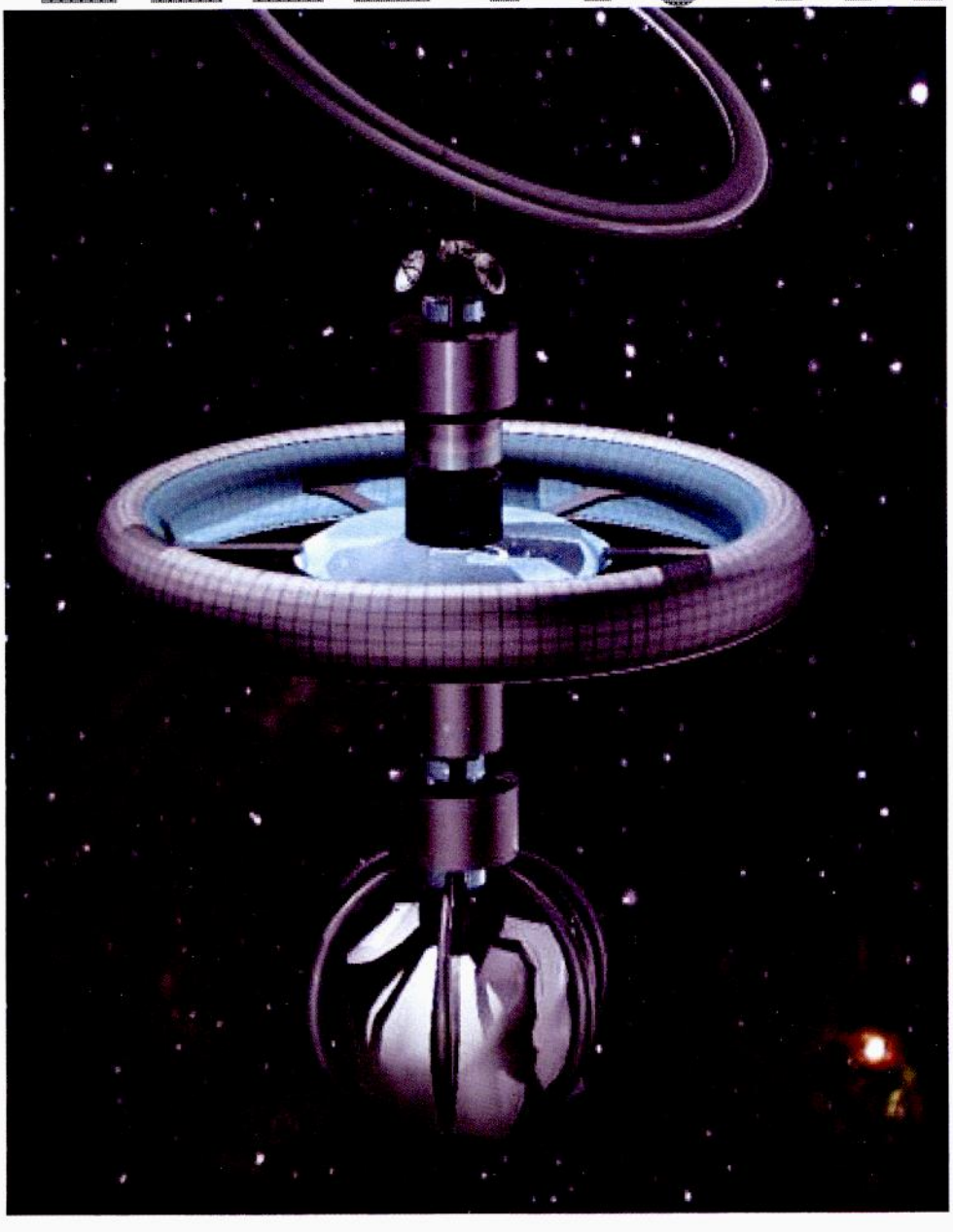
BELLEVISTA



EXECUTIVE SUMMARY

EXECUTIVE SUMMARY

Northdonning Heedwell (NH) is pleased to announce the fully compliant Bellevistat Space Settlement proposal in response to the Foundation Society's RFP dated 2 January, 2028. It is Mankind's endeavour to conquer the realms of outer space and beyond. Thus, with extreme dedication and an aspiration to be part of this ambitious project, our expert design team has developed this comprehensive design plan.

Bellevistat is proposed to be a settlement supporting 18000 permanent residents at a time. The salient features of the design are:

- A unique aspect of the modular design is that the settlement will be inhabited within just a few years of construction so that the settlements purpose of being a hub for on orbit refining and mining of extraterrestrial materials and zero g heavy manufacturing
- Views of outer space will be visible to the residents. The comfort of the residents will not be compromised at any cost. Different neighbourhoods will be provided so that the residents are not bored with a monotonous community infrastructure.
- Three widely separated docking ports have been provided with multiple docking strips. This will enable efficient and quick communication with other settlements particularly Alexandriat, the moon and the earth.
- To increase efficiency and for the comfort of the residents of Bellevistat, robots and multiple automated systems have been introduced
- A complete schedule and an estimate of the cost has also been attached along with a thorough detail of the structure and operations to be carried out in the settlement.
- Bellevistat will be a highly profitable venture as it has the ability to harness space resources and transfer them to the earth.
- An earth like environment will be provided by constructing green patches, parks and gardens, kitchen gardens, water bodies and lakes, special areas for camping and hiking and by maintaining a proper day and night cycle.
- Provision of a healthy and a balanced diet to the residents will be ensured and utilities like electricity, water supply, waste disposal will be taken care.
- Innovative engineering techniques will be used to reduce construction time in the settlement.
- Backup systems and contingency plans have not been ignored, incase there is an emergency.
- Bellevistat will have a flourishing tourist industry, with tourists coming from the earth as well as other settlements. These tourists will have a luxurious stay with attractions and activities not available on the earth.

POPULATION	PERMANENT: 18000 TRANSIENT: 1000
DATE OF CONTRACT	2ND JANUARY 2028
YEAR OF COMPLETION	2052
COST	US$200 BILLION

STRUCTURAL DESIGN

2.0 STRUCTURAL DESIGN

2.1 External Configuration

2.1.1Main features of Bellevistat:

1. Effectively shielded cylinder and torus for construction.
2. Provisions for attachment to asteroid, and mining of asteroid material.
3. Mirror-system for natural day-night cycle
4. Attractive and functional community design
5. Tourist attractions
6. Multiple docking ports in case of redundancy

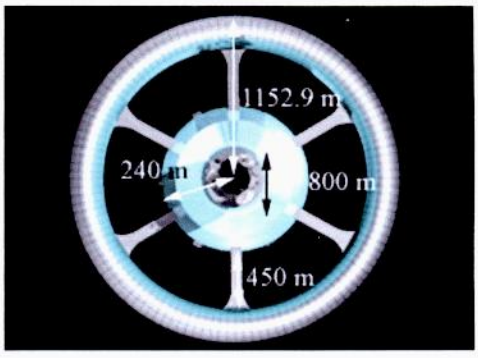


Figure 2.1.0 Top View of Settlement

2.1.2 Main Structural Components of Settlement:

1. segmented central cylinder
2. single torus
3. Spokes connecting the torus to the cylinder.

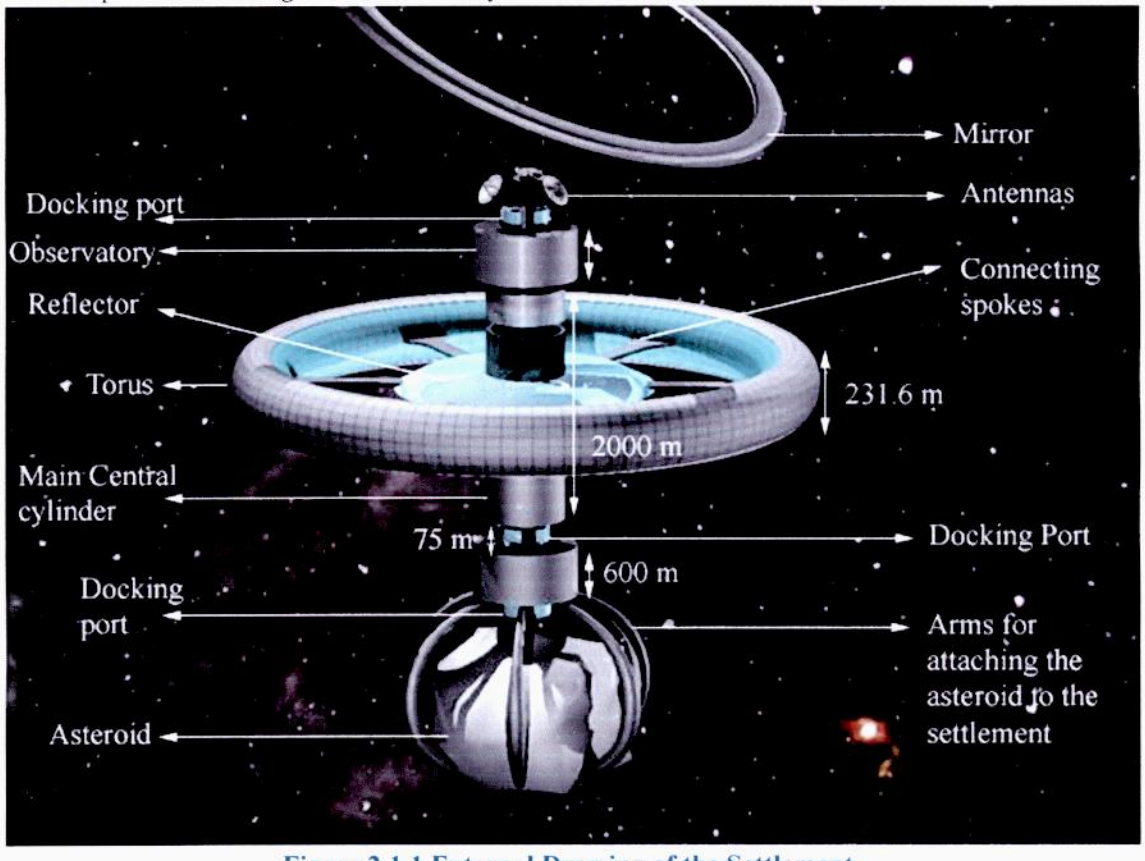


Figure 2.1.1 External Drawing of the Settlement

Table 2.1.1: USES OF LARGE ENCLOSED VOLUMES	
Segmented Central Cylinder	Automation services, storage, heavy industry, asteroid mining, storage and refining, research, power generation, observatories and other zero-g activities.
Torus	Residential area, agricultural area, industrial area.
Spokes	Upper circumference lined with solar panels for power generation. Connect central cylinder to torus.

Docking Ports	Transportation of cargo and passengers.
Asteroid Centre	Mining, storage and refining of asteroid material.

Table 2.1.2: Dimensions of Main Structural Components:		
Structural Component	Dimensions	
Torus	Major Radius (R1)	1152.9m
	Minor Radius (R2)	231.6m
	Down Surface Area	2948800m^2
Segmented Central Cylinder	Radius	700m
	Length	2000m
	Volume	3078770000m^3
Spokes	Radius	45m
	Length	450m
	Volume	2862776m^3

2.1.3: CONSTUCTION MATERIALS:

While selecting materials for use in the construction of the main structure of Bellevistat, (the company) has kept the safety of the residents and the viability of the structure a top priority, as well as keeping economic feasibility in mind.

The structure will have multi-layered walls for optimum protection, and will consist of a non-moving shell surrounding the torus. This will provide additional shielding from radiation and debris, and at the same time, due to being detached from the torus, will not add to the weight of the settlement. The settlement will have a glass ceiling to allow sunlight to filter in, for the psychological benefit of the residents. There will be observation windows to provide views of space and of the Earth.

Table 2.1.3: Construction Materials			
Outer Wall (Main Layer)			
Material	**Source**	**Use**	**Reason For Selection Of Material**
NASA High Strength Aluminium Alloy (MSFC398)	Aluminium obtained from asteroid produced in Alexandriat.	Main hull (first layer of wall)	• Very high strength and wear resistance at high temperatures of 500-700°F. • Material cost of less $1 per pound.
Carbon Nanotube mesh	Asteroid	Second layer	• Extraordinary strength. • Tensile strength of 200 GPa. • Young modules of over 1 Tera Pa.
Super Adobe	Lunar Soil	Third layer	• High strength and resistance. • Good insulator.
Silicon Nitride	-	Fourth layer	• Good high-temperature strength. • Creep-resistant and Oxidation-resistant. • Good thermal-shock resistance.
Aluminium Silicate	-	Fifth layer	• Excellent high-temperature capability. • Thermal shock resistance is exceptional. • Thermal insulator.
Crushed lunar regolith	Moon	Non-moving (outermost shell)	• Crushed lunar regolith matrix will be a non-moving shell in some areas so that hull does not need to bear extra

			weight.
Silica rubber Adhesives	Earth	Adhesive	• Specially developed for use on space vehicles. • Very strong adhesion.

2.1.4: Radiation And Debris Protection	
Material	**Properties**
Graphite fibres diffused with Bromine	• Effective shield against electromagnetic radiation
Silica Aero gel	• Most effective Aero gel insulator • Absorbs infrared radiation
Nextel	• Protects from debris due to its high tensile strength
Kevlar mesh	• Debris protection due to high tensile strength and Young Modulus.

2.1.5: Materials For Transparent Portion (Ceilings And Windows)	
Material	**Reason For Selection**
Lead-glass	• Shields from X-rays
Silicon Aero-gel	• Producing Silica Aero gel in a weightless environment (micro-g industry in central cylinder) can produce particles with a more uniform size and reduce the Raleigh scattering effect in Silica Aero gel making it transparent • Prevents heat transfer through conduction, convection, and radiation.
Aluminium Silicate glass	• Shields against radiation.

2.1.4 GRAVITY AND PRESSURE:

Generation of Gravity: Gravitational force will be produced by rotation. Centrifugal force generated by the rotation will act as a gravitational pull. Pseudo gravity will be produced by rotating the torus at an rmp of 0.86. This is an ideal rate of rotation because it produces gravitational field strength of 1g. Furthermore, this rate of rotation requires that the settlement have a major radius of 1152.9 m to produce 1g, which is ideal for the population size specified by the Foundation Society. It provides an ideal balance between economic feasibility and comfort of the residents as the line of sight thus generated is 63.5 m, which is essential for psychological stability of the inhabitants. In addition, a low rpm prevents the inhabitants from experiencing the Corollis Effect. The formula used for determining rotation rate is as follows:

`STRUCTURAL COMPONENT	PRESSURE	GRAVITY
TORUS		
SPOKES		
DOCKING PORTS		
OBSERVATORIES		
ASTEROID HARVESTING CENTRE		
CENTRAL CYLINDER		

Figure 2.1.3 Pressure & Gravity Distribution

$$W^2 \times R1 = 9.81 \qquad W=0.0922 \text{ rad/s} \qquad r.p.m = 0.86$$

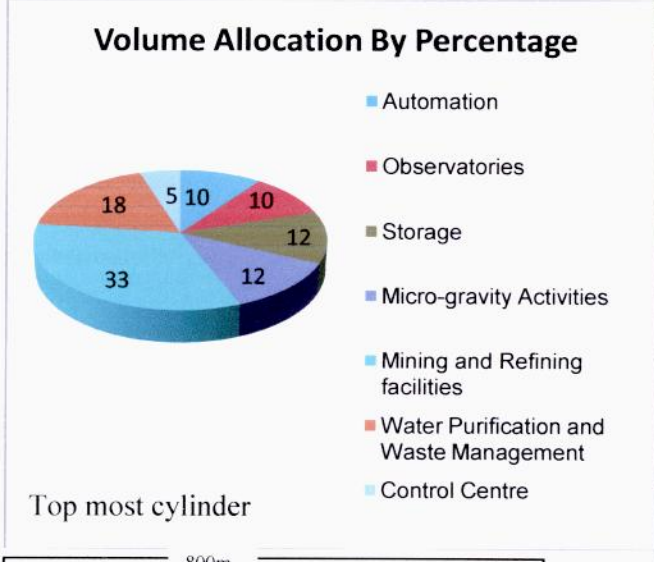
The settlement will contain areas lacking pseudo gravity, as this is essential for optimum output from various sectors such as industry and refineries.

