample for family interaction. our Family Condominiums connect

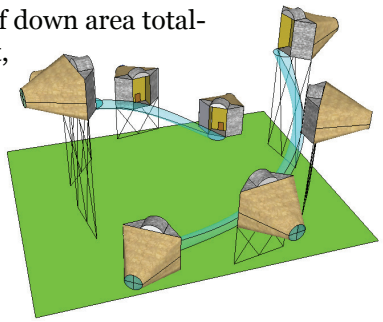


Image 4.2.5 A large interior and spacious living room amplifies the interaction time within the family

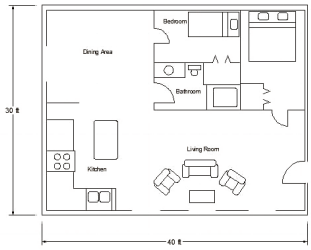


Image 4.2.6 Smaller bedrooms accommodate for children of all sizes.

to two other condos. Inter-family interaction is important for community, but since each unit is heavily soundproofed, the cacophony of family life can be controlled. Additionally, our family units are extremely sanitary: electrodynamic dust shielding and miniature pneumatic tubes suck all the harmful particles away from the family. Another fun feature in the Family design is our Kidafy robots which replaces and cleans all the toys or other misplaced items and replaces them in their proper space when the family is absent from the house (see Section 5.3.3). Kidafy robots form into a child's readily available friend. Later, teens can use their Kidafy in the robot leagues. Nooks, crannies and fort spaces adorn childrens' rooms creating fun places for entertainment and storage.

4.2.6 Transient Apartment Residences

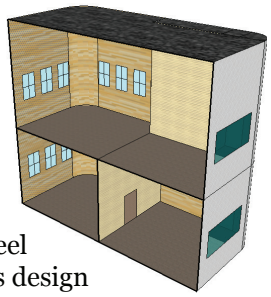


Image 4.2.7 Folding walls and lightweight furniture allow each apartment for easily conversion to storage areas.

Both space efficient and simple, the Transient Apartment Residences caters to the visiting population perfectly. The minimalistic design cuts down on costs but doesn't sacrifice comfort. To make each transient resident feel welcomed into our culture, this design contains areas for planned community interaction periods such as live entertainment. This design offers a maximum of 800 square feet and has movable walls that converge to accommodate for extra storage when vacant. A room elevator protruding from the side of the house transports all residents and goods to the second story limiting the coriolis effect on our residents.

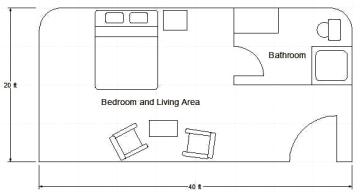


Image 4.2.8 This design welcomes and makes all short-term residents integrate completely.

4.2.7 Informal Singles Condominium

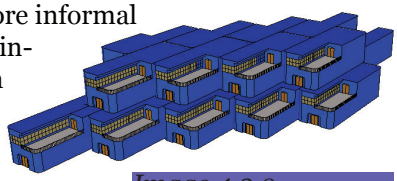


Image 4.2.9 Incorporating strict geometry into our Informal Singles Condominium design allows each resident to be informal as possible.

With a more informal feel in mind, our singles condominium accommodates singles both young and old. The multi-directionally tiered apartments favor an open floor-plan design and accommodates personal customization. This apartment, when outfitted with a more modern furniture design, creates a smart and stylish living space. Each apartment contains a media room for casual community meetings and entertainment purposes. Our tiered apartments gives each resident about 1000 square feet per condo.

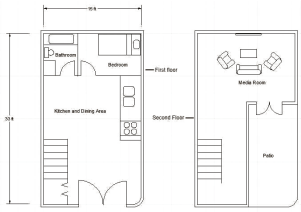


Image 4.2.10 The single story design gives each resident versatility to choose any style of decorations they please.

4.2.8 Formal Singles Condominium

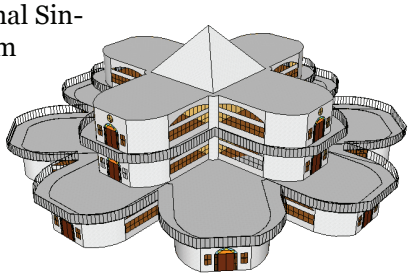


Image 4.2.11 Through the simplistic color scheme and organizational routine, the Formal Singles Condominiums dwindle the trying impacts of stress.

Our Formal Singles Condominium design highlights functionality and adaptability. The Condominium design appeals to various tastes in housing and illustrates versatility where organization and reduction of stress are the key factors. Each condo utilizes the full 1200 square feet. With ample room to play, the capabilities for entertainments options within each condo are endless.

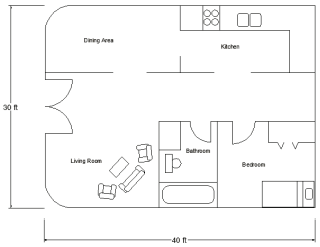


Image 4.2.12 Ample dining area and a versatile living room give this design the ideal entertainment hotspot.

4.2.9 Terrace Apartments

Image 4.2.13 Vibrant colors and views give this design its true beauty.

The Terrace Apartments utilizes our high terraces to maximize lines of sight. Our terrace design gives each resident a full view of our community and allows them to divulge themselves into unimaginable dwelling opportunities. Each apartment has over 1400 square feet of open space and supplies the residents with a beautifully curved aperture to peer about the community. Including a water display, this apartment exceeds quality in aesthetics and luxury. Vibrant and intricate features such as high-quality art galleries that are inside each apartment give the individual sufficient means to flourish in multiple ways of luxury.

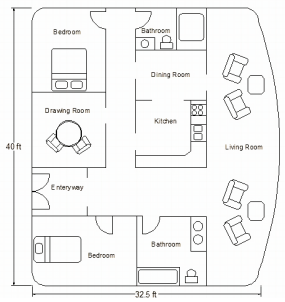


Image 4.2.14 Efficiently-placed living areas augment the desire to live in the Terrace Apartments.

4.3 Human interaction with pressurized volumes

Northdonning Heedwell expresses the utmost concern for each resident's personal safety while still providing feasible and attractive spacesuits. With extensive safety measures, our spacesuits and exterior mobility devices exceed necessities required for absolute assurance for each resident in or out of the settlement.

4.3.1 Recreational Space Jacket

Upon entering our Residential Wings, each resident receives a small pouch of lithium dioxide sewn directly into their clothing ensuring the safety during a cause of depressurization and/or loss of stable atmospheric oxygen levels. Minute sensors alert the residents of abnormal atmospheric levels and sends a safe electrical charge to the lithium hydroxide for activation. Lithium hydroxide is the main ingredient for carbon dioxide scrubbing. The scrubbing removes carbon dioxide from exhaled gases by producing lithium carbonate and water. Even the smallest metathesis reaction produces a sufficient amount of atmosphere purification for each resident. Northdonning Heedwell only insists on the usage of our Recreational Space Jacket in our Manufacturing and Operations Core. Unlike traditional spacesuits, our Recreational Space Suit does not completely encompass the user but still maintains the complete level of necessary safety within our settlement. Only an additional work jacket stored at each Operations Core entrance supplies sufficient protection. Yet, this small jacket provides bodies sensors and health monitors for each person and measures their chemical blood levels, heart rate, blood pressure, and a readout of the current atmospheric pressure and mixture. Innovating on the Heads-Up Display, our Recreational Spacesuit utilizes a small glass projection system that uses the water molecules as a background to present the electronic information from the jacket sensors. This projection system attaches like a hands-free communication device and directly links with the jacket.

Image 4.3.1- The stylish Recreational Space Jacket ensures safety and guarantees full mobility.

4.3.2 Exterior Spacesuit Design

Our Exterior Spacesuit Design emphasizes both safety and comfort. A small layer of high density polyethylene covers the exterior of the spacesuit combating all forms of radiation. All areas of the spacesuit incorporate freon cooling pipes for passive cooling and heating, keeping the resident in full comfort throughout their exterior journey. The Heads-Up Display measures heat, interior atmospheric pressure, blood pressure, heart rate, and chemical blood balance

Image 4.3.2 The Exterior Spacesuit Design adds additional protection from cosmic and solar radiation while still maximizing work mobility.

with sensors akin to our Recreational Space Jacket. Underneath the high density polyethylene layer, a mixed layer of Gortex, kevlar, and graphite/epoxy compositions form the perfect shape conforming with the rear-entry airlock and dust mitigation design. The airlock neutralizes the need for interior spacesuit storage and decreases dust in both the spacesuit settlement storage area while limiting the necessity for airlocks within our EMV (see Section 4.3.5). For additional protection against harmful radiation, each headset has an abrasive sun visor. Lotus leaf texture covers the outside of the spacesuit minimizing dust collection with the geometric permutations in the skin that limit surface area.

4.3.3 Airlocks

Northdonning Heedwell assures the safety of all residents through a triple-redundant airlock system utilizing one standard docking airlock from the Residential Wing into the operations core, a second airlock from the operations core, where the Exterior Spacesuits reside, into the EMV hanger, and a third airlock through the rear-entry space suit design attaching to the back of the vehicle. These redundancies certify the safety of each user of the outside equipment as well as protection for the settlement.

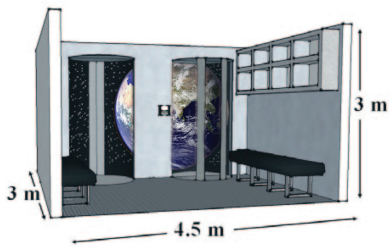


Image 4.3.3 Airlocks ensure the safety of residents and enable easy movement between hospitable and inhospitable volumes.

4.3.4 Dust Mitigation

To guarantee full protection from dust, electrodynamic shields surround the space suits with a dual protection bucky structure layer and shields surrounding the transportation systems. With pulsations, the electrodynamic shields shed the accumulated dust and protect even the smallest cracks from dust. Electrodynamic shielding techniques prove much more efficient and effective than other techniques, aiding in the multitude of safety precautions taken for our residents in Bellevistat. Upon re-entry, the objects receive an amplified pulse of electrodynamic energy to certify the eradication of all dust. Residential housing utilizes the same electrodynamic devices to eliminate dust (see Section 5.2.1). Pneumatic tubes collect the dust in the exterior walls and then send the dust to water and waste management.

4.3.5 Exterior mobility designs

For hull inspections and repairs necessitating direct human interaction, the Exterior Mobility Vehicle (EMV) carries out all nonautomated functions on the exterior of the hull. The vehicle includes thrusters on all six sides for proper locomotion through space and has the capabilities to transport up to 4 residents. Hypergolic fuel thruster supports optimal positioning and movement around the exterior of the settlement. For control of the vehicle, the driver uses customizable Autofy arms for manual piloting and labour inside the vehicle. The Autofy arms contain sensors embedded within them to communicate with the vehicle for accurate use. To protect from radiation as well as dust, the EMV utilizes electrodynamic shielding as well as a layer of buckystructures for ultimate protection. The EMV holds adequate food and water for four residents for three days. For communication with the settlement while working the EMV, users can engage their HoloCom for an insurance of complete contact ensuring functionality. The EMV has 2 pressurized high-density polyethylene tethers that alternate on 20 meter spaced out anchor points. These tethers maintain the capability to lock into a fixed position with a small electronic charge applied to the ER fluid core. The stable ER fluid core encourages safe and efficient work in even the most oblique angles or positions with the help of the Autofy arms.

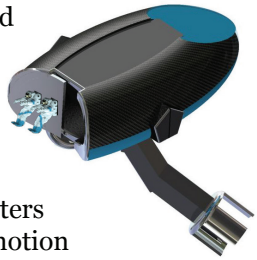


Image 4.3.4 Our EMV efficiently locomotes about the exterior of Bellevistat with minuscule consumption of fuel.

4.4 Social Community Feature

Bellevistat cannot be a thriving settlement, nor can it be a productive or innovative settlement unless it is a healthy and fun community. Northdonning Heedwell affirms the comfort and integration of all its residents through versatility with its community attributes. Bellevistat aims to welcome and assimilate all of its residents through

a variety of social and physical aspects geared towards entertainment and welcomeness. With the incorporation of trees and rounded corners into the layout and design, residents and visitors feel integrated and welcome within their first steps onto the settlement.

4.4.1 Attributes to Enable Welcomeness of New Residents

Image 4.4.1 Healthy and fun preliminary community encourage augmented interaction.

To welcome new visitors, vacationers, and family visitors into the community, Bellevistat takes attentive measures to ensure the comfort and integration of all residents. Transient residents must go to a preliminary community for short acclimation to supply visitors with the most comfortable environment possible. With access to recreation centers, our recent residents have an opportunity to participate and interact within the community. Activities sponsored at our recreational facility encompass reduced gravity sports games as well as provide a Personal HoloCommunicator hotspot. This Virtual Interaction Area, VIA, allows people to connect with each other in a virtual community. Electrochromic glass lines the geodesic dome simulating a virtual reality where multiple users can interact with each other to achieve social unity. The geodesic dome shape comes from Buckminster Fuller's shape of the buckyballs. Upon entering the dome, each user must place their HoloCom into one of the designated areas to gain full access to this versatile reality.

4.4.2 Ways of Hospitality Integrated into Settlement Life

In regards to hospitality, Bellevistat creates a pleasant and livable environment. Our incorporation of trees into Bellevistat is an important addition to the community. Trees encourage healthier relationships between visitors and residents, and boost psychological rejuvenation while ensuring a safe and welcoming settlement for visitors (see Section 3.2.2). Our hospitality protocols include community participation and public outreach.

Image 4.4.2 This special array of HoloComs gives the community a place to exercise and divulge into our friendly community.

The community, as a whole, participates in public outreach guaranteeing interaction within visitors and residents. Examples of public outreach include indulging in festivals, collective group games, and fun activities.

4.4.3 Physical Community Feature

With a welcome center located in the preliminary community, visitors can readily access information regarding the activities available in Bellevistat. As Bellevistat has restaurants, recreational centers, and parks, it supplies many communal options for short-term residents to exercise at their will. Some options may consist of scheduled team sporting events and social gatherings. Furthermore, these communal spaces enforce a more friendly environment for short-term residents and provide opportunities for them to feel incorporated into the community. Incorporating accessible public transportation (see Section 3.2.7) into Bellevistat, social interactions and the sense of community are prominent features inside our settlement.

4.4.4 Social Community Feature

As a tight-knit and versatile community, Bellevistat provides a variety of features for all residents. With a host family program available, families and visitors who share common interests come together to guarantee a feeling of welcomeness to all who participate. In addition, the host family program allows for permanent residents to share their extensive knowledge and immense delight in their community.

4.4.5 Settlement's Social Structure and Reason for Design

Long lines of sight provide the basis for Bellevistat's structural design utilizing our differentiating gravity levels in an unique way. While the Coriolis Effect proves unavoidable, our stress free environment aims to minimize its effects. Rounded walls and corners are more appealing to the eye as well as psychologically pleasing. Rounded corners provide a more natural environment and are more inviting. The colors blue, inspiring creativity and imagination, and red, aiding in problem solving and accuracy, fully integrate into the settlement in the specified areas, to encourage mindful thinking in individuals as well as throughout their community. Communal dining areas added to the neighborhoods also promote integration and

welcomeness to all residents. Through its design, Bellevistat achieves welcomeness and hospitality as our residents maintain a peace of mind due to our inviting surroundings.

4.5 Our Passengers' Experience

Northdonning Heedwell ensures a fun and memorable experience during passenger travel. We accommodate all the desires of passengers from afar with our innovative and luxurious Passenger Lounges. We believe in the beauty of space travel and have designed our ports to ease and intrigue new and familiar travels.

4.5.1 Methods of Hospitality

Here at Bellevistat, we intrigue our residents with a full display of hospitality measures throughout our settlement, and our docking sector only elevates this standard. Our main goal is for all visitors to feel welcome and embrace them into our community with our services. Accomplishing this with seemingly invisible service utilizing a biotechnology innovation of light bending, Northdonning Heedwell hides the hustle and bustle of everyday life. This makes the service seem almost effortless, out of sight, and without worry, yet still intentional. Imagine the splendor of a successful landing where the lighting changes to illuminate a greeting team specially trained to provide essential information and services to the passengers. Another benefit of our docking is the instant connectivity once residents or visitors arrive on our settlement. Upon entering our lovely receiving areas, we give each visitor a Holocom that links each person into a network of information and a menu of services (see Section 5.3.2) where entertainment, education, and connectivity constantly stream throughout our community. Staying connected throughout the whole procedure means the visitors are less likely to feel abandoned or lonely as they can still keep in touch with home or adventure into the newly-created beautiful view and experience all that is Bellevistat. During the course of the day, and depending on the multitude of traffic through the docking area, the interior accommodates for the size of the passenger population currently in the docking sector. If the docking traffic is minimal, the interior compresses to a comfortable size with movable walls locking into a new fixed position (see Image 4.5.1 and Image 4.5.2). Additionally, the brightness of the lights change with the time of day still ensuring visibility but adapting to the general notion of the time of day (see Section 3.2.8). These ambient changes allow the brain to flow with innovation and adaptiveness. From the instant passengers arrive on Bellevistat, residents receive elegant service that fulfills their every need ranging from obtaining a simple concierge to their final destination to filling out a Host Family program survey. Furthermore, Visual sensors passively monitor each passengers' heart rate, giate, chemical blood balance, and body heat, and this gives our automated systems sufficient information to accurately assess any situation concerning the passengers.

Image 4.5.1 The Passenger Arrival Lounges welcome all passengers with calming lights and intricate connectivity procedures.

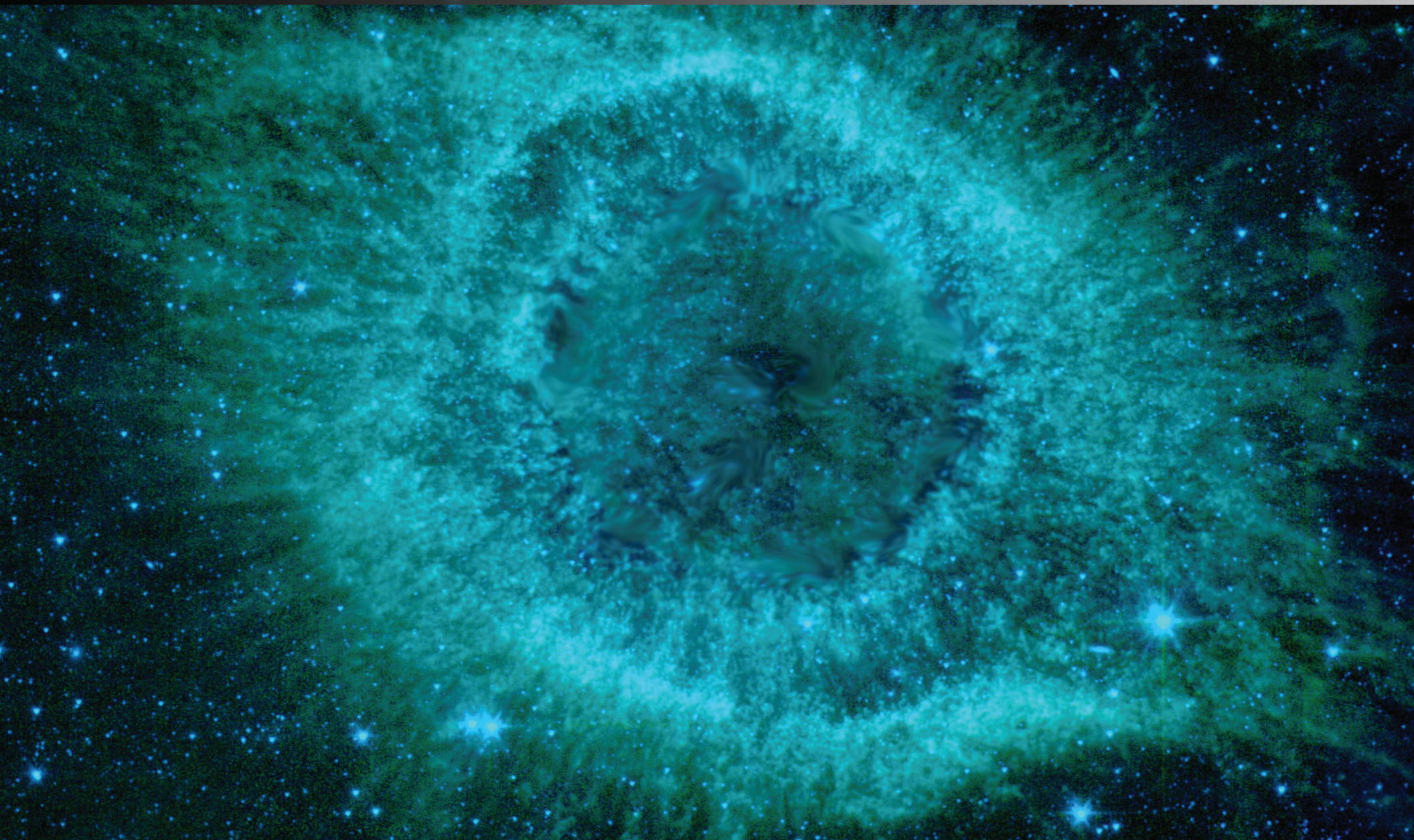
4.5.2 Passenger Arrival and Departure Lounges

From their first or last steps into Bellevistat, residents view the greatest aspects of our dynamic community. The Passenger Departure Areas give the passengers a final farewell from Bellevistat and encourage each passenger to return to our beautiful settlement. Our Passenger Arrival Areas integrate the passengers as quickly as possible into our community. The aspects of our docking community the passengers notice first are the numerous relaxation areas, the hospitality of our docking staff, and the vast array of services we provide. One of those services being the incorporation of eMaps into our settlement and docking sector. These maps are interactive and they show the passengers where all of our services are and more in-depth description of what they may provide. Such as clicking on the House Icon on the map leds the passenger to a overview of all our housing designs, a survey for the Host Family program, and even a more in-depth description of our community layout. For easy navigation, these eMaps can plot out the most efficient route to a destination and gives the current location of the user. Moreover, Northdonning Heedwell supplies the Foundation Society with the means to welcome incoming passengers with a taste of our natural feel of home efficiently and effectively within minutes of first arriving onto Bellevistat.

Image 4.5.2 The Passenger Departure Lounges have a bountiful array of dynamic features to give passengers the best possible final interaction.

5.0 AUTOMATION DESIGN AND SERVICES

NORTHDONNING HEEDWELL



5.0 Automation Design and Services

When creating the automations for Bellevistat, our engineers kept in mind versatility and variety in order to create a safe and efficient environment throughout Bellevistat. The epitome of our creation manifests itself in the form of the supremely versatile and redundant Autofy robots. With the ability to take any shape or form, our Autofy robots make Bellevistat a more efficient and versatile settlement. Northdonning Heedwell's versatile and expedient networking creates a supreme and effective settlement. Our multilayered, all-encompassing contingency plans prevent the compromising of the safety of Bellevistat, and provide swift and efficient repair results with our array of automated processes. In accordance with our high standards, all of our automations utilize the highest echelons of modern technology to ensure our residents safety and enjoyment.

5.1 Automation for Construction

We designed AutofyC robots for construction of Bellevistat with versatility in mind. Autofy's have the ability to take on any shape necessary, thus permitting them to effectively complete any essential task, including the incredible task of construction of Bellevistat.

5.1.1 Automation for Exterior Construction

Northdonning Heedwell sees that you need versatility because of the nature of the job at hand. Therefore we created Autofy robotics to formulate an efficient construction process. We decided Autofy Construction (AutofyC) robots render a versatile and swift moving construction robot. The robots move along the exterior of the settlement beginning with the construction of the opps taurus and moving to the residential wings. Bellevistat has one robot specifically designed for transportation and manipulation of panels and a second for welding and finishing of the skeleton and the exterior of the of the Bellevistat. The AutofyC has a large 16m by 31m cargo area that moves construction materials through the cargo bay to two manipulation appendages, which are located on the underside of the cargo area. The smaller dodecahedron autofy robots hold materials in the cargo bay by creating a latch over the materials after we load them. Four claw-like structures at the endpoints of the appendages which achieve maximum manipulation abilities. The appendages have the ability to move in any plane since Autofys makeup the appendage and claw-like structures. The small dodecahedrons that create the larger AutofyC each have their own power source and form of artificial intelligence. When combined into a larger robot they combine

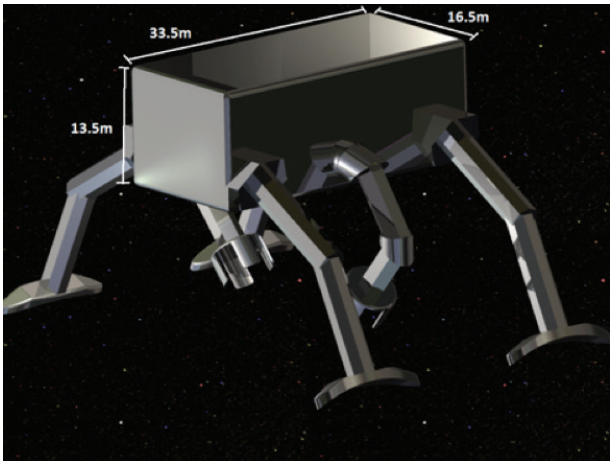


Image 5.1.1 The little robots in the cargo hold move the pieces of the hull through the cargo area allowing the arms underneath the robot to focus purely on placing tiles.

intelligence and power allowing them to complete any task through programing and strength. In order to ensure the AutofyC robots remain in control and adhered to the exterior of Bellevistat during construction, they utilize gecko adhesion on each of the four flexible feet, (located on the endpoints of each of the four legs). The four flexible feet, located at the end of the four movement legs, create a form of movement for the AutofyC robot. Extensive sensors on each Autofy scan the area where it is traveling, calculating where the best place for the next foot placement is. We equip the welding and finishing robot with construction tools to effectively build Bellevistat such as conventional arc welding, as it is the most reliable. The welding robot is the same shape and uses the same method of locomotion as the transportation robot, yet without the cargo hold. Our optimized construction sequence,

which involves building from the inside out, ensures the most efficient settlement construction, by decreasing the amount of transportation needed to build our settlement (see Section 2.3).

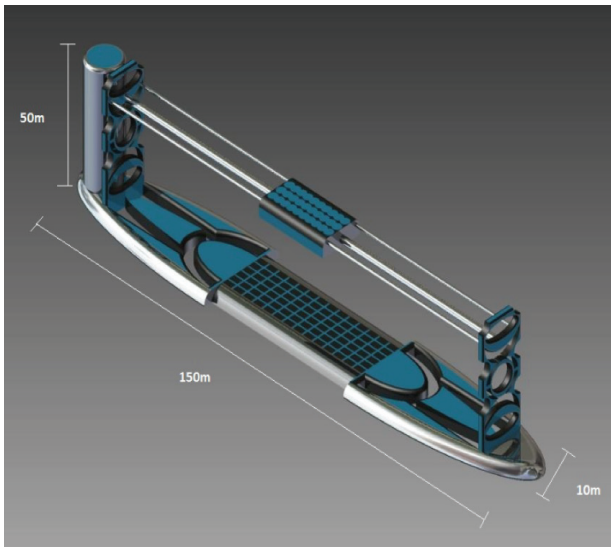


Image 5.1.2 With the improved contour crafter it will cut our interior construction time down considerably.

5.1.2 Automation for Internal Constuction

Our creation of a more versatile contour crafting system expedites the interior construction of Bellevistat. The original contour crafting system was an extremely good design, it consisted of one spray nozzle a tank to hold housing materials and the ability to print houses from the ground up. With some improvements our new contour crafter is superior in several aspects. We have added an additional nozzle to eject bamboo pulp, ferronickel alloy, polyethylene, and buckystructures during construction of the buildings on the interior of Bellevistat, which expedites the process to almost twice the speed (see Section 3.3). Although our main construction materials for buildings is bamboo pulp, the contour crafter's have the ability to work with a variety of materials such as lunar regolith. Additionally, a laser gridding sensor system forms an extremely precise process for construction of housing permitting for no error whatsoever. In the final stride to create a more expedient processes for your investment we pressurize the material tanks with recyclable argon gas to create the most expedient contour crafter to this point in time. For interior finishing and minimal furnishing we equip the same AutfyC robots with the necessary tools to finish the interior of buildings in Bellevistat. AutfyC robotics efficiently add the final touches to create your attractive settlement Bellevistat.

5.2 Automation for Maintenance, Contingency, and Computing Systems

The versatility of our Autofy robots ensures the safety of Bellevistat, through their maintenance and repair of the settlement, even in extreme circumstances, such as solar flares. Our state of the art security for computers and access to locations provides supreme redundancy through the diversity of the systems Northdonning Heedwell utilizes.

5.2.1 Maintenance and Repair

Northdonning Heedwell developed a system for taking care of all interior and exterior maintenance and repair, through our multifunctional Modular Self Assembling Robots (MSAR) or Autofy robots. The Autofys are composed of small rhombic dodecahedrons and self assemble into any necessary shape. Each face of the Autofy robots has the ability to flex, vibrate, sense surroundings, and communicate with its neighbors. We also equip the faces with rigid or flexible pins for rigidity or a flexing ability, and gecko adhesive so that the flexing and vibration of the faces of the

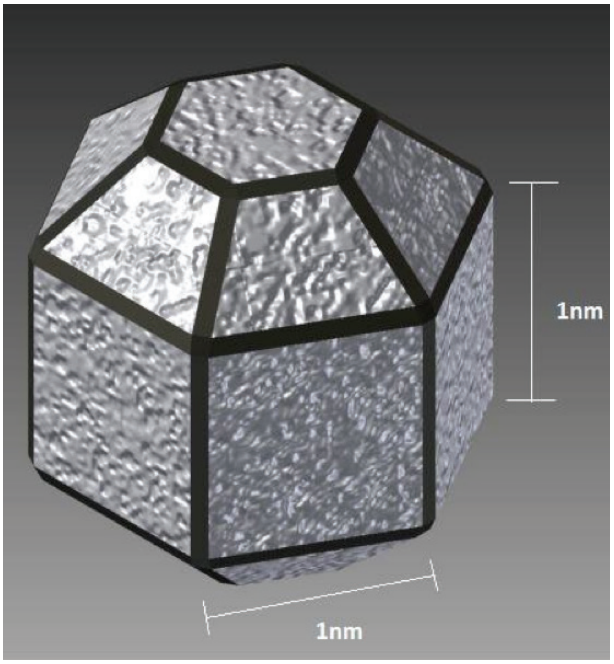


Image 5.2.1 With the ability to conform to any shape, Autofy robots are so versatile that anything is possible.

Autofys allow for movement. The flexing enables the Autofys to shift into position and allow the final product to function. The vibrations allow the robot to disassemble, and also for the Autofys to move to their desired locations. These robots have the ability to take on any shape and perform any function, even during solar flare activity. Our revolutionary electrodynamic shielding coupled with a layer of protective buckystructures shield against harmful dust and radiation. Electrodynamic shielding uses small amounts of energy to send small waves of electricity pulsating throughout our robotics, deflecting charged particles from space and forcing dust from the surface of the Autofy. The electrodynamic shielding enables Autofys to work at all time as the shielding is running constantly for the duration they are on the exterior of the settlement, always deflecting solar particles and dust. Through the Autofy's versatility they accomplish a variety of tasks from repairing major hull breaches to minor fractures in the walls of our settlement (see Section A.1).

5.2.2 Backup and Contingency Plans

Bellevistat contains systems to account for any emergency situation in order to ensure a secure investment for you. An off-the-grid power source, still run by the solar arrays, runs all of our critical computing systems to mitigate the chances of failure in the event of power loss (see Section 3.2.3). In the event of a hull breach, we have a fleet of Autofys at the ready to rush and seal the hull with extra tiles, while our emergency airlocks protect the residents of Bellevistat. We store a specific set of Autofy robots in every safe house, and underneath each terrace specifically programmed for hull repair to provide a quick response time to a hull breach. Equipped with ER fluid bucky structure nets (ref. 2.1.4) and bio-foam, the Autofy robots seal off the hull breach in the least amount of time possible (see section A.1). We also employ an extensive system of sensors to foresee possible problems such as explosions, toxic gas leaks, asteroid impact, and suspicious human behavior. Using a MAIR (Monitor Analyze Integrate Reanalyze), a system Carnegie Mellon University military robotics uses, we integrate the system of sensors into Bellevistat to monitor all residences and quality of the settlement. Sensors such as facial recognition, behavior recognition, infrared gas imaging, palm scanning, strain gauges, heat sensors, air quality sensors, pressure sensors, and humidity sensors continuously monitor Bellevistat for any discrepancies. If one of the sensors identify a problem they check it against the other sensors via the cloud-like network of servers. If necessary the servers notify the nearest Autofy robots to mitigate the problem. If an explosion seems imminent, indicated by a rise in heat, rapid air pressure drop and/or severe drop in air quality, then the server network deploys the isolation nets (see Section A.2). Fire outbreaks call for Autofy robotics to swarm and spray fire retardant foam, made from synthetic detergent hydrocarbon surfactant, on the affected areas (see Section A.2). They achieve the spraying of fire retardant through their ability to swarm together tight enough to contain and expel the foam. In addition, our radiation resistant hull protects the interior of our settlement from solar flares. For the sake of redundancy, however, an additional layer of high density polyethylene protects all our major computing centers; and an electrodynamic feild coupled with a layer of silicon buckystructures protects all of our robotics from radiation. Our safety systems ensure rapid and efficient response to any emergency, while keeping our residents safe.

5.2.3 Access to Robotics and Computing Systems

Our Computing Access System (CAS) controls all access to systems ranging from home robot access to mainframe system

Table 5.2.1 Through three levels of critical access we achieve the most secure systems in Bellevistat.

Levels of Security	Types of preventative measures	What is included in Level
Low security level	Voice recognition, thumb print scanning, file encryption	HoloCom devices, home Autofy Robots,
Medium security level	Passive DNA testing, voice recognition, palm scanning	Housing, Settlement operations, Main server access
High security level	Separate server system, Facial vein mapping, DNA testing	Restricted areas. Control centers. Main robotic access, Critical server access

control. The CAS system designates each resident and guest a security clearance level. Voice recognition and hand vein mapping control access to most areas in our settlement including access to household robotics and systems. For the higher security levels, we incorporate facial vein mapping, and passive DNA testing, which utilizes small filters which collect the human particles that fall off each individual. All of these devices work together to create a secure, yet simple and quick system to be certain of an individuals identity.

5.3 Automation for Maintenance and Resident Convenience

Our automated technologies, including our HoloCom, revolutionize the way residence processes information and materials. Through the expedient transfer of information from Li-Fi our networking proves the most advantageous for Bellevistat.The HoloCom technology generates supreme versatility for the Foundation Society through its ability to perform in any environment or situation.

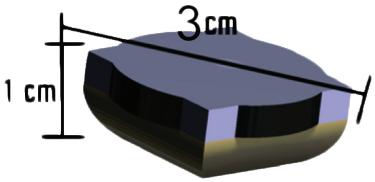
Table 5.2.2 Automations strives to create a more efficient and versatile Bellevistat.

Robotic device or system	Purpose	Location in Settlement	Dimensions	Quantity
Autofys	Maintenance	Everywhere	1m X 1m	100
AutofyC (Construction)	Settlement Construction	Exterior during construction phase	33.5m X 18m X 14.5 m	600
AutofyR (Repair)	Repair	Everywhere	1mX1m	100
AutofyP (Personal)	Personal Robots	In residences	.5mX.5m	600
AutofyD (Docking)	Docking robotics	Buckminster Bay Docking	Any size to match space vehicle's entry	20
HoloCom	Personal Computation devices	On residential torus	1cm X 3cm X 1cm	11500
Computer Access System	Security database and mainframe system	Operations core	1m X .5m X .2m	2
Ore Transportation System	Cargo movement	Operations center	5m X 5m X 1m	30
X-loader	Loading and unloading of cargo	Operations center	20m X 1m X 4m	10
Improved Contour Crafter	Interior construction of buildings	Residential during interior construction	150m X 150m X 25m	50

5.3.1 Automation to Enhance Livability and Convenience

We developed the HoloCom to enhance the livability and convenience of the residents on Bellevistat. It provides instant research, instant entertainment and instant communication through ionized water vapour technology, which transmits holographic images or videos by displaying them upon a field of charged water molecules.

Image 5.3.1 With new holography technology the HoloCom gives residents the ability to charge into the future with vigor.



The ionised vapour setup projects holograms from the palm of the users hand into the air. Users interact with the HoloCom by gestures and speech, which a laser gridding system and voice recognition software decipher. The holography has the ability to display movies, play music, run programs, and perform any other tasks the user desires. The HoloCom utilizes a combination of cloud and local computing with a petabyte of memory split between cloud and local computing, thus

permitting residents to experience the HoloCom in its full three dimensional glory. Users interact with a "swipe and tap" interface for the most effective user interface. A Titanium-Vandium shell encases the communicator to ensure durability and longevity. The Ion-Exchange glass that covers the camera lens protects the camera from any scratches or cracks to ensure a clear interpretation of the user throughout the communicator's long lifespan.

5.3.2 Automation to Enhance Work Productivity

Computing devices connect user and machine to enhance productivity at work by providing an interface that is intuitive and informative. For workstations our ionized hologram technology creates a fully immersive environment where the user can interact with through voice and gesture recognition. If it is more comfortable for the user, there is a chair and desk that withdraws from the wall and padded flooring for comfortable sitting and standing. For mobile workers, we use our standard HoloCom technology to aid workers in their tasks. All of these computing devices make it easier for workers to be more productive in their tasks.

5.3.3 Automation for Convenience for Residents

Northdonning Heedwell utilizes an automated merchandise delivery system and automated cleaning devices to enhance convenience and perform routine tasks in residences. A transfer system going to every residency delivers supplies, food, and any other items of importance through pneumatic tubing. The automated delivery system sends main meals to the communal dining areas (see Section 4.4.3). If a resident needs anything they merely need to talk to their HoloCom and the HoloCom will communicate with the delivery system to send the resident whatever is needed with in seconds. For residents who enjoy cooking they can specify how they want their food to appear through the transfer system, and from there cook and prepare food. A mechanical dishwashing unit, and an automatic laundry-cleaning unit virtually eliminates routine cleaning. We placed Laundry and dish holes in the kitchen and each room so that no one needs to travel far to clean up. Once through the laundry shoot we send the laundry to a cleaning unit and send it back up to the resident with in minutes. Dishwash and other objects that require cleaning follow the same process. We connect all housing automated features to the cloud-like computing system, and transfer of information via Li-Fi, thus connecting the entire house to the resident's personal HoloCom. Since Li-Fi doesn't travel through walls the commands residents send to their automated systems remain secure and the servers only send it to the appliances in their own housing. From each HoloCom, resident's have the ability to control and determine all automated features of housing. Bellevistat's housing units employ a version of electrodynamic dust shielding to mitigate human dust by sending it to the edges of interior walls where pneumatic tubing transfers it to water and waste management. Our electrodynamic dust removal requires less energy and much less maintenance than a fleet of cleaning robots. To animate and clean up housing of families we created Kidafy robots which can act as a playmate for children and clean up toys and other messes children tend to make (see Section 4.2.5). For medical purposes we have integrated a series of sensors into resident's bathrooms such as weight sensors in the floor, infrared health sensors in the mirror, and waste monitoring sensors in the toilet (see Section 4.1.3). We send all the information the sensors collect to the servers, which then evaluate the information based on personal longitudinally cataloged health data. If the system discovers a major health problem, the system sends out an alert to the resident and hospitals nearby via HoloCom. Northdonning Heedwell employs automated process such as self-healing electronics for heat susceptible parts, use of automated refinery procedures, automated loading and unloading of shipments, and automated delivery of shipments within Bellevistat. All of these systems work in tandem to compose an exceedingly efficient and versatile system which reduces the need for manual labor within our settlement.

5.3.4 Personal Access to Personal Files

We designed the HoloCom to personalize the consumer experience by providing personal data and entertainment through an extremely secure system. The HoloCom utilizes a thumb scanner to ensure integrity of the devices contents. Thumb scanning technology adds security for the HoloCom without the hassle of a passcode. If the thumb scan fails, no holographic projection appears and the HoloCom sends an alert to the

nearest Autofy to resolve the situation. The HoloCom does not wipe data, because while erasing data protects it, the user loses all of their data. As well as varying levels of encryption of files ensures the owner's safety of files on their personal HoloCom.

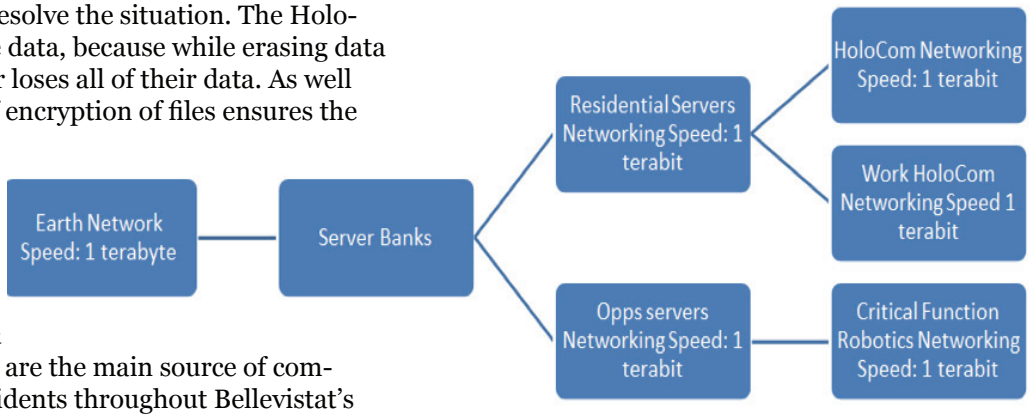
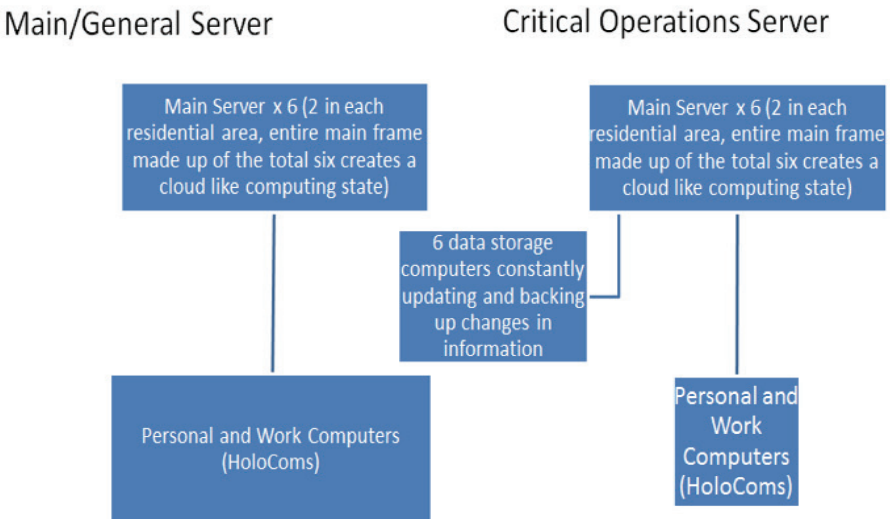


Image 5.3.3 With networking speeds (per second) far exceeding those of Wi-Fi we can communicate and transmit information faster than ever before

5.3.5 Internal and External Communication

HoloComs are the main source of communication for residents throughout Bellevistat's interior. Our HoloComs utilize the Li-Fi communication included in all of the lighting within our settlement to communicate with each other and residential servers in order to provide expedient and accurate internal communication. Li-Fi provides ultra-high speed communication throughout the interior of Bellevistat with speeds reaching up to 1 terabit per second (131,000 megabytes) as compared to Wi-Fi that only provides up to 100 megabytes speeds. Li-Fi is cheaper, more pervasive and much more efficient than Wi-Fi. For exterior communication a system of lasers transmit information to and from Earth. Our main servers receive the information and transfers it to the appropriate recipient, permitting real-time communications with speeds of up to one terabyte per second. As a redundant and versatile communication backup, Bellevistat utilizes UHF radio waves (see Section 3.2.6). Our server system contains two completely different sets of servers, one for residential and one for critical functions to ensure maximum security.

Image 5.3.2With critical functions on a completely different server it gives critical functions more networking speed and absolute security.



Six main servers, which store data, communicate with all personal devices, housing units, and each other together make up the general server system of Bellevistat. Spread throughout the settlement, the six main servers communicate continuously to form a cloud-like computing environment. The critical information network works in exactly the same way, except in order to ensure no loss of data in the event of failure we created six additional data storage servers which constantly back up new information passed through the critical data network. We dispersed all servers throughout the settlement to ensure the continual integrity of our networking system. All of these systems working in concert ensure our residents remain connected and their personal data remains safe during any event.

5.4 Loading Unloading, and Transportation of Shipping Containers

We at Northdonning Heedwell created versatile automated robots and systems to handle all movement and manipulation of ore-filled shipping containers, transporting them to and from storage facilities, and emptying them in the refining area. Redundancy and added safety features are prevalent throughout the designs for any automated systems.

5.4.1 Loading and Unloading of Shipping Containers

We designed multiple automated (X-Loader) systems that unload shipping containers from ships, limiting the need for excessive manpower and complication for you. Once the transport ship approaches the docking area, a laser grid around the docking area accurately identifies the position of the ship, and controls the guidance systems that control relatively minute adjustments to the opening of the docking system. Unlike inaccurate and obsolete cameras, a laser grid system renders more accurate guidance into the docking area. Utilization of the docking system outlined in Section 7.1 allows for uniformity when transferring cargo between multiple transport ships.

A loading and unloading appendage named the X-loader completes the action of removing the shipping containers from the transport ship, as well as reloading the empty shipping containers. Positioned just above the port opening the X-loader can easily reach into the transport ship, to manipulate, load, and unload the shipping containers with minimal effort. Hydraulics rendered from low viscosity oil, to reduce susceptibility to cold, which buckystructures insulate (see Section 2.1.4) create a powerful and efficient unloading tool for the profits of Bellevistat. The hydraulics provide for all mechanical power for all movements the X-Loader makes. A two centimeters thick sheet of bucky-structure fabric protects each of the two joints for durable protection from any sort of debris. The layer of protective buckystructure fabric also protects the moving parts from damaging dust or regolith. The three arms, made from a reinforced titanium-vanadium alloy, are telescoping permitting for a wide reach. Collapsed, the arms are 2m, while fully extended each arm length could reach up to 10m. These capabilities of the X-loader allow for full access to everywhere in the bay of the transport ships. Four arms making an X shape comprise the head on the Loader. The four arms render a sufficient connection with the shipping container. At the center of the X, a laser-grid coupled with a spectrometer allows for easy identification and positioning of each shipping container. The spectrometer emits wavelengths, and measures their change from contacting the ore, determining the composition of ore for later refining. Once this system identifies the container, the arm automatically loads or unloads the container. Our location in zero g immensely increases the ease of movement for each of these containers so the relatively slender manipulation arm can completely control each shipping container and everything within it.

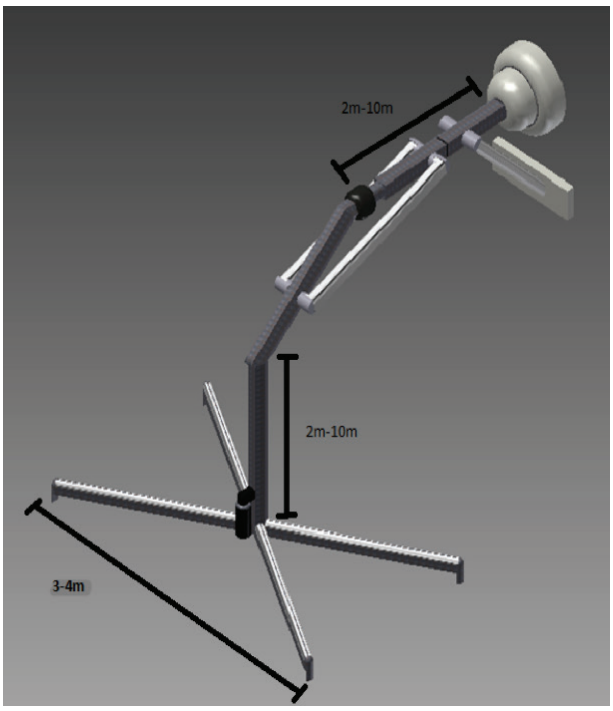


Image 5.4.1 Telescoping to up to 30m allows the X-Loader to load and unload all storage crates with ease.

5.4.2 Transportation of Shipping Containers

A modified low friction rail system generates a secure transportation system for all shipping containers. The rail system moves the containers via mobile “pucks,” 5m by 5m which low-friction bearings support. A hard carbon coating coats the bearings to reduce friction, increases durability, and acts as a redundancy to any stray dust in the area. Chemical vapor deposition processes form a carbon-silica compound which makes up the carbon coating. Permanent bearings line the bottom of each puck on the two outward facing L rails. Automated systems control certain pneumatic arms along the rail, activating and deactivating them to direct and propel shipping containers. The bearing track system provides the most efficient, and safe means of transportation for shipping containers from the unloading area to the refinement area, as compared to magnetic rails which would prove harmful due to the attraction of dust. Along the center of the track electrodynamic shielding

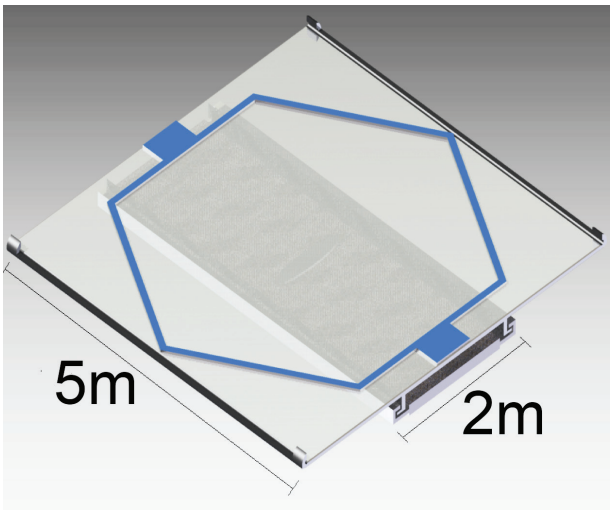


Image 5.4.2 The absence of magnets renders a safer form of transportation during the fairing of ore to refining centers.

systems prevent any particles from interfering with the tracks supporting the pucks. The top of the puck is flat, and 5m by 5m, with a small clamp on each corner to secure the shipping container when centered over the puck. Small hydraulic systems also power the securing hooks that hold the containers into the pucks.

In the case that we are receiving ore faster than we are processing the ore, a storage facility is necessary for the remainder of the ore. Storage areas, between the refining, manufacturing and docking areas minimize transport time. An X-loader moves the containers onto and off of the rail system to within the storage area. All stored shipping containers would not remain on the pucks; they are stored separately.

5.4.3 Unloading of Ore

Pressurization assists in the emptying of the shipping containers once they reach the refinement area. We pressurize each shipping container with argon gas. The argon passes into container through a one way valve, very similar to those used in pneumatics. After the depressurization pushes the Argon into the zero-g container, a filter recaptures the contaminated Argon. Because it is relatively cheap and unreactive, argon is the best gas for this task. During unloading, we create a near airtight seal between the shipping container and another zero-g shipping container headed for refining, and therefore upon opening the front of the container the pressure releases all contents in rapid decompression. The decompression process takes anything within the container, and puts it into a specified zero-g refinement container. For anything the decompression leaves behind we designed a hydraulic ram rod that pushes one end of the container through the center of it pushing out and particles left behind by the decompression. The process takes just under two minutes and is much quicker than a hydraulic arm alone.

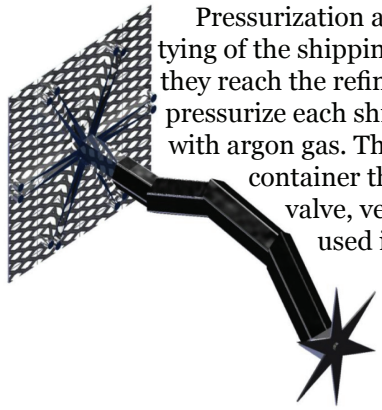


Image 5.4.3 Although depressurization alone is a decent method of unloading, the hydraulic arm removes more ore from the containers that depressurization does not.

Once the ore is within the refinement containers, “pucks” take it to a specific location within the refinement area for refining and processing. In this area the ore is refined, and the refining transport container returns for reuse later in the refinement process (see Section 7.2.1).

5.5: Automation for Docking on Bellevistat

Northdonning Heedwell acknowledges the ever growing struggle of docking various space vehicles from various companies and countries. To rise to the challenge, and enlarge your profits through more incoming transports of ore, we created Buckminister Bay. The docking system utilizes the versatility of our Autofy robotics to dock with a variety of ships ranging in shape and size.

5.5.1 Automated Docking systems

New applicants and new capabilities will overrun docking standardization.We designed a system to keep you ahead of the every changing future. As ships approach Bellevistat we deploy tug ships which slow down and direct the incoming vehicle to the correct port. Once the vehicle is within ten meters of the settlement, telescoping gecko arms reaching up to 215 meters to secure even the largest diameters on ships. Northdonning Heedwell created these telescoping, hydraulically powered from a low viscosity oil, gecko arms. Concentric cylinders to allow for great length through telescoping and power through hydraulics. We placed the telescoping gecko arms on a rail system that runs from each docking area to the next to expedite the docking process. We cover the endpoints of the arm’s four fingers in gecko adhesive to grasp onto

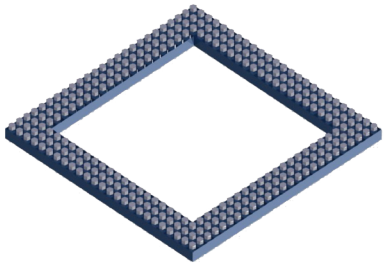


Image 5.5.1: AutofyD (docking): The versatility of Autofy robotic systems allow Buckminster Bay to trump all other conventional docking systems.

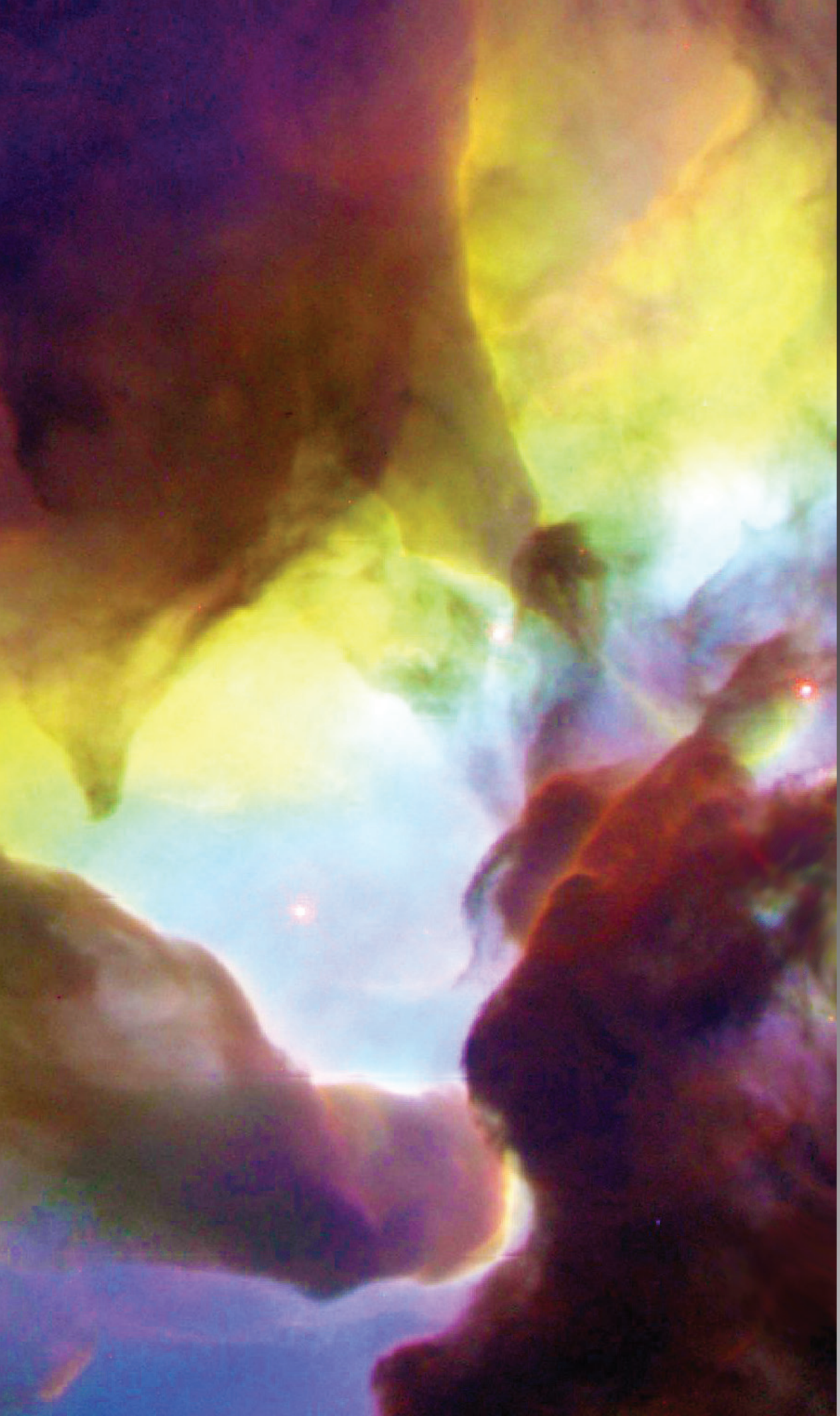
the space vehicle and slowly bring it within five meters of the Buckminster Bay docking system. Once within these five meters an infrared scanning system scans and analyses the port or entryway of any space vehicle. The scanner then sends the information it has complied to AutofyD (Autofy Docking) robotics. The AutofyD's reconfigure themselves to match the space vehicle's entryway, thus providing a supremely versatile mechanical locking system for any ship we encounter. To create an airtight seal we deploy a cover of PTFE (Polytetrafluoroethylene) which is a polymer that survives in a large range of temperatures. Once fully docked to the space vehicle, our communications with the vehicle allow us to determine the correct pressure to pressurize the gangway with in order to create smooth transitioning from space vehicle to Belevistat. After ships leave Buckminister Bay docking the AutofyD's and the PTFE cover retract back into Bellevistate and we seal off the dock to preserve its integrity. For repair on ships that dock with Buckminster Bay Docking we use similar techniques as on Bellevistat through our deployment of AutofyR's and air filtration systems as specified in Section 7.3.4.

5.5.2 Differences in Docking Techniques

Since there is no estimating the types of cargo and ships Bellevistat receives, we created several different procedures to accommodate any abnormalities. Since ships bring in ore from a number of locations that may or may not contain harmful contaminants, we differentiate our unloading procedures for ore and human cargo. Human cargo move through the docking system described above (5.5.1). Ore cargo uses the same system without the gangway. Tug ships still slow down ore bearing ships, telescoping gecko arms still pull in the ships, and an infrared scanning system still scans the port or entry way, but instead of creating a mechanical locking gangway the X-loader simply uses the information from the infrared scanning to determine the best way to unload the standard shipping containers. To accommodate any size of ship even ships half the size or more of our operations core, we created the tug ships to transport supplies and humans to and forth from the larger vessels. We simply can't dock with something of that magnitude because its sheer mass would throw off our center of mass and eventually our rotation. But we at Northdonning Heedwell still find a way to make interfacing with these monstrous ships swift and efficient.

5.5.3 Automation for Mitigation and Cleansing Techniques

With a variety of vessels docking at Bellevistat we realized there are several contamination concerns. With the largest concern being dust contamination, all cargo, including humans, goes through the same dust mitigation procedure. In the first room cargo enters we send waves of non-harmful electrodynamic pulses which loosens and removes most dust particles. For redundancy and utmost effectiveness, an electromagnetic wand then sweeps up and collects excess dust. The next most hazardous contamination would be the possible extreme charges produced from vessels that employ ion propulsion systems. These charges could possibly disable our AutofyD robotics thus rendering docking impossible. To counteract this right before we bring the ship in close enough to dock with Bellevistat we attach a battery to the ship, thus diverting and storing types of unwanted charges away from the docking system for later usage. Finally a smaller yet still hazardous problem with docking is the exhaust fumes from stabilizing thrusters on vessels, most likely from hypergolic fuel. Docking bays we are utilizing stay at a safe mode, with a PTEF, RAGuard, and liquid glass cover ensure no contaminants affect unused docks. These materials effectively protect unused docking areas from harmful contaminants like radiation and dust. We cover the area around the Buckminster Bay docking system in Liquid lotus leaf covered glass to ensure easy of cleaning of any contaminants that our docks may encounter.

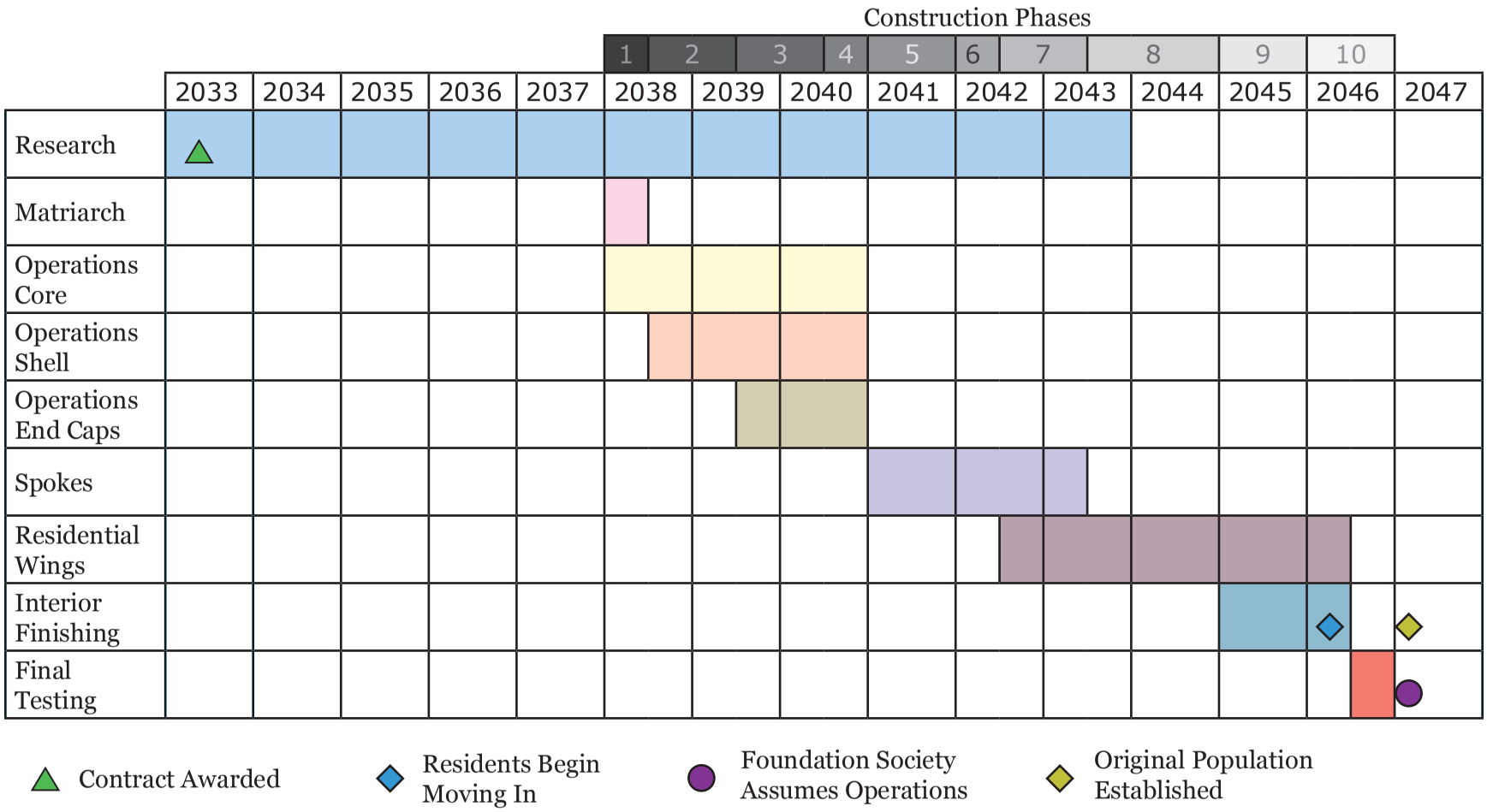


6.0 SCHEDULE AND COST

NORTHDONNING HEEDWELL

6.0 Schedule and Cost

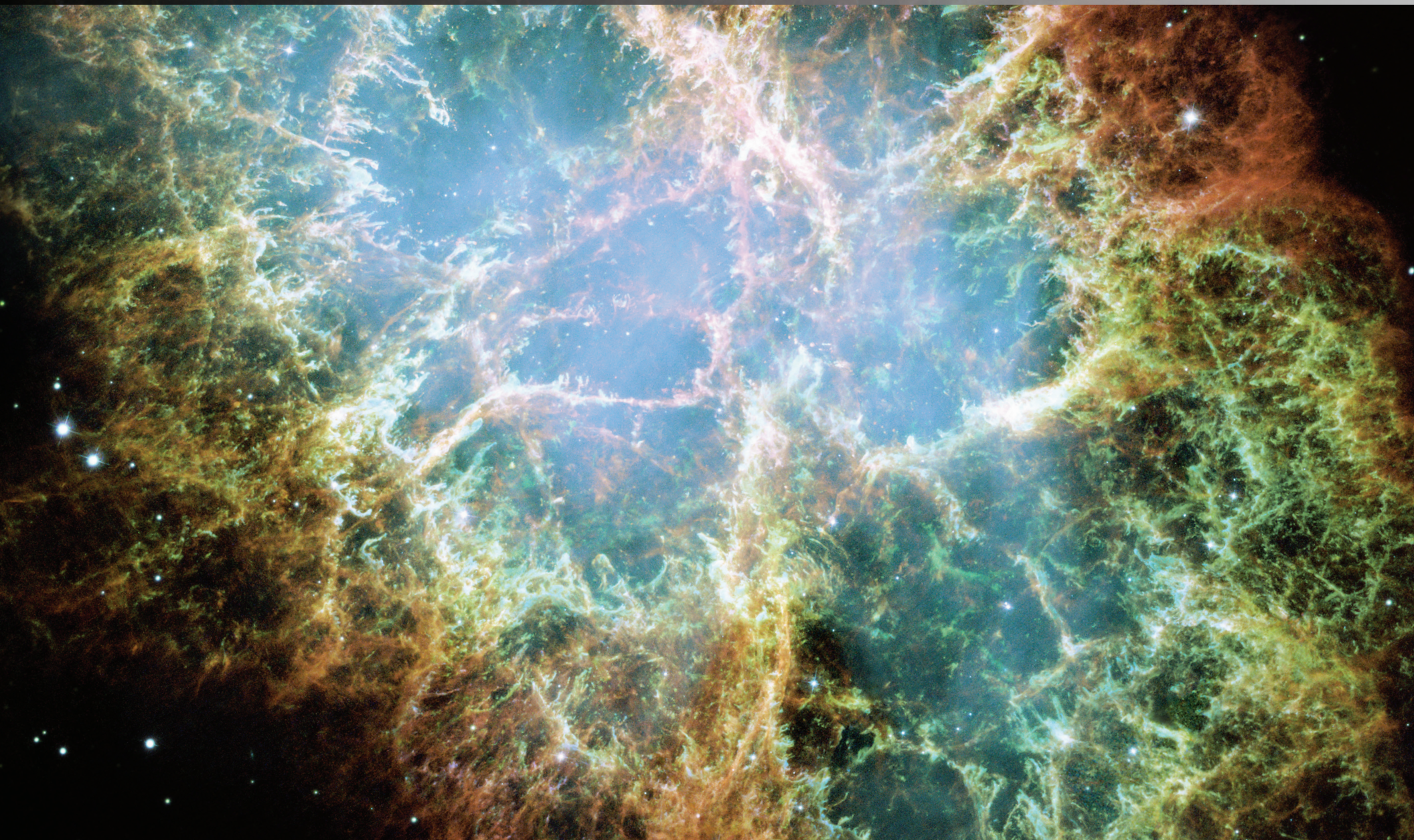
6.1 Schedule for Completion and Occupation of Bellevistat



6.2 Cost

Construction Phase	Items	Cost Of Item	Employees	Cost of Phase
Initial Research	Personal	$6,000,000,000	4000	$29,000,000,000
	Materials	$23,000,000,000	NA	
Transport Costs	Personal	$35,000,000	1000	$235,000,000
	Percheron Costs	$200,000,000		
Phase 1 - Matriarch	Transport Unit	$12,000,000,000	1200	$26,500,000,000
	AutoFy Construction Robots	$13,000,000,000		
	Solar Panels	$1,500,000,000		
Phase 1, 2, 3, & 4 - Operations Core	Basic Infrastructure	$8,700,000,000	2000	$63,350,000,000
	Rail System	$750,000,000		
	Processing Facility	$50,000,000,000		
	Tracking System	$900,000,000		
	Ongoing Research	$3,000,000,000		
Phases 2, 3, & 4 - Operations Shell & Caps	Hull Components	$560,000,000	300	$313,740,000,000
	Structural Interface	$290,000,000,000		
	Docking Systems	$180,000,000		
	Solar Sterling Engines	$23,000,000,000		
Phases 5, 6, 7, & 8 - Residential Wings	Hull Components	$7,640,000,000	1500	$16,240,000,000
	Basic Infrastructure	$6,300,000,000		
	Water Cost	$2,000,000,000		
	Rocket Engines	$300,000,000		
Phases 9 & 10 - Interior Finishing	Contour Crafters	$1,300,000,000	1500	$8,106,000,000
	Transport Systems	$478,000,000		
	Buildings and Homes	$820,000,000		
	Life Support Systems	$1,230,000,000		
	Communication Systems	$778,000,000		
	Automation	$3,500,000,000		
			Total Cost	$428,171,000,000

7.0 BUSINESS DEVELOPMENT



7.0 *Business Development*

Northdonning Heedwell recognizes Bellevistat's inherent potential to reap the resources of outer space. The huge variety of extremely valuable elements and potential for profit is unparalleled in any terrestrial mining operation. We capitalize on these resources and establish Astroveria as a highly profitable business endeavor through the versatile processing of rare elements, the efficiency and safety of our docking system, and the large scale production of silicon buckystructures.

7.1 Lunar and Asteroid Materials Port and Storage

Versatility in our docking system allows you to dock a variety of ship sizes. Our gecko arm capture is low impact to maximize safety and protect your investment. Additionally our tracking system lets you efficiently process any number of materials.

7.1.1 Port Services

For the use of port services each vessel is charged a rate dependant on the number of standard shipping containers and the amount of uncontained cargo unloaded. On average you can expect a 30% profit margin for port services and a 1 hour turn around time for ships carrying under 100 standard shipping containers. Ships carrying uncontained cargo can expect turnaround times in under 3 hours.

7.1.2 Ore Identification and Tagging

A 0g anteroom, just inside the Buckminster Bay Ore Dock, holds containers before the tagging process. In the following passage, the Bellevistat Identification Transponder initially uses solid state Nuclear Magnetic Resonance, at the procurement point to accurately determine the molecular structure of contents. The Bellevistat Identification Transponder tags each container with an unique code describing the composition and mass of its contents, using a radio-fluorescent signal. After the coding of the container, a robotic probe re-samples the contents of the container to confirm chemical composition, thus providing a redundancy system to ensure accuracy. Real time mass spectrometry analyzes the sample to confirm Nuclear Magnetic Resonance. This evaluation guarantees redundancy and efficiency in processing materials.

7.1.3 Non-Ore & Non-Bulk Tagging

There is a second Buckminster Bay Dock for unloading passengers and cargo in Non-standard shipping containers (see Section 2.5). Our internal transport system (see section 5.4) loads Materials needed in residential wings into the central operations core transport shaft (see section 2.1.2). The shaft takes products to the spokes for distribution in each wing (see section 4.1.5). We load products destined for storage into standard shipping containers, tag the container with a Bellevistat Identification Transponder, and transport them to the storage facility.

7.1.4 Tracking and Storage

Bellevistat Identification Transponders track containers at all times as our internal transport system (see Section 5.4) moves them through Business and industrial storage facilities (see Section 2.1.2) with a total volume of 120 million cubic meters. Transition points read each Radio-fluorescent tag at entry and independent robotic sensing units patrol the storage facilities, constantly updating inventory with a Radio Frequency Identification system. Radio Frequency architecture provides redundancy to the Bellevistat Identification Transponder. Systems monitor both on query, and automatically at transition points. At the entry to the each S, Bellevistat Identification Transponder coding dictates each container's destination assuring efficient deliverance of all inventory. Processing facilities receive containers needing immediate processing to ensure that prioritized shipments arrive on schedule. The RFID system inventories and organises surplus ore containers according to their anticipated processing date.

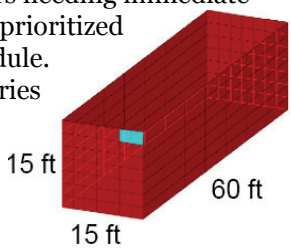


Image 7.1.2 Bellevistat Identification Transponders ease transport and tracking throughout our settlement.

7.2 Refining and Manufacturing of Extraterrestrial Materials

With versatility and variety in mind, our refining process simplifies metal extraction through a series of centrifuges and electrolysis. The universal ore melting process also cuts harmful chemical processing and improves the safety of our settlement.

7.2.1 Refinement of Ore

A melting centrifuge melts ore high in valuable metals. Then the centrifuge rotates to separate different metals by density. Pores in the walls draw out the separate densities of material from the centrifuge. Initial density separation eases the purification process of each metal as this process removes impurities without excessive chemical processing. A melting vat in 0.2g then performs electrolysis on molten aluminum oxide, titanium oxide, and iron oxide to extract each pure element. Electrolysis simplifies refinement and cuts costs compared to contemporary chemical refining processes. Other materials undergo ion exchange processes to extract pure metals.

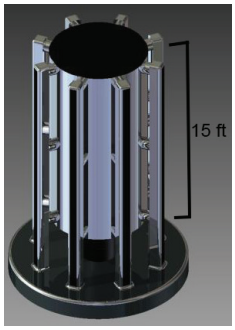


Image 7.2.1 Melting Centrifuges cut refining costs and ease material separation

7.2.2 Silicon Buckystructures

An ore grinder crushes silicon ore sourced from s-type asteroids and lunar mines. A pressure/vacuum system transports the resultant sand into an electrode arc furnace. Our pressure/vacuum system allows continuous processing of silicon in 0g.Within the arc furnace charcoal sourced from c-type asteroids collects oxygen from the silicon and produces 98% pure silicon sand.

Next, chemical vapor deposition in an electric arc reactor forms the silicon nanotubes that make up buckystructures. 0g processing allows non-gravity vapor deposition for maximum purity in our nanotube structures. For some products we introduce impurities in our nanotube manufacturing process to enhance certain qualities of our buckystructures.

7.2.3 Raw Metals

With our processing system, you can expect pure, raw, celestial sourced materials ready for sale at the following prices:

Material	Sale Price ($/tonne)
C-Type Asteroids	
Iron	$128
Carbon	$24,000
S-Type Asteroids	
Silicon	$2,500
M-Type Asteroids	
Nickel	$16,000
Cobalt	$30,500
Lithium	$95,000
Ruthenium	$14,000,000
Palladium	$24,000,000
Iridium	$42,000,000
Osmium	$77,000,000
Rhodium	$760,000,000
Lunar	
Aluminium	$2,200
Titanium	$6,600,000
Helium 3	$10,000,000,000

7.2.4 Market Dilivery

To Deliver both buckystuckture products and refined materials to consumers on Bellevistat, visiting ships, and export, our internal transport system (see section 5.4) either transports products to the docks on each end cap to be loaded on visiting ships and ships we have contracted for exporting goods to earth and other settlements or loads products into the central operations core transport shaft (see section 2.1.2). The shaft takes products to the spokes for distribution in each wing (see section 4.1.5)

7.2.5 Current Lease Space and Expansion

We recognize that refining and manufacturing is a huge pursuit and may become the job of many companies. To accommodate these many companies, we have built Bellevistat with expansive volumes of lease holdable space in the operations core including 32.8 million cubic meters in 0g and 32 million cubic meters in 0.25g each with customizable pressures. Such variety and variability affords the greatest quality and efficiency for third party production on Bellevistat.

In addition to lease-held property, we designed Bellevistat to expand from its light manufacturing facilities to one day accommodate the

entire construction of interplanetary spacecraft. We designed both operations endcaps so that reconstruction can easily enlarge, reconstruct, and configure them to accommodate extremely large, heavy manufacturing.

7.3 Ship Repair and Restoration

Our repair services offer versatility to repair any ship, safety to keep both passengers and our settlement safe, and efficiency to keep shipments on schedule.

7.3.1 Space Tugs

By providing and maintaining a fleet of 10 space tugs, we offer you greater mobility when approaching and docking with Bellevistat as well as when shuttling personnel and supplies from any sized craft. Bellevistat can dock five of these tugs at any time on an array of five miniature Buckminster Bay docking systems purposed for fueling and unloading shuttled cargo and passengers. These tugs encounter spacecraft as they approach Bellevistat and arrest the craft's momentum by grasping the craft with Gecko arms and firing thrusters, protecting Bellevistat from collision. They then control the craft and guide the spaceship into the grasp of our gecko arms that connect the it to the port for scanning and docking.

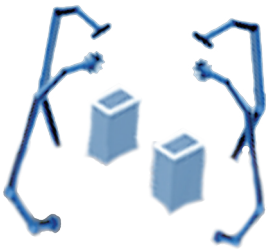


Image 7.3.1 Buckminster Bay tug docks allow us to efficiently refuel and unload passengers to allow us to have usable tugs at anytime

7.3.2 Repair Docks

After our tugs dock ships requiring repairs, the Buckminister Bay Docking System then unloads the ship's cargo and personnel. After the ship is unloaded the tugs regain possession of the ship and push it to the other hemisphere where another set of gecko arms capture the ship. Once adjacent to the hull, a bag of Nextel aerospace fibers coated in ER fluid surrounds the ships as the gecko arms recede, creating a temporary pressurized hangar, and facilitating versatile hanger options for all types and sizes of ships up to 200 meters by 200 meters by 200 meters. Once in the hanger, ships receive prompt attention, ensuring expeditious and quality repair of ship functions (see Section 3.5.2).

7.3.3 Future Port Expansion

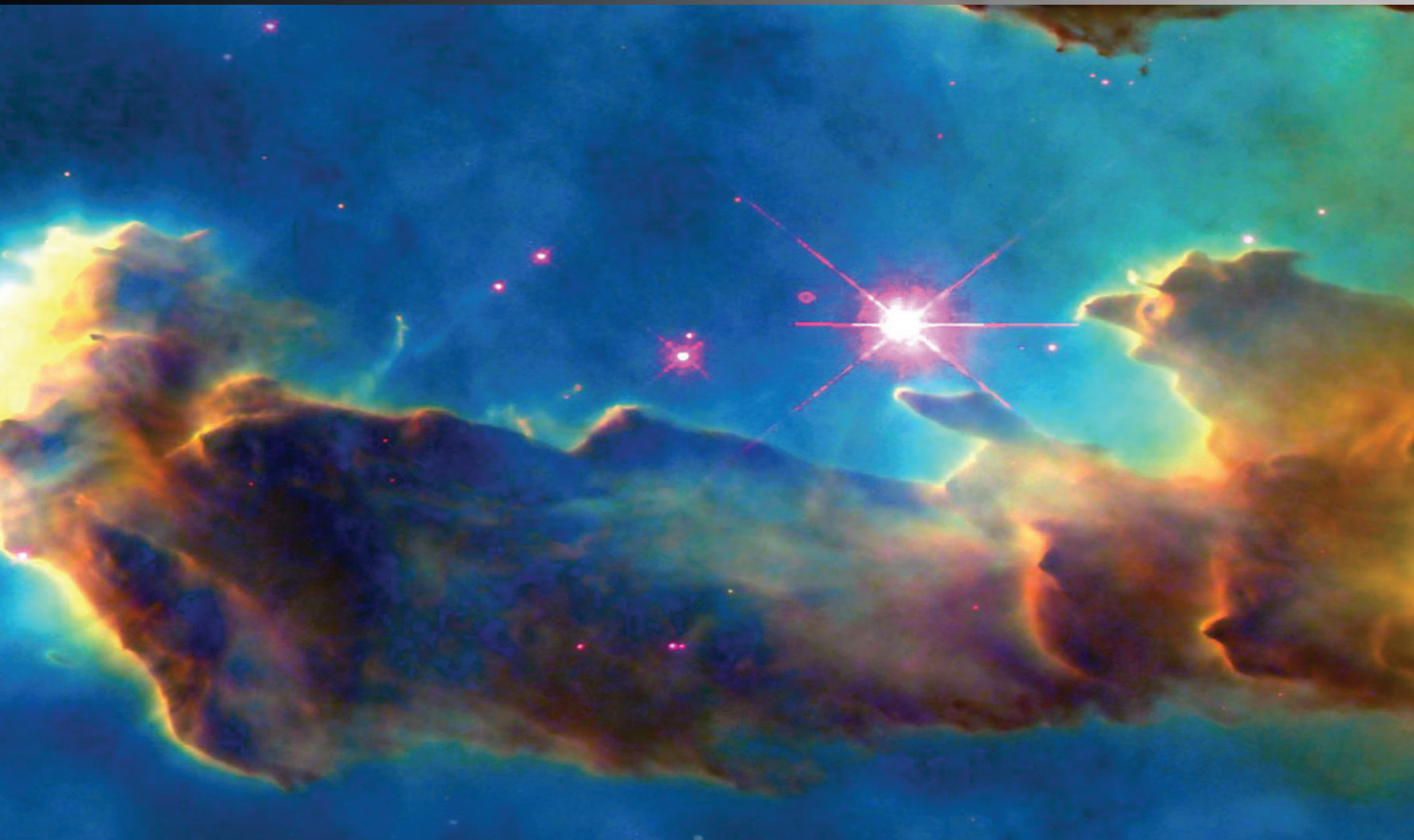
Because Bellevistat expects immense expansion in ore refining, buckystructure production, and manufacturing. we have the ability to incorporate future port expansion for a variety of visiting ships. We designed the bottom endcap of Bellevistat's operations core with expansion in mind. As future operators enlarge the endcap for interplanetary ship construction there will be an increase in surface area for the allocation of more and larger docking facilities. Northdonning Heedwell designed each modular Buckminster Bay system for versatility so you can build a larger dock or add another dock to the surface of an enlarged end cap in less than a week.

7.3.4 Safety Procedures

In the event of an explosion on an incoming ship, procedures entail the safest and most efficient actions possible. To protect Bellevistat and your residents from the shrapnel and forces expelled during an explosion, we keep damaged or malfunctioning ships in a pressurized exterior hanger and control these ships with our space tug fleet so that the ships do not fire their engines and only run systems necessary for survival. In the event of an explosion in a ship outside of our hanger, we use our tugs to shuttle passengers from the damaged ship to our settlement so as not to bring the ship close to and endanger our settlement. We deploy Autofy R robots (see Section 5.2.1) to use foam to control the blaze and ER fluid nets to temporarily patch the ship's hull (see Section A.1). We then defuel the ship and shut it down before docking it to our settlement and deploying our pressurized hangar where we repair it.

In the event of atmospheric contamination on a docked ship, we evacuate passengers while we filter our atmosphere using zeolite molecular sieves and allow some of our atmosphere to slowly escape from vents in our gangway, causing an airflow away from our port and airlock. After all passengers are through our airlock, we depressurize our port and gangway allowing all contaminated air to escape. In the event of a fire on board a docked ship, we deploy foam Autofy R's and evacuate passengers while we follow all the procedures for atmospheric contamination due to the toxic smoke emitted from burning ship material. After the robots have estingised the fire, tugs re-dock the ship in a hanger equipped repair port.

APPENDIX A OPERATIONAL SCENARIO



Appendix A - Contingency Plans

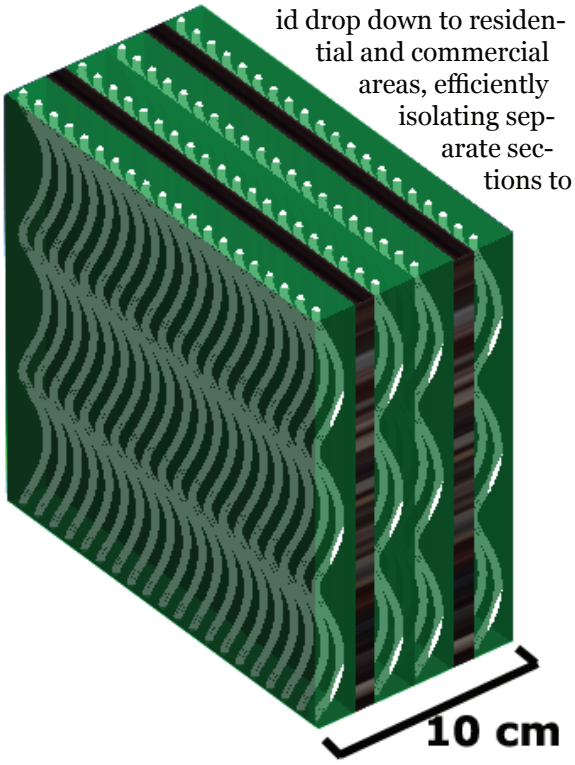
We at Northdonning Heedwell recognize that any steps taken towards moving humankind to permanent habitation in space must be taken with a healthy respect for the dangers inherent in the environment. We have full confidence in Bellevistat's ability to keep your residents safe during normal operations, and our Survival, Repair, Reinstate emergency response system protects residents during rare emergencies such as hull breaches or internal explosions.

A.1 Hull Breach

All Bellevistat emergency procedures operate under a three-step system: Survival, Repair, and Reinstate (SRR). This emergency response system was designed to function under a fully-automated control system, a human emergency response director, or a combination of the two, allowing you to customize the system to your preferences.

In the event of a hull breach anywhere on the settlement, sensors in the hull activate warning systems, alerting all automated systems and the community to possible problems. If depressurization begins, automated systems react immediately by initiating emergency procedures or alerting your designated emergency response director to do so. Buckystructure nets with ER fluid drop down to residential and commercial areas, efficiently isolating separate sections to maintain pressure in undamaged sections (see Image A.1.1). Meanwhile, the internal heating systems adjust to keep the internal temperature of all habitable volumes comfortable and safe. Depending on the location of the hull breach, systems may temporarily shut down so that emergency back-up systems more securely located in the settlement may replace them. Emergency lighting clearly directs residents to nearby safe buildings. At first warning, all residents report to the nearest safe building and check in with automated systems, giving you peace of mind in assuring that every individual has reached safety. Safe buildings located throughout the settlement ensure that no person has to travel more than 100 meters to reach one (see Image A.1.2). Safe buildings store enough food, water, power, and medical supplies to last one week, protecting your residents while repairs take place. We equipped all safe buildings with permanent airlocks as doors, providing residents with safe passage points through the buckystructure bulkheads so they may evacuate to another terrace level

Image A.1.1 Buckystructure nets section off the damaged region to protect residents



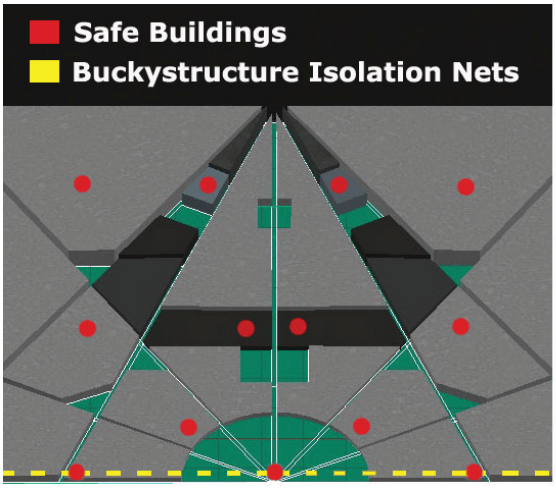


Image A.1.2 Safe building interspersed throughout the terraces shelter residents during emergencies

if necessary. If an emergency occurs that surpasses the capabilities of these safety measures, residents can access escape pods through elevators located in the safe buildings, travelling beneath the terraces to access escape pods located on the exterior of the residential wings. These escape pods eject outside the rotation of the settlement so that rescue ships can capture them and return them to Bellevistat. The Survival portion of the emergency procedures secure or evacuate all residents to safe places capable of sustaining them during repairs.

The second step, Repair in the SRR emergency system, consists of multiple levels of redundancy and variety in order to repair any hull damage as quickly and completely as possible. In the event of an underside hull breach, buckystructure nets with ER fluid deploy beneath the terraces to isolate the damaged region (see Section 2.1.5). Since the hull breach initially occurred, our uniquely innovative hull has been repairing itself, shielding residents from the harsh space environment without requiring any reaction time from an automated system or your emergency director. As the hull breach exposes the inner layers of the hull to the extreme cold of space, a unique crystal layer within our hull, silver(I) hexacyanocobaltate(III), expands and closes off the breach. If the settlement is facing the sun during the time of the impact, a layer of chlorinated polyvinyl chloride (CPVC) inside the hull expands with the heat to block the hole. In addition to the automatic expansion materials, swarms of Autofy repair robots (see Section 5.2), stationed at each safe building, respond promptly to a hull breach or other emergency. These robots spray a hardening bio-foam sealant onto the breach to create an airtight seal and backup the crystal system. Next, robots deploy buckystructure nets onto the breach to add thermal insulation and tension strength. Our multileveled temporary patch system protects residents from the dangers of depressurization emergencies, while the robots work to install a permanent replacement hull panel. In this way the emergency systems deal with any underside hull breach so that normal settlement function can resume more quickly and safely. If the hull breach occurs on the topside of a habitable volume a different set of repair steps come into play. Because the windows surround the entire top section of the residential and commercial areas in the rotating sections of the settlement, a substantially crystal-lined hull no feasible. Instead, robots and the sealant become responsible for hull repair, along with the added measure of an ER fluid-enforced buckystructure net, deployed by robots and shocked with a small electric current to solidify the ER fluid and block the breach. Both systems protect against multiple breaches of up to 0.5 square meters in area in various sections of the habitable portions of Bellevistat. Through these various safety measures we equip Bellevistat to deal with an emergency hull breach quickly and completely.

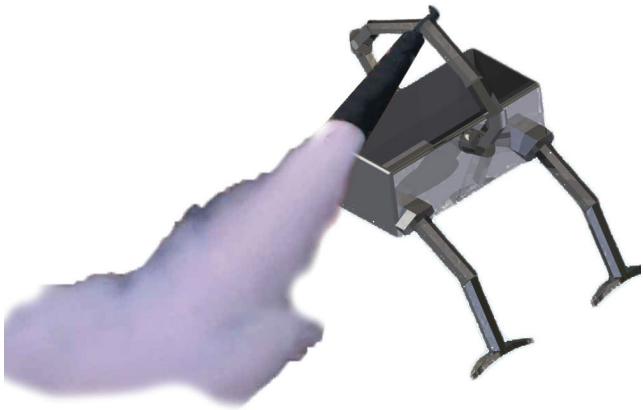
In the final Reinstate stage of the emergency SRR system, residents reinstate themselves into the residential and commercial areas. Before residents can exit safe buildings or return to the damaged settlement section, all systems complete at least two thorough automated inspections and at least one human inspection. Any systems that shut off during the emergency undergo more functional testing before being cleared for reoperation. Minor repairs of non-critical or safety-related systems take place once the residential and commercial areas have been repopulated.

A.2 Internal Explosion

As with a hull breach, Bellevistat follows the Survival, Repair, and Reinstate (SRR) procedures in the case of an internal explosion.

Ensuring the survival of all Bellevistat residents becomes the number one priority in an explosion emergency. Photoacoustic gas sensors and other sensors within the industrial centers work continuously with the aim of preemptively predicting and detecting dangerous situations. Our proactive

Image A.2.1 Autofy robots use fire suppression foam to extinguish fires from internal explosions



approach alerts your residents with an alarm so they may move to safe buildings before explosions occur. Each terrace contains 13 safe buildings that can accommodate up to 200 people per building. Insulation protects safe rooms from the heat of the explosion and airlocks prevent toxic gasses from entering. Each safe building is equipped with food, water, and oxygen to last at least seven days as well as medicine to treat burns or effects of toxic gas. In the space above the terraces, electrorheological (ER) fluid barriers drop to confine the explosion to a smaller area. Below the terraces, we use smaller ER fluid barriers to isolate the section that may explode. When sensors predict a threat before an explosion occurs, the area of the threat will be isolated using only the electrorheological fluid buckystructure barriers around this area. However, if the event occurs without warning, computer systems activate all the ER fluid buckystructure nets in the residential wing to minimize the spread of toxic gas. Pressure release valves located in the hull relieve pressures of up to five times normal atmospheric level, significantly reducing damage to internal infrastructure and releasing some of the heat released in the explosion. Understanding that explosions often result in fires, we equipped Autofy emergency response robots stationed at safe buildings with a Class A synthetic detergent hydrocarbon suffocant, a variety of fire suppression foam. Autofy robots spray this foam to extinguish fires (see Image A.2.1). Our use of this foam significantly reduces clean-up and repair time as it eliminates the need for water as a fire suppression technique. It also absorbs and dissipates the heat of the fire much more efficiently than water-based suppression systems.

Next, we begin repairs for areas damaged by the blast. Systems work to return the atmosphere to a habitable state immediately; this includes returning to an acceptable temperature and eliminating all hazardous gas released by the explosion. If the explosion releases only minor amounts of heat and gas, the barriers between sections can be removed after only a small filtering period, allowing the heat to dissipate without aid. Fans take in air near the ceiling, and filter it with using loose-fill molecular filters (see Image A.2.2). The loose-fill filters adjust to remove any molecules that may result from an explosion. After the filters clean the air, the air enters compressors. Compressors then release air through vents near the floor. The air expands, cools, and settles near the floor while the hotter, contaminated air rises toward the ceiling and the vents that take it in to be filtered. The air filtration system purifies the entire atmosphere, so in the event that the toxic gases are heavier than the air, the filters remove the harmful particles by changing the degree of compressor use. During the air filtration process, we deploy Autofy robots to search for stranded residents and bring them to safety.

Finally, repair measures return the damaged sections to normal functionality. Autofy robots remove debris and begin reconstruction of all damaged buildings or systems. Robots repair areas associated with food production, sanitation and waste management, air filtration, and other vital functions first. Normal settlement life resumes after only a few days, as the Autofy robots repair less essential systems in the background.

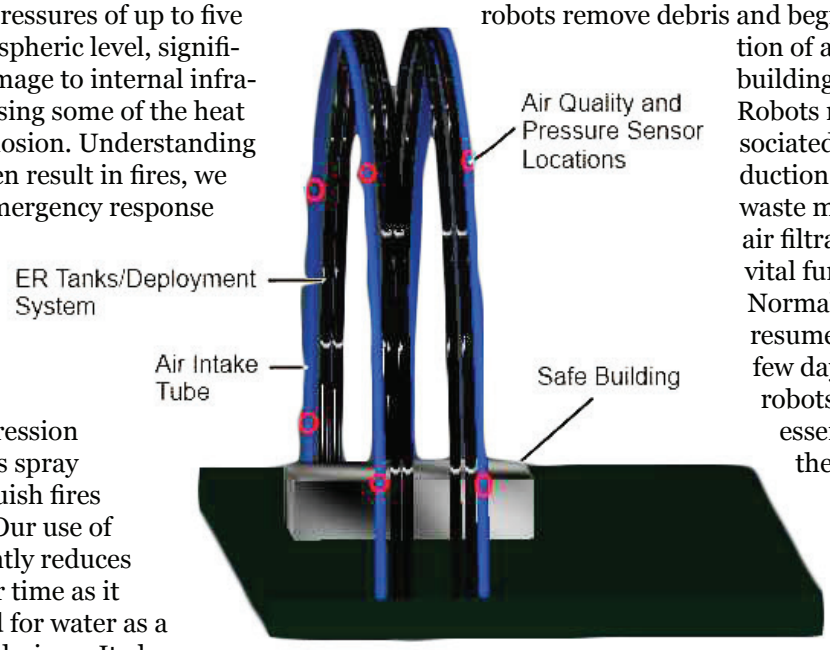


Image A.2.2 Air filters purify the atmosphere, removing any harmful gases released in an explosion

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APPENDIX C COMPLIANCE MATRIX

Appendix C - Compliance Matrix

Requirement	Where Met	Page
2.0 Provide a safe and pleasant living and working environment	*Sections 2.1-2.5*	2-8
2.0 Enable residents to have natural views of Earth and the Moon	*Section 2.1.4, Table 2.1.2*	3
2.1 Identify large enclosed volumes and their uses	Section 2.1.2, Image 2.1.2, Image 2.1.4	2-3
2.1 Show dimensions of major structural components and design features	Table 2.1.1, Image 2.1.3	2
2.1 Identify construction materials for major hull components	Section 2.1.4, Table 2.1.2, Table 2.1.3	3-4
2.1 Specify volumes where artificial gravity will be supplied	Section 2.1.1, Section 2.1.6, Image 2.1.2	2, 4
2.1 Specify means for initiating and sustaining artificial gravity	Section 2.1.6, Section 2.3.1, Image 2.3.11	4, 6
2.1 Specify structural interface(s) between rotating and non-rotating sections	Section 2.1.3, Image 2.1.5	3
2.1 Show capability to isolate at minimum any five separate habitable volumes in case of a depressurization or other emergency	Section 2.1.5, Image 2.1.6, Image 2.1.7	4
2.1 Minimum Requirement: Overall exterior view of settlement with major visible features	**Image 2.1.2**	2
2.1 Minimum Requirement: Overall exterior view of settlement showing rotating and non-rotating sections	**Image 2.1.2**	2
2.1 Minimum Requirement: Overall exterior view of settlement showing pressurized and non-pressurized sections	**Image 2.1.2**	2
2.1 Minimum Requirement: Overall exterior view of settlement indicating functions inside each volume	**Image 2.1.4**	3
2.2 Specify percentage allocation and dimensions of interior “down surfaces”	Image 2.2.1, Table 2.2.1, Table 2.2.2	5
2.2 Drawings labeled to show residential, industrial, commercial, agricultural, and other uses	Image 2.2.1	5
2.2 Show orientation of “down surfaces” with respect to overall settlement design	Image 2.2.2	6
2.2 Show vertical clearance in each area	Table 2.2.2	5
2.2 Minimum Requirement: Overall map or layout of interior land areas, showing usage of those areas	**Image 2.2.1**	5

Requirement	Where Met	Page
2.3 Describe the process required to construct the settlement, by showing the sequence in which major components will be assembled	Images 2.3.1-2.3.10, Table 2.3.1	7
2.3 Specify when artificial gravity will be applied	Section 2.3.1, Table 2.3.1	6, 7
2.3 Describe a construction technique for interior structures making use of minimally refined lunar materials	Section 2.3.2, Table 2.3.2	6
2.3 Minimum Requirement: Drawing(s) showing at least ten intermediate steps of settlement assembly	**Images 2.3.1-2.3.10**	7
2.3 Minimum Requirement: Drawing showing method of initiating artificial gravity	**Image 2.3.11**	6
2.4 Production facility for silicon buckystructures requires 50,000 sq. ft. (4645 sq. meters) with at least 26 ft. (8 meter) ceiling height in 0.25g, plus a comparable volume with 10 ft. (3 meters) in one dimension in zero g	Section 2.4, Image 2.4.1	6, 8
2.4 Production facility requires 1 MW of continuous electrical power	Section 2.4	6, 8
2.4 Minimum Requirement: Show locations on overall structural drawing of buckystructures production facilities	**Image 2.4.1**	8
2.4 Minimum Requirement: Show means for moving parts between those facilities	**Image 2.4.2**	8
2.5 Port facilities must accommodate various sizes, configurations, and purposes of visiting ships	Section 2.5, Image 2.5.1, Table 2.5.1	8
2.5 Minimum Requirement: Drawing(s) of dock configuration(s), including ships in port	**Image 2.5.1**	8
3.0 Describe facilities and infrastructure necessary for building and operating the Bellevistat space settlement and its communities	*Section 3.1-3.5*	9-17
3.1 The settlement will operate in orbit around the Earth-Moon L4 libration point	Section 3.1	9
3.1 Identify sources of materials and equipment to be used in construction	Table 3.1.1	9
3.1 Identify means for transporting construction materials to the Bellevistat construction location	Section 3.1.3	9
3.1 Identify storage for construction materials between arrival and use	Section 3.1.2	9
3.1 The maximum payload size that can be launched from Earth is 20 feet (6 meters) diameter by 80 feet (24 meters) long	Section 3.1.3	9-10
3.1 The maximum size that Alexandriat can build and ship is 23 feet (7 meters) diameter by 100 feet (30 meters) long, or flat plate 100 ft. (30 meters) by 50 ft. (15 meters)	Section 3.1.3	9-10

Requirement	Where Met	Page
3.1 Minimum Requirement: Table identifying types, amounts, and sources of construction materials	**Table 3.1.1**	9
3.2 Show elements of basic infrastructure required for the activities of the settlement's residents, including (but not limited to) atmosphere, food production, electrical power generation, water management, household and industrial solid waste management, internal and external communication systems, internal transportation systems, and day/night cycle provisions	Section 3.2	10
3.2 Identify air composition, pressure, humidity, thermal control, and quantity	Section 3.2.1, Table 3.2.1, Image 3.2.1	11
3.2 Describe food production including growing, harvesting, storing, packaging, delivering, and selling	Section 3.2.2, Table 3.2.2, Image 3.2.2, Image 3.2.3	11
3.2 Describe electrical power generation, and specify kilowatts distributed to habitable areas	Section 3.2.3, Table 3.2.3, Image 3.2.4	12
3.2 Describe water management, and specify required water quantity and storage facilities	Section 3.2.4, Table 3.2.4	13
3.2 Describe household and industrial solid waste management, and specify recycling and/or disposal	Section 3.2.5, Table 3.2.4, Image 3.2.5	13
3.2 Describe internal and external communication systems, and specify devices and central equipment	Section 3.2.6, Table 3.2.5	13
3.2 Describe internal transportation systems, and show routes and vehicles with dimensions	Section 3.2.7, Table 3.2.5, Image 3.2.6, Image 3.2.7	14
3.2 Specify day/night cycle schedule and mechanism/operations for providing it	Section 3.2.8, Table 3.2.6, Image 3.2.8	14-15
3.2 Define storage facilities required to protect against interruption in production of food or commodities required for daily life	Section3.2.1, Section 3.2.2, Section 3.2.4, Section 3.2.5	10-13
3.2 Supply lines for imports may be interrupted for two weeks	Section3.2.1, Section 3.2.2, Section 3.2.4, Section 3.2.5	10-13
3.2 Minimum requirement: Chart or table specifying quantities required of air	**Table 3.2.1**	10
3.2 Minimum requirement: Chart or table specifying quantities required of food	**Table 3.2.2**	11
3.2 Minimum requirement: Chart or table specifying quantities required of power (for residents)	**Table 3.2.3**	12
3.2 Minimum requirement: Chart or table specifying quantities required of water	**Table 3.2.4**	13
3.2 Minimum requirement: Chart or table specifying quantities required of waste handling	**Table 3.2.4**	13

Requirement	Where Met	Page
3.2 Minimum requirement: Chart or table specifying quantities required of communications devices	**Table 3.2.5**	13
3.2 Minimum requirement: Chart or table specifying quantities required of internal transport vehicles	**Table 3.2.5**	13
3.3 Show conceptual designs of primary machines and equipment employed for constructing the settlement, especial for assembling exterior hull and interior buildings/structures	Section 3.3, Image 3.3.1	15
3.3 Describe materials, components, and/or subassemblies delivered to the machines	Section 3.3.1, Section 3.3.2	15
3.3 Describe how the machines convert delivered supplies into completed settlement structures	Section 3.3.1, Section 3.3.2, Image 3.3.1	15
3.3 Minimum Requirement: Drawing(s) of primary construction machinery, showing how it shapes and/or manipulates raw materials or structural components into finished form	**Image 3.3.1, Image 3.3.2**	15
3.4 Experience at Alexandriat shows that supplying paper is a major challenge in space	Section 3.4	15
3.4 Show process(es) for providing paper (or equivalent) products in Bellevistat, including recycling	Image 3.4.2	16
3.4 Minimum Requirement: Chart of table listing raw materials source(s) and facilities or paper (or equivalent) production processes	**Table 3.4.1**	16
3.5 Bellevistat will provide repair services for visiting ships	Section 3.5	17
3.5 Minimum Requirement: Show how docks for ship repair differ from unloading/loading docks	**Image 3.5.1**	17
4.0 Describe provisions to allow Foundation Society members to maintain traditional comforts of Earth without the sacrifices normally associated with a frontier environment	Section 4.1-4.5	18-26
4.0 Describe provisions to meet residents' expectations of community attributes available to residents of Earth's large towns in developed countries	Section 4.1-4.2, Section 4.4-4.5	18-23 25-28
4.0 Assure that natural sunlight and views of Earth and the Moon are readily available for residents	Section 4.1.1, Section 4.1.6,	18, 19
4.0 Provide options for residential areas in 1g, 0.8g, and 0.5g; and with 1.0, 0.8, and 0.6 times Earth sea level atmospheric pressure	Section 4.2, Image 4.2.1, Image 4.2.3, Image 4.2.5, Image 4.2.7, Image 4.2.9, Image 4.2.11, Image 4.2.13	20-23
4.1 Provide services that families could expect in comfortable modern communities (e.g., housing, entertainment, medical, parks and recreation)	Section 4.1.1, Section 4.1.2, Section 4.1.3, Section 4.2, Image 4.1.1	18, 20

Requirement	Where Met	Page
4.1 Provide variety and quantity of consumer goods	Section 4.1.4, Table 4.1.1	19
4.1 Provide areas designed with open space and long lines of sight	Section 4.1.1, Section 4.1.6, Image 4.1.2	18-20
4.1 List major types of consumables, and quantities	Section 4.1.4, Table 4.1.1	19
4.1 Depict or specify means of distributing consumables (including food) to Bellevistat residents	Section 4.1.5	19
4.1 Minimum Requirement: Map(s) and/or illustration(s) depicting community design and locations of amenities, with a distance scale	**Image 4.1.2**	19
4.1 Minimum Requirement: Identify percentage of land area allocated to roads and paths	**Table 4.1.2**	20
4.2 Provide designs of typical condominium or apartment residents, clearly showing room sizes	Section 4.2, Image 4.2.1-4.2.14	20-23
4.2 Home designs will be no smaller than 800 sq. ft. and no larger than 1400 sq. ft.	Section 4.2	20
4.2 Identify source(s) and/or manufacture of furniture items, appliances, and personal items	Section 4.2.1-4.2.2	20-21
4.2 It must be expected that demographics and population of the settlement will change with time	Section 4.2.3, Image 4.2.1-Image 4.2.2	21
4.2 Minimum Requirement: External drawing and interior floor plan of at least six home designs	**Image 4.2.1-Image 4.2.14**	20-23
4.2 Minimum Requirement: Specify the area (preferably in square feet) for each residence design and the number required of each design	**Table 4.2.1, Section 4.2**	20
4.3 Designs of systems, devices, and vehicles intended for use by humans outside of artificial gravity and pressurized volumes will emphasize safety	Section 4.3.5, Image 4.3.4	24
4.3 Show safety systems to enable human inspection and repair of exterior surfaces of rotating volumes	Section 4.3.3-4.3.5, Image 4.3.3-4.3.4	24
4.3 Show features required for spacesuits enabling work outside of pressurized volumes	Section 4.3.1-4.3.2, Image 4.3.1-4.3.2	23
4.3 Show airlock designs for exiting/entering habitable areas from unpressurized volumes and the exterior	Section 4.3.3, Image 4.3.3	24
4.3 Minimum Requirement: Drawing showing spacesuit designs	**Image 4.3.1-4.3.2**	23
4.3 Minimum Requirement: Drawing showing airlock designs	**Image 4.3.3**	24
4.3 Minimum Requirement: Drawing showing exterior mobility device designs	**Image 4.3.4**	24

Requirement	Where Met	Page
4.4 Studies of human behavior in isolated environments have shown a tendency for permanent residents to regard visitors and temporary residents as outsiders or intruders	Section 4.4.1-4.4.2, Section 4.4.4, Image 4.4.2	25
4.4 Describe community attributes intended to enable short-term residents to feel welcome and integrated into the settlement's community life	Section 4.4.1-4.4.2, Section 4.4.5	25
4.4 Minimum Requirement: Describe at least one physical community feature intended to involve non-permanent residents in social structures of the settlement	**Section 4.4.3, Section 4.4.5**	25
4.4 Minimum Requirement: Describe at least one social community feature intended to involve non-permanent residents in social structures of the settlement	**Section 4.4.4-4.4.5**	25
4.5 Visitors' first impressions of Bellevistat will be the passenger receiving areas	Section 4.5.2, Image 4.5.1	26
4.5 Create pleasant and efficient areas for passenger arrival and departure	Section 4.5.2	26
4.5 Minimum Requirement: Illustration(s) of the passenger experience when arriving at Bellevistat	**Image 4.5.1-4.5.2**	26
5.0 Specify numbers and types of computing and information processing devices required for Bellevistat's facility, community, and business operations	*Table 5.2.2*	30
5.0 Specify numbers and types of multi-function personal electronic tools required for Bellevistat's facility, community, and business operations	*Table 5.2.2*	30
5.0 Specify numbers and types of servers required for Bellevistat's facility, community, and business operations	*Image 5.3.2*	32
5.0 Specify numbers and types of network devices required for Bellevistat's facility, community, and business operations	*Image5.3.2*	32
5.0 Specify numbers and types of robots required for Bellevistat's facility, community, and business operations	*Table 5.2.2*	30
5.0 Describe types and capacities of data storage media, data security, and user access to computer networks	*Image 5.3.3*	32
5.0 Show robot designs, clearly indicating their dimensions and illustrating how they perform their tasks	*5.0*	27-35
5.1 Describe use of automation for construction	5.1.1	27

Requirement	Where Met	Page
5.1 Consider automation for transportation and delivery of materials and equipment	5.1.1	27
5.1 Consider automation for assembly of the settlement	5.1.1-5.1.2	27-28
5.1 Consider automation for interior finishing	5.1.2	28
5.1 Consider automation for manufacture of furniture and appliances	5.1.2	28
5.1 Minimum Requirement: Drawings showing automated construction and assembly devices for exterior applications and illustrating how they operate	**Image 5.1.1**	27
5.1 Minimum Requirement: Drawings showing automated construction and assembly devices for interior applications and illustrating how they operate	**Image 5.1.2**	28
5.2 Specify automation systems for settlement maintenance, repair, and safety functions, including backup systems and contingency plans	5.2.2	29
5.2 Robots required for emergency external repairs must survive and accomplish tasks during solar flare activity	5.2.1	28
5.2 Describe means for authorized personnel to access critical data and command computing and robot systems	5.2.3	29
5.2 Include descriptions of security measures to assure that only authorized personnel have access, and only for authorized purposes	5.2.3	29
5.2 Minimum Requirement: Chart of table listing anticipated automation requirements for operation of the settlement, and identifying particular systems and robots to meet each automation need	**Table 5.2.2**	30
5.3 Describe automation devices to enhance livability in the community	5.3.1	30
5.3 Describe automation devices to enhance productivity in work environments	5.3.2	31
5.3 Describe automation devices to enhance convenience in residences	5.3.3	31
5.3 Emphasize use of automation to perform maintenance and routine tasks, and reduce requirements for manual labor	5.3.1	30
5.3 Provide for privacy of personal data and control systems in private spaces	5.3.4	31
5.3 Describe devices for personal delivery of internal and external communications services, entertainment, information, computing, and robot resources	5.3.5	32

Requirement	Where Met	Page
5.3 Minimum Requirement: Drawings of robots and computing systems that people will encounter in Bellevistat	**Image: 5.3.1, Image 5.1.1, Image 5.2.1**	27, 28, 30
5.3 Minimum Requirement: Diagram(s) of network(s) and bandwidth requirements to enable connectivity	**Image: 5.3.2-5.3.3**	32
5.4 Ore from the Moon and asteroids will arrive in standard shipping containers, 15 ft. square by 60 ft. long	5.4	32
5.4 Automate unloading of shipping containers from ships	5.4.1	33
5.4 Automate transfer of containers to refining facilities	5.4.2	33
5.4 Automate unloading of containers in zero g and vacuum	5.4.3	34
5.4 Minimum Requirement: Drawings of automation systems to deliver ore to refining processes	**Image 5.4.1-5.4.3**	32-34
5.5 Automate final docking of ships in the various port facilities	5.5.1	34
5.5 Show differences in docking procedures for different types of docks	5.5.2	35
5.5 Minimum Requirement: Show automated docking aids for at least two different types of ships	**Image 5.5.1**	34
6.0 Include a schedule for completion and occupation of Bellevistat within 13 years	*6.1*	36
6.0 Include costs for design through construction phases of the schedule	*6.2*	37
6.1 Describe contractor tasks from the time of contract award (15 May 2033) until the customer assumes responsibility for operations of the completed settlement	6.1	36
6.1 Show schedule dates when Foundation Society members may begin moving into their new homes and when the entire original population will be established in the community	6.1	36
6.1 Minimum Requirement: Durations and completion dates of major design, construction, and occupation tasks, depicted in a list, chart, or drawing	**6.1**	36
6.2 Specify costs billed per year of Bellevistat design through construction in U.S. dollars, without consideration for economic inflation	6.2	37
6.2 Estimate numbers of employees working during each phase of design and construction in the justification for contract costs	6.2	37

Requirement	Where Met	Page
6.2 Minimum Requirement: Chart(s) or table(s) listing separate costs associated with different phases of construction, and clearly showing total costs that will be billed to the Foundation Society	**6.2**	37
7.0 Bellevistat will host various commercial and industrial ventures, which may change with time	*7.2*	39
7.0 The basic design must be sufficiently flexible to add compatible business types with little configuration change	*7.2.5*	39
7.0 The original configuration must accommodate three major business pursuits: port for receiving lunar and asteroid materials, production of goods manufactured form extraterrestrial materials, and repair and restoration of ships and other space infrastructure elements	*7.1, 7.2, 7.3*	38-40
7.1 Describe port for receiving lunar and asteroid materials	7.1	38
7.1 Ore will arrive in standard shipping containers	7.1	38
7.1 Ore arrives in batches but is delivered for continuous processes, so must be stored between delivery and use	7.1.4	38
7.1 Provide method(s) and route(s) for transferring raw materials to processing facilities	7.1.2, 5.4	38, 32
7.1 Most—but not all—bulk cargo will arrive in standard shipping containers	7.1.3	38
7.1 Provide separate port facilities for passengers and cargo other than raw materials	7.1.3, 2.5	38, 8
7.2 Describe production of goods manufactured from extraterrestrial materials	7.2	39
7.2 Materials require processing varying from minimal to refining for extraction of metals and rare earth elements	7.2.1	39
7.2 Many processes require operations in both zero g and at least 0.2 g	7.2.1, 7.2.2	39
7.2 Manufacturing will encompass a wide variety of products; the Foundation Society will welcome companies to lease space for manufacturing facilities	7.2.5	39
7.2 Products will be created at Bellevistat for export, provisioning visiting ships, and internal use/consumption	7.2.1, 7.2.2, 7.2.3, 7.2.4, 7.2.5	39
7.2 Provide delivery paths from manufacturing area(s) to consumer acceptance for each market	7.2.4	39

Requirement	Where Met	Page
7.2 Allow for future expansion of manufacturing areas, to eventually include assembly of large interplanetary ships	7.2.5	39
7.3 Describe repair and restoration of ships and other space infrastructure elements	7.3.2	40
7.3 A fleet of 10 space tugs will operate from Bellevistat, of which up to 5 tugs may be docked at any one time	7.3.1	40
7.3 Repair docks are required to accommodate different types and sizes of ships	7.3.2	40
7.3 Allow for future port expansion, both for increasing numbers and sizes of visiting ships requiring services	7.3.3	40
7.3 Provide safety procedures in the event a visiting ships develops a hazardous situation	7.3.4	40
A.0 Describe in detail processes that will occur during two different emergencies	*Section A.1, Section A.2*	I, II
A.0 Describe how normal functions will be restored after each situation is stabilized	*Section A.1, Section A.2*	I, II
A.1 Hull breach at an interface between to separate habitable volumes containing residential and commercial areas, with a hole equivalent to 6 inches (15 centimeters) diameter in each volume	Section A.1, Image A.1.1, Image A.1.2	I
A.2 Internal explosion without a hull breach in a habitable industrial area resulting in a large release of heat and toxic gas	Section A.2, Image A.2.1, Image A.2.2	II

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