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I understand that if our Team qualifies for the	International Space Settlement	Design Finalist
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1.0 Executive Summary

The progress made from Alexanderiat, primarily aimed to provide orbital satellite refurbishment, to a space settlement to accommodate more than ten-thousand permanent dwellers, is a great leap forward in the most significant expansion of man since Columbus's time. Fully aware of the confidence a successful attempt will bolster and the settlement's responsibility to afford an example to its successors, we took its name from the ship Arabella, on which John Winthrop delivered his famous sermon urging the colonists to build in the new world a "City upon a Hill", a model for those on the ground to look up to.

Designers of Bellarat observe that nothing is more important for such an ideal dwelling place in space than the spiritual and material well-being of its inhabitants. Thus we have been guided from the very beginning by two goals — on one hand, to provide a home-like environment that is no less satisfying than the best that Earth has to offer; and on the other, to guarantee absolute safety for those on board so that the first settlers can live and work with an easy mind.

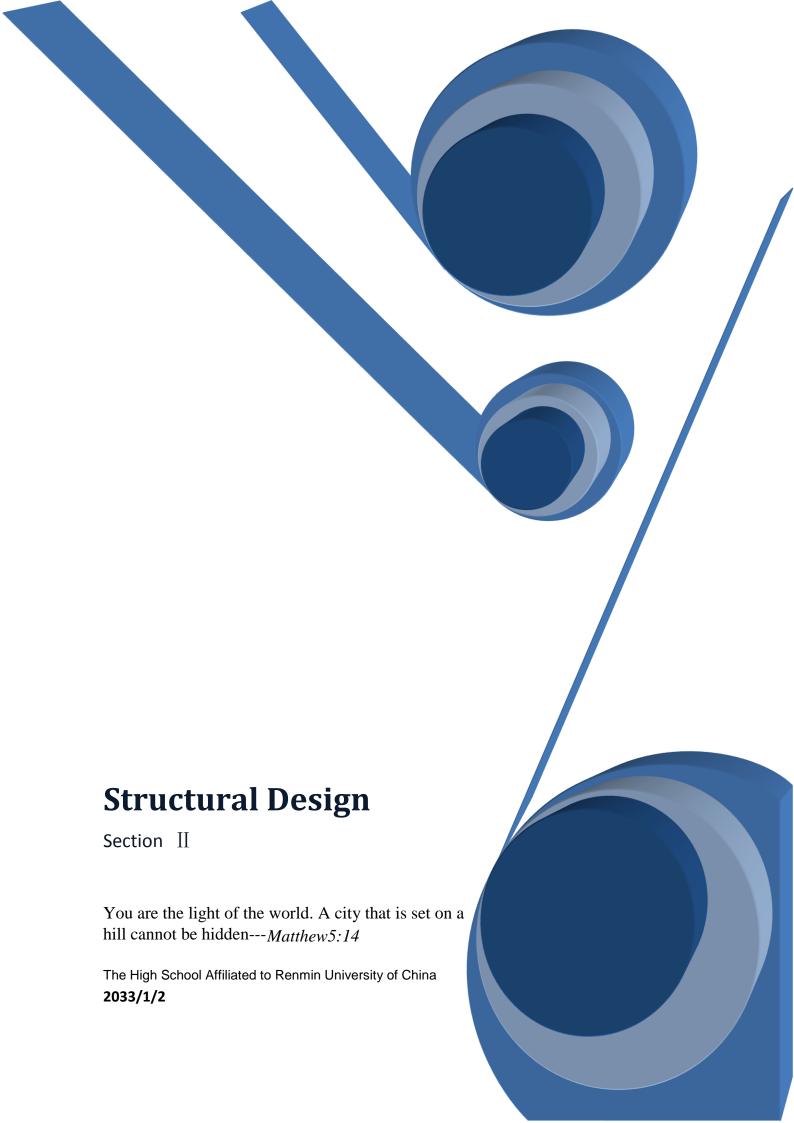
In the making of home-like environments we believe we have found a reliable balance between innovation and tradition. The application of new technology enables residents to have an almost real view of the blue "sky", feel weather changes and experience day-and-night cycles; yet what we are presenting here is not a mere counterfeit of earth. Real sensations that derive from social contacts cannot be substituted by artifacts, so a wide variety of community activities including education, religion, recreation, entertainment, sports, business and others are accessible to residents to promote active participation and create a wide range of opportunities.

Furthermore, Bellarat ensures all Bellaratian's safety from external and internal dangers. The settlement's unique structural design boasts two major innovations. First, the symmetrical layout provides backups for power supply, resource storage and transportation routes. Second, the separation of residential zones makes it possible to shut down any of them without affecting the others. In short, whatever happens to Bellarat, there is always an alternative.

In addition to its merits in improving spatial habitability, Bellarat is capable of functioning as a major business center and tourist attraction in the years to come. Members of the Human Factors Department have specially designed a zero g amusement park and two Airtels, hotels at the docking port, for tourist and business uses respectively. Meanwhile the Axis Major, around which rotating parts revolve, is designed to be comprised of independent modules to minimize the cost of future expansion when attachment of a new rotating part becomes necessary due to growing population and business development.

Designed with ceaseless efforts of its designers, Bellarat is ready to fulfill its mission—not only as a space settlement, but also as the "City upon a Hill", as our predecessors put it, advancing our frontier high above the sky, in yet another new world, inspiring generations of pioneers to the endeavor. May His providence guide us to happiness and prosperity, but for this first step we have to walk alone, knowing that His cause is here our own. Join us in the conquest of the last frontier.

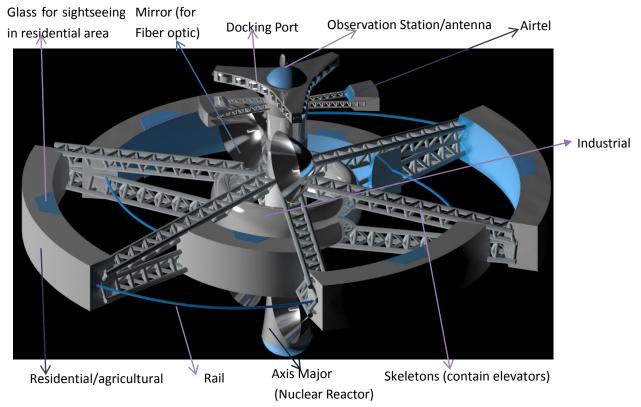




2.1 External Configurations

2.1.1 Main Structure

In general, Bellarat is designed to be highly symmetrical, thus providing available sheltering alternatives in case of emergency. On the other hand, it will reduce the impact of unequal dynamic forces to the structure. The direction of its autorotation will be the same as its revolution, so that it can permanently keep its attitude. The design of maximized radius is expected to mitigate the Coriolis Effect significantly.



The residential volumes are designed in large measures, in both height and width, to give residents larger room for activity and broader views. In this way, chances of being affected by psychological problems like island fever can be decreased (cf. 4.4). Also, the synchronicity of residential and industrial volumes as well as closely connected residential and agricultural zones and provides Bellaratians the convenience of communication and transportation. Air tight, enclosed rails between distant volumes make travelling between residences more efficient.

Each volume has the ability to be shut down and separated from the whole structure in case of emergency.

Furthermore, agricultural sectors would function as buffers for the residential sectors were the settlement hit by space debris. Six posture adjustors will be constructed on the outside hull of residential-agricultural sectors to initiate and to adjust its rotation (cf. 2.3). The observatory complex, which contains communication antennas, space telescopes and a sightseeing center, is located at the top of Axis Major, and is also used to dispatch docking space crafts. Bellarat's energy come mainly from solar and nuclear power. The solar power satellites provide abundant energy for Bellarat, with the solar power receptor set at the top half of the Axis Major (cf. 3.2). The 0g sectors provide room for nuclear energy (cf. 3.2), 0g industry, and storage of ore and other resources (cf. 3.1), scientific researches and experiments, etc.

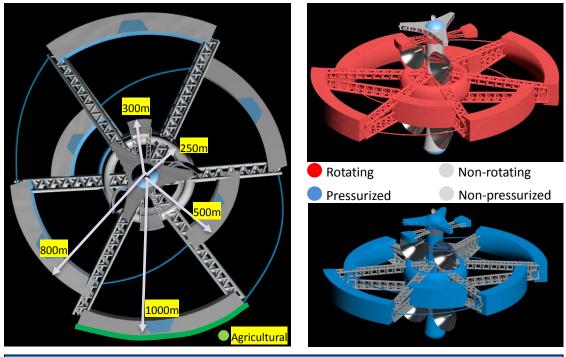
Airtels, aka spaceport hotels, are designed as temporary residence and receiving area, providing services and relaxation for dock passengers and staff. The Airtels are also intended to leave visitors the best first impression



possible. It can be a shelter in emergency as well. A magnetic field of large size and moderate intensity as well as a Faraday cage, conductive cables surrounding the settlement, will be created around the Bellarat to protect Bellaratians from dangerous high-energy cosmic particles. All these designs are made to make Bellarat a safe and comfortable settlement for its residents.

Three arc-shaped docking ports are designed to perfectly accommodate ships of various types and sizes. Passengers and cargo are separated on arrival, and are then transported to their destinations respectively (cf. 3.2). An array of specialized repairing ports provides service for ships in need of repairing.

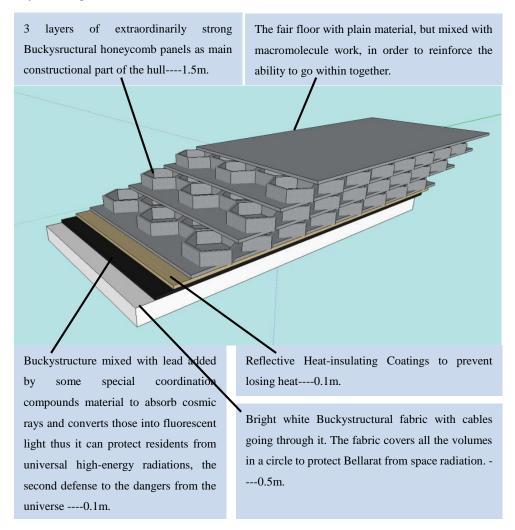
It is noteworthy that the Axis Major consists of an upper half and a lower half; when expansion becomes necessary, the joint between the two are unlocked and middle halves can be easily added to include more rotating volumes.



Sections						
Sections	Quality	Radius /m	Gravity/g	Pressure /atm	Rotating period/s	Speed / (m/s)
Residential&	2	1000	1	1.0;0.8		100
	2	800	0.8	1.0;0.6	62.8	80
Agricultural	2	500	0.5	0.8;0.6	02.8	50
Industrial	1	250	0.25	0.8		25
Airtel	2	300	0.6	1.0	44.4	42.5

● 2.1.2 Materials for Major Hull Components

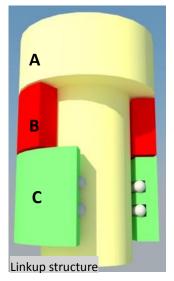
Materials for major hull components are selected with considerations on a general balance between safety and economy, favoring the former.



●2.1.3 Linkup between Rotating and Non-rotating Section

Our design of the linkup between rotating and non-rotating sections makes it convenient for people to pass. When people want to get into Axis Major from any of the residential sectors, they will be put into the structure C at first. C rotates together with the residential area around Axis Major. B is a transit part connected to the Axis Major and it can slow down the speed of the elevator to zero by magnetism. Then the elevator will be pushed into structure B by a robot system. As the elevator has no relative speed in B, it is able to get into the Axis Major (shown as A in the picture) directly. In the same way, people or cargo can be carried from the Axis Major to manufacturing areas or Airtels. (cf.3.2)

To avoid abrading, the moving parts are not always fixed on the Axis Major. Instead, they are kept at certain distances with Axis Major by superconductive maglev technology (cf. 3.2). When the magnetic force is unable to hold the distance,

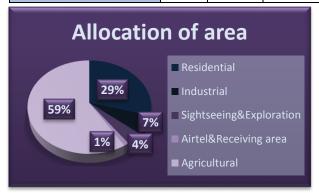


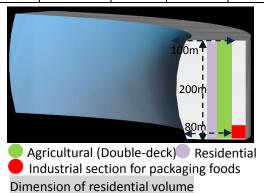


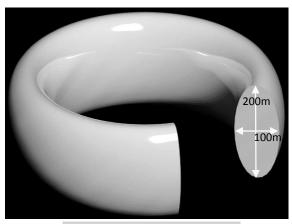
roller bearings will provide a mechanical alternative. The radius of the bearings is smaller than the normal distance between the two parts, so the bearings will function only when the distance becomes smaller than normal.

2.2 Interior Design

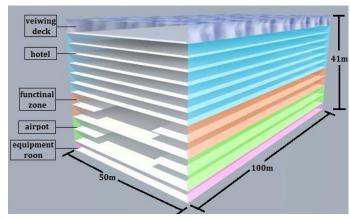
Sections	Radius	Width	Floor & Height	Area	Area /m²		Volume/m ³	
Sections	/m	/m		Each	Total	Each	Total	
Residential & Agricultural	1,000	200	1F,2F	209,440	963,421	19,896,753	90,058,987	
	800		agricultural	167,551	+	15,707,963		
	500		10m;	104,720	1,926,844	9,424,777		
			3F residential					
			80m					
Industrial	250	Max 100	6×9m	Max	753,600	6,658,600	6,658,600	
				157,000				
Sightseeing & Exploration	100	200	30m	31,416	31,416	4,188,790	4,188,790	
Airtel & Receiving area	300	50	11 ×4m	5,000	55,000	20,000	220,000	







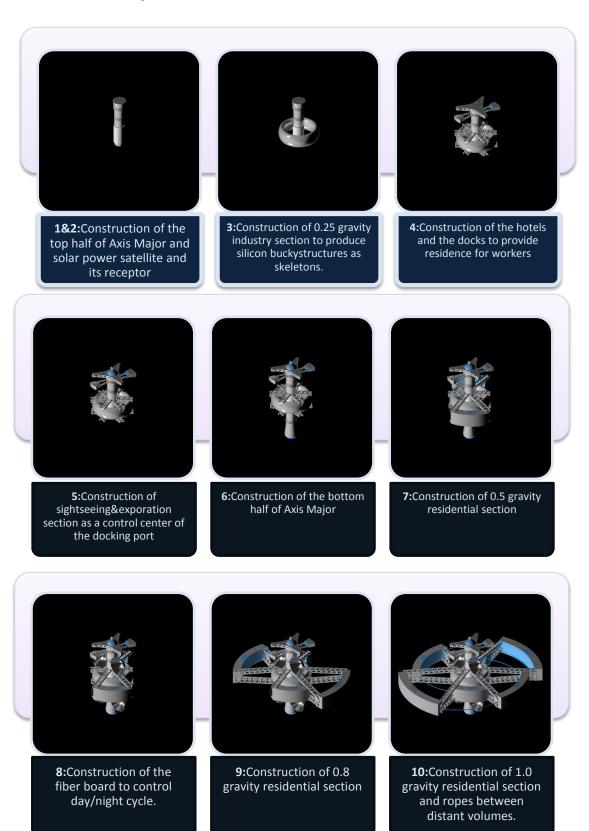
Dimension of industrial volume



Dimension of Airtels & Receiving area

2.3 Construction Sequence

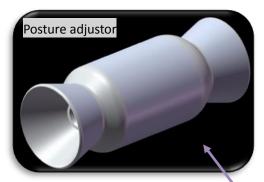
● 2.3.1 Assembly Process



■2.3.2 Initiation of Artificial Gravity

There are two posture adjustors connected to each volume, which can initiate and keep the rotation. Each posture adjustor is made of a ion thruster and a demonstration using flattop fission which is filled with U-235. The demonstration using flattop fissions will supply electricity for the ion thrusters to accelerate the Xenon ions in the direction of the electric field and push them into the space at a high speed.

Apart from initiating and sustaining rotation, two nozzles on each side of the sectors can cooperate to



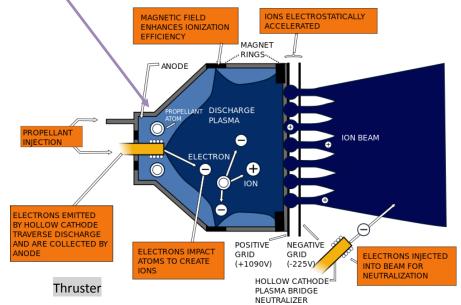
correct the posture of a certain part. For example, the fiber board should be maintained to face the sun so that it can supply enough light for the whole space settlement. After being shut down in emergency, the failed sectors are separated from the settlement. Posture adjustors are used during and after the separation to sustain the position of the settlement and the separated sector.

2.3.3 Construction

Technique for Interior

structures

We use Buckystructure to be the interior structures, and they are made by silicon and some other elements. As we know, SiO₂ is almost 50 percent of the soil of the moon, so there is a big amount of silicon on the moon. Furthermore, the low gravitation of the moon makes



a convenience for the transportation of the ore. To refine the silicon ores, we first heated them in electric furnace with carbon, then we will get impurity silicon product which silicon will only be the 95 percent of them. Chlorine will be used to react with them then, and TiCl₄ will be the main product. It is liquid at room temperature. So we can get pure TiCl₄ by distillation. Finally, heat it in the atmosphere of hydrogen; we can get pure silicon for making various Buckystructure.

2.4 Buckystructure Production Facility

The facility for Silicon Buckystructure production will be set in the middle floor of 0.25g industrial volume. There it will provide a 1570m-long 100m-wide and 52,030m² area to produce it

There will be two means of moving parts between: conveyor belt and railway robot. The conveyor belt is for conveying small products in large quantities. The railway robot will transport large equipment and products.

As for the transportation, operators can moved to 0.25g industrial section by elevators in the skeletons from As for transportation, operators can be moved to 0.25g industrial section by elevators in the skeletons from



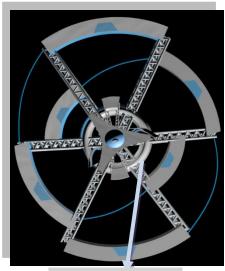
the other volumes. (cf.3.2)

Solar power satellites transmit power to Bellarat.104, 600Ware distributed to Buckystructure facilities.

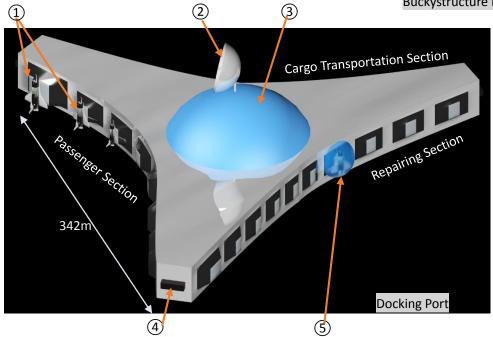
2.5 Port Facilities

Three arrays of arc-shaped docking ports are located at the upper half of Axis Major. Ships are captured by robots and set on the platform. Passengers and cargo are separated. In addition to its normal capabilities, the port is also equipped with an array of repairing docks to provide services to damaged space crafts.

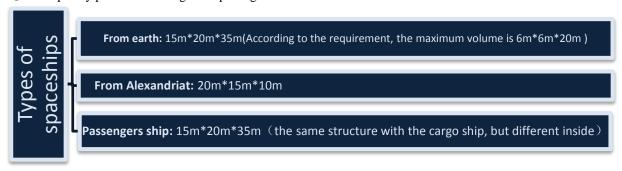
Cargos are directly transmitted into Axis Major as passengers are sent to Airtel as their first step of the Bellarat.



Buckystructure in 0.25g



- ① Ships in types of sizes are docked in the docking port
- ② Antennas to detect the direction of spaceship and oversee the docking process.
- 3 Controlling center with 360°view of universe which can also be used as sightseeing section and the observatory.
- ④ Joint of extension, which make it possible for the expansion of docking port.
- (5) Temporary protective casing for repairing.







3.1 Location and Materials Sources

•3.1.1 Various Materials

Various kinds of materials from Earth and the Moon are used to construct Bellarat. A preference is decided on using lunar resources, such as aluminum and silicon. Both raw materials and final products will be transported to the industrial sectors, which will be established before the major constructions. (cf.2.3)

Materials	Source	Amount	Function
Buckystructure	Lunar mine	32,000,000m ³	Two types are used, one is strong in tension for frame, another is for shielding radiation
Aluminum alloy	Lunar mine	4,000m ³	Used by robots and some other facilities
Photochromic glass	Transport from earth	150,000m ³	A part of glass
Electro chromic glass	Transport from earth	150,000m ³	A part of glass
Lead	Transport from earth	Mixed in Buckystructure	Protection of radiation
Semiconductor silicon	Lunar mine	5,000,000m ²	Generating energy
Reflective Heat- insulating Coatings	Transport from earth	15,000m ³	Heat insulating

•3.1.2 Means for Transportation in Space

Nuclear fusion propulsion rockets take materials and cargo from earth to Bellarat, while a fixed orbit between moon and Bellarat is settled, which offers great convenience for the rockets to carry He-3, the material scanty on the earth, from moon. Researchers have estimated that there are more than 10,000,000 tons of He-3 on the moon, abundant enough for maintaining the operation of the Bellarat and providing the propulsion of rockets.

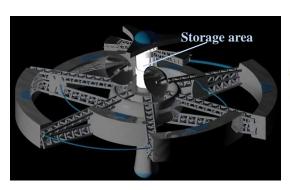
In the course from the earth to Bellarat, rockets will carry some amount of liquid hydrogen and water, serving as the raw material for hydrogen fusion by electrolysis. Neutrons, the product of fusion, could be spurted through a magnetic jet nozzle to produce thrust.

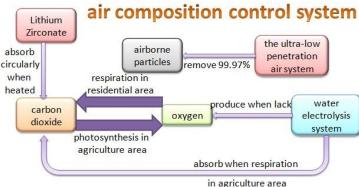
When a rocket is on the journey between Bellarat and moon, it can utilize the rest of H-2 and H-3 for fusion to produce thrust. But when the fusion materials are on the edge of depletion, the rocket can use chemical fuel temporarily and replenish H-2 and H-3 from other space crafts launched from earth.



•3.1.3 Storage of the Materials

The materials and cargo are carried, docked (cf. 5.4), and then stored in the top half outspread of Axis Major, which connects with ground level via elevators. (cf.3.2)





3.2 Community Infrastructure

•3.2.1 Atmosphere

Atmosphere composition

The settlement provides different pressures in different residential areas. In the 0.8atm and 0.5atm area, the pressure of Oxygen remains unchanged to ensure normal breathing. The table below identifies the specific air composition.

An air composition control system in the settlement constituted of four parts works as is shown in the figure. Levels of carbon dioxide and oxygen will be regulated by respiration and photosynthesis of living organisms. If oxygen level is low, Lithium Zicronate and water electrolysis system will work as back-ups. The carbon dioxide absorbed by Lithium Zicronate will be released when needed in the condition of heating. Airborne particles will

also be handled by modern technologies.

The Mediterranean Climate on the earth which remains pleasant all year round will be imitated in the settlement. Temperature does not change much, thus curtailing the demand for clothing. As shown in the table, temperature is in the range of $14 \, \text{C}$ to $20 \, \text{C}$ in winter and $24 \, \text{C}$ to $30 \, \text{C}$ in summer. Humidity in the whole year will be regulated within

40% to 70%, a scope in which
human have the greatest
comfort and machinery won't
be damaged. The humidity in
the settlement will be
controlled through water
absorbing. The temperature
during the day is controlled by
adjusting the brightness of
light coming into residential
volume (cf3.2.8), and at night
will be maintained by thermal

Season				
Season	Temperature(℃)	Humidity(%)		
Spring	20 - 25	40 - 55		
Summer	24 - 30	40 - 60		
Autumn	18 - 25	45 - 65		
Winter	14 - 20	50 - 70		

	Atmosphere Composition							
	reside	ntial area	Nitrogen	Oxygen	Carbon Dioxide	<u>Total</u>		
1g		Percentage(%)	78.9	21	0.1	100		
x1 0.8g	1.0atm	Volume(m³)	10,714,896	2,851,874	13,580	13,580,350		
x1	<u> </u>	Quantity(g)	13,393,620,000	4,705,327,946	26,616,800	18,125,564,746		
1g	x1 0.8atm	0.8atm	Percentage(%)	74.9	25	0.1	100	
x1 0.5g			Volume(m³)	8,137,346	2,716,070	10,864	10,864,280	
x1			Quantity(g)	11,747,635,841	4,481,264,710	24,646,320	16,253,546,871	
0.8g	x1 0.5atm V		Percentage(%)	60.85	39	0.15	100	
x1 0.5g		Volume(m³)	4,131,820	2,648,170	10,185	6,790,175		
x1		Quantity(g)	5,964,977,359	4,369,233,093	23,105,910	10,357,316,362		

blanket of buildings like extruded sheet (XPS). An air conditioning system, consisted of pipelines integrated into the hull, will be used to cool down the atmosphere as well.

Wind and cloud

Wind in city is considered a necessity to provide Bellaratians a comfortable earth-like environment. Here the idea of creating "lungs", used in the construction of Biosphere II, is applied. Two giant pistons are built on each side of the residential area to produce wind. They can also be used to control air pressure.

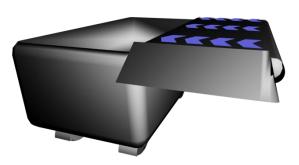
Certain areas on the electrochromic glass on transparent volume ceilings are turned opaque to imitate clouds. (cf.3.2.8)

•3.2.2 Food Production

Considering the food pyramid offered by China and the United States, We divide our agriculture area into 4 parts: Aeroponics place for crops and vegetables, herbs and cotton, and paper volumes, (seen in 3.4 Paper productions) and the last soil-based part for woody fruit tree.

3.2.2.1 Aeroponics area:

With the advantages including bacteria-free, high yielding, short growing period, water saving, nutrient saving and soil-free, aeroponic crops will have 3 times energy-providing-efficiency with powerful space breeding



and low gravity(2 times in growing period and 1.5 time in direct yield) than counterpart now considered extremely efficient on earth. All the corps and vegetables are produced in the basic high-pressure aeroponics containers above while the specific size and height vary of different species. Cultivated in high pressure vapor solution in which necessary growing elements and minerals are dissolved, aeroponic plants can grow enormously fast.

Space allocation of agriculture area

1					
Food:	ton/acre per year	gram/person per day	space allocation		
Wheat (Aero)	30	400	13.08%		
Rice (Aero)	30	300	9.81%		
Vegetable (Aero)	100	700	6.87%		
Fruit (Soil)	100	300	2.94%		
Soybean (Aero) [oil & food]	6	400	65.41%		
Cotton (Aero) [Cloth]	12	3	0.25%		
Bamboo (Soil)[paper]	30	50	1.64%		
Totals	308	2153	100.00%		

3.2.2.2Meat & Milk: Vitro meat economizes lots of space for animal breeding and retrenches lots of cost in fresh meat restoration. With stem cells from different livestock, we can produce various meat scientifically in a small factories, which can fulfill 11,000 people's need for animal proteins. Moreover, vitro meat will be more adapted to laboratory environment with the development of trans enosis technology,. However, subsequent problem arises that it is hard to produce milk without live animal. To solve this issue, we offered a great substitute for milk: Composed of Nutrose, Lactose and water, artificial milk with even more nutrition compared with real milk can be produced under processing. Consequently residents are able to have the same delicious bread as those on earth now.





3.2.2.3 Soil based tree:

Soil based trees produce common fruits like apples, pears, peaches, plums, etc. Trees are treated in the same way as they're treated on earth.



Manufacturing Process of food

- •Newly- designed manipulator to collect mature corps and mark its category with electrical marker.(picture 2)
- All the corps are stored in -170 centigrade and are cllasified by electrical marker.
- Paperfoam, the newest recyclable paper is used to customize different shapes using 3D printer
- •Using inside cargo transportation system, which could recognise the electrical marker out of the package
- Vending machine & Butler Robots handle market services themselves.

Storage for the food is up to 2 month's amount of all residents' need, it is always full unless newly produced food implement its place. Environment of -170° C can greatly reduce respiration and corruption so as to increase its quality.

•3.2.3 Power Generation

Solar energy

Abundant solar resource in space would be the major source of energy. Solar power satellites (SPS) are used to obtain that energy.

By providing energy to earth, SPS can be commercially productive. Since the satellites are separated from the settlement, upgrading can be done simply by launching new satellites. Construction time can also be saved by launching the satellites before major construction starts.

As the settlement is located in the L4 point, the SPSs are designed to work in the orbit of points L1 or L3 to minimize the change of relative distances between the satellites and the settlement.

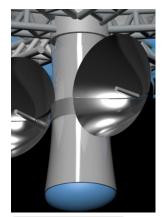
The SPS converts solar power into electromagnetic wave and delivers the wave to the settlement. The receptor, fixed outside the settlement, transforms the wave back to electricity.

According to the needs of the settlement, 7.7*105m² of solar panel is needed on the satellite. This needs about 4 satellites with a solar panel of 1.925*105m²each.

The power generated is 1385w/m² on average, and the maximum efficiency of solar photovoltaic cell is 40%. As a result, the total power generated by solar power satellites is 4.24*10⁵kw.

Fast-neutron reactor

Undeniably, solar energy has its intrinsic disadvantages. For instance, solar power cannot work if we can't get continued sunlight. As a result, an alternative system is needed to provide Bellarat with enough energy when solar power is unavailable. Fast-neutron reactor, settled in the bottom half outspread of main pole is the secondary choice, which can generate power at anytime and anywhere. In the reactor, Pu -239 and U-238 would be the nuclear fuel. The fission of Pu-239 produces plenty of neutrons and a part of which are absorbed by U-238 and translated into Pu-239 as newborn nuclear fuel, while the other part maintain the process of Pu-239 fission. Since fission of Pu-239 must be kept on by fast neutrons, the reactor is not equipped with moderator. NaK carries heat, and is



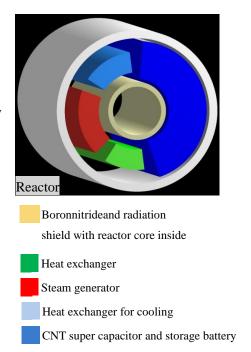
Location of the reactor

pushed by three electromagnetic pumps into turbines to generate electricity. The electricity is stored in CNT super capacitors and storage batteries. Control rods are made of Cadmium and hafnium. As the numbers of the escaped neutrons is high, some of them cannot be used; so the boronnitride hull will be settled out of the reactor core to absorb the extra neutrons, as the loop system will be covered with the same materials. An outer hull, made of reinforced concrete, protects the whole reactor.

The reactor is operated at a low power in 3.4*10⁵kw, unless it during emergency. For example, when Bellarat runs into the penumbra zone, so that no sunlight can be utilized, the reactor will will gradually shift to the highest power output of 7*10⁵kw. Even when the entire SPS system failed, the nuclear reactor is still capable of meeting the most important demands of electricity on Bellarat.

Distribution of the energy

Purpose	Power/kw
Residential	17,141
Commercial	18,500
Communal facilities	10,000
Industry	590,957
Agriculture	100,000
Transportation	16,000
Total	752,598



•3.2.3 Water Management

Every drop counts in space. To improve water efficiency, Bellarat greatly emphasizes the reliability of water cycle and utilizes some key technologies as listed below.

Aqua producer: Extracting pure water from humid air. The humid air in agricultural areas are pressed against a filter, which stops all living organisms – flies, mosquitoes, bugs, etc from entering the system. The air permeates through the filter and is separated from the

water it contains.					
Bioleaching	System:	Using	bacteria	and	other
microbes to remov	e contami	nants by	assimilat	ing th	em. M

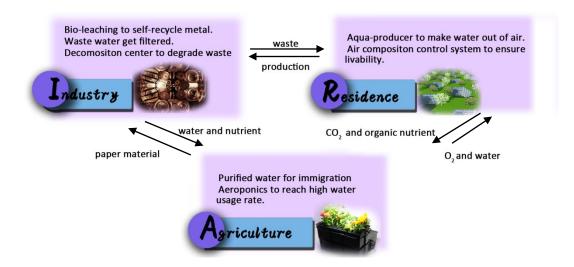
Water Consumption (Liter)	
food preparation	6.94
drinking	2.12
Cleaning	10.46
hand/face washing	1.82
shower	5.45
laundry	12.5
Total for each person	39.29
Residence	471480
Industry	1147000
Agriculture	1619100

microbes to remove contaminants by assimilating them. Microbes, and the metals they've taken in, are recollected for further use. This system is capable of recollecting and separating different metals at an efficient speed.

Nano filtration membrane: Blocking all the chemicals except water out of the water cycle system.

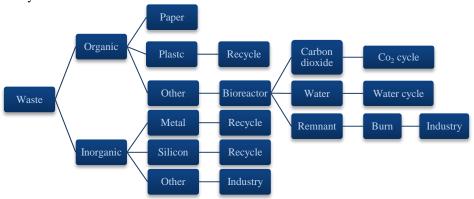
Automated Water Storage System: providing water of different purity to industrial and agricultural area to meet varied needs. This automated system has the ability to measure water storage and balance water input and output. In case of emergency, such as leakages or water contaminations, warnings shall be given immediately and water supply shall be cut off.





•3.2.5 Waste Management

Waste can be divided into two main parts: organic waste and inorganic waste. Organic waste will be used as feed of bacteria which will transform the waste into carbon dioxide and water. The carbon dioxide and water are then delivered to agricultural sectors to bolster the growth of crops. Remnants of the biodegrading process will be burnt and transmitted for industry use. Metal and silicon wastes will be recycled in the industry area. Biodegradable plastic will be recycled many times and processed as other organic waste. Unbiodegradable plastic and paper are recycled.



•3.2.6 Internal and External Communication

Internal communication

For communicational stability and security, broadband fiber optic technology is used for network services in the settlement. The technology has a speed as high as 10tbps and is very reliable. The fiber, made of silicon, is easy to produce in space and is able to be connected to all the static devices in the settlement.

For personal portable devices, Wi-Fi network will be built. The network is based on the 802.11ac standard in 5.0GHz providing connection speed up to 1Gbps. For each 400-meter-long area there are two base stations. All the controlling devices will be enciphered to make sure of the security. Another frequency range of 11 GHz will be used in urgent circumstances and for special purposes.

External communication

Radio wave transmission:



Deep Space Network (DNS) can be used for communication between the settlement and the earth. Several relay satellites are set on earth orbit to enhance the stability of Bellarat's external communication.

Stem network is used among the satellites, Alexandriat and the base stations. And the settlement will be connected to this network. The radio wave frequency will be 1-4&6-10 GHz and connection speed will be at least 1Gps.

The radio wave transmission technology is mature and stable. Equipped with satellites, DNS will provide good quality data communication and a wide brand.

(For external communication, the settlement will use phased array antenna system to communicate with earth and other space settlement or spaceships. Internal network is connected to the internet on earth via phased array antenna system, reinforcing the contact between Bellaratians and people on earth.)

•3.2.7 Internal Transportation System

Bellarat's inner transportation is divided into three categories:

- ·Primary transportation- from spaceports to Axis Major.
- ·Secondary transportation- from a rotating sector to Axis Major, or to another rotating sector.
- ·Tertiary transportation- transportation within one of the sectors.

Primary transportation

Primary transportation is provided through high temperature superconducting maglev rail lanes that connect the spaceport with Axis Major and elevators that connect Axis Major to the rotating sectors. Temperature at L4 point is 2.7°K in space due to the "3 degree microwave background radiation", a temperature far below the superconductivity temperature of YBaCuO superconductors. Permanent magnets are attached to train bulks and will provide an elevating force as a result of the Meissner effect.

Each passenger train is designed to carry 10 passengers and a pilot. A total of 10 passenger trains will be on board Bellarat. At the same time 2 cargo trains will transport goods from the industrial sectors to residential sectors and the spaceport. Passengers and cargo are separated on arrival. After going through safety inspections, visitors and goods board the superconducting maglev trains which are pulled to Axis Major. To save energy an energy recollecting system is used: generators are attached to the cables so that the process of braking when the trains go down to the spaceport could generate energy. Pulling force to drag the elevators up is provided by electric motors, part of which uses electricity produced from the braking process. At Axis Major the trains are connected to elevators which are going to be introduced below.

Secondary transportation

Elevators carry passengers and cargo "up" to Axis Major and "down" to the rotating sectors. The energy recollecting system used to drag trains for primary transportation is also applied here.

A 1g residential sector has 5 elevators with a capacity of 1000kg each; a 0.8g sector has 4; and a 0.5g sector 3. A rotating industrial sector has one such passenger elevator and 3 cargo elevators, each of which are capable of lifting 3000kg of industrial products up to Axis Major.

An alternative for elevators are trains carrying passengers along the rails inside air tight tunnels between distant volumes. Technologies for the elevators and primary transportation trains, such as superconductive maglev and the energy recollecting system, are also used here.

Tertiary Transportation

Transportation within residential areas is designed to be as personal and flexible as possible.

Walking is recommended, given that the residential volumes are not so large, to reduce energy consumption and to provide chances for physical exercises. Roads are set around the residential zone in the form of a loop line. Since the width of a residential sector is only 200m, it will take less than 1 minute to reach the loop lines.





On the loops are two kinds of small and flexible transportations: the more traditional bicycle, and the more innovative SegwayTM series, a kind of two wheeled, self-balancing, battery-powered personal transport vehicle. Computers and motors in the base of the device keep the Segway upright when powered on with balancing enabled. A user commands the Segway to go forward by shifting their weight forward on the platform and backward by shifting their weight backward. The Segway detects, as it balances, the change in its center of mass, and first establishes and then maintains a corresponding speed, forward or backward. Gyroscopic sensors and fluid-based leveling sensors detect the weight shift. To turn, the user presses the handlebar to the left or the right. Speed is limited below 15km/h, as fast as that of a casual bike ride, a speed which is promises efficiency and safety at the same time.

Apart from its standard design, the Segway is also developed into a series to meet different needs: the SegEnforcer, being able to outrun suspects with a top speed of 30km/h, is a foot taller than other Segways,

enabling police officers aboard to be easily noticed even in a crowd so that people can find help more conveniently; the SegDuet, with extended platform area, makes possible intimate travels for two, be them a couple or a parent and his/her child; the SegNurse, with a seat for babies as has been widely used on shopping carts in supermarkets, frees mommies from holding their children in their arms; the SegSeat has a chair on its platform and can be controlled with a joystick instead of by leaning; finally, the TriSegle, the only three-wheeler in the family, has an extra piece of enlarged platform and is designed to carry loads of goods across the residential areas.

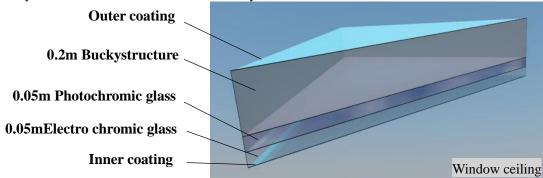
Such means of transportation takes less than 4 minutes to travel across the entire residence.

At the same time, cargobots are used to carry heavy cargo in both residential and industrial areas. (c.f. 5.3)

•3.2.8 Day Night Cycle

The space settlement will have the same day and night cycle pattern as on earth.

Natural sun light is gathered by large concave mirrors facing the sun on axis major and transmitted by optic fibers to the outer side of 0.25g industrial area. There, the fiber bundle is divided into 6 branches and separately shed natural sunlight over each residential area. The optic fiber output end is in shape of a small circle, so the light coming out there looks quite like a sun, making it more natural and comfortable for all in Bellarat. Then the light goes through the window ceiling to residential area. Sunlight will be transmitted to three of the six sectors for twelve hours while the other three are in the dark. The specific time schedule of lighting time allocation will meet the simulation of changing seasons, around 11 hours for winter and 13 for summer. The time difference between adjacent residential sections is 4 hours. Layers of photochromic and electro chromic glass are placed under the Buckystructure to shield the sun when necessary.



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Outer coating

• There will be a very thin coating covering Buckystructures on the top to reflect dangerous ultraviolet rays from the universe.

Buckystructures

- Buckystructure is the main constructional part of the transparent ceilings. It is in usage of the extraordinarily strong transparent Buckystructures to significantly reinforce the large ceilings.
- It is mixed with Lead, mainly for preventing high-energy universal radiation like x-ray and γ-ray. It is designed thicky to protect residents from those rays.

Photochromic glass

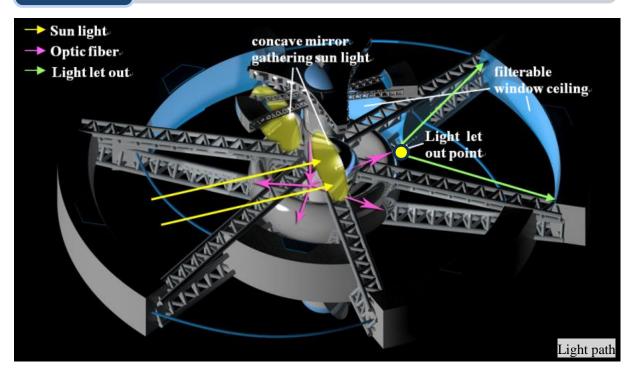
• Photochromic glass is mainly used as an automatic control of the lights' entrance. By adding certain chemicals, the gray of it will change as the brightness of the light changes. And in that way the entering of light will be controlled to keep a certain brightness.

Electrochromic glass

- Electrochromic glass is used to control the day and night cycle. By setting up electric
 currents, the color will range from fully transparent to opaque. So that the day and
 night can be controled.
- It can also control the brightness of light going through, in which way temperature is controlled.

Inner coating

• Inner coating is made of optically thinner medium in certain thick, that can let all lights in but only reflect blue light from residental areas' diffuse reflection. in that way it can provide the residents a blue sky imitating the natural view of sky.



•3.2.9 Food Storage Facilities in Emergency

We can utilize one sixths of the area of agricultural sections as emergency food storage. This food comes from Bellarat's food production line. After being harvested, crops are sent to the storage on one end of the agricultural section, where they are temporarily stored as emergency storage for up to 3 days before being replaced by the newer ones. Should emergency set in, storage can be activated to sustain food supply for at most two weeks. The storage is replenished as soon as the crisis is over.



3.3 Construction Machinery

The huge mechanical arms of construction robots can help hold the structural components and place it to specific location. Once the components reach their destination, small- scale interior robots can be released with multifunctional tools to fulfill specific tasks.

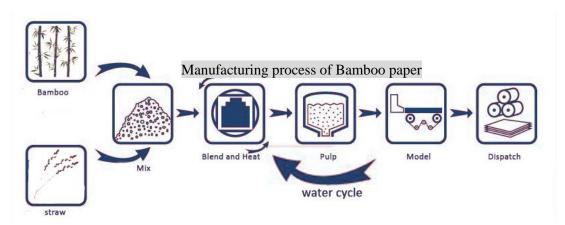
For exterior construction, satellites around Bellarat and the construction headquarters will send signals to control huge mechanical arms to grab robot and materials and put robots at the spot to start working.

For interior construction, the human-like interior machineries are equipped with different tools to process different materials and perform different tasks. The robot can also be controlled by human to accomplish difficult tasks. Interior construction robots can be used as service robots on board after construction is complete. (cf.5.1)

3.4 Paper Production

Two methods of producing paper are introduced to Bellarat. Cellulose from bamboo and agricultural residue, especially straw, is applied to make traditional high quantity but relatively low quality paper; Paper foam, on the other hand, is used for high quality packaging using 3D printing technology.

Chinese people first produced paper from bamboo 1500 years ago. Using bamboo as the source of paper has several benefits. First of all, bamboo is the fastest growing plant on the planet with some capable of growing more than a meter a day. In sharp contrast to trees, which require decades to recover after being harvested, bamboo reaches maturity in 3 to 5 years or less and can continue to grow after it is cut. Finally, a bamboo forest produces 35% more oxygen than a forest of trees does, thus benefitting Bellaratians significantly.



Paper Foam is one of the most environmental friendly packaging materials available. It is made via an injection molding process. Paper Foam is made completely from natural resources, most of which are starch and glucose, and is a compostable product. With the development of 3D-printing, Paper foam is an ideal choice for packaging products in Bellarat.

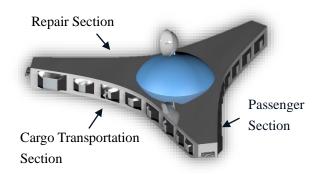


All these paper will be under strict supervision in order to maximize our recycling amount. Moreover, as the trend of working paperless, we also offer powerful software and smart devices (refer to 5.3) to cut the need of using paper.

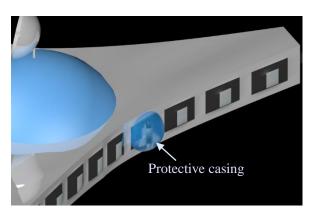


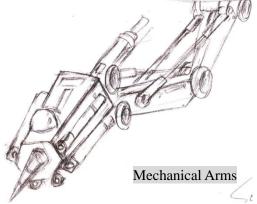
3.5 Repair Service

As seen in the picture, one array of the docking port is dedicated to repairing spaceships. Once the central antenna receives signal from spacecraft in need, it will automatically guide the spaceship to different parts of repair section according to its damage and size and provide services below. When manned operations are needed to repair a spaceship, a temporary protective casing, normally folded inside the port structure, will stretch out and cover the spaceship. Then the joint between the casing and the port hull will be sealed, and the space enclosed by the casing will be pressurized, making it easier for people to work inside the casing. (cf.2.5)



	Category	Operation					
Automatic	Fuel charging	A long tube descends and guides itself to add fuel					
repair service	Cleaning	Charged brushes can remove the dust on the surface of t					
		ships.					
Artificial	Accessory	Mechanical arms controlled by engineers can remove					
repair service	replacement	specific part out and call for its substitution and assembly it.					
	Meticulous	Different size of mechanical arms and sensors will examine					
	maintenance	the damage part and convey the data to engineers and wait					
		for instructions.					





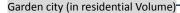




Central idea

A beautiful garden city is built on board Bellarat. The best place to lead a natural and comfortable life, the city contains rich and diverse flora that looks after both the physical and mental health of its dwellers.

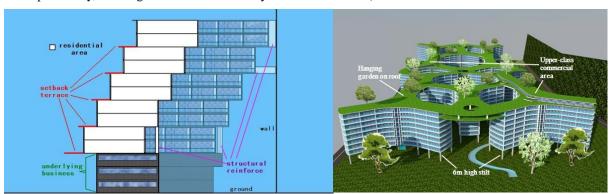
Unlike its counterparts on earth, the city of Bellarat is designed with equal considerations on three dimensions. Buildings with different numbers of floors and volumes of different heights contain different facilities to promote area efficiency. But the height of buildings serves not only as a multiplier of floor space; height has spirits of its own.





Hanging garden upon the roofs: gardens are built on top of the roofs. The roofs are linked up, and trees and grass are planted. Standing on the roof, an unimpeded view of the entire city comes into view.

Specifically, buildings are not connected anywhere but the roofs, so that house ventilation won't be affected.



Stilt buildings: Bottom of buildings will be elevated from ground to 6m high, to leave the whole ground for greening and other uses. We will significantly enlarge the open space to 2-3 times bigger, broad enough for various human activities. So people can just relax and have fun in their yards near home.

Setback in buildings: We design a type of building with large setbacks, so that the houses could receive enough warm sunlight on its terrace. Nothing will block the sunlight or any view of outside garden-like scenery, and residents in such half-villa buildings will have the feeling of living in countryside.

Commercial complex& underlying business: In commercial district, there will be a very tall building as the landmark of the city, assembling various facilities and departments for commercial, entertainment, public services, office building and other uses. The multifunctional building will serve as the public center where residents could do shopping, get oneself entertained, have public services, do commercial activities and go to work in just one place.

Some small business area and public services will be set in apartment buildings to bring convenience to residents, who will no longer have to go to the distant commercial district. Also this method will reduce the space



of business buildings.

Better use of side walls: As a part of the 3-dimensional city, the side walls of residential volume couldn't be left empty. Large part of them will be greened, with diverse grass and flowers planted, forming different colors and shapes, to create a better environment for all residents. At public center, walls will be changed into large pieces of glass, which enable residents to have the wonderful view of universe including earth and moon. The wall will also be the support of buildings with setback.

Duplex apartment: We have 2-floor home designs with a 2-floor high patio, whose ceilings are partly raised up in living room to create a larger space, for more sunlight and long line of sight.

Furthermore, in order to have better ventilation in homes, homes are designed with both sides available to contact the air. We give out the special solution of using 2 homes combined in particular shape, so that passages are always in middle of building, taking no face width.

In addition, ceilings are heightened in lower gravity volumes for better comfort.

View of Earth and Moon

We provide three ways for residents to have natural view of Earth and Moon.

The huge ceilings of residential volumes are made of transparent materials to let sun light in (cf3.2). Through such window, Bellaratians could have a broad view of the universe.

At the public center, both sides of the volume's walls will be changed into large pieces of glass. There, residents will be surrounded by fantastic scenes of the universe in 3 dimensions.

The 0g sightseeing sector (cf4.1) is the best place to enjoy views of the universe behind large French windows in a very special zero g environment.

Natural Sunlight (cf.3.2)

To create an earth-like environment, we use natural sunlight, which is good for residents both physically and mentally, as day lighting.

4.1 Facilities and Means of Distributing Consumables

•4.1.1 Introduction

While designing the inner structure of the settlement, considerate actions are taken to make the community in Bellarat as close to the community we are now accustomed to as possible, as well as offering much services, for which there are plenty of facilities that meet the residents' requirement, clinics, churches, gaming centers included.

•4.1.2 Volume functional distribution

Due to various gravity and atmosphere pressure in different volumes, we put institutes in similar functions together to enable them to share the infrastructures, thereby saving cost and energy, communicate the information, and promote innovation and cooperation, etc. Therefore, these institutes are relatively designed close to one another. The cooperation of these volumes will form a whole system of Bellarat.

Yet because of the difficulty of adapting to other volume environment, almost all facilities are accessible in each volume.

Since children, elders, and scientists are the most susceptible to low gravity environment, schools, nursing home and major parts of science institution region are in 1g.

The certain lab for less gravity is set in 0.6g area to meet its requirement.

Here are the major functions of different cabins:

1g: Education & Study region; Nursing (Mostly in B);



0.8g: Business (C); Government& settlement control (D)

0.5g: Recreation; Certain lab (E);

•4.1.3 Facilities

Faci	ilities	Distribution	Note
EDUCATION	EDUCATION School/College		1 kindergarten, 1 elementary school, 1 high school and 1 college are included. Distant education is also an option.
	Library	All	
SCIENTIFIC	Medical Research Centre	В	
RESEARCH	Space Lab	AE	
INSTITUTE	Other Scientific Research centers	A	
	Mall	All	It consist of separate stores and offers a variety of items in daily use, clothes, as well as products produced only in space and souvenirs for visitors.
	Cinema(IMAX) & Theatre	All	New films will be shown as soon as they are revealed on Earth.
RECREATION	Space Museum	AF	Space museums serve as tourist attraction and can be used for education or entertainment.
	Visual Gaming Center & Simulation Center	F	
	Theme Park	F	In the theme park, residents as well as tourists can enjoy the low gravity experience exclusively in space. Monthly carnivals and parties are held to welcome newcomers and short-term residents and help them get integrated into the settlement's community life. (Also see 4.4)
PUBLIC	Bank	All	In order to minimize the use of paper, paper money is not used in the settlement and people use credit cards instead. Therefore, banks provides service excluding saving/withdrawing money.
WELFARE	Supermarket	All	
FACILITY	Gym & Fitness Center	All	Because of the unpredictable hazard of universe, gyms and fitness centers are considered necessities in each volume to lead Bellaratian a healthy life. And various equipment are set for them to keep fit and get exercise, as well as mutual communication.



	Religious Service (church etc.)	All	The designers of Bellarat concerns and respects all types of religious and believers. Thus, the required public places for religious service are designed deliberately for them.
GOVERNMENT &	Administration Center & Council Hall	D	
COMMUNITY	Community Center & Club	All	
	Hotel	All	
SAFETY & SECURITY	Police Station, Fire Station and Rescue Headquarter	All	
неастн	Hospitals	All	To make sure that all the residents' and tourists' health cares keep up with the high standard on Earth, hospitals are distributed to all volumes and offer a thorough medical examination annually. To make full uses of the resources, the hospital in Volume F is designed as a general hospital, while the other 5 are each specified in several aspects.
112/12/11	Clinic	All	
	Nursing Home	В	This care facility for the elderly who need daily assistance with grooming, hygiene, meal preparation, and other health issues provides custodial and medical care in the same location and offers residents comprehensive medical care from a staff that includes physicians and nurses.
0G SIGHTSEEING		Out of residential volume	The 0g entertainment district is in the major axis of the settlement. There is all around French window for tourist to enjoy the beauty of space. Some games are also available in there. For example, people can play balls in zero-gravity zoon. Special devices are design for man to move in microgravity (cf4.3). And the walls will be covered by soft materials to protect people from being hurt.

Note: In residential areas, there are places for public services from Floor1 to Floor3. Grocery stores, clinics are designed within.

Functional zones:

To make the city (each residential volume) operate more efficiently and more orderly, we divide the land into several functional zones. Each zone has its particular uses, and these zones will all work together as a whole city. **Commercial complex:** the center area of city commercial, entertainment activity and public service. It serves as an office building as well. It is built in the middle of city to shorten distance.

Public center: a central plaza for outdoor activities (recreation), with parks (theme parks). People can have different festivals there. Built in the middle of city for shorter distance.

Residential area: One type of apartment will have 3 floors of underlying business area for small commercial, entertainment and public service facilities. Residents can have these services without going far.

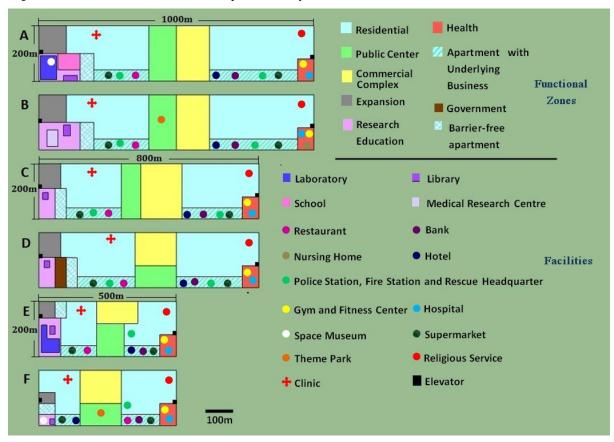


We have a barrier-free apartment zone for children, the old and new-comers. Considering the demographic changes, we have enough such apartment and special devices to help the children and the old. Facilities in such area will also help new-comers get used to the new environment (cf4.4).

Research & education area: for scientific research and laboratory, public education (library, art school, museum etc.) and school education. Away from commercial center for a peaceful environment.

Health center: it involves hospital, gym, fitness center, and nursing home (in volume B). At one end of volume for leaving patients' a peaceful environments, it is kept away from residential area.

Expansion area: an area left for future expansion. Easy to add new facilities.



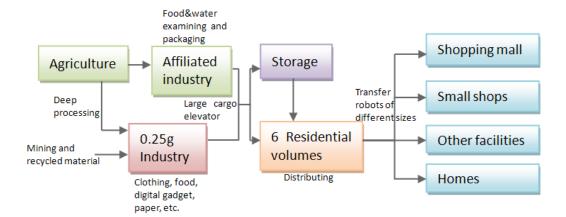
In the recreation area (in commercial complex), each volume will have a shopping mall, a food area and a cinema or a theatre for residents' casual livings. Volume F will also provide other entertainments such as visual gaming center and simulation center.

•4.1.4 Roads and Path

Total area: Roads take up 248,500 m², or 24.85% of the residential area. 10.0% of the total 24.85% is for vehicles like bicycles and Segways, the remaining 14.85% is all for footpath.

• 4.1.5Means of Distributing Consumables and Food

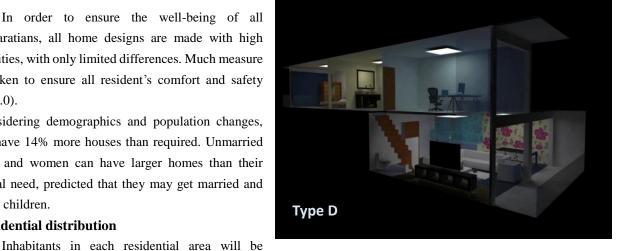
consumab	le	quantity(per person	quantity(total per year)			
paper		7.2kg 80t			80t	
medicine		180g	200kg			
hygienic produc	cts	2.4kg		26t		
consumable	quantity(per person per year)		quantity(tota	al per year	consumable	
food		310kg	3,30)0t	paper	
dringking water		540kg	5,800t medicine		medicine	
domestic water		3,400kg	37,000t		hygienic products	
cloth	1.2kg		13	t	electric energy	



4.2Residential Design

In order to ensure the well-being of all Bellaratians, all home designs are made with high qualities, with only limited differences. Much measure is taken to ensure all resident's comfort and safety (cf.4.0).

Considering demographics and population changes, we have 14% more houses than required. Unmarried men and women can have larger homes than their initial need, predicted that they may get married and have children.

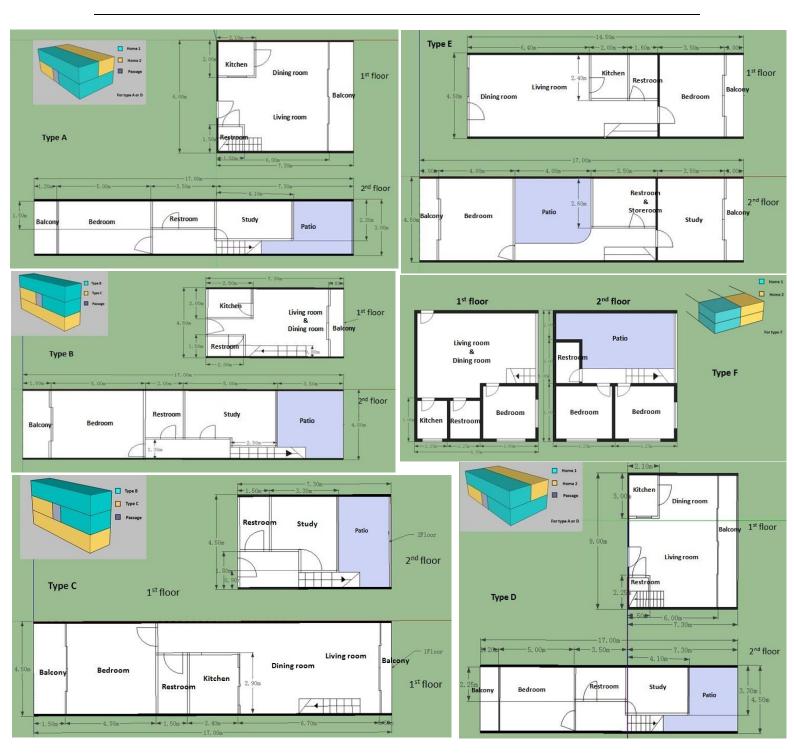


Residential distribution

relatively evenly distributed in race, nationality and religion etc. The distribution of residence will somehow respect people's willing, but there won't be any kind of agglomerated settlement in Bellarat. This measure will maintain the Omni bearing balance in the settlement. Inhabitants will have an opportunity to contact people of different backgrounds and experience their lives in a totally fresh new way. Living with different backdrop people will help a person have a brief understanding on the world and learn to accept each other and different culture in a short time and a right way. Technology ensures that people won't have trouble communicating with each other, and what they are going to do is to develop a wider and much more beneficial interpersonal relationship in this brand new world.

Residence	Bedroom	Floor	Surface	Percentage		Percentage		Perce	ntage	Pero	centage	Number	Remark		
design type	&			for		for		for		for					
	study			married		married		married		sin	gle	W	hole		
A	2	2	82	5%		5%		5%		28	3%	22	25%	2225	
В			93.6	15%	30%	20%	40%	19%	38.25%	1912	B&C are				
С			98.1	15%		20%		19%		1912	similar				
											types				
D			123.0	24%		24%		24	-%	2	24%	2400			
Е	3		127.8	20%		20%		4	%		8%	800			
F			122.6	10)%	4	%	5	5.5%	550	At ending				
											of a floor				





Furniture

items		furniture and appliances						
3	material	Aluminum Alloy	buckystructure stone		wood	plastics		
		corrosion resistance						
feature	advantage e	light weight,	high hardness	high hardness	environment friendly	long service life		
		high strength						
	disadvantage	1	7	heavy weight	rare in space	rare in space		
source quantity		Moon and Alexandria	Moon and Alexandria	mining and meteorolite	/	1		
		major	major	minor	minor	minor		



All the furniture, appliances and personal items will be batch produced in flow shop in 0.25g industrial area. 10% of the production will be stored in warehouse in residential area, and others will be placed in agriculture area. The materials of those items are as shown in the table.

items		personal items					
		clothing an	shoes				
material		cotton	bamboo fiber	ploy urethane			
	advantage	soft and closed-fit	good air permeability	wear-resisting			
		good moisture absorption	strong resistance to wear	good air permeability			
feature		good air permeability	good dyeing property	good toughness			
	disadvantage	1	1	1			
source quantity		agriculture area	cellulose	/			
		major	major	major			

4.3 Safety Access

•4.3.1 Spacesuit

Given the inconvenience of donning traditional spacesuits, bio-suits are provided on Bellarat. Made of special thin silicon nanotube combined with other molecules, bio-suit is like an outside skin, surmounting the

limits experienced by spacesuit wearers before.

The cardinal advantage of bio-suit is that it does not require denitrogen and oxygen inhalation, because the bio-suit can directly provide one third of standard atmospheric pressure. For this reason the time of donning and doffing a bio-suit is less than 10 minutes. Furthermore, flexibility guaranteed by the thin textile can give astronauts much freedom.

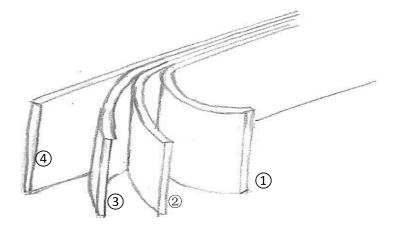
The different layers of our spacesuit are given below:



- to provide pressure and absorb secretion from skin like sweat.
 with equipment to measure heart rate, body
 - with equipment to measure heart rate, body temperature, breathe, suit temperature, radiation dose.
- Temperature

 in this layer large number of PVC tubes with liquid in them are put in order. We can control temperature by the flow of the liquid.
 - Radiation
 Protecting
 Layer:
 •We use carbon fiber and aerogel to make the cloth like human body and isolate heat, we will coat silver ion fiber fabric to protect radiation.
- Protection

 birght white fabric buckystructure that protect man from space debirs
- External Equipment
 Oxygen bottle, control component and power supply, communication device, alarm system.

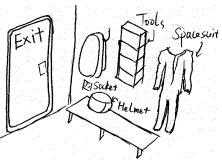


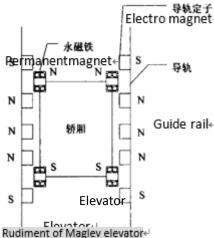


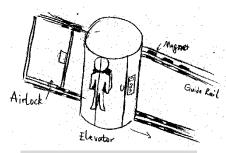
•4.3.2 Airlock

Airlocks will be placed outside our space settlement and between different atmosphere areas inside. Connected with a high pressure gas pump and energy network of space settlement, all airlocks are supply depots for astronauts.

Aside from the bio-suit, several outside extravehicular package are also placed in the airlock, which contains different equipment for communication, oxygen, repairing and so on. Consumables such as cooling liquid can also be renewed in the airlock.







Maglev Elevator's working condition

When people go back to the airlock, the spacesuit will be cleaned carefully first to ensure the safety of the settlement.

●4.3.3 Maglev Elevator

Maglev elevator will be installed outside our space settlement for astronauts to perform extravehicular tasks.

As is seen in the schematic diagram, maglev elevator has many advantages over many traditional mechanic systems: Easy to accelerate, high energy efficiency as there is no heat waste, longer service life than mechanic components, no need for lubrication, and adaptability to extreme low temperature (in space).

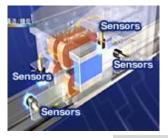
The electric guide rail and magnet is placed like roads along the space settlement, enabling the repairing robots to reach every corner of the settlement easily.

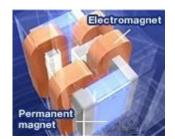
To ensure worker's safety, security equipment including oxygen bottle, control component and power supply, communication device, and alarm system are designed respectively,

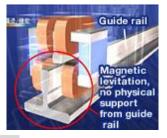
Various tools for detecting and repairing tasks and communication device are in the elevator. Considering the relatively short distance to the settlement, people outside will communicate with the HQ by microwave transmission through the settlement.

•4.3.4 Safety Rope

Activities in pressurized microgravity areas are similar. A Bellaratian is linked by tethers to a mobile machine on guide rails, which enables him to go anywhere as he pleases.







3-D illustrations showing principle of maglev elevator

4.4 Community Attributes for short-term residents

1 "Getting to Know"

Free brochures are offered to visitors and new residents to present life in Bellarat, including a thorough introduction of life routine, community functions, the mode of production, recycling, etc. Furthermore, volunteers from each volume offer free orientation around the whole 6 volumes monthly, giving introductions as well as answering questions.

Both services can help new-comers get familiar with the environment around them faster; they can also prevent the potential offense felt by old Bellaratians by reducing the chance of inadvertent violation of Bellaratian traditions and customs by ignorant visitors.

New-comers are offered the choice to live in a specific apartment designed for the new for at most 6 months, and can choose to leave whenever they want during the 6 months. The apartment enjoys more user-friendly facilities which are more accessible for the new.

2"Helping to Understand"

Measure1 provides a way for visitors to know about the Bellaratians, while measure2 can make the latter learn about the former. It will be ensured that the new residents can get their positions in Bellarat as soon as possible so that they won't be considered burdens. Meanwhile, as their work can begin as soon as possible, Bellaratians are aware of their contributions and the new residents may feel integrated into the settlement's life simultaneously.

3"Welcoming & Integrating"

Monthly carnivals and parties are held in the theme park, during which everyone, including permanent residents, short-term residents and tourists is invited to play around and meet people, thereby communication and understanding is promoted.

Moreover, different festivals are held in Bellarat. Residents may enjoy all kinds of festivals from cultures from all over the world. Authentic food and performances given by residents from various cultures are presented.

4 Other Measures

Apart from the measures above, the treat with no discrimination should be taken into consideration. In addition, strict and careful inspections shall be given at the port customs before anyone could enter Bellarat, for the tendency of repulsion will raise if any malicious individual shall prove visitors as a whole a menace to the safety of Bellaratians. Not only should a sound system be established in Bellarat, but actions preventing danger shall be taken.

4.5 Receiving Area (Airtel)

The settlement will create two airtels for visitors' smoother and more convenient travel.

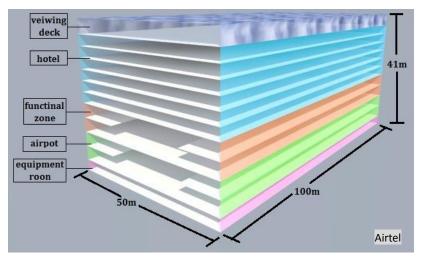
After the spaceship gets berthed, airport trains will transport the passengers to airtel, where the newcomers will have their first impression of Bellarat. In order to give them a good impression, we use various approaches to create a pleasant and efficient area for them.

During entering the airport, visitors will see a huge casement window directly and enjoy the magnificent view of the universe. Both outside and inside the customs will have information desks and a large number of signposts will be placed in the two-floor airport so that passengers can get a considerate service the whole trip.

The next two floor of the airtel will be the functional zone. Visitors will have an undisturbed work environment on the one side of the floor. More than ten modern council halls in different sizes support different



Human Factors and Safety



needs of working at the same time. On the other side of the zone, all kinds of recreation facilities, like restaurants, shops, gaming center and gymnasium, will be settled for passengers' needs. There will not be interferences between each other and the public service such as dispensary and security office will be a manual cut off for two parts. If any of the visitors feel

uncomfortable in the space environment, health care service will provide timely and effectively treat. A regular settlement-train will transport these visitors directly. During their waiting for the train, a Bellarat show will be in the waiting hall. Models of the Bellarat and posters will be displayed so that newcomers can get a brief but comprehensive first-impression on the whole space settlement.

Even higher up is a six-floor hotel which can hold 300 people in maximum. There will be three different kinds of rooms, standard single room, standard twin room and deluxe suites for people's choice. We hope to provide a more thoughtful living condition for all the visitors. In the hotel lobby, visitors can also leave for the residential area or the 0g area.

On the top floor of the airtel, there will be a huge viewing deck for visitors to enjoy themselves. Through the glass walls, the inky sky, the flying spaceship, and even the shadow of planets far away, will all be caught by their eyes.

After a few days' visit here, when passengers are about to leave, duty-free souvenir stores will be on business on their way out the airport. The health care will provide a thoroughly physical examination for them. And passengers won't need the cumbersome departure formalities, the ID card scanning system will tell their identity from the database of the arrival registration for their convenience.





5.1 Automation of Construction Processes

● 5.1.1 Exterior Construction Robot

This exterior robot is designed to do the earlier construction work. It has a main robot arm controlled by the construction system and a container below that carries exterior hull panels or the skeleton pipes. The robot is guided by laser so that it can move in straight lines to amalgamate materials accurately and concisely. It can also be used for interior work.

Meanwhile, we designed a carrier robot that helps construction robots carry the large materials so that construction robots need not move frequently only to grab necessary materials far away in warehouses.



● 5.1.2 Interior Construction Robot

This interior construction robot, controlled by remote control or drivers, builds up the interior buildings and rooms. It works like a human, but its efficiency is far superior than that of a human worker- it can decorates a house in a single day! Also, the spare exterior construction robot can help the interior construction work.



Name	Drawing	Size	Function
Body		1m*1m*2m	Provide a body for replaceable modularized devices
Sucker		2m*0.5m*2m	Carry panels and other heavy subjects.
Brush		2m*0.5m*0.5m	Brush the paint the interior structure is completed.
Driller	Q ide	2m*0.5m*0.5m	Drill holes somewhere.



5.2 Facility Automation

● 5.2.1 Maintenance and Repairs

A central computer shall arrange workers to promptly assemble new robots and settle a wireless network to control as much as 400 existing robots to perform regular inspection and maintenance tasks at designated spots. Enough robots shall be allocated in such a way as there could be enough evenly-distributed robots on duty at any time within any area. Should any anomaly (such as structural damage, abnormal stress distribution or material aging) be discovered, the robots would repair or replace the failed part immediately.

FIRE

•Alarms are set off when temperature over safety level or oxygen deficiency is detected. Meanwhile robots will be dispatched to extinguish the fire by spraying liquid carbon dioxide or sand (when active metals like sodium or magnesium are on fire). After the all-clear signal has been given, oxygen will be emitted to the affected area; exhaust gas will be treated as well to ensure the breathability of air.

Hull damage

• Computerized tomography detectors alert robots with mechanical arms to fix the breaches. Massive surface damages shall be tackled by module replacement.

PLAGE

• Contaminated organisms shall be quarantined; Citizens shall be alerted and informed of ways of prevention via broadcast.

AUTOMATION FAILURES

- •In case of software errors all computers on Bellarat are equipped with inspection programs that watch over every access into the central control system. Moreover, both the control system and all saved data are duplicated. Backups are installed in isolated storage that is only activated when the whole system needs resetting.
- •Hardware faults are under strict monitoring by the central control system and surveillance robots. Should any failure be discovered, robots will be dispatched at once to the spot to repair or replace the failed hardware.

Criminals

• A database of dangerous contraband and suspects is set up to help camera surveillance. Criminals found will be knocked down immediately by atmoized stunning agentia.

SOLAR FLARE

• Detector arrays are set up on the outer surface of the hull to monitor particle flow. The hull functions as a Faraday cage to protect all personnel and devices within. Sensitive electronic devices and personnel outside the cage must be evacuated at once and brought within emergency shelters. Communication is unaffected by the chaotic magnetic field during solar flares as antennas only conduct effectively electromagnetic waves that have been modulated to their resonance frequency.

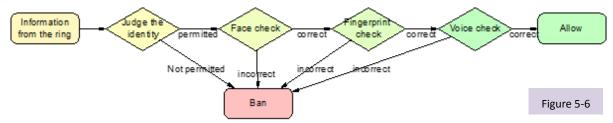
5.3 Habitability and Community Automation

Computer	Bandwidth	CPU speed	Storage	Number
Home	5Gb/s	5GHz	20Ть	Every home has one
Office	8Gb/s	10GHz	50Tb	Every office has one
Public	10Gb/s	50GHz	250Tb	100
Central	30Gb/s	100GHz	1000Tb	10



● 5.3.1 Privacy of Personal Data

For safety reasons, all residents in Bellarat will acquire ID rings that record their face images, fingerprints and voices specifically. If one wants to enter Bellarat Settlement, he or she has to swipe the only certificate- the ring- on the sensors. Compared with ID cards, rings are evidently safer (It is hard for a criminal to steal a ring on one's finger.) and indubitably easier to be carried. Significant facilities in high confidentiality will adopt excess passwords such as iris scanning or vocal checks. Residents can set individual passwords for their private room.

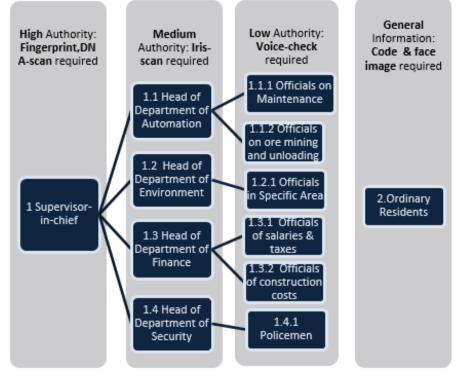


Codes used under various conditions

In consideration of victims being forced to offer his or her ring and information, Bellarat Security System should be able to distinguish whether the entered resident is threatened by terrorists. If so, it shall protect the resident's life and arrest terrorists. After swiping the ring, residents are required to input their codes, and if criminals point the gun to victims' head, residents can input the spare codes set before to warn Bellarat Security System that he or she is threatened. Thus, Bellarat Security System will conceal important documents and reject criminals' vital applications (e.g. application for rights of control robots if the threatened manager have input the spare code) even if the finger prints or other information are correct. Such measures avoid the possibility of criminals obtaining information that matters or controlling Bellarat Security System.

Hierarchy in the Bellarat Privacy System

All information involved in Bellarat's running will be put in the central computer which connected to Public Computers. Each Public Computer with Bellarat Security System guaranteeing data safety and privacy is able to



provide residents with access to information permitted. The difference of extent of secrecy requires a hierarchical system for security. The following charts provide a brief introduction of the hierarchical structures.



Automation Design and Services

Numbers	1	1.1	1.2
Accessible	information about departments'	Data available by	Data available by
Data	running, data about important	1.1.1&1.1.2,working	1.2.1,working
	events, reports from heads, etc.	conditions of officials in	conditions of officials in
		Department of Automation	Department of
			Automation
Numbers	1.3	1.4	1.1.1
Accessible	Data available by	Data available by 1.4.1, working	Progress of repairing in
Data	1.3.1&1.3.2,working	conditions of officials in	specific area, conditions
	conditions of officials in	Department of Security	of Repairers, etc.
	Department of Finance		
Numbers	1.1.2	1.2.1	1.3.1
Accessible	The kid of the ore and the source	Air conditioners' location,	Records of Residents'
Data	of it.	greening in specific area, etc.	taxes payment,
			administration costs, etc.
Numbers	1.3.2	1.4.1	2
Accessible	Construction in specific area.	Criminals' Information, data	Available robots'
Data	Estimated costs, resources	about crimes, etc.	location, map of Bellarat,
	needed, etc.		humidity, temperature in
			specific area, etc.

●5.3.2 Robots in Community

Home Robot

This robot companies residents in their house. It can communicate with its owner and can help to do most of the housework. There is a cleaner under its body so it can easily do the tidy work. The drawer can contain the necessary things. The camera equipped on the head can search for items recognize them.

Ambulance Robot

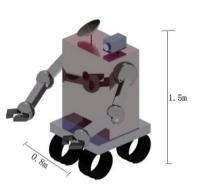
This is the ambulance robot that is capable of doing simple operations for patients on the way to the hospital. When a patient needs first aid treatment, the central computer will send a message to his or her nearest ambulance robot so that it soon arrive at place to pick up the patient and transit him or her to the hospital. The protecting shield protects the patient from exterior dangers.

Repair Robot

When something needs repairing, the central computer will receive the requirement and then convey a message about the place and items in need of fixing to a nearby operated repairing robots. It will soon receive the message from the central computer and find its way to the ordered place. Its body contains all tools it will use during reparation works. The robot arm can handle most of the repairing job so that human workers can be saved for more skilled work.

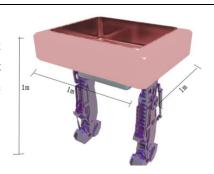




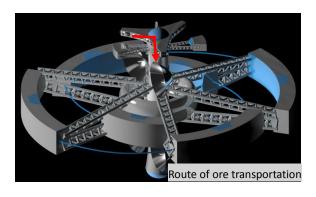


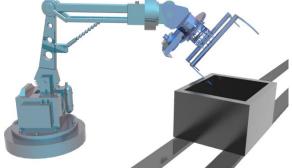
Trucking Robot

This trucking robot can help human carry heavy things and move it in a long distance in the community or in the house. It is human-size so it can easily move to almost everywhere human can get. People can put the things need to be carried on the plate of the robot.



5.4 Automation for Ore Transportation





The delivery system will use magnetics to transport containers to the refining facilities. Containers will be put into different sizes of magnetic boxes whose magnetic pole opposes to that of magnetic belts, so that they will generates magnetic levitation when placed on magnetic belts and be easily transferred. Each box will obtains its unique mark that contains information of items in the box so that automation system will recognize and align it to the right place. Some of the containers will be transported to the refining facilities while others will be directly transported to the zero g storage area.

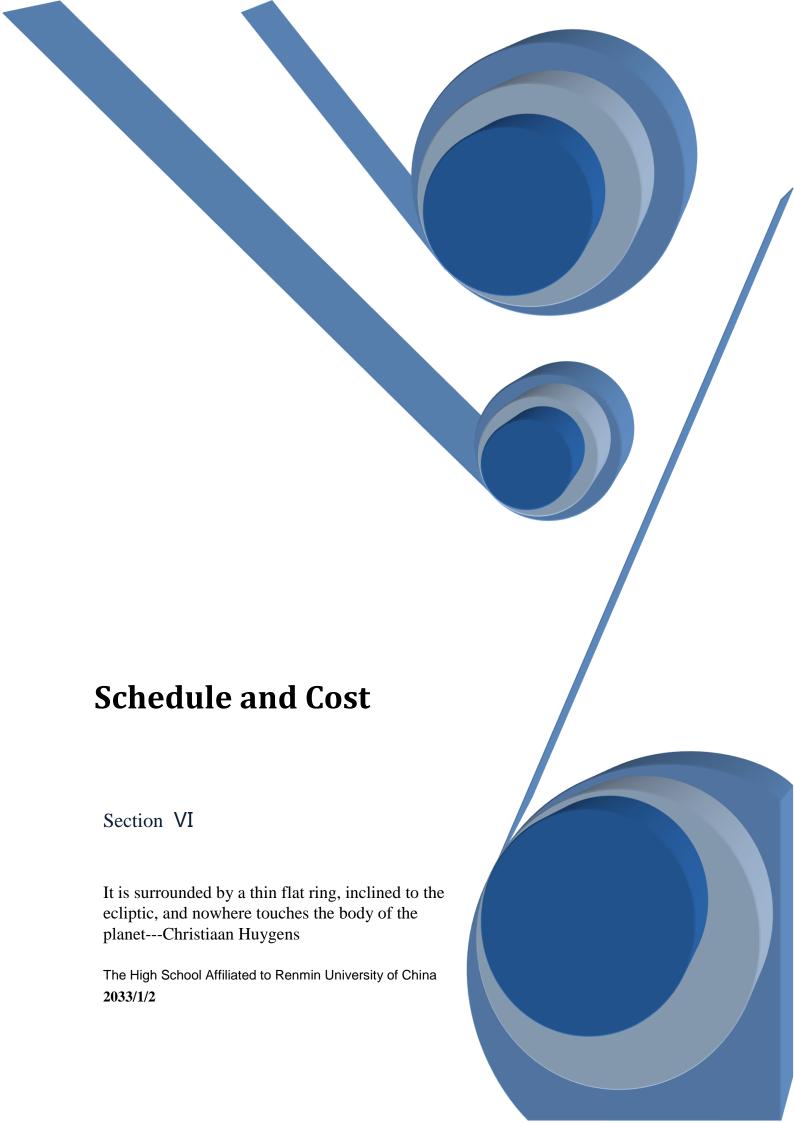
5.5 Docking Automation

First of all, the ships should be precisely docked onto the port. A system for measuring and adjusting each coordinate can communicate with the ship, so then the ship will finally decide which propeller would work to make the adjustment.

In order to guide the ship to park at a proper place, we need the whole set of the automation system, such as detecting system, database system and feedback system. Detecting system mainly contains cameras checking whether a lot has been fully occupied; database system provides ship data; and feedback system supervises the ship's safety. We also will assemble EM wave generator to provide WIFI so that the settlement can communicate with the docking ships. Finally the ship will know everything about the places and the recommended route.

And after parking, the passengers need to float to the "promoting and demoting elevators" without losing their ways or being hit by other ships. The EM wave generators send all information to their personal devices and guide them so that passengers would be able to reach the elevators.





Schedule and Cost

6.1 Schedule

Figure 6-1

	2033	2034	2035	2036	2037	2038	2039	2040	2041	2042	2043	2044	2045	2046	2047	2048	2049	2050	2051
Top half of Axis Major																			
Posture adjustors																			
Industrial section(0.25 g)																			
Zero gravity industrial																			
Food supply																			
Skeleton of airtels and 0.25g industrial																			
Worker residence(in hotel)																			
Sightseeing & exploration																			
Bottom half of Axis Major																			
Skeleton of 0.5g residential sections																			
Residential section(0.5 g)																			
Four fiber boards																			
Water cycle																			
Residential facilities																			
Residence in 0.5g																			
Skeleton and Residential section(0.8g)																			
Residence in 0.8g																			
Skeleton and Residential section(1.0g)																			
Residence in 1.0g																			
Ropes																			
		Consti	ruction				Operat	tion		Cons	truction	Lasting	18 years	s					



6.2 Cost

Cost for Phase 0 & 1 (Preparations)

Items	Units	Cost Per Unit (\$)	Total Cost
Research Fee		-	50,000,000,000
Employee Training		-	1,000,000,000
Spaceships	100	30,000,000	3,000,000,000
Operating Supervisor	3	50,000,000	150,000,000
Information Transit	2	30,000,000	60,000,000
Construction Robot	225	700,000	157,500,000
Security Robot	35	300,000	10,500,000
Transport Robot	120	200,000	24,000,000
Construction Robot	225	700,000	157,500,000
Construction Robot	225	700,000	157,500,000
Security Robot	35	300,000	10,500,000
Transport Robot	120	200,000	24,000,000
Storage Facilities			5,000,000
Solar Power Generator	10	1,000,000	10,000,000
		TOTAL	4,766,500,000

Costs of Phase 2 (Main Structure)

Parts	Category	Cost
1.Main rotating section		
Agricultural Section	Hull Component	14,700,000,000
	Material	2,140,000,000
Industrial Section	Hull Component	8,000,000,000
	Material	1,700,000,000
Residential Section	Basic Infrastructure	1,300,000,000
	Life Sustaining System	4,100,000,000
	Inner Transportation	600,000,000
2.Axis Major		
	Basic Structure	984,000,000
	Nuclear Reactor	570,000
3. Docking System		500,000,000
TOTAL		45,724,570,000

Maintenance Costs

Category	Cost(\$)
Communication	1,000,000
Systems	
Earth Control Stations	500,000
Robot Maintenance	20,000,000
Docking Ports	6,000,000
Storage Areas	300,000
Industrial Areas	450,000
Agriculture Areas	250,000
TOTAL	28,600,000

Table for Revenue Generation &

Activity &	Revenue
	Generated(\$) ₽
Tourism↩	3,500,000,000 ₽
Passenger	100,000,000 ₽
Expenditures 🕫	
Import/Export←	250,000,000 🕫
Advertising	250,000,000 ₽
Rights₽	
Property Rights₽	700,000,000 ₽
Transport Taxes₽	300,000,000 ₽
Recreation &	900,000,000 ↩
Port taxes↔	1,250,000,000 🕫
Cargo Transfer	500,000,000 ₽
fees⊍	
Repair &	1,250,000,000 🕫
Maintenance of	
Space Ships 🕫	
TOTAL ₽	9,000,000,000₽



Schedule and Cost

Costs of Phase 3 (Industrial Units)

Parts	Quantity	Cost per	Costs(\$)
		Unit(\$)	
Industrial Section	2	200,000	400,000
Agricultural Section	1	150,000	150,000
Storage(Agriculture)	1	8,000,000	8,000,000
Warehouse(Industrial)	8	10,000,000	80,000,000
Maglev elevator	1,000,000	100	100,000,000
Food laboratory	10,000,000	2	20,000,000
Food factory	20,000,000 1		20,000,000
TOTAL			
			221,350,000

Costs for Phase 4 (Infrastructure)

Parts of Phase	Sub Parts	Quantity	Rate (\$)	Total (\$)
Recreational	Parks	4	5,000,000	20,000,000
Areas	Fitness	12	8,000,000	96,000,000
	Centers			
	Shops/	25	20,000,000	500,000,000
	Archives/			
	Cinema			
	Halls /Malls			
	Sport	2	250,000,000	500,000,000
	Stadium			
	Restaurant	15	25,000,000	500,000,000
	Sections			
Tourism Areas	Hotels &	8	550,000,000	4,400,000,000
	Resorts			
Water, Waste &			660,000,000	660,000,000
Power Systems	Water/Waste			
	Treatment			
	Power		700,000,000	700,000,000
	system			
Life Sustaining				2,000,000,000
System				
Communication				3,000,000,000
Networks				
TOTAL				12,376,000,000

Total Cost billed to the foundation Society is \$ 6,471,000,000,000 Payback Period: 7.19 years





Bellarat, established with an aim to obtain space commercial prosperity, will have four major business pursuits: Receiving and transporting lunar-asteroid material, manufacturing extraterrestrial goods, repairing spaceships, space infrastructures, and Emergency management.

•7.0.1 Receiving and Transporting Lunar-Asteroid Material

Transport

Since ores will arrive in standard shipping containers, Bellarat will use conveyer belts and robot arms to transfer ores. (Cf. 5.4 Ore Transportation) Containers will be assigned their unique marks, recognized by robot arms, and transferred separately. Some ores will be shipped to refining facilities while others will be transferred to zero-gravity industrial zone or conveyed into warehouses.

For non-bulk cargoes, those in standard shipping containers will be transferred in the same method as that of ores. As for cargoes not in standard containers, they will be unloaded onto huge conveyer belts, delivered into warehouses and left for further artificial classification.

Storage

Bellarat will construct huge warehouses to fit ore and cargo storage demands. Warehouses are established in the Axis Major (Cf. 2.1.1 Main Structure), and ores waiting for transportation or use will be straightly transferred in. When in need, ores stored in warehouses can be conveyed to ports or industrial areas via the conveyers. Raw materials are transferred in the same way.

Ports for passengers and cargoes other than raw materials

In order to provide residents and travelers with a comfortable departure and arrival ambience, Bellarat ports are built as three sections: Passenger Section, Cargo Transportation Section, and Repairing Section. (Cf. 2.5 Portal Facilities) Passengers in terminal can enjoy a comfortable terminal, while cargoes can be concisely delivered. Meanwhile, Cargo Transportation Section is divided into two parts, left side for normal goods and right side for raw materials. This method ensures the efficiency of delivery system.

•7.0.2 Manufacturing Extraterrestrial Goods

Extractions

The energy needed for extractions comes from solar power. (See 3.2.3 Solar Energy)

Bellarat will transfer the solar energy to microwaves to heat the materials collected to avoid explosions. The heat and force bump will compress the mixture to bump out the elements in need.

Gravity accommodation

①Productions in need of zero gravity:

Bellarat's satellite "Factory zero" will be sent orbiting the whole station to simulate absolute zero gravity. Small amount of productions can be manufactured there.

2) Productions in need of approximately 0.2g:

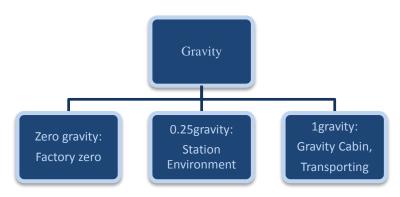
Bellarat station itself, due to self-rotation, provides the ambience of small gravity. Large factories are built in the factory place. (Cf. 2.1.1 Main Structure)

③Productions in need of normal gravity:

Bellarat's normal gravity multiple-use cabins are built both in manufacturing areas and living areas to generate gravity. Moreover, transporting materials back to earth where the compose can be done is as another method.



Storage cargo



Delivery paths

Productions from Bellarat will flow to different markets: exports, provisioning visiting ships, and internal consumption. Different paths are settled for different markets.

All productions at first need to go through Primary Transportation step and Secondary Transportation

step on maglev rail lanes that connect the spaceport with Axis Major and elevators that connect Axis Major to the rotating sectors. Export goods and productions for visiting ships will be transferred directly in the Cargo Transportation Section, while internal-consumed goods will be shipped via the Tertiary Transportation step, taking elevators into residential volumes.(Cf. 3.2 7 Internal Transportation System)

Expansion policy

Future expansion in manufacturing area will be promoted in the following two aspects.

First, space for further manufacturing facilities will be reserved. Bellarat will continuously install new facilities to meet new production requirements and increase product standards.

Second of all, industrial areas are designed in patches with joints of extension so that it will be easy to expand the manufacturing area. (Cf. 2.5 Port Facilities) Bellarat will expand industrial areas progressively and eventually meet the standard of assembling large interplanetary ships.

•7.0.3 Repairing Spaceships and Space Infrastructures

Repair work is indubitably significant in space. Bellarat's and its spaceships' abrasions will be repaired routinely and continuously to assure safety of the settlement.

Since a fleet of ten space tugs will be operate from Bellarat, of which up to five tugs may be docked at any one time. Bellarat can handle up to three or four spaceships' reparation work. Such rate is absolutely enough at the beginning, and along with development of the settlement, more repair ports that can handle larger spaceships with larger volumes are going to be established. Specifically, repair ports suitable for different sizes of ships are going to be built in order from the smallest to the largest according to whole settlement's expansion speed.

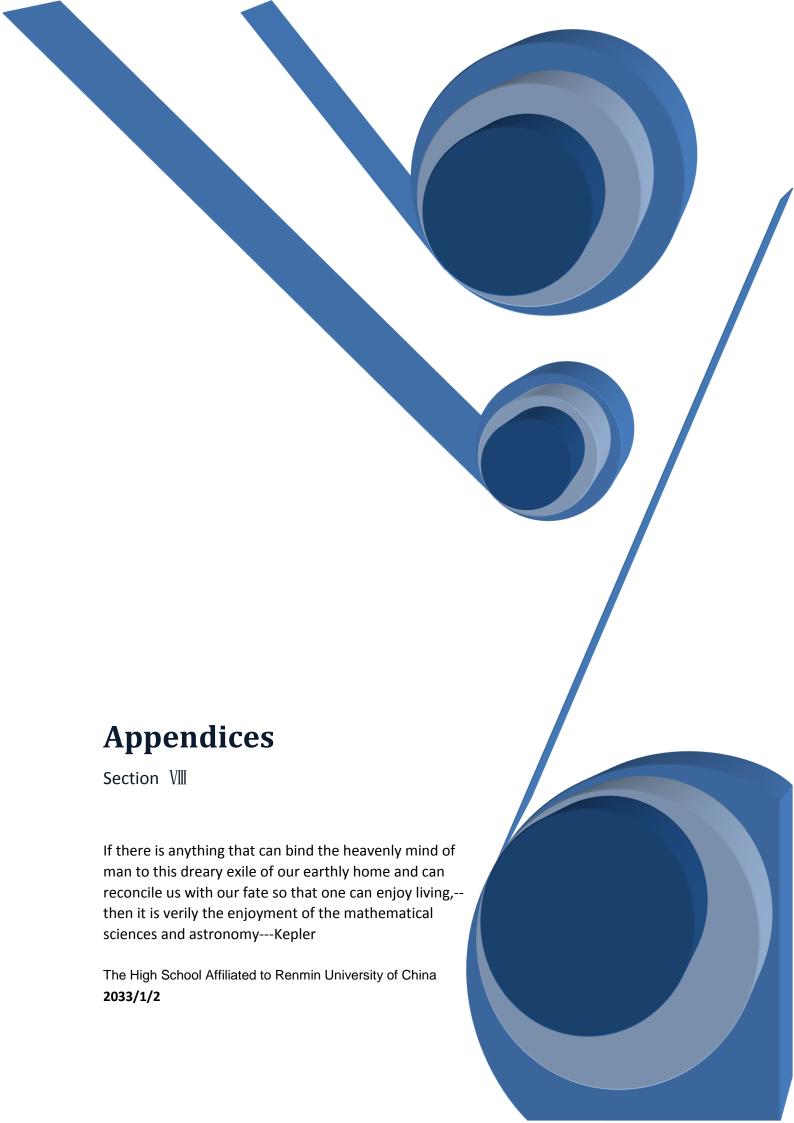
As to the station's abrasions, the designed repairing robot can fix them easily. The repairing robot will receive the message from the central computer and find its way to the place need repairing. (Cf. 5.2.3.2 Repairing Robot)

•7.0.4 Emergency Management

If a visiting ship meets a hazardous situation, Bellarat's Emergency Plan will operate immediately in the following procedure.

Bellarat's central computer will figure out the cause and place of such incident. Whether it happens inside the settlement or in space? Whether it is a chemical problem or a mechanical problem? If it happens inside, the ambulance robots and emergency repairers will rush to the place at once. If it happens in space, spaceships with docking ability will be sent to space to collaborate with the original ship and transfer humans safely into the other ship to the station. Chemical problems will be fixed with certain materials like anti-toxic sprays and supercritical CO2, while mechanical problem will be corrected by the work of repairing robots.





A. Operational Scenario

A1: Hull breaches at interfaces between two habitable volumes, especially those with different pressures, are catastrophic for Bellarat and its residents. Thus designers have specially had residential volumes separated from each other to avert potential pressure problems.

Despite measures taken in blueprint, the danger of hull breaches is still considerable if breakage at interfaces between residential volumes and their adjacent maglev elevator tunnels. To minimize affects brought by the disaster, detectors are installed during construction, sending off alarms when constant air flow vertical to the wall surface is detected. Broadcasts ordering evacuation are then delivered to residents. Those close to the breach are granted priority to leave and should be instructed to run along the leaking surface first. Abandonment of personal belongings is demanded as elevators on the other side of the breakage are used for evacuation, and no capacity can be spared for individual property.

Efforts to repair the breach start as soon as emergency is announced. Since the supporting hexagon structure is modular and overlaps with one another, restoring broken surface is relatively easy. Robots will first identify broken hexagons and then remove them. Other robots will fetch pre-manufactured hexagons and install them by mortise and tenon joints. Interfaces are then sealed with PTEF, which could endure extremely low temperatures.

At last the air recycling system will emit oxygen and nitrogen to replenish the lost gases. After a 30-minute pressure test, residents will be informed all-clear via broadcasts.

A2: When explosion occurs, sensors will send off alarms immediately and detect released heat and the composition of air. Checkout equipment will soon analyze the sensors' date and come up with an effective reaction to eliminate released toxic gases, and all machines nearby will be shut down for safety. The broadcast system will evacuate people at once, while fireman robots will rush to the exploded place simultaneously to put out fire and

save people. Air recycling will pump system pernicious gas out and emit oxygen and nitrogen to the right proportion. The repairing robot will also enter this area to repair exploded items and equipment.





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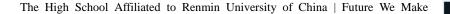
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With bio-based coupling agent

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Qualifying-round Proposal of China

Figure 2-5 Figure 2-7 Figure 2-18 Figure 3-6 Figure 3-9 Figure 3-10 Figure 3-16 Figure 4-15 Figure 4-16 Figure 4-17 Figure 5-6



C. Compliance Matrix

Requirements	Subsection	Page
1.0 Executive Summary	N/A	1
2.0Structural Design: provide a safe and pleasant living and working	2.0	2-8
environment for a population of 11,000 full-time residents, plus an additional		
transient population, not to exceed 500 at any time.		
2.1 External Configuration: Identify large enclosed volumes and their	2.1.1	2-5
uses, and show dimensions of major structural components and design	2.1.2	
features.	2.1.3	
2.2 Interior Design : Specify percentage allocation and dimensions of interior	2.2.0	5
"down surfaces"	2.2.1	
	2.2.2	
2.3 Construction Sequence : Describe the process required to construct the	2.3.1	6
settlement, by showing the sequence in which	2.3.2	
Major components will be assembled.	2.3.3	
2.4 Bukystructures Production Facilities: show locations on overall	2.4	7
structural drawing of bukystructures production facilities, and means for		
moving parts between those facilities.		
2.5 Port facilities: accommodate various sizes, configurations, and purposes	2.5	8
of visiting ships.		
3.0 Operations and Infrastructure: Describe facilities and infrastructure	3.0	9-19
necessary for building and operating the Bellarat space settlement and its		
communities.		
3.1 Location and Materials Sources: Identify sources of materials and	3.1.1	9-10
equipment to be used in construction.	3.1.2	
	3.1.3	
3.2 Community Infrastructure :Bellarat design will show elements of	3.2.1	10-17
basic infrastructure required for the activities of the settlement's residents,	3.2.2	
including:	3.2.3	
• atmosphere	3.2.4	
food production	3.2.5	
• electrical power generation,	3.2.6	
• water management,	3.2.7	
household and industrial solid waste management	3.2.8	
internal and external communication systems	3.2.9	
• internal transportation systems		
• day/night cycle provisions		
Define storage facilities required to protect against interruption in production of		
food or commodities needed for daily life; supply lines for imports may be		
interrupted for two weeks.		
3.3 Construction Machinery: Show conceptual designs of primary	3.3.1	18
The state of the s		
machines and equipment employed for constructing the settlement, especially	3.3.2	

3.4 Paper Production : Shows that supplying paper	3.4	18
3.5 repair services for visiting ships.	3.5	19
4.0 Human Factors and Safety	4.0	20-30
4.1 Facilities and Means of Distributing Consumables: Bellarat	4.1.1	21-25
communities will provide services that families could expect in comfortable	4.1.2	
modern communities	4.1.3	
	4.1.4	
	4.1.5	
4.2Residential Design: Provide designs of typical condominium or	4.2	26
apartment residences, clearly showing room sizes.		
4.3 Safe Access: Designs of systems, devices, and vehicles intended for use	4.3.1	27-28
by humans outside of artificial gravity and pressurized volumes will emphasize	4.3.2	
safety.	4.3.3	
	4.3.4	
4.4 Measures Taken to Enable Short-term Residents to Feel	4.4.1	29
Integrated: Studies of human behavior in isolated environments have shown	4.4.2	
a tendency for permanent residents to regard visitors and temporary residents as		
outsiders or intruders.		
4.5 Passenger receiving areas: Create pleasant and efficient areas for	4.5	29-30
passenger arrival and departure.		
5.0 Automation Design and Services: Specify numbers and types of	5.0	31-35
computing and information processing devices, multi-function personal		
electronic tools, servers, network devices, and robots required for Bellarat's		
facility, community, and business operations.		
5.1 Automation of Construction Processes: Describe use of automation	5.1	31
for construction.		
5.2 Automation for Maintenance and Repairs: Specify automation	5.2.1	32
systems for settlement maintenance, repair, and safety functions, including		
backup systems and contingency plans.		
5.3 Habitability and Community Automation: Drawings of automation	5.3.1	32-35
systems to deliver ore to refining processes.	5.3.2	
5.4 Automation for ore transportation: Describe automation devices to	5.4	35
enhance livability in the community, productivity in work environments, and		
convenience in residences. Emphasize use of automation to perform		
maintenance and routine tasks, and reduce requirements for manual labor.		
5.5 Automate final docking of ships in the various port facilities:	5.5	35
Show differences in docking procedures for different types of docks.		
6.0 Schedule and Cost: The proposal will include a schedule for completion	6.0	36
6.1 Schedule: Durations and completion dates of major design, construction,	6.1	36
and occupation tasks, depicted in a list, chart, or drawing.		
6.2 Cost: Specify costs billed per year of Bellarat design through construction	6.2	37-38
in U.S. dollars,		

7.0 Business Development: Bellarat will host various commercial and	7.0	39-40
industrial ventures, which may change with time.		
A. Operational Scenario: Describe in detail processes that will occur during	N/A	41
two different emergencies, and how normal functions will be restored after each		
situation is stabilized.		
B. Bibliography / References	N/A	42-46