2.2.1 ALLOCATION OF INTERIOR DOWN SURFACES

Table 2.2.1: Area Allocation In Torus		
Uses of Areas	**Surface Area Required Per Person(M^2)**	**Total Area Utilized**
Residential	49	931000
Schools and Colleges	1	19000
Shops and Offices	3.3	62700

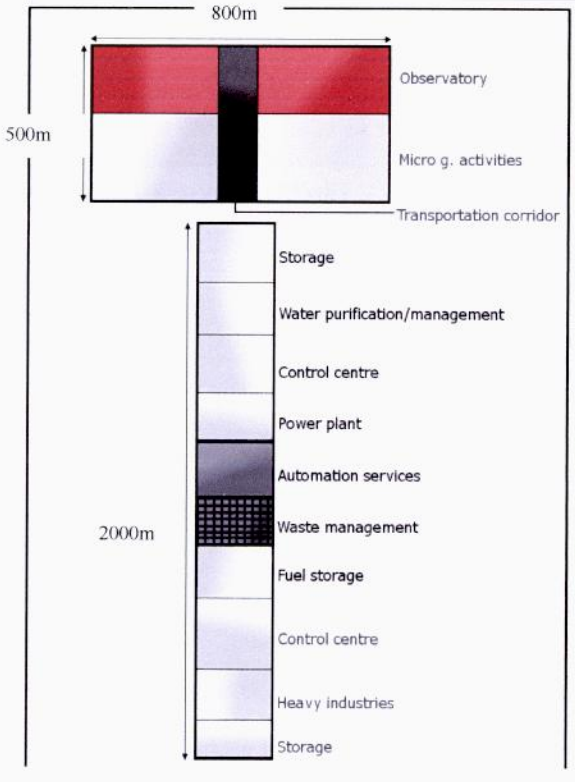
Hospitals	0.3	5700
Assembly	1.5	28500
Open space	10	190000
Storage	5	95000
Transportation	12	228000
Service Industries	4	76000
Agriculture	61	1159000
Misc. Infrastructure	7.1	134900
Recreation	1	19000
Total	155.2	2948800

2.2.2 USE OF MICRO GRAVITY AND UNPRESSURIZED FACILITIES



Top most cylinder

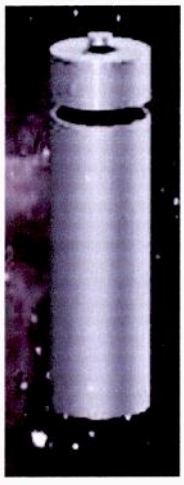
Table 2.2.2: Uses Of Micro-Gravity	
Recreation	• Zero-Gravity games
Medical Facilities	• Heart diseases and burns can be treat-ed more efficiently under micro-gravity.
Manufacturing services	• Super conductors and alloys that cannot be manu-factured under a gravitational force of 1 G can be man-ufactured in micro-gravity.
Advantage for physically handicapped people	• Assists in mobility, and movement is possible without any wheelchairs or support.



2.2.3 Vertical Clearance in Each Area:

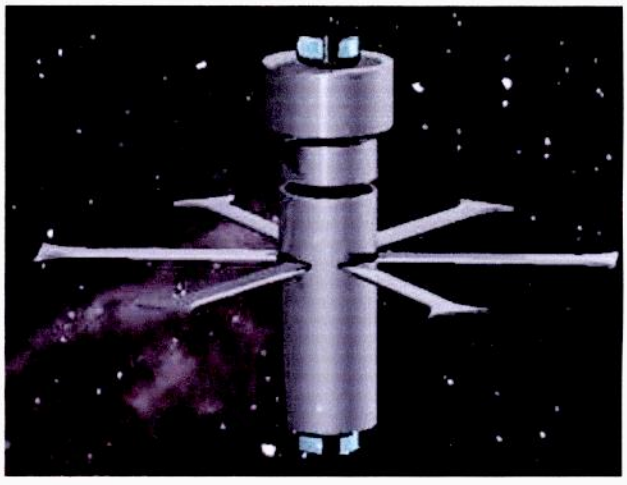
Structural Component	Vertical Clearance
Torus	245 m
Spokes	100 m
Docking Ports	50 m
Asteroid Mining and Refining Centre	300 m
Heavy Industry Cylinder	250 m

2.3.1: Construction Sequence:



Phase 1
Construction of
Central Cylinder

Phase 2
Construction of
Docking Ports



Phase 3 Construction of Spokes

Phase 4 Construction of Torus

Phase 5 Construction of Antennas

Phase 6 Construction of Reflector &
Mirror

Phase 7 Construction of Refinery
& Third Docking Port

Phase 8 Construction of Arms

Phase 9 Capture of Asteroid

2.4.1: Attachment of Asteroid:

As illustrated in the diagram arms will be constructed to attach the asteroid to the settlement. The arms are segmented and movable provided with anchors at front these anchors will clutch the asteroid brought near the settlement. In the arms near the anchors there will be a decontamination room to separate the dust from ores. The segments will act as a pathway for transportation of miners, tourists, automated machinery and robots to the asteroids where the machinery and robots will do mining work and tourists can have an experience of viewing the mining site.

2.4.2: Ore Refinery Operations:

There will be ore refinery industry in the cylinder (Fig 2.4.1) constructed near the asteroid as shown in the diagram. A docking port will be constructed right next to the refinery for efficient transport of refined ores to earth or other settlements.

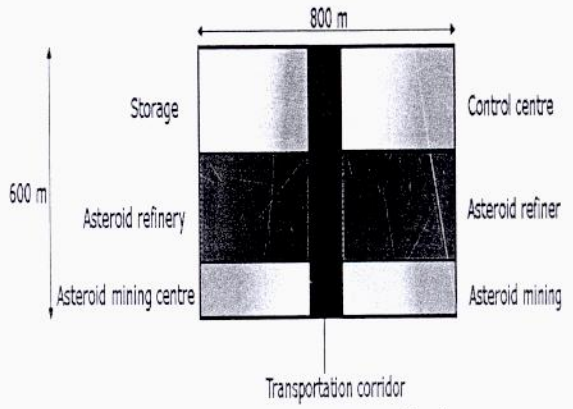


Figure 2.4.1: Lower cylinder

2.4.3 DUST SEPARATION SYSTEM:

A robot (ex-bot) will specially be constructed and will be used to separate all the dust from exterior surfaces of the settlement. It will also work on docking ports to separate the dust from docking surface. Hence the dust will get collected In the chamber present in the robot. Dust separation mechanism is also used for preventing the entry of dust in the interior of the settlement. In this mechanism vacuum dust suckers will be used in the tunnel providing path from docking tunnel to the central transportation corridor. This will be pressurized
so that vacuum can suck the air. When the dusty ores enter this tunnel, the dust being a lighter particle also gets sucked with air.

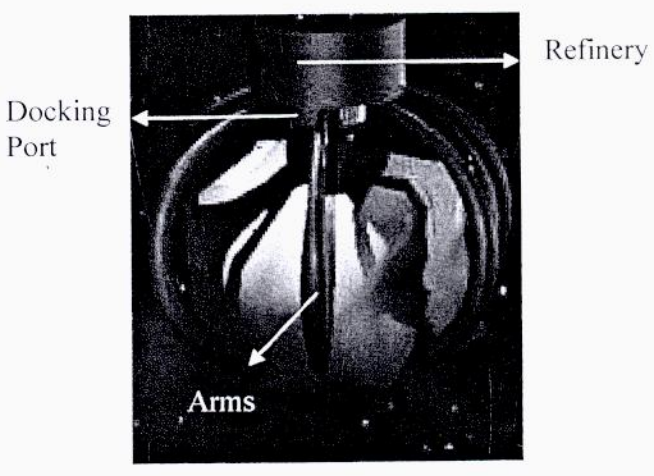
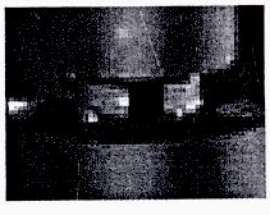


Figure 2.4.1: attachment of asteroid

2.5.0: Docking Ports:

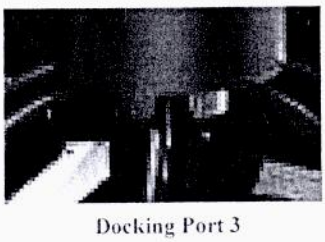
There will be 4 docking ports. The docking port is away from the pressurized areas therefore any deviations of the vehicle from their original paths will not .effect the pressurized volumes. The ports are widely separated from each other so that in case accident on one port the other port can be used. These docking facilities will also be needed if space tourism is to become an economical activity at Bellevistat.



Docking Port 1

The three main zones of the docking port are: storage zone, docking zone and controlling zone

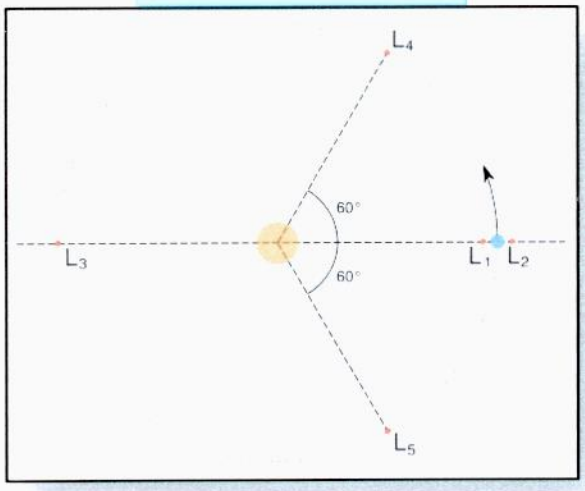
Docking Port 2



Docking Port 3

OPERATION AND INFRASTRUCTURE

3.1.1: Orbital Location



The orbital location chosen for the Bellevistat is L4 due to the following reasons:

- The stability given to the settlement due to L5's resistant to gravitational perturbations. When and if the equilibrium of this settlement is disturbed it returns to orbit the Lagrange point without drifting further away, and without the need of frequent rocket firings.
- Absence of settlements in L4 provides ample space for Bellevistat to harness and use asteroids without and damage to other settlements.

3.1.2. Table for the materials required and their specifications:

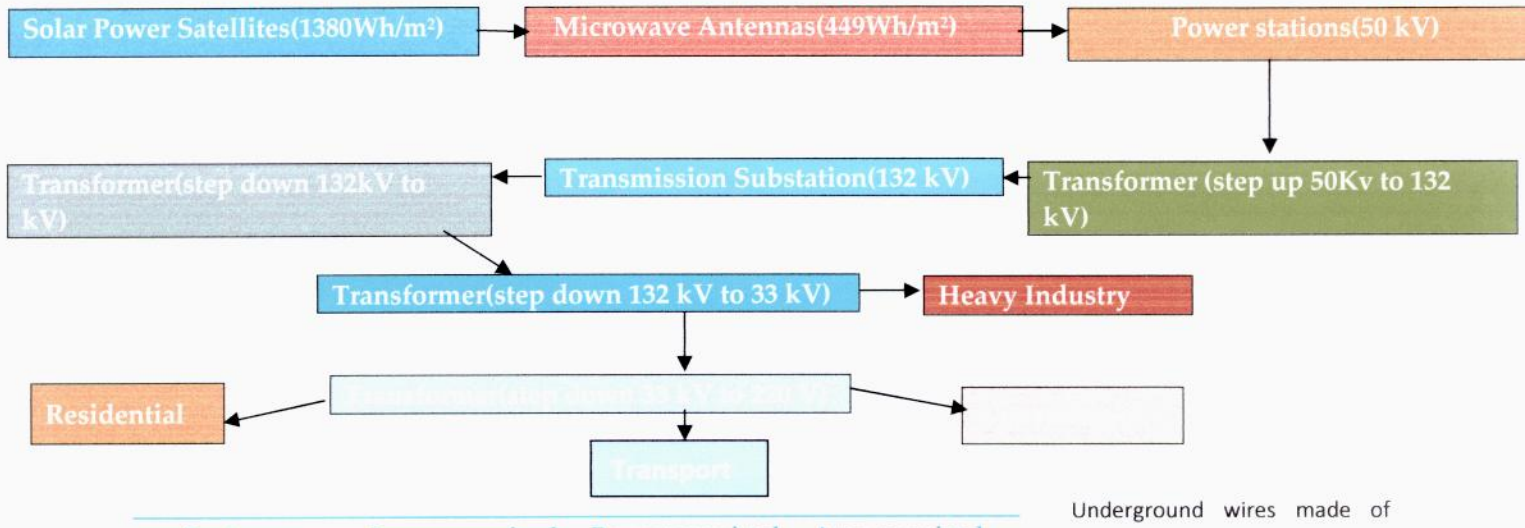
Material/Equipment and Purpose	Composition	Source	Transportation	Storage
Robots (For construction as specified in Automation)	-	Earth	Pico Jet/XP 2028	Used immediately
Oxygen and nitrogen (Atmosphere)	-	Earth	Pico Jet/XP 2028	Used immediately
Water (power generation)	In the form of ice	Moon	Solo-2000	Used immediately
Kevlar mesh	C, H_2, N	Moon	Solo-2000	Central Cylinder
Carbon Nanotube (Second layer of structure)	Carbon	Earth	Pico Jet/XP 2028	Central Cylinder
Super adobe (third layer of structure)	Regolith	Lunar Soil	Solo-2000	Central Cylinder
Aluminosilicate glass (fifth layer of structure)	Al, Si, O_2	Moon	Lunar shooters/ mass catchers	Central Cylinder
Nextel (Debris protection)	Al, O_2	Moon	Lunar shooters/Mass catchers	Central Cylinder
Lead glass (ceilings and windows)	Pb	Earth	Pico Jet/XP 2028	Alexandriat
Graphite fibers diffused with bromine (protection against EM radiation)	-	Earth	Pico Jet/XP 2028	Central cylinder
Silicon Nitride (fourth layer of structure)	Si, N	Earth	Pico Jet/XP 2028	Alexandriat
Aluminium Silicate (fifth layer	Al, Si	Earth	Pico Jet/XP 2028	Alexandriat

of structure)				
NASA High Strength Aluminium Alloy (MSFC398) (for the Main hull)	Al	Alexandriat	Solo-2000	Central Cylinder
Silica Rubber Adhesives (as an adhesive)	-	Earth	Pico Jet/XP 2028	Central Cylinder
Crushed Lunar Regolith (for outer-most shell)	-	Moon	Solo-2000	Central Cylinder
Silica Aero-gels (as an insulator)	-	Earth	Pico Jet/XP 2028	Alexandriat
Kevlar fibers (for the mesh)	-	Earth	Pico Jet/XP 2028	Alexandriat

3.2.1. Food Production:

Growing	Harvesting	Storing	Packing	Distribution
Aeroponics; Hydroponics	Robot	Vacuum storage and thermo-acoustic refrigeration technique	Vacuum packing	Underground capsules and delivery trucks dispatched at orders placed through a computer by customers; sold in malls

3.2.2. Power Generation: Solar power satellites (SPS) containing photovoltaic cells made of Gallium Arsenide will be used (30-35% efficient). These cells will directly convert sunlight into energy. This energy will be transmitted to antennas located in the central cylinder of the torus in the form of microwaves. The antennas will convert the microwaves into DC electricity providing a power of 449Wh/m^2. The power station will also be located in the central cylinder.



Sector	Power required per day/kWh	Power required per year/kWh	Area required of solar panels required/m^2
Domestic	9.3	3409	7592.5
Agriculture	8.3	3008	6700.3
Industry	52.1	19017	42355.0
Transport	20.5	7482.5	16664.9
Total power	90.2	32886.5	73311

Underground wires made of superconductors will be used to transfer electricity from the power stations to the residential, agricultural and industrial areas of the settlement. Superconductors will be used to allow minimum energy loss.

3.2.3: Internal and External Communication and Transport System:

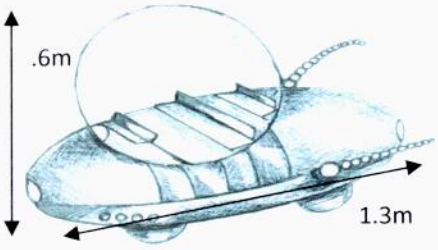


Figure 3.2.1: space Scooty

Figure 3.2.2: Luxury car

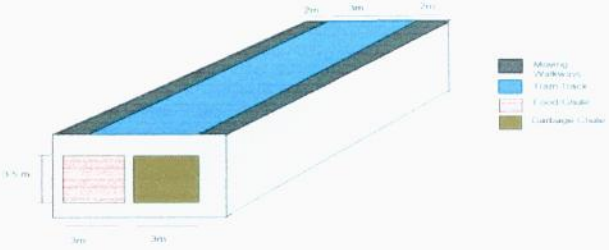


Figure 3.2.3

Within the colony	With the Earth	With the Moon & Alexandriat
• Electrical Elevators connected to the micro-gravity centre • Electrically powered Personal Rapid Transport travelling on tracks made of high conductivity materials to reduce power loss as shown in fig. 3.2.3 • Space Scooty (Fig. 3.2.4) • Underground Magnetic Capsule Pipeline system (Robot-Supernova and Nova) used to transport exports and other goods to and from port facilities. • BMX Biker MAX (provisions for shielding as illustrated in Fig 3.2.5 • Luxury electrical car will be available for tourists to rent and for families which can afford	• Space Shuttles (specified in 3.3)	• Mass Catcher: to receive raw material from the moon • Mass Launcher • Space Shuttle (specified in 3.3)
• Portable communication receiver with miniature virtual display, an optical system to produce and transmit virtual images and a microphone/speaker to receive and transmit audio. • WiMax-World Wide Interoperability for microwave access is a technology aimed at providing wireless data over long distances. • Use of fiber optics • Ultra High Frequency System	• Satellites (powered by solar power): 3 around earth at GEO, 3 around the moon, 2 at LEO and 1 at L4. Use of 2 types of antennas: Low-gain(Omni-directional) for close communication and High-gain(Unidirectional)for distant communication.	• Satellites (powered by solar power) using radio wave transmission using antennas specified earliar (in communication with the Earth)

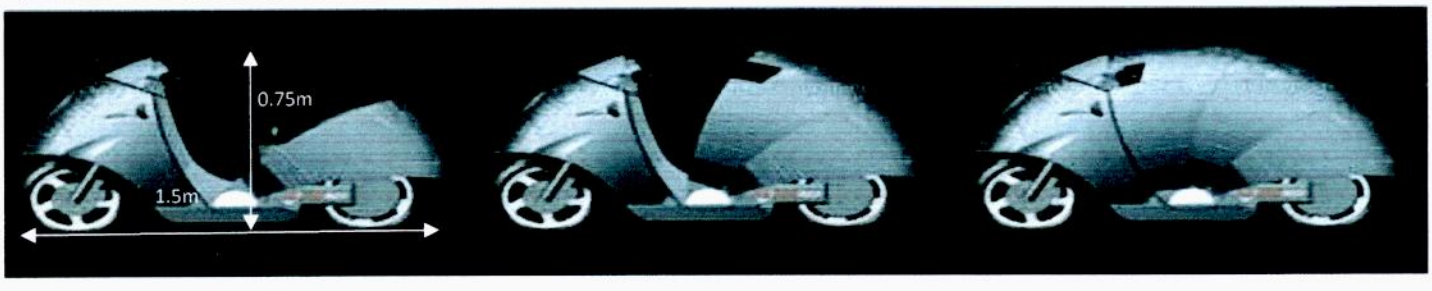
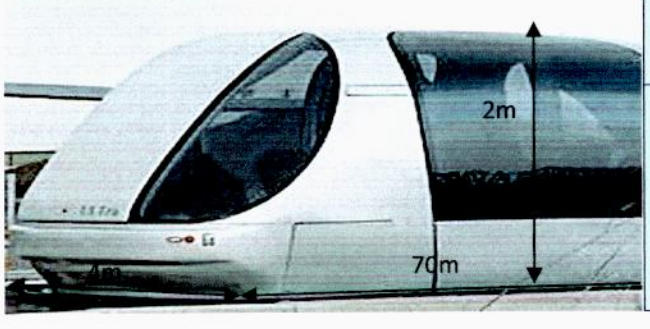


Fig 3.2.4 BMX biker



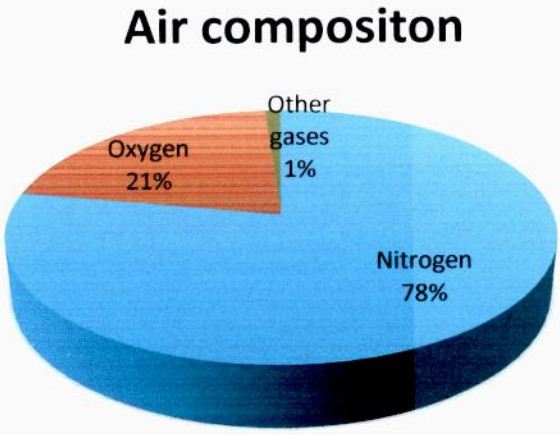
Number	Capacity	Duration of one complete journey	Number of Stops	Speed
2 (1 clockwise and 1 anticlockwise)	100 each	10 mins (including stops)	4 stops of 1 min each	30 km/h

3.2.4. Climate/Atmosphere Control:

Temperature (18-25°C): using condensing heat exchangers which employ extraction of extra heat and lowering of humidity

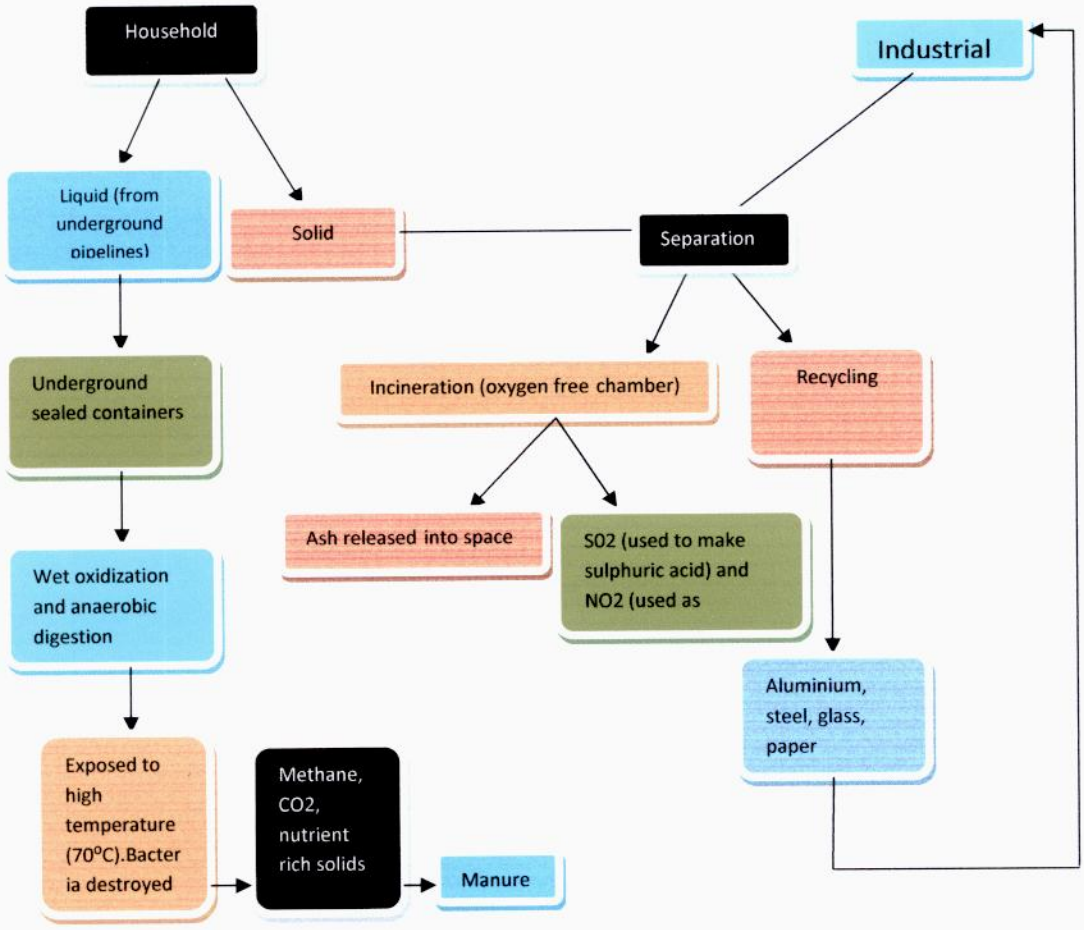
Humidity (40-60%): by cooling air below dew point, condensing and separating the moisture. The ceiling will be equipped with precipitation generators to provide occasional rain

Air pressure (101 kPa): Blowers will be used to generate wind blowing at speeds from 8-20km/h



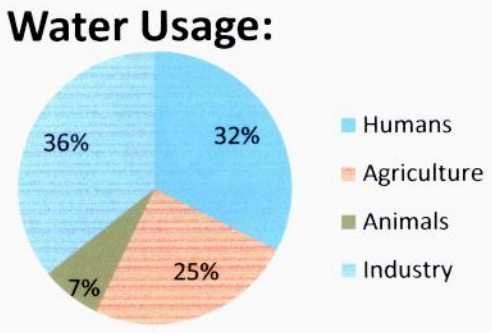
Substance	Initial Source	Regeneration
O_2	Oxygen Generating System (OGS); pressurized tanks from the Earth	Photosynthesis; OGS
N_2	Ammonia; Urea	Vapour Phase catalytic ammonia reduction
Rare Gases	Earth; Moon	Not required due to their inert nature.

3.2.5. Waste Management:



3.2.6. Water Management:

Water Usage: Daily a human being consumes 1.5-2 litres.



	Quantity(l/day /individual)	Total Amount(l/day)
Humans	30	570000
Industry	33.8	646000
Animal	6.6	125300
Agriculture	23.4	447500

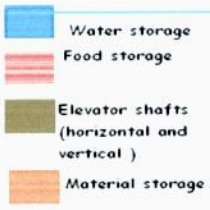
Fire Detection, Alarm and Emergency Services:

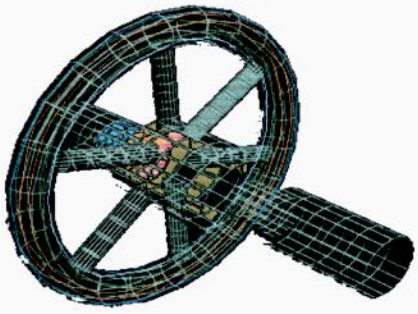
The VESDA (Very Early Smoke Detection Apparatus) Alarm system is used for fire detection. A hotline to the fire department has been installed and the fire extinguishing mechanism uses Dry Chemical (monoammonium phosphate) Extinguishers.

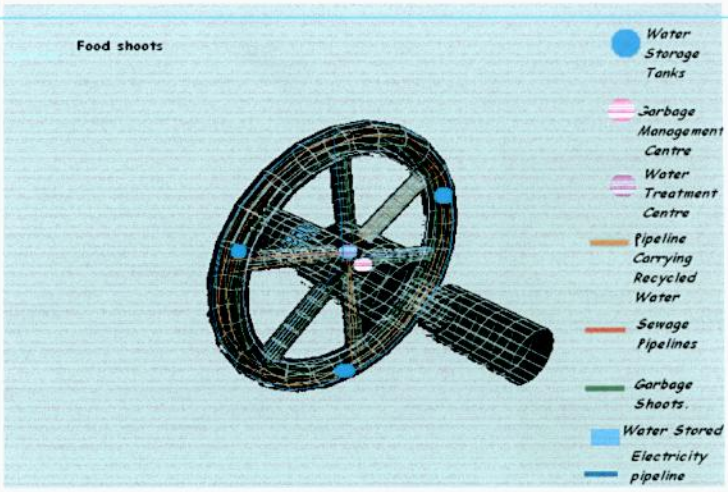
3.2.7 Water Production

Initially water would have to be extracted from the moon as ice which would then be melted by the solar energy and then purified. Water can later be produced by the Hydrogen fuel cell ($2H_2+O_2->2H_2O$) method. Recycling and use of excess humidity is also a feasible method. Hydrogen fuel cell is the most reliable method as it does not have any excess by products. Oxygen can be brought from the moon and hydrogen from the earth

Purification	Microbial check valve	Multifiltration process	Volatile removal apparatus	Ozone and iodine
Distribution	Underground pipelines to every house and industry	Superstores and malls	Excess storage in all tanks	-
Storage	Interconnected tanks with valves and pumps	-	-	-
Emergency	Lake for recreational purposes may also be used	-	-	-







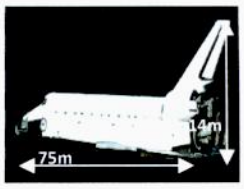
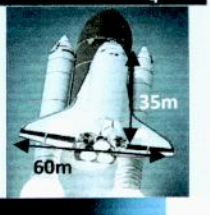
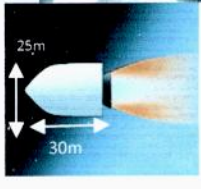
3.2.8. Day/Night Cycle:

Duration	Day	Night
14 Hours long day and 10 Hours long night	• Natural Light via windows for wide spectrum light • Mirrors continuously adjusted at different angles to provide illumination from dawn till dusk • Intensity of light controlled by smart glass • Artificial lightening in homes/work places/buildings	• Shutters • Smart Glass

3.3.1: Space Vehicles and Infrastructure:

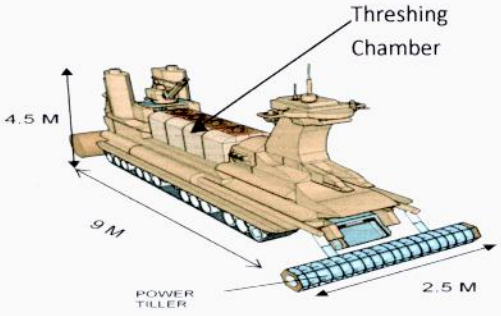
Space Infrastructure		
Name and Location	**Required No.**	**Purpose**
Alexandriat at L5	-	Commerce, banking and trading along with industries based on research, tourism and manufacturing.
Lunar Shooters on the Moon	6	Used to transfer lunar materials to MEO port.
Mass Catchers at L4	6	**Active** and **Passive** catchers installed to catch materials from lunar shooters
MEO Port at MEO (Medium Earth Orbit)	3	Base for vehicles (launch and orbit) to undock and start
Space Tugs at Bellevistat	2-3	To move satellites between orbits
Solar Power Satellites in the Low Earth Orbit (LEO)	6	To provide electricity from solar power

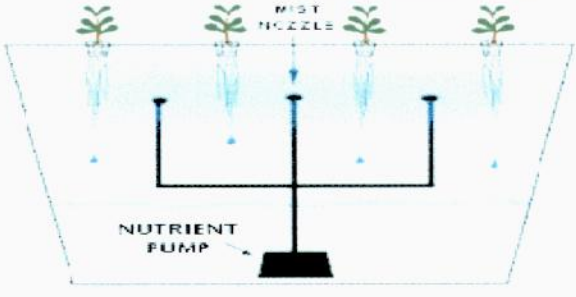
3.3.2: Space vehicles:

Name and Contract Status	Purpose	Fuel	Duration of flight	Fleet Size	Payload/ lbs	Flights per year	Illustration
Pico Jet (Included)	Transport cargo/passengers from Earth to MEO port	Hydrazine	3-4 days	12	150,000	10-12	
XP 2028 (Included)	Transport cargo from MEO port to Bellevistat	Liquid Hydrogen Oxidizer: Liquid Oxygen	Variable-around 4 days	6	350,000	15-20	
Orbit MAX (Included)	Transport Passengers from MEO port to Bellevistat	Ammonia	Variable-around 3-4 days	6	350,000	14-18	
Launch Xbox (To be contracted)	Transport of passengers from Earth to Bellevistat	Hydrazine	3 days	10	110,000	8-10	
Solo-2000 (Included)	Transport cargo between Bellevistat and Alexandriat/other locations e.g. moon	Water (hydro/steam propellant system)	28-30 days	5	450,000	As required	

3.4. Agriculture and Livestock:

Agriculture		
Method	Crops	Area Required (m^2)
Aeroponics (Fig. 3.4.1); Hydroponics	Lettuce,soybean,tomato,pea, artichoke, sparagus,squash, spinach,pepper,celery, cauliflower,broccoli,cabbage,eggplant	347,700
Soil (From moon)	Wheat,rice,maize,pulses,fruits Eucalyptus trees and rose bushes lining the roads and in recreation parks	5215500





Livestock			
Method	**Type**	**Facilities Required**	**Area Required (m^2)**
Micro cattle and cloning (somatic cell nuclear transfer technique)	Microcattle, chickens, tilapia, myotonic goats	• Shearing • Slaughter Houses • Disease Control Centers • Sanitization • Packing	• For growing feed and rearing- 173,850 • Facilities-115900

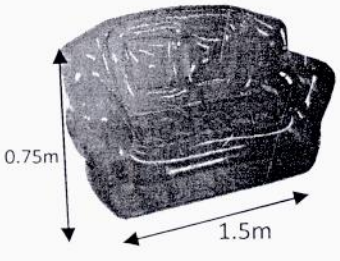
3.5 Innovative Designs and Facilities

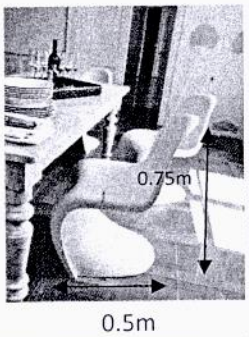
The trees on the settlement will not be used for industrial purposes and so the furniture will not be made out of wood.The following things will be made of fibreglass:

- Tables
- Chairs
- Crockery and cutlery
- Shower Cabinets
- Shelves and cupboards

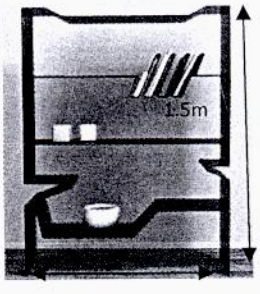
Materials	Product	Sources
Fiberglass(Si,O_2)	Tables, chairs, crockery, cutlery, cupboards etc	Moon
Polyethylene (thermoplastic)	Inflatable sofas and beds	Earth

Fiberglass is used because silicon and oxygen are easily available from the moon. Fiberglass is lightweight, highly resistant to impact and convenient to install and use. Inflatable sofas and beds made of plastic will be used which can be inflated using an automatic pump. They will save space as they can be deflated when they are not needed and stowed away.

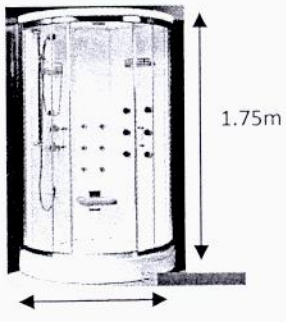




0.5m



1m



1.5m

3.6: Space Manufacturing and business opportunities:

Business Opportunity	Details
Manufacture of spacecrafts	Manufacturing facilities and assembly of spacecraft at Bellevistat will be situated in the central cylinder. Special warehouses will be constructed for storage of goods used for spacecraft manufacturing.
Production of innovative interior furnishings	Surplus will be exported to Alexandriat and Earth. The manufacturing unit will be close to the Docking ports for fast, easy and efficient transport.
Provide equipment for large scale space and Lunar construction.	Robots including supernova, Mar-Ed, FSM, SSNS-4 and many more can be transported to new settlements for construction purposes. Bellevistat will serve as a construction site for new settlements and lunar projects. Construction of smaller subunits will be carried out on Bellevistat which can then be transported to the assembly point-in space or on the moon- and assembled accordingly.

Manufacture and Launch of satellites	Launch of satellites for space exploration projects from Bellevistat will efficiently reduce the cost as compared to launching from the earth. Research centers in Bellevistat will ensure the manufacture of satellites which will introduce a new era of space exploration.

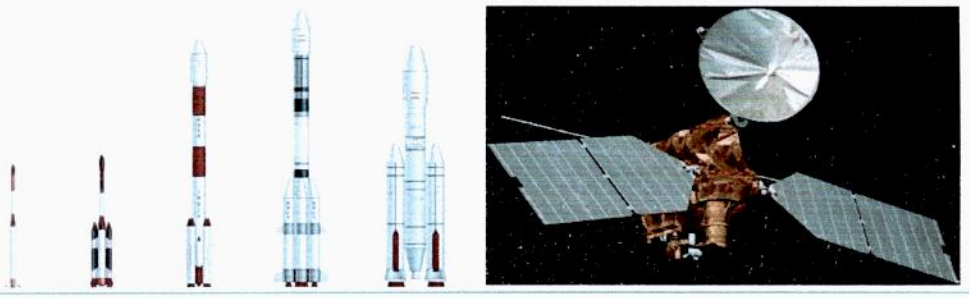
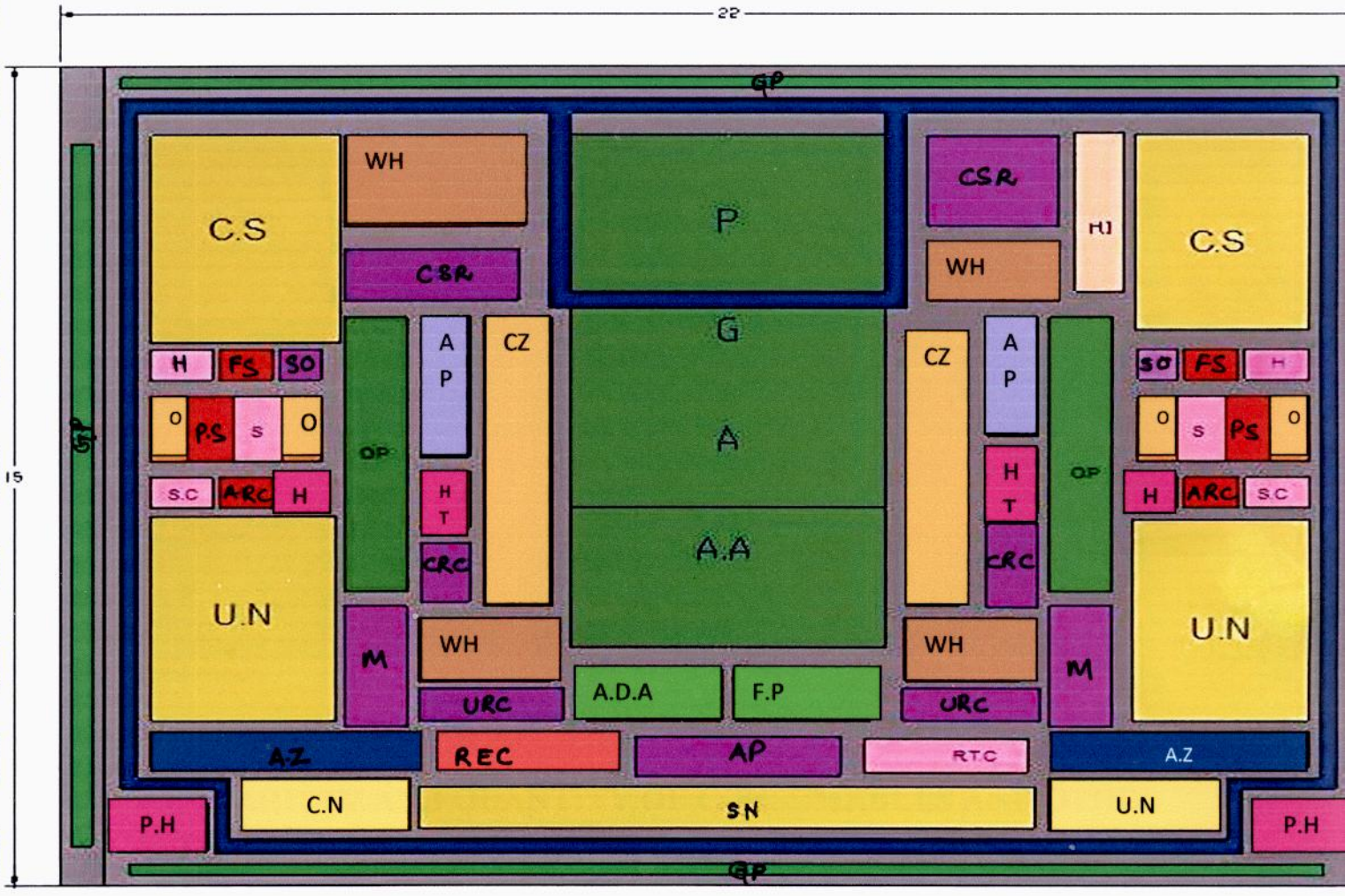


FIG 3.6: SOME EXAMPLES OF PRODUCTS TO BE MANUFACTURED ON BELLEVISTAT

HUMAN FACTORS

HUMAN FACTORS

4.1.1 Community Design and location of Amenities:



4.1.2 KEY FOR COMMUNITY DESIGN

REGION	SPECIFICATION	SYMBOLS	TOTAL AREA /cm2
Open area	Green Patch	G.P	17.6
	Health Centers	O.P	30
	Gyms, Spas, etc	O.P	1.5
Residential Area	Country side	C.S	84
	Urban neighborhood	U.N	84
	Space neighborhood	S.N	56
Community Services	Schools	S	1
	Hospitals	H	1
	Research and Training Center	R.T.C	2

Represents water bodies in the settlement

Service Industry	Assembly and Religious Centers	A.R.C	6
	Police stations	P.S	4
	Fire stations	F.S	3
	Repair and Emergency Center	R.E.C	2
Recreation and Entertainment	Urban Recreation Center	U.R.C	2
	Amusement Park	A.P	6
	Museum	M	4
	Commercial Recreation Center	C.R.C	1.6
	Countryside Recreation	C.S.R	4
	Space Observatory	S.O	2
Storage	Warehouse	W.H	24
Transportation	Roads and Pathways	R.P	29
Commercial sector	Offices	O	4
	Commercial Zones	C.Z	28
	Shopping Complex	S.C	3.2
Agricultural Sector	Plant growing Areas	P.G.A	212
	Animal Areas	A.A	24
	Food Processing	F.P	19.5
	Agricultural Drying Area	A.D.A	39
Tourism	Hotels	H	3.2
	Hotels	H	1.5
	Private Houses	P.H	12
Administrative Zone	-	A.Z	10
Miscellaneous Infrastructure	-	M.I	17
Total Area	-	T.A	738.2

The areas mentioned above and the design of the community is with respect to half of the torus. The other half will have a similar arrangement with minor changes. All areas have been calculated according to the requirements put forward by the NASA space study.

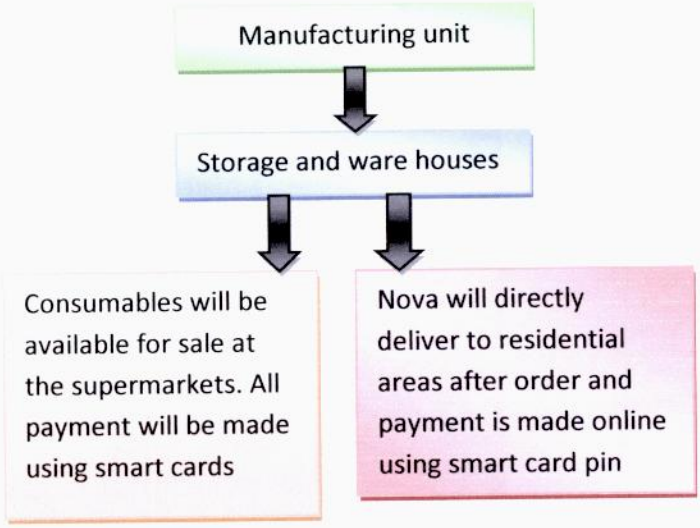
Distance scale: 1 cm2 = 3932 m2

4.1.3 VARIETY AND QUANTITY OF CONSUMABLES AND OTHER SUPPLIES

Consumables	Production/person/month
Water	3600 liters
Electricity	3000 KWh
Cloth	10 m
Toiletries	1 kg
Electrical appliances/equipment	5 units
Storage devices/units	4 GB
stationary	2 kg
Other Office equipment	1 kg
Medicine	200g

Average monthly Space settlement diet

Variety	Amountg/person	Cal's/kcal
Meat:		
Trout	1200	2340
Rabbit	1200	1920
Beef	1200	4260
Chicken	1200	1470
Produce		
Eggs	720	1170
Milk	15000	9900
Dry plant produce:		



Wheat	5400	18240
Rice	3000	10890
Sugar	3000	11550
Vegetables and fruit:		
Carrots	3000	1260
Lettuce	3000	420
Peas	4500	3780
Apple	3000	1680
Potato	3000	2280
Tomato	3000	660
Orange	3000	1530
Totals	54420	73340

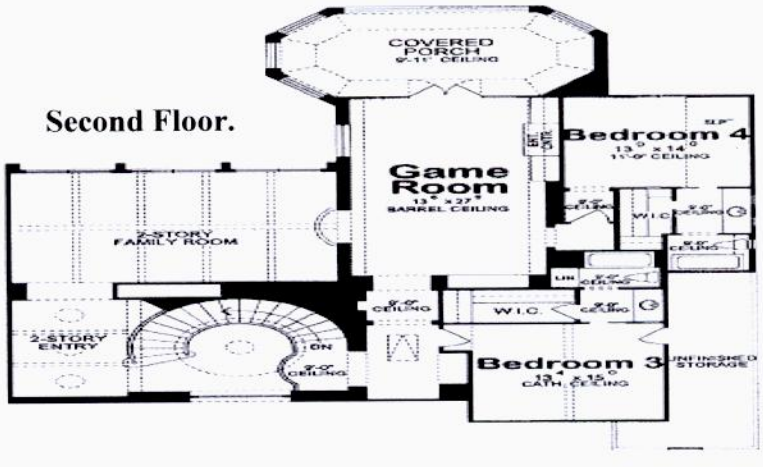
Figure: Distribution of consumables

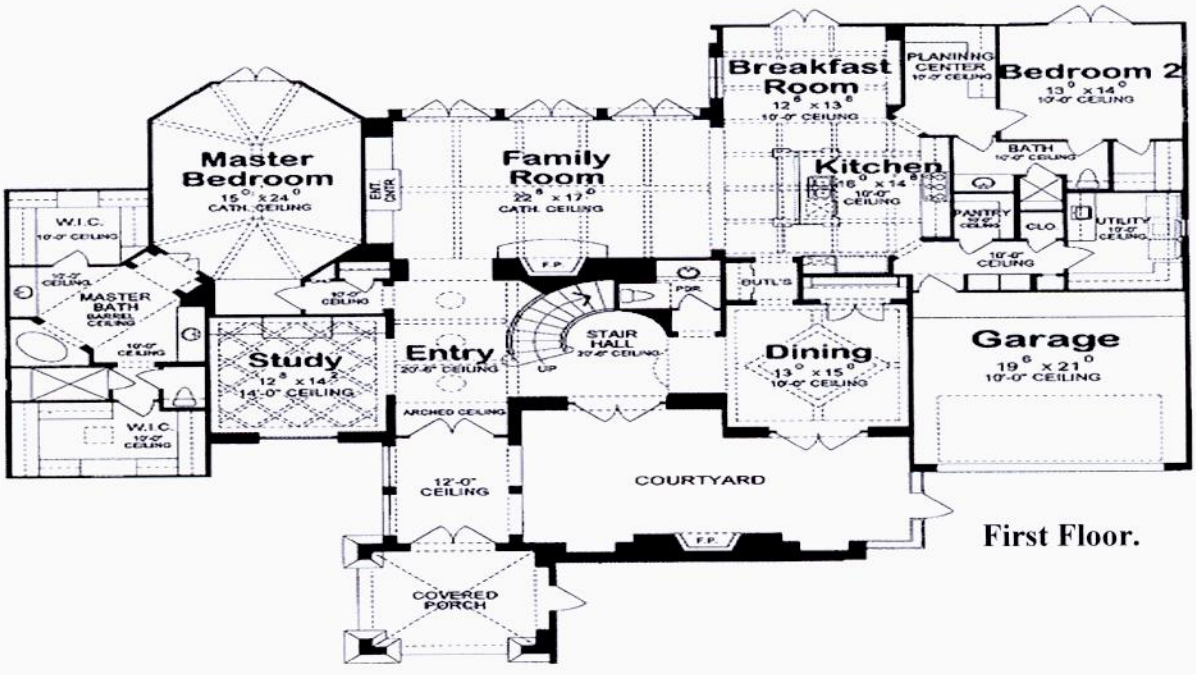
Smart cards will be used for all forms of payment online or otherwise. The residents will earn and spend points, the record of which will be stored in the card. Consequently a record of all the transactions made can be kept.

4.1.4 PSYCHOLOGICAL FACTORS

Psychological Problems	Steps taken
Adjustment to new atmosphere	Artificial gravity, seasons provided, psychologists, medicos
Claustrophobia and Solipsism syndrome	Yoga classes, gyms, peaceful environment
Monotonous lifestyle	Community clubs, spas, zero-gravity games, camping, 3 different types of neighborhood designs
Home (Earth) sickness	Mimic of day/night cycle, climate change

4.2.1: External Drawing and interior floor plan of a family country house:





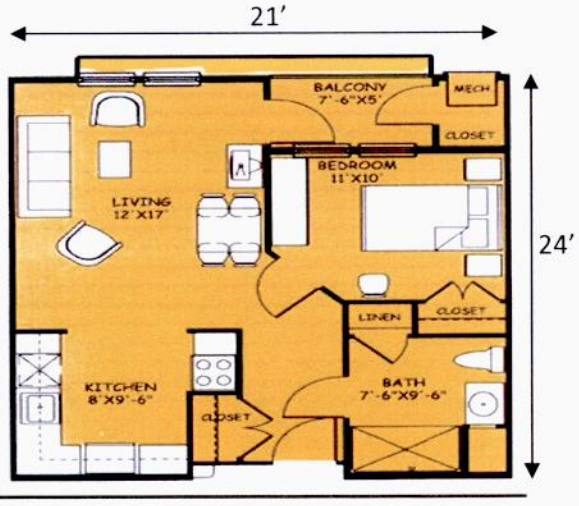
First Floor.

Area of the house: 292m²

Maximum Number of people that can be accommodated: 6 persons.

Number of these houses: 16

4.2.1: External drawing and Interior floor plan of modern apartments for singles:



Area of an apartment: 47m²

Number of persons per apartment: 1

Number of apartments: 5000

4.3.1: DESIGNS OF SYSTEMS, DEVICES, AND VEHICES FOR USE BY HUMANS

Systems, Devices, and vehicles for enhancing Productivity

Acebot to help with office work (refer to 5.3.2)
Saber to help with household chores (refer to 5.3.3)
Cleanso for community cleaning (FIG 4.3.1)
Robomed to deal with medical Emergencies (refer to 5.3.1)
Transport robots: Olympic, Urbie, and Famtron (refer to 5.3.1)
Nova for delivery of goods (refer to 5.3.1)
Wi-Max technology to provide internet to all users (refer to 5.3.6)

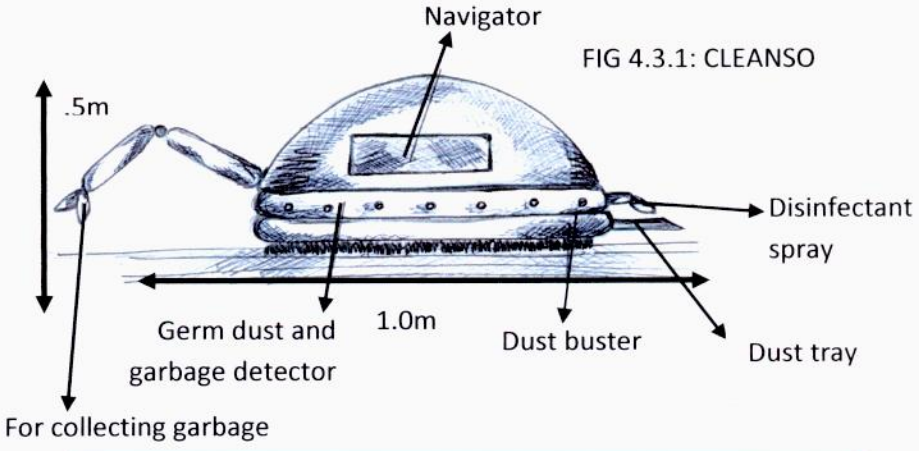
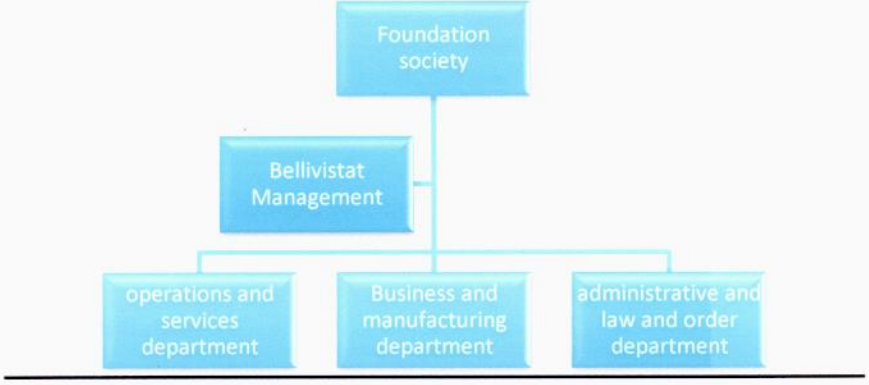
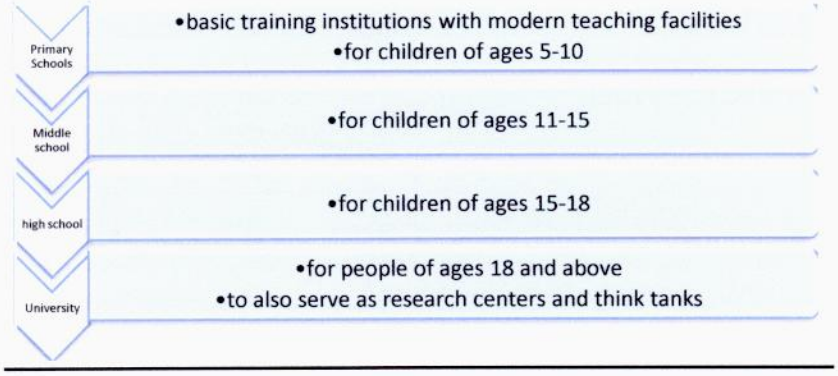


FIG 4.3.1: CLEANSO

4.3.2: Government and Management:



4.3.3: Educational System:



4.3.4: MEANS FOR SAFE MOVEMENT IN LOW GRAVITY:

Safety in low-g areas

- **Safety belts**
- **Padded walls**
- **Emergency exits**

Workers can move around the low g area with the help of a moving rail on the inner surface of the central cylinder, which would allow them to attach and detach themselves at their own will.

4.3.5 SPACE SUIT DESIGN FOR WORK OUTSIDE PRESSURIZED SETTLEMENT VOLUMES

Aerial

Double walled vacuum separated helmet

Air pipeline

Roomy armhole

Strap supports to each back pack (air and temperature conditioning unit, radio etc)

Controls for back pack

Self heating easy to wear boots with insulating sole and flexible spiked-metal under sole

Movement in low-g areas

Handholds to facilitate movement

Tethers to facilitate movement

Magnetic boots to keep people bound to surface

Man maneuvering units with safety precautions

FIG 4.3.1:LAMBOT

Key features of space suit:

Maintenance of pressure, temperature, gas composition for comfort of the user
Protection from micrometeoroids and radiation
Enables communication with ground controllers and other astronauts
Not bulky at all. Easy to don and doff. Unbreakable, lightweight helmet.
Inside layer: light weight nylon with fabric vents. 5 layers of aluminized Mylar interwoven with 4 layers of Dacron for heat protection.A layer of Teflon-coated cloth for protection from scrapes

4.3.6: MAJOR CATEGORIES OF WORK IN AND AROUND THE SETTLEMENT:

MAJOR CATEGORIES OF WORK IN AND AROUND THE SETTLEMENT	TOOLS NEEDED TO DO THESE TASKS
Transportation	Olympic train, The Famtron for families and The Urbie for kids (ref 5.3.1)
Communication	Antennae's, Radar system, virtual screens that enable contact of individuals with robots
Warehousing and Delivery	Novas which are Delivery robots, security cameras, conveyor belt, counters, computers, consumable detection and ordering system
Finance and Business	Computers

Health and Services	Robomed which is a medical robot, disease examination system, nano devices, surgical equipment. Facility for remote surgery
Engineering and Robotic Services	Scientific and communication equipment, Material stock, Computers, Laptops, Robotic parts and torch helmets, KX-1 for interior finishing and Zulubot for floor installation
Education and Research	Acebots, lab equipment, sports equipment and e-books
Settlement Maintenance and Security Services	Cleanso for community cleaning, Inspiron for public safety, Saber for house maintenance, lambot for maintenance of gardens.
Other Government Services	Inspiron, encyclopedia, computers, e-books, communication system

4.4.1: Differentiated Neighborhoods:

COUNTRY NEIGHBOURHOOD

Fig 4.4.1: Country side house

Fig 4.4.2: Lake House

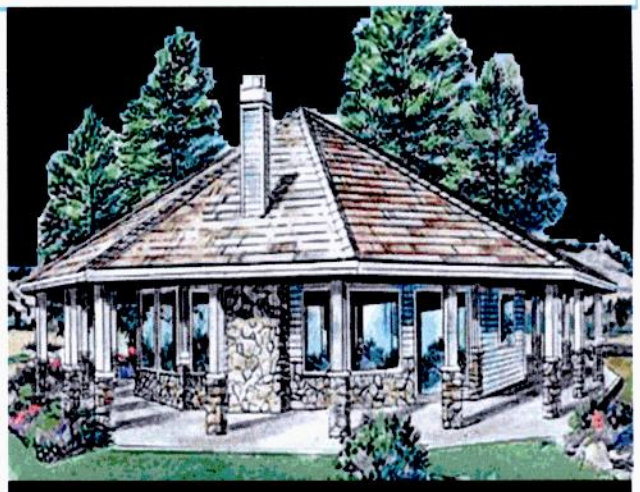


FIG 4.4.3: URBAN NEIGHBOURHOOD (FAMILY HOUSE)

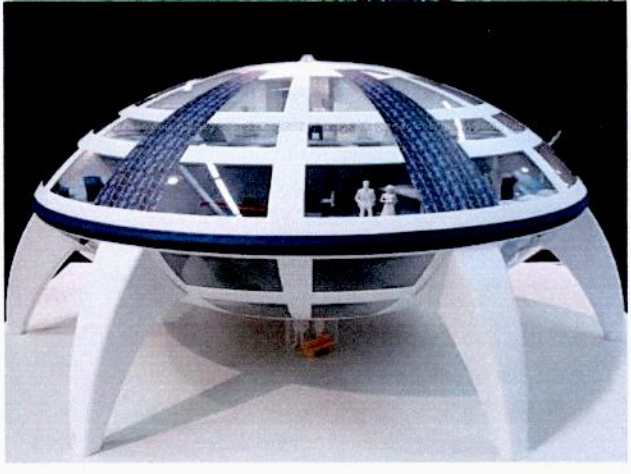


FIG 4.4.4: SPACE NEIGHBOURHOOD

Variety of neighborhoods	Sizes of different neighborhoods/ m2	Description
Country side	372 400	Include country houses (both for families and for singles) located near the open space and agricultural sector and lake houses overlooking a stream.
Space colony	186 200	Located near the space observatory so residents will have a wide view of the space. Residents only in this colony will have the luxury to use the most sophisticated robot called the 'Saber' who will perform almost every task.
Urban residential area	372 400	Modern houses located near the commercial area for people who want a typical earthly lifestyle but with a little more style. Apartments for single men and women
Total residential area	931 000	

4.5: RECREATION AND ENTERTAINMENT AVALIABLE

FIG 4.5.1: SPA

Variety of activities for residents	Promote physical fitness		Promote mental stimulation		Description
	Enterta inment	Recre ation	Enterta inment	Recreat ion	
Camping area					Area in the forest especially reserved for camping.
Zero gravity games					Games using man maneuvering unit.
Gym					Include all sorts of machines from weight reducing to body building equipment.
Shopping centers					All sorts of consumables available.

Virtual games	A section in the shopping centers dedicated to this.
Yoga centers	Customers of all ages will get professional guidance.
Beauty saloons	From haircuts to makeup done by the very best.
Fishing	Boats, fishing nets, ice boxes can be rented for fishing at the lake.
Trips outside settlement	Small trips outside settlement accompanied by professionals
Parks	Colorful manual exercising units placed in parks for everyone's use.
Spa	All kinds of beauty treatment available from massages to face masks.
Amusement parks	Rides and state of the art entertainment facilities available. Perfect for a day out with family and friends.
Museums	Precious artifacts and space objects available for viewing by both residents and tourists.

FIG 4.5.2: AMUSEMENT PARK

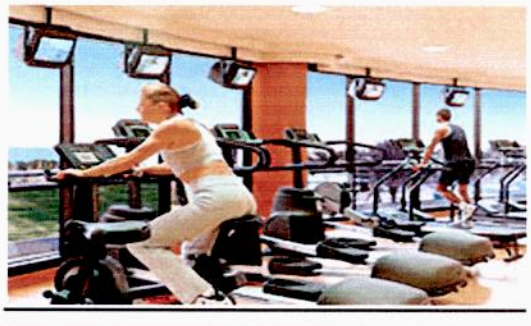


FIG 4.5.3: GYM AND YOGA CENTER

4.6: TOURISM INDUSTRY IN BELLIVISTAT:

Places Specifically Designated to Tourism	Description/Factors Providing Attraction to Tourists

Hotels	• Locations of Hotels (meant for tourist accommodation) have been shown in 4.1.0. • Hotels are located inside the Residential Sector (Urban and Countryside), for Tourists who wish to spend a longer period of time on the settlement . e.g : Visit their relatives etc. (as the houses have just enough space to accommodate the permanent residents.) • Hotels are located at equal distances between the commercial zone and Open space Belt , This is for Tourists who are more "Holiday Oriented"*The features of the open belt and commercial sector are listed below . • Hotels are also located near the "Space Neighborhood" and the "Space observatory" for tourists who wish to totally get the Space Effect .
Space Observatory. (For tourists on the settlement for Educational as well as Recreational Trips.)	• It will constitute of a Planetarium, which provides different presentations on space. • It will have space observation Panels, with telescopes and other observation instruments can provide you with an actual view of the scenario outside the settlement. • For tourists who are on the settlement for an educational trip, the observatory would provide documentaries "About the Settlement." As well as the recent updates and Discoveries.
Green Patch and Lake Sides.	• Greenery always adds to the scenic beauty which is one the key elements for a tourist to visit. • Lakes have been provided around 6 different points around the Settlement, 4 of which are located near the Green Patches so that Activities such as Camping and Fishing are possible.
Open Space	• This area is provided with facilities such as "Health Clubs, Gyms and Spas." • This is a great attraction for the tourists as they aren't really accustomed to the Space Environment, and might need regular medical Check-ups or "Relaxation Therapies."
Recreation and Entertainment centers.	• *refer to the recreation and entertainment center for their various features, providing attraction to the tourists. • The Recreation and Entertainment Centers are situated near the Hotels so that they are easily accessible to the tourists. • They are also near the Commercial Zones for entertainment with shopping. • Some area in the zero- g region will be reserved for games and entertainment. Games like zero-g football and dodge ball will be introduced.
Museums	• A great attraction to the tourists on Educational Trips.
Trip to the mining location	• Guided Tours to the mining location on the asteroid will be arranged. For this purpose a transportation corridor is reserved for passengers. Space suit will be available with other security arrangements.

FIG 4.6.1: MUSEUMS

FIG 4.6.2: CAMPING

FIG 4.6.3: LAKESIDE

AUTOMATION DESIGN AND SERVICES

Automation Design and Services

5.0.1: Types of Computer

Figure 1: PDA

Figure 2: Mini Computer

Types of Computers	Uses	Memory (RAM)	Storage Capacity	Quantity
Potex PDA	Using internet facilities, watching television, video calling etc. Will give mobility to the users, as they will be able to stay connected wherever they are.	1 GB	80 GB	15,000
Multi-core computers	Used in houses to access the internet, playing games, keeping records, watching movies etc.	8 GB	2 TB	6500
Mini computers	For use as servers in the offices	16 GB	4 TB	300
Multi-core computers	For use as workstations in offices	4 GB	1 TB	5000
Super computer	For monitoring orbital paths and trajectory, informs the control centre in case of emergencies, and will help in planning extraction of useful resources from the asteroids passing the space station.	1 TB	100 TB	2

5.0.2: Types of Servers

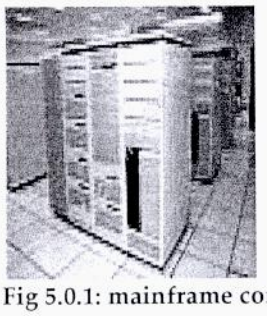


Fig 5.0.1: mainframe computers

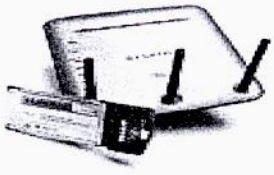


Fig 5.0.2: consumer industry server

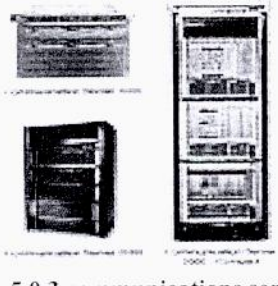


Fig5.0.3 communications server

Types of Servers	Processing Speed	Memory(RAM)	Storage Capacity	Quantity
Main Server (Main Frame)	5 GHz	25 TB	5 PB	2
Sub Server	4 GHz	5 TB	1 PB	2
Communication server	5 GHz	20 TB	4PB	2
Industrial servers	variable	variable	variable	4
Consumer Industrial servers	variable	variable	variable	5

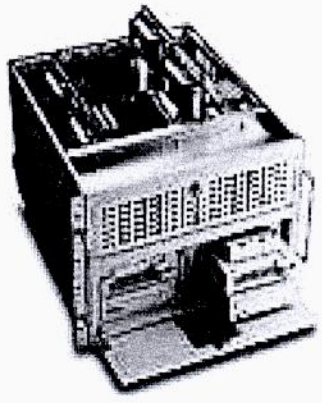


Fig 5.0.4: industrial server

5.0.3 Types of Software

Name of the Software	Purpose
Ming	Monitors drilling and extraction of mining materials
Industro	Monitors automated machines involved in tasks such as manufacturing and packaging
COM	For data collection, data processing and sales transaction
WOK	For creating reports, spreadsheet and performing different official tasks
Zii-Ex	For web-browsing and playing games
NCS	Network Communication System
Antri	Protection from virus
Controsoft	Monitors air pressure, temperature and moisture level
Robo Customized Software	Control robot functional programs. Every robot has its own specific customized software.

Fig 5.0.5: Wi-Max

5.0.4 Types of Network devices

Types of Network/Device	Specification	Purpose
Fibre Channel	Bandwidth 10 Gbps	It is a faster and more flexible way of transmitting data between computer Devices.
Bellest Router	Data transfer rate 200 Mbps, Frequency band 3.3 GHz	It is used to direct the data packets to the required destination.
Wi-Max	Bandwidth 50 Mbps per Channel	Provides wireless broadband access for the entire space settlement.

Fig 5.0.6 router

Fig 5.0.7 WiMax-wireless internets

5.0.4: Types of storage devices:

3D optical data storage technology is used for storing data. This storage Media is called tapestry Media. The data is stored in a holographic format. It has a data transfer rate of 200Mbps and a storage capacity of almost 2 Tb.

5.0.6: Data collection:

Data is collected from the Expert systems working at various places like Hospitals, industries and mining sites. Various sensors like Infra Red, pressure and humidity sensors installed in the robots will also collect data in critical circumstances.

5.0.7 Data Distribution

Special routers designed for Bellevistat called Bellest routers will make sure that the collected data reaches its destination without any interruption. These routers will be installed with all the servers located at particular places.

5.0.8 User Access to computer Network

The user can access the Wi-Max technology that will provide them with all the internet facilities through their Potex PDAs. There will be a line of sight communication with the microwaves signals being sent from one tower to another. This is to ensure that the users do not develop any health disorders due to the exposure of the harmful waves especially the radio waves which can spread over a wide area due to their lower frequency.

5.1.1: Automation for Construction

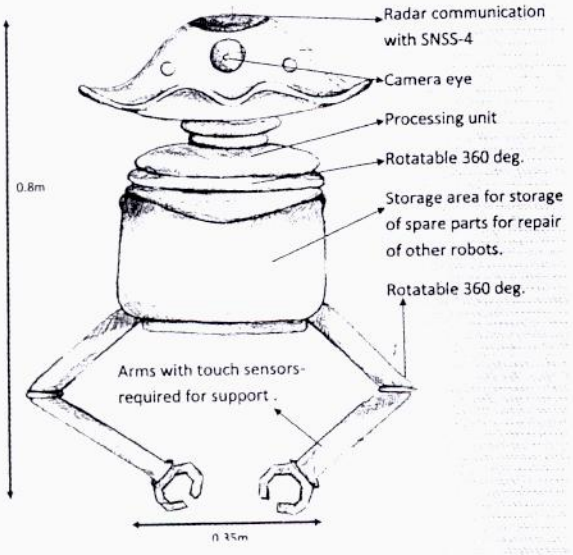


FIG 5.1.1: FSM-2

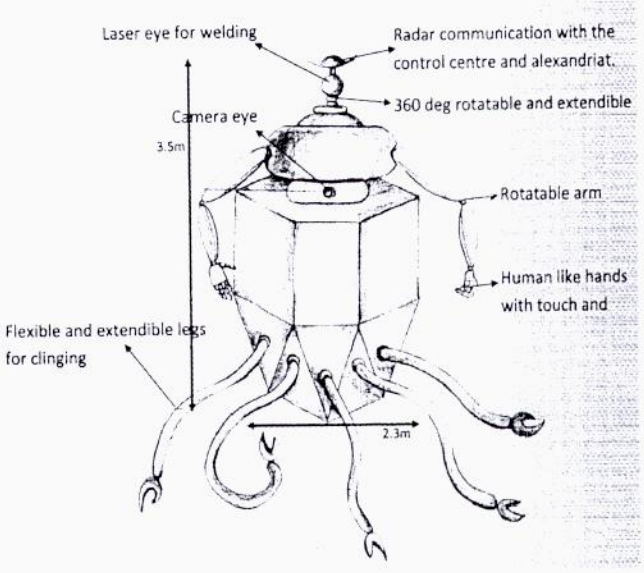


FIG 5.1.2: SNSS-4

FIG 5.1.3: DELIVERY CAPSULE

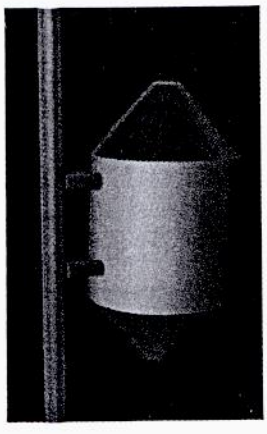
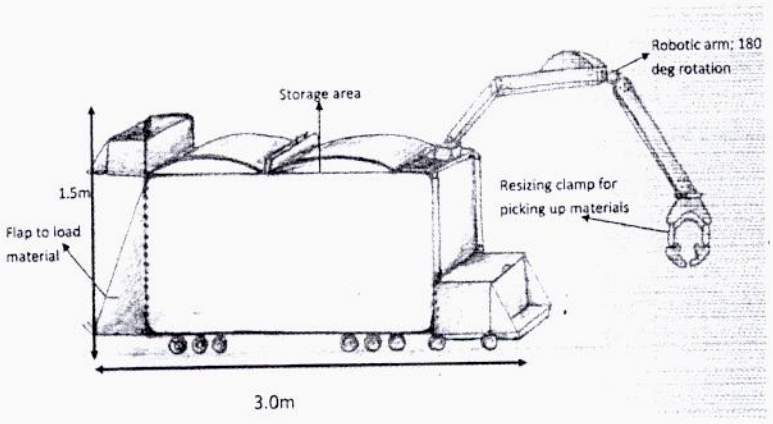


FIG 5.1.4: SUPERNOVA



NAME OF ROBOT	FUNCTION AND PROPERTIES
Delivery Capsule	• Two parallel delivery capsules (5 meters in length) travel through transportation tunnel inside the central cylinder carrying all the excavated and raw material and equipments from the asteroid excavation site to the refinery and research centre.
Super Nova	• It is used for transporting materials and equipments within the torus and the spokes. • It has four wheels with safe-move sensors to avoid hindrances. • The Robotic arm has resizable clamps to pick up equipments. • Its rear end has a flap which opens downwards to load the material inside the storage area. • Its software contains the whole map of the settlement so it is programmed to move from one place to another without human controllers. • After construction of the settlement it will be converted to Nova.
SNSS-4	• It has 4 legs which can wrap themselves around the basic components and then its 2 arms can bring two components or modulus together to be joined. Its main purpose is to bring together and weld different parts of the settlement. • The laser uses the electron beam welding method which can be used conveniently in vacuum. • This method uses the kinetic energy of high velocity electrons and converts it into heat energy upon impact to melt the materials and weld them together strongly. The diameter of the beam can be varied to adjust the penetrating power of the beam. • It has camera eyes that can form a 3D image of the part that it has to weld together.
FSM-2	• It has a strong processing unit designed to carry out mathematical and geometrical operations • It can form a 3D pictures of the parts being joined together and send the data to SNSS-4 which can carry out the instructions • Carries spare parts for repair of other construction robots.
Razor	• Installs glass and other important components of the settlement
Mar-Ed	• It is used for the construction of roads and pavements. • The cylindrical rear wheels have an in-built heating system that melts the mixture so that it sticks and forms uniform road. • The base has sensors that are responsible for laying down an even layer of the construction mixture and it is levelled out by the rear cylindrical wheel • It is powered by solar panels. • It constructs a 100 meter long road in 30 minutes.
Voltaire	• It is a contour crafting technique which uses super adobe and lunar soil for constructing various shapes and sizes of houses. • The grinded, quick-setting, concrete-like paste enters the Contour-Crafting nozzle through pipes. This nozzle moulds the materials into shape. • Specially programmed gantry system carrying the nozzles moves on two parallel lanes installed at the construction site. • These nozzles move to and fro laying down a layer of the construction mixture each time. • In this way the whole building is constructed in less than a single day without human intervention.
Constuctobot	• For the construction of buildings inside the settlement. • Will be used along with Voltaire to increase efficiency and decrease settlement construction time.
KX-1	• It is used for interior finishing. • Efficiently carries out tasks such as lighting, wiring and plumbing.(refer to 5.4)

Zulu-Bot	• **It is used for floor installation (refer to 5.4).**

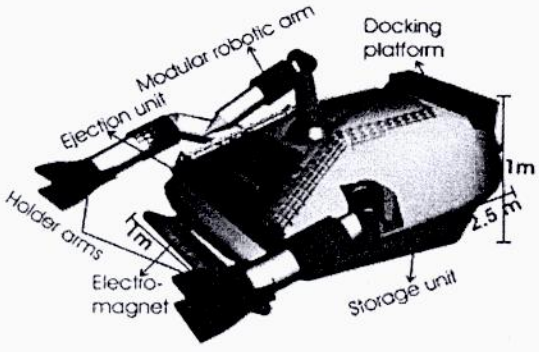


FIG 5.1.5: RAZOR

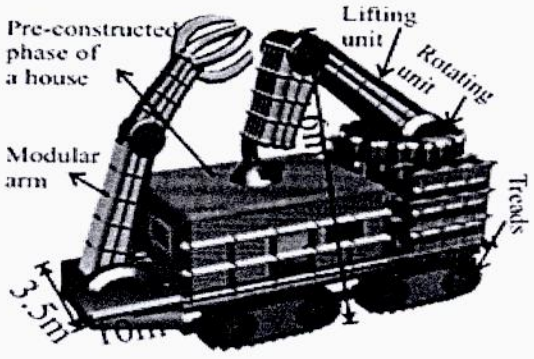


FIG 5.1.6: CONSTRUCTO

5.1.2: Construction of the settlement:

Once the settlement's basic structure has been laid. Mar-Ed constructs the roads and pavements while Voltaire build and constructo build the houses which are completed by KX-1and Zulu-Bot.

5.1.3: Transportation of material and equipments:

Delivery Capsule brings materials from the asteroid or the docks to the central cylinder while Super Nova transports them from the spokes to the required area in the torus. Super Nova also transports equipments anywhere within the torus.

5.1.4: Assembly of the settlement

SNSS-4 and FSM-2 are designed to assemble the different parts of the settlements structure. They have been constructed using Aluminum Oxide, which in turn is covered by a layer of Polyethylene. Aluminum Oxide has been used because of its hardness and strength and a relatively lower density. Also because of it's relative inertness at higher temperatures and its high melting point. To give it added strength a little percentage of magnesium oxide has been mixed with it. The layer of Polyethylene protects the robots from cosmic rays produced during the solar flare activities. It stops the rays from penetrating inside the robots and it is chemically inert.

Since there are a large number of SNSS-4 and FSM-2s they work together as a multi robot system which has self diagnosing and self repairing facilities. If a fellow robot malfunctions they can repair it without human intervention as they carry extra modular components for each robot.

5.2.1: Safety, Maintenance and Privacy of Data:

All data sent via Fibre Channels and Wi-Max will be encrypted to provide privacy. This involves the sender having the public key to encrypt the message and only the receiver having the private key to decrypt the message. This method is called the public private key technology.
For safety purposes firewalls are installed in the computers. This involves Proxies which stop the packets of data at the firewall and inspects them before they pass to the other side. This also protects the computers against viruses.

Fibre optics prevents the tapping of Data by unauthorized personnel.

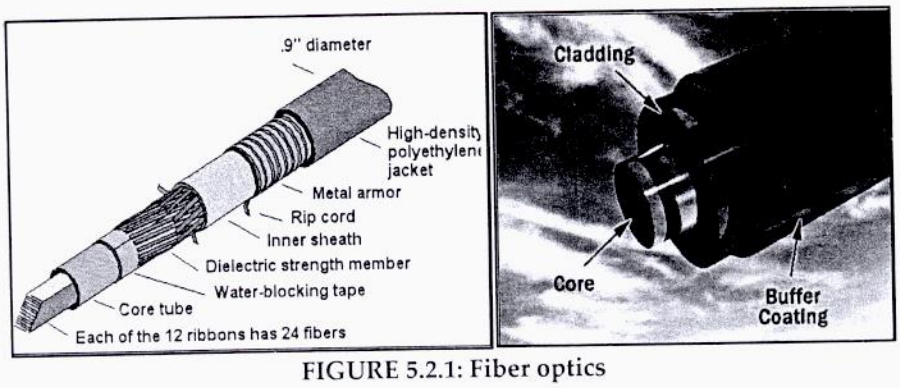


FIGURE 5.2.1: Fiber optics

5.2.2 Backup Systems

The major servers that include Main server, Sub server, Communication Server and the super computer have a backup. This starts working within 30 seconds of the server failure.

Type of Contingency	Solutions	Time Taken
Major Power Failure	I) Backup system will start working II) Robot will be sent for fixing the situation	• < 30 sec • < 1 min Repairing time varies
Fire	I) Fire sensors will inform the control centre II) place will be evacuated III) back up will start if a server is damaged Fire extinguishers will be used and the Intelligent robot will handle the situation	IV) < 10 sec V) <3 min VI) < 30 sec VII) variable
Space threats like asteroids and/or meteoroids approaching Bellevistat	I) Super computer will inform about the threat beforehand II) Protection shields will be activated III) People will be moved to the central cylinder	IV) < 1 min V) < 10 min
Main server/ Sub server/ Communication server Failure	I) Back up System(s) will takeover	II) < 30 sec
Air Contamination	• The place will be evacuated • Nanobots will be sent to clean the air	I) < 2 min II) < 1 min
Gas leakage	I) The place will be evacuated II) Robogas will be sent to fix the situation	III) < 2min IV) < 2 min Repairing time is variable
Medical Emergency	• Robomed will be sent to handle the situation	• < 2 min

5.2.3 Physical Locations of Computers and Servers for critical functions

Computer/Servers	Physical Locations
Main Server	In the control centre located at the central cylinder
Sub Server	In the residential area located in the torus
Industrial Server	In the Industrial area located at the central cylinder
Agriculture Server	In the Agriculture area located in the torus
Super Computer	In the control centre located at the central cylinder

5.2.4: Robots required for emergency external repairs

Names	Purpose
Externo	For repairing and cleaning the exterior
Glider	For repairing and maintaining the sewage system
Robogas	For detecting and repairing gas leakage
Intelligent	Detects fire and informs the population
Nanobot	Cleans the dust particles from air

5.2.5: Means for Security, Privacy and authorized access to Data

Authorised Access:
Authorized personnel will have to verify their identification by a heart beat scan followed by an index finger scan. The scanning processors will have predefined data about various users and if that Data matches with the Data stored for an authorized personnel he/she is given access to the critical data stored in the computer/server. Authorized personnel will be required to enter passwords if they want to access critical data.

Even after the verification the personnel is given access to particular data. If he/she tries to make an illegal move the whole system would shutdown automatically after saving the recent changes.

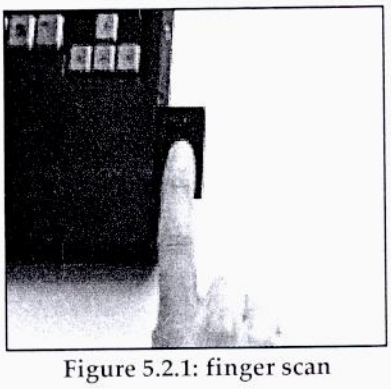


Figure 5.2.1: finger scan

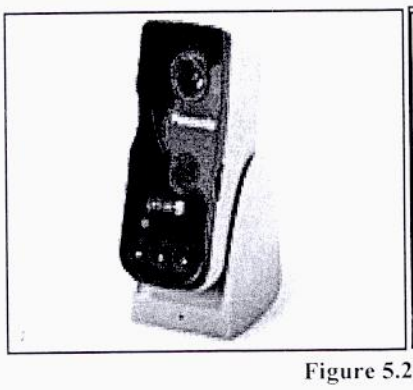


Figure 5.2.2: Retina scan

SECURITY:

There will be a special code to lock the computer when the authorized personnel are not around. Infra red rays or laser beams will be used to cover a radius of 1 meter around the computers/servers. These will be switched off once the code is entered and the person provides his/her finger scan or retina scan which should match one of the predefined scans. If someone steps in without switching it off alarms will be activated that will alert the robots.

Privacy of Data:

The data encryption method ensures the privacy of all sorts of data.
Personal data such as the data of patients in a hospital, or of the account holders in a bank or the data held by an insurance company will be accessed after a positive result in a retina scan.

5.3.1Automation System to Enhance Livability in the Community:

In Bellevistat, luxury is deemed important. For comfortable living of the inhabitants and to provide a pleasant ambience, automated services are provided throughout the settlements, which are discussed below:
Vista houses fully automated and have the following features:

Features	Description
Self-healing walls and doors	Made up of microcapsules containing a liquid monomer. Should the wall rupture indicating some cracks, the monomer will fill the space and will polymerize, in the presence of the catalyst Grubb
Doors	Laser sensors detect human presence and it opens and closes after verification.
Kitchen	Voice automated to help in various cooking tasks. Fire detectors and suppression systems.
Bathrooms	Air fresheners and pathogen detectors to ensure clean air.
Bedrooms, Dining area, lobby	Sensors to control temperature, humidity, and deodorizers that freshen the air.
Garden	For vista country houses. Automated water sprinklers, which waters gardens when needed.

Other robots to enhance livability include the following:

FIG 5.3.1: MEDBOT

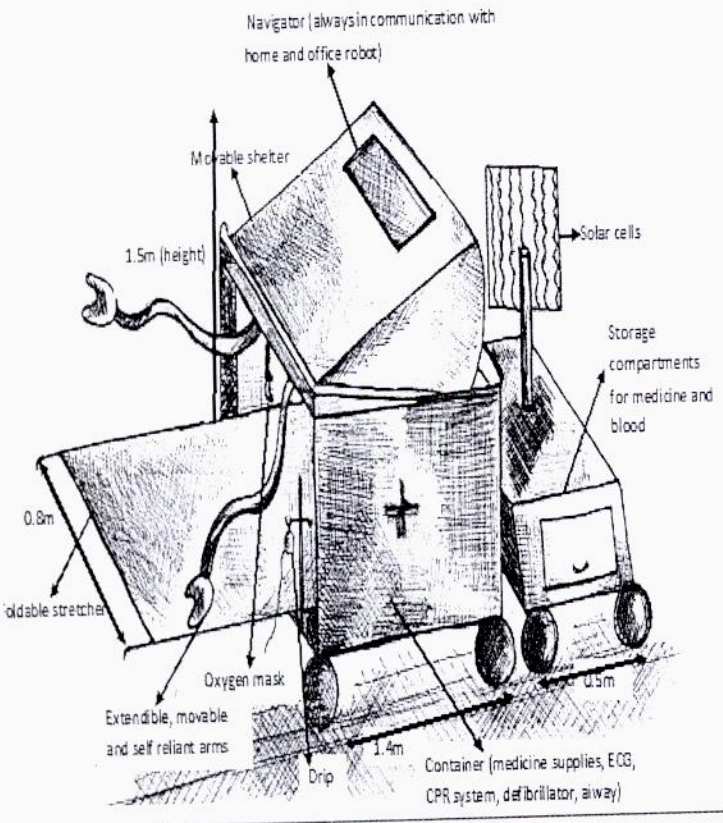
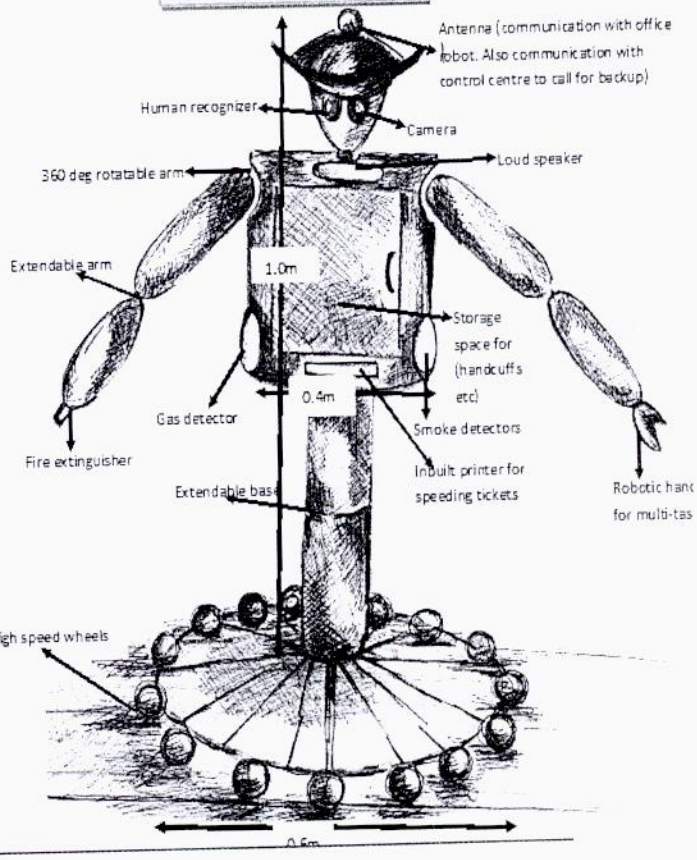


FIG 5.3.2: INSPIRON



Robot Name	Purpose	Features
Inspiron	Ensures public safety	Navigation system for contact with Acebots (refer to 5.3.2),saber and control centre for backup rotatable camera and human recognizer Extendable arms for fire extinguishing and a robotic hand for multi tasks. Gas and smoke detectors High speed wheels to chase and an inbuilt printer for speeding tickets.
Robomed	For medical emergencies	Extendable stretcher to adjust with the size of the victim(s) Extendable, movable and self-reliant arms. Blood bank and Storage for medical supplies. In built life support system such as ECG, CPR and de-fibrillate.
Cleanso	For community cleaning	Dust, germ and garbage detector and dust buster in addition to a disinfectant spray to keep the environment clean. A robotic arm with special claws to pick up wrappers and garbage

		items.
Novas	Delivery robot	**For delivery of consumables to residential areas**

5.3.2productivity in work environment:

Robot Name	Purpose	Features
Acebots	Performs functions in offices to reduce manual labour.	Navigation system for communication with Novas, Robomed and other Acebots. In built printer .Interacts socially, recognizes humans and voice inflection and responds appropriately

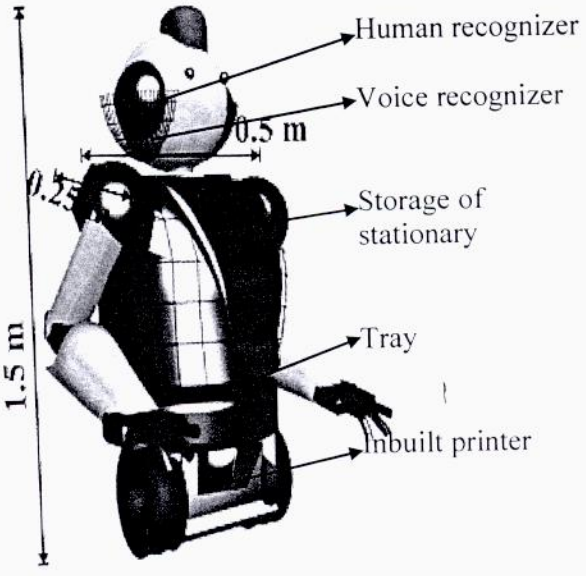


FIG 5.3.3: ACEBOT

5.3.3 Convenience in residences:

Robot Name	Purpose	Features
Saber	To perform routine tasks at vista homes	Performs vacuum cleaning, serving and surveillance Storage compartmen t and inbuilt microwave oven. Rotatable camera ,voice commander and stereo system

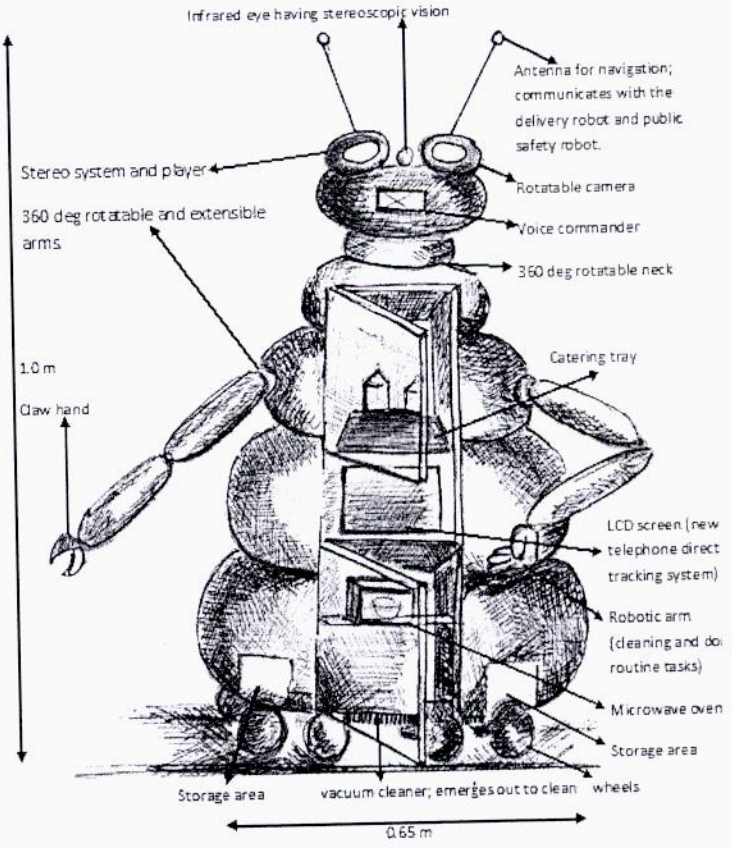


FIG 5.3.4: SABER

5.3.4 Privacy of Personal Data And Control Of Systems In Private Spaces Data Encryption Method Ensures Privacy Of All Sorts Of Data:

Personal data such as the data of patients in a hospital or of the account holders in a bank or the by an insurance company will be accessed after a positive result in a retina scan.

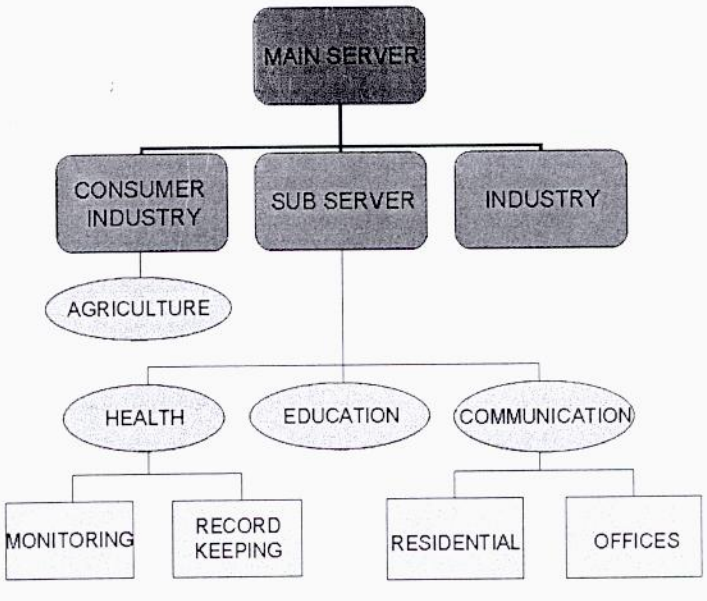
5.3.5 Access to Computer Network and Community Computing For Vista Homes and Offices:

User Access to computer Network:

- The user can access the Wi-Max technology that will provide them with all the internet facilities through their Potex PDAs.
- Access to community computing
- To prevent users form developing any health disorders from exposure of the harmful waves there will be a line of sight communication with microwave signals being sent from one tower to another.
- Users can access the High-speed internet provided by Wi-Max through their Potex PDAs or computers at home. Officials can use their mini computers to have access to internet facilities.

5.3.6: Access to robot resources from vista homes and offices: Virtual screens that enable contact of individuals with robots and the control system.

5.3.7 NETWORKS AND BANDWIDTH REQUIREMENTS



Bandwidth Requirements (Refer 5.1)

5.4.1: MEASURES TAKEN TO REDUCE CONSTRUCTION TIME:

- Assembly of the basic structure with the help of automation and robots mentioned in 5.1.
- Use of automation for interior construction and community configuration-refer to 5.1.

Use of robots for interior finishing of residences and other buildings-details follow.

- Use of robots for designing, manufacturing and finishing of furniture.

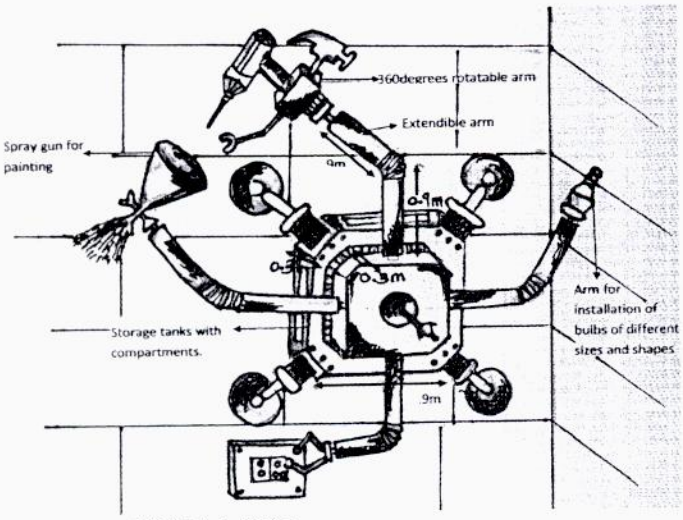


FIG 5.4.1: KX-1

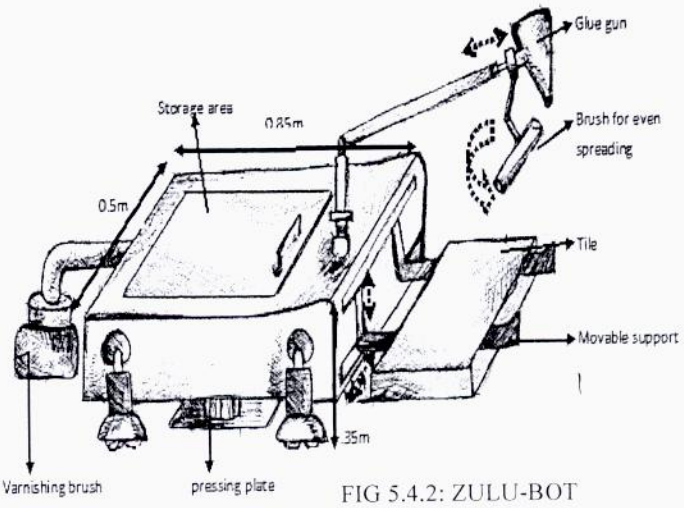


FIG 5.4.2: ZULU-BOT

Estimated time required to complete the interior of a building: 23 hrs.

ROBOT	PUPOSE
KX-1	plumbing, wiring installation, lighting, painting
Zulu-bot	floor installation and polishing
nova	manufacturing and finishing furniture

5.5.1: ASTEROID HARVESTING AND MINING:

Automated System for Mining and Transporting Asteroid Ores to Refining Facilities
Mining asteroids pose both a threat and a promise. A source of metals and minerals, worth trillions of dollars; its mining becomes a critical step in building supplies for Bellevistat. The robot Grover helps in achieving exactly that, by tackling the dangers of zero gravity and constant rotation of the asteroid.

ROBOT	PURPOSE	FEATURES	HUMAN CONTROLLERS
Grover	Mining and harvesting asteroid ores	• Solar powered. • Light weight. • Have grapples to anchor to the ground. • A camera arm to allow range and depth perception • A navigator for complex pattern recognition. • Has the ability to act as a bulldozer and a crane. • Has the ability of laser grading by means of a grading blade and grade sensors. • Has a robotic hand with both grapple and a driller.	Two human controllers.
Troy	Transporting asteroids to refining facility	• Has a front end bucket, with a dozer blade attachment.	One human controller.
Aldo	Mineral testing	• Ultra portable laboratory for mineral testing	two

and excavation	• Coating of super adobe layer for protection against radiations and solar flares • Excavation tyre for fast efficient mining • Moves on a track which will be fixed to the surface of the asteroid. • Ability to estimate the quantity of a certain mineral below the asteroid surface.	human controller

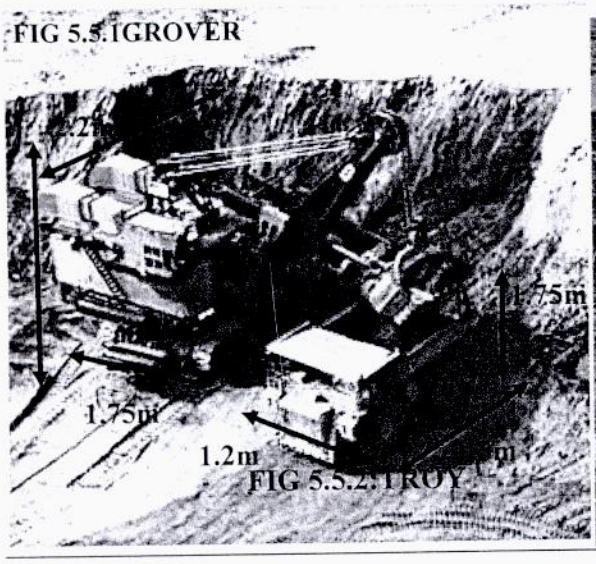


FIG 5.5.1GROVER

FIG 5.5.2: TROY

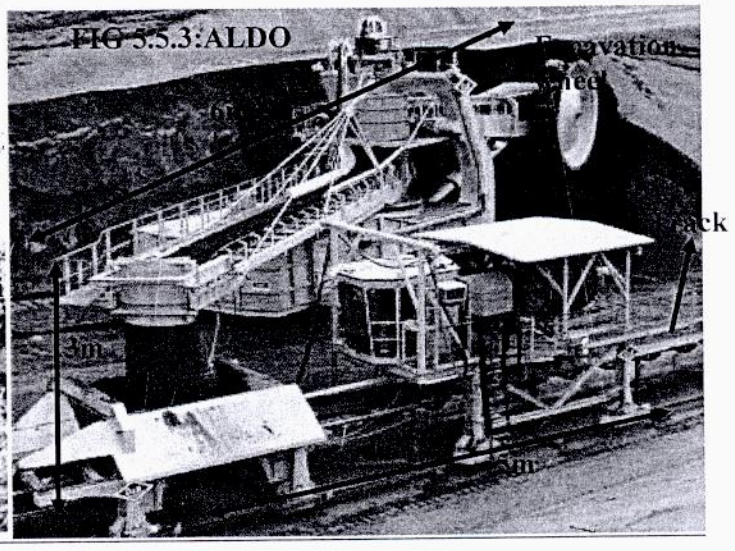


FIG 5.5.3:ALDO

5.5.2: TRANSPORT OF RAW MATERIAL AND SPACE MANUFACTURED GOODS:

GOBOT will be specially designed to transport raw material extracted from the asteroid and the goods manufactured on Bellevistat to the Earth's surface.

The main body of this 'one-way' re-entry vehicle will be made up of Iron and Iron silicates with an outer layer of lunar regolith for protection. The vehicle has an approximate internal capacity of 16,000 m^3.

Gobot will use a water (hydro/steam) propellant system. Water will be made on Bellevistat as mentioned in 3.2.

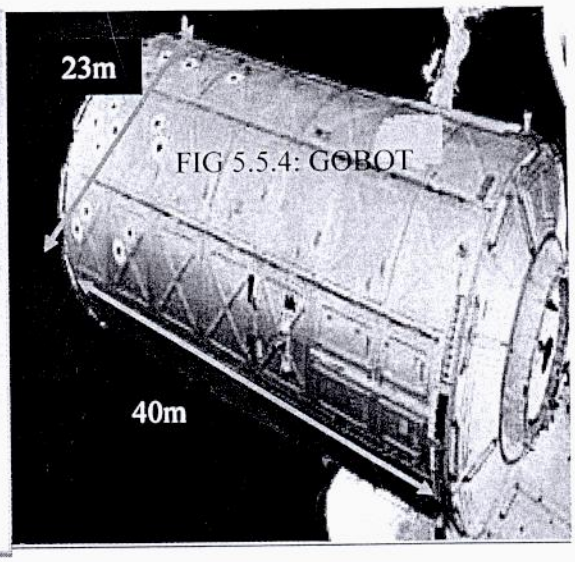


FIG 5.5.4: GOBOT

SCHEDULE AND COST

	0-2190	2191-4380	4381-6570	6570-8760	COST /UNIT	UNITS	TOTAL (M)
Contract awarded and initial designing and research on feasibility					-	-	S2850
Robot construction					1 M	750	750
Earth station construction					100M	5	500
training and physiological testing					-	-	80
Awarding of subcontracts					-	-	
Assembly of mining system					30M	16	480
Construction of central cylinder					9000M	1	9000
Construction of docking ports					20M	4	80
Construction of torus ,thrusters and clamps for asteroid attachment					-	-	30000
Construction of communication satellites and communication system					-	-	4000
Transport to L4					-	-	5000
Construction of shield and central disc					-	-	15000
Testing of operations					-	-	3000
Finishing of interiors and completion of internal transport					-	-	121050
Recheck of details and final touches					-	-	70
Inauguration					-	-	-

DETAILS OF TOTAL INTERNAL COSTS/M			
ACTION	AVERAGE COST/UNIT	UNITS	TOTAL COST
Houses	50 000	1	50 000
Commercial infrastructure	1000	3	3000
Industrial infrastructure	5000	1	5000
Parks and gardens	0.5	100	50
Hydroponic system	2000	1	2000
Aeroponic system	6000	1	6000
Internal furnishing	5000	1	5000
Vehicles and transport	50	1000	50000
Total cost			121 050

NOTE: ALL COST MENTIONED IS IN US$.

KEY FOR COST AND SCHEDULE:

CONTRACT AWARDED

RESEARCH PERIOD

CONSTRUCTION

USAGE

Employee	Average cost/person	Quantity	Total cost(M)
Engineers	$30 000	2500	75
Pilots	$30 000	250	7.5
Designers	$10 000	400	4
managers	$10 000	200	2
labourers	$5000	3000	15
Total cost			103.5

APPROXIMATE TOTAL COST: $ 200 BILLION

COMPLIANCE MATRIX

2.3.1	Describe the process required to construct the settlement, by showing the sequence in which the major structural components will be assembled.	Diagrammatical construction sequence showing details of each phase of assembly. Multiple diagrams and a schedule for the phases.	6
2.4.1	Show structural attachment to and construction on an asteroid captured for harvesting of materials.	Details on the attachment of asteroid given in a paragraph.	7
2.4.2	Identify location(s) where ore refining operations will be conducted.	Paragraph specifying the locations.	7
2.4.3	Include systems to minimize transfer of asteroidal surface material (dust) into areas of the settlement where they can affect the quality of life.	A diagram and detailed paragraph of the dust separating system.	7
2.5.1	Specify docking ports to prevent redundancy in the event of an accident.	A detailed description of the four docking ports including the zones in which they are present; storage zone, docking zone and controlling zone. A diagrammatical representation of the location of the docking port.	7
3.1.1	Orbital location	Reasons for the selection L4 as the orbital location for the Bellevistat	8
3.1.2	Table for the materials required and their specifications:	A table containing information about the materials; Composition, source, transportation and storage	8
3.2.1	Food Production	Information regarding hydroponics and aeroponics in tabular form.	9
3.2.2	Power Generation	Flow chart and tables regarding power consumption in the settlement.	9
3.2.3	Internal and External Communication and Transport System	Table stating transport systems within the earth, with the earth and with the moon and Alexandriat.	10
3.2.4	Climate/Atmosphere	Information regarding air composition, temperature, humidity and air pressure.	11
3.2.5	Waste Management	A Flow chart demonstrating waste management.	11
3.2.6	Water Management	Pie chart regarding water usage.	12

3.2.7 and 3.2.8	Water Production and Day/Night Cycle	Table for the purification and distribution of water. Table for the day/night cycle.	12,13
3.3.1 and 3.3.2	Space Vehicles and Infrastructure	Table regarding space infrastructure and space vehicles	13,14
3.4	Agriculture and Livestock	Table regarding the method of cultivation, types of crops and the area required for cultivation. In addition, a table regarding livestock.	14,15
3.5.0	Innovative Designs and Facilities	Materials, products and sources in tabular form.	15
3.6.0	Space Manufacturing and business opportunities	Business opportunities and their details.	15,16
4.1.1	Community Design and location of Amenities	Diagram of community design with color coding.	17
4.1.2	Key for community design	Description of each color coded segment.	17,18
4.1.3	Variety and quantity of consumables and other supplies	Table stating production per month of consumables, average monthly diet and a flow char regarding distribution of consumables.	18,19
4.1.4	Psychological factors	Table stating the problems and the how to overcome them.	19
4.2.1	External Drawing and interior floor plan of houses	Floor plans, exterior design of a family country house, its area and how many people it can accommodate.	19,20
4.2.2	External drawing and Interior floor plan of houses	Floor plan of the houses for singles and the area it occupies.	20
4.3.1	Designs of systems, devices, and vehicles for use by humans	Description of all the robots that enhance livability.	21
4.3.2	Government and Management	Flow chart stating all the information.	21
4.3.3	Educational system	Information about the education system for children of all ages.	21
4.3.4	Means for safe movement in low gravity	Information about the safety of low-g areas.	21,22
4.3.5	Space suit design for work outside pressurized settlement volumes	Description of all the features of the space suit.	22
4.3.6	Major categories of work in and around the settlement	Table providing the required description	22,23
4.4.1	Differentiated Neighborhoods	Urban and country houses. Urban neighborhoods and space colonies.	23,24

4.5	Recreation and entertainment available	Spa, gym and amusement parks	24,25
4.6	Tourism industry in bellivistat	Description about tourist attractions.	25,26

5.0.1	Specify number and types of computer	A table containing type , quantity, storage capacity and memory.(refer to table 5.0)	27
5.0.2	Specify types of servers	A table containing all the required information. (refer to table 5.0.1)	27,28
5.0.3	Types of softwares	Differentiation of softwares refer to table 5.0.2	28
5.0.4	Types of network devices	A table specifying types, specification and purpose of each network device.	28
5.0.5	Types of storage devices	A detailed paragraph regarding 3D optical data storage technology.	28
5.0.6	Data collection	Refer to section 5.0.6	29
5.0.7	Data distribution	Refer to section 5.0.7	29
5.0.8	User access to computer networks	Information regarding accessing the Wi-Max technology.	29
5.1.1	Describe use of automation for construction, transport and delivery of material.	Diagrams of robots for different functions, with a table stating properties and features of each robot.	29,30,31
5.1.2	Construction of the settlement	By MAR-ED, Voltaire , Constructo and Zulu-Bot.	31
5.1.3	Transportation of material and equipments	Role of delivery capsule and super nova.	31
5,1,4	Assembly of the settlement	Role of SNSS-4 and FSM-2	31
5.2.1	Safety, Maintenance and Privacy of Data	All data sent via Fibre Channels and Wi-Max will be encrypted to provide privacy. Fibre optics prevents the tapping of Data by unauthorized personnel.	31,32
5.2.2	Backup Systems	Table containing backup system and Contingency plans	32
5.2.3	Physical Locations of Computers and Servers for critical functions	Physical locations of omputers And servers are presented in he Table.	32

5.2.4	Robots required for emergency external repairs	Names and purpose of each robot.	33
5.2.5	Means for Security, Privacy and authorized access to Data	Complete description with the help of diagrams.	33
5.3.1	Automation System to Enhance Livability in the Community	Table stating the features of Vista houses and description of different robots.	33,34,35
5.3.2	productivity in work environment	Description of Aceebot	35
5.3.3	Convenience in residences	Description of Saber	35
5.3.4	Privacy of Personal Data And Control Of Systems In Private Spaces Data Encryption Method Ensures Privacy Of All Sorts Of Data	Personal data such as the data of patients in a hospital or of the account holders in a bank or the data held by an insurance company will be accessed after a positive result in a retina scan.	36
5.3.5	Access to Computer Network and Community Computing For Vista Homes and Offices	Access of WiMax is described in full detail.	36
5.3.6	Access to robot resources from vista homes and offices	Virtual screens that enable contact of individuals with robots and the control system.	36
5.3.7	Networks and bandwidth requirements	A flow chart specifying all the requirements.	36
5.4.1	Automation for interior finishing	Features of KX-1 and Zulubot	37
5.5.1	Asteroid harvesting and mining	Automated System for Mining and Transporting Asteroid Ores to Refining Facilities	37,38
5.5.2	Transport of raw material and space manufactured goods	Description of Grover Troy and Aldo	38
6.1	Duration and completion dates of major design, construction and occupation task	Table showing dates and costs	39
6.2	Cost of the settlement and an estimated number of employees	Table estimating number of employees and the final cost of Bellevistat	40

BUSINESS DEVELOPMENT (SECTION 7) HAS BEEN INCORPORATED IN SECTIONS 3,4 AND 5 AND IS PRESENTED AS A PART OF THESE SECTIONS IN THE ABOVE COMPLIANCE MATRIX.