

BENVECTORAS

AMITY INTERNATIONAL SCHOOL MAYUR VIHAR,
NEW DELHI, INDIA



16th Asian Regional Space Settlement Design Competition Team Data Form

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Names, [gender], and (grade/age) of 12 students currently expecting to attend the Finalist Competition: (we advise that participants be at least 14 years old, and not older than 19 as on July 31, 2019)

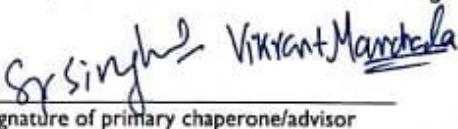
Name [gender](grade/age)

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DUTTATREYA JENA	[M] (XI/16)	AVIRAL MALIK	[M] (XI/16)
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Names of two adult advisors currently expecting to attend the Finalist Competition:

VIKRANT MANCHANDA [M] Dr.S.K.SINGHAL [M]

I understand that if our Team qualifies for the Asian Regional Space Settlement Design Finalist Competition January 2020, we will be expected to finance our own travel to / from Om Shanti Retreat Center, Manesar and share the cost of boarding / lodging during the competition.

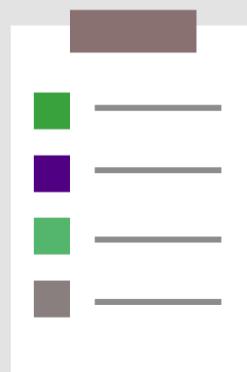

Signature of primary chaperone/advisor

07-12-2019

Date

EXECUTIVE SUMMARY

1



OVERVIEW



PRECISE

EXECUTIVE SUMMARY

Beyond the comfort zone of the Earth, humanity has found a new renaissance, a new home. Orbiting in the Aldrin cycle, is the scientific marvel, that is, Benevectoras. The settlement emphasizes its dominant design and structural features, optimizing surface area, which have been designed to bring all individual components of the settlement into one, cohesive unit. Highly versatile carbon composite constituents of the base construction material combined with an ergonomic structural design give the settlement advanced impact dispersion capabilities and serious tensile strength. Minimum vulnerable contact area ensures safety and security of the settlement and its occupants, while the carefully devised allocation of area allows for maximum productivity and economic profitability, without any compromise on comfort. The rugged but lightweight materials, structural stability and a simple but effective design, add more feathers to its cap. Connectivity between residential to residential and residential to industrial provides the staff and residents alike with high management capabilities and allow for maximum communication and connectivity. A logical and feasible step-by-step construction sequence ensures that the arrival of new citizens doesn't put the old one's safety and comfort in jeopardy. The instalment of specialized tug interfaces allow for optimal manoeuvrability in space, while the pressurized and non pressurized industrial zones make Benevectoras a lucrative deal for residents and businessmen alike.

Highly efficient space tugs allow for efficient transport of both cargo and manoeuvrability, while our versatile manufacture and transportation services maximize the effectiveness of the methods used to run our settlement.

All these provisions are what the public sees, but what goes in behind the scenes is what makes it all work. Meet our behind the scenes team, introducing the human equivalent of calculators for the settlement - Operations and Infrastructure. Our operations team is the brains behind the whole settlement, ensuring affordability, promptness, practicality and Efficiency. Here at Benevectoras, we believe that simplicity is the key to success, and that's why the Benevectoras boasts its simple but effective methods for vertical aeroponics in specialized agricultural chambers, gas recycling and atmosphere, environment friendly electric power generation, water management etc. Our cutting edge jigs and truss systems and top of the line tug designs are incredibly versatile and our innovative module based mechanism allows for safe and prompt delivery of all types of cargo, and ensures optimum mobility, with maximum efficiency and absolute economic reasonability.

Autonomy is key for living a life of sophistication and luxury, and keeping that in mind, High tech Bene-watches have been designed which can monitor vitals, stress levels, place and pick calls and important texts or emails, and are the latest in communication and PDA technology and maximize convenience, and comfort of the user, using them. We respect the privacy of our citizens, and strictly for safety purposes, the Bene-watch will track the bearer's location, which can only be accessed by authorized personnel.

Benevectoras thrives on its 3 valuable gems...introducing.... The Roll-E, Wall-O and IO (Nano bots). These are engineered for high versatility and compatibility and can suit multiple jobs, as per the need. Improving upon the peak of robotics technologies and machine learning capabilities, multipurpose home utility domestic bots have been provided to all citizens to suit the needs of the individual, no matter what lifestyle they have. Secure decentralized servers, advanced biometric identification system and analysis of threat level of suspects and a complex and intricate system for loading and unloading of CASSSCs, ensures the safety, security and efficiency of the backbone and foundation of all systems of the settlement.

Our dedicated human factors department have ensured the safety and comfort of all citizens coming on board the settlement with highly versatile space suits, smartly designed city maps and optimized space management, allowing for a completely self-sustainable, comfortable and Earth like environment. Compact but convenient housing designs and multi purpose domestic bots allow for a safe and secure way of life on board, keeping the spirit of humanity intact; a perfect blend of tradition, practicality and technology. Multiple windows allowing view of space directly from the client's room give an eccentric twist by adding the aesthetic of space to an earth like environment. For contingency purposes, effective countermeasures are present, and our safety pods have a highly ergonomic design, utilizing space and maximizing stability, even at high velocities. Extremely efficient honeycomb window designs, with protective materials have been used to shield the settlement and its occupants from solar flares. Thanks to an accurate quantitative estimation, high availability of daily essentials and other commodities keeps a balance of safety and comfort such that no human could feel out of place. Professional office designing, a healthy work environment and variety of recreational sources ensures maximum productivity of all residents on board the Benevectoras, and makes for massive profits, even in space.

STRUCTURAL DESIGN

2



EFFICIENT



ROBUST

STRUCTURAL DEVELOPMENT

2.0 Structural Design

Benevectoras' structure encompasses the premier measures in safety and efficiency, without ever compromising on the necessities and desires of our residents. The magnificent space views, expansive port and docking systems, luxurious residential spaces, thorough contingency plans, and a highly viable distribution of spaces between industrial, residential and business sectors, that too, at an extremely reasonable and affordable price, make Benevectoras a home...away from home. Our R&D team has put in weeks and weeks of effort to inculcate innovation, sophistication, and imagination to design a structure, for YOUR satisfaction.



Fig. 2.1 Benevectoras

2.0 External Configuration

2.1.1 Major Enclosed Volumes

All enclosed volumes being utilized for the completion of the structure, and their features are given as follows

Docking systems

- The docking systems on Benevectoras are located on the front and back faces of the settlement.
- They have been aptly named, keeping their function in mind, which is indeed docking and storage of space tugs.
- The docking systems serve as a gateway from the space environment to the safety of the settlement. They essentially serve as an entry and exit point to and from Benevectoras.
- **Main function:** All lifeforms and cargo gain access in and out of Benevectoras, through the docking stations, via the space tugs.

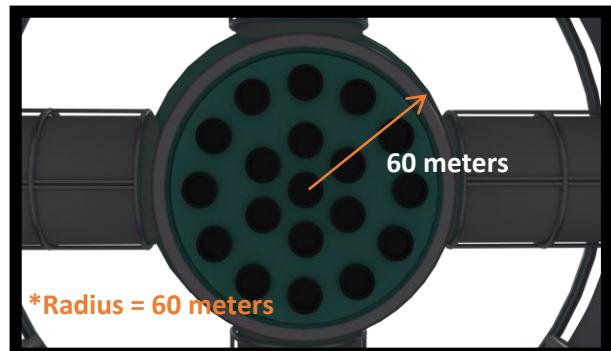


Fig: 2.1.1

Residential Segments

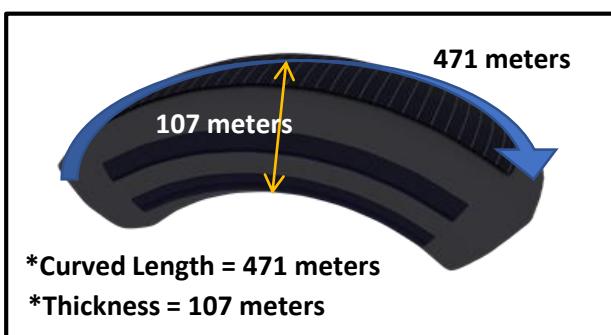


Fig: 2.1.2

- The residential segments facilitate the accommodation of all citizens aboard the settlement.
- Benevectoras (at full operational capacity) would consist of 5 "modules" each encompassing 4 such segments, which equals to a total of 20 segments comprising the settlement, at full operational capacity.
- **Main function:** The citizens would unremit occupancy of the residential segments, and each subsequent city would find it's place in the residential segments only.

Trusses

- The trusses serve as a pre requisite for the structure to be fabricated around and provide a skeletal framework around the settlement
- Northdonning Heedwell has sub contracted the construction and assembly of trusses to (insert name). More details can be provided by the sub contracted company themselves

STRUCTURAL DEVELOPMENT

- Main function: Serve as an "exoskeleton" for the settlement, facilitate initial construction endeavours of major components, while providing ease of access and manoeuvrability, minimizing efforts, and maximizing output.

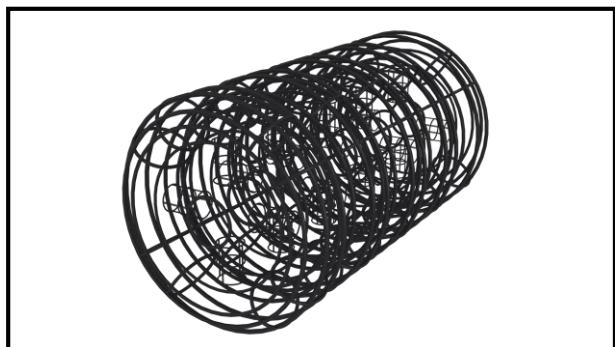
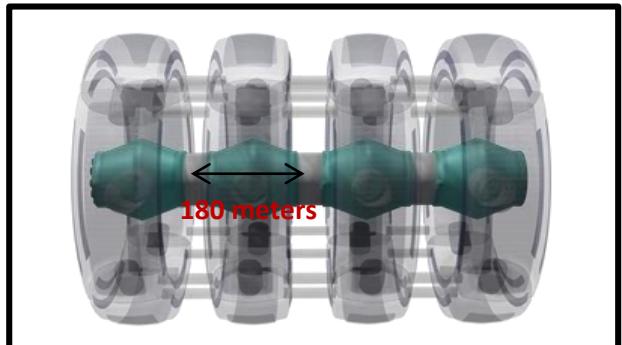


Fig: 2.1.3

Industrial Segments (Commodity Manufacturer and Mars Infrastructure)

*(For 1 frustum) $h = 90$ meters * $r = 60$ meters * $R = 85$ meters



- Benevectoras would contain 7 industrial segments in total (4 for commodity manufacturing and 3 for manufacturing components of mars infrastructure, which would later be assembled in the spokes.)
- The green segments are based on design of 2 frustums, and are for commodity manufacturing while the white ones are designed as cylinders, and bear responsibility for fabrication of mars infra components.
- At IOC, Benevectoras would possess capability of manufacturing commodities for the initial population (1800 approx.) and at each near Earth pass, a commodity manufacturing segment, and a mars infra segment would be added, till the specified limit of 7 has been reached
- Main Function: Industrial segments are to be utilized for production of commodities and mars infrastructure.

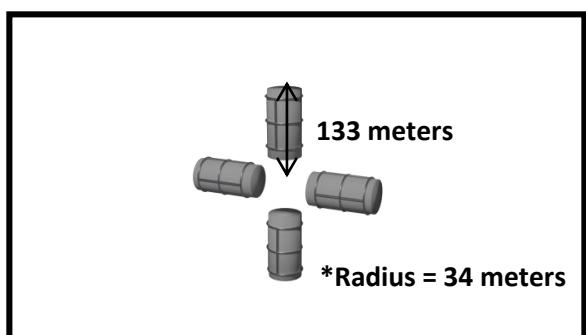


Fig: 2.1.4

- Main function: Storage of mars infrastructure and volatile ingredients, essential for proper functioning of the settlement.

Transportational Tubes

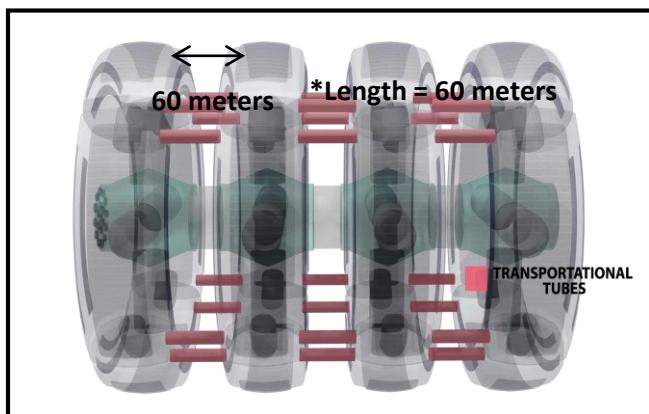
- The transportational tubes facilitate transportation of cargo, goods, bots and any other abiotic component of Benevectoras
- It's important to note that these transportational tubes are intended only for construction materials, bots etc. NOT FOR RESIDENTS
- Main function: Transport for cargo from one torus to another

STRUCTURAL DEVELOPMENT

2.1.2 Artificial Gravity

- A gravitational acceleration of $0.38g$ (3.724 m/s^2) has been requested by the customer, and to fulfil that requirement, the structural R&D department of Northdonning Heedwell concludes that the settlement needs to spin at an angular velocity of 0.11145293476 radians/second, which would amount to 1.064297129351287 rotations per minute.
- Rotation of specific parts of the settlement would be conducted with the help of Ion Thrusters.
- Rotation to provide artificial gravity would begin commencement once IOC has been achieved. *refer to 2.3

Rotating and Non-Rotating	
Docking Stations	Non-Rotating
Spokes	Rotating
Residential Segments	Rotating
Transportational Tubes	Rotating
Commodity Manufacturer	Non-Rotating
Mars Infrastructure	Non-Rotating



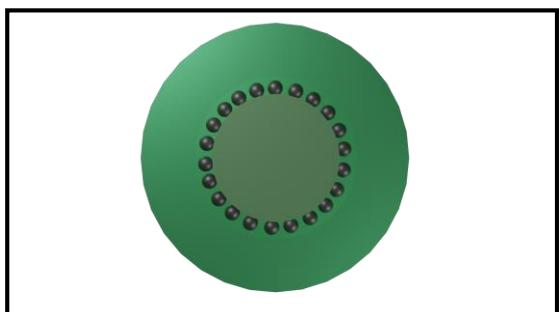
2.1.3 Rotational/Non-Rotational Segments; Pressurized/Non-Pressurized Segments

- The following tables illustrate the segregation amongst rotational and non-rotational, and pressurized and non-pressurized segments of the settlement

Pressurized and Non-Pressurized	
Docking Stations	Non-Pressurized
Spokes	Pressurized
Residential Segments	Pressurized
Transportational Tubes	Pressurized
Commodity Manufacturer	Pressurized
Mars Infrastructure	Non-Pressurized

2.1.4 Rotational Interface

- Ball bearings have been utilized to form the rotational interfaces between the rotating and non rotating areas, located between the main cylinder and spokes.
- The outer race would be attached to the spokes, while the inner race is to be connected to the primary cylinder.
- Ion thrusters would be facilitating rotation, eliminating chances of any unwanted movements or torques.
- A groove encapsulating the ball bearings would be set in place, so that no axial displacement takes place.



STRUCTURAL DEVELOPMENT

2.2 Internal Arrangement

- The allocation of area between different sectors of Benevectoras has been devised in a way to maximize efficiency, productivity and economic profitability of the settlement, while also preserving the comfort levels and without any compromise on the living standards of the people.
- The following illustrations shall serve as representations of the distribution of down surface areas, allocated to different sectors of the settlement.

Component (for Individual Components)	Down surface Area
<i>Residential segment</i>	62,576 meters ²
<i>Tug port</i>	11309.73 meters ²
<i>Commodity manufacturer</i>	42,546.58 meters ²
<i>Mars infrastructure manufacturer</i>	19,377.34 meters ²

- At 1st Near Earth Pass

Component	Down surface area
<i>Residential segments</i>	500,608 meters ²
<i>Tug ports</i>	33,929.19 meters ²
<i>Commodity manufacturer</i>	170,186.32 meters ²
<i>Mars infrastructure manufacturer</i>	19,377.34 meters ²

- At 2nd Near Earth Pass

Component	Down surface area
<i>Residential segments</i>	750,912 meters ²
<i>Tug ports</i>	45,238.92 meters ²
<i>Commodity manufacturer</i>	255,279.48 meters ²
<i>Mars infrastructure manufacturer</i>	38,754.68 meters ²

- At 3rd Near Earth Pass (FOC)

Component	Down surface area
<i>Residential segments</i>	1,001,216 meters ²
<i>Tug ports</i>	56,546.65 meters ²
<i>Commodity manufacturer</i>	340,372.64 meters ²
<i>Mars infrastructure manufacturer</i>	58,132.02 meters ²

- At IOC

Component	Down surface area
<i>Residential segments</i>	250,204 meters ²
<i>Tug ports</i>	22,619.46 meters ²
<i>Commodity manufacturer</i>	85,093.16 meters ²
<i>Mars infrastructure manufacturer</i>	N/A

STRUCTURAL DEVELOPMENT

2.3 Construction Process

	Figure
❖ <u>Step 1-</u> Initial efforts to fabricate trusses would commence. Construction of trusses has been subcontracted to Beam-Builders.	
❖ <u>Step 2-</u> Primary docking stations to be established, tugs bearing construction ingredients initiate arrival.	
❖ <u>Step 3-</u> Initiation of construction of trusses supporting spokes and residential segments.	
❖ <u>Step 4-</u> Completion of construction of spokes, providing storage capabilities for construction materials and establishment of repair stations, which would facilitate repairing services for bots. And other purposes alike.	
❖ <u>Step 5-</u> Initial module fabrication would commence. The module is to be constructed with a pattern comprising of 4 subsequent segments.	
❖ <u>Step 6-</u> Once such operational capability has been reached, rotation and pressurization would be initiated, marking achievement of IOC. <u>(Artificial gravity would be experienced after commencement of rotation).</u>	
❖ <u>Step 7-</u> Modules would be added subsequently at each near Earth pass, till maximum operational capacity has been reached (4 modules).	

STRUCTURAL DEVELOPMENT



2.4.1 Tug Ports

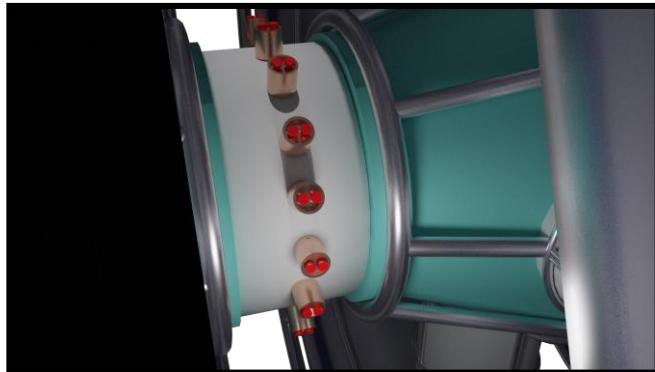
- The tug ports serve as a centre for repair, refuelling and storage of space tugs.
 - The tug ports are to be located at the front and back of our industrial segment (at IOC).
 - This grants Benevectoras a capability of storing approx. 78 tugs, without cramming them, in one tug port, which amounts to a total tug storing capacity of upto **156** tugs at IOC, **234** tugs at the 1st near Earth pass, **312** tugs at 2nd pass, **390** tugs at 3rd pass and **468** tugs at 4th pass (FOC). *Please note that the mentioned values are approximate
 - Northdonning Heedwell recognizes the vitality of consistency, and our R&D team has therefore devised that at each subsequent near Earth pass, another tug port should be added to the corresponding side, in order to maintain uniformity of the initial conception of the tug port locations. Following this method, the composition of the front and back alignments of tug port locations at both ends of the structure would remain uniform and consistent at all points of time, from IOC to FOC. *refer to fig 2.4.1
- The tug ports have a **radius** similar to our docking system, which is **60 meters**, along with a **height** of approx. **30 meters**. *refer to fig 2.4.2

STRUCTURAL DEVELOPMENT



2.4.2 Tug Interfaces

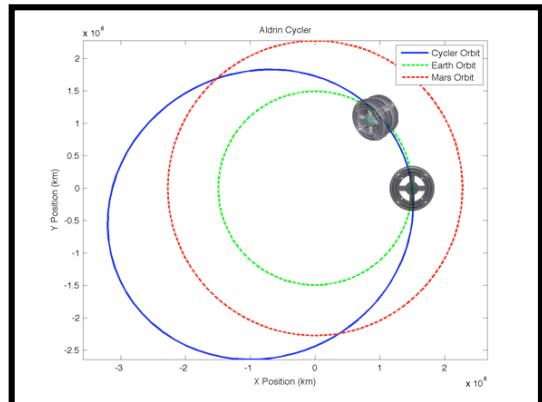
- The tug pushing interfaces are located on the outsides of the industrial segment.
- The outer surface of mars infra manufacturing segments (white cylinders) have the tug interfaces installed, for tugs to efficiently manoeuvre or push Benevectoras. The design choices have been made in a way to minimize unwanted torque, and ensure favourable omnidirectional movement. *refer to fig 2.4.3



2.5.1 Capability Upgradation

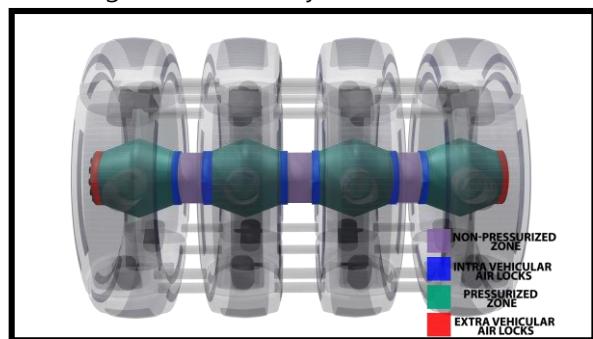
- After achieving IOC, the Benevectoras would be upgraded to increase accommodation and manufacture capabilities at each subsequent near Earth pass, till FOC has been reached.
- Construction and assembly of additional components begins at point A (where the settlement and Earth are relatively close), as illustrated in the diagram above.
- Upgradation is scheduled to end at point B (before the distance and costs for transporting materials and components are no longer feasible). (ref figure 2.5.1)

- A time period of approx. 1.7 months (51 days) is consumed by the settlement to traverse from point A to B, while travelling in the orbit.
- The same process is to be repeated, till FOC is achieved.



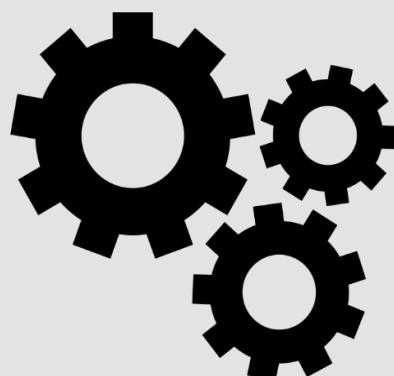
2.5.2 Mars Infrastructure Manufacturing

- The following diagram illustrates the division of the industrial segments into their respective pressurization and non-pressurized zones, along with locations of Intra Vehicular and Extra Vehicular Air Locks.
- The pressurized zones comprise the volumes for manufacture of commodities, and are connected directly to the residential segments through the spokes.
- As per the customer's request, the manufacture of mars infrastructure has been allocated to the non-pressurized zones, which would then transport the fabricated components to the spokes for storage and assembly.



OPERATIONS AND INFRASTRUCTURE

3



STRATEGIC
MECHANISMS



HUMAN
CALCULATORS

OPERATIONS AND INFRASTRUCTURE

By seamlessly integrating state-of-the-art technologies with basic human needs, Benevectoras optimizes the fluidity of operations while minimizing disruptions in the normal flow of life within Benevectoras. From advanced infrastructure to lavish modifications which cater to your business goals, Northdonning Heedwell capitalizes on efficiency and accessibility, ensuring the security and wellbeing of the residents and your investment.

3.1 ORBITAL LOCATION AND MATERIAL SOURCES

3.1.1 ORBITAL LOCATION

Benevectoras will be constructed in the **Low Earth Orbit (LEO)**, 500km above sea level. We have selected this location while keeping in mind the **proximity from Earth** to ensure good communication and proper support during the construction phase. The earth's magnetic field provides initial **protection from radiation**. Periodic propulsion with the help of space tugs will be provided during the construction phases to avoid orbital decay. The Low earth orbit also gives ease of transport of materials from earth as well as extraterrestrial sources.

After Initial Operational Capacity (IOC) is achieved Benevectoras will be guided into the **Aldrin cycler orbit** with the help of space tugs.

3.1.2 CONSTRUCTION MATERIALS AND SOURCES

We have ensured the use of **minimally refined extraterrestrial materials** which can be easily found on nearby asteroids and the moon to minimize construction costs and time.

We have also ensured that the materials are such that they do not cause any risk to the **safety of our residents**.

CASSSCs which have been contracted to '**Custom Cargo Accommodations**', have been used to reduce transport costs.

Refer to Table 3.1

3.1.3 TRANSPORT OF MATERIAL

Transfer of materials from Alaskol is done with the help of **mass drivers** which have been subcontracted to '**Magnetic Propulsion Company**'. **Space tugs** have been used for effective transfer of CASSSCs from the source location to the construction location. The proximity of material rich resources

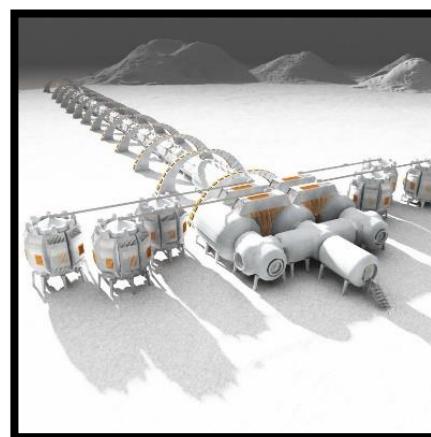


Fig 3.1 Transportation of CASSSCs

MATERIAL	USE OF MATERIAL	SOURCE	QUANTITY (MASS-kg)	CASSSC LOADS
<i>Carbon nanotubes</i>	Exterior Hull	Tubular Technologies	594085600	37160
<i>Silica aerogel</i>	Exterior Hull	Bellevistat	653494160	40876
<i>Titanium grade 5</i>	Exterior Hull	Bellevistat	6692374284	418613
<i>Aluminium Oxinitride</i>	Windows	Alexandriat	686911475	42966
<i>Silicon Buckystructure</i>	Windows	Bucky Breakthroughs	742607000	46450
<i>Lead crystal glass</i>	Windows	Bellevistat	712902720	44592

Table 3.1 Construction Materials and Sources

OPERATIONS AND INFRASTRUCTURE

3.2 SUSTENANCE OPERATIONS

Benevectoras provides innovative methods for basic sustenance operations which cater to the luxurious lifestyles of its residents while keeping their safety uncompromised. While being innovative these are well tested mechanisms which are reliable.

3.2.1 Atmosphere and Climate

Benevectoras will maintain a comfortable 22°C in open residential areas. Temperature in homes can be adjusted by thermostats which are controlled by Bene-watches

To ensure the optimal comfort, health, and safety of our residents, Benevectoras maintains an air composition similar to that of Earth's, but without harmful gases.

The gasses will be supplied by the subcontractor, 'Stuff of Life' and will be transported and stored in liquefied form.

All pressurized zones maintain a constant pressure of 0.65 atm

Gas	%Comp	Partial pressure (atm)	Mass at IOC (Kg)	CASSSC loads at IOC	Mass at FOC (Kg)	CASSSC loads at FOC
N_2	75.50	0.4907	20,515,292	1,292	82,061,168	5,168
O_2	23.15	0.1501	7,189,008	453	28,756,032	1,812
Ar	1.28	0.0083	496,880	31	1,987,520	124
CO_2	0.0035	0.00002	1,452	1	5,808	1
H_2O	0.0465	0.00029	8,118	1	32,472	2
Total	100	0.65	28,210,750	1,778	112,843,000	7,107

Table 3.2 Atmospheric Composition

3.2.2 Food Production

Benevectoras will provide a wide range of dietary options to maintain a healthy and nutritious diet for its residents. Crop production is done at specified 'Agricultural Chambers' located within the residential areas. The crop production is carried out using aeroponics. These techniques would help to grow plants without the use of a medium like soil, also less water and energy will be consumed.

Cycle of Gases (by 'Clean up your act')

- Methane would undergo pyrolysis to get separated into Carbon and hydrogen.
- The Hydrogen produced and the Carbon dioxide will be recycled back into the reaction. Some of the surplus Carbon dioxide will be sent to the agricultural sector.
- The Hydrogen will again get recycled back, closing the loop, while Pyrolytic graphite will be left over for various other uses.
- Air vents in residential sector will regularly stream out Oxygen and take in Carbon dioxide and vice versa in the agricultural chambers.
- Hydrophilic collectors will maintain humidity and collect water in form of water vapors.
- HEPA purification systems will be placed regularly every 15m throughout the settlement.

Food production in these chambers is completely automated. Agro-bots control and monitor the growth of the crops. The quantity of each crop is controlled by these bots which is calculated on the basis of the dietary preferences and health condition of the residents. Panels of OLED lighting maintain an optimal light spectrum for plant growth. Open spaces have apple trees and strawberry bushes.

OPERATIONS AND INFRASTRUCTURE

Bio-printers supply a cost effective and innovative alternative to livestock, offering a nearly infinite array of vegan meat products to suit all tastes. Subcontractor '*Garden-A-Go-Go*' will be called upon during this setup.

Special HYV seed will be used to enhance plant growth.



Fig 3.2 Agrobots and Aeroponics

	kCal/1800 people/ 2 weeks	Kilograms/1800 people/ 2 weeks	kCal/8800 people/ 2 weeks	Kilograms/8800 people/ 2 weeks
Corn	1134	252	5544	1232
Fruit	13608	3024	66528	14784
Legumes	11340	1260	55440	6160
Rice	2772	756	13552	3696
Spirulina	378	126	1848	616
Sorghum	6804	1512	33264	7392
Soybeans	10836	2268	52976	11088
Vegetables	18648	4410	91168	21560
Wheat	5040	1512	24640	7329
Total	70560	15120	344960	73290

CASSSC Loads at IOC-25

CASSSC Loads at FOC-120

Table 3.2 Food Quantities

3.2.3 Electrical Operations and Management

Benevectoras is completely reliant on solar energy to fulfil its energy requirements. This is due to the ample amount of solar energy which is available to Benevectoras while in orbit.

Benevectoras is covered by a total of 576000 m² of solar panels. The solar panels have been contracted to 'Zap! Industries'

The power distribution grid is subcontracted to 'Zap! Industries'



Fig 3.3 Solar Panels

Surplus energy is stored in lithium ion batteries which are present in the spokes.

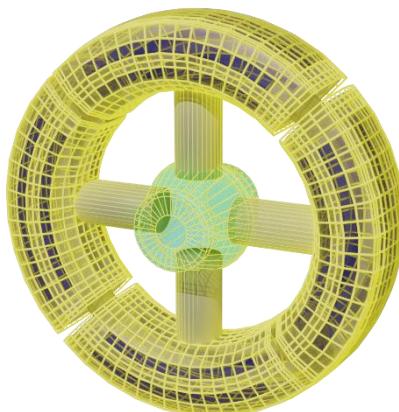


Fig 3.4 Power Grid Distribution

Piezoelectric tiles are also used in pathways for small scale power generation such as powering street lights.

OPERATIONS AND INFRASTRUCTURE

	Consumption at IOC	Subsequent increase	Consumption at FOC
Agriculture	40,000kW	5,600kW	56,800kW
Industrial	320,000kW	73,600kW	540,800kW
Residential	130,000 kW	14,300kW	172,900kW
Automations	150,000kW	10,500kW	181,500kW
Other Processes	80,000kW	2,400kW	87,200kW
Total	720,000kW	106400kW	1,039,200kW

Table 3.3 Power Distribution

3.2.4 Water Management and Distribution

Water supply of Benevectoras has been subcontractor to 'Stuff of Life'. Several methods have been used to bring down the daily use of water. Benevectoras has an expansive storage of water.

A 9 step filtration system has been integrated to provide the cleanest water to our residents.

The water filtration systems has been subcontracted to 'Clean up your Act'.

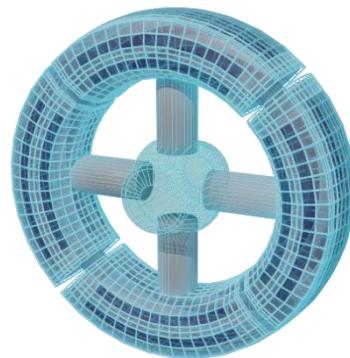


Fig 3.5 Water Distribution

	Volume at IOC (L)	CASSSC Loads at IOC	Subsequent increase (L)	Volume at FOC (L)	CASSSC Loads at FOC
Residential	4,250,000	23	1,785,000	9,605,000	52
Agricultural	7,500,000	40	5,025,000	22575000	122
Industrial	60,00,000	32	3,360,000	16080000	87
Emergency storage	5,100,000	27	1,071,000	8313000	44
Total	22,850,000	122	11,241,000	56573000	305

Table 3.4 Water Quantities

3.2.5 Household and Industrial waste management

3.2.5.1 Human waste

Dry Flush Washrooms will be installed. By products of faeces like water, protein, undigested fats, polysaccharides, bacterial biomass, ash, and undigested food residues will be appropriately processed and then be used as manure and the ruminants that are not being used as manure left will be incinerated.

Urine will be processed and also be used as a fertilizer.

3.2.5.2 E-Waste

It will be collected periodically and dismantled into different parts by automated shredding equipment to recover metals like Copper, aluminium and platinum from the circuit boards using cryogenic decomposition. The emissions are captured by scrubbers. The plastic would be separated and recycled.

OPERATIONS AND INFRASTRUCTURE

3.2.5.3 Plastic

Plastic being non bio-degradable, would be recycled and turned into other useful products. This would reduce the cost of exporting them again and again. The products would first be sorted based on their type of polymers and then melted. They can then be reshaped and made into plastic furniture, containers etc.

3.2.6 Internal and External Communication Systems

3.2.6.1 Internal Communications

Transistors and telecommunication will be established similar to that of Earth and major controlling units will be connected to each other using RF module. Fiber optics will be provided by subcontractor 'ZAP! Industries'. Telecom companies will be providing Internet services to all the residents.

Bene-watches are provided to all residents of Benevectoras. These enable fast communication among the residents as well as to Earth and Mars.

3.2.7 Internal Transportation System

Bicycles and cyber pods will be used by the residents. Emergency vehicles and ambulances will be used in state of emergencies. CASSSCs will be transported using automated mechanism and bots.



Fig 3.6 Futuristic Cycle

3.2.5.4 Disposal of corpses

The active organs of the corpses can be removed and donated with appropriate permission. Since the body would need to be isolated within 24 hours to avoid contamination, it would be immediately placed into a Gore-Tex bags that would be inflated into a type of sarcophagus

3.2.6.2 External Communication

Communication will be done with earth via NASA's deep space program which will communicate directly with the latest artificial satellite which is the closest to the settlement. Advanced satellites which incorporate deep space optical communication (like NASA's Psyche mission). Will be used for communication with Earth. Therefore, communication will be done with the earth via SATCOM. The subcontractor, 'Orbit Link Communications' will also be providing antennas for direct communications of earth for the residents.

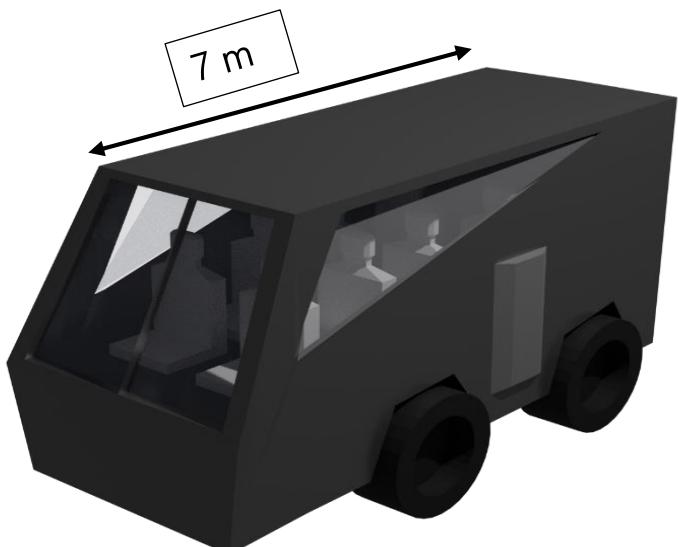


Fig 3.7 Cyber Pod

Cyber pods are a form of public transport which can accommodate up to 10 people at a time

OPERATIONS AND INFRASTRUCTURE

3.2.8 Day/Night Cycles

The Night will be converted into day and vice versa using reflective mirrors provided by subcontractor '**Mirror Image**'. Day and night will be observed in the residential sectors as per the same region as Greenwich. Mirror Image will provide us with mirrors which will reflect the light of the sun which will cause day and then the mirrors will face the sun to stop the light and cause night. UV radiation resistant glass will be used throughout the settlement.

3.3 Construction Machinery and Equipment

Northdonning Heedwell maximizes the speed of our multi-phase construction sequence. We recognize the task of constructing our settlement in the least amount of time while maintaining high quality standards. In order to balance these constraints we have created a construction process which will ensure a speedy construction of the settlement.

3.3.1 Jigs and truss system

To compete the mammoth task of the construction of Benevectoras, an innovative Jigs and Truss system has been used to carry out the exterior construction.

The jig which are connected to the exterior construction bot traverses about the truss structures.

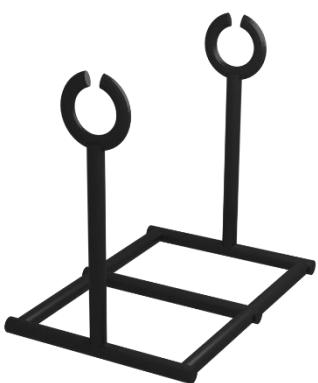


Fig 3.7 Jigs

Time Period	Light Intensity	%Change/Min
06:00-08:00	5	0.625
8:00-10:00	80	0.042
10:00-11:30	85	0.033
11:30-12:30	88	0.017
12:30-14:00	90	0.022
14:00-16:00	85	0.025
16:00-20:00	85	0.333
20:00-06:00	5	0

Table 3.5 Day/Night Cycles

3.2.2 Construction Bots

For the most efficient way to construct Benevectoras, we have designed external and internal construction bots which enable simultaneous construction of the settlement both inside as well as outside.

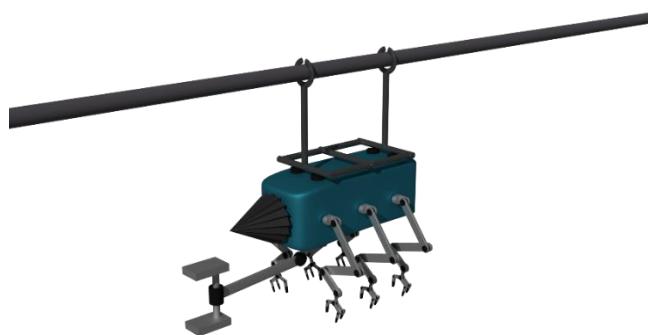


Fig 3.8 External Construction Bot

The external construction bot is well equipped and packed with efficient and useful tools which remove the need for multiple bots. Some of the tools include cutters, grabbers, dispensers and welders



Fig 3.9 Internal Construction Bot

OPERATIONS AND INFRASTRUCTURE

3.4 SPACE TUG DESIGN

Benevectoras provides completely flexible and reusable space tug facilities which come from its '**Module**' based design. This makes transport of people and cargo smooth and clutter free.

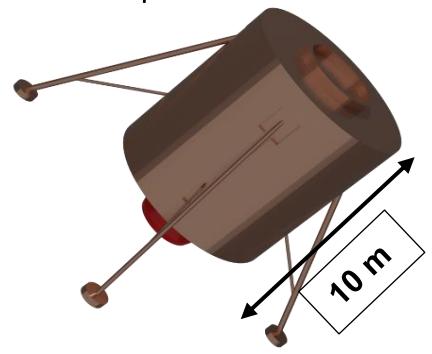
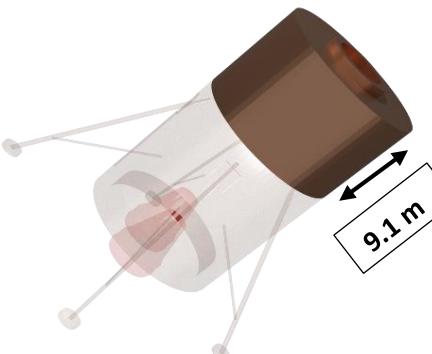
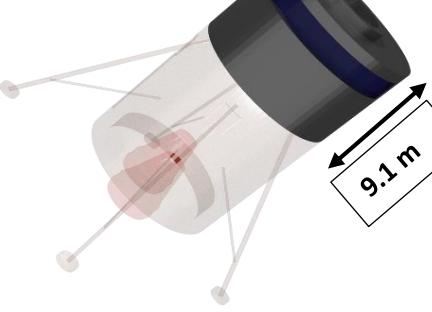
MODULE DESIGN	FEATURES	Quantity
 <p>Propulsion Module</p>	<p>The propulsion unit is specially designed to provide maximum efficiency. The propulsion module can be connected to up to 5 crew or cargo modules. The modules are connected using mechanical clamps as well as an electromagnetic connection system to prevent any chance of unwanted disassembly.</p>	335
 <p>Cargo Module</p>	<p>The cargo module has been strategically designed to maximize the number of CASSSCs it can accommodate. Each Cargo Module can accommodate up to 7 CASSSCs.</p>	275
 <p>Crew Module</p>	<p>The crew module provides a secure way for the transport of personnel to and from Benevectoras. We have kept in mind the comfort of the passengers during travel and have provided with business class seats. The passengers are also provided with windows to be able to experience space views throughout the journey. Each Crew Module can accommodate up to 78 people at a time.</p>	55

Table 3.6 Tug Designs and Features

OPERATIONS AND INFRASTRUCTURE

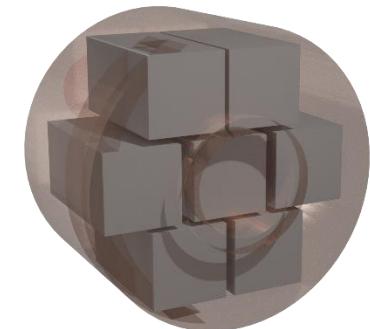


Fig 3.10 Packing of CASSSCs and Cargo Module

3.5 MANUFACTURE OF MARTIAN INFRASTRUCTURE

Benevectoras provides a wide range of manufacture of Martian infrastructure which will move humanity one step closer to making Mars habitable and takes us closer to become an interplanetary civilization. This infrastructure is made in the form of sub-assemblies which makes transport in CASSSCs easier.

3.5.1 Rotating Living Space Sub-Assemblies

Mars has just about 30% surface gravity compared to earth. This would lead to Martian settlers to lose bone density, muscle waste and cardiovascular problems over long periods of time. To prevent this and slow this process down, rotating living spaces will be utilized. These living spaces will provide the Martian settlers with artificial gravity to compensate for the loss in surface gravity.



Fig 3.11 Rotating Living Areas
(Cross-Section)

3.5.2 'Fusion Founders' Nuclear Plant sub-assemblies

Mars receives only 40% of solar energy compared to Earth. This is further obscured by the frequent dust storms. Thus this makes solar energy non-viable to meet the requirements of the fast growing Martian settler population. Thus the only viable source of energy which can be used is nuclear power. Thus 'Fusion Founders' is contracted to manufacture nuclear fusion power plants on Benevectoras.

3.5.3 Land Rover Assemblies and Construction Bots

Land rovers are necessary for on surface analysis to navigate and locate Martian resources. Because of the toxic atmosphere and fine Martian dust, all on surface construction activities will take place with the help of construction bots similar to those which will help in the construction of Benevectoras.

3.5.4 Satellite Assemblies

Satellites are used to search the surface for habitable areas and analysis of mineral resources. Communication satellites will be used to enhance communication with the mars community.

3.5.5 Aircraft Sub-Assemblies

The fine Martian dust which can hinder the function of surface vehicles in long distance travel. Therefore, aircrafts are used for fast transfer of people and cargo from one Mars community to another.

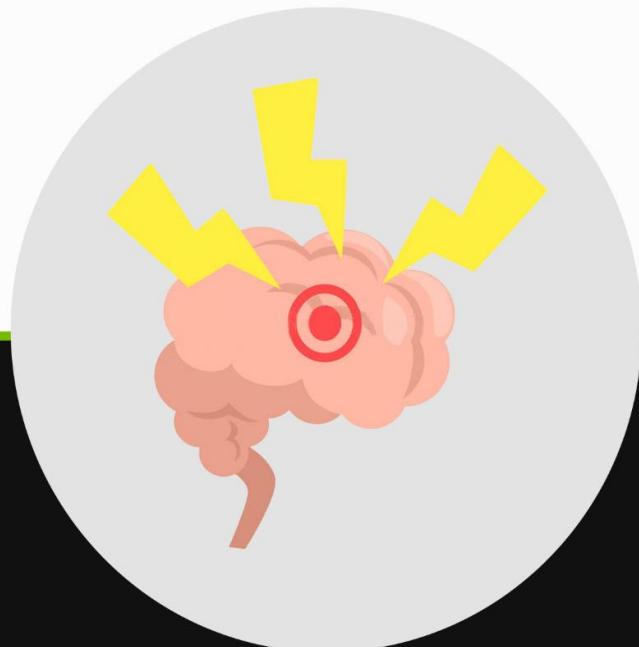
3.5.6 Soil Decontamination Assemblies

Mars soil is very alkaline having a pH of 8-9 and lacks nitrogen which is necessary for the growth of plants. The soil needs to be decontaminated and treated for agriculture to be possible.

In the absence of such decontamination assemblies, methods such as aquaponics can be used for agricultural purposes.

HUMAN FACTORS

4



ERGONOMICALLY
STABLE



SAFETY

HUMAN FACTORS

We at North Donning Heedwell propose to provide its residents with a comfortable and luxurious lifestyle at **Benevectoras**. It has been expertly designed to fulfil all the required amenities such as housing, entertainment, education, parks, and medical facilities.

Some key features have been given utmost importance while designing the cities such as contingency plans, green spaces, providing long lines of sight, efficient mass transit, and psychological and physical relaxation.

SPACE VIEWS

The residential sector of **Benevectoras** is surrounded by highly protected windows. The windows which are made of 4 layers of aluminum oxynitride , silicon Bucky structure provided by 'Bucky Breakthroughs' subcontractor , Lead crystal glass and another layer of oxynitride , protect it from any kind of radiation and **solar flares** from affecting the settlement .These windows also provide **mesmerizing views** of the Earth , the solar system and space in general.

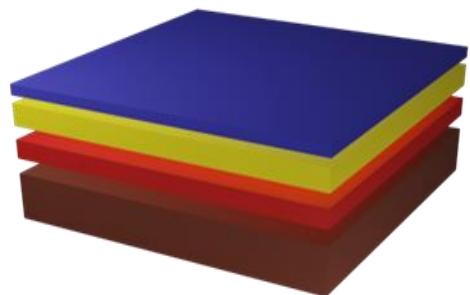


Fig.4.1 Layers of protection in windows



Fig.4.2 UV Ray Protection

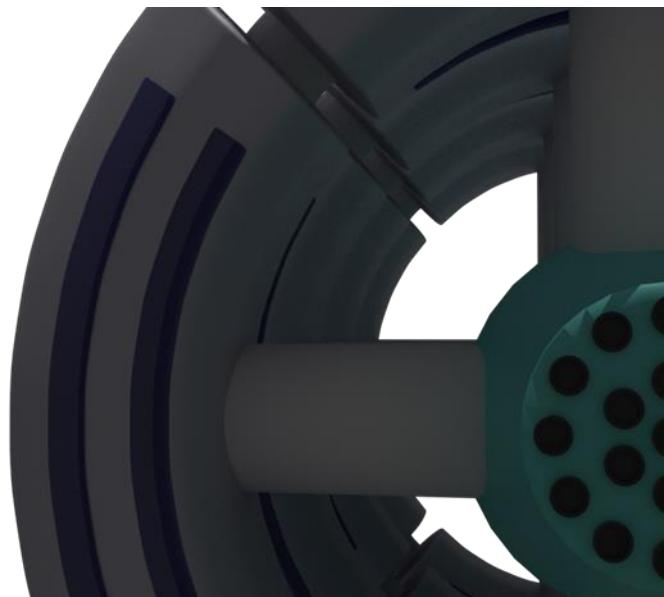


Fig.4.3 Space Views

HUMAN FACTORS

4.1. Community Design

4.1.1 Community plan

Our community layout emphasizes greatly on the **comfort of the individuals**, so that they have a pleasant and enjoyable stay at **Benevectoras**. Along with this great emphasis has been given to **office and job opportunities**. Each section of the city contains provisions to enhance an individual's experience while **not compromising on privacy**. (Refer to fig 4.2 and table 4.1 for community plan And key)

STORAGE	HOSPITAL
AGRICULTURAL CHAMBERS	SCHOOL
COMMAND CENTRE	GOVERNMENT BUILDING
SERVER ROOM	MEDITATION
DORMITORIES(4)	OFFICES
GREEN SPACES	MOVIE THEATRE
2 BHK(2),3BHK,4BHK	AIRLOCK
MALL	OBSERVATORY

Table 4.1 Key

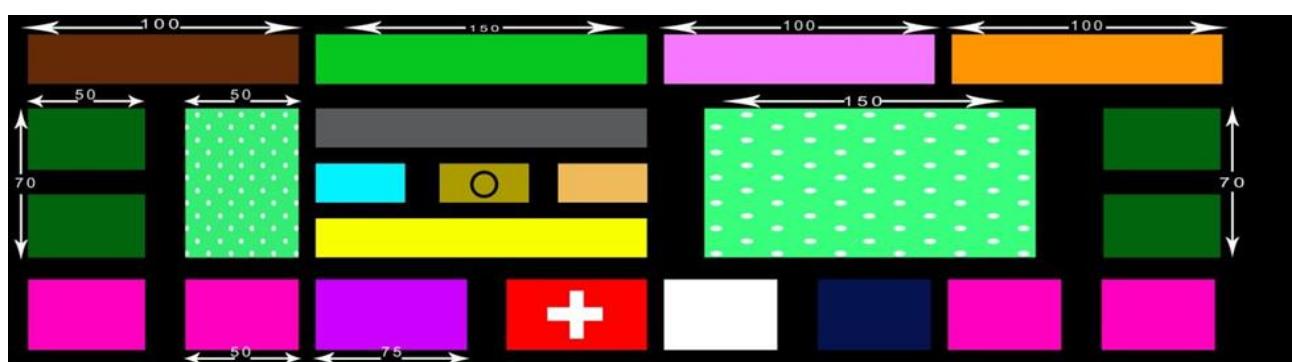


Fig.4.4Community plan

4.1.2 Amenities

- HOSPITALS:** Benevectoras is prepared for every medical emergency it may encounter .The settlement is equipped with a highly efficient medical bot known as **TARS**.
- MALLS:** It is located in the center of the housing sector of each city, each mall contains a number of retail outlets , along with a hall for the hosting functions and also contains various gaming arcades containing laser tag, virtual reality and much more . The shopping complex also offers varied choices of cuisines
- SCHOOL:** Benevectoras will contain one K-12 school in the entire settlement , so that the children in the settlement can pursue their education
- LONG LINES OF SIGHT :** The houses and the dormitories ,the shops in the mall offer magnificent space views surrounding the settlement.



Fig.4.5 TARS

- MEDITATION CENTRES:** We at North Donning HeedWell understand the strain of the transition from their home planet to Benevectoras of both in-transit and permanent transition we have added a meditation center in every city. Along with this the Benewatch closely monitors also helps immensely in the mental health of the people .(refer to 5.3 for further information)

HUMAN FACTORS

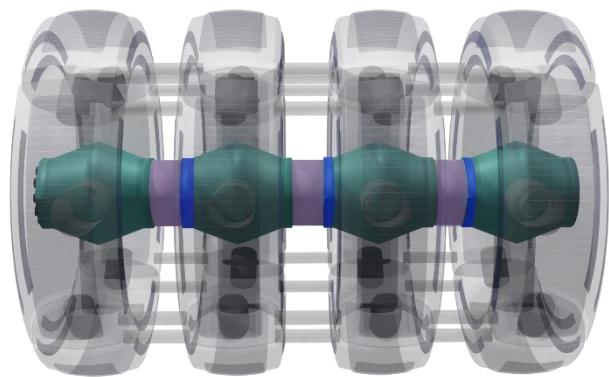
- **GREEN SPACES:** to evoke anamnesis of Earth ,green spaces have been constructed offering not only long lines of sight but also having green apple trees and strawberry bushes.
- **AIRLOCKS:** The air locks are located near the observatory. We will be hiring subcontractor 'lossless airlocks' which will be providing us with airlocks.
- **HEADQUARTERS :** The HQ resides in the (location) of the settlement. From below, the canopy appears as an undulating frame to the sky, giving a calming feel to the residents and the in-transit mars settlers.

4.2 Residential areas

Benevectoras ensure maximum comfort of all of its residents and in transit settlers alike. We have included **5 kinds of houses** in our settlement in a total of **16 cities**. There is **ample space** in each house for every person's **well-being and satisfaction**. We have hired subcontractor '**SEALS-IT-ALL**' for the exterior paint of all buildings in the city.

4.2.1 LOCATION

The housing sector exists in the **bottom half** of the city. Located in an ideal location right next to the hospital and shopping mall to ensure maximum comfort to the residents (**refer to fig 4.2**)



**EXTRA VEHICULAR
AIR LOCKS**



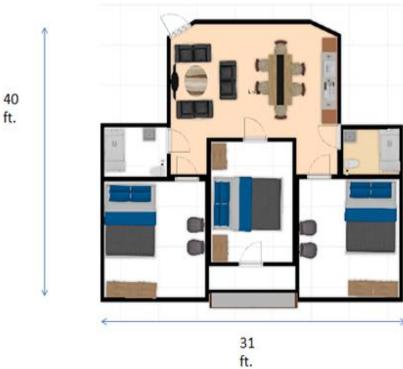
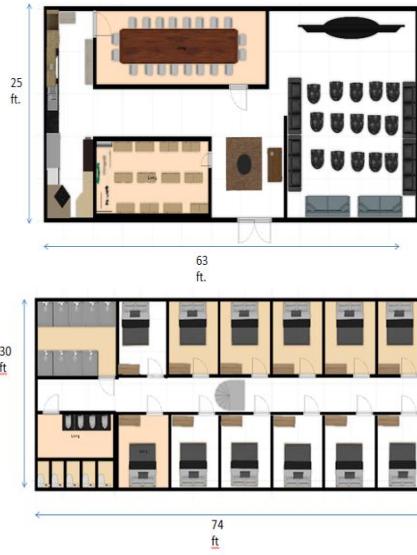
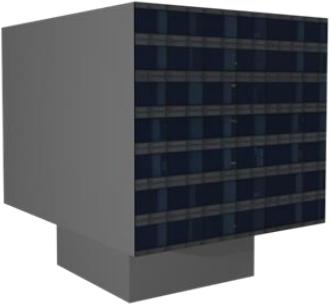
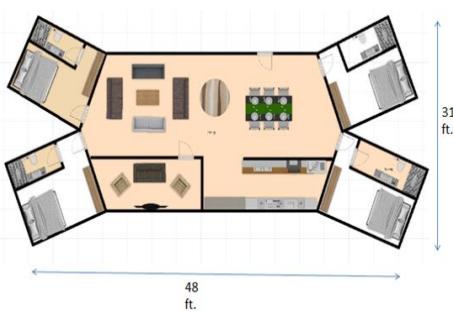
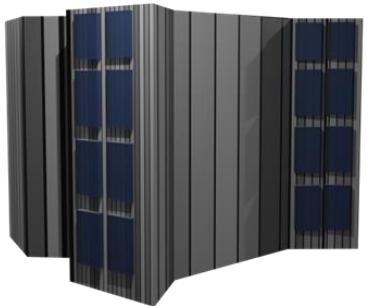
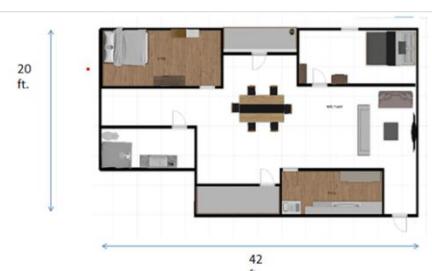
**INTRA VEHICULAR
AIR LOCKS**

Fig.4.6 Air Locks

4.2.2 Floor Plans

<p>2 BHK NO. AT IOC:80 NO. AT FOC:200 DSA:1050 sq. ft. VERTICAL CLEARANCE:48m</p>		
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HUMAN FACTORS

<p>3BHK NO. AT IOC:70 NO. AT FOC:150 DSA:1200 sq. ft. VERTICAL CLEARANCE:48m</p>		
<p>DORMITORIES NO. AT IOC:12 NO. AT FOC:65 DSA:1575 sq. ft. VERTICAL CLEARANCE:50M</p>		
<p>4 BHK NO. AT IOC:100 NO. AT FOC:220 DSA: 1488 sq. ft. VERTICAL CLEARANCE:48m.</p>		
<p>2BHK NO. AT IOC:70 NO. FOC:150 DSA:820 sq.ft. VERTICAL CLEARANCE:</p>		

HUMAN FACTORS

4.3 SAFETY

4.3.1 ISOLATION CAPABILITIES

Each compartment and module in the settlement is compartmentalized by airtight doors. These doors are designed to slam shut immediately in case of hull penetration and subsequent depressurization which will preserve the atmospheric pressure in the undamaged modules

4.3.2 Spacesuit types

The spacesuits in our city will be subcontracted to 'EXTREME SURVIVAL TECHNOLOGIES'. Three types of spacesuit exist; namely IVA (intra vehicular activity), EVA (extra vehicular activity), IEVA (intra extra vehicular activity).

- IVA suits are used for movement inside the spacecraft.
- EVA suits are meant to be used for movement outside the spacecraft like spacewalking.
- IEVA suits are used for both inside and outside movement of astronauts.

4.3.3 Spacesuit features

The spacesuit will have 14 layers : a liquid cooling garment (3 layers), a pressure garment (4 layers), and a thermal micrometeoroid layer (7 layers)-

1) Provides pressurized atmosphere

Pressure to keep the fluids in your body in liquid state.

2) Oxygen packs

Provides oxygen to the astronaut during spacewalks, oxygen is provided either from the astronauts backpack or from spacecraft via a tether.

3) Scrubbing

Spacesuit uses lithium hydroxide canisters to remove carbon dioxide

4) Sight (visor)

Helmets made up of durable polycarbonate for clear sight of space and tinted visors to reduce glare inside of the visor.

5) Communication

Spacesuits will be equipped with dual band radio transmitters.

Emergency frequency: 100.1mhz

6) MAG(maximum absorbent garment)

Helps in the ejection of fluid waste of astronauts.

7) IDB(in-suit drink bag)

Water for the astronaut to drink while on spacewalk or planetary exploration.

8) LCVG(liquid cooling and ventilation garment)

Made of nylon tricot and spandex laced with thin plastic tubes to remove heat produced by astronaut

4.3.4 Spacesuit quantities-1200

4.3.5 Safety systems

A) Safety tethers

About 55 feet long (16.7 m), ensuring necessary mobility and they are attached all times to the waste tether by a large hook , extra tethers on wrists keep the tools intact and prevent it from going adrift.

B) MMUs(manned maneuvering units)

Large propulsive vehicles attached to space suits for mobility and to perform more complicated tasks.

C) SAFER(simplified aid for EVA rescue)

Emergency MMU system that are attached to spacesuits' backpack

D) Handrails

Helps the astronauts ' mobility

E) Trace gas analyzer-Mass spectrometer,

It is about 2 inches long, placed on the astronauts chest so it can easily be pointed at areas of interest, it also detects leaking water, seeping rocket fuel or escaping oxygen.

4.3.6 Location of airlocks

The airlocks are located in the center of each city beside the government building . Refer to 4.1 for further information



Fig.4.7 Space Suits

HUMAN FACTORS

4.4 COMMODITY LIST

Benevectoras recognizes that the necessities and the needs of its residents are not expendable. Following are the food consumables and household commodities for the in-transit settlers, permanent settlers and the Martian settlers are listed below in the following four tables. Refer to tables given below.

Storage and transportation of commodities

For storage of goods , in each city ample space has been provided , goods will be stored in repurposed CASSCS. These spaces are placed in a strategic position , that is ; its proximity to office spaces. For its location refer to table 4.1.

For Mars bound commodities to be transferred to tugs , we have devised a novel method of using conveyor belts to safely and efficiently transfer goods . Refer to Figure 4.4

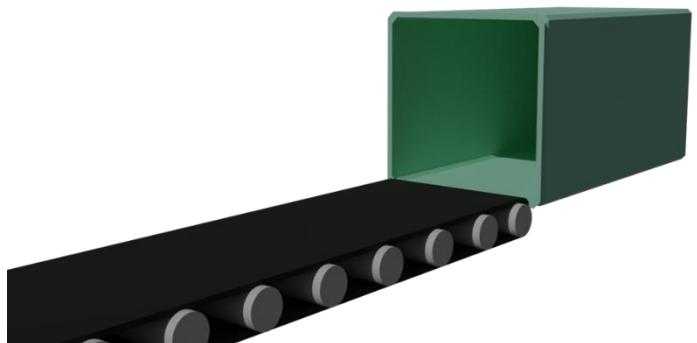


Fig 4.8 Transport of mars bound commodities

FOOD CONSUMABLES			
Serial Number	Food Item	Initial Quantity provided (kg/ 2 weeks)	Subsequent quantity provided(kg/ 2 weeks)
1.	Vegetables	4410	21560
2.	Wheat	1512	7329
3.	Dairy Products	30240	147840
4.	Rice	756	3696
5.	Sugar and Salt	907.2	4435.2
6.	Meat	110880	492800
7.	Fruits	3024	14784
8.	Pulses	1260	6160

Table 4.2

HUMAN FACTORS

HOUSEHOLD COMMODITIES			
Serial No.	Item name	Initial Quantity provided	Final quantity provided
1.	Beds/Mattresses	1500	9000
2.	General appliances	700	5600
3.	Miscellaneous	1300	9000
4.	Toiletries	6000	36000
5.	Sanitary Pads	109000	800000
6.	Emergency Kits	As per requirements	As per requirements

Table 4.3

For toiletries we will hire subcontractor '**Bottom Cleaners**'

4.5 OFFICES

Benevectoras provides ample opportunities for both in-transit and permanent settlers to pursue their businesses and jobs. Every city will have ample space for office work.

1.The offices are located adjacent to storage facilities and the server room.(refer to fig4.5)

2.The offices have high speed connectivity and Wi-Fi up to 100 gigabytes per second speed.

3.Businesses will be given special waivers for trade with other settlements and mars settlers.

4.All the employees and their families will get special benefits like education and ration at subsidized rate

The offices will contain:

- Cubicles
- Conference rooms
- Receptions
- Gym
- Toilets
- Café and restaurant

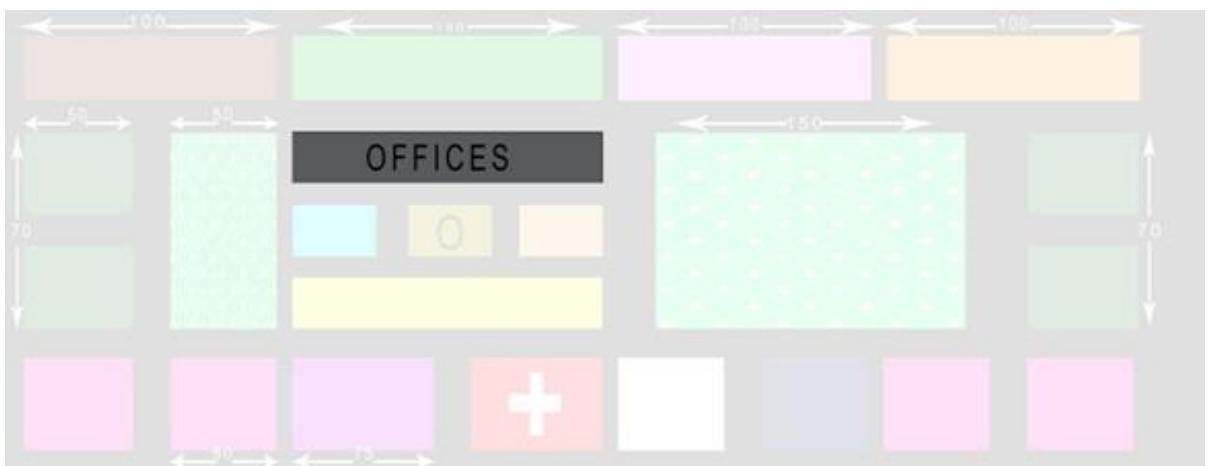
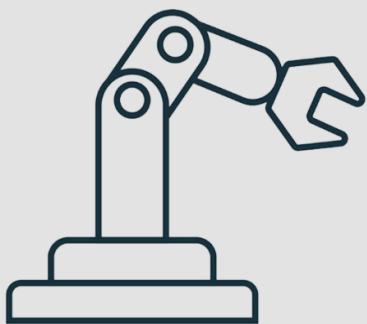


Fig 4.5

AUTOMATION DESIGN AND SERVICES

5



RELIABLE



OPTIMIZED

AUTOMATION AND DESIGN SERVICES

5.0 Automation

Benevectoras has been provided with an **extensive** range of **autonomous** robots and devices for making life at Benevectoras **serene** and purposeful.

From day to day monotonous tasks to large scale projects, all are looked after by automated robots. Occasionally human **intervention** is required to overlook the **functioning** of the robots.

All the automation systems are predominantly powered by **solar** energy. For **backup**, power walls have been installed so that the working of crucial construction bots and command centers remains uninterrupted. *Zap Industries* has been subcontracted for provision of wire harnesses which provide **electrical power** in cases of power outages and helps in **updating** the automation data **servers** with new **bot data**.

5.1 AUTOMATION OF CONSTRUCTION PROCESSES

1) ROLL-E

- Roll-E is the **main** construction bot and responsible for the primary **external** construction of Benevectoras.
- It is made up of a **carbon fiber** aluminium core composite structure which is **lightweight** and has **superior** mechanical properties.
- A **blueprint** of the basic structure needs to be designed so that Roll-E can **construct** the structure with **precision** and accuracy.
- Its **high tensile** strength allows it to store and carry substantial amount of heavy construction material and equipment.
- After 100% completion of the external structure of Benevectoras, Roll-E will be **used** in the **manufacturing** where it will help in **transportation** of inventory within the warehouses and other **warehouse** activities.

Quantity: At IOC : 175 Bots

At Final Operational Capacity : 316 Bots

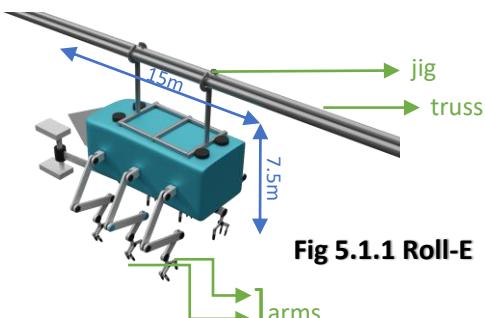


Fig 5.1.1 Roll-E



Fig 5.1.2 Roll-E

2) U-Bot

- It is a **multipurpose** bot with varying capabilities. It gives a status **report** of all the construction activities and also generates reports of **all the bots** engaged in construction. It will also report any **malfunctioning** in the working of the bots. It uses **CMOS** (complimentary metal oxide) sensors for capturing **images**. There will be around **250 U-Bots** per ring.
- It also has **access** to the automation data **servers** and **updates** the sever with new bot **data**.
- It **roams** around the construction site gathering **updates** to make **progression** reports about the construction activities. In addition as it roams around, it also helps in **transportation** of construction materials and tools within the site.
- Through jigs the U-Bot will be connected to the trusses which will help it move around the construction site. After completion of Benevectoras it will be used as a **delivery** bot and will be used to transport and deliver **commodities** of everyday use.

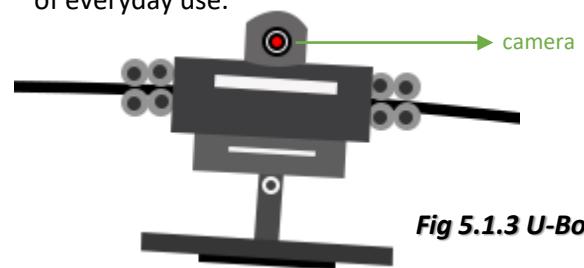


Fig 5.1.3 U-Bot

3) INT-EXT Bot

- This bot is responsible for **repairs** of mainly the **exterior** structure.
- Complicated **internal** repairs which **cannot** be handled by **Wall-O** will also be taken care of by Int-Ext bot. It consists of **specialized** arms to handle different **intricate** tools for major repairs.
- It uses **friction stir** welding which is the most **reliable** welding technique with a very high weld **strength**.
- It has been **equipped** with **proximity** sensors which helps it detect the presence of nearby objects **without** any physical **contact**.
- During IOC, Int-Ext bot will work **alongside** Roll-E for the **initial** construction sequence of Benevectoras.
- After the completion of the external structures many of its **components** will be **removed** which will in turn make it smaller and more suitable for **day to day** external and internal repairs.

Quantity: At IOC : 100 Bots
At Final Operational Capacity : 250 Bots

4) Interius Structor

- Interius Structor** as the name suggests is used **solely** for **internal** construction.
- It has been **equipped** with a basic **toolkit** and other tools for construction are provided by the **U-bot**.
- It has a **large** storage **space** for construction supplies.
- For building it has 2 **large** arms for handling **intricate** tools and with the help of **proximity sensors** and **cameras**, it can work dynamically and efficiently. It needs an input on the **interior design** to construct a **clear-cut** structure and can complete the final interior **finishing** according to the wishes of the **user**.

Quantity: At IOC : 124 Bots
At Final Operational Capacity : 510 Bots



Fig. 5.1.4 Interius Structor

5.1.2 Delivery of Materials for Interior Construction

The U-Bot is attached to the **truss** and can move around the whole **settlement**. It has a **magnetic** plate which can carry **CASSCS** which has **construction** materials in it.

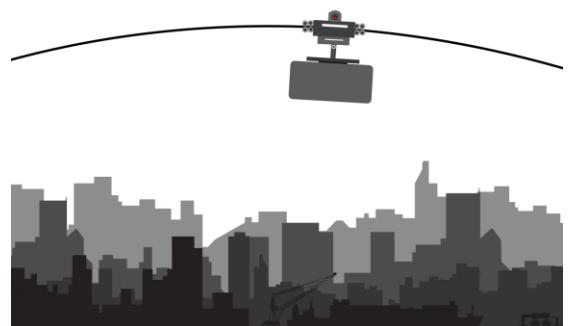


Fig. 5.1.5 Delivery of Materials

5.1.3 HUMAN INTERVENTION

Humans can take **control** of the bots through the **imperium module** whenever human intervention is necessary, for instance when there is a **malfunctioning** in the bots.

IMPERIUM MODULE

The Imperium module has **thrusters** which enables it to attach to the construction bot at a **specific** height which is then **securely** attached to the bot with the help of an **adapter module**.

Each bot has an adapter module **port** where the imperium module can **connect** with it and a human can **commandeer** the bot.



Fig. 5.1.6 Imperium Module

AUTOMATION AND DESIGN SERVICES

5.2 Facility Automation

5.2.1 Repair and Maintenance

Repair and maintenance of the settlement will be **sufficed** by **Wall-O** and **Int-Ext**, which will be **deployed automatically** upon detection of damage to the settlement by the **sensors**/Closed Circuit television system present throughout the **critical areas** of the settlement.

The **functionality** of WALL-O and Int-Ext are mentioned in 5.3 and 5.1 respectively.

5.2.2 Data Access

All **critical data** of the settlement from the **sensors** monitoring the essential habitability conditions will be **analysed** by the **supercomputer** present in the **command** centre. If any anomaly is detected, the data will be **reviewed** manually by **level 4** officers.

There is a **decentralized** network for the **storage** of **general** data (Level 1 as aforementioned).

(A **decentralized** network works by **channelling** the data **efficiently** through different **routes** depending on **usage**, priority and **load**, this decentralized network will function as a replacement to the World Wide **Web** and also as a **method of communication** between the residents of the settlements)

Level of Security	People who can Access	Security
Level 1	For personal use, homes	Face Recognition and Biometric scanner
Level 2	For work places	Iris Recognition
Level 3	For industries, administration and control rooms	DNA Mapping

Constituent Servers	Server Location	Storage
Automation Data Medical Records Critical Data	Command centre servers	15 PB
Manufacturing Warehousing	Industrial Sector	2 PB
Contingency Servers	Escape Pod	17 PB
Decentralized network for all personal devices	All Devices	5 PB

Level of Security	Purpose	Can be accessed by	Device to access	Security
Level 1	General data (Entertainment, infotainment, etc.) personal data.	Everyone	Bene-watch, Personal computers, AXEL	Facial recognition, Pin (As per the convenience of user)
Level 2	Medical tracking, medical records.	Paramedics, medical officers, TARS(bot)	Specialised computers present in medical centres	Iris scanner
Level 3	Automation Data	Super computers present in command centres, Controllers (who analyse data provided by the super computer)	Specialised devices present in the command centre.	Access to the room can only be gained Iris scanner and scanning of ID with unique RFID code.
Level 4	Critical Data	Super computer terminal present in command centre, controllers (who analyse data provided by the super computer)	Specialised devices present in the command centre.	Access to the room can only be gained by multiple levels of security including Iris scanner, biometric scanner, metal detector and scanning of ID with unique RFID code.

AUTOMATION AND DESIGN SERVICES

5.2.3 Human Interventions

When the **problem** detected surpasses the **threat level** percentage and cannot be taken care of by the **automated** systems then **human** interventions will be required. In the fore coming **contingency** plans we have mentioned when human interventions will be necessary.

5.2.3: Contingency plans

Emergency Response protocol will be as follows:

1. Execute Common Emergency Protocols
2. Response Determine Reserve Time
3. Evaluate Settlement Integrity
4. Establish leaking segment
5. Establish/Isolate leaking segment
6. Pinpoint and repair leak (if applicable)
7. Begin evacuation

Code Red[Hull Breach] : If in any case, be it due to a meteor strike, or other reasons, if a hull breach is detected, immediate depressurization will take place, and sensor alarms which have been located all over the spacecraft in separate parts, to detect drop in atmospheric pressure, once the pressure drops below 0.6 atm, depressurization alarms will trigger and alert the command centre. In case of a large leak detected rapid depressurization takes place, the system will automatically sound the alarm, and emergency air pockets separated by volume separators will be activated, and once the sensors confirm the area free of humans, the individual area will be quarantined by the hull breach walls. In case of multiple leaks that may take place due to the settlement encountering stray objects the whole sector, will be quarantined.

Code Silver[Power Surge/Outage]: As well, but in addition to failure of robot charging systems, thus it is imperative that the safety robots are kept charged and are not utilized for miscellaneous tasks, also secondary power sources have been located which will supply power only to the Command Centre or Secondary Command, and to the Docks.

Code yellow[On Board Fire]: While significant care has been taken to ensure that no such mishap takes place, it is always better to plan. The protocol followed in an onboard fire will be much the same as a code red, except that once an area has been quarantined by the emergency walls, the automatic protocol will be to manually depressurize the area, as fast as possible, this will lead to easy extinguishing of large on-board fires. For safety purposes of preventing these, no candles will be allowed on the settlement or for that matter, no form of lighters as well.

Code Blue[System Crash]: Though not a physical emergency, this can have very serious physical implications, when the Control Centre system fails or crashes. Although safeguards have been built to reduce these, the whole point of crashes is that they are not known to happen. When and if the Control Centre fails, the command will be transferred to the Secondary Command centre, located in the docking area, for the control of the system. The Secondary control system can only handle intermittent and important tasks, which are required by the settlement at all costs, as it exists to serve the purpose until the primary Command Centre control is re-established. The secondary command can handle all evacuation procedures, emergency situations and other controls.

While every **effort** has been made to **minimize** placing **humans** at **risk** and minimize the **work** done by humans during **emergencies**, after most of the immediate solution to each **emergency** code has been **implemented**, the complete solution will be deployed by a **level 4** officer only after assessment of the damage has been completed.

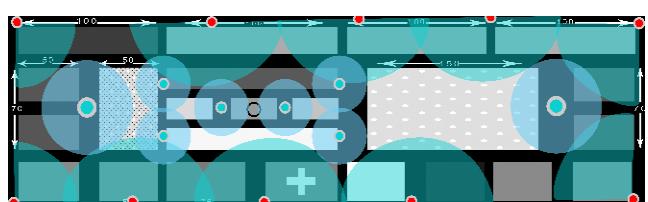
AUTOMATION AND DESIGN SERVICES

5.2.4 Safety Measures

Problem	Detection	Immediate Solution	Complete Solution
<i>Hull damage</i>	Sensors located on hull along with Closed Circuit Television to monitor hull from the command centre.	Repair bots will automatically deploy to the section and begin fashioning a temporary but strong weld on the damage.	Safety and Hull maintenance robots to be dispatched to the location to repair damage.
<i>Complete penetration of hull and Depressurization</i>	Pressure Sensors along with CCTV surveillance.	The airtight doors to be closed and sector evacuated.	Hull repaired by first assessing the damage and replacing wireframe if necessary and tiling.
<i>Climate Control Failure</i>	Sensors like thermistors and gas detectors to sense atmospheric Composition.	Heat generated by Industrial sector diverted to residential area	Repair of Climate Control Systems accordingly.
<i>Fire</i>	Fire detection systems and thermistors.	Fire extinguishers placed and space tugs can be used for dropping water.	Depressurization after closing the air tight doors of sector.
<i>System Crash</i>	Activation of Secondary command centre and backup of data.	Computing resources transfer to backup server and Secondary Command Centre.	Repair of the same
<i>Power Failure</i>	Failure of most electrical systems.	Diversion and activation of backup power through power walls.	Repair of present power systems
<i>Agriculture Failure</i>	Crop failure	Crop failure Backup food stored.	Import of food from Earth and new crops to be grown.

5.2.4 Human Interventions and Surveillances

When the **threat level AI surpasses** the **intervention** level in emergencies then human intervention is **requisite** for handling the **emergency** effectively along with the **automated** systems. This threat level system **works** by gathering **data** from **sensors** throughout the settlement which is then analysed by **AI**.



NON-ROTATING CAMERA



ROTATING CAMERA

AUTOMATION AND DESIGN SERVICES

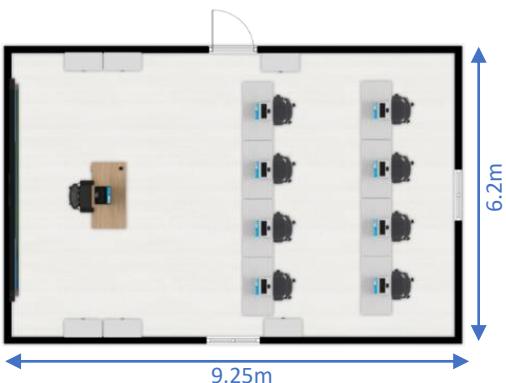


Fig. 5.2.2 Command Centre

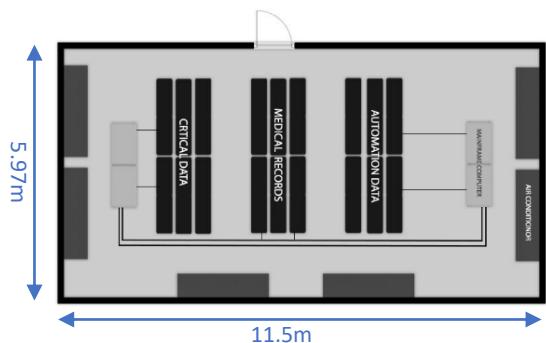


Fig. 5.2.3 Server Room

5.3 Advanced Liveability

5.3.1: Conveniences in residences

1) WALL-O

- Wall-O has been **solely** designed for the **maintenance** and **upkeeping** of every residence.
- It receives **information** about any requirement of **repairs** in the household by the **RDS** sensor.
- It contains a **standard** toolkit which will be **sufficient** for most repairs. In case other tools are needed Wall-O has been **equipped** with **special arms** which can **make use of** other varying **high spec** tools.
- It has been **equipped** with **proximity** sensors, cameras and **actuators** for carrying out the desired action to **fix** the problem at hand.
- Lastly, it has been also equipped with **xenon's** in case of an unfortunate **blackout** to keep the houses **illuminated** at all times.

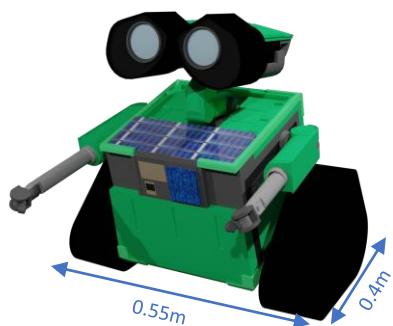


Fig. 5.3.1 WALL-O

2) AXEL (Personalized virtual assistant)

- Axel is a **virtual** assistant with capable of voice **interactions**, music playbacks, making to do lists, **contacting** Housekeeper 101 and providing **real time** information updates and emergency **notifications**.
- It tries to create a **user-oriented** experience by learning more and more about the **needs** of the user through **machine learning**. It can be called upon by the user in **any part** of the **house** as it is **interconnected** with RDS sensor.
- Axel's **within** all residences are **interconnected**, so it can be used to **contact** other people **within** the settlement. Moreover, it can also be used to **contact** people **on earth**.
- It uses Axel **V2.0** software which gets regular over the air **updates**. It also shows the **status** of all the bots **working** in the **residence** like the **efficiency** percentage, **battery levels** and a warning notification when the **service** of the bots is due.

The **RDS** sensor has been **installed** in every house which **detects** any faults or **damages** in the **mechanisms** of the house. For example: Water **Leakages**.



AUTOMATION AND DESIGN SERVICES

3) HOUSEKEEPER 101

- The **provision** of this bot has been **subcontracted** to **BOTS 4 U**.
- Housekeeper 101 **specialises** in **cleaning** household surfaces, **washing** dishes, doing laundry, **moving** furniture, and **fetching** household **items** for their owners.
- These will be present in **houses**, **hospitals**, **work** spaces and other **commercial** areas.

5.3.2 Personalized Devices

The BENE Watch

- The **BENE Watch** is a **smart** watch which is expected to be worn by all the **residents** of Benevectoras at all times.
- It **incorporates** fitness **tracking** and **health-oriented** capabilities with integration of the Bene watch **V10** software. It keeps a **record** of all the **vitals** of the user and also detects **behavioural patterns** to monitor **mental health**.
- It detects various aspects of health such as:
Step Detection: is monitored by the **accelerometer**.
- Pulse and Heart rate variability*: is **monitored** by **photodiodes** and the watch checks the **pulse** at regular **intervals** of 5 minutes.
- Body Temperature*: is **measured** by **infra-red** sensors and *blood sugar levels* by near **infra-red** **spectroscopy**.
- Sleep*: of each **individual** is monitored by a **gyroscope**.

The Bene Watch has been mainly designed for the **safety** of the **users** so in **addition** to the **vitals** of the individual it also tracks the **location** of the **user** which can be **accessed** only by **authorized** personnel in the case of a **mishap**.



5.3.3 Bots in Everyday Life

TARS

- The **Bene watch** sends **signals** to **Tars** when **medical** attention is **necessary**.
- Tars has been **equipped** with **dual motors** and **air suspension** with controlled **dampers** which are designed to **absorb** and damp **shock impulses** for a **rapid** and **smooth ride**.
- It acts as **both** a **medical** bot and an **ambulance**. If a **major** procedure is required then it **transports** the **patient** to the **hospital** immediately. It has access to **medical records** of all individuals.
- Tars consists of most of the **crucial** medical equipment and **supplies**. Tars consists of **panels** which become **flat** and act as a **stretcher** to take the patient to the hospital **comfortably**.
- All Tars bots in the **meantime** are present in **hospitals** and act as **assistants** to doctors. They can project **UV** beams which kill **bacteria** and help in **sanitization**.

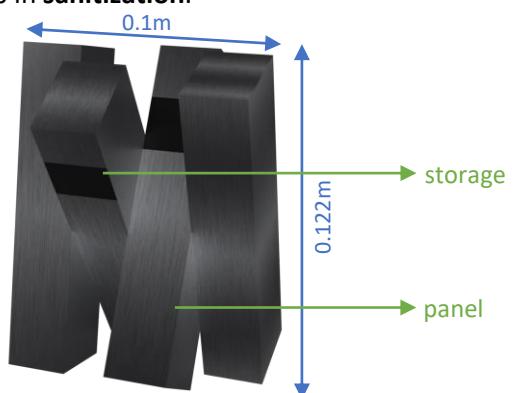


Fig. 5.3.3 TARS

5.3.4 Productivity in Work Environment

- Employees** will be given **targets** for each day of the week. There will be **no fixed hours** of work.
- Employee** of the **month** will be **awarded** to the individual who is able to **complete** his/her targets within the **time** specified or set.
- The Bene Watch will **notify** the user to take **breaks** when the **efficiency** of the user **decreases** or when the user is **mentally tired**.
- Provision** of indoor **games** and **gaming consoles** are present for taking **small breaks** during work.

AUTOMATION AND DESIGN SERVICES

5.4 Tug Ports



Front View

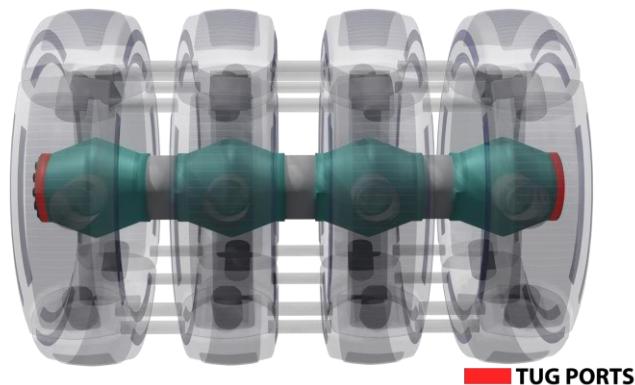


Fig. 5.4.1 Tug Ports

5.4.1 Tug Port location and Control Centre

	PRIOR TO IOC	DESCRIPTION
Port Location	The temporary tug port is located in the outer torus for initial docking of the tug fleet.	A permanent tug port is located in an inner sphere which provides fully automated docking for all types of space tugs.
Control Centre	The Space tugs will be controlled from the Spaceport Freedom, prior to IOC	Post IOC Space tugs will be controlled from the main control centre.

Table 5.4.1

5.4.2 Space Tugs

Space tugs have been provided **amply** for the settlement and can be **launched** from the **Dock module**, and can be used for transporting **cargo**, **bots** and other **ships** to and from the docks.

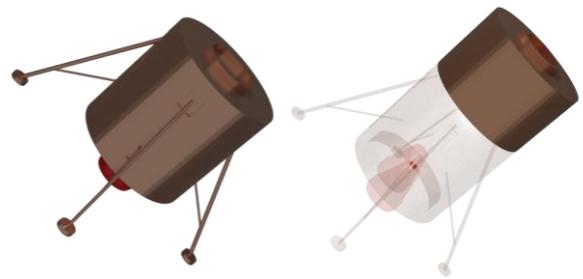
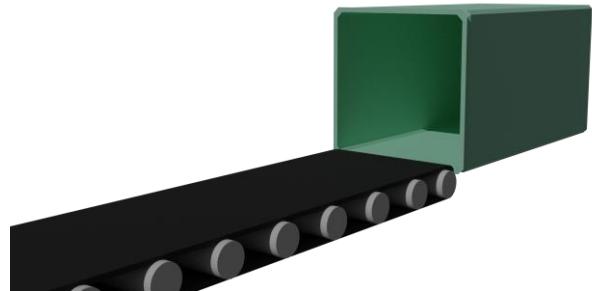


Fig. 5.4.2 Space tugs

Benevectoras provides reusable space tug facilities which come from its '**Module**' based design. This makes transport of people and cargo smooth and clutter free.

5.4.3 Automated loading and unloading of CASSCs



5.4.4 Location of command centre



The **Tug fleet** can be **remotely** controlled by humans in the command centre. Human **intervention** will be required time to time for **smooth functioning** of the **automated** port. If something **suspicious** takes place the concerned **authorities** will be informed and the matter will be **resolved** as soon as possible.

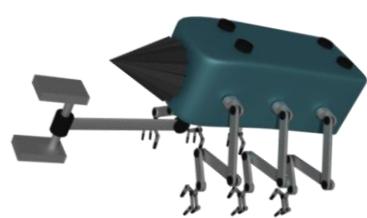
5.5 Warehousing and manufacturing

The **warehouses** are made from **recycled** CASSCs. For **customized** CASSCs we will contact *Custom Cargo Accommodation*, this sector will also contain **specialized equipment** and **supplies** will be provided by *3D Logistics* with the help of their **advanced** 3D printers.

For 3D printing of **large** items, the subcontractor *Large Print* will be contacted.

AUTOMATION AND DESIGN SERVICES

5.5.2 Automation used in Manufacturing Sector

MONIKER OF BOTS	DESCRIPTION AND QUANTITY
 (i) IO Nanobot	<p>These bots have been subcontracted to <i>Nano-Solutions</i> and are meant for small repairs and maintenance. These are well equipped and advanced.</p> <p><u>Quantity:</u> 16 grams</p>
 (ii) Solenoid System	<p>Voluminous items are transferred slowly and securely through this solenoid system. It has alternate positive and negative terminals so that at each step it is slowed down then by-passing AC current the terminal is de-magnetized and passes on to the next step.</p> <p><u>Quantity:</u> 300 (around 18 per warehouse)</p>
 (iii) Bionic Arm	<p>The Bionic arm is meant for lifting heavy materials. It will be able to also work with other machines, move inventory around and picking items for assembly and production. Various attachments for the Bionic arm will be provided by <i>3D Logistics</i>.</p> <p><u>Quantity:</u> 750 (45 per warehouse)</p>
 (iv) ROLL-E	<p>After the construction of our settlement Roll-E will be used in manufacturing sector. It will help in packaging and shipment of heavy materials outside of the warehouse. Small deliveries and shipments are managed by U-Bot.</p> <p><u>Quantity:</u> (aforementioned in 5.1)</p>
 (v) Labour Bot	<p>It has cameras which will help in surveilling the whole warehouse and give a 24x7 surveillance. These will be mainly used for laborious tasks within the warehouse.</p> <p><u>Quantity:</u> 920 (around 55 per warehouse)</p>

SCHEDULE AND COSTING

6



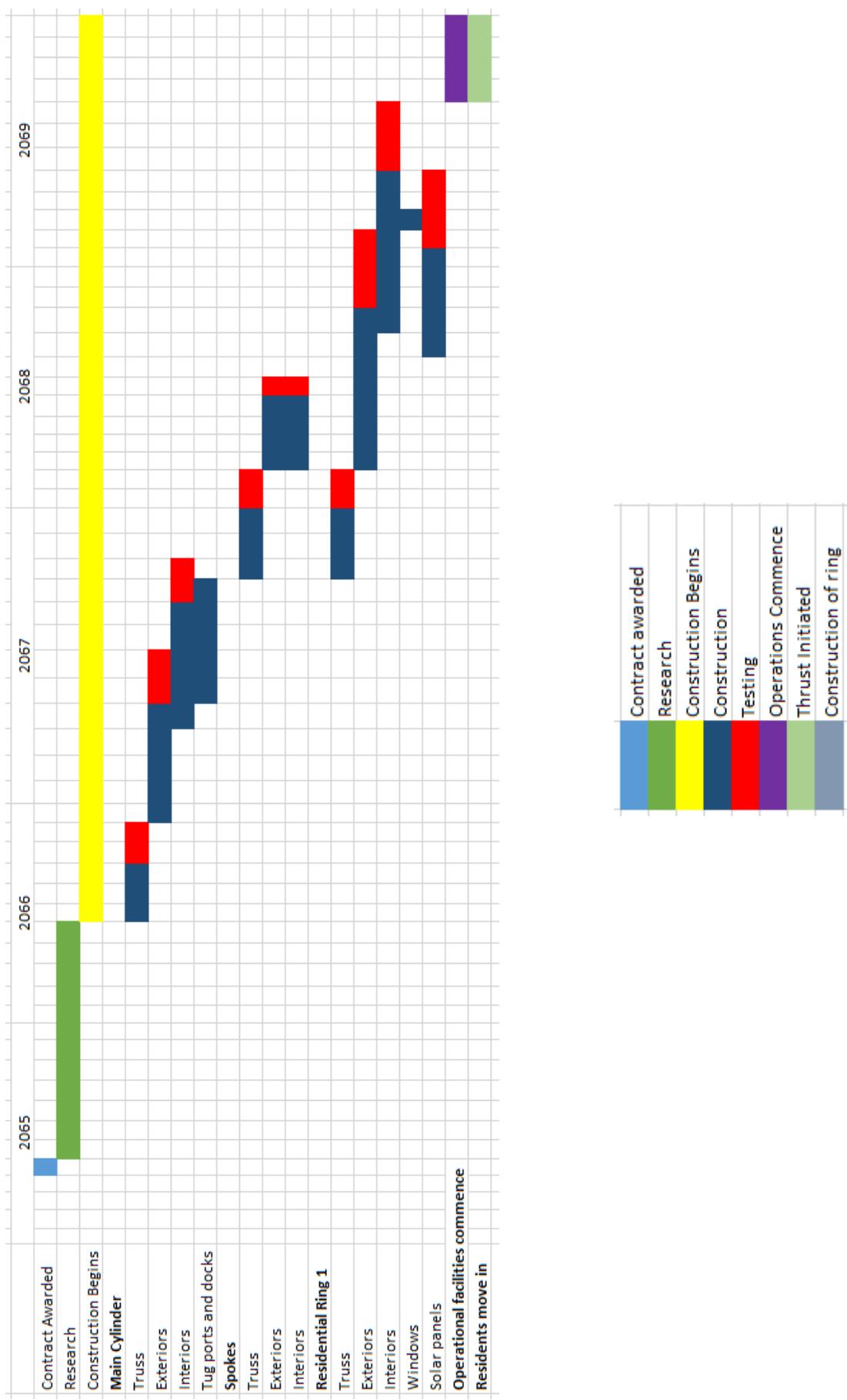
FEASIBLE



PRECISE

SCHEDULE AND COSTING

6.1 Schedule



SCHEDULE AND COSTING

6.2 Costing

Material Costs				
Material	Initial Mass	Initial cost	Final Mass	Total cost
Carbon nanotubes	594085600	2079299600	2376342400	8317198400
Silica aerogel	653494160	1503036568	2613976640	6012146272
Titanium grade 5	6692374284	8700086569	26769497136	34800346277
Aluminium Oxinitride	686911475	4808380325	2747645900	19233521300
Silicon			2970428000	
Buckystructure	742607000	-	0	-
Lead crystal glass	712902720	4919028768	2851610880	19676115072
Total		22009831830		88039327321

Space Tugs			
Module	Unit cost	Units	Cost
Propulsion Module	2700000	335	904500000
Cargo Module	1690000	275	464750000
Crew Module	16340000	55	898700000
Total	20730000	665	2267950000

Automation and Bots			
Bot	Unit Cost	Units	Cost
ROLL-E	300000	316	94800000
U-BOT	560000	1000	560000000
INT-EXT BOT	750000	250	187500000
Interius Structor	830000	510	423300000
Imperium modules	690000	75	51750000
WALL-O	180000	755	135900000
Axel	350000	700	245000000
Housekeeper 101	88000	1560	137280000
Bene-Watch	1200	9000	10800000
Tars	4000000	800	3200000000
Nano-Bots			0
Solenoid System	500000	300	150000000
Bionic Arms	25000	750	18750000
Labour Bots	33000	920	30360000

2074

2073

2072

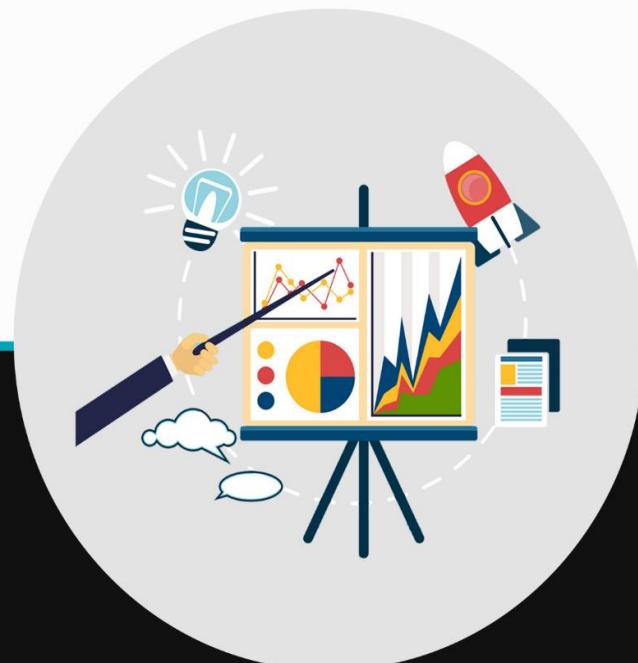
2071

2070

Ring 2
Main Cylinder
Spokes
Residential Ring 2
Ring 3
Main Cylinder
Spokes
Residential Ring 3
Ring 4
Main Cylinder
Spokes
Residential Ring 4

BUSINESS DEVELOPMENT

7



AFFORDABLE



PROFITABLE

BUISNESS DEVELOPMENT

The main purpose of Benevectoras is to act like a *cargo module* connecting earth and mars. It is also meant to behave like a carrier for the **in-transit population**. Our main objective is to make mars settlement **self-sustainable**. There are various resources in abundance present in mars. Benevectoras's task is to make the most of all the minerals and resources without exploiting them. At our settlement our job is to make consumables and building components for mars infrastructure along with the help of many sub-contractors. These operations will take place between the time when we our settlement will transverse between mars earth and vice versa.



Fig. 7.1 Front view of docking system

7.1 Space tug ports

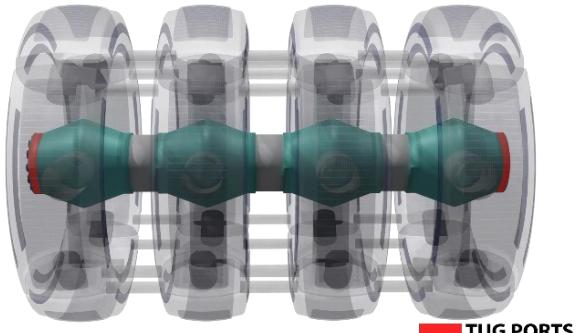


Fig. 7.2 Tug Ports Location

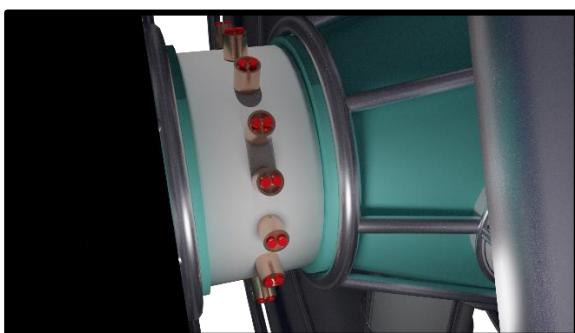


Fig. 7.3 The pushing mechanism of tug ports



Fig. 7.4 How tugs are stored inside the docking facility provided

7.1.1 Zero g docking facilities

We have a **solenoid system** for transportation. A plate is connected to the bottom and can be used as lift base. We just need to reverse the pole and by repulsion the plate will go up. This mechanism will also be used to transport CASSSCs. For further transportation we have conveyer belts.



Fig 7.5 Solenoid System

7.1.2 Rapid loading and unloading

The time period given to us is eight days. We need rapid loading and unloading of CASSSCs. We have bionic arms present here for movement of space tugs. For more efficient and rapid movement we have. The bionic arm can place CASSSCs and tugs in the respective sections.

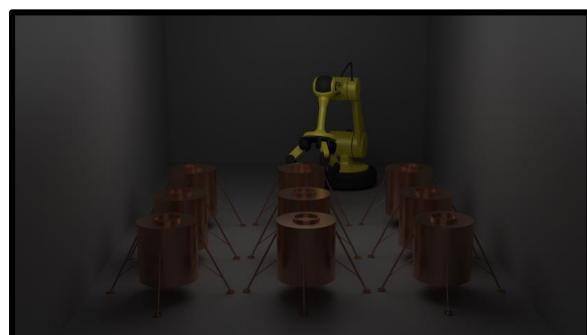


Fig 7.6 Loading of tugs

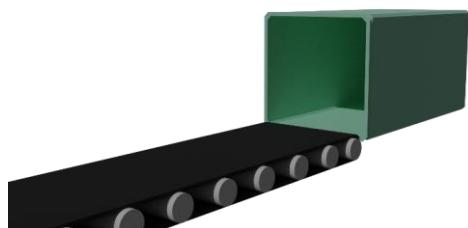


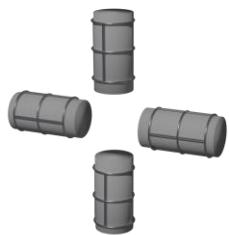
Fig 7.7 Conveyer belt system for transporting

BUISNESS DEVELOPMENT

7.2 Manufacturing Commodities for use on Mars

North Donning Heedwell strives to create a fluid and secure platform for **interplanetary trade**, provides **excess capacity** for manufacturing commodities so that there is **NO compromise** made in making availability of supplies to all the residents of Benevectoras and in-transit mars settlers.

7.2.1 Excess Capacity for Manufacturing Commodities



*Fig 7.8 Spokes
Excess capacity will be stored in these spokes*

For extra capacity for storing food and other commodities we have specialised cylinder connecting the central axis and all the four rings. We have vessels in which the food will treated with **specialised preservatives** and will maintain a cold climate inside.

7.2.2 Specific Quantities and Varieties of Agricultural Products

NO.	Food Item	Initial Quantity provided (kg/ 2 weeks)	Subsequent quantity provided(kg/ 2 weeks)
1.	Vegetables	4410	21560
2.	Wheat	1512	7329
3.	Dairy Products	30240	147840
4.	Rice	756	3696
5.	Sugar and Salt	907.2	4435.2
6.	Meat	110880	492800
7.	Fruits	3024	14784
8.	Pulses	1260	6160

Table 7.1 Food Items

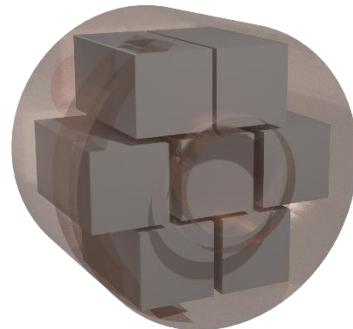


Fig 7.9 CASSSC packing in the cylinder structure

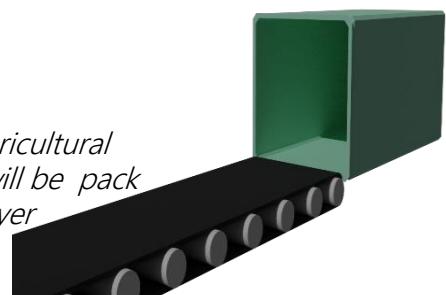


Fig 7.10 The agricultural commodities will be pack through conveyer belt system

7.2.3 Specific Quantities of Household Commodities

No.	Item name	Initial Quantity	Final quantity
1.	Beds/Mattresses	1500	9000
2.	General appliances	700	5600
3.	Miscellaneous	1300	9000
4.	Toiletries	6000	36000
5.	Sanitary Pads	109000	800000
6.	Emergency Kits	As per requirements	As per requirements

Table 7.2 HOUSEHOLD COMMODITIES

BUISNESS DEVELOPMENT

7.3 Trade with Earth

7.3.1 Infrastructure en route Mars

A unit of Assembling and Manufacturing bots and nanobots from Nano Solutions would be present in transit vehicles for the assembling and building, along with 3D Printers from 3D Logistics. Raw materials for 3D Printing would be pre stored before transit or bought en route from Hard Roll. Circuitry and other materials for manufacturing would be bought from Electro Protect and stored.

- For construction of infrastructure to support the **growing economy** on Mars, Benevectoras's construction bot - Excon and Incon would be serviceable. The bots can be manufactures en route using the aforementioned facilities.
- Parts of vehicles for transportational use by the settlers can be manufactured en route. These parts can be later assemble on Mars for instantaneous use.
- Telecommunication products** too will be built by similar processes.
- To provide self sufficiency in terms of agro-based commodities for settlers, means to manufacture portable aeroponic production units would be provided in the transit vehicle using the manufacturing bots
- Other infrastructural items as per the requirement of the settlers can be manufactured too with the help of the provided facilities.

7.3.2 Minerals from Mars

For **excavation of minerals** on Mars, custom built mining equipment will be bought from Holey Moley. The equipment will be customized to be functional on Mars.

Tridymite

- Silicon Dioxide (SiO_2) is present in significant amounts in polymorphic form as Tridymite.
- Tridymite in its raw form holds great value for collectors and hobbyists and is also used in scientific study under crystallography. It is also used for the production of refractory ceramics.
- North Donning Heedwell will sell **Tridymite** after refining (as it is a purely composed of Silicon Dioxide, only accumulated dust will be refined) for cis-lunar use.

Silica and Silicon

- Surface type 2 (ST2) which is common in the younger plains north of the dichotomy boundary of Mars and is silica(SiO_2) rich. Silica reserves will be excavated from these regions and will be sold as silica is extremely useful. Silicon Dioxide is also a major component of glass and is used in manufacturing aerosol styrene-coated fiberglass.

- Silicon will be refined too from silica reserves for its usage in isolated form.

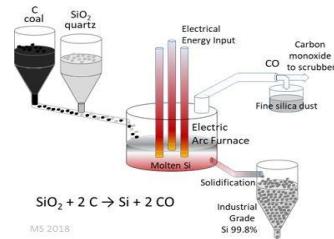


Fig 7.11 Refining Process

- Many important metals too such as iron, magnesium, aluminum, calcium, and potassium are the most abundant on the Martian crust. These metals can be extracted from their ores by **electrolytic refining**. Mars also has reserves of Titanium, Chromium and Manganese.
- Titanium is mainly found as its oxide (TiO_2) from the ore rutile. Extraction of titanium from rutile. Rutile(impure titanium(IV)oxide is heated with chlorine and coke(C) at a temperature of about 1000 Celsius.



Chloride vapors are passed into a reaction vessel containing molten magnesium in an argon(Argon is the second most abundant gas present on Mars) atmosphere, and the temperature is increased to about 1000°C.



These minerals and metals will be sold by North Donning Heedwell for cis-lunar use.

Deuterium

- Deuterium is one exquisite mineral that is present in a much larger quantity on Mars and proves to be a compelling fuel to suffice the power and propulsion needs of spacecrafts and future aircrafts. With advanced future-existing technology, Deuterium will be mixed with *lunar 3 helium to power fusion ships*.
- Deuterium is received in purified liquid form from Mars and must be kept isolated and intact till it is shipped off to Earth. Multi-storey floor system is facilitated in the unpressurized Spokes to carefully transport ample amount of resources as a rapid rate for faster future growth. One spoke allows 1126 m² area of storage which can store up to 1,902,940 kg of Deuterium per floor. This not only ensures availability on Earth but reduces the shipping cost of multiple rounds of cargo transfer.

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➤ **Appendix – A (Operational Scenario)**

❖ **Introduction**

Here we follow Rachel Yang from “Foundation Media” to make a documentary on Foundation Society’s latest scientific marvel – Benevectoras. Located in the Aldrin Cycler Orbit, Benevectoras is a space settlement with a capacity to accommodate 8800 residents at FOC, and while being a safe and sound abode for it’s citizens, Benevectoras encapsulates a full fledged industrial sector to manufacture commodities and martian infrastructure.

❖ **Scene – 1 (At the boarding platforms)**

Rachel: “Hello viewers, this is Rachel Yang on behalf of Foundation Media, and we welcome you today to exclusive footage of the Foundation Society’s newest creation – Benevectoras ‘The Martian Carrier’. We are currently on the boarding stations, and are about to board a tug, that’ll take us straight to the settlement in little to no time!”

❖ **Scene – 2 (Inside the space tugs)**

Rachel: “As you all can see, I’m currently on board the space tug that’ll take passengers to the settlement. The tugs are fairly spacious, especially with the reclining seats, which are comparatively bigger than an average airplane seat.” ***Rachel positions mic in front of an elder man***

Hello sir, would you like to share your experience so far with the viewers of Foundation Media?”

Sam: “Ofcourse! Hello everyone, I’m Sam, and I work with Fletchel Constructions. To say that my experience so far has been pleasant, would be a MASSIVE understatement. The efficiency and cooperation of the staff and management made entry to the boarding platform easier than sending emails! Having been on multiple first class flights and private jets, I can conclude without any doubt that these space tugs are better designed than most first class flights. Firstly, the turbulence you can feel on this thing is negligible, then you have the spacious seats to lounge on and enjoy the magnificent space views with a glass of champagne. Considering we are going to SPACE, the costs are highly affordable and feasible, and every necessity or desire of the people have been well thought of already. Each and every system or object has been designed to maximize the comfort levels and luxuriousness of Benevectoras’ citizens.”

❖ **Scene – 3 (At the reception of residential segment)**

Rachel: “So as you can see ladies and gentlemen, we’ve arrived at Benevectoras, and we can already observe from the grandeur of the reception that the insides of the settlement are going to be SPLENDID. Upon

reaching the docking stations, we passed through an airlock, and were taken via a cyberpod to the residential segments, and I must say, it feels an awful lot like the Earth with the artificial gravity here. It's truly a shocking thing to look out the window and gaze at the stars from this distance, deep within space, revolving in the aldrin cyller orbit, and all of a sudden realizing that we can breathe, walk and run around just normally."

A humanoid bot approaches Rachel

Bot: "Welcome to Benevectoras 'The Martian Carrier'....a home, away from home. We hope you had a comfortable flight and an equally pleasant journey via our internal transportation system. Please collect your Benewatches for the absolute Benevectoras experience."

Rachel: "Ah the Benewatches! They're essentially the smart phones of the settlement, and so much more. Benewatches not only monitor the health and vitals of every citizen on Benevectoras, but also make their life significantly more convenient by giving them capability to easily place calls on the go, compose emails, you name it! Enough talking, let's see these in action and proceed to the actual residential segments of the settlement."

❖ **Scene – 4 (Inside the residential segments)**

Rachel: "As we can all see, this is arguably the most important part of the settlement, the residential area. What we're seeing right now is just one of the EIGHT cities that are currently on board the settlement, which will go upto SIXTEEN once we're at FOC. One can see the effectiveness of the placement of every building and structure here, there's loads of open space here, nothing feels crammed in. One can gaze at the stars quite literally from here, as the space views from the residential segments are mesmerizing, and it's completely safe ! The windows act as shielding towards all sorts of radiation like UV rays. Let's have a chat with one of the residents to get an actual idea of how it feels like to live here."

Rachel approaches a middle-aged businesswoman sitting in the park

Rachel: "Hello ma'am, I'm Rachel from Foundation Media, would you please share your experience so far on the settlement with our viewers?"

Anita: "Oh, I would love to! Hello everyone, I'm Anita, and I'm currently working with Vulture Aviation. I can't believe it has been over 2 years since I stepped on this settlement, and I do not regret that decision AT ALL! Our company has had nothing but profits after establishing our offices on here. There's no traffic, just smooth transport all the way from home to work. The peace of mind and stress-free environment is almost impossible to even IMAGINE back on Earth. Our offices are spacious and comfortable, and above all, there's a lingering peace of mind everywhere, everyday. The amount of recreational activities available to us just

blows my mind sometimes, it's been over 2 years and I still find new things to do here everyday. I have plenty of time for myself apart from my work hours, and am extremely satisfied with the amenities provided to us. Lush green parks just like this one, entertainment centres, the overall nature of the people and the environment of the community just checks all the boxes for me, and I'm looking forward to living here for many more years to come!"

Rachel: "I'm glad that to hear that you are happy with our services! Alright viewers, how about we go and see what those kids playing over there have to say!"

Rachel approaches a teenage boy playing in the park

Rachel: "Hello my dear, would you like to be on TV? Would you please share your experience with all our viewers who are watching this back from earth?"

Steve: "Sure! I came here 2 years ago with my parents, they work with Dougeldyne Astrosystems, and had opted to shift their working place to space. The past 2 years have been the best 2 years of my life! I've never had so much fun before! There's lots of open space for me and my friends to play in, and it's so mesmerizing to stare out of the windows and gaze at the stars from UP HERE! I never wanted to go to school back on Earth, but the schools in Benevectoras are so much fun! Our teachers are highly capable and anything and everything they teach is easily understandable due to the advanced infrastructure at the schools in Benevectoras, me and my friends love school and it's always so informative, we get to learn something new everyday. Apart from that the environment here is very peaceful and stress free, and we barely get any homework at all. I love the parks and the magnitude and variety of facilities that are available here, it's impossible to ever get bored with all these recreational spaces, there's really something for everyone here!"

❖ **Scene – 5 (At the apartments, near the offices)**

Rachel: "Here we are at the housing facilities of Benevectoras, and must I add, the grandeur of these designs are astounding! We are here to talk to Mr. Jack today, who has been one of the very first people to set foot on this settlement!"

Rachel hands over mic to an elder citizen

Jack: "Alright, hello everyone, I'm Jack and I work with Rockdonnel. I was transported here on the very first space tug that carried people to the settlement from the boarding stations. To sum up my experience of living here for approx. 2.1 years now would be unfair to the settlement, as my gratitude and satisfaction can't be expressed in words. I'm about 65 years old, and am a patient of Asthma, but unlike the Earth where I once struggled to even breathe, there's no pollution in the environment here, just clean, pure air and cool breezes blowing across the settlement such that, I barely have to use my inhaler anymore. Apart from that, the work environment here is excellent. Everyone's calm and at peace, nobody's shouting at us to keep working like machines till some work is done or to meet some

deadline, the stress levels in the offices here are negligible and everyone's always happy and in a good mood, which is beneficial for the mental health of Benevectoras' citizens, especially its youth. The homes are luxurious and do their job well, I live in a 4 BHK apartment here and not once have I faced a problem regarding space in the past 2 years. The views from our windows and balconies are worth a sight for frozen eyes. The domestic bots are very well built and I've never had them malfunction or glitch out on me. Frankly, I am a bit careless and have a messy lifestyle, and coupled with my age, it became a real pain in the back, quite literally, back on Earth whenever guests were coming over or I had to clean my home, but here, the bots take care of literally everything, I have never had any trouble with any one of them. Coming to Benevectoras was one of the best decisions of my life, and I do not regret it one bit. For all the services that we receive, the prices are very reasonable and I'm very happy and satisfied with the complete package that I received for my money."

Rachel: "As we can all see ladies and gentleman, Benevectoras is indeed a scientific marvel, a home away from home, a Neo Renaissance, if you will. All our customers and clients are satisfied and that is what matters to the Foundation Society at the end of the day. We value our customer's feedback, and our goals and objectives, are all centered around our customer's contentment and satisfaction. There's something for everyone here on Benevectoras, for any age group, gender, working class, you name it. This has been a truly tremendous experience with you guys, and now it's time to say goodbye. Until next time guys! This is Rachel Yang from Foundation Media, signing off."