
ARESAM

External Configuration

2.1.1 Components and Dimensions

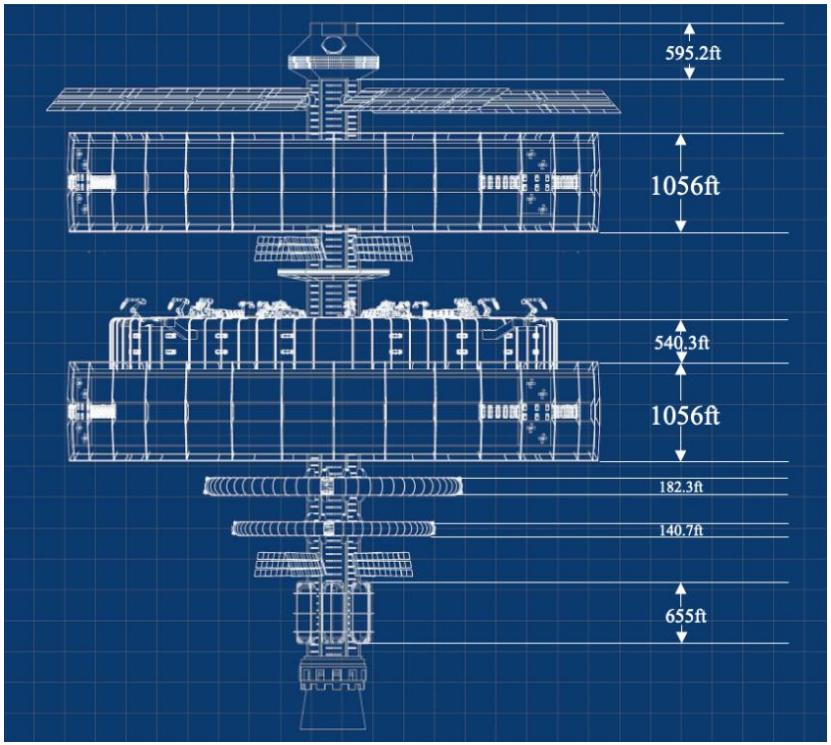
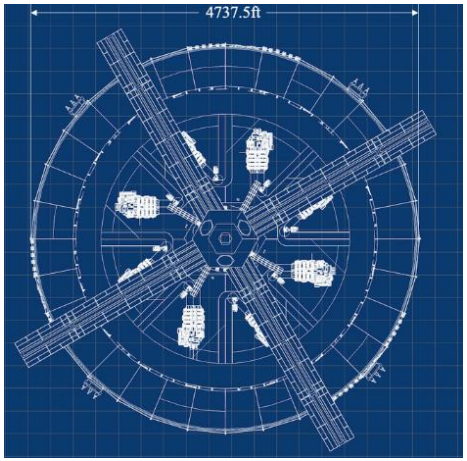
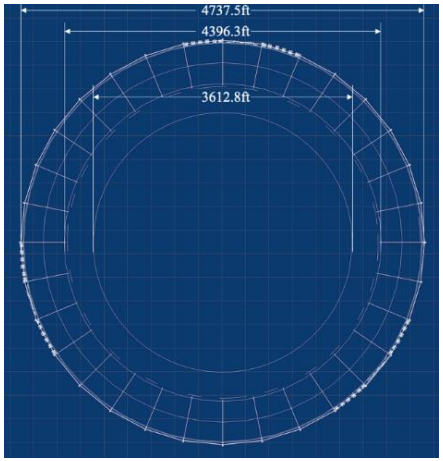
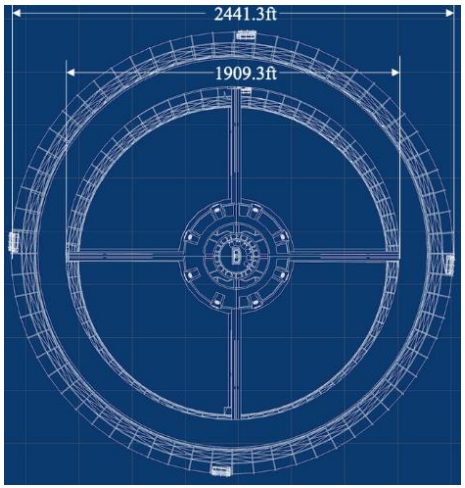


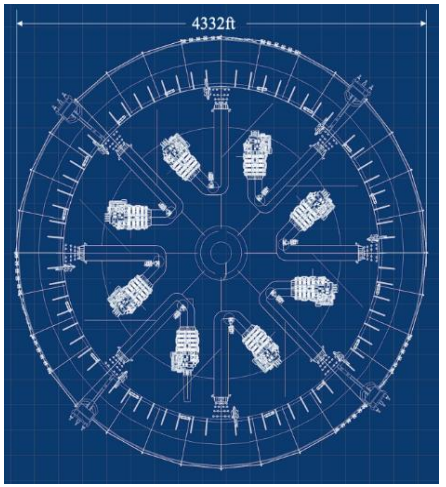
Fig 2-1-1 *General dimension [Chenjunrui, SketchUp]*

The large, enclosed volumes and their uses in Aresam are marked in the diagram. The primary construction materials of Aresam are titanium alloy and aluminum oxynitride. The minerals required to compose them, including Ti, Al, V, O, and N, can be obtained from the minerals and atmosphere of Mars and Earth.









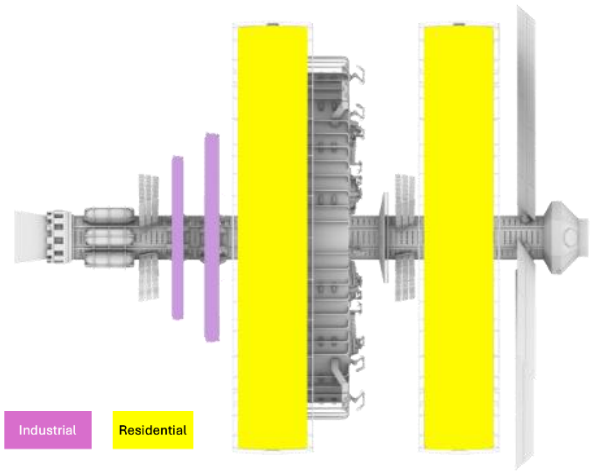
From left to right: ***Fig 2-1-2*** *Top view [Chenjunrui, SketchUp]；* ***Fig 2-1-3*** *Residential torus [Chenjunrui, SketchUp]；* ***Fig 2-1-4*** *Industrial torus [Chenjunrui, SketchUp]；* ***Fig 2-1-5*** *Port and storage area [Chenjunrui, SketchUp]*

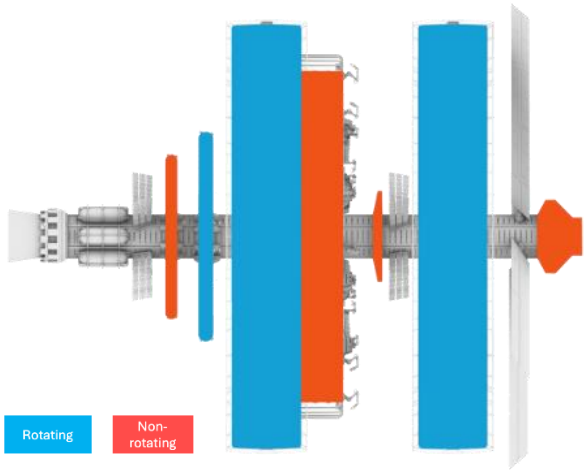
2.1.1 Components and Dimensions

Table 2-1-1 *Components [Chenjunrui, Word]*

Component	location	Usage
Central axis	Through the center of all the torus.	The transfer of personnel and material between torus; Transportation of water, electricity, garbage, waste, etc.
Central control room	At the top of the central axis.	Pilot Aresam and control its overall movement.
Radiator	Surround the central control room.	Dissipate extra heat and moderate temperature.
Solar panel	At the top of the central axis, under the central control room.	Generate electricity to support the whole system.
Residential torus1&2	At the center of the residential ring.	Provide artificial gravity for people to live in.
Spokes (*16)	Between the central axis and residential torus	Connec the rings and the central axis; transport the personnels and supplies between the central axis and the rings.
Port (Deck)	Above residential torus 2.	Receive space vehicles and transport the CASSSCs via airlock pods and lifts to stock area below the deck.
Docking bridges (*4)	Surround the Port (Deck).	Dock of the personnel transport craft.
Stock area	Under the port (Deck).	Parking for spacecrafts and storage of CASSCs.
Industrial torus 1	Between residential torus 1 and residential torus 2.	Production of precision instruments and electronic components that rely on a zero-gravity.
Industrial torus 2	Under both residential tori.	Production of traditional manufacturing products, such as video, clothing, machinery parts, etc.
Fuel tanks	Surround the bottom of the central axis.	Change the flight speed to achieve orbital transfer.
Thrusters	At the bottom of the central axis.	Adjust Aresam’s orbital altitude by changing its acceleration.

2.1.2 Rotation and Pressurization





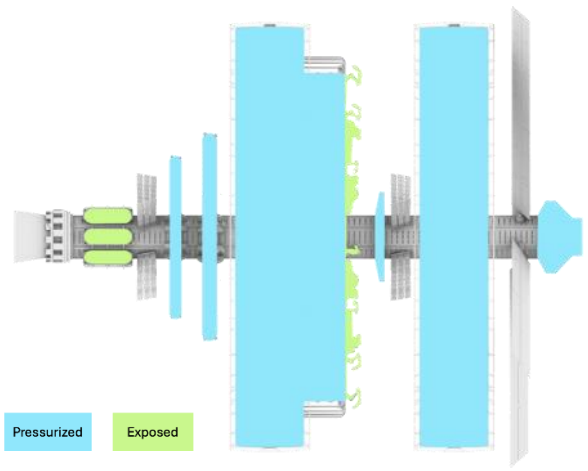


Fig 2-1-6 *Industrial and residential [Chenjunrui, Photoshop]* ***Fig 2-1-7*** *Rotating and non-rotating [Chenjunrui, Photoshop]* ***Fig2-1-8*** *Pressurization [Chenjunrui, Photoshop]*

Aresam will provide 0.75g artificial gravity in all residential areas and one industrial area. Since residents will spend a significant amount of time in the residential areas, the artificial gravity in these areas helps prevent various diseases caused by weightlessness. The artificial gravity in the industrial area facilitates industries that require gravity, such as aircraft manufacturing. All residential areas, the control center, two industrial areas, and the storage area under the deck will be pressurized. People and cargo will need to pass through airlocks when entering or exiting these areas. The table below shows the artificial gravity, corresponding rotation rates, and pressure conditions for each section.

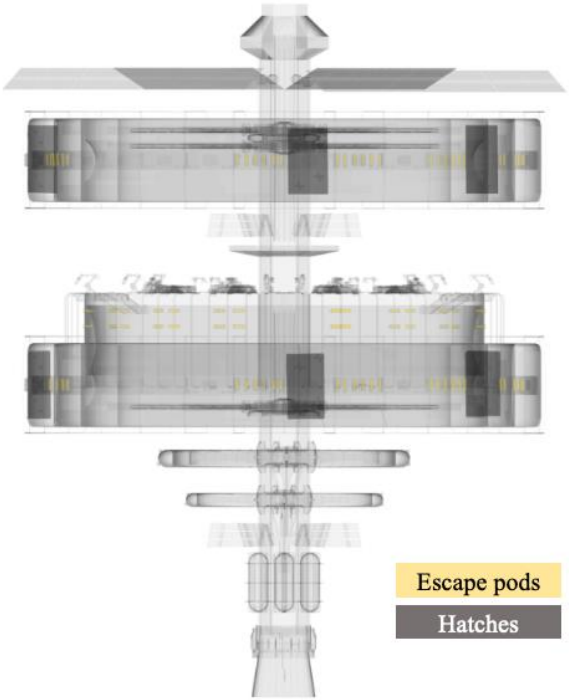
Table 2-1-2 *Rotation and pressurization [Heziruo, Word]*

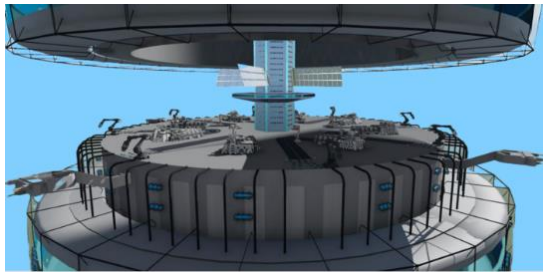
Volume	Rotatory Capacity	pressurization	Angular velocity(rad/s)	Inner Radius(ft)	Gravity (on the inner surface)
Central Axis	Non-rotating	Pressurized	N/A	N	0g
Central control room	Non-rotating	Pressurized	N/A	N/A	0g
Residential torus 1&2	Rotating	Pressurized	0.1047	2198	0.75g
Port	Non-rotating	Exposed	N/A	2166	0g
Stock area	Non-rotating	Pressurized	N/A	2166	0g
Industrial torus 1	Non-rotating	Pressurized	N/A	1221	0g
Industrial torus 2	rotating	Pressurized	0.115	955	0.25g

2.1.3 Axis

Port and Control Center

The port of Aresam is designed as a combination of a deck and docking interfaces, used respectively for loading and unloading cargos, personnel as well as the spacecrafts. Cargo spacecraft will stop in space near the deck, where they will be grabbed by mechanical arms and secured onto tractors for movement on the deck. The cargo from the spacecraft will then be unloaded and placed on elevators (if the spacecraft requires repairs, storage or crew rest, it can be directly placed on the elevator and transported to the cargo bay). Personnel transport spacecraft will dock with the docking bridges, allowing personnel to enter the airlock through the bridge, and after pressurization, enter the terminal. The deck has eight cargo spacecraft taxiways, which can accommodate eight cargo spacecraft simultaneously. The port also has four bridges that can dock four personnel transport spacecraft simultaneously.





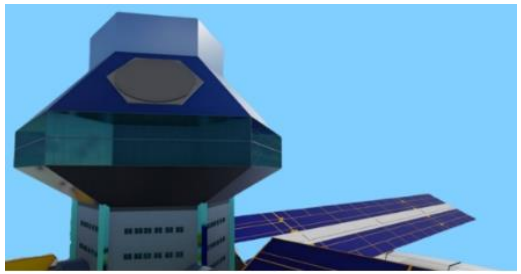
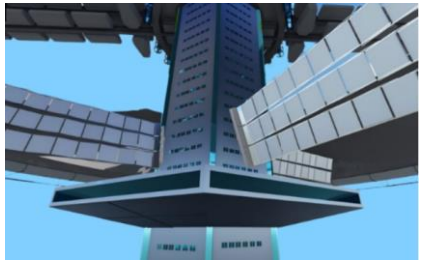
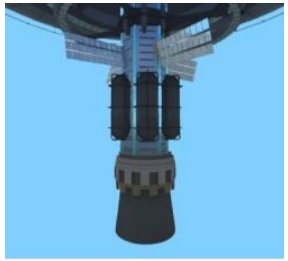
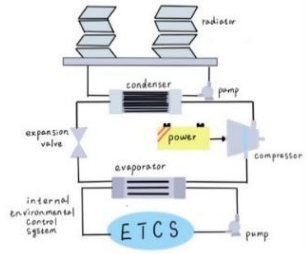


Fig 2-1-9 *Port (deck) and storage area [Chenjunrui, Lumion]*
Fig 2-1-10 *Control Center [Chenjunrui, Lumion]*

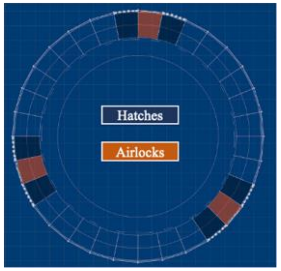






From left to right: ***Fig 2-1-11*** *radiator [Chenjunrui, Lumion];* ***Fig2-1-12*** *Working principle of the radiator [Heziruo, Krita];****Fig 2-1-13*** *Thruster [Chenjunrui, Lumion]*

Fig 2-1-14 *Hatches and escape pods [Chenjunrui, SketchUp]*
Fig 2-1-15 *Hatches and airlocks [Heziruo, Krita]*

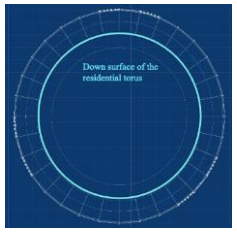


Isolation of Volume

Aresam is equipped with numerous airlocks and hatches, distributed in the positions shown in the diagram. In emergency situations, residents and staff can use these hatches for evacuation. Normally, they are also used for entering and exiting space, moving within Aresam, and loading and unloading cargo.

2.2.1 Residential torus

The lower surface of the residential ring is primarily used for residential, agricultural, and commercial activities. It is also equipped with research areas and small industrial zones for the manufacturing of light industrial daily products. The entire lower surface of the residential ring is divided into three small communities, with specific land use layouts shown in figures 4-1-2 and 4-1-3.



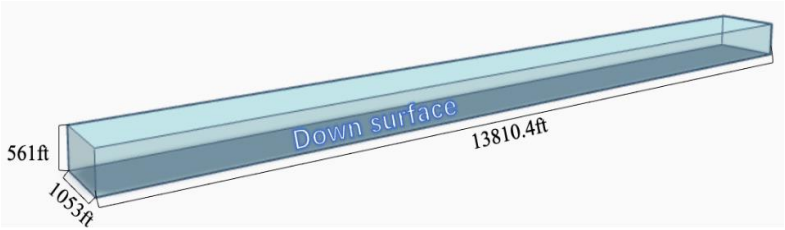
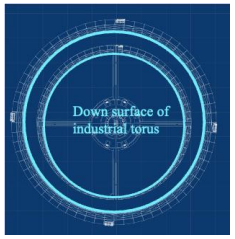


Fig 2-2-1 *Down surface of the residential torus [Heziruo, ppt] Fig 2-2-2 Dimensions of the residential torus [Heziruo, Tinker cad]*

2.2.2 Industrial torus

Both industrial tori are divided into three levels. The rotating industrial torus has a vertical clearance of 59 feet per level and is primarily responsible for the assembly and testing of large equipment, as well as traditional heavy industry. The non-rotating industrial zone has a vertical clearance of 39.4 feet per level and is dedicated to new technology development and high-precision scientific research.



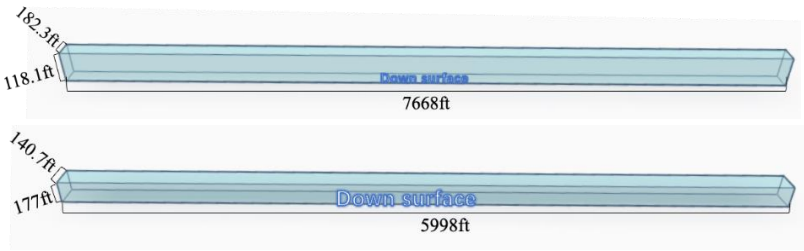
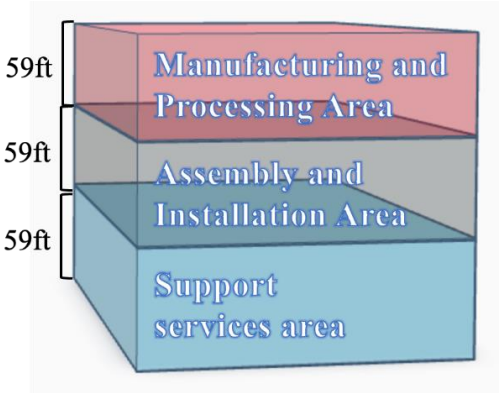


Fig 2-2-3 *Down surface of the industrial tori [Heziruo, ppt]*

The Rotating Industrial Zone comprises three levels: the Manufacturing and Processing Area, responsible for general manufacturing and processing activities; the Assembly and Installation Area, designated for assembling and testing large equipment and components; and the Support Services Area, which includes maintenance, repair, tool storage, and employee support facilities. The Non-Rotating Industrial Zone also has three levels: the Storage and Logistics Area, used for the storage and distribution of raw materials and finished products; the Research and Laboratory Area, dedicated to developing and testing new technologies and products; and the Support Services Area, providing similar support functions as in the rotating zone.



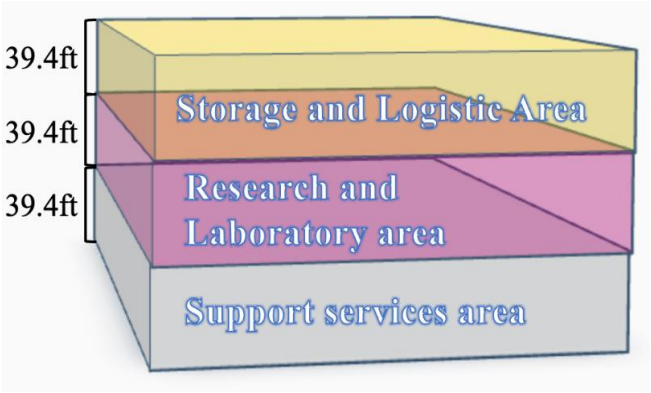
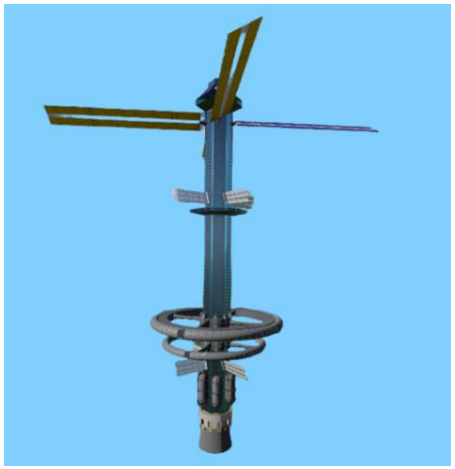
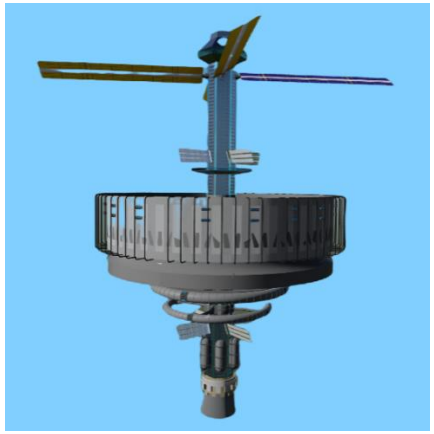


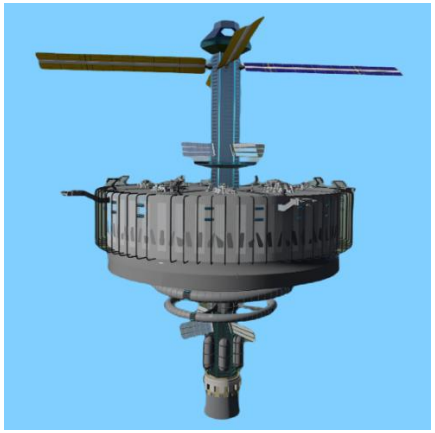
Fig 2-2-6 *Interior view of the rotating industrial torus [Heziruo, Tinker cad]*

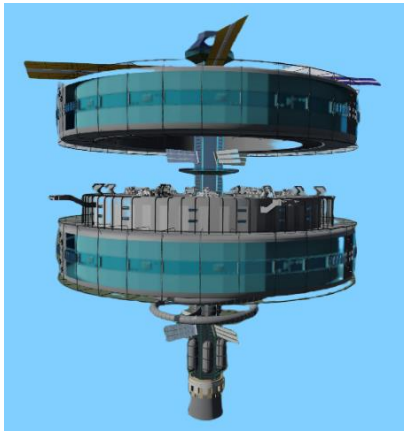
2.3.1 Construction Steps



From left to right: ***Fig 2-3-1*** *Launch the central axis and engine [Chenjunrui, Lumion]；* ***Fig 2-3-2*** *Launch the radiator [Chenjunrui, Lumion]；* ***Fig 2-3-3*** *Launch the industrial volumes [Chenjunrui, Lumion]*







From left to right: ***Fig 2-3-4*** *Launch the civil port [Chenjunrui, Lumion]；* ***Fig 2-3-5*** *Launch the Accessories [Chenjunrui, Lumion]；* ***Fig 2-3-6*** *Launch the residential volumes [Chenjunrui, Lumion]*

Step 1-Launch the central axis and engine： The central axis, along with the thrusters, and the fuel tank are launched as part of the rocket. The central axis is used to determine the position of the subsequent parts, ensuring that they are aligned.

Step 2-Launch the radiator： Launch the solar panels, radiator, central control room, port tower and other smaller facilities. Meanwhile, install and pressurize the central control room. During this step, the solar panels can start generating electricity in preparation for the next construction steps.

Step 3-Launch the industrial volumes： Launch two industrial tori with their corresponding spokes and bearings. Fix them to the spindle and pressurize them. Then, industrial zones can start producing some materials in advance, such as spacecraft, Mars landers, robotic arms, and so on.

Step 4-Launch the civil port： Launch the civil port and stock area below.

Step 5-Launch the accessories： Launch the required accessories on the port, such as robotic arms, airlock pods, lifts, etc., and assemble them on the port. The installation of the port can facilitate the subsequent reception of personnel and materials.

Step 6- Launch the residential volumes： Finally, two residential areas and their corresponding spokes and bearings are launched, and the solar panels can be retracted for easy assembly.

2.3.2 Artificial Gravities

On all sides of the torus that require artificial gravity are equipped with the reaction control system, a small hypergolic rocket engine, shown in the diagram below. They help Aresam adjust his attitude and provide the thrust needed to initiate the rotation required by artificial gravity. However, after completing the construction step 7, these engines will be activated for a certain amount of time and accelerate the angular velocity of the residential and rotating industrial areas to 0.1047rad/s and 0.115rad/s to obtain 0.75 and 0.25g of artificial gravity, respectively.

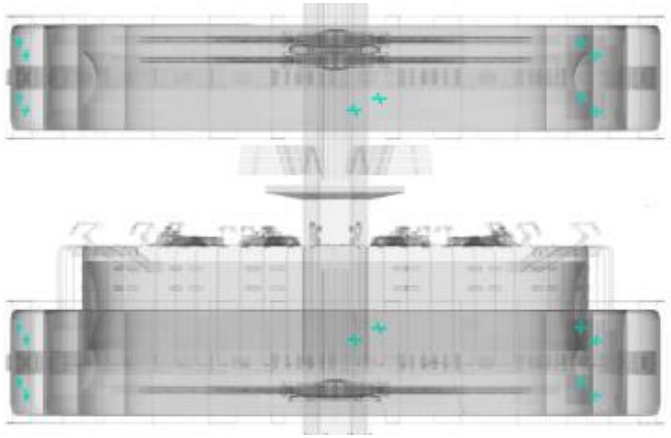


Fig 2-3-7 *Distribution of reaction control system [Chenjunrui, SketchUp]*

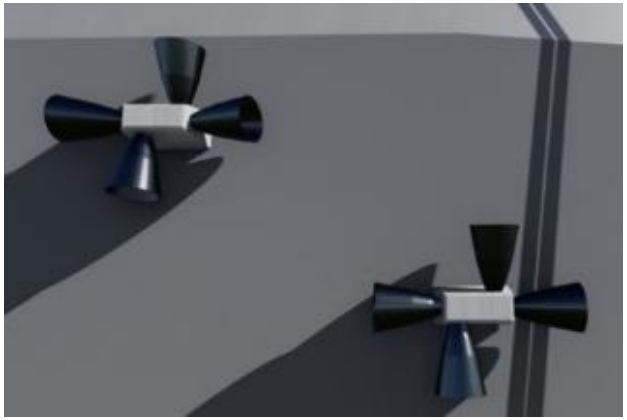
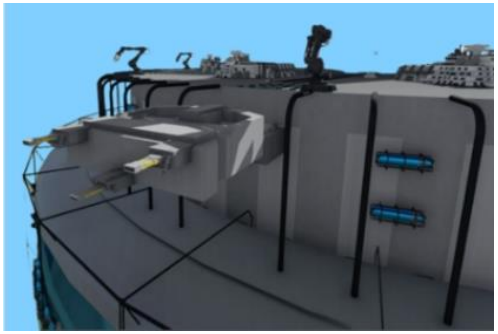


Fig 2-3-8 *Reaction control system [Chenjunrui, SketchUp]*

HighPort has two kinds of docking equipment. The first one is the traditional form of docking interface, which can complete docking with Interplanetary ships, International Space Station and other common space equipment, shown in Fig 2-4-2. The other is the robotic arm, which can grab and fix various types of spacecrafts, such as the space shuttle, and then move it to the storage area below the deck for storage, see Fig 2-4-1.



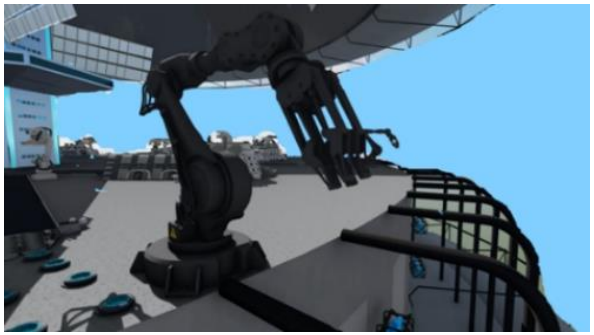
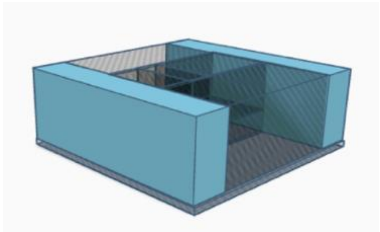
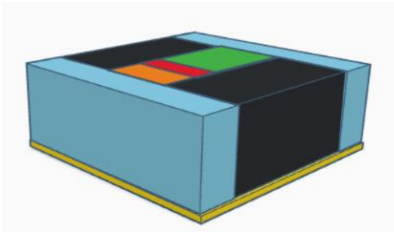
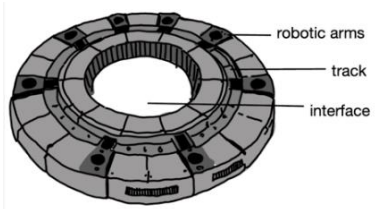


Fig 2-4-1 *Robotic arm on HighPort [Chenjunrui, Lumion]* ***Fig 2-4-2*** *Docking port on HighPort [Chenjunrui, Lumion]*

There are two types of docking facilities on the MarsPort. One is for ferry services with four small machine arms to help docking, and the structure leaves a large space allowing visitors and cargo to get into the MarsPort. Another one is for Mars landing vehicles. The spacecraft transporting landing vehicles will be uniform-- similar to CASSSC. Their docking facilities can easily capture and depart them.







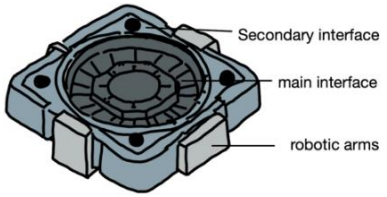


Fig 2-4-3 *Docking facilities and boarding area on MarsPort [Libingqian, Tinker cad]*
Fig 2-4-4 *Sketch of MarsPort [Libingqian, Tinker cad]*

Fig 2-4-5 *Docking facilities for ferry service of MarsPort [Heziruo, krita]*

Fig 2-4-6 *Docking facilities for Mars landing vehicles of MarsPort [Heziruo, Krita]*

MarsPort's community size is smaller than HighPort's community size. A small community can accommodate 200 to 300 temporary staff. The community in MarsPort does not have schools, police stations, public restrooms, and other convenience facilities because most of the residents are short-term research personnel who do not need these functions. However, hospitals, fire stations, restaurants, shopping mall and green space are retained to meet basic needs.

HighPort's residential buildings are divided into two types, apartments and villas. The floor height of each building is more than 9 feet, and each individual room is equipped with bathroom, kitchen, living room and other infrastructure, as shown in 4.2. MarsPort's temporary residential buildings are more hotel-like, eight feet high, each single room has only

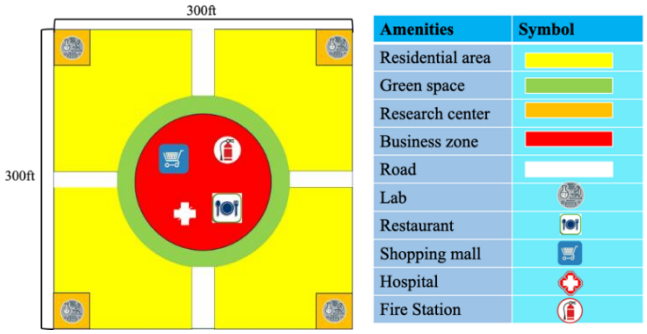
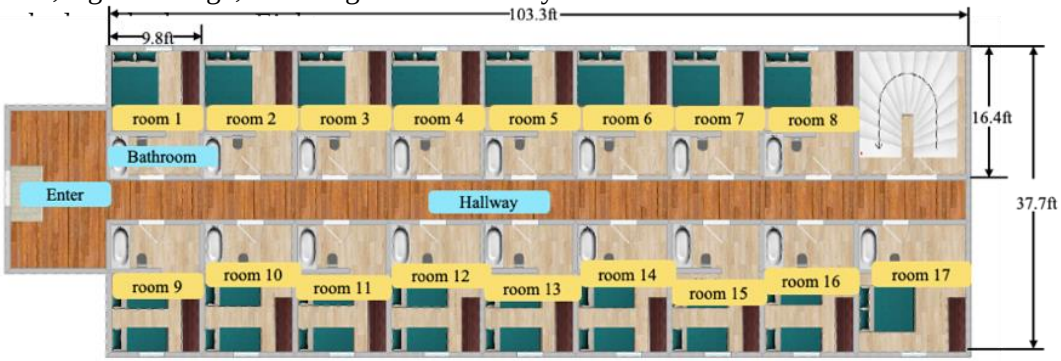
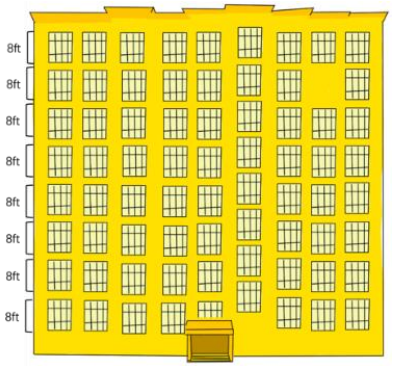


Fig 2-5-1 *Communities on MarsPort [Heziruo, ppt]*

Fig 2-5-2 *Temporary residential area on MarsPort [Heziruo, Room Skecher]*
Fig 2-5-3 *Exterior view of the temporary residential building on MarsPort [Heziruo, Krita]*



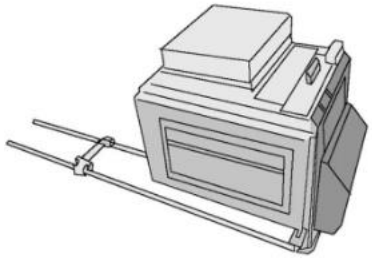


3.1.1 Orbital Location

orbital altitude：above 5000km.
orbital inclination：63.4 degrees.
orbital plane：Molniya orbit.
Features of the orbit:

- This inclination allows the satellite to avoid the radiation belts near Mars' equator, reducing radiation damage.
- At higher points in their orbits, satellites are slower and stay longer, allowing them to cover specific areas of Mars for extended periods of time.
- The total orbital period is 12 hours, and the average 7 to 9

3.1.3 Constructing Locations



The basic components of the city (the Sargon system) will be processed on the earth, and then sends to Mars through rockets. The Aresam will be built at the high-Mars orbit, the basic components will form a Panel Ring by welding together the panels for that ring.

Fig 3-1-1 *A basic component carrying materials [Wangzhiru, Procreate]*

Materials	Usage	Quantity	CASSCs	Component	Source
Grade 5 Titanium Alloy (Ti-6Al-4V)	Exterior hull of the residential tori, industrial tori and storage area.	231,538t	23	Ti, Al, V	From Mars Surface: extract from Ilmenite, Bauxite, and Titanomagnetite from Mars surface.
Aluminum Alloy 7075	Exterior hull of the port and spoke.	33,051t		Al, Zn, Mg, Cu	From Earth.
Aluminum Oxynitride (ALON)	Windows on exterior hull of the residential tori.	96,693t	137	Al, O, N	From Earth and Mars Atmosphere: Oxygen and Nitrogen can be extract from mars atmosphere.
Nickel-based superalloy	Thruster.	1t		Ni, Cr, Co, Mo, Al, Ti, W, Ta, C, B, Zr.	From Earth.
Cable	Electron communication.	N/A	N/A	N/A	Subcontractor company: ZAP! Industries.
Solar cells	Solar panels.	4,887,000ft^2	7	N/A	Subcontractor company: ZAP! Industries.
Machines	Preparation for the industry, including machines for robots, furniture, spacesuit etc.	N/A	N/A	N/A	Subcontractor company: 3D Logistics,Bottom Cleaners,Dirtbuilders,Fusion Founders,Nano Solutions,Wheels of Fortune,ZAP! Industries.

3.2.1 Atmosphere control

Table 3-2-1 *Atmosphere control [Yuhaoze, Word]*

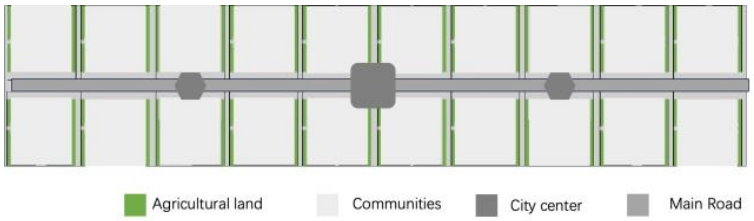
Gas Type	Agriculture	Residents
Oxygen	78%	78%
Nitrogen	21%	21%
Carbon Dioxide	≈0.5%	≤0.1%
Temperature	15 to 20°C	18.3 to 26.7°C
Density	≈1.3kg/m^3	≈1.205kg/m^3
Pressure	1.00932×10^5	1.013×10^5
quantity	≈36000000L	
Amount	CASSSCs ×190	CASSSCs × 190

3.2.2 Food production

Table 3-2-2 *Food production and consumption [Yuhaoze, Word]*

Food	A person's consumption per day/g	Total consumption in the first six month /t	CASSCs in total for six months	Food source
Meat	160	432	3	Imported from Garden-A-Go-Go
Eggs	24	64.8	1	
Milk	500	1350	9	
Dry Plant Produce	380	1026	10	
Vegetables	550	1485	11	
Fruit	200	540	4	
Total	1814	4897.8	38	

3.2.2 Food production



Agriculture
Each community is surrounded by wedges of agricultural land, which save space and allow residents to see the green fields within their communities.

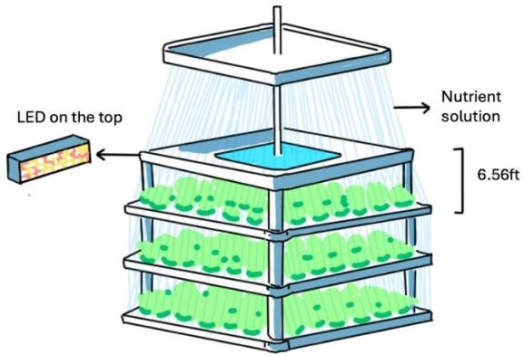


Fig 3-2-2 *Vertical farm [Heziruo, Krita]*

Food Production
A combination of vertical farming and hydroponic technology is used in the planting. The vertical farming system is tower-like, with hydroponic planting beds on each tower. Nutrient solution is supplied through the top of the tower, through the gravity of the plant roots at each level, and finally recycled at the bottom level. Each layer is 6.56 feet high and the number of layers is between 10 and 20.

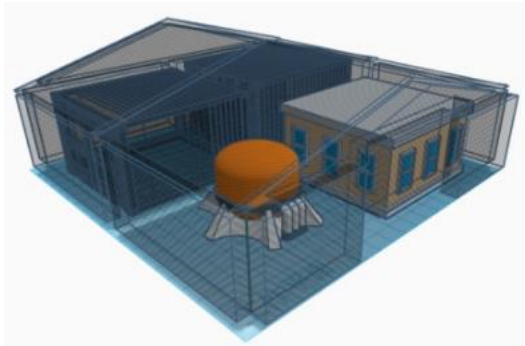
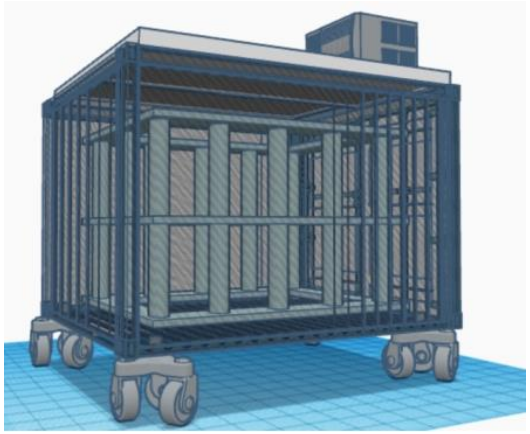


Fig 3-2-4 *Food preservation equipment [Lixujin, Tinker cad]*

Food Preservation
This picture shows a food storage room. It can store a large amount of food, not limited to meat, vegetables, cooked food, etc., providing security for residents' lives. The facility in the lower left corner can detect temperature and humidity and make adjustments as necessary. The facility on the right is a freezer with a temperature of negative 18 degrees Celsius, which can store some meat.

Fig 3-2-3 *Food deliver equipment [Lixujin, Tinker cad]*



Food Distribution
This picture shows a food delivery device. The exterior of the box is made of iron, which can effectively protect the food. The device on the box can execute delivery commands and monitor the temperature inside the box in real time to ensure food safety. There is a huge space inside the box, which can be used to place an intelligent adjustment device for cooling or keeping food warm in hot or cold weather.

3.2.3 Electrical power generation

According to the data given on the official website, the future non-industrial human communities will require about 10 megawatts per 5000 people, which is 0.2KW per person. We estimate the industrial communities will require twice as much electricity as the non-industrial communities and the population in the industrial communities will be about 2000. Therefore, the total power needed will be 16000*0.2KW+2000*0.4KW=4000KW. From the subcontractors' information, the power that one solar panel can generate in Earth orbit is 38W and each panel takes about 0.18 square meters (2 square feet). Adding that the power of sunlight on Mars orbit is 589W/m2 and on Earth is 1367W/m2 which we gain from Marspedia.org, each solar panel can generate approximately 16.37W. So, the number of panels needed will be 4000*103 W/16.37 which is approximately 244350, which is 44960 square meters (488700 square feet).

3.2.4 Water management

Water consumption per day

The ratio of domestic water, industrial and agricultural water, and other water (commercial, etc.) is about 5:4:1.

Water filter

Wastewater is pumped through a 0.5-micron depth filter to protect the Multifiltration Beds from particulate loading.Two identical Multifiltration Beds follow for the removal of ionic and organic contaminants. Then, Catalytic Oxidation Reactor is designed to remove low molecular weight, polar organics that are not efficiently removed by the Multifiltration Beds. Next the process water is passed through an ion exchange bed for removal of ionic by-products from the reactor and addition of a residual level of iodine (1-4 mg/l) as a biocide. Bed is used to determine when the bed is expended. If the Reactor Health Sensor or the Ion Exchange Bed effluent conductivity are not within specification, the process water was recycled to the inlet of the WP for reprocessing. If the product water was qualified, it would go into the product water tanks.

Table 3-2-5 *Water consumption [Yuhaoze, Word]*

Sector	Water quantity/ft^3
Residential	39729.3
Industrial and agricultural	31783.2
Commercial	7945.8
Total per day	79458.3

Fig 3-2-5 *Water processor functional schematic [Heziruo, Krita]*

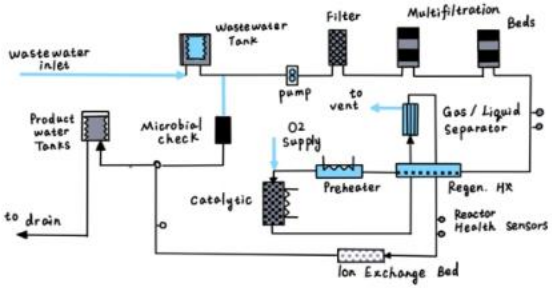


Fig3-2-6 *Water tank [Wangzhiru, Procreate]*

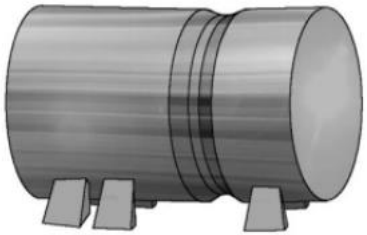


Table 3-2-6 *Water tank size [Heziruo, Word]*

Length/ft	6.56
Diameter/ft	3.28
Volume/ft^3	55.45
Numbers needed	1500

3.2.5 Household and industrial solid waste management

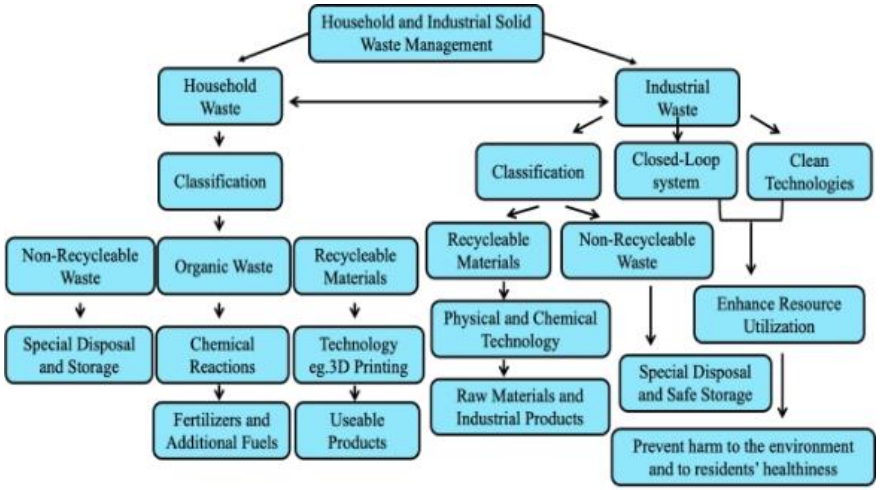


Fig 3-2-7 *Waste sorting process [Lijianyang, ppt]*

Table 3-2-7 *Waste management [Lijianyang, Word]*

Factors	Description
Total amount of waste	4500 tons solid waste would be produced in 10 months (300 days) (1kg/person/day * 15000 people * 300 days = 4500 tons)
Area for Storage and Disposal	A volume around 21 CASSSCS is required for building a garbage station. This area is sufficient to store, dispose and recycle the amount of both household and industrial waste produced in the garbage cycle. The garbage station is designed to be located near the industrial area so that it won't interrupt people who live on the major torus.
Waste Transportation	Building pipelines underground that connects households, industrial area to the garbage station. These pipelines contain the function of compressing, incinerating, and sorting waste automatically into different types based on recycling standards.

3.2.6 Internal and external communication systems

1.Internal communication system

Table 3-2-8 *Internal communication system [Songjiaqi, Word]*

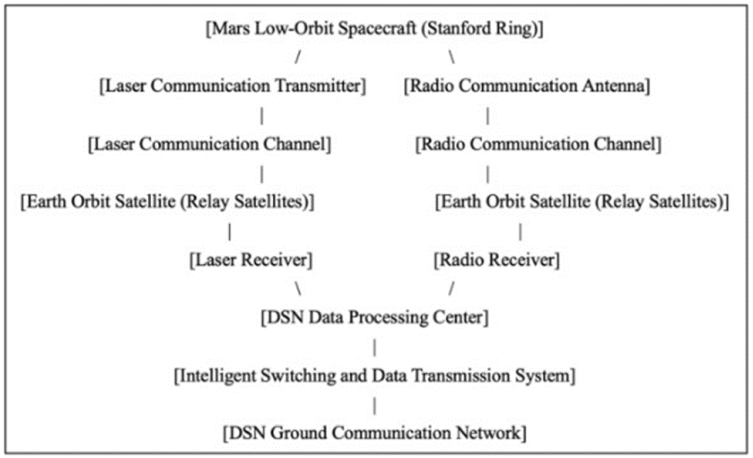
Category	Hardware	Description
Core Equipment	Core Communication Server (Main Server 1)	Manages major data flow, routing, and storage with a high-performance setup and built-in fault tolerance
	Backup Server (Main Server 2)	Synchronizes data in real-time and automatically takes over in case of failure, with identical configuration as the primary server
Network Equipment	Fiber Switch (Switch 1)	Facilitates high-speed fiber connections with transmission rates exceeding 10 Gbps, ensuring efficient connectivity between core servers and terminal devices
	Fiber Switch (Switch 2)	Acts as a backup with redundancy design for high network availability and stability
	Wireless Access Point (Wi-Fi Access Point)	Uses advanced radio wave-based mesh technology with optical and electrical multiplexing to ensure seamless, high-speed communication. Managed by Orbitlink Communications, it features dual-band Wi-Fi 6 routers throughout the area, providing Mesh Wi-Fi speeds over 150 Gbps for reliable connectivity.
Terminal Devices	Automation Controller	Manages and monitors automation systems with an embedded platform that supports a variety of communication interfaces
	Sensors	Measures environmental factors (e.g., temperature, humidity) for real-time monitoring and data transmission
	Actuators	Executes physical operations (e.g., switching, adjusting) in response to control signals, supplied by a third-party vendor
Auxiliary Equipment	Uninterruptible Power Supply (UPS)	Ensures continuous operation of critical equipment during power outages with backup power
	Cooling System	Maintains stable operating temperatures for core equipment under high loads

3.2.6 Internal and external communication systems

2. external communication system

A. Main communication links

Fig 3-2-8 *Main communication links [Songjiaqi, Word]*



For data encryption and security, we use AES-256 for data protection, the Authentication and Access Control will ensure only authorized access. By integrating parabolic antennas, laser communication, microwave communication, and DSN systems, a highly efficient and stable communication link between Mars low-orbit spacecraft and Earth can be established. The system meets diverse data transmission needs and enhances reliability through redundancy and optimization measures.

B. Hardware Configuration

Table 3-2-9 *Hardware configuration [Songjiaqi, Word]*

	Component
Mars Low-Orbit Spacecraft (Stanford Ring)	● Parabolic Antennas: Transmit and receive microwave signals; placed near solar panels. ● Laser Communication Equipment ● Attitude Control System
Relay Satellites	● High-Gain Parabolic Antennas ● Laser Communication System
Ground Stations (DSN)	● Large Parabolic Antennas: Receives data from Mars; located globally for continuous reception ● Data Processing Systems

3.2.6 Internal and external communication systems

2. external communication system

C. Communication device

Table 3-2-10 *Communication devices [Songjiaqi, Word]*

Key Features	Description	Technical Specifications	
AR Virtual Display	High-resolution AR display overlays virtual information, such as navigation, notifications, and application interfaces, onto the user's view.	High-resolution transparent OLED	
Integrated Headphones	High-quality headphones embedded in the temples support music playback, phone calls, and voice assistant functions.	High-fidelity audio, Bluetooth support	
HD Camera	The HD camera on the frame supports 1080p video recording and real-time video calls.	HD 1080p	
Wrist Assistant Tool	A wrist-worn tool similar to a smartwatch provides GPS location, activity tracking, and health monitoring functions, and can control the glasses' settings.	Color touch screen, supports GPS and health monitoring	

D. Apps

Table 3-2-11 *Apps [Songjiaqi, Word]*

Application Type	Sync Frequency	Description
News Application	Hourly	Keeps users informed with the most recent news updates.
Social Media Application	Every 30 minutes	Delivers a near-real-time experience, ensuring users stay up-to-date with social activities.
File Sync and Storage Application	Real-time	Instantly sync file changes to give all parties access to the latest documents as soon as possible
Video Streaming Application	On-demand	Syncs content in real-time upon user request, ensuring a smooth streaming experience.
Email Client	Every 15 minutes	Ensures prompt delivery of new emails to the user's inbox.
Office and Productivity Application	Hourly	Maintains up-to-date documents and collaborative content for efficient workflow.
Financial and Trading Application	Every minute	Offers the most current financial market data for timely decision-making
Gaming Application	Continuous real-time	Maintains continuous sync of game progress and state for a seamless experience
Health and Fitness Application	Hourly	Regularly updates health metrics and activity logs for accurate tracking and analysis.

3.2.7 Internal transportation systems

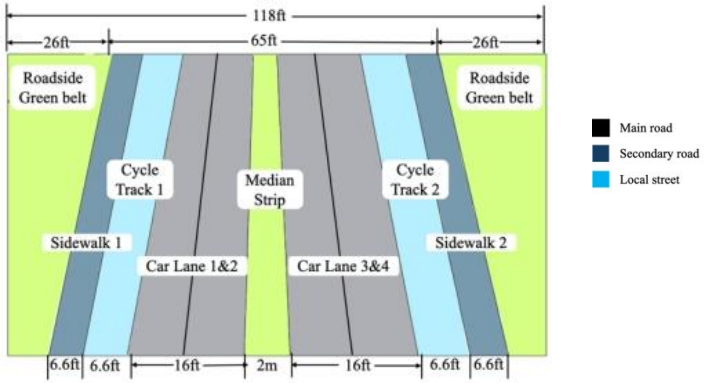


Fig 3-2-10 *Detailed view of the main road [Heziruo, Krita]*

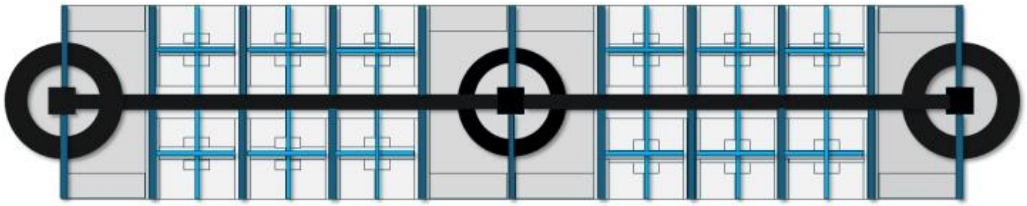


Fig 3-2-9 *Traffic distribution map [Heziruo, ppt]*

Roads in the city are divided into main road, supporting major transportation of the whole city, secondary road, and local street for intra-community traffic. The main road is a dual carriageway, with traffic flowing in both directions separated by a lush green median strip. Each direction has two lanes, and each lane is 8 feet wide.

Automatic Drive

Both the public transportation and the private transportation are equipped with automatic driving system.

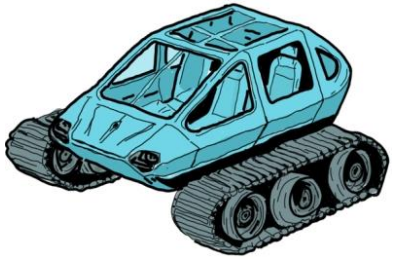
Fig3-2-10 *Crawler and sizes [Heziruo, Krita]*

3.2.7 Internal transportation systems

Private Transport

Crawler

The design of Crawler provides a larger ground contact area compared to wheeled vehicles, which is crucial in low-gravity environments. This larger contact area distributes the vehicle's weight, increasing ground friction and enhancing stability and traction. By spreading the weight over a larger area, tracked vehicles reduce ground pressure, minimizing the risk of sinking into soft or uneven terrain and improving mobility.



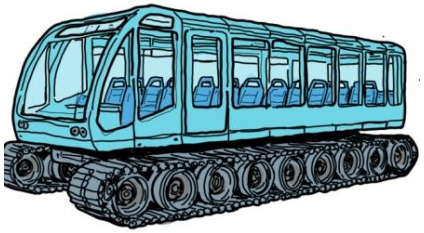
Material	Al-body, AlON-window, Rubber-track.
Width/ft	6.5
Height/ft	5.25
Length/ft	13
Carrying Capacity	1～4 people

Fig3-2-10 *Crawler and sizes [Heziruo, Krita]*

Public Transport

Large transit station is located at the city center and both boundaries of the city. There are also small transit stations at each community center.

Fig 3-2-13 *Bus and sizes [Heziruo, Krita]*



materials	Al-body, ALON-window, Rubber-track.
Width/ft	8
Height/ft	10
Length	40
Carrying Capacity	20～30 people

Bicycle

Bicycles are an excellent mode of transportation in low-gravity environments, allowing people to ride with greater ease. However, ordinary bicycles have wheel widths ranging from about 0.9 to 2.5 inches. To increase the contact area and traction, the wheel width of special bicycles designed for low-gravity environments is between 3 and 5 inches. The bicycle also has a front suspension system and a rear suspension system shown in fig 3-2-The front suspension system, featuring shock-absorbing forks, smooths out bumps for a comfortable ride. The rear suspension system, with shock absorbers and linkages, enhances stability and absorbs rear wheel impacts.

Materials	Frame- Carbon Fiber.
Height/ft	3.5
Length/ft	5
Width of the wheel/ft	0.3
Diameter of the	2.5
Carrying Capacity	1 person

Fig3-2-11 *Bicycle and sizes [Heziruo, Krita]* ***Fig 3-2-12*** *The front suspension system and rear suspension system [Wangzhiru, Blender]*

3.2.7 Internal transportation systems

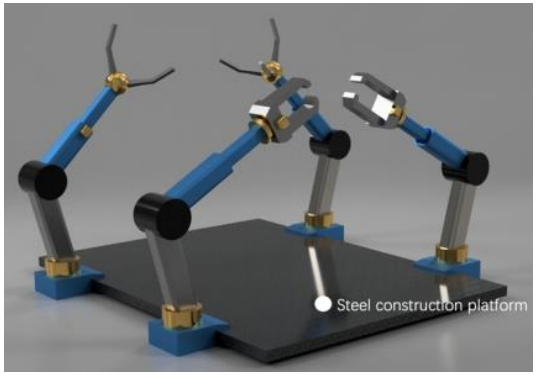
Automatic Drive

Both the public transportation and the private transportation are equipped with automatic driving system.

Table 3-2-12 *Automatic driving devices [Heziruo, Word]*

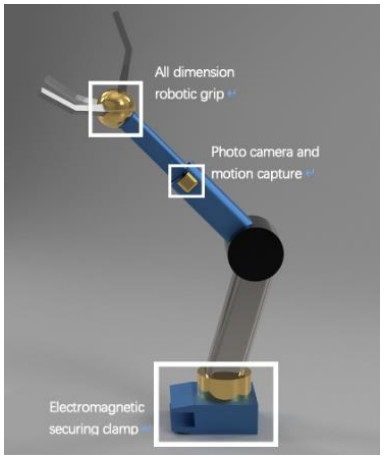
Device Name	Function
Camera	Object detection, lane detection, traffic sign recognition
Radar	Detects distance and speed of surrounding vehicles
Lidar	Provides high-precision 3D mapping of the environment
Ultrasonic Sensors	Short-range obstacle detection (e.g., during parking)
GPS	Provides global positioning information
Inertial Navigation System (INS)	Combines with GPS for high-accuracy positioning
SLAM System	Simultaneous localization and mapping
Central Processing Unit (CPU)	Processes sensor data and executes algorithms
Graphics Processing Unit (GPU)	Accelerates image and data processing tasks
Control Unit	Controls steering, acceleration, and braking
User Interface Display	Displays driving status and path planning
Communication Module	Enables communication between different system components
Backup Power Supply	Ensures system operation in case of primary power failure
Data Storage	Stores sensor data and system logs
Ethernet/Controller Area Network (CAN) Bus	Facilitates communication between system components
Emergency Stop System	Allows manual override and stopping of the vehicle
Cooling System	Manages temperature of critical components
Safety System	Includes redundancies to ensure reliability

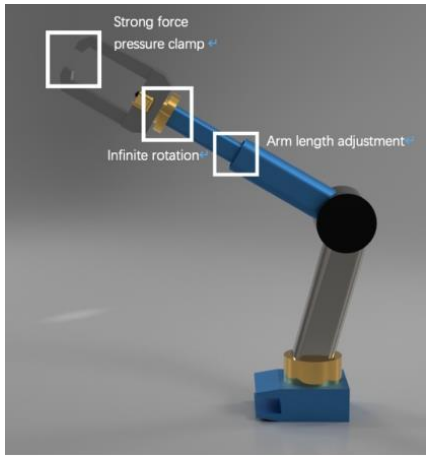
3.3.1 Interior manufacturing and exterior manufacturing



We have designed two types of robotic arms, both of which can be used for exterior and interior construction. The bases of both robotic arms are equipped with electromagnetic securing clamps, allowing them to securely attach to the ferromagnetic surfaces of Aresam for operation.

Fig 3-3-1 *Construction scene [Jiangtianyu, Fusion 360]*



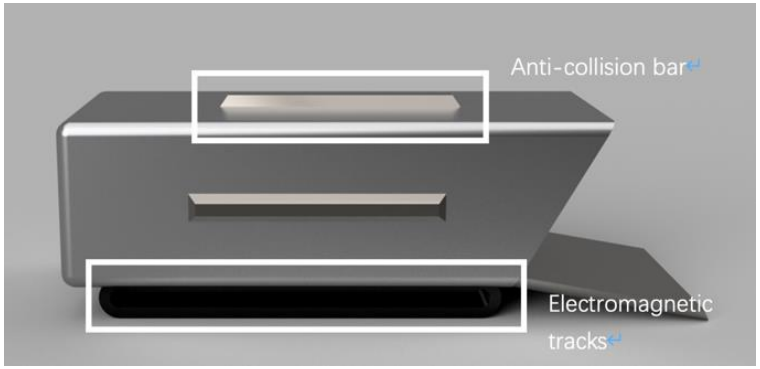


The two robotic arms differ in their end-effectors. The robotic arm with a clamp end-effector is primarily used for exterior manufacturing, making it more suitable for grasping and securing larger, regularly shaped objects.

In contrast, the robotic arm with a grip end-effector is more flexible and is used for interior manufacturing, ideal for handling smaller, lighter objects and manipulating irregularly shaped, delicate components.

From left to right: ***Fig 3-3-2*** *Robotic arm with clamp end effector [Jiangtianyu, Fusion 360];* ***Fig 3-3-3*** *Robotic arm with grip end effector [Jiangtianyu, Fusion 360]*

3.3.2 Delivery Machine



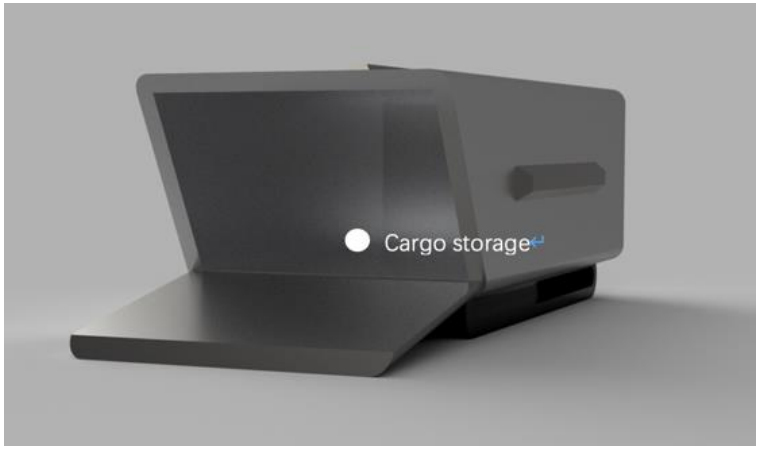
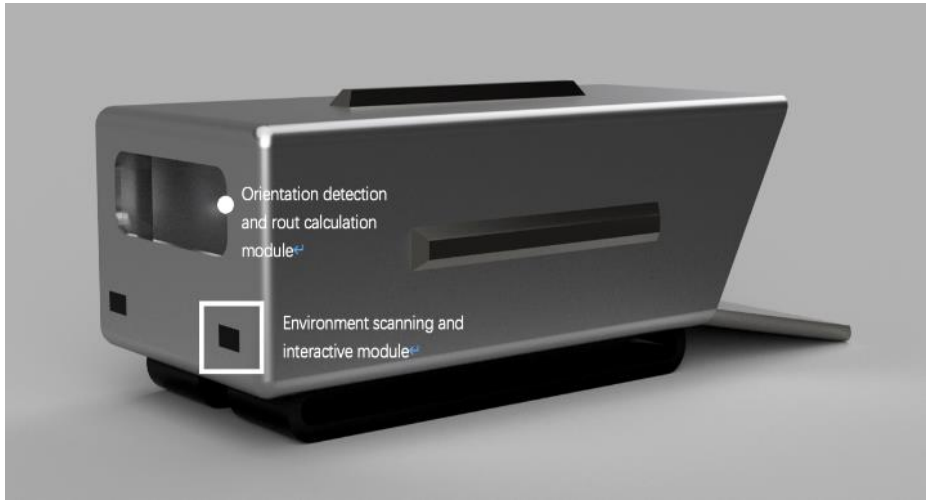


Fig 3-3-5 *Cargo storage function [Jiangtianyu, Fusion*

The machine attains abundant storage space. With a width of 16 ft, a height of 10ft, and a depth of 34.4 to 28.6 unequal, the enclosed space has a volume of approximately 5,038 ft^3.

This machine is capable of both interior and exterior delivery due to its uniquely designed electromagnetic tracks that attaches to metal surfaces which creates friction even in weightless environments.

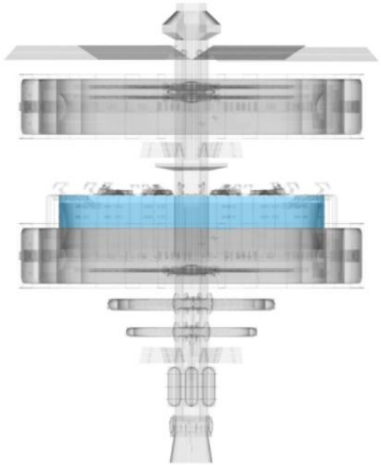
Fig 3-3-4 *Delivery function [Jiangtianyu, Fusion 360]*



Fi g 3-3-6 *Automation function [jiangtianyu, Fusion 360]*

Sensation, computation, and interactive modules ensure the automation of the delivery vehicle transportation system. The machine scans the environment to avoid possible obstacles and compute best routs to destination based on its location, orientation, and position of other vehicles. Delivery machines are linked together via a virtual platform coordinating every vehicle’ s status and position. The interactive module at the head of each cart consolidates the relative distance between vehicles which can be accessed through the delivery management virtual system.

At HighPort, the ferry fleet is typically stationed in the storage area below the deck. The deck is equipped with mechanical arms and docking interfaces to facilitate transfers, and it also features a runway.
At MarsPort, the station is on one side of the facility, and to make the internal transportation convenient, the porting area will be divided into two parts: one for fleet carrying only goods (CASSSCs), and another for visitors or visitors and goods.



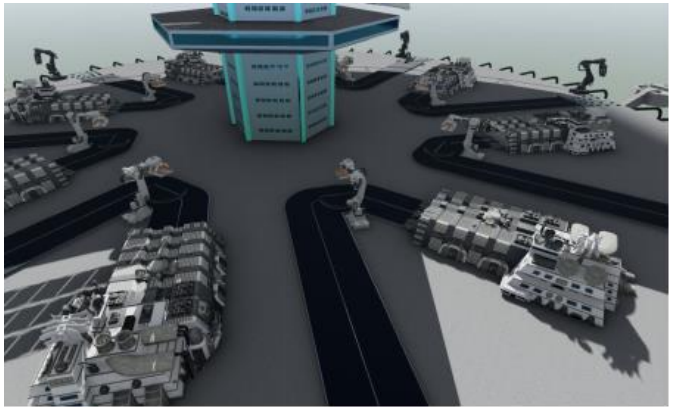
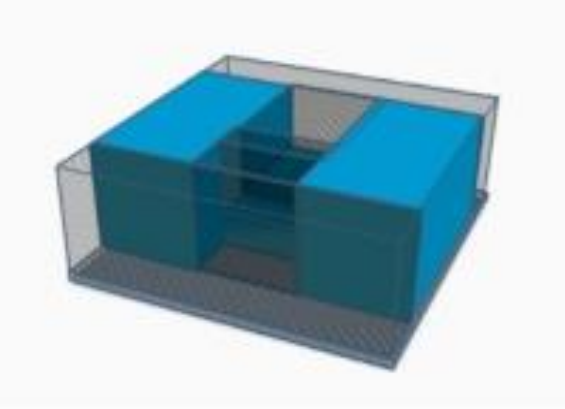


Fig 3-4-1 *Location of ferry base on HighPort [Chenjunrui, SketchUp]*

Fig 3-5-1 *Warehouse on MarsPort [Libingqian, Tinker cad]*

The warehouse for storing CASSCs and the ferry base at HighPort are located in the same place, namely the storage area below the deck, as seen in Figure 2-1-9. For the specific location, please refer to Figure 3-4-1.
CASSSCs is mostly stored in HighPort. CASSSCs sent to the MarsPort mostly contain Mars landing-vehicles, materials and equipment for the laboratory, and supplies necessary for running the MarsPort. The warehouse in the MarsPort can store over 200 of CASSSCs, enough for using and short-time storing. With the help of automation, docking and transmission of the CASSSCs, and the visitor's guidance will all be done without humans. The work humans need to do is providing services for visitors, routine checking, command docking, and departure. So, the number of staff will never be larger than 15 people. In our design, each ferry can carry two CASSSCs or 120 people at most. The MarsPort can receive 4 ferries carrying cargo and 2 ferries carrying people, which is 8 CASSSCs and 240 people at one time. The period of each ferry (from HighPort to MarsPort and going back) is about once every 3 days.



Community design

The inner circumference of a residential ring is approximately 13,802 feet, with a height of 1,023 feet. The interior of the residential ring is divided into three sections, each forming a small community with a span of 4,601.4 feet. We have designed two different community layouts, shown in fig 4-1-2 and fig 4-1-3.

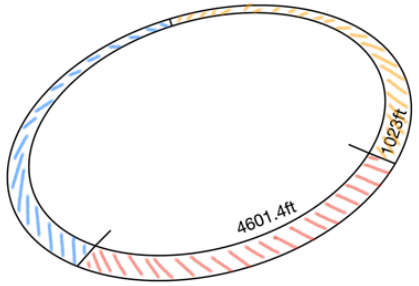
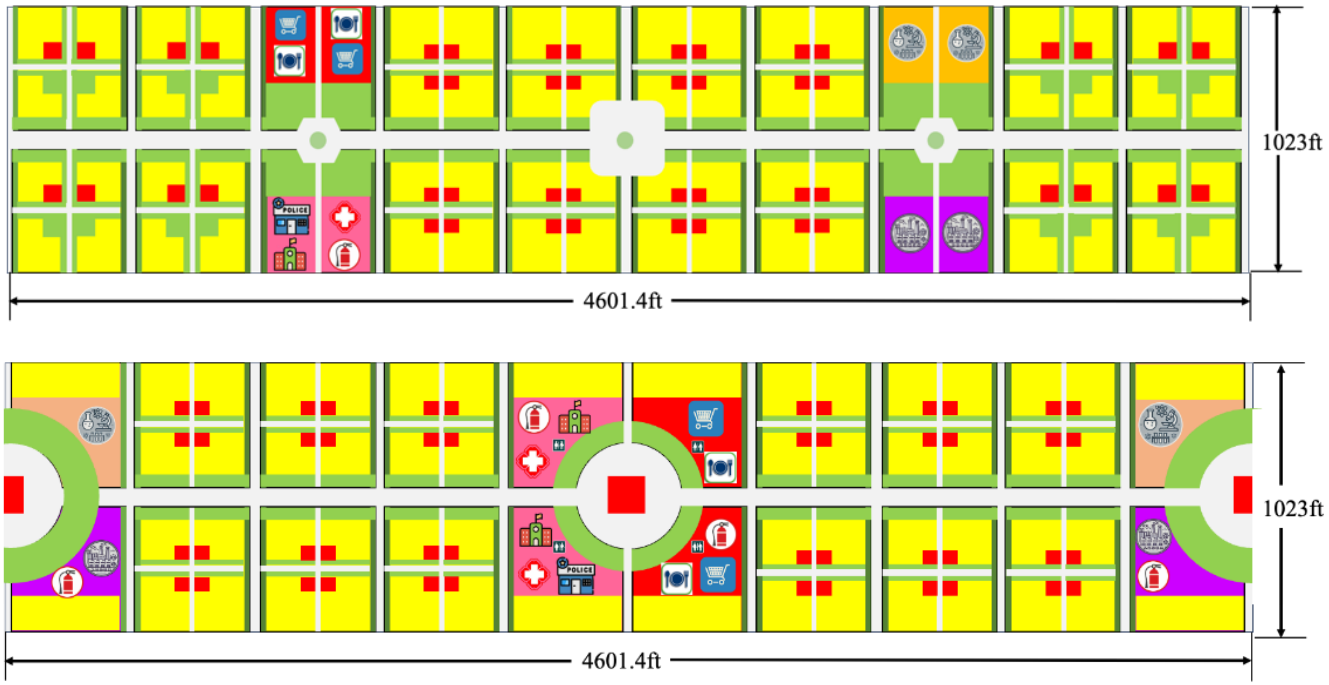


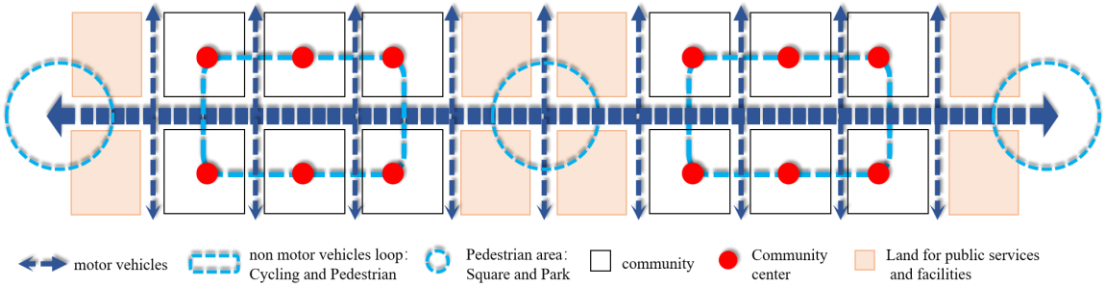
Fig 4-1-1 *Community division [Heziruo, notability]*

Fig 4-1-2 *interior map of the community 1 [Heziruo, ppt]*



Regional function	symbol
Residential area	
Green space	
Research center	
Road	
Business zone	
Manufacturing district	
Agricultural district	
School	
Hospital	
Police station	
Fire station	
Restaurant	
Shopping mall	
Lab	
Manufactory	
Public convenience	

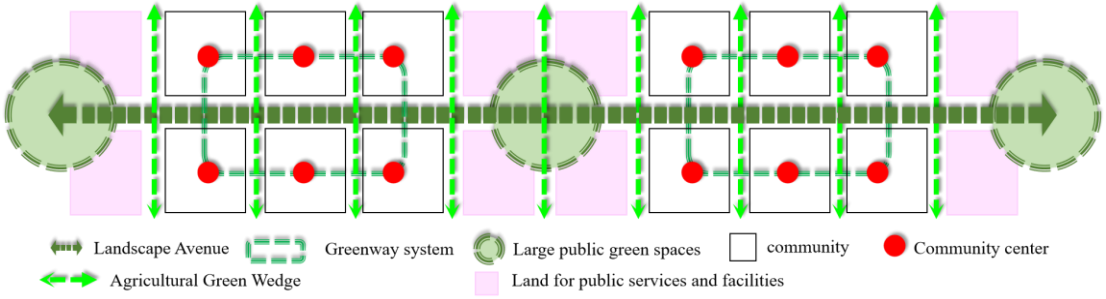
Fig 4-1-3 *interior map of the community 2 [Heziruo, ppt]*



Separation of motor vehicles and non motor vehicles

Efficiency and safety, comfort in harmony.

Fig 4-1-4 *Traffic map [Heziruo,ppt]*



A network combining agriculture and green landscape

Green at the doorstep, a park within five minutes, natural scenery within ten.

Fig4-1-5 *Community greening plan [Heziruo, ppt]*

Table 4-1-1 *Consumables [Heziruo, Word]*

Consumables	Quantities each year	Cassscs each year	Consumables	Quantities each year	Cassscs each year
Toothbrush	60,000	1	Computer	3,000	1
Cup	17,000	1	Pen	180,000	1
Towel	30,000	1	Book	180,000	1
Bath cream	90,000	1	Clothing	300,000	4
Pillow	17,000	2	Detergent	180,000	5
Toilet paper	1,800 000	10			

Aresam has a resident population of 15,000 people. Each person replaces their toothbrush approximately every three months, their cup and towel once a year. On average, each person uses one bottle of bath cream every two months and replaces their pillow once a year. Each month, they need ten rolls of toilet paper. On average, each person replaces their computer every five years, but they use up two pens, two bottles of detergent, and buy one book every month. Additionally, each person buys five pieces of clothing every quarter.

Table 4-2-1 *House type [Heziruo, Word]*

House Type	Area per floor/ft²	Floor number	Total area/ft²	Required resident number	Number required
House Type 1: Apartment for the Single	1613.8	3	4841.3	5*3: each floor consists of five separate rooms for single person.	580
House Type 2: Villa for married adults without children	812.2	2	1624.4	4~6: one floor is designed for a couple. May also include a newborn.	350
House Type 3: Apartment for married adults without children	1093.2	2	2186.4	8: each floor can carry two couples.	500
House Type 4: Villa for married adults with children	1722	1	1722	3~4: the villa is suitable for a family with one or two children	275

Fig 4-2-2 *Exterior design of house type 2 [Wangzhiru, procreate]*

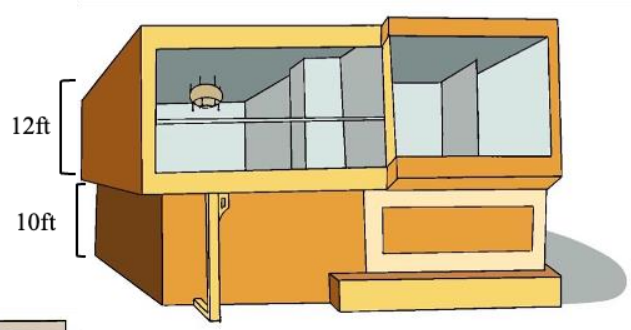


Fig 4-2-4 *Exterior design of house type 4 [Wangzhiru, procreate]*

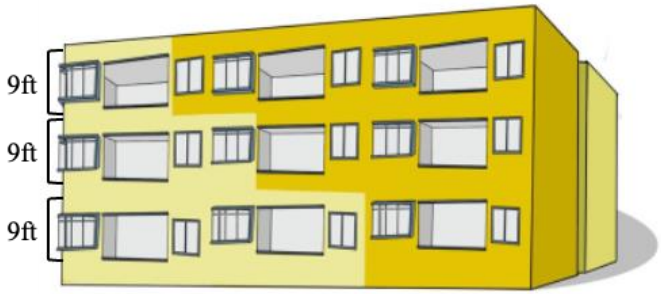
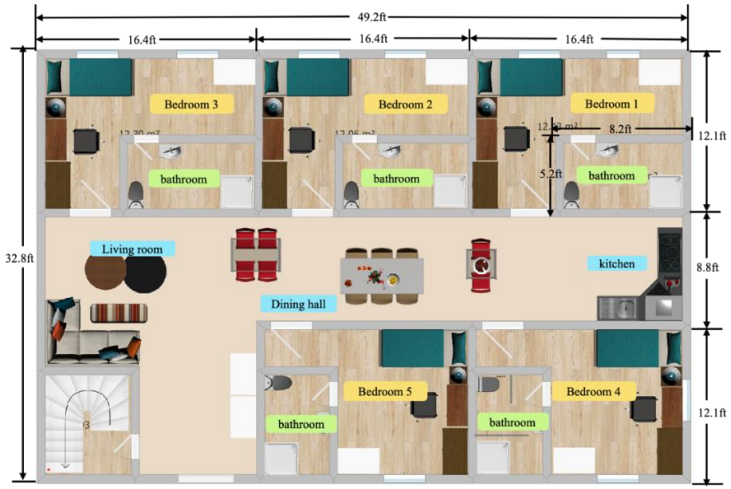


Fig 4-2-1 *Exterior design of house type 1 [Wangzhiru, procreate]*

Fig 4-2-3 *Exterior design of house type 3 [Wangzhiru, procreate]*

House Type 1: Apartment for the Single



Type 1 apartment is for single men and women. The design combines five small rooms, each equipped with necessities, a bed and a toilet. The living room, dining room and kitchen are shared Spaces, saving floor space and promoting interaction among the residents.

Fig 4-2-5 *Interior design of type 1 [Heziruo, Room Skecher]*

Fig 4-2-6 *Detailed view of the dining hall [Heziruo, Room Skecher]*

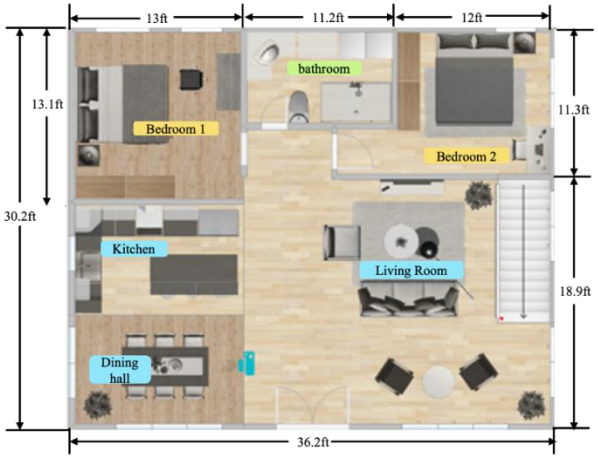
House Type 2: Villa for married adults without children

Each floor is equipped with a separate bedroom, toilet, living room and kitchen, as well as a crib to cope with unexpected staffing increases. The bathroom is dry and wet depart, which means that the toilet, the bathroom and the sink are in three relatively independent spaces.

Fig 4-2-7 *Interior design of type 2 [Heziruo, Room Skecher]*

Fig 4-2-8 *Detailed view of the bathroom [Heziruo, Room Skecher]*

House Type 3: Apartment for married adults without children



Two couples can be accommodated on the same floor, sharing the kitchen, living room and dining room.

Fig 4-2-9 *Detailed view of the shared dining hall[Libingqian, Room Skecher]*

Fig 4-2-10 *Interior design of type 3 [Libingqian, Room Skecher]*

House Type 4: Villa for married adults with children

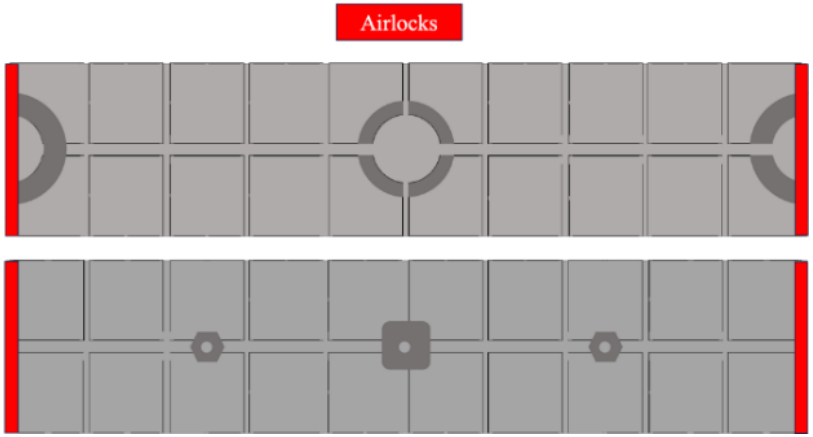
Type 4 adds a laundry room and a enter area, and there are two living rooms. A family of four with one or two children has enough activity space here, and there are two space suit cabinets in the enter, easy to change clothes.

Fig 4-2-11 *Interior design of type 4 [Yuhaoze, Room Skecher]*

Fig 4-2-12 *Detailed view of the enter area [Yuhaoze, Room Skecher]*

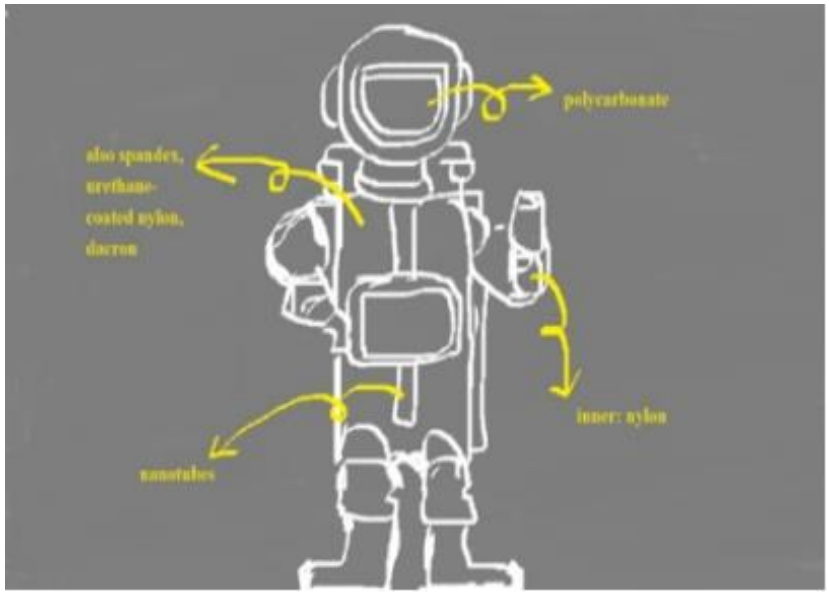
Fig 4-2-13 *Detailed view of the laundry room [Yuhaoze, Room Skecher]*

Safety System



Residents don and doff spacesuits at the airlocks located at the boundaries of the community.

Fig 4-3-1 *Locations for spacesuit donning / doffing [Heziruo, ppt]*



The astronaut's helmet, made of polycarbonate, provides high strength, impact resistance, heat resistance, and excellent optical performance. The inner wall has pads and embedded pipes for shock absorption, insulation, noise reduction, ventilation, and oxygen supply.
The spacesuit uses nylon for warmth and heat resistance, with spandex, urethane-coated nylon, and Dacron to maintain internal pressure and protect against temperature extremes. The outer layer prevents fire, heat radiation, and space hazards. Nanotubes on the surface prevent carbon dioxide poisoning, supply oxygen, and facilitate water circulation.

Fig 4-3-2 *Astronaut's helmet [Lixujin, Freeform]*

MarsPort provides medical services and emergency facilities such as fire safety, but it does not have educational institutions or public transportation stations due to its small and short-term community size. See Fig 2-5-1 for details. The community structure of HighPort is shown in Fig 4-1-2 and Fig 4-1-3.

HighPort's boarding areas are available in various forms, primarily including airlock passageways, passenger capsules, and docking hatches. Each residential ring features three hatches, each equipped with airlocks for pressure adjustment. After exiting the airlocks, passengers can directly enter the capsule spacecraft. The deck on the residential ring is also equipped with docking hatches, allowing passengers to access spacecraft through internal transit tubes within the docking hatches. These methods facilitate the handling of large passenger flows, and the variety of boarding options prevents compatibility issues between different spacecraft and deck interfaces.
In contrast, MarsPort has only one type of boarding area, which is the docking hatch. MarsPort accommodates fewer passengers, primarily staff, and most work spacecraft are compatible with the port's docking hatches.
Fig 4-5-1 *Hatch and capsule spacecraft [Chenjunrui, Lumion]*

5.1.1 Method to create appearances of instant access

Method	Description	Examples
Prefetch and predict	Predicts user data needs based on behavior patterns and historical requests, pre-fetching and caching this data from Earth.	A news app preloads the top 10 articles every morning based on user reading habits.
Smart Caching	Uses machine learning algorithms to analyze user behavior and dynamically adjust caching strategies, ensuring frequently accessed data is always in local cache.	A video streaming service keeps the first episodes of popular series locally cached for instant viewing.
Incremental Sync	Synchronizes only data changes since the last request, reducing transmission volume and increasing sync speed.	A document editor syncs only the changes made to a file instead of re-uploading the entire document.
Progress Indicator	Displays loading animations, progress bars, or information to inform users that their request is being processed.	An e-commerce site shows a progress bar while syncing the latest product listings from Earth.
Local Processing and Proxy	Runs proxy services on Aresam’ s local server to handle and respond to user requests while performing remote data synchronization in the background.	A search engine processes queries locally and syncs with Earth servers periodically to update results.
Local mode	Provides offline access to cached data and automatic sync updates when reconnected if immediate data retrieval is not possible	The music player stores the user's downloaded songs locally in Aresam, and users can still enjoy the music when there is no earth connection.

Additional description of synchronization

In addition to transferring only the content that changes each time（incremental sync）, we also assign different synchronization frequencies to different sites and apps based on their usage.

Two main benefits.

- Save network bandwidth
- Improve synchronization efficiency

5.1.2 Construction Machinery

Interior construction machine and exterior construction machine are shown in 3.3

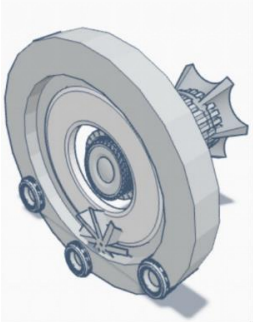
5.2.1 Automation of maintenance and repair

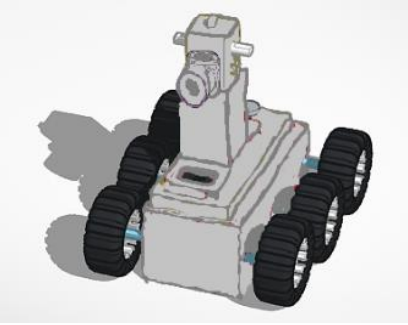
Exterior detecting robot is ring-shaped with a thruster at the bottom. It can rotate around Aresam. The emergency robot has camera and caution light on its head, detecting robots with breakdowns and reporting about the situation immediately. Interior cleaning robot has a robotic arm to collect the garbage and wipe out the stain, with four wheels and a vacuum cleaner at the bottom. Interior robot detector has camera on its head, examining which part of the internal structure needs to be repaired and the potential danger. The maintenance robot and the exterior cleaning robot have same design, with four robotic arms supporting maintenance work and cleaning work. The fire-fighting robot has a fire hose nozzle at top.

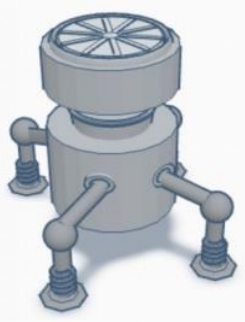
Fig 5-2-1 *Robot detector (large-scale & exterior) [Wangzhiru, Tinker cad]*
Fig 5-2-2 *Emergency robot [Wangzhiru, Tinker cad]*
Fig 5-2-3 *Robot cleaning (interior) [Heziruo, Tinker cad]*
Fig 5-2-4 *Robot detector (interior) [Wangzhiru, Tinker cad]*
Fig 5-2-5 *Maintenance Robot/Robot cleaner (exterior) [Wangzhiru, Tinker cad]*
Fig 5-2-6 *Fire-fighting robot [Lixujin, Tinker cad]*

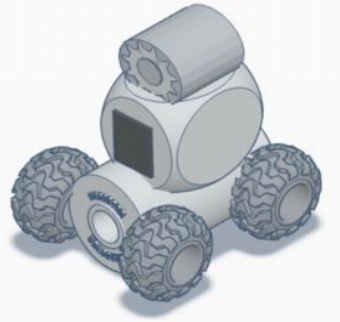
Table 5-2-1 *maintenance and repair robots [Wangzhiru，Word]*

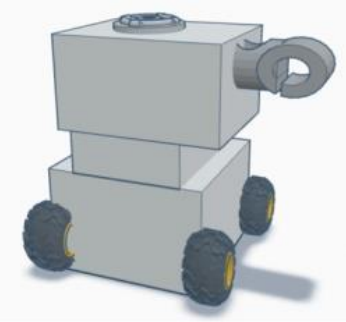
Robot	Number	Function
Robot cleaner (interior)	10000	Interior cleaning of Aresam.
Robot cleaner (Exterior)	500	Cleaning of the exterior hull.
Robot detector (large-scale & exterior)	100	Detect the potential danger outside Aresam.
Robot detector (interior)	8000	Detect the potential danger within Aresam, including fire warnings.
Fire-fighting robot	600	Fire-fighting.
Maintenance robot	800	Maintenance of facilities and regular replacement of aging equipment.
Emergency robot	200	Report robot accident.











Facility Automation

5.2.2 Automation of authorization system

System Designation	Properties Monitored	Control Measures	Notes
Environmental Control System	● Temperature ● Humidity ● Pressure ● Content of Oxygen and CO2	Adjustment through the monitors in Automatic climate control system	● Alert on environmental abnormalities ● Isolating people from abnormal areas
Structural Integrity Monