



ASIAN REGIONAL SPACE SETTLEMENT DESIGN COMPETITION

Proposing Team Data



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I understand that if my team qualifies for the Asian Regional Space Settlement Design Competition, January 10-14, 2008 we will be expected to finance our own travel to New Delhi, India

Rupinder Singh Ghotra

Signature of Senior Teacher / Advisor

Name of the Signatory

30-11-2007

Date

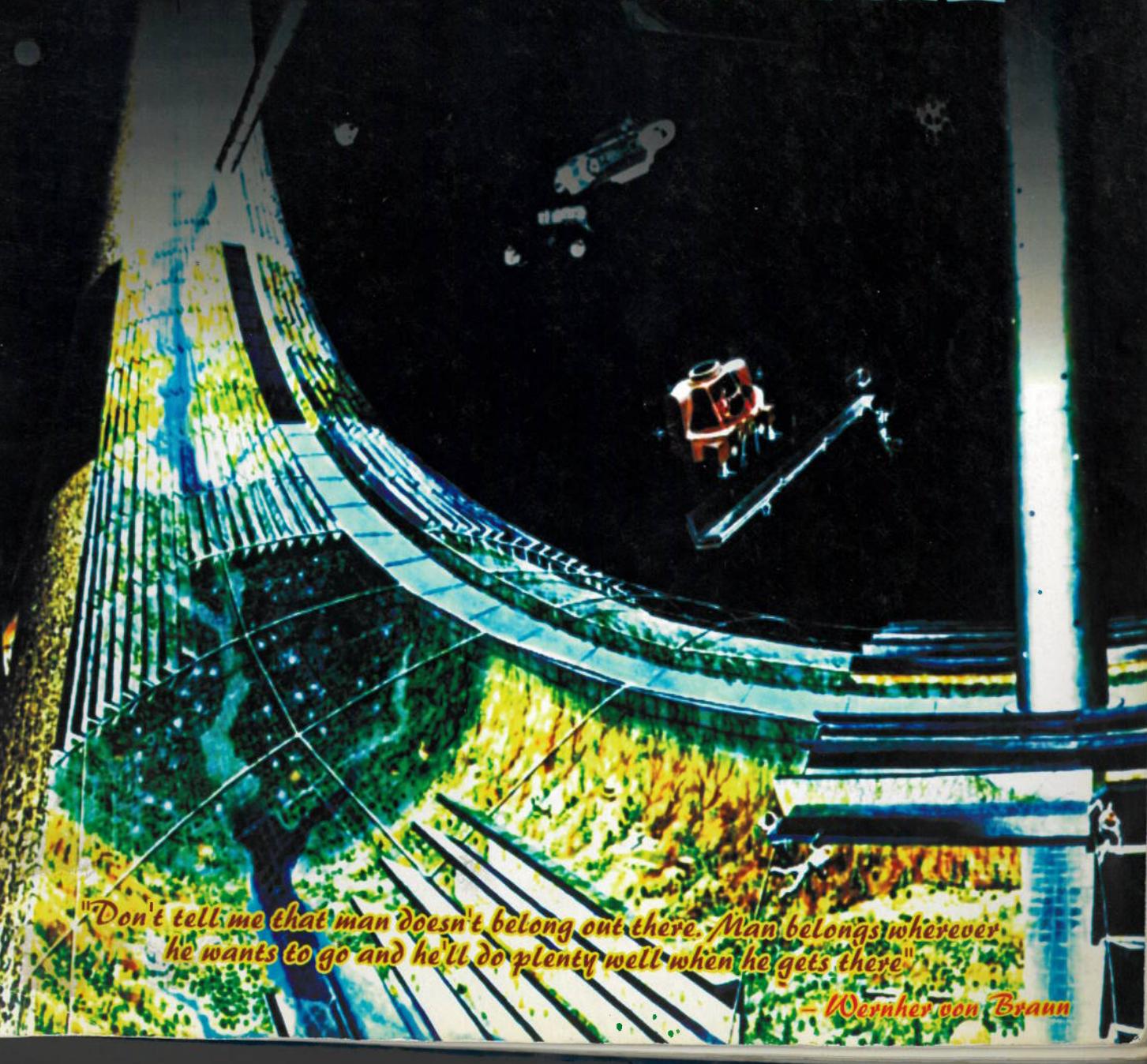
WOM

...An endless spirit

Kurukshetra, INDIA

presents

Bellevista!



"Don't tell me that man doesn't belong out there. Man belongs wherever he wants to go and he'll do plenty well when he gets there."

- Wernher von Braun

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1.0 Executive Summary

Introducing Bellevistat, a self sustaining residential and commercial space settlement which would tempt the bourgeoisie to sojourn and dwell there. The first and foremost motive of this settlement is to grant the residents a cost effective and an earthly atmosphere in space and making the availability of all the desires and needs of humans. To gratify this motive, better than the best technologies would be anticipated. There are many aspects that are to be considered for the realization of this objective.

High tensile strength materials will be used for the structure so as to endow the settlement, complete protection against harmful solar and cosmic radiations, meteorites and space debris.

For the survival of any self-sustaining unit, regular energy supply and better agricultural techniques are a must. Keeping in view these two things, highly efficient and productive techniques will be used.

Multipurpose communication system will be introduced for all types of communications that would pacify not only needs of the present time but also would be fruitful for the future.

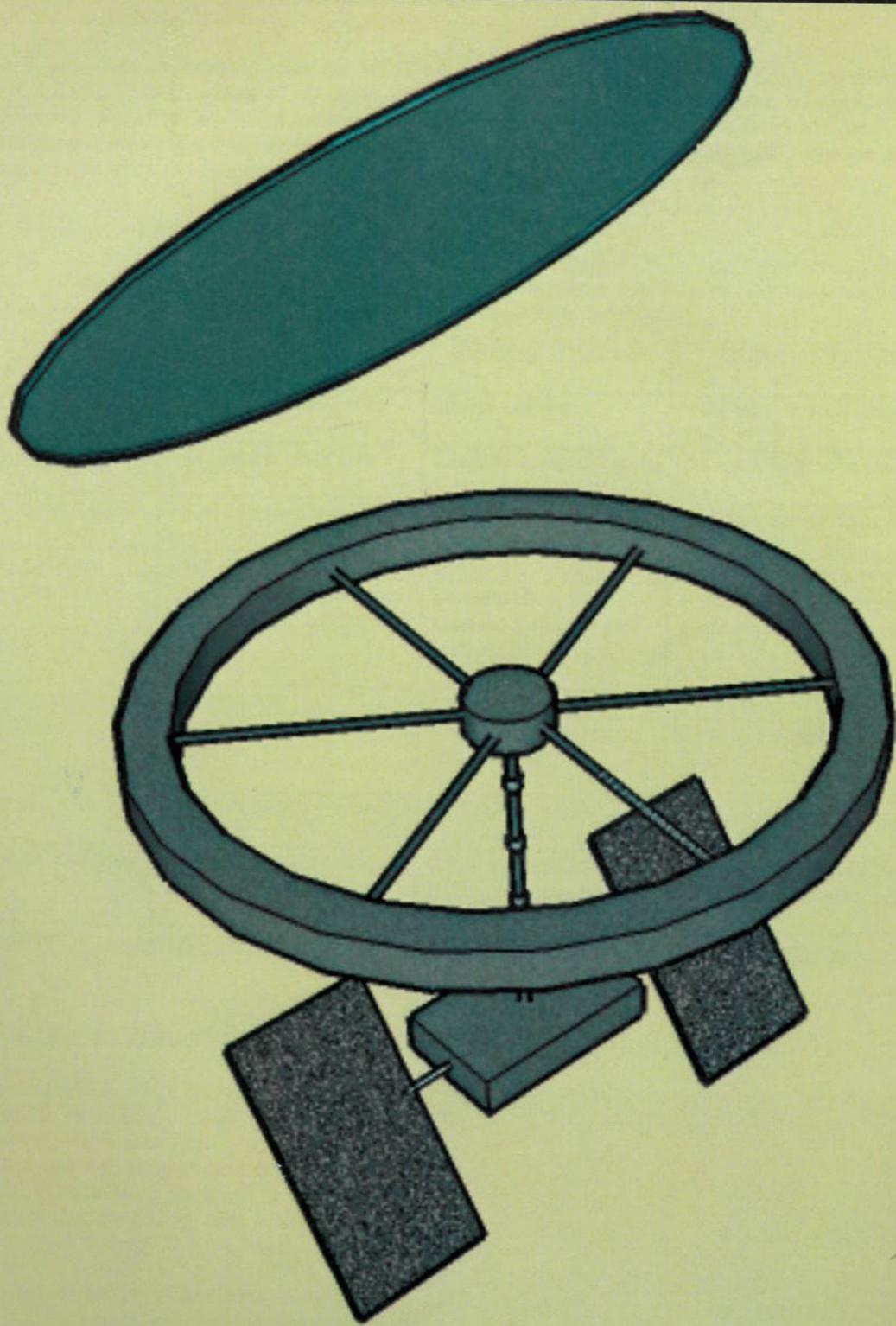
The processors, which will be used in the computers, will be that much omnipotent that they could make the settlement fully automated and configure all the security systems to ensure the privacy and endorsement of the residents.

The most noticeable feature of the settlement is that nothing will go waste. Appropriate recycling provisions will be set up for all the leftovers and trash.

Psychological factor has also been focused; outside space and earth views, gaming zones, various holy places for the peace of mind etc. will help in pleasing the residents.

There will be a provision of backup plans as well in case of any power failure or any misfortune in automation department. As the dangers of meteorites and space debris can't be overlooked, special contingency plans will also be setup to minimize the loss in case of any mishaps.

The team while designing the proposed settlement has taken into consideration every aspect related to human colony and tried its best to create a likeness to the Earth's atmosphere and settlement. Yet there might be scores of other spheres that need to be looked after. The proposed project, while nearing its realization will need a team of experts and professionals not only to find out those areas but also to suggest practical measures and designs thereof.



STRUCTURAL DESIGN

2.0 STRUCTURAL DESIGN

Proposed Bellevistat has been designed for 18000 full time residents and additional 1000 transient residents of business, official visitors, guests of residents and vacationers, providing them suitable environment climatic conditions and safety from hazardous mishappenings. The proposed structure has been designed in such a way that the residents will enjoy all the comforts and luxuries present on the Earth. The design will enable the residents to have natural view of space outside and the Earth below.

2.1.a EXTERNAL CONFIGURATION

The basic design of the settlement has been chosen to be a Stanford torus. It is because the torus has a lot of advantages over the other two designs proposed by various researchers and scientists.

BASIS OF DIFFERENCE	TORUS	BERNAL SPHERE	O'NEIL CYLINDER
Volume	Has less volume	Larger volume	Very large volume than other Two
Surface Area	Less total surface area	Large total surface area	So much large area than other two
Utilization Area	Provides more utilization area	Provides less utilization area	Provides less utilization area than torus
Rotational Rate	Easy to maintain	Difficult to maintain it	Large size restricts to do so
Meteorites safety	Less surface area reduces probability of meteorites collision	Large surface area increase probability of meteorites collision	Much prone to meteorite collision due to large surface area
Gravity variation	No variation	Large variation	No variation
Psychological Factors	No psychological side effects	Everything appears Upside down	Everything appears upside down
Isolation	Easy to isolate in case of accidents	Difficult to divide	Difficult to divide
Construction Period	Requires less time due to small surface area	Require more time due to large surface area	Required much more time due to very large surface area
Maintenance	Very easy to maintain	Difficult to maintain	Difficult to maintain

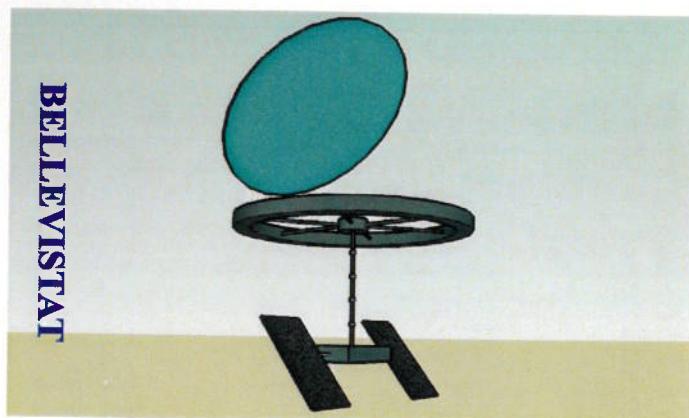
COMPARISON TABLE

DETAILS AND DIMENSIONS OF MAJOR STRUCTURAL COMPONENTS

The structure will consist of a torus having a gravity of 1g, a concentric central tank having micro-gravity and a zero gravity zone below. The central tank will be connected to the outer torus with 6 connecting rods and it will be connected to the zero gravity zone with a long transporting rod having 4 docking ports.

- 1) The major radius of the torus will be 1200m; the height from the down surface will be 100m and breadth of the down surface will be 391.3m.
- 2) The central tank will be in the shape of a cylinder having a height of 300m and radius 250m.
- 3) There will be six transporting rods of length 850m each connecting the central tank and outer torus. There will be one additional transporting rod of length 1500m connecting the central tank and the zero gravity area.

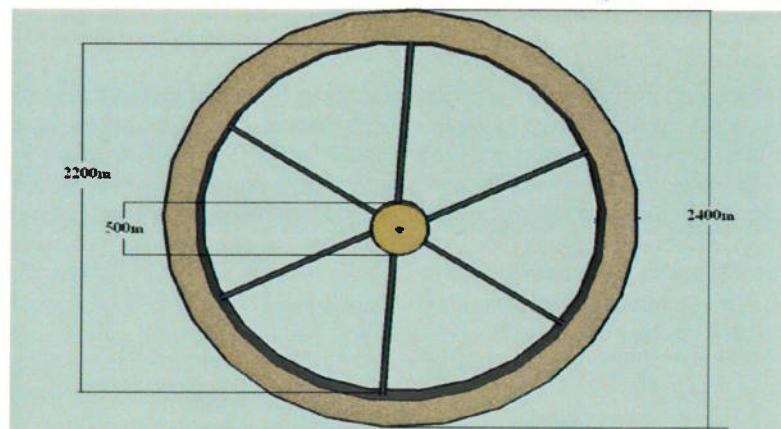
BELLEVISTAT



NORTH DUNNING HEADWELL

- 4) Two of the six transporting tubes will have an internal radius of 5m and the rest of the rods will have that of 10m. The internal radius of the lower transporting tube will also be 10m.
- 5) The external radius of all the rods and tube will be 30m.

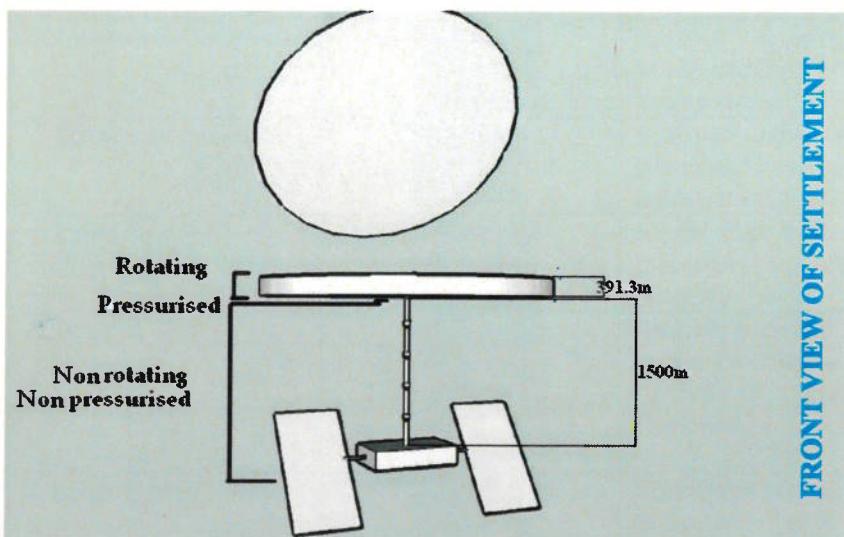
Torus will have a flat surface i.e. if its cut section is viewed it will look like a cuboid. This feature will result in no variation in gravitational pull as one moves from one place to other. For day and night cycle, a mirror of radius 1200m will be constructed over the torus at an angle 45° with the torus. The upper part of the torus will have a glass window which will allow ample amount of sunlight to enter into the torus. This window covering 10% of the total surface area of torus will also provide the residents, a view of space and earth.



TOP VIEW OF SETTLEMENT

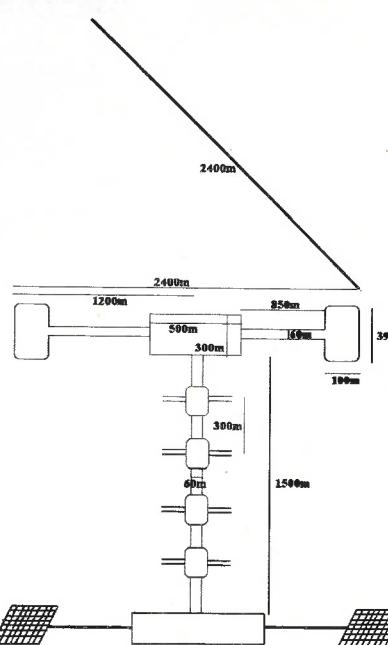
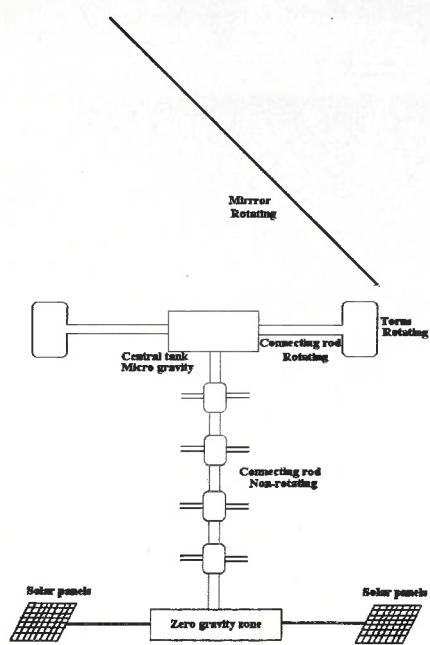
1200m

The unpressurized zero gravity zone will comprise of a refining industry for asteroidal and lunar material and zero gravity science laboratories for research work. The refining industry will also be fitted with filters which will stop the dust to reach the pressurized area. The communication satellite will be located in the zero gravity zone which will be able to communicate with Earth, lunar base, space ships etc.



FRONT VIEW OF SETTLEMENT

ROTATING & NON-ROTATING COMPONENTS OF SETTLEMENT



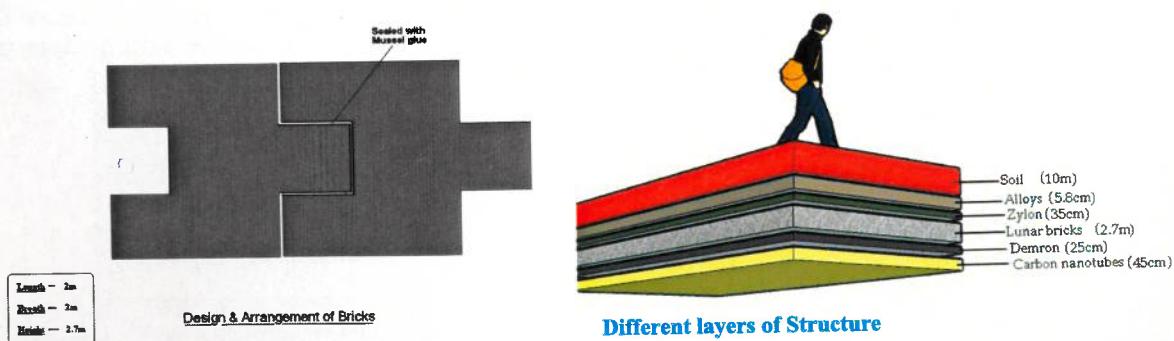
**DIMENSIONS OF CUT SECTION
OF SETTLEMENT**

2.1. b. MATERIAL REQUIREMENT

The settlement will be made up of three layers. The first layer will be made of aluminum and titanium composite for providing strength to the structure because of their high tensile strength. The layer of matrix will be coated with aluminum titanium nitride which will act as protective layer from erosion, provide hardness and also resist from corrosion. The second layer will consist of lunar bricks and zylon. These two will provide protection against radiations and zylon will also provide protection against small meteorites. Third layer will be made up of carbon nanotubes and demron. Carbon nanotubes have a high tensile strength; so they will provide protection against meteorites and space debris. Demron will provide protection against alpha, beta and gamma radiations and X-rays. For joining the layers perfectly two adhesives RTV-E-952 and Mussel glue will be used. As the settlement will face the sun for only 15 days and for rest of the 15 days, there will be complete darkness, there will be a great variation in temperature which may result in the expansion and contraction of the materials; Shape Memory Alloy will be used in the materials which will reduce the chances of cracking of the layers.

Material	Image	Property	Uses
Carbon nano tube		Strongest material with high tensile strength	Outer shield for protection from meteorites
Aluminum Composite		Easily available on Moon and have good tensile strength	Supportive and base layer
Titanium Composite		Easily available on Moon and have good tensile strength	Supportive and base layer
Zylon		Strong fiber with radiation protection property	Supportive layer
Demron		Protects from fast moving ions and particles	Second outer shield protecting from radiations
Lunar bricks		Radiation protection	Major radiation protection shield
Lunar glass		Strong and radiation protective	Windows of Bellevistat

MATERIALS FOR CONSTRUCTION



MATERIAL FOR WINDOWS

The upper part of the torus will be made up of lunar glass. There is a great variety of glasses on earth but they are not chemically resistive and hard because of the presence of water and oxygen. But lunar glass is anhydrous i.e. it has no oxygen and water content. It is very hard and has very good metallic property. Since it is a mixture of calcium, iron and silicon, its expansion coefficient is less than the ordinary glass. This glass will also be coated with a layer of carbon nanotubes so as to protect it from meteorites and fast moving objects.

2.1.c PROTECTION AGAINST RADIATIONS

As previously mentioned, the second and third layer consists of lunar bricks and demron which will provide radiation protection to the settlement. If lunar bricks are used 5ton/m² then it will reduce the solar radiations to .5rem/yr which is equal to radiations entering to earth's atmosphere. The principle components of the lunar soil are oxidized silicon, iron, calcium, magnesium which is heavy enough to scatter the ionic particles but light enough not to cause deceleration and therefore Bremsstrahlung radiation. This soil will cause a dramatic reduction in radiation however; using ice within the soil will also provide additional advantage that the incoming ions will simply reduce rather than being amalgamated into the crystal structure of the next (metal) layer. The second component will be demron which will consist of a polyethylene and PVC-based polymer fused between two layers of a woven fiber. The polymer molecule has been designed so that incoming alpha, beta, gamma and x-rays will meet a large electron cloud, which will deflect or absorb the radiations.

2.1.d METHOD FOR PROVIDING GRAVITY & MAINTAINING IT

Rotational method will be used to provide the required amount of gravity as it is a feasible way to attain and maintain it. After the external construction is completed then the ion propulsion rocket boosters will be used to provide the necessary rotation. The central tank and transporting tube will be connected with each other by using magnetic bearings. Due to these bearings there will be no physical contact between rotating and non-rotating part. To maintain the rotational rate, small thrusters will be attached to the rim of the settlement.

ADVANTAGES OF ION PROPULSION

- 1) Provides large amount of energy.
- 2) More efficient than other propellants.
- 3) Xenon gas is used as propellant and it can be reused by capturing and neutralizing.

ADVANTAGES OF MAGNETIC BEARINGS

- 1) No physical contact between two parts.
- 2) No wear and tear.
- 3) No friction and no emission of heat energy.

The minimum radius required for least line of sight (63.5m) is 1186m. The rotation rate should not increase from 2 rpm. The height of the torus from the down surface will be 100m. The radius of the structure will be 1200m because it will provide the minimum required line of sight and the rotation rate will also be less than 1rpm. The radius can not be taken more than the proposed because if it increases, the breadth of the down surface will decrease thus resulting in the reduction of the area of the down surface.

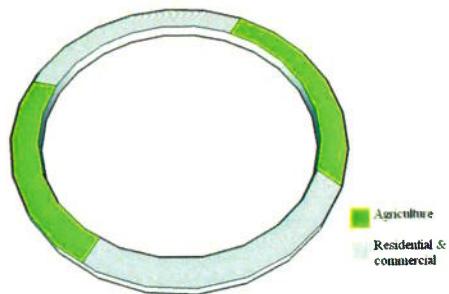
Major Radius	1200 m	1230m	1170m
Minor Radius	1100m	1130m	1070m
Perimeter	7536m	7724.4m	7347.6m
Height (from down surface)	100m	100m	100m
Breadth (of down surface)	391.3m	381.756m	401.33m
Area (of down surface)	2948836.8m ²	2948836.8m ²	2948836.8m ²
Volume	294883680m ³	294883680m ³	294883680m ³
Rotation rate (in rpm)	0.8634	0.8528	0.8744
Gravity	1g or 9.8m/s ²	1g or 9.8m/s ²	1g or 9.8m/s ²

COMPARISON OF CONSIDERED RADIUS

2.2.a INTERNAL ARRANGEMENT

According to NASA summer study, a person requires 155.2m^2 area. As the cut section of the torus is cuboidal, so its down surface will be rectangular. The circumference of the outer surface is 7536m and the breadth of the down surface is 391.3m. The total utilization area will be 2948800m^2 which is 41.56% of the total surface area i.e. 7096265.86m^2 . The distribution of area in bellevistat for different regions like residential, commercial and agricultural.

The lower part of the structure will be unpressurized and will have zero gravity, so it will be used for industrial purpose like refining of asteroid material, research works because many scientists want to perform experiments in zero gravity and it is easy to lift and transfer heavy materials there. The control tank is pressurized and will have micro-gravity which will be used for recreation purposes like micro-gravity Olympic ground, large storage area and installing flywheels.



INTERNAL ARRANGEMENT

Space Use	Surface area Req.(in sq.m)	Estimated Height(in m)	Volume (in m cubic)	For 19,000 People	
				Volume	Area
Residential	49	3	147	2793000	931000
Business					
Shops	2.3	4	9.2	174800	43700
Offices	1	4	4	76000	19000
Pubic & semi Public					
Schools	1	3.8	3.8	72200	19000
Hospital	0.3	5	1.5	28500	5700
Assembling(Church/Halls)	1.5	10	15	285000	28500
Rec. & Entertainment	1	3	3	57000	19000
Public open space	10	50	500	9500000	190000
Service Industry	4	6	24	456000	76000
Storage	5	3.2	16	304000	95000
Transportation	12	6	72	1368000	228000
Misc. Infrastructure	7.05	4	28.2	535800	133950
Agriculture					
Plant Growing Areas	44	15	660	12540000	836000
Animal Areas	5	15	75	1425000	95000
Food Processing, collection, storage, etc.	4	15	60	1140000	76000
Agriculture Drying Area	8	15	120	2280000	152000
TOTAL	155.2		1738.7	33035300	2948800

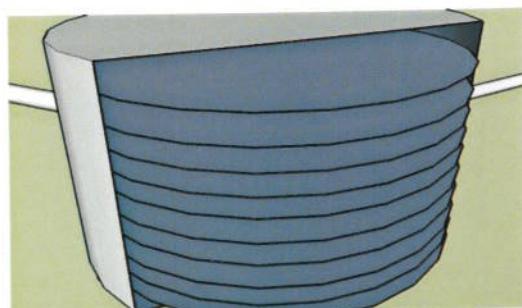
AREA & VOLUME REQUIRED BY ONE PERSON IN SPACE

BLOCK	NUMBER	DIMENSIONS	AREA (in m^2)
Residential & commercial	2	2287*391.3	1789806.2
Agriculture	2	1481*391.3	1159030.6

AREA OF DIFFERENT BLOCKS

CENTRAL GRAVITY TANK

One of the main attractions for the residents will be the experience of micro gravity. The researchers can also perform their experiments there. Since, the gravity inside the central tank will be very low, thus, industries will be established inside the central tank as the movement of large masses easier there. The tank will be divided into 20 floors each of height 15m. The antennas and radars will be beside the emergency exit. There will be a micro-gravity zone in the central tank.

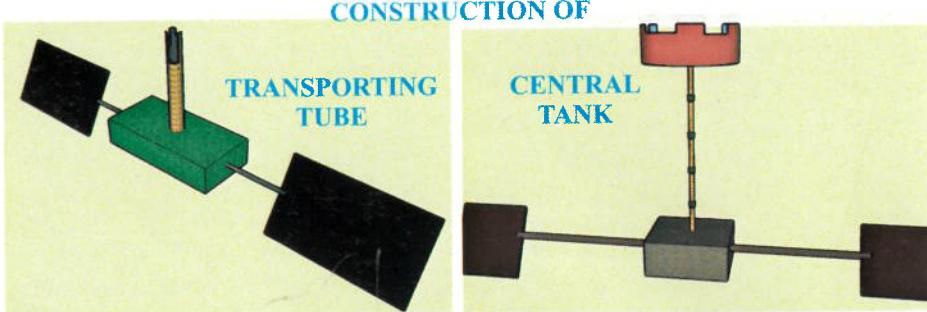


CUT SECTION OF CENTRAL TANK

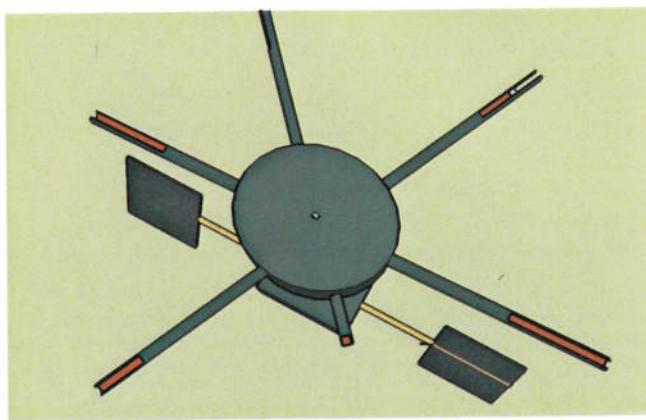
2.3 CONSTRUCTION SEQUENCE

PHASE I: The construction sequence is associated with the establishment of lunar base for mining and base of refining factory at L4. It will become the zero gravity zone of the settlement in future and also the base of the construction work. The robots and control station will also be launched to L4 so the construction work can proceed.

PHASE II: In this phase lower transportation rod will be constructed firstly taking the zero gravity zone as a base. As it will complete, the central tank construction will start along with shielding of lower transporting tube.

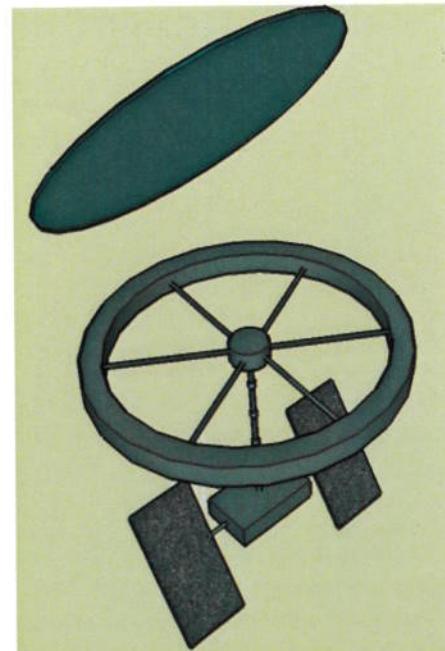
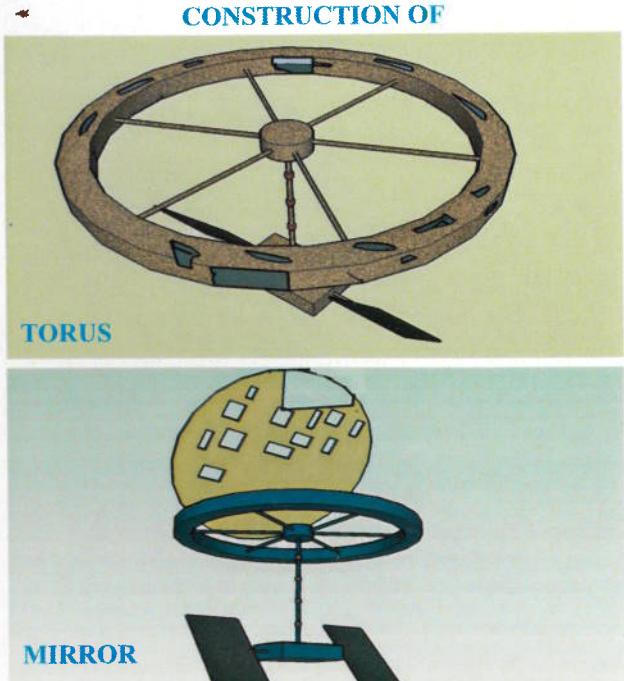


PHASE III: After the construction of tank is completed. The tank will be rotated to examine and test the stability of conditions. After the completion of this step transporting rods will be constructed and shielding of the central tank will start.

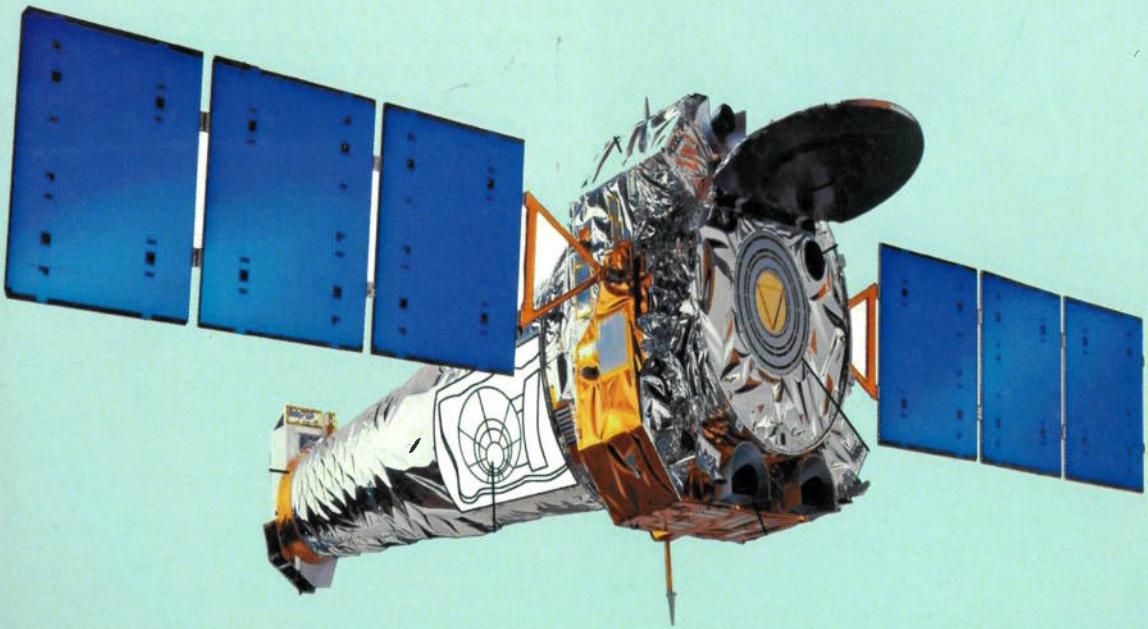


PHASE IV: When the construction of the rods will be completed the most important task of constructing the torus will start. Meanwhile the glass manufacturing factory will be used for making the giant mirror and the windows of the settlement. When the construction and shielding of the torus will be completed, the conditions will be tested and 10m thick layer of lunar soil will be laid. Then the interior finishing and construction of the torus will start after which the settlement will be available for the human to live.

CONSTRUCTION OF TRANSPORTING ROD



BELLEVISTAT



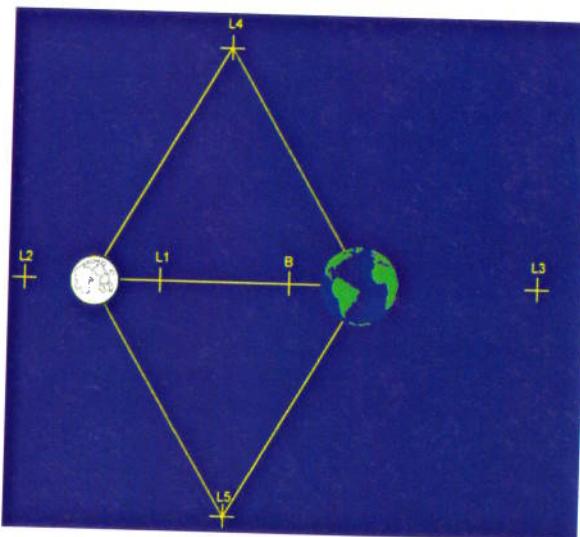
**OPERATIONS
AND
INFRASTRUCTURE**

3.0 OPERATION AND INFRASTRUCTURE:

To ensure a comfortable and luxurious life for the residents, the settlement will be fully equipped with different types of instruments and devices. Safe location accompanied with basic amenities such as large & different varieties of crops, fruits, vegetables, meat and dairy products, electricity, fresh air and water with pleasant atmosphere, internal and external communication, transportation system with modern inputs, natural views of external space and earth will make the life better. Entire infrastructure of the settlement has been developed and designed in such a way that one will not feel the absence of the earthly environment.

3.1.a ORBITAL LOCATION:

To ensure maximum safety to the life of residents, it is necessary that the settlement should be located at an orbital location which experiences extremely less effect of gravitational pull of heavenly bodies. There are five such points known as Lagrange points L₁, L₂, L₃, L₄ & L₅. An object at L₁, L₂, L₃ is not stable. Like a ball placed on the top of a hill, a little push or bump and it starts moving away. An object at one of these points has to use frequent rocket boosting or other means after every 23 days to remain at the same place. So, L₁, L₂, and L₃ are not appropriate for building the space colony. But at L₄ or L₅, any object is truly stable, like a ball in a bowl. When gently pushed away, it orbits the Lagrange point without drifting farther and farther and without the need of frequent rocket firing. The Sun's pull causes any object at L₄ and L₅ locations to orbit the Lagrange point in 89 day cycle. Since L₅ is occupied by Alexandria, therefore, L₄ has been selected as the orbital location for Bellevistat. L₄, Moon and Earth form equilateral triangle and L₄ is ahead of earth in its orbit with reference to the sun. So it will take equal time to travel from earth to Moon or Earth to L₄ or Moon to L₄. The distance between these three points is 0.002562 A.U.



ORBITAL LOCATION OF L4

3.1.b CONSTRUCTION MATERIAL SOURCES

Stage 1

Material	Source	Uses	Transportation	Storage
Aluminum Composite	Moon	Provide strength to structure	Mass driver	Not required
Titanium Matrix	Moon	Provide strength to structure	Mass driver	Not required
Carbon Nano tubes	Asteroids	Meteorites protection	Asteroid miners	Zero gravity zone
Titanium Aluminum Nitride	Earth	Protective layer of matrix layers	Reusable launch vehicle and Aerospear	Zero gravity zone
Zylon	Earth	Protective layer	Reusable launch vehicle and Aerospear	Zero gravity zone
Lunar bricks	Moon	Protective layer from radiation	Mass driver	Not required
Demron	Earth	Protective layer from fast moving ions	Reusable launch vehicle and Aerospear	Zero gravity zone

MATERIAL FOR TRANSPORTING RODS

On Moon & L4, robots will assemble the goods for factories from the Earth. Then the various materials would be transported to L4 by using mass driver. As soon as the materials reach L4, will be processed and used. The materials would be placed over desired location to construct the central tank and the lower transportation rod using the robots and robotic arms. Meanwhile, bricks would be transported to settlement using mass drivers. The robots will be used during construction. The zero gravity zone will be used as a temporary storage for other constructing materials used during construction.

NORTH DUNNING HEADWELL

Stage 2

Material	Source	Uses	Transportation	Storage
Aluminum Composite	Moon	Provide strength to structure	Mass driver	Not required
Titanium Composite	Moon	Provide strength to structure	Mass driver	Not required
Carbon Nanotubes	Asteroids	Meteorites protection	Asteroid miners	Zero gravity zone
Titanium Aluminum Nitride	Earth	Protective layer of matrix layers	Reusable launch vehicle and Aerospear	Zero gravity zone
Zylon	Earth	Protective layer	Reusable launch vehicle and Aerospear	Zero gravity zone
Lunar bricks	Moon	Protective layer from radiation	Mass driver	Not required
Demron	Earth	Protective layer from fast moving ions	Reusable launch vehicle and Aerospear	Zero gravity zone

MATERIAL FOR CENTRAL TANK

After the construction of central tank, it will be rotated and the construction of transporting rods will begin. The processed materials will be continuously used for the construction. While the construction rods will be done, the shielding of central tank and lower rod will be completed.

Stage 3

Material	Source	Uses	Transportation	Storage
Aluminum Composite	Moon	Provide strength to structure	Mass driver	Not required
Titanium Composite	Moon	Provide strength to structure	Mass driver	Not required
Carbon Nanotubes	Asteroids	Meteorites protection	Asteroid miners	Zero gravity zone
Titanium Aluminum Nitride	Earth	Protective layer of matrix layers	Reusable launch vehicle and Aerospear	Zero gravity zone
Zylon	Earth	Protective layer	Reusable launch vehicle and Aerospear	Zero gravity zone
Lunar bricks	Moon	Protective layer from radiation	Mass driver	Not required
Demron	Earth	Protective layer from fast moving ions	Reusable launch vehicle and Aerospear	Zero gravity zone
Lunar glass	Zero gravity zone	Windows of torus	Robots and robotic arms	Zero gravity zone
Soil	Moon	Soil bed & land	Mass driver	Not required

MATERIAL FOR TORUS

The torus will be constructed at the end. The robotic system will be used which are controlled by the control station. The various systems will be installed after construction and the torus inspecting team will come to look and test the efficiency of structure, meanwhile other systems would be installed.

3.2 COMMUNITY INFRASTRUCTURE:

3.2.a FOOD PRODUCTION:

Food is the basic and foremost requirement of life. The settlement has two agricultural sectors where different climatic condition will be provided for the proper growth of plants so that the residents can enjoy a fresh variety of fruits, vegetables and staple crops.

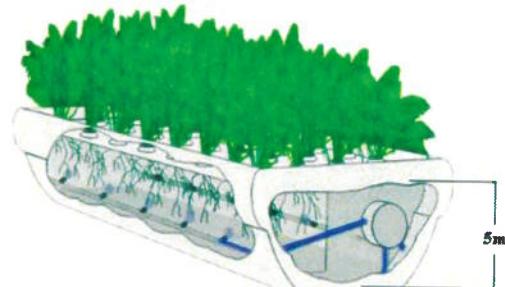
NORTH DONNING HEDWELL

How to be grown:

The crops will be grown by using aeroponics. Aeroponics enjoys advantages over other techniques as it is cost-effective, requires less nutrients and yields more production. Plants grown in aeroponics will spend 99.98% of their time in air and 0.02% in direct contact with hydro-atomized nutrient solution. These plants reduce water consumption by 98%, fertilizers by 95% and pesticides by 99%. A variety of nutrients solution will be administered to the root zone with the help of robots. This will enhance the production.

The plants will be grown with a 5m deep tunnel under the surface and the nutrients will be sprayed on the plants in the tunnel through robots. Also, the growth of pathogens can be reduced by adopting preventive measures such as:

1. By growing plants at such an optimum distance from each other so as to prevent the pathogens from spreading the diseases.
2. By providing the plants the best kind of nutrients.
3. By allowing the plants to grow without any physical barriers.
4. By spraying the fungicides and disinfectants to the aerial and root parts separately.
5. By reducing the per plant exposure to surface where pathogens can linger.



PLANTS IN AEROPONICS

The fruit trees with an average height of 18 feet can be grown easily using aeroponics. Yields will be increased up to 45-75% by using this technique, use of LEDS increases this yield up to 60% and Mylar wall covering will redirect 98% of the sunlight which will result in more illumination, thus, increasing the rate of photosynthesis. For improving the health of crops a real time sensor that monitors plant's health by sensing plant responses related to the process of photosynthesis will be used which is Plant Fluorescence Sensor. It is capable of detection of plants' stress resulting from nitrogen deficiency as well as applied stress and sensing the unhealthy plant which could help to improve the health of the plant.

Crops to Be Grown:

S.No	Name of crop	Nutritive value	Growth temperature	Storage temperature	Maturing period (Days)
01)	Lettuce	Carbohydrate, Fiber,Fat,Protein,Fe,(A,B ₉ ,C)*	25°C-32°C	32°F	45-70
02)	Soybean	Protein,Oil,Carbohydrate,Ash	20°C-30°C		80-120
03)	Corn/Maize	Fiber,Mn,Fe,K, protein, Fat,(B ₁ B ₃ , B ₆ ,C,E,B ₅)* Carbohydrates	13°C-18°C	32°F	55-60
04)	Pea	Carbohydrate,Sugar,Fiber,Fat Protein,(A,B ₁ ,B ₂ ,B ₅ , B ¹ B ₆ ,B ₉ ,C)*Ca-rotene,Ca,Fe,Mg, P,K	17°C-25°C	<0°C	60-70
05)	Potato	Carbohydrates,S-tarch,Fiber,Fat, Protein,(B ₁ ,B ₂ ,B ₃ , B ₆ ,C)*,Ca,Fe,Mg P,K		4°C	70-75
06)	Oats	Protein, Amino acid,Carbohydrates,Fat,(B ₅ ,B ₉)* Fe,Mg, ^b Glucan		30°F	77-80
07)	Wheat	(B ₁ ,B ₃)*,Mg Fe, Zn,Se			

08)	Rice	Carbohydrates, Fat Protein,(B ₆)	25 ⁰ C-30 ⁰ C	32 ⁰ F-40 ⁰ F	
09)	Sorghum		30 ⁰ C-35 ⁰ C	32 ⁰ F-35 ⁰ F	
10)	Tomato	(C,E,A)*Fiber	86 ⁰ F-95 ⁰ F	38 ⁰ F-40 ⁰ F	90-120
11)	Beet Root	Fibres,K,Vitamins	68 ⁰ F-77 ⁰ F	32 ⁰ F	50-80
12)	Broccoli	(C,A,Bcomplex)*		32 ⁰ F	70-150
13)	Cabbage	(K,C)*Fiber,Zn Cu,Fe,Mn,Cr,Co, Mg	77 ⁰ F-86 ⁰ F	32 ⁰ F	62-110
14)	Kale	Carbohydrates, Sugar,Fiber,Fat Protein,(A,B1,B2, B3,B5,B6,B9,C)* Carotene,Ca,Fe, Mg,P,K,Zn		32 ⁰ F	70-100
15)	Spinach	Ca,Fe,(B9,C,A,E, K)*Na,K	68 ⁰ F-86 ⁰ F	32 ⁰ F	40-50
17)	Chad			30 ⁰ F	
18)	Onion(spring)	Fat,Na,Cholestrol, (A,C,K,B ₁ ,B ₂)*	77 ⁰ F-86 ⁰ F	32 ⁰ F-34 ⁰ F	85-120
19)	Melon(water/ musk)		77 ⁰ F-86 ⁰ F /86 ⁰ F-95 ⁰ F	32 ⁰ F-35 ⁰ F	75-90/ 65-95
20)	Apples	(A,C,B ₉ ,E)*,K,Ca,P,M g,Se,Fe,Mn,Cu	10 ⁰ C-15 ⁰ C	32 ⁰ F-40 ⁰ F	-

CROPS TO BE GROWN IN SETTLEMENT

Processing: The crops collected by robots need to be processed for which they will be sent to the processing unit in the central tank, via transporting rod. First of all crops will be washed. The washing equipments depend upon the size, shape and fragility of the particular kind of vegetables:

1. Floatation cleaner for peas and other small vegetables.
2. Rotatory washer in which vegetables are tumbled while they are sprayed with jets of water, this should not be used to clean fragile vegetables. Second step will be sorting. It includes removal of fragile vegetables. Pre cleaning separator will be used for cleaning the vegetables by a set of sieves. The machines will work with a closed recycling air circuit with limited exchange form outside. It will be applicable mainly in pre cleaning sections of flour mills and other plants where granary materials will be graded and cleaned. Some vegetable require a skin removal. It has 3 processes namely mechanical, chemical and thermal.

In mechanical process, a machine with abrasion device for potatoes, root vegetables and equipment with rotating sieve drum for root vegetables will be used to peel skin.

In chemical process, vegetables are submerged in hot alkali solution. Lye may be used at a concentration of about .5 to 3% at approx 93⁰C for a short time. The vegetables with loosen skins will be then conveyed under high velocity jets of water which will wash away the skin and residual lye.

In thermal process, the vegetables having thick skin such as beets, carrots, potatoes, may be peeled with steam under pressure about 10atm. As they pass through cylindrical vessels, this will soften the skin and will wash away with jets of water at high pressure up to 12 atm. Onions will be peeled by exposing them to direct flame at about 1000⁰C or to hot gases in rotatory tube flame peelers for 1 min. The next step will be blanching. The special heat treatment to inactivate enzymes (catalase and peroxidase) is known as blanching. It depends upon the specificity of vegetables. If these two are destroyed then the other significant enzymes in the vegetables will also be inactivated. Blanching as a unit operation is a short time heating in water at temperature of 100⁰C or below. It will be performed in double bottom cattle's in special baths with conveyer belts. In order to reduce losses of hydro-soluble substance (mineral salts, vitamins etc) during water blanching the temperature should be at 85 -95⁰ C. For drying the vegetables are conveyed directly from steaming equipments to drawing installation without cooling. Vegetable steaming is carried out in continuous without cooling installations with conveyer belts made from metallic sieves. Cooling needs to be done after all above processes to avoid excessive softening of the tissues. It can be achieved by water sprays to reach a temperature value under 37⁰C

For fruits such as apples, berries, mangoes, cherries etc fruit dehydration plant will be set up. The dehydration unit consists of electrical heaters, blowers and trays which will dehydrate the fruits at a low temperature with air recirculating arrangement. The blowers carry the heat from the heaters and evaporate the water of the fruits. The fruit grader separates the damaged fruits from fresh fruits. The jam-jelly machines and fruit juice packaging machines will also set up there for convenience.

NORTH DUNNING HEDWELL

Harvesting:

The robot **Salucus** will cut the required part of the plant and the waste part will be collected for fodder which will be collected by robot **Rancher**.

Storage:

The processed products are then needed to be stored. After sending the required production to the commercial and residential area, the surplus will be stored in the central tank. In central tank where the required conditions like temperature humidity(less than 14%), pressure, and proper ventilation will be maintained. The storage in the central tank will be quite beneficial as it will make more utilization of area and its closeness to the processing unit. The facilities of the Refrigerated storage will also be there as crops need cool storage area. Bellevistat will provide the residents food for six months in case of any emergency.

Packaging:

A bag will be used for packaging the food which is formed of a laminated film of different material with different property. Polyester type sealant layer with low melting point and polyester type sealant layer with high melting point will be combined to form the bag. This bag can be recycled easily. A stable safe biodegradable and microbicidal products to disinfect fruits and vegetables will be used which is PROSAN. The powder concentrate as a water soluble package will be used one the packet of food is dropped in water, the packet dissolve and creates a sanitizer. This sanitizer keeps food safe from harmful food borne bacteria such as E coil, salmonella, cholera, shigella, and staphylococcus. It is able to kill hundred million bacteria in 30 seconds with 99.99% efficiency and the taste flavor and color of fruits and vegetables is maintained. It can be used on counter tops, cutting boards, utensils and forks. This makes it useful in hospital, restaurants and offices.

Delevering:

The manufacturing goods in the central tank will be transferred via the transporting rod. The robot Terminator will transport the goods to the location of requirements. The requirements will be sent to the transportation control centre from where the whole transport of goods is supervised.



Selling:

The manufacturing goods will be collected by the consumers from the shops and the malls. The cost of the production will be fixed by the maintenance society.

To maintain the biological balance as well as to fulfill the human needs for non-vegetarian food, animals DNA will be brought to the settlement. They will be evolved by using the technology of DNA cloning. Special areas will be provided to them so as to grow and reproduce. The food requirement of the animals will also be fulfilled inside the special areas.

Name of animal	Sorghum	Soybean	Corn	Animal meal	Fish meal	Consumption by humans	Number
Steers	77760kg	51840kg	-----	-----	-----	75 g/person/day Steers	1,800
Dairy cattle	25200kg	7200kg	-----	-----	-----	.5kg/person/day Milk	800
Rabbits	90000kg	90000kg	-----	-----	-----	40 g/person/day Rabbits	28,000
Fish	-----	48115.3kg	-----	38973.6kg	-----	40 g/person/day Fish	139,000
Laying hens	-----	3060kg	4590kg	-----	-----	24 g/person/day Egg	1,700
Chickens	-----	139050kg	-----	-----	34299kg	40 g/person/day Chickens	51,500
Total	192960	339265.3	4590	38973.6	34299	-----	2,22,800
Area	25520m ²	188481.1m ²	4262.26m ²	-----	-----	-----	95,000m ²

LIVE STOCK REQUIREMENTS

3.2.b POWER PRODUCTION AND DISTRIBUTION

The main power supply of Bellevistat will be based on solar cells as an ample amount of solar energy will be reaching the settlement. Therefore, a revolutionary technique of utilizing and harnessing is necessary to fulfill all the energy needs of the settlement. Nanocrystalline solar cells i.e. quantum dot solar cells will be used as solar cells. These quantum dot solar cells have an efficiency of 70% which is increased to 80% with help of carbon nanotubes which will be coated on it and a per watt price of \$100 or less per m². Besides solar cells two more power sources which is the remains obtained from glass recycling plant and the solid waste recycling plant which is when dried and mixed with non-recyclable paper and textile waste obtains a calorific value of 18 MJ/kg. In case of any failures, flywheels will be used as a back up power source.

POWER REQUIREMENT	
Requirement per capita per hour	6.06 KW/hr
Requirement per capita per day	145.44 KW/day
Residential requirement per capita	1.56 KW/hr
Residential requirement for 19000 persons	29640 KW/hr
Agricultural requirement per capita	.85 Kw/hr
Agricultural requirement for 19000 persons	16150 KW/hr
Industrial requirement per capita	3.65 KW/hr
Industrial requirement for 19000 persons	69350 KW/hr
Total requirement for 19000 persons per hour	115140 KW/hr
Total requirement for 19000 persons per day	2763360 KW/day
Requirement per person for 19000 persons in joules	9948096000 kj

BACKUP SYSTEM

Since the settlement is orbiting around the earth so there will be 15 day dark phase when no sunlight will be there. So the settlement, away from the sun, will fulfill the energy requirement through a back up system installed in the central tank. Fly wheels connected with super-capacitors will be used for this job. Flywheel is a device used for storing energy or momentum in a rotating mass. As the large angular momentum is required to store more energy, supercapacitor is used to fulfill this need. Super capacitors can be charged and discharged for unlimited no. of times. They can discharge in matters of milliseconds and are capable of producing large amount of current. Hence they are very useful for heavy load applicants and fields where a sudden boost of power is needed in a fraction of a second. They also do not release any thermal heat during discharge. Flywheels are mainly based on energy storage system. They are able to store energy more efficiently than any type of rechargeable batteries.

Electric Power System (EPS) Advantages	
Energy storage characteristics	Resulting Benefits
5-10+ times greater specific energy	Lower mass
Long life (15 yr.) unaffected by number of charge/discharge cycles	Reduced logistics, maintenance, life cycle costs and enhanced vehicle integration
85-95% round-trip efficiency	More usable power, lower thermal loads, compare to <70-80% for battery system
High charge/discharge rates & no taper charge required	Peak load capability, 5-10% smaller solar array
Deterministic state-of-charge	Improved operability
Inherent bus regulation and power shunt capability	Fewer regulators needed
Magnetic bearing suspension reduces vibration	Improved sensor payload performance, and microgravity environment
Large momentum storage capability due to friction	No decrease in speed level

POWER BACKUP

- Energy storage specifications:
- 1 Very high usable specific energy-saves mass.
- 2 Higher efficiency-saves power

- 3 Long life-15yrs in LEO
- 4 Less volume than Nickel hydrogen Batteries

Due to these favorable properties & characteristics of fly wheels, they will be used as power backup system.

Energy Saving:

A energy is the basic requirement of settlement RSK reflectors will be used. It is a reflector made of synthetic film, coated with alluvium surface. Due to aluminum conversing, it is not affected by chemical and environment factor. It is capable of adjusting in place of eight fluorescent lamps which is very cost effected. It is 50% lighter than any other reflector. It requires low cost maintenance and easy to be fitted, requires no more than a minute due to light weight. It offers a superb efficiency which reduces the energy consumption of 50%. It also reduces the loss of energy up to 45%. It keeps working in a temperature range of -200°C to 130°C. So it is capable of saving the energy which will be used for the settlement need.

3.2.c INTERNAL COMMUNICATION:

It is quite necessary to keep communicating with earth and those who live inside the settlement to maintain the closeness & attachment with our species. To fulfill this requirement APCOS 4000 (advanced platform communication system) will be installed in the settlement. The main feature of this system is:

- 1) Most reliable END-TO-END communication.
- 2) Unjustified Networking switching.
- 3) Integrated Ethernet
- 4) Switching of voice Data, video, Ethernet.

APCOS 4000 will be capable of providing communication network requirement such as:

- 1) Tactical voice communication.
- 2) Internal voice communication
- 3) External communication with radio system (Such as ITRS)
- 4) Voice, data control signal routing and switching
- 5) IP routing, voice over IP computer to computer network
- 6) Voice control Terminals (VCT)
- 7) Separation of classified and unclassified information to ensure IT security.

Communication networking will be done by using optical fiber cables. APCOS-4000 consists of:

- 1) Network Nodes
- 2) For switching and concerning
- 3) Interconnected via reluctant ATM network links.
- 4) Terminal Adopters (TA) for the Adaptation of the external Terminals.

The system consists of latest SDH-ATM technology which is the backbone of networking, and has an ability to expand to form large networks.

It consist of many outstanding features and flexibility such as new terminals for voice and control VCT for strategic communication, So it can fit the need of modern combat system and can be used for personal communication. Its menus allow access to any combination of communication channel and remote control of radio or machine according to need.

Communication reliability and security:

Flexible network idea with enhanced combat survival automatic reconfiguration is considered to avoid the damage added with VCTs and others which add to its security along with security in terms of red/black separation to protect eaves dropping of secure information. It is easy to operate and maintain, requires, less standard modules and full exchangeable modules (non tuning / alignment) standard telecom components which add to its optimized logistical and life cycle support.

It provides Audio/data switching and distribution terminal capabilities for existing system and digital data and remote control system for all users like VCTs Public address, radio modems, cryptos and other sub systems. It nodes with Quadruple 622Mb/sand also helps in easy network extension by adding nodes. Nodes may be connected to other ATM Network, configuration of large no. of wires network is also possible.

Terminal Adapters & Terminal Adapters Unit:

Each terminal of APCOS is connected to a terminal adapter. The TA codes the incoming and outgoing voice, audio, digital serial data and remote control signal for the terminal. Coding is done by following signal.

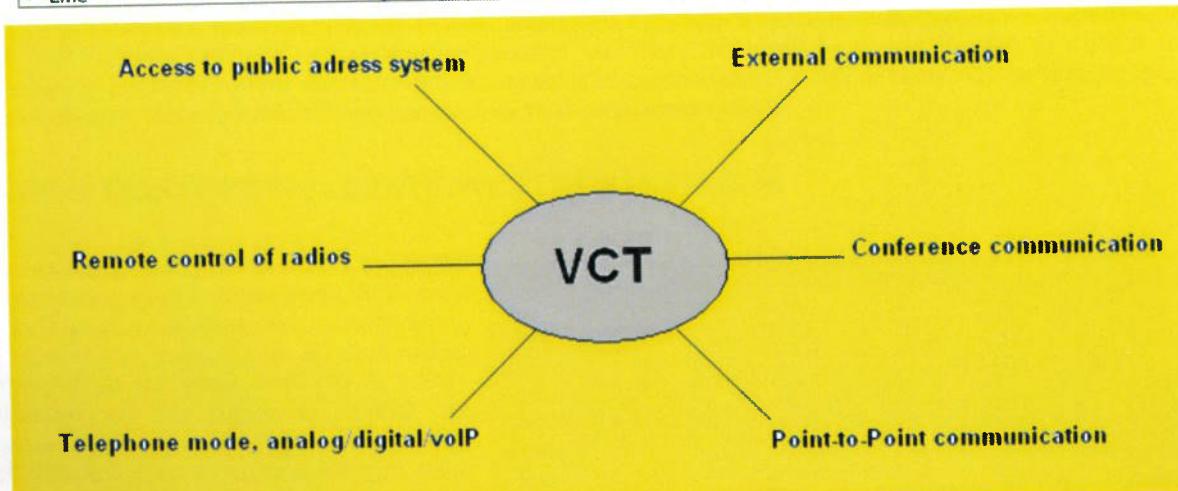
Each TA can be connected to two nodes to increase system reliability and functional survivability.

- Voice (3.4 kHz)
- Music (10kHz)
- Wide band audio (22 kHz with 80 dB dynamic for Sonar & ESM)
- Digital synchronous and asynchronous serial data (up to 64 kbps for MHS, Modem and Cryptos)
- Remote control data to terminals

Following type of TA use in the system:

DIGITAL COMMUNICATION NETWORK APCOS 4000

<ul style="list-style-type: none"> • Number of Nodes • Data Rate Network • Data Rate Node - TA/VCT • Max. Distance Node - VCT • Transmission Media Network • System Reaction Time • Audio Channel Bandwidth • Signal to noise ratio • Cross Talk • Power Supply • EMC 	<ul style="list-style-type: none"> 1....> 20 per network 622 Mbit/s + 10 Gbit/s Ethernet 2 Mbit/s E1 + 10/100 Ethernet appr. 300 m Fiber Optic Cable (FOC) < 70 ms 3 kHz, 10 kHz and 22 kHz <u>channels available</u> > 55 dB > 100 dB 18-32 VDC acc. STANAG 1008 acc. to MIL-STD 461, class A3 	Voice and Control Terminal (VCT): For tactical external/internal communication various types of CT in APCOS
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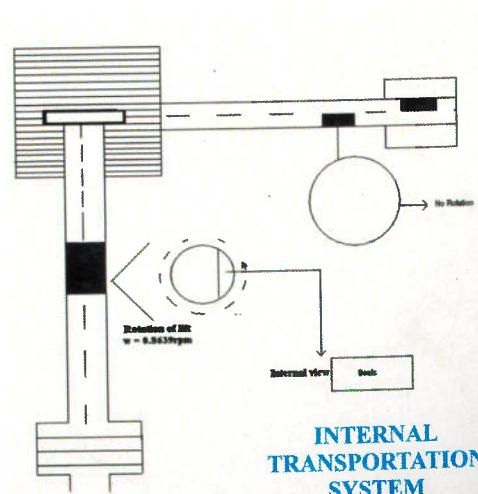


3.2.d EXTERNAL COMMUNICATION:

All the satellite vehicle of the Bellevistat will be equipped with receiving transmitting antenna & radars. The satellites will be use high frequency signals for date transfer to the ground station on the earth & also will maintain a link between the vehicles & other space base. There will be antennas installed above the central tank so to be connect the satellites

3.2.e INTERNAL TRANSPORTATION:

To maintain link between different parts of torus, transportation with an important segment to be looked upon. Internal transport system will be based on tram system which will run over the track. Trams will run over the agricultural area at about a height of 20m above the ground. Conveyor belts and flyovers will be constructed over river to prohibit any kind of disturbance. A number of stations will be built in different areas except the agricultural area and the distance between two stations will be 682m. Four tracks will run parallel to each other having trams moving in opposite direction. PRT vehicles will be used in hospitals for emergency.



Transportation from rotating to non-rotating part:-

For transportation between rotating and non-rotating part it is very necessary for us to come over the acting coriolis force i.e. main torus and central tank are rotating while docking parts & lower transportation tube are non-rotating. The lift in non-rotating part moving from lab at the bottom to rotating central tank will run. When people will sit in it, it will rotate with same omega as the rotating part. The lift will thus enter the rotating part slowly. Near the central tank six lifts in separate tubes will transport people and goods to various parts of residential, commercial and agricultural area.



The circumference of outer surface of the torus will be only 7.536km. It means the maximum a person will ever have to travel is 3.786km to get to any destination inside Bellevistat. So it is not necessary to provide the resident with transportation system as people can walk the distance. But due to stress of work some relaxation will be provided to residents. This is also done to provide public service which is an alternate means of transportation. For the purpose of public transport PRTs will be used. Along with PRTs which will provide all time services at the nearby stations. Bicycles will also be provided for personal use. Since there will be a river flowing throughout the settlement, so it will provide one more option for means of transportation i.e. use of boats. All the vehicles being used will produce no noise & will only use electricity as energy requirement.

3.2.f ATMOSPHERE/CLIMATE/WEATHER CONTROL

To maintain life processes adequately the organisms require an atmosphere. Bellevistat will have its own atmospheric composition. The necessary gases for the survival will be provided in the torus. Nitrogen is a very essential gas for plants as nitrates are consumed. Nitrogen and argon decreases the combustion effect of oxygen. Oxygen is the main gas which is required by every living being.

Gas	Composition(in %)	kPa	mmHg
O ₂	37.9	19.21	144.08
N ₂	60	30.42	228.16
Ar	.9	0.91	6.82
CO ₂	.2	0.204	1.53
Water	1	1.08	8.10
vapour			
Total	100	51.824	388.69

TEMPERATURE CONTROL SYSTEM:

As there is no natural medium to control the temperature, a temperature control system called MEMS will be used for this purpose. It uses a thermodynamic cycle to provide cooling or heating directly to a thermally loaded surface. To precise temperature control it can be switched between cooling and heating modes in milliseconds. Fabrication and assembly are accomplished by wet etching and water bonding techniques which are used routinely in the semiconductor processing.

The basic capabilities of MEMS are:

1. Extended environment temperature range in harsh environments.
 2. Lower operating temperature for electronics and other components.
 3. Precision spatial and temporal thermal control for temperature – sensitive devices.
 4. The enabling of micro system devices the require active cooling and/or temperature control.
- The device will be used for precise thermal control as well as cooling.

Atmosphere supervising sensors:

Temperature monitoring will be done by using GE-Rockford's temperature sensor, wire-wound sensors and thermistor sensors. The characteristics of these sensors are:

Transportation from rotating to non-rotating part:-

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Water vapour	1	1.08	8.10
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Atmosphere supervising sensors:

Temperature monitoring will be done by using GE-Rockford's temperature sensor, wire-wound sensors and thermistor sensors. The characteristics of these sensors are:

1. Engine overheat warning
2. Duct temperature sensing
3. Outside air temperature measurement
4. Have a positive & negative temperature coefficient.
5. Stainless steel enclosures that withstand high stress duct environments.

Atmospheric impurities sensing and purification system:

The impurities in the air will be detected by using Tunable Diode Laser (TDL) gas sensor system. TDL gas sensors have applications for industrial process control, smokestack monitoring, environment monitoring, atmospheric science, aircraft safety and medicine. Such detection includes water vapour, ammonia gas, acetylene, carbon dioxide, hydrogen chloride and hydrogen fluoride gas. This sensor will be capable of detecting relative moisture level and also low level of gas at the parts-per-million or even parts per billion level.

Whenever impurities will be traced by these sensors Dutch Breeze carbon air filters will be used to remove pathogens from air to about 99.5%. It purifies air and prevents odour and disease causing organisms from entering or growing in environments. It will reduce air borne diseases.

Snow Fall

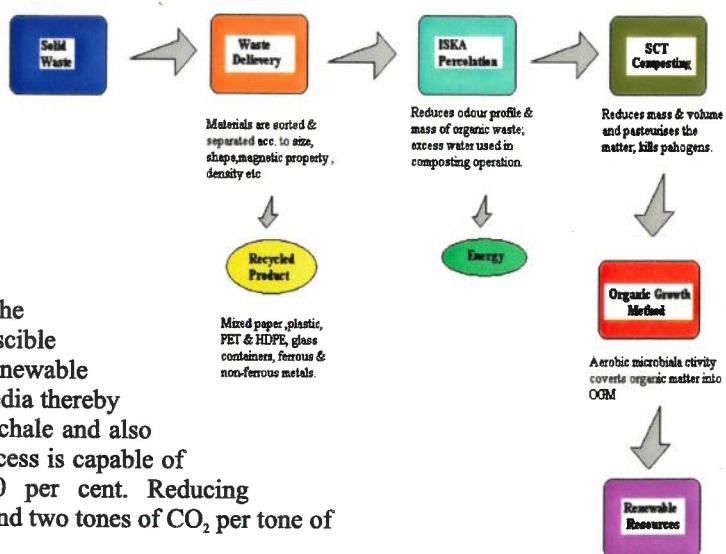
Snow and rain add to the scenic beauty of any place. So, snow making & rain making devices will be installed. The machine is feasible and noiseless. If the temperature is above 0°C and the relative humidity is low it will provide snow fall and give out rain when humidity is high and temperature is low. It produces powdery snow flakes.

3.2.g FIRE DETECTION:

Maintenance of false alarms is the major problem in the fire detection. Many optical detectors are not able to discriminate between different types of smoke. So the system consisting of electronic noses, which are capable of discriminating between different types of smokes will be used. These conducting polymer sensor arrays, when combined with suitable mathematical method can provide such information. The three major elements of this sensor are: sensor arrays, exposed to volatiles, conversion of sensor signals to readable format, software analysis of the data. Interpretation from sensor can be done by various methods like pattern identification, component analysis, discriminated function analysis, cluster and artificial neural network analysis. This system can discriminate between fire type. With this system bestouch package system will also be used which can be connected to various kinds of detectors. Further its function can be controlled with remotes. Two attached detectors will consider data communication with the help of initially embedded monitors without a separate translator to minimize the risk. The system has various features such as automated extinguishing emergency power which works automatically in case of power failure. It can be displayed on LCD and LED which will help in discriminating the situation, easy to control and operate, integrated watch based on digital data communication (RS485) and detection.

3.2.h SOLID WASTE MANAGEMENT:

To utilize the solid waste coming from household sector, commercial sector and from agricultural sector a technology namely UR-3R process will be used. It is able to deliver the waste solution by reducing green house gas and leachate emissions by processing the putrescible portion of the waste stream, recycling the valuable recyclables from the non-putrescible portion recycling the organic portion into renewable energy and high quality organic growth media thereby reducing greenhouse gas emission and leachate and also helping to close the carbon cycle. The process is capable of increasing recycling rates by over 100 per cent. Reducing greenhouse gas emission by between one and two tones of CO₂ per tone of MSW and generating renewable energy.

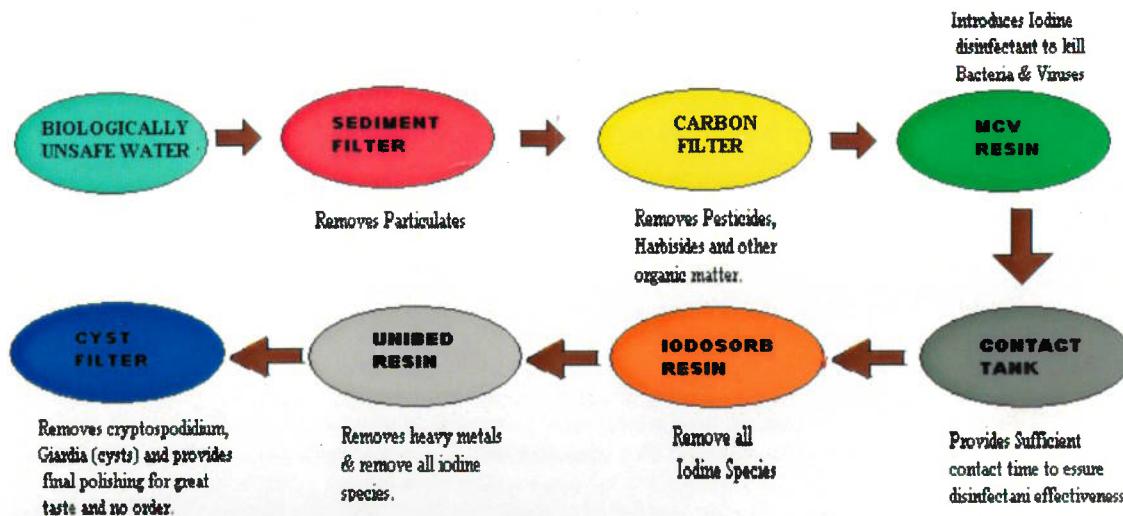


Once the material is dried it has a calorific value in excess of 12MJ/KG or can be combined with the non-recyclable plastic, paper and textile waste fractions to produce a fuel with a calorific value in excess of 18 MJ/Kg.

3.2.i WATER MANAGEMENT:

Water purification: Water is indispensable for human health and well being. A person can not live for more than a few days without clean drinking water. The system used for this will be "Discovery WSC4". The system is capable of purifying the waste water from respiration, sweat, sewage water into drinking water.

The other microorganism contaminants being removed by this system are.



This system has a capability of purifying water at the rate of 4 Gallon per minute. Some of the major advantages of this system are that it does not consume electricity and maintenance cost is very low.

SUBSTANCE	INFLUENT CHALLENGE CONCENTRATION	REDUCTION
Chlorine	2.0mg/l +/-10%	99%
Turbidity	11ntu +/-1	>95%
Cysts	minimum 50000/ml	99.95%
Poliovirus/Rotavirus	28500pfu/ml	>99.99%
Ms2Phage	509000pfu/ml	>99.99%
Klebsiela	11000000 cfu / 100ml	>99.9999%
Virus		99.99%
Bacteria		100.00%

WATER DISTRIBUTION

There will be six water management plants located in each of the residential and commercial areas. Two water purification plants will be installed at one location to reduce the occupied area. The location has been selected keeping in view that the waste water coming from public areas and live stock area, agricultural area and the river water is purified easily. The water requirement of 19,000 residents is 665,000litres per day. The water management plant will be capable of purifying and supplying this required amount of water. The pipes will be made of copper coated with thermosil. There will be no need of transporting water from earth because there is a huge reserve of ice on moon. There are about 6.6 billion tons of ice on moon of which 4.6% is at North Pole and 3% at South Pole. This huge reserve is sufficient to fulfill the need of the settlement. Half of the total volume of required water will be stored in the central tank for emergency need.

3.2.j DAY NIGHT CYCLE PROVISION:

A 12 hr day and 12 hr night cycle provision will be created to reflect natural phenomena. A large partially polished mirror of radius 1200m, inclined at 45° with the settlement will rotate on its axis to provide the day night cycle provision. But this will be useful only when the settlement is in the light phase i.e. in front of the sun. When the settlement will enter the 15 days dark phase i.e. behind the earth, the need of light will be fulfilled by energy backup system & artificial lightings. The rotation rate of mirror will 6.944×10^{-4} rpm for a complete 24 hrs day and night cycle provision.

3.2.k INTERIOR FINISHING MATERIAL:

The houses will be provided with automatic lighting, doors, taps system.

Liquid metal vitriol is a new type of metal that is twice as strong as titanium, but behaves more like a plastic with its flexible, moldable properties. Due to its specification it will be used in interior finishing works of kitchen, bathrooms etc. As it is resistant to permanent deformation from impact and more elastic. So it can be used for flooring purpose.

Smart Glass: It is required to keep care of privacy along with beauty in buildings, hotels, malls etc. So, LC smart glass has been chosen for this purpose. The glass includes a vast range of properties which can be mainly classified as:

1. Partitioning can create good effects internal partitioning replaces the use of curtains & internal blinds, pass approx. 77% light in both on & off modules, sound proof tugging & low maintenance mentally pleasing, Being use in teller screen showing if door is open or closed, enhance domestic & corporate image.
2. Screens- Contains high- resolution perfection screen, switching on and off using preset routines can help catching special eye effects, creates comfortable lighting effect in room.
3. External Glazing front of a shop can be turned into advertising medium, can be glazed (single/double) including low E glass resulting improved performance and reduced solar heat gain, reduced solar glare, increases the sense of security, makes the world see you in a different way and improves corporate image.
4. Security & safety can hide precious items which are to be viewed only by a selected person, Add to security & safety which is due to the bogeyed and laminated glass construction can be supplied in low/no space bullet proof configurations according to customer requirements.
5. Internal uses: Can be used in Boardroom & offices, exhibitions, bespoke cabinetry, showrooms, Desk partitions, Room dividers, Teller screen.

FURNITURE:

The residents of Bellevistat will be provided with comfortable furniture's the following data below gives details of furniture and materials:

1. **TABLE CUM REFRIGERATOR:** It will prove to be a useful product for the people who have habit of forgetting. This smart table has a circular refrigerator, containing glass shelves and food trays. It is built of materials including stone or glass. At the touch of remote central button a circular refrigerator rises from the center of the appliance.
2. **SMART DRAWING ROOM SET:** A collection of four powder coated aluminum frame chairs with a table. When it is not in use it can be stacked up to make room spacious. They form another piece of art when stacked.
3. **SMART CHAIR :** A chair features fiber glass exterior painted with automotive paint and cotton upholstery on molded foam interior.
4. **BIBLICOCHAISE CHAIR :** There is a **biblicochair** that can hold up to 'five meters' worth of books. It is designed to emphasize illustrated books. This type of furniture an also be designed to expose food in kitchen area.

KITCHEN EQUIPMENT:

- 1) A multipurpose Halogen cooking pot combines numerous cooking functions in one machine, which can replace more than to traditional electrical appliances including oven, rice cooker, stewpot, sterilizer, skillets, griller, toaster, bread maker, egg maker, etc. Cooking time is 3 times faster than conventional appliances; therefore, food nutrients will not be lost during the cooking process. Multi-purpose cooking Pot is easy to operate, time saving and energy-efficient.
- 2) A cost effective and self working system which is easy to handle than any conventional combi steamer will be used. By using a touch screen, simply select the food and now you want it cooked. The self cooking system does the

rest automatically selecting the cooking mood, temperature time and humidity level. At last, a fine food according to your taste will be served.

Kitchen steam cleaning: A steam cleaning machine will be used to clean all types of commercial residential kitchens. It has a time saving steam cleaning marching. It is capable of cleaning all type of surfaces like safety flooring, vinyl, tiles grout or stainless steel. It will be used to emulsify grease on canopies, disinfect surfaces, kill bacteria on contracts sanities and unblock drains.

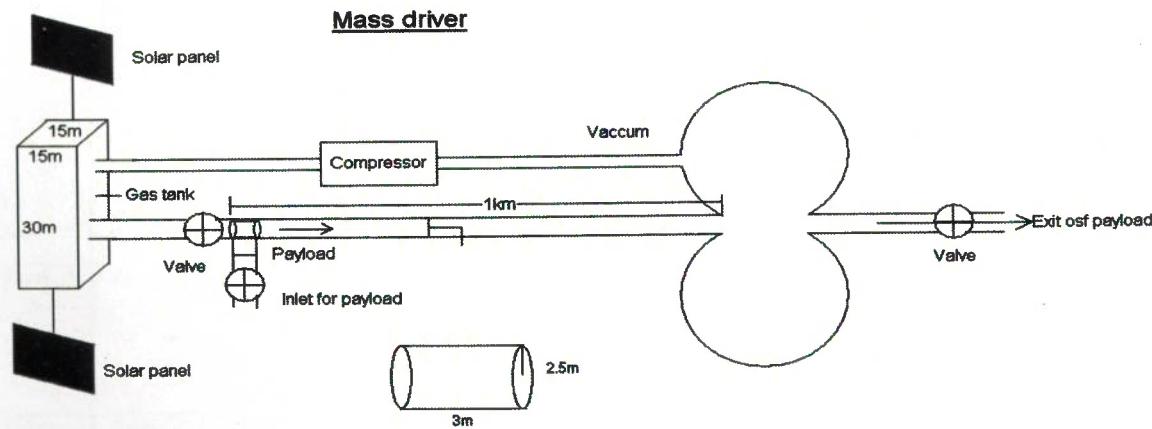
3.3 SPACE INFRASTRUCTURE :

3.3a EXTERNAL TRANSPORTATION SYSTEM:

It is a major requirement for Bellevistat because it will play its role from the time of construction to the transfer of persons & goods to the settlement. It will be used for future tourism. During the construction period materials will be coming from moon & as well as from earth. So reusable launch vehicle will be designed & used so as to reduce the transportation cost. Some of the vehicles will transport the personnel & goods to LEO & other vehicles with transfer them to the settlement. The materials for construction will be transferred from moon to settlement by using mass drivers & mass catchers.

3.3.b MASS DRIVER:

The main source of construction material for our settlement will be moon as coming or going to moon by our space ship is easy. So this system will be set up on the moon which will be capable of transferring the material from moon to the settlement quite easily. It will work when the gas pressure will be applied on the payload. A large tank of size 15m x 15m x 30m will be filled with gas and will be joined with an accelerating tube of 1km and the payload will be placed in that tube. A plate will be placed between the payload and the gas valves. When the gas valve will be opened, the gas will exert pressure on the plate and plate will strike the payload resulting in the payload to move forward. In the 1km long tube the gas will accelerate the payload by applying a very high pressure. At the end of the accelerating tube the payload will be released and the plate will attached to the end for making sure that the gas is not leaked. The compressor will be used so that the gas can be again filled in the tank which can be used again. This mass driver will be capable of driving of launching small & large payloads & annual mass which will be transferred to the settlement from the moon will be of 1 million ton.

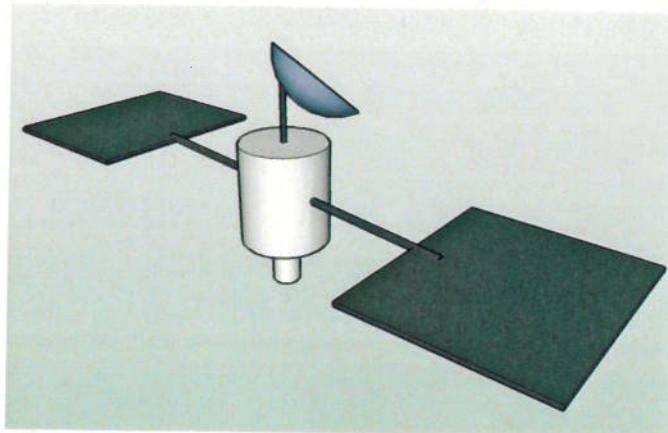


3.3.c MASS CATCHER

This catcher will be used to catch the material released by the mass driver or by the robots. The front view of the mass catcher will be rectangular and will be held by four strong rods having length 700m and width 1000 meters. In the front there will be two generating wheels which will lie opposite to each other. There will be a large tank of width 950m placed inside the large tube for catching the material. The large tank will be connected to the generator wheels by a strong metal rope. The wire of the generator will be wound around the tube and of the other generator around the tank. At last, there will be storage tank of dimension (100x100) m for collecting payload. When the material will strike the tank, than it will move inside the tube along with it. The generator will be started because of the stretched rope and the current will be produced and it will travel throughout the wire. Then the wire which was rolled around the tube will produce magnetic field and the wire will act as a solenoid. The continuous flow of current will create magnetic poles. The arrangement will be made as if the same poles come in front of each other and they start repelling each other. Hence the material will slow down. The rope will be stop in front of the storage tank. Then the material will be collected and stored in storage tank and will be transferred to the Bellevistat.

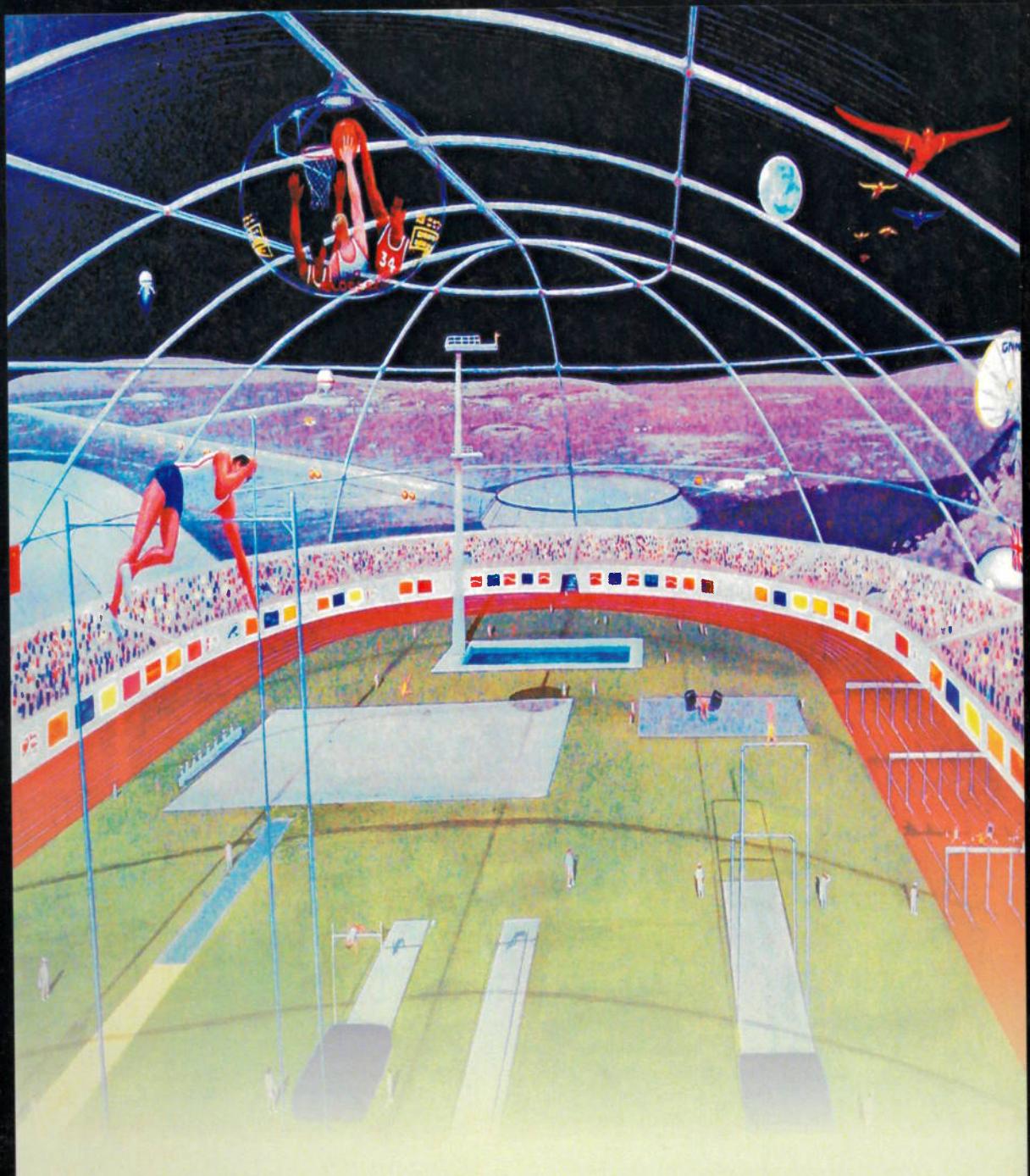
3.3.c SATELLITE:

Communication with earth, space vehicle & other space bases is an important point to be taken in care. Also one eye is needed to be kept at the space & the happening occurring there. So, satellites will be equipped with all the required facilities like signal transmitters & receivers, radars, camera & telescopes. Two satellites will be orbiting & one will be at the zero gravity zone. Antennas & radars will also be there on the top of the central tank which will be connected to the communication servers.



3.3.d VEHICLES FOR SPACE TRANSPORTATION

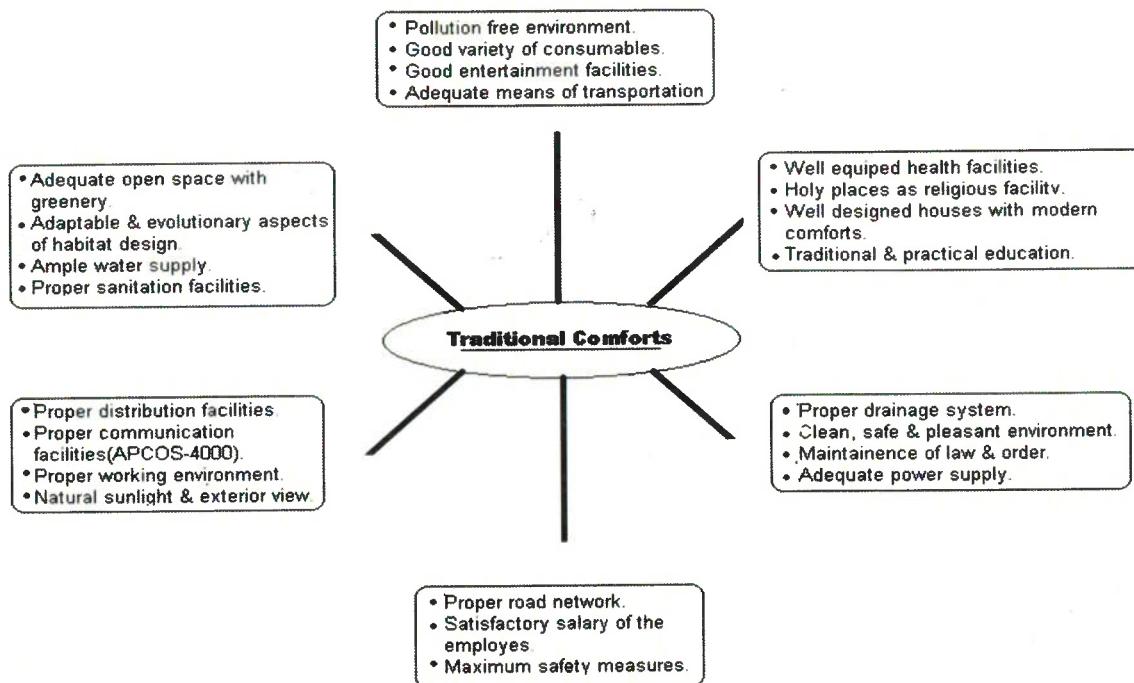
<u>FROM</u>	<u>TO</u>	<u>NAME NAME</u>	<u>SPECIFICATION</u>	<u>IMAGE</u>	<u>POSITION IN CONTRACT</u>
<i>Earth</i>	<i>LEO</i>	<i>Skylon</i>	An unpiloted fully reusable air craft. Transporting 12 tons of cargo and is intended as a replacement for expensive, expendable launcher.		Included
<i>Earth</i>	<i>LEO</i>	<i>Hotol</i>	A horizontal take off single stage to orbit reusable rocket engine that would have burned compressed air rather than liquid oxygen up to a speed of mach-5.		Included
<i>Earth</i>	<i>LEO</i>	<i>Davinci</i>	A piloted hot air balloon lifts the vehicle to an altitude of 40,000feet. Kerosene engines and then ignite with the vehicle suspended at 60° altitude and detaches from balloon before assuming vertical orientation and climbing to 130,000feet and continuous of height 120km before descending back into the atmosphere approximate 3minute of weightlessness. Reentry and landing is achieved first an inflated shuttle cock for stability and then a protective inflated cone to shield the engines and cushion the landing. A parachute is deployed at 1000feet showing davinci to 9m/s on contact with the ground.		Included
<i>Earth</i>	<i>LEO</i>	<i>Saenger</i>	It is 2-stage launch vehicle. First stage would use air breathing rocket engines to reach approximately mach-6 at which the upper stage would separate and use rocket engines to reach orbit. Upper stage carry 36,40,44 passenger.		Included
<i>Earth</i>	<i>LEO</i>	<i>Canadian arrow</i>	It will of 2stage suborbital rocket design to take 3 people into space and back. 1st is liquid propellant whose aerodynamic shape thrust chamber. It boosts the vehicle to the edge of space at maximum of 4.5G acceleration before detaching and falling back for a parachute slowed splash down and recovery. The second stage use solid rocket engines to rise to an eventual maximum altitude of approximate 70miles. Three main parachutes to make its own splashdown roughly 15 miles down range.		Included
<i>LEO</i>	<i>Different planets</i>	<i>Aero spear</i>	It will be based on Xenon ion propulsion system. It can attain a high speed and also can carry a large payload.		To be developed



HUMAN FACTORS

4.0 HUMAN FACTOR

The Bellevistat will provide a tremendous quality of life which will fulfill the resident's traditional comforts, comforts in houses, fine food, access to entertainment, natural sunlight and view of earth & space. The residents will enjoy all those facilities they enjoy on earth without any sacrifice. The Bellevistat has been designed keeping in mind all the psychological effects that will come into action during a long stay in micro & zero gravity regions. The traditional comforts that will be enjoyed by the residents of the Bellevistat are as follows:



TRADITIONAL COMFORTS PROVIDED TO BELLEVISTAT RESIDENTS

Facilities for services of a comfortable modern community of the Bellevistat are as follows:

FACILITIES FOR SERVICES	
<ul style="list-style-type: none"> ❖ Tourism to moon ❖ Door to door service through robots ❖ Driving centres to help people learn driving ❖ Esc tasy (PRT) for public service and hospital facilities ❖ Bicycles for personal use ❖ Ample water supply ❖ 24 hr power supply during 15 day dark phase which will be produced from quantum dots, flywheels, glass recycling plant, heat strike generator, solid waste management ❖ Robots for maintaining the society ❖ Industries for all basic requirements including clothes, paper furniture, steel industries ❖ Maintaining the society with law through maintaining society 	<ul style="list-style-type: none"> ❖ Emergency exits ❖ 24 hour emergency service in hospitals ❖ Hi-tech practical education provision ❖ Voice communication, future radio system, control system routing, computer to computer communication through APCOS-4000 ❖ External communication to earth through satellites attached with APCOS-4000 ❖ Maintaining society will also maintain the stock exchange ❖ Conveyer belts to cross the river ❖ Information centers for the tourists ❖ Provision of space suits ❖ Space crafts for transportation of personals from earth to torus and vice versa

SERVICE FACILITIES OF HUMANS IN SETTLEMENT

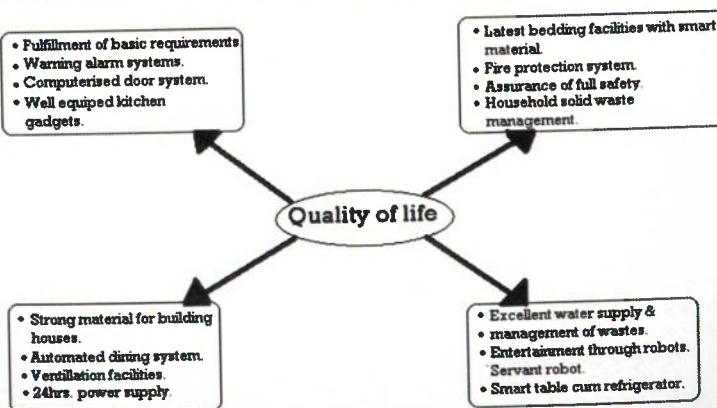
4.1 COMMUNITY DESIGN

AREA DISTRIBUTION

Structure	No.	Dimension (feet)	Area (sq.feet)
Apartments	126+251		974915.4496
Houses	900+450		1565379.475
Roads		15% of total area	1444158.773
Hospital A	1	262.4 * 164	43033.6
Hospital B	1	213.2 * 262.4	55943.68
Malls	2	360.8 * 410.984	296566.0544
School	1	186.8 * 328	64550.4
Station	4	49.2 * 49.2	9682.56
Function Hall	2	196.8 * 393.6	154920.96
Hotel	2	213.2 * 262.4	111887.36
Museum	1	246 * 341.12	83915.52
Holy place	4	319.8 * 131.2	167831.04
Amusement park	1	510.04 * 820	417775.568
Library	1	196.8 * 164	32275.2
Public service area	4	82 * 85.28	27971.84
Control centre	2	131.2 * 213.2	55943.68
Water management	6	85.28 * 131.2	67132.416
Waste management	4	131.2 * 213.2	111887.36
Office complex	5	229.6 * 164	188272
Storage	1	262.4 * 131.2	34426.88
Planetarium	1	164 * 426.4	69929.6
Bars & restaurants	4	131.2 * 164	86067.2
Lab	1	295.2 * 164	48412.8
Sports complex	1	787.2 * 410	322752
River	1	49.2 * 7501.36	369066.912
Power plant	1	328 * 328	107584
Park		11% of total area ex(amusement park)	641274.2275
Forest	1	10% of total area	962772.5511
Meditation centre	4	65.6 * 82	21516.8
Race course	1	410 * 656	268960
		TOTAL AREA	8806805.907
		REMAINING AREA	820919.6044

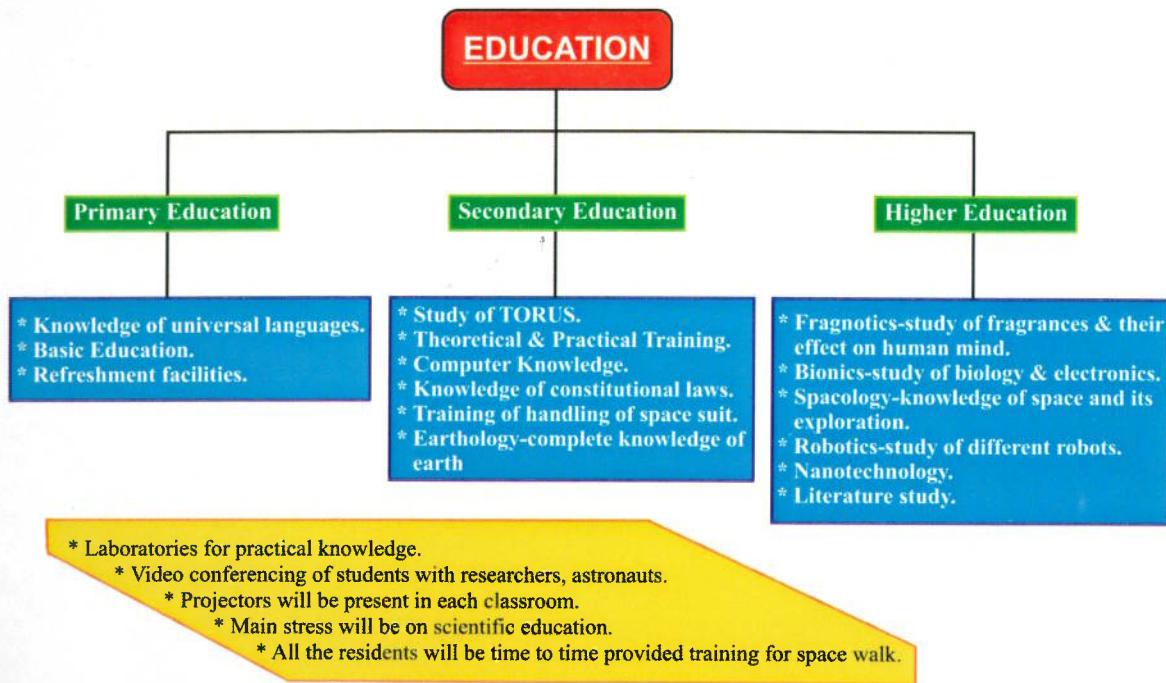
4.1.a QUALITY OF LIFE

a) Housing –Bellevistat will provide a comfortable & smart way of living. There will be 754 apartments for singles & each apartment will comprise of 16 flats with four floors .Together there will be 2700 houses for the couples or families .Other features of housing is that there will be societies comprising of groups of apartments & houses .There will be gyms ,dispensaries ,community centre ,control centre ,parks, play stations ,ponds etc in each society.



b) Parks- Bellevistat will have 11% of the total area of each block as park including an amusement park featuring 3-D space shows, stormforce, maelstrom, shockwave, vertical drop & many other recreational facilities especially for children .The river flowing through the amusement park will also provide a pleasure to the people .The parks which are a very good asset of natural environment will also support the biological balance.

c) Education- The education that will be provided will be traditional, hi-tech, modern & scientific .The main stress will be on providing technical& practical knowledge

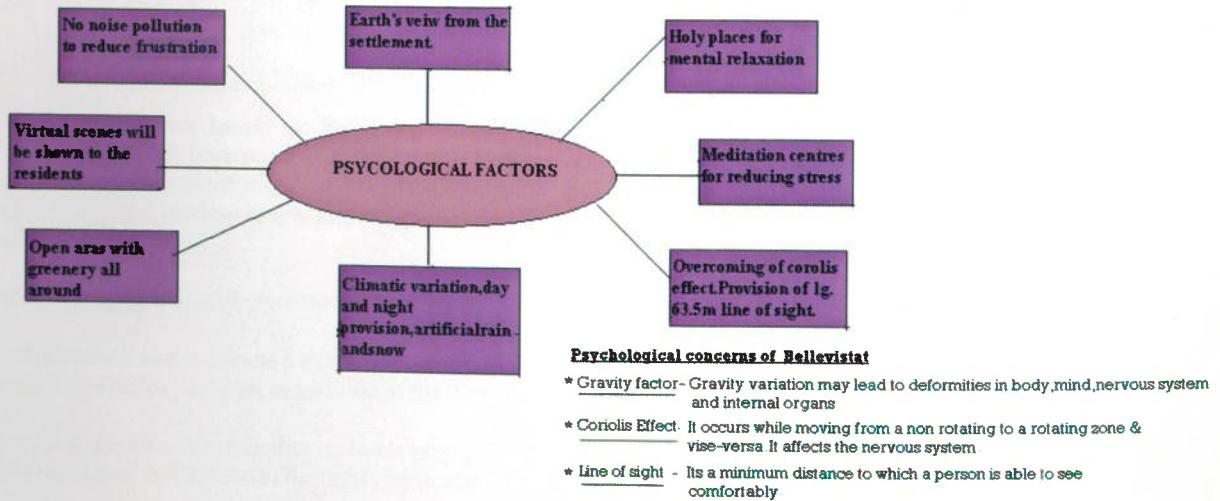


EDUCATION SYSTEM IN SETTLEMENT

* Libraries which will be present in the school as well in the city comprise of 40% print media & 60% electronic media. There will be provision for research labs in different regions of zero, micro & normal gravity. This will be done because there are several experiments that act differently in different gravity regions.

d) Medical facilities- The hospitals will be well equipped with latest tools & machines & fully computerized network. There will be special emergency ecstasy(PRT), which will serve as ambulance. Each hospital will have the capacity to accommodate 1500 patients at a time. There will be 2 hospitals in one R & C block (one big & one small).

*Psychological factors that affect the health are -



FRAGRANCES & THEIR QUALITIES

Muguet	Provides happiness, increase relaxation & stimulation , lowers depression , apathy and irritation .
Douglas Fir	Lowers negative moods.
Pine Needles	Provides ease to travelers and the stress of travel.
Tuberose	Relaxing and sensous profile , enhance romantic moments , lowers depression
Osmanthus	Stimulating and happy quality to reduce apathy and depression
Hyacinth	Increases happiness , sensuality , relaxes and stimulates while lowering negative moods
spiced apples	Ward off panic attack and reduces stress levels
lavender vanilla/rose/neroli	Provides relaxation to body
lavender	Aids the relaxation and sleep process
cedar wood,cinnamon,clary sage	Known for their aphrodisiac properties.
Aromas	Increases saliva and stimulates the digestive track which encourages the efficient metabolism of food

*For the convenience of the residents PDA (personal diagnosis assistant) & MOTE will be provided which will time to time inform the people about their health. PDA is a type of gadget that will tell about the location maps & several other functions such as e-mail, browsing, photography, positioning, surfing systems etc.

*Physical exercise is also recommended with a balance and properly cooked food.

4.1.b VARIETY & QUANTITY OF CONSUMABLES

Gender	Age (years)	Sedentary ^b	Moderately Active ^c	Active ^d
Child	2-3	1,000	1,000-1,400	1,000-1,400
Female	4-8	1,200	1,400-1,600	1,400-1,800
	9-13	1,600	1,600-2,000	1,800-2,200
	14-18	1,800	2,000	2,400
	19-30	2,000	2,000-2,200	2,400
	31-50	1,800	2,000	2,200
	51+	1,600	1,800	2,000-2,200
Male	4-8	1,400	1,400-1,600	1,600-2,000
	9-13	1,800	1,800-2,200	2,000-2,600
	14-18	2,200	2,400-2,800	2,800-3,200
	19-30	2,400	2,600-2,800	3,000
	31-50	2,200	2,400-2,600	2,800-3,000
	51+	2,000	2,200-2,400	2,400-2,800

a) These levels are based on Estimated Energy Requirements (EER) from the Institute of Medicine Dietary Reference Intakes macronutrients report, 2002, calculated by gender, age, and activity level for reference-sized individuals. "Reference size," as determined by IOM, is based on median height and weight for ages up to age 18 years of age and median height and weight for that height to give a BMI of 21.5 for adult females and 22.5 for adult males.

b) Sedentary means a lifestyle that includes only the light physical activity associated with typical day-to-day life.

c) Moderately active means a lifestyle that includes physical activity equivalent to walking about 1.5 to 3 miles per day at 3 to 4 miles per hour, in addition to the light physical activity associated with typical day-to-day life

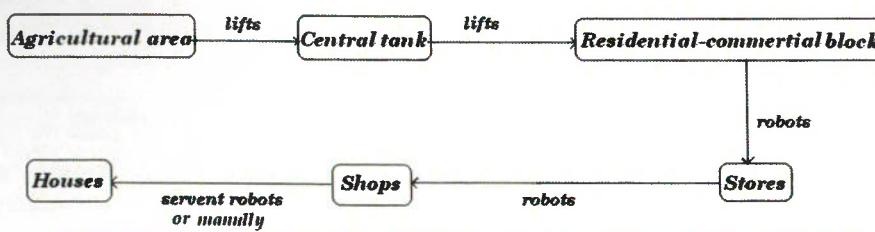
d) Active means a lifestyle that includes physical activity equivalent to walking more than 3 miles per day at 3 to 4 miles per hour, in addition to the light physical activity associated with typical day-to-day life.

<u>Variety And Quantity Of Consumables:</u>		
Consumables	Amount (gm/person/day)	Calories
1) Meat		
a) Trout	40	78
b) Rabbit	40	64
c) Beef	40	142
d) Chicken	40	49
e) Fish	40	N/A
2) Produce		
a) Egg	24	39
b) Milk	500	330
3) Crops		
a) Wheat	180	608
b) Rice	100	363
c) Sugar	100	385
d) Oats	N/A	N/A
e) Barley	N/A	N/A
f) Corn	N/A	N/A
g) Maize	N/A	N/A
4) Vegetable & Fruits		
a) Carrot	100	42
b) Lettuce	100	14
c) Peas	150	126
d) Apple	100	56
e) Potato	100	76
f) Tomato	100	22
g) Orange	100	51
h) Sorghum	317	N/A
i) Soyabean	470	N/A
j) Kale	N/A	N/A
k) Broccoli	N/A	N/A
l) Water	35L	

4.1.c DISTRIBUTION OF CONSUMABLES :

From the agricultural sector the food will be sent to the central tank for processing where the food processing industries will be located. After that it will be sent to R & C block through lifts, from there to the storage through robot T, then to shops & later on to the houses through servant robots or manually.

MEANS OF DISTRIBUTING CONSUMABLES



4.1.d PERCENTAGE OF ROADS AND PARKS

To provide good surrounding environment to the residents. Bellevistat will provide a forest, which will be 10% of the total area of R & C block. Further there will be 15% roads for the ecstasy & EPTs as well as for cycling & walking.

4.2 RESIDENTIAL DESIGN

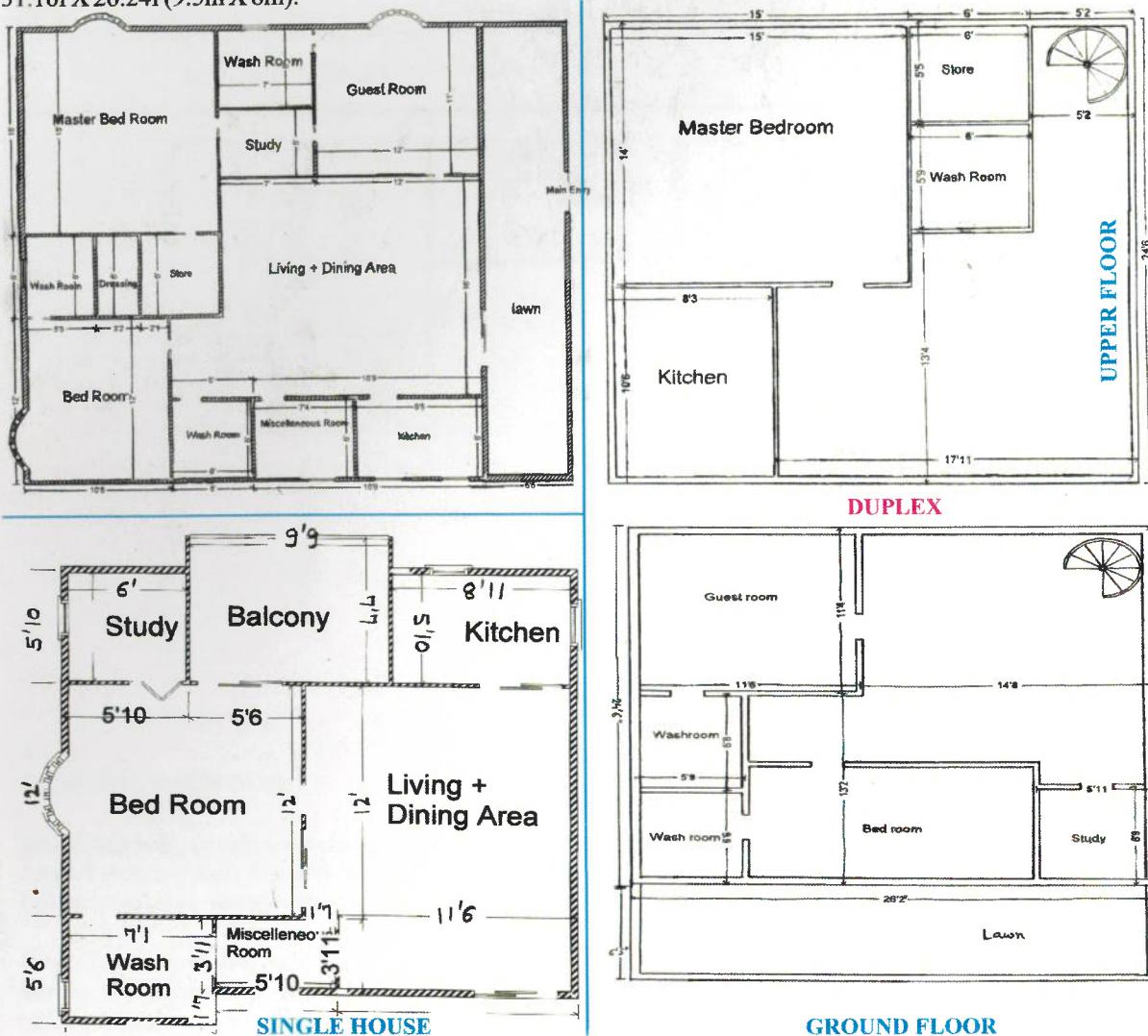
As mentioned above that there will be apartments for singles instead of single floor houses. There will be 10m soils forming the base of the settlement so there will be almost negligible change in gravity & together this factor will conserve a large area that can be used for various other purposes.

4.2.a RESIDENTIAL HOUSES

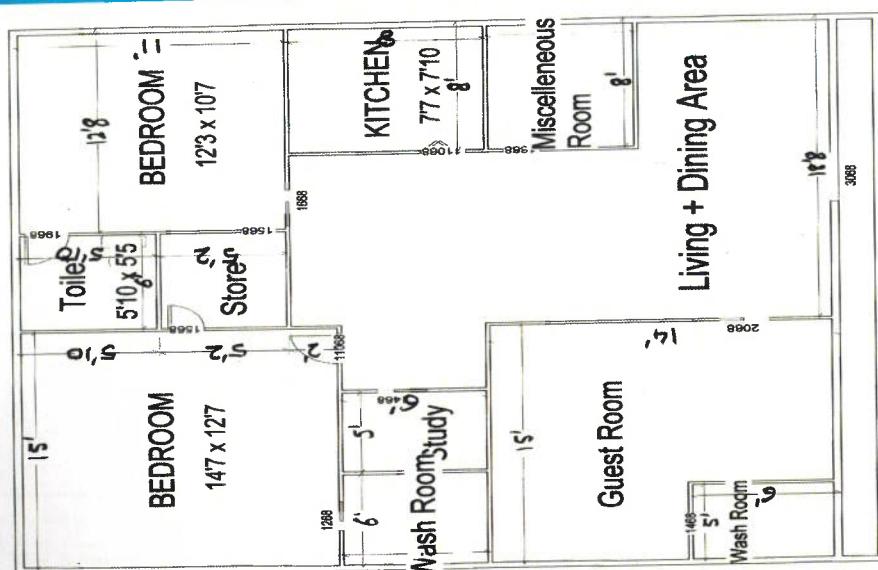
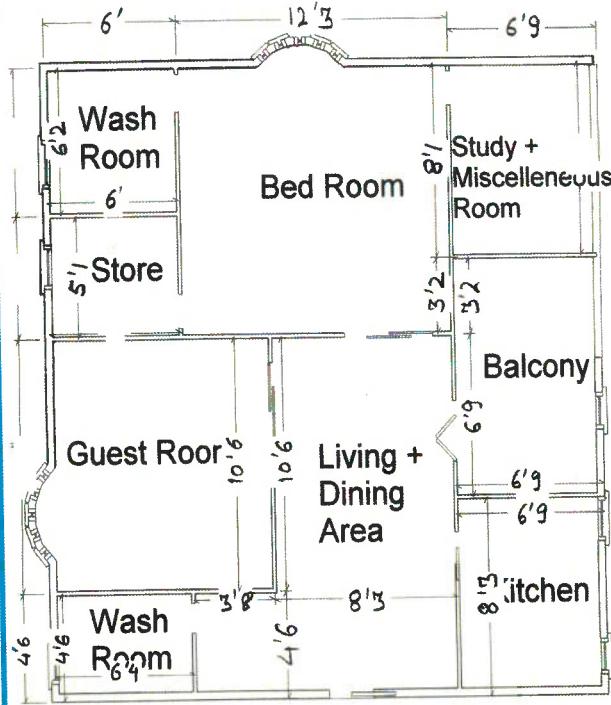
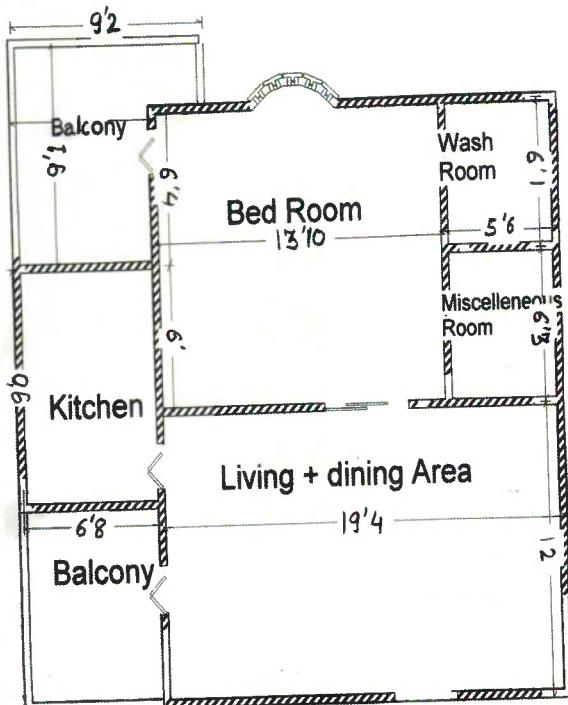
The houses will be hi-tech & full of comforts. The partition of the room will be made by th smart glass instead of wall as it will be very cheap. There will be-

- *3 different floor plans for the flats.
 - *3 different floor plans for houses including a duplex.

The dimensions of the flats for the singles will be 23.45f X 22.96f(7.15mX7m) and 24.6fX 26.24f(7.5m X 8m).For the family houses the dimensions will be 40.56f X 32.8f(12.367m X 10m) and for the duplex dimensions will be 31.16fX 26.24f(9.5m X 8m).



NORTHDONNING HEEDWELL

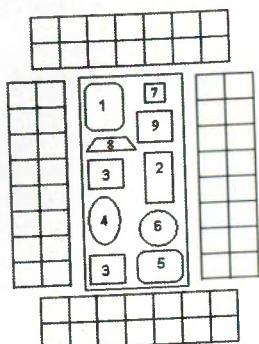


4.2.b

NEIGHBOURHOOD:

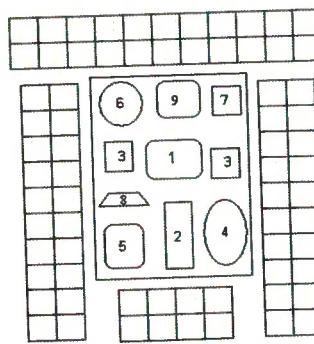
Bellevistat will provide a comfortable & open space neighborhood to the residents .Every society will constitute of several common activities which will promote the interaction between the people from different places resulting in exchange of their views ,culture etc.

* After accomodating an area for 19,000 people still there will be 152610 mt.sq. area left in both residential blocks. The advantage being here will be that 975 more people can be accomodated along with providing them all the facilities.

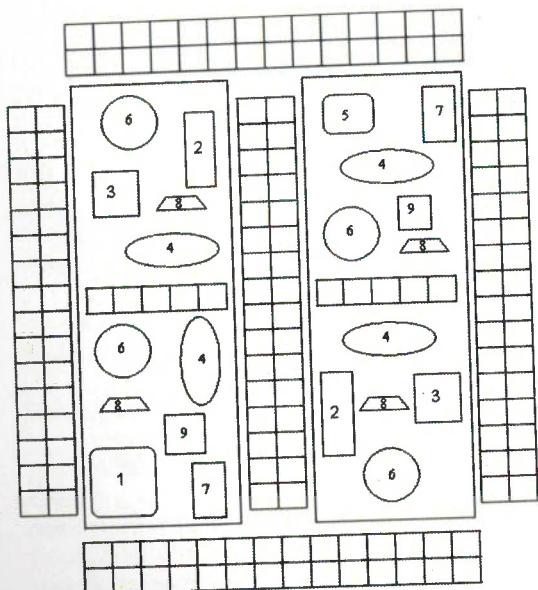


A — DUPLEX (Family houses)

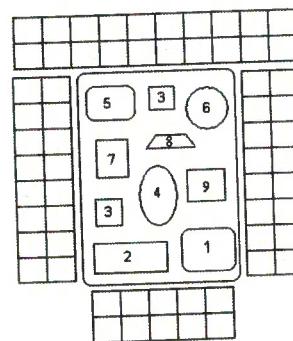
- INDEX**
1. Community centre
 2. Shops
 3. Gym
 4. Garden
 5. Control office
 6. Swimming pool
 7. Playstation
 8. Laundry
 9. Dispensary



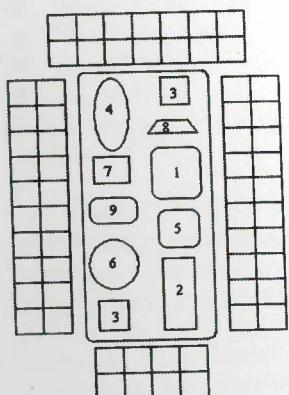
E — single floor houses



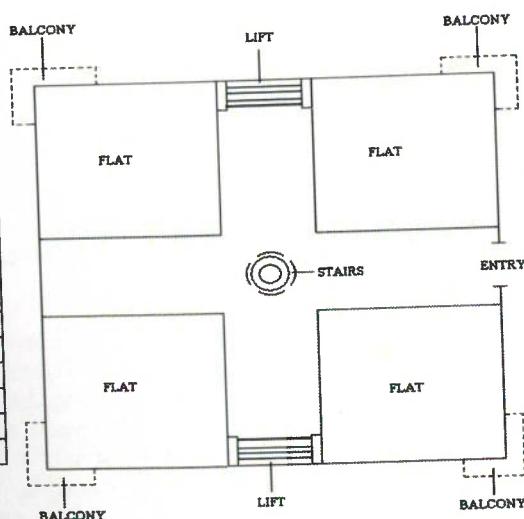
B — GROUND FLOOR HOUSES



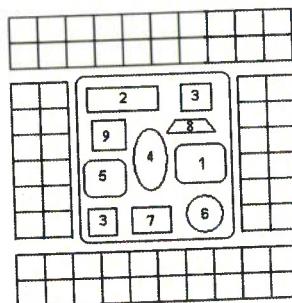
F — Apartments (without guestroom)



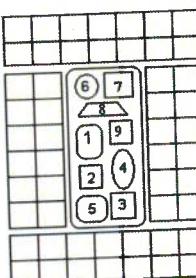
C — Apartments (with guestroom)



Base of an Apartment



G — Apartments (without guestroom)



D — Apartments (with guestroom)

4.3 WORK ENVIRONMENT

4.3.a SPACESUIT

There will be a provision of space suit to every resident for the EVA i.e. extra vehicular activity or in case of any emergency.

There will be two types of spacesuits -

Space suit for internal purpose

This spacesuit will be helpful for the transportation of people from docking port to the hull part or in case of any emergency exit .The spacesuit will comprise of the following-

- *One-piece pressure garment with integrated pressure bladder& ventilation.
- *A full pressurized helmet with the locking clear vision & black sunshade.
- *A communication cap worn under helmet.
- *An anti-suffocation valve at the back of the helmet for passing out carbon dioxide from the helmet.
- *A small oxygen pack at the back.
- *Black leather paratrooper boots with zippers.



INTERNAL SPACE SUIT

The space suit will be a "bio suit" as they are very strong & can adjust themselves according to the body. Also they are very light in weight.

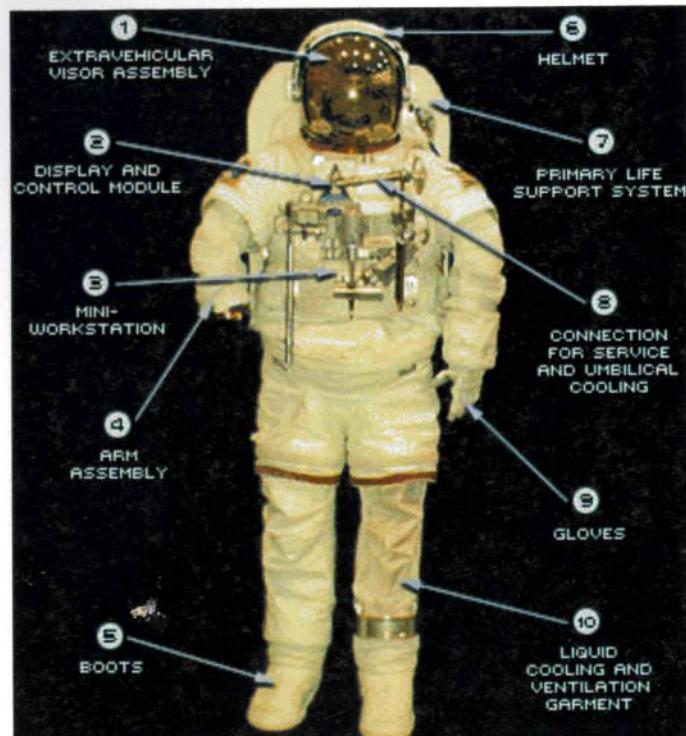
Space suit for external use

Keeping in mind all the requirements and needs for an EVA , the space suit will be well equipped & will have the ability to protect itself from small debris in the space, the space suit will have many parts .The most important of them is PLSS (primary life supporting system)

It includes the following contents-

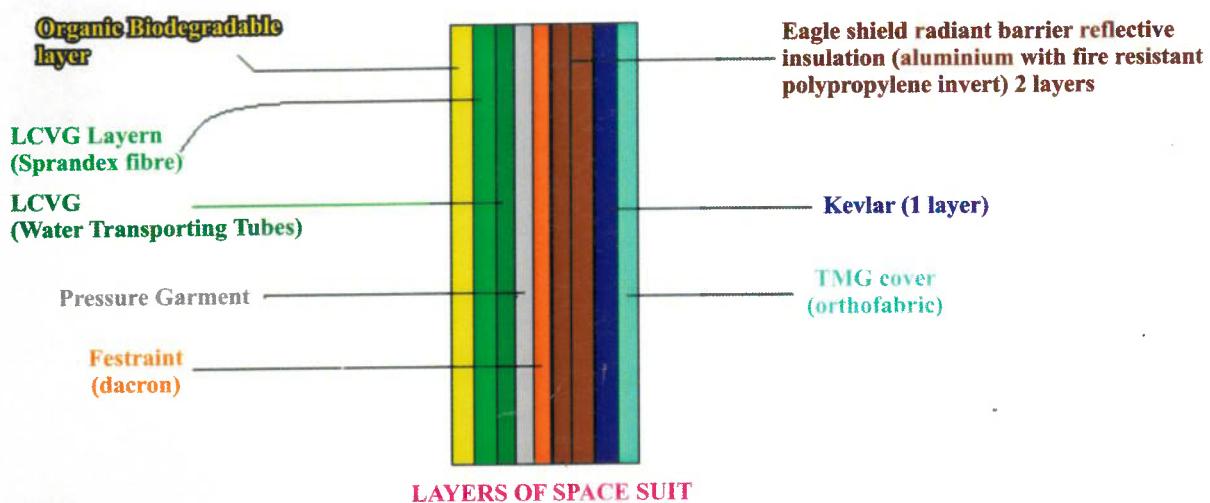
- ✖ Oxygen tank
- ✖ Storage water tank
- ✖ Containment control cartilage
- ✖ Radio & communication system
- ✖ Ventilating fans
- ✖ A sublimation
- ✖ Jet pack
- ✖ Micro-processor ,caution & warning system

The PLSS will be worn by the astronauts on their back. There is an EMU battery which is made up of zinc cells & provide a facility of 27 ampere hours .The power source is the EMU battery which can be used for several more missions .The display & control module contains all the operating systems which are needed to operate any EMU .It also interacts with caution & warning system of PLSS .The hard upper torso will contain PLSS & DCM (display & control module) . It will be attached to the legs, helmet & arms of the space suit.



EXTERNAL SPACE SUIT

The space suit will comprise of 9 layers. The thickness of a layer is about $3/16''$ to $3/14''$. The different layers are as follows with their uses-



1)	LCVG Liner (Nylon tricot)	It is used to maintain the comforts of the astronaut.
2)	Organic biodegradable layer	It will act as an artificial muscle fiber to increase strength & stamina.
3)	Water transporting tubes	It is used for transportation of water to astronauts.
4)	Kevlar	Used for radiation protection, high temperature prevention, prevents wear & tear due to toughness.
5)	TMG (Neoprene coated)	To protect the astronauts from the micro meteoroids hitting the Space Suit.
6)	Eagle shield radiant barrier reflective insulation (Aluminum with fire resistant polypropylene invert)	To insulate the astronauts from high temperature of space. It has two layers.
7)	TMG (Ortho fabric)	To cover the inner layers white in colour to reflect heat.
8)	Restraint (Dacron)	To protect against UV rays of Sun and prevent inner layers from tearing.

LAYERS & THEIR PROPERTIES

4.3.b RECREATION & SPORTS

One of the very important aspect of a space colony is that the people living there should be supplied with all facilities of entertainment. Also in Bellevistat there will be a lot of sporting facilities .The following will be the different area allotted to the recreational activities.

* Sporting facilities-the Bellevistat will provide

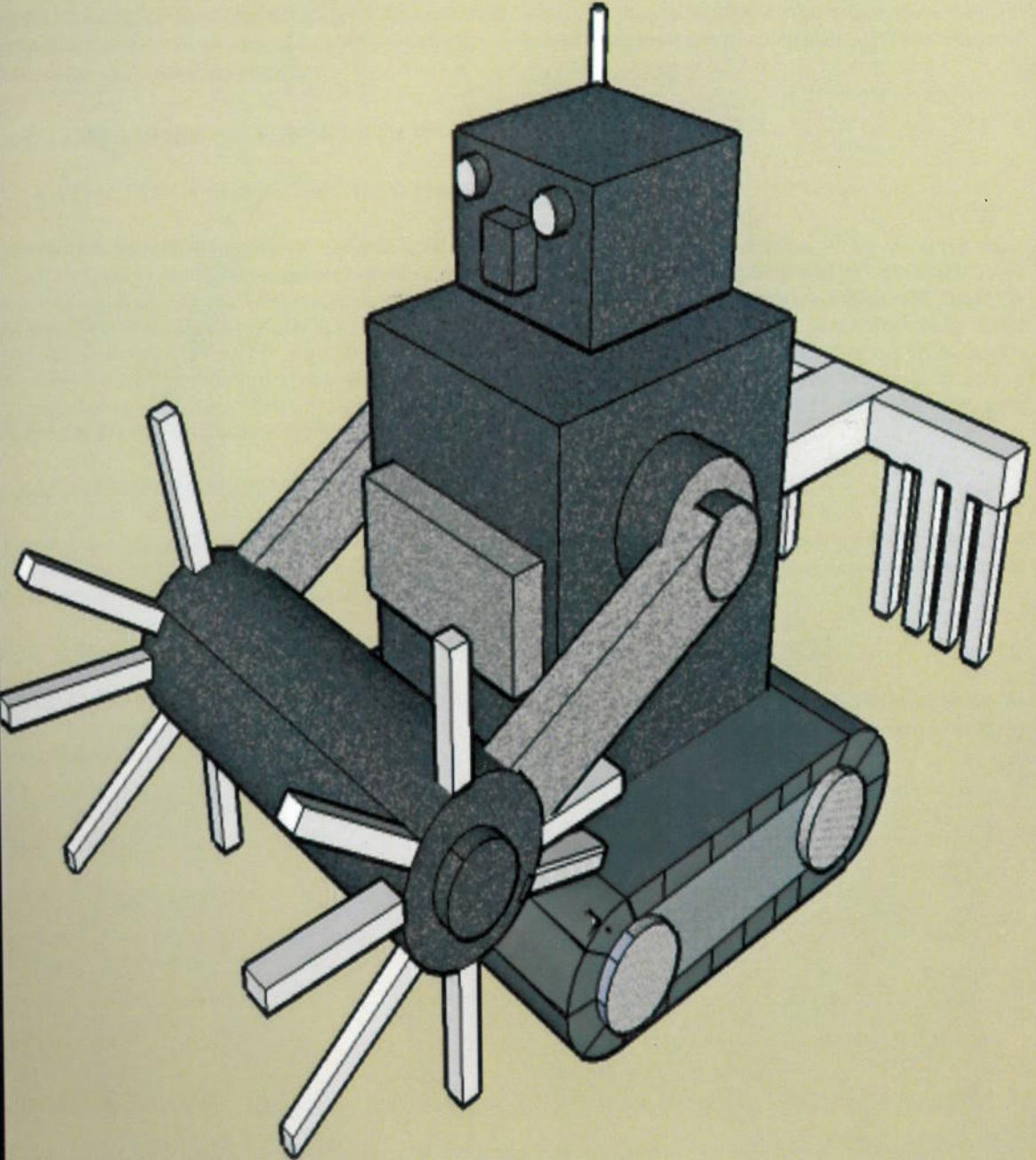
- A sports complex in each block that will provide facilities for the games that could be played in a closed boundary .The purpose for keeping such complex is to interlink people with each other.

- A racing track will also be provided in the city. Here the races will be held at some intervals so that people can enjoy fast driving.
- A mini Olympic ground in the microgravity central tank will also please the people. Here games like long jumps, high jumps, Aero swims, pole vault, basketball, triple jump, hurdle races & throwing events will take place.
- * **Non-sporting facilities & recreation**
- For the non-sporting entertainment of people there will be bars & restaurants, malls, shopping complex, hotels, museums, planetariums, parks, libraries, virtual gaming zones entertaining robots etc.
- There will be a provision of boating in the river to really enjoy the beauty of surrounding area.
- Meditation centers & holy places will be there to maintain psychological peace.
- The museum will provide the information about the different cultures, heritage, and traditions & also about the emerging technology on earth.
- The planetarium will provide all the information about the space & the procedure of the formation of the settlement. To give it a differentiated feature its shape will be like a dome.
- There will be an amusement park across the river. Torus week will be celebrated in it annually; this will give the people to spend sometime with their relatives from their busy schedule.
- There will be virtual gaming zone in which the mental imagination power will be used to play games.
- Bellevistat will organize recreational & educational tours to the moon & Alexandriat that will be an additional entertainment source to the residents.

4.3.c OCCUPATIONAL FIELDS

The Bellevistat will provide the employment to the residents to carry on their comfortable lifestyle. The different occupation, salary, no of persons required in an industry are mentioned as under-

Occupational Fields	No. of Workers	%age of Pop.	Annual Salary	Supplies & Needs
Tourism	200	2.7	\$60000 - \$110000	Hotels, information centres, guidemaps, spaceships etc.
Hospital	360	4.88	\$50000-\$200000	Medical equipments, surgical, tools, computers, EPT's
Education(inc. management)	100	1.34	\$40000-\$75000	School, labs, books, video conferencing, projectors, desks, chairs etc.
Networking,engg.,comm.	700	9.48	\$70000-\$120000	computers, APCOS-4000, Wi-max, books, Equipments, IT
Transportation	20	0.26	\$60000-\$90000	Ecstacy, mining vehicals, mass catcher, mass driver, lifts, EPT's, conveyer belts, robot ULTIO
Science & Research	150	2.02	\$100000-\$200000	Labs, apparatus, computers, technical knowledge.
Entertainment & Recreation	250	3.38	\$30000-\$50000	sports complex, sports equipments, malls, planetarium, measum, estaurants & bars, parks etc
Religion	50	0.66	\$50000-\$80000	Holy places,idols,worshiping goods,etc
Food production & distribution	500	6.78	\$60000-\$90000	robot for thrusting, weeding, harvesting, sowing. Distribution by lifts, ROBOT-T.
Controlling	100	1.34	\$50000-\$80000	computer, technical systems, technology.
Commercial industry	3800	51.56	\$50000-\$90000	HI-tech machines,computers,robots,lifts
Maintainance Society	150	2.02	\$80000-\$120000	strict rules & regulations, computers, robots.
Banking	20	0.26	\$70000-\$110000	smart cars, smart card reader, superb security system
Recycling	200	2.7	\$50000-\$90000	machines, robots
Cultural management	40	0.54	\$60000-\$90000	function halls,electronic equipments
Army	40	0.54	\$40000-\$50000	robots,computers,guns,tanks,
Business development	100	1.34	\$50000-\$70000	Robots, computers, commercial knowledge.
Security (internal)	250	3.38	\$40000-\$60000	robots, computers, guns, tanks
Revenue collectors	40	0.54	\$70000-\$90000	computers, Equipments, Information Technology
Repair work	300	4.06	\$70000-\$90000	Technical knowledge, robots, Spacesuit (EVAs), tools.



AUTOMATIONS

5.0 AUTOMATION DESIGN AND SERVICES

As the Bellevistat will provide a good environment for 19000 people to live in, there is a need for an automated system to maintain the settlement and reduce human labour. The construction of bellevistat is a very tiring and big job which will require a large amount of man power which will be quite difficult to attain. So, robots will be developed to complete the construction work fast and efficiently. After this, the robots will be used in the settlement for maintenance and repair by just removing their jetpacks. A system to mine on asteroid and transport the material to the settlement will also be developed.

5.1 AUTOMATION OF CONSTRUCTION PROCESS

5.1.a AUTOMATION FOR CONSTRUCTION

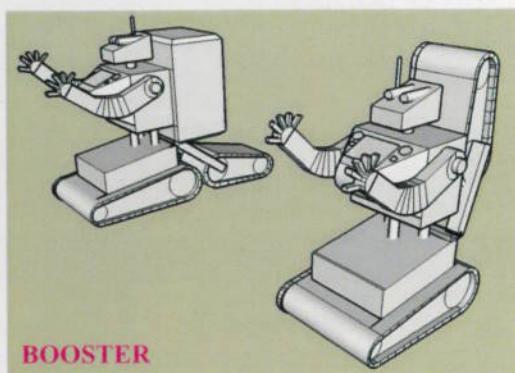
The robots will be fully programmed to perform all the exterior and interior construction work by replacing some of its parts like jetpacks. All these robots will be controlled by control station **I-98** which will be transported from the earth along these robots. The programming of robots will be evolutionary computing which will make the robots learn from their faults and not to repeat them in future. The parts of robots will be made flexible by using biomorphic materials in them. The transfer of large and heavy parts can be easily done in zero gravity by using jetpacks in the robots. The robots will also be installed with 3-D scanners which will be helpful in interior finishing work like rubbing, painting, flooring, wiring, plumbing etc. If a robot breaks down, then in the mean time of its repair, there will be no need to stop the work as some extra will be there.

5.1.b AUTOMATION FOR TRANSPORTATION

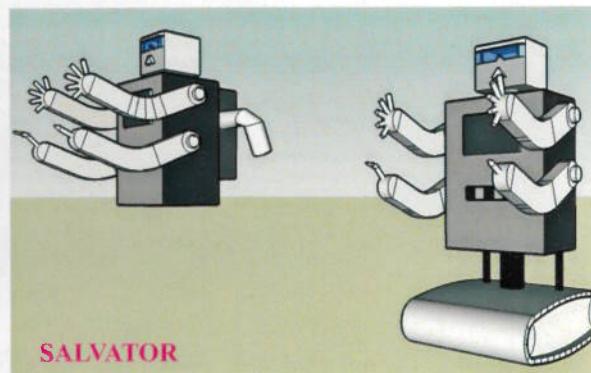
Control station, communication satellite, robotic arm and a port for storing the robots will be transported from earth to construction site using a space vehicle. The robots will be unloaded using a robotic arm and stored in the port. The broken robot will also be repaired at this very port.

5.1.c AUTOMATIONS FOR DELIVERY OF MATERIALS AND EQUIPMENTS

There will be an important role of the automation to play in making availability of materials and equipments to various parts of construction site. **SALVATOR** and **BOOSTER** will be fitted with jetpacks which will enable them to deliver material around the construction site.



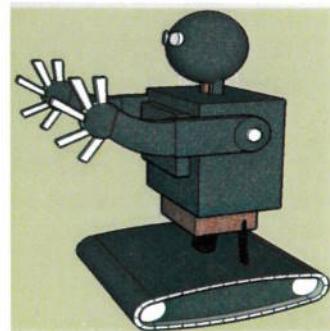
BOOSTER



SALVATOR

5.1.d AUTOMATION FOR ASSEMBLING OF SETTLEMENT

The robotic arm will be capable of gripping the materials and assembling them on the right location. For the purpose, **VIPER** and **BOOSTER** will be well equipped, drilling, hammering devices and many other small tools. The 3D scanners will recognize the type of material required at a particular point of time. The robots will resort the solar energy through their integrated solar panels but during the dark phase, they will exercise the energy stored in their batteries and recharge them from the storage port.

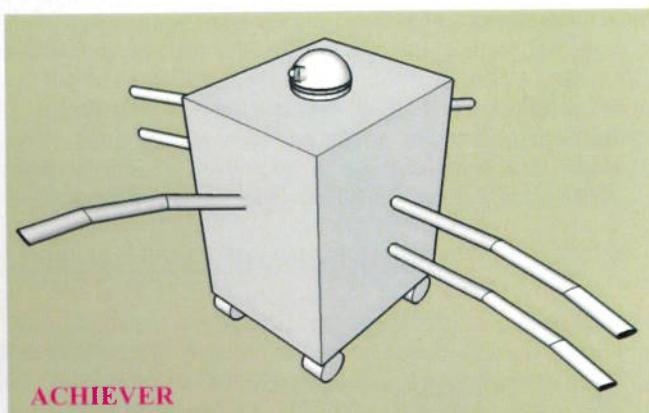


VIPER →

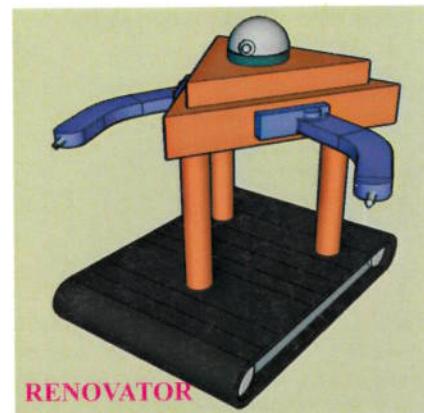
Robot	Function	No.	Dimensions	Power supply
SALVATOR	Possesses a jetpack which enables and helps it while performing external construction work and transportation of materials and equipments. -Other -Can be used in interior construction transportation by removing jetpack.	350	2.25m*1m	Battery
VIPER	Used in external assembling of the torus. Possesses a magnetic base for easy movement and stability while performing the given task -Other - Can be used in internal construction and transportation by changing the magnetic roller with a simple roller .	490	2.5m*1m	Solar power
BOOSTER	Used in assembling and transportation -Other- construction , Lunar mining , Household work , transportation	490	1.75m*0.75m	Solar power

5.1.e INTERIOR FINISHING

RENOVATOR and **ACHIEVER** will be employed for interior finishing works like plumbing, wiring, flooring etc.as they will be fitted with various tools. **RENOVATOR** will have many integrated system inducted in it such as drillers, welding machines, sprayers for painting and scrubbers for polishing the floor. **ACHIEVER** will be used for analytical tasks like wiring, soldering, plumbing etc. both these robots will fix up all the electronic and electrical devices. It will take the robots around 5years for completing all types of finishing works.



ACHIEVER



RENOVATOR

Robot	Function	No.	Dimensions	Power supply
ACHIEVER	Used in electrical repairs , safety and interior finishing	1700	2m*1.25m	Solar power
RENOVATOR	Used in interior finishing and exterior construction	1550	2.5m*1.5m	Solar power

5.2 FACILITY AUTOMATION

5.2.a AUTOMATIONS FOR MAINTENANCE

Automated system will be established to provide all types of facilities to the residents of Bellevista.. **COLLABORATOR** will be designed with 4 arms to perform all the household works like cleaning, carrying clothes to laundries and vice versa, watering plants and many more. It will be fitted with sensors and scanners to locate various household things and obstacles and work continuously



COLLABORATOR

and efficiently. It will scan blockages in pipes. The complete house map installed in it will help it to put the right thing at right place. It will also be fitted with a small computer which will be connected to that of owner's through signals to assign other works.

5.2.b REPAIR AND SAFETY FUNCTIONS

As the bellevistat is completely human made, shortcomings are obvious. So, an automated system will be developed which will provide robots to detect, arrive and rectify the fault. **ACHIEVER** will be designed to repair all the electronic components and circuits if other robots as well as houses. Its cameras will be enable to examine the fault closely and clearly and arms will be capable of replacing, soldering and testing the circuits. The major safety measure is against the space debris and meteorites that may pierce holes or cracks the shield and whole atmosphere may escape out. As per the characteristics feature of the torus, it can be divided into many small parts which can be isolated whenever needed. This will be done with the help of sensors which will be patrolling across the atmosphere and structure. The **VIPER** and **BOOSTER** will locate and repair the problem and the atmosphere which has escaped will be replaced by using the surplus in the central tank. The **VIPER** and **BOOSTER** will be used for internal and external repair work because they need very small modification according to their work environment.

5.2.c AUTOMATION FOR BACKUP SYSTEM

I-98, K-56, HP-4, C-3 will be the sub segments of the main control system and will be interlinked. In case of failure of any of the servers, the errors will be rectified by the backup system. Even if the problem is not corrected the main computer will take its charge and try to remove it and if it is not done automatically, then the error will be removed manually.

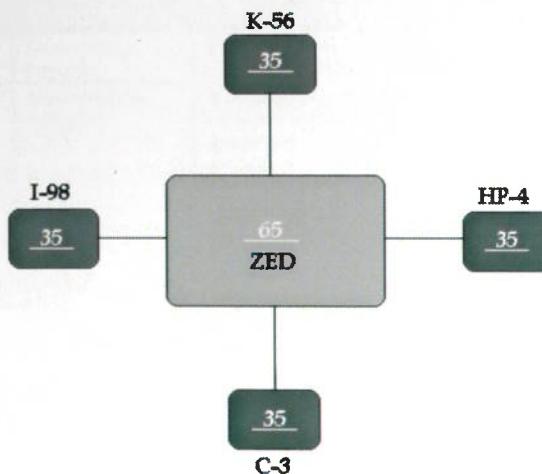
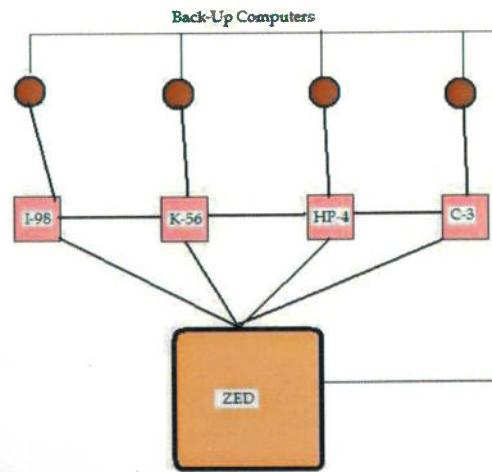
Contingency Plans : Although the threat from the space debris has been lessened to a large extent still there will be a need of a backup system which would accommodate the residents until the problem is conquered. No doubt there is a large area in the central tank for the residents with all the facilities but the gravity there will be very low. So a network of underground chambers will be developed in the residential area where the residents can live easily and comfortably with all basic needs.

5.2.d SOLAR FLARE SHIELDING

Although the possibilities of solar flares are almost negligible at L4, still some measures will be developed. All the robots which will be used for exterior construction and repair purposes will be shielded with a thick layer of lead on the critical parts and a thin layer on the non-critical parts. This shield will prohibit the solar flares from committing any harm to the robots.

5.2.e LOCATION OF COMPUTERS AND ROBOTS FOR CRITICAL FUNCTIONS

The whole computing system will divided into five sections **I-98, K-56, HP-4, C-3** will be the subsections which will be linked with each other and the main control centre. This computing system will supervise the system like internal networking, communication with each, lunar base and space vehicles. The robots undertaking the repair and maintenance works will be supervised by this computing system. It will also control the devices and instruments used for maintaining the environment. The robots will be stored in the storage provisions in the living area and they will come into action when they will receive commands from the computing system.



5.2.f SECURITY MEASURES

In the Bellevistat, the residents will be provided all sorts of royal facilities. It, therefore, has to ensure the security of personal data of residents through scanning their already stored identity and physical features. Various types of Biometric security system i.e. the technology that identifies one on the basis of one's physical traits will be used for this purpose. They are:-

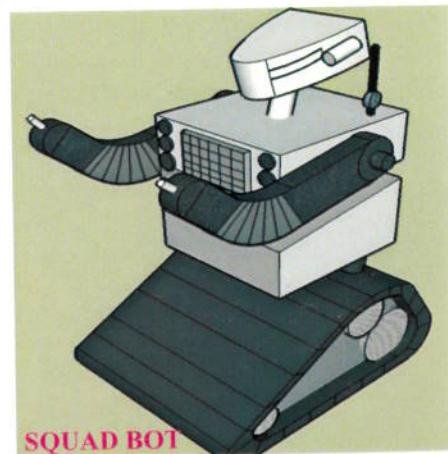
- 1) Hand and finger scanning: This system matches the curvature and fingerprints of the person with the stored data and can detect almost 60 differences between two curvatures.
- 2) Iris scanning: This system scans the centre and edges of the pupil, iris, eyelids, eyelashes and matches with stored data. It can detect almost 100 differences between the iris of two humans.
- 3) Facial recognition: It will be used mainly in public areas as it can scan 15 faces without their concern and can make the 3D image of the face and match with the stored one.
- 4) Vein recognition: The veins of hands will be scanned by using infrared rays and match with the stored one.
- 5) All the system will be installed as per the security level in different places and will altogether enhance the security of the Bellevistat.

5.2.g SECURITY ROBOTS

A company of robots will be on board for maintaining law and order. Each robot will work as police on the earth and will be fully equipped with weapons and sensors to track and catch the criminals. One of the robots that will be used is **SQUAD BOT**. It is designed to perform serious tasks like encounter with criminals. It will be equipped with rubber bullets, stun strike, dazzling laser light weapons. It will also have an audio outlet through which it will give warnings to the criminals and will fire the stun strike or the laser light after the warning duration. All the weapons will be non-lethal i.e. they will not harm physically but only confuse or make the criminal sub-conscious. If the criminal does not surrender, it will fire rubber bullets. It will have four sensors which are thermal imaging, GPS, anti-collision sound waves receiver and night vision. It will also have a siren to give signal to the people and robots to clear the way. The other robot will be **FALCON**. It will be a small robot will like helicopter, which will fly and chase the criminal across the settlement. The sensors and cameras installed in it will give the complete information about the criminals.



FALCON



SQUAD BOT

Robot	Major function	Weapon	Power supply	Special feature
FALCON	Chasing the culprit	Dazzling laser light	Solar energy, batteries	Swiftness, nightvision, small size, face-recognition fast reaction, flight.
SQUAD BOT	Taking appropriate measures against the culprit and attempting arrest. Other – transporting injured people to hospital.	Pain ray, LRAD, Blind ray, Dazzling laser light, Stun strike.	Solar energy, batteries	Warning system, nightvision, face-recognition, fast-speed, 360° rotation of upper body.

5.3 HABITABILITY AND COMMUNITY AUTOMATION

5.3.a AUTOMATION FOR THE LIVABILITY IN THE COMMUNITY

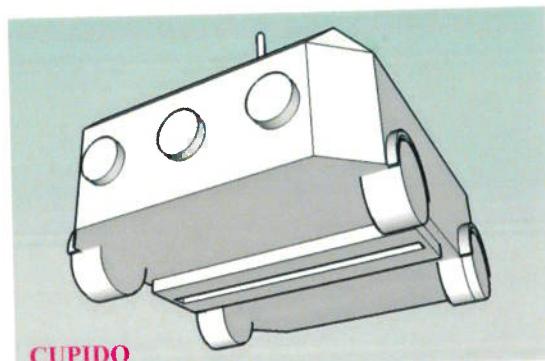
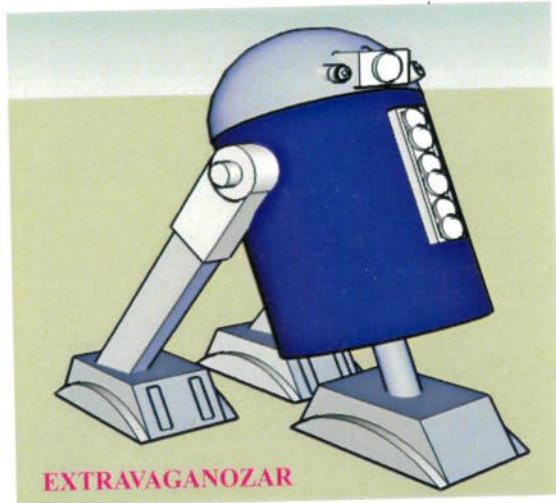
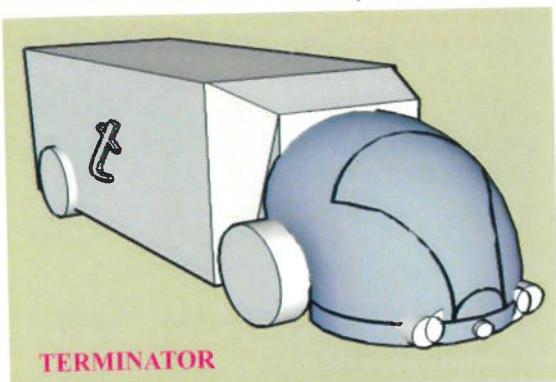
TERMINATOR will be developed to carry goods across the bellevistat in an easy and safe mode. They will be in the form of mini trucks which will be able to guide themselves through the ways as to complete map will be in their

memory and the users only will have to give the location. The sensors installed in it will help to scan and get rid of the obstacles coming in its path. Providing automated system for washing clothes to each house will be very costly. So, laundries will be established. The **COLLABORATOR** will carry the clothes to the laundries and again back to home. The clothes will be put in an automated system which will wash and dehydrate the clothes. Then the clothes will be folded by the folder. Among all the factors, health factor is the most important one which should be observed continuously. For this, a small system named **MOTE** will be developed which can be carried as a wrist watch and will completely examine the changes in the body like temperature, blood pressure, heart beat and other changes in the body. So, one would not have to go to clinics frequently. The details will be displayed on the screen of the watch. A well designed network of pipes and ducts will be laid all across the settlement for proper drainage of the waste. Ducts will be laid beside roads, in houses and all other places through which the robots can drain waste after cleaning. These ducts which will have screw like design at their inner walls will rotate for moving the cost forward and preventing the blockage. The waste will be collected at the waste management plant where it will be recycled.

EXTRAVAGANOZAR equipped with all types of electronic devices for entertainment like T.V projectors, MP3 player, DVD and videogames will be developed. Moreover, it will be connect with satellites which will make it capable of displaying the channels of earth as well. It will also display the whole map and location of various places of bellestat.

CUPIDO which will be in the shape of a small car; is designed for cleaning the roads. It will be having a compressor at the base which will assimilate waste material on the road. It will also detect the cracks or pot holes on the road and send a message to the control system. The waste and dirt will be dumped at the waste management system.

ACHIEVER will be used for repairing robots, electronic and electrical devices as it is installed with scanners, cameras and biomorphic arms.

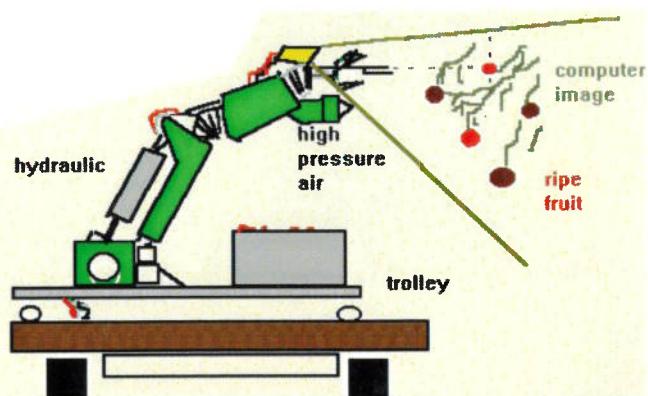
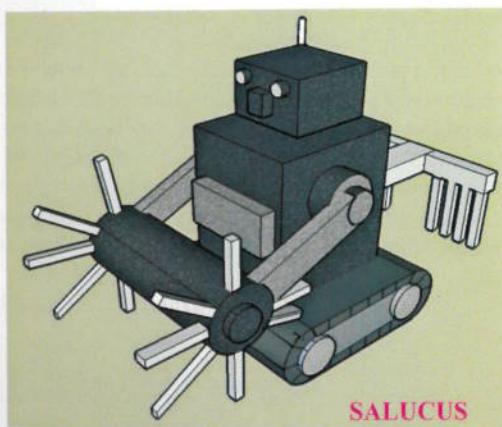
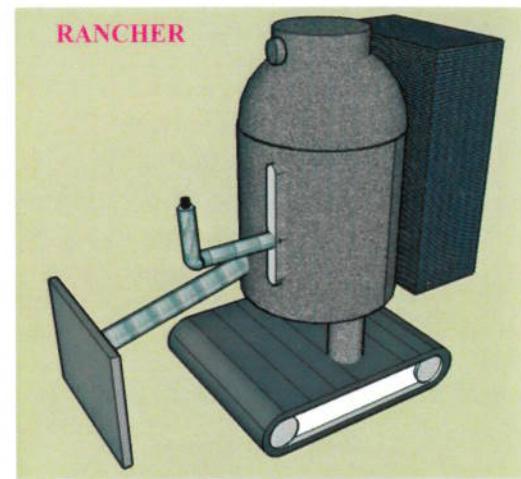


Robot	Function	No.	Dimensions	Power supply
COLLABORATOR	Used in maintenance and livability -Other- Temperature control , gas control , air purification	12500	1m*1.75m	Solar power, batteries
CUPIDO	Used in routine cleaning of roads	50	2m*1.25m	Solar power, batteries
TERMINATOR	Used in transportation of goods , heavy tools and machinery	45	3.5m*1.5 m	Solar power, batteries
EXTRAVAGANOZAR	Used in entertainment, video conferencing and various entertainment tasks such as music listening, I pod or mp3 player docking etc.	15500	1.5m*0.5 m	Solar power, batteries

5.3.b AUTOMATION FOR PRODUCTIVITY IN WORK AND REDUCTION OF MANUAL LABOUR

A robot will be designed to water the plants and trees in the living area. Aeroponics will be applied in agricultural area. There will be a hollow tunnel of about 5m under the surface where **RANCHER** will work. It will spray the nutrients after fixed intervals. **SALUCUS** will harvest the crops and separate cereals, grains and straws. **RANCHER** will again come in action and will bring out the left over roots from the small outlets. **PICADOR** will be capable of smelling and scanning the fruits and vegetables to determine whether they are ripe or not. Then it will pluck the desired fruits and vegetables and also those are hidden under leaves by blowing air.

The main refining industry is located at the end of the transporting tube below the torus. It is because the zero gravity bone allows the robots to carry more load. No humans will work there. Only the scientists will be allowed to go to the zero gravity labs for research work. The asteroid and lunar mining will be done by robots in which power drillers and other equipments will be fitted.

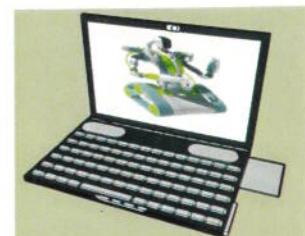


PIKADOR

ROBOT	FUNCTION	No.	DIMENTIONS	POWER SOURCE
RANCHER	Used in aerponics tunnels for spraying and for collecting the waste in the tunnels.	180	1.5m*0.5m	Solar power, batteries
SALUCUS	Used for cutting and ploughing of fields for trees	120	2m*1.5m	Solar power, batteries
PIKADOR	Used in agriculture fields for picking ripe fruits	120	1.5m*2.5m	Battery, batteries

5.3.c AUTOMATION FOR PRIVACY OF PERSONAL DATA AND CONTROL SYSTEM IN PRIVATE SPACES

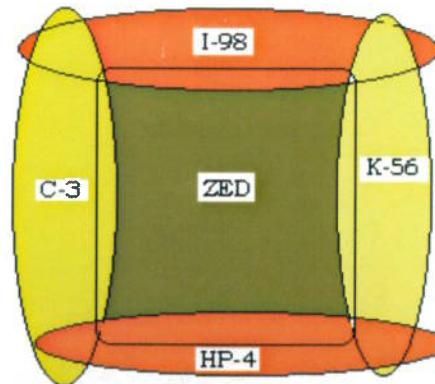
Privacy of the personal data of the residents' should be taken care with great caution. For this purpose, personal computer equipped with biomorphic scanners which will be capable of scanning hand prints, hand geometry and iris will be developed for the secured personal work of the residents. The operation of the computer will be limited to itself & its users only. Specially designed software **TORTO** will act as an interface between network and user. Optical fibers will be used for the networking which will produce an efficient, fast and secured data transmission. Internet facilities will be provided through wireless networking.



5.3.d COMMUNITY COMPUTING AND ROBOT RESOURCES FROM HOMES AND WORKPLACES

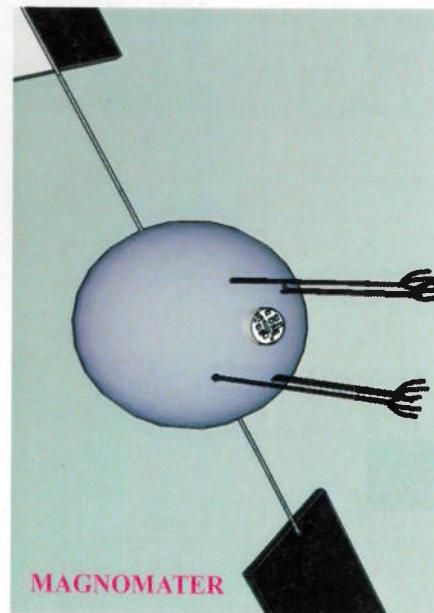
TYPE	NUMBER	SPECIFICATION	USE
PDA	19,000	10THz Processor, 265Gb RAM, 33Gb storage	Used by residents for positioning, health, monitoring, communication
COMPUTER	20,000	12THz Processor, 521Gb RAM, 69Tb Hard drive	To be connected with outer world and get latest information rapidly
CONTROL STATION	5	29THz Processor, 12Tb RAM, 109Tb Hard drive	Control the systems of settlement and communication with Earth

The settlement will be supervised by the main control station ZED and sub stations I-98, K-56, HP-4, C-3 all the PCs and other electronic devices using internet will be located and identified by the control station. All the robots except the household robots will be controlled by the control station. Household robots will be controlled by the computers of the residents. The control station will be communicated with earth through the satellite. Optical wires and radio signals with band width of about 30Mbps for data transmission will be used. This speed will allow the control station to establish links with the earth and space vehicles quickly. To save the complete network from sudden collapse, the backup system will store a copy of all the important data. A control station will be installed at the beginning of the settlement of the construction, and after completion, will be made a part of the complete computing system with the controlling the robots.



5.3.e ASTEROID MINING

Asteroid mining is a very difficult and expensive task but it has to be undertaken because asteroid contains valuable minerals like carbon, magnesium silicates, iron silicates which will prove very beneficial to the Bellevistat. The asteroid miner will be used for performing the mining purpose on crithne, Agamemnon, Achilles and hector etc. The process will be fully automated and robotic. MAGNOMATER will be circular in shape having a large storage tank and four flexible rod like legs made up of strong materials which will have the properties of contraction and expansion. Robot will be launched from settlement's refining location. When it will approach asteroid its legs will automatically open and penetrate into the asteroid surface. Then it will bring down itself to the surface and will start mining through various mining equipments which will be already installed in it. After the mined minerals completely fill into its storage tank, it will take out its legs and will leave the asteroid using its thrusters and will move towards the settlement's refining area, 15 persons will be supervising the procedure.

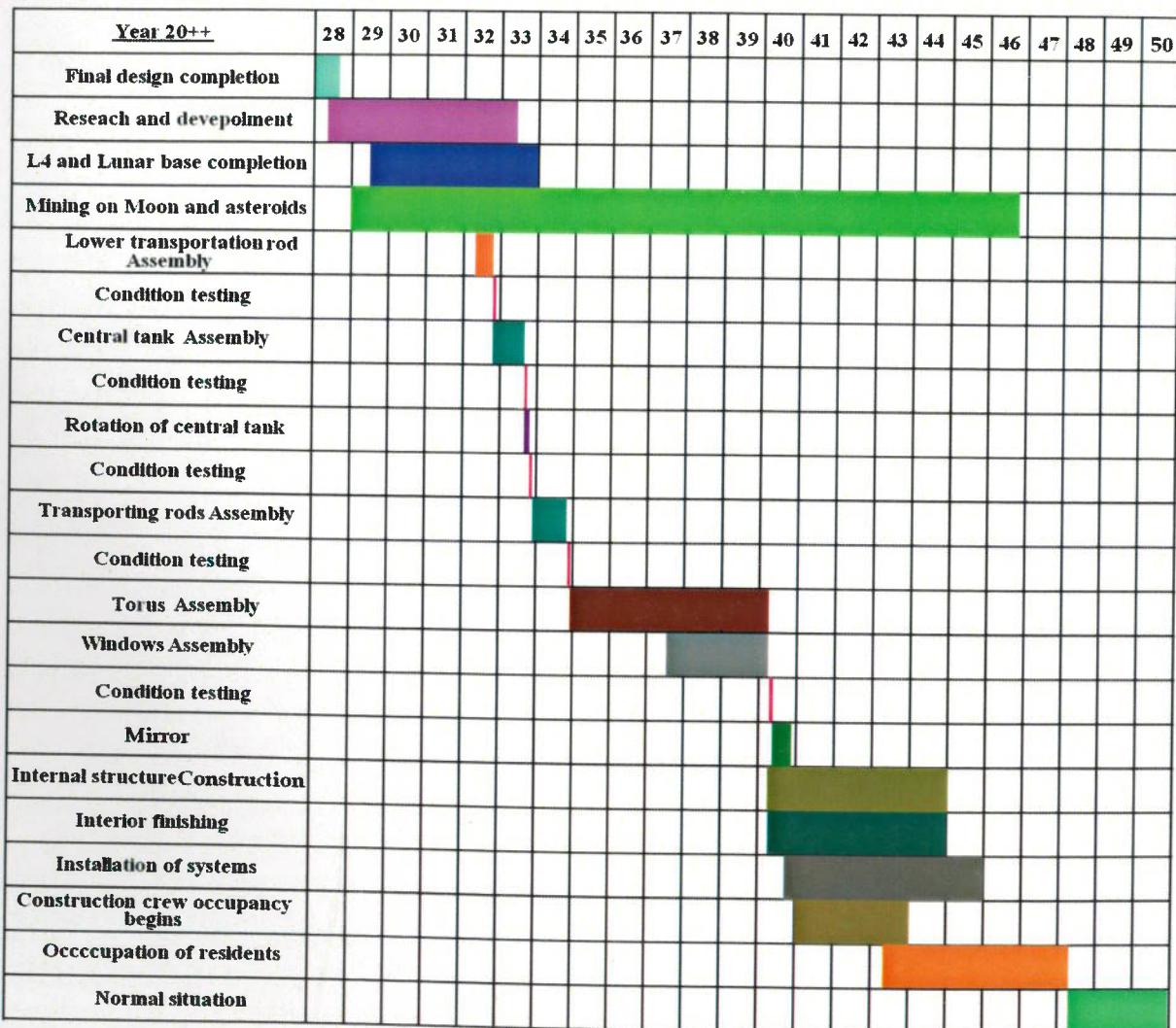




**SCHEDULE
AND
COST**

COSTS

STRUCTURE		HUMAN FACTOR
Research & Development:-	\$ 10,400M	
Mining & Transportation cost		\$ 1364.292M
From moon to L4	\$ 45,760M	\$ 764.292M
Metal Refining & Processing	\$ 140,966M	\$ 872.4176 M
Resupplies & other materials	\$ 80,000M	
SUBTOTAL	\$ 277,126M	SUBTOTAL
		AUTOMATION
INFRASTRUCTURE AND OPERATION		
Community Infrastructure	\$ 80685.6M	Community Design
Space Infrastructure	\$ 1165M	Facility Automations
SUBTOTAL	\$ 81,850.6M	Habitability and Community Automation
		SUBTOTAL
		\$ 4165.15M
TOTAL		\$ 366142.7516M



DEVELOPMENT SCHEDULE FOR BELLEVISTAT

presentation by

WOM
...An endless spirit

Gita Niketan Awasiya Vidyalaya, Kurukshetra INDIA

APPENDIX (Structural Design)

1.1 Calculations in structure

- 1). Total area required for 19000 people- $155 \times 19000 = 2948800 \text{m}^2$
 - 2). Line of sight (LOS) = 63.5m (A/c to nasa studies)
 - 3). Minor radius = 1186.806m
 - 4). Radius of torus(R) = 1200m
 - 5). $G = w^2 r$
Or, $9.8 = w^2 \times 1200$
 $w = 0.0903692/\text{min}$
 $w = 0.8634\text{rpm}$
 - 6). Outer circumference = $2 \times 3.14 \times R$
 $= 7536\text{m}$
 - 7). Area = $7536 \times x = 2948800 \text{m}^2$
 $x = 391.295\text{m}$
Total area = $2948800 + 2(7536 \times 100) + 2 \times 3.14 \times (1200 - 100) \times 392$
 $= 7096265.86 \text{m}^2$
- %age of utilization area = 41.56%
- Utilization area = 3008853.1m^2
- Volume of torus = 294880000m^3

DAY NIGHT PROVISION

By rotating mirror on its own axis
Angle of inclination = 45°

$$\begin{aligned} W &= 2 \times 3.14 / T \\ T &= 24 \text{ hrs.} \\ W &= 0.00436/\text{min} \\ W &= 6.944 \times 10^{-4} \text{ rpm.} \end{aligned}$$

1.2 Shape memory alloy

1.2.1 Introduction

A shape memory alloy (SMA, also known as a smart alloy or memory metal or muscle wire) is an alloy that "remembers" its geometry. After a sample of SMA has been deformed from its original crystallographic configuration, it regains its original geometry by itself during heating (one-way effect) or, at higher ambient temperatures, simply during unloading (pseudo-elasticity or superelasticity). These extraordinary properties are due to a temperature-dependent martensitic phase transformation from a low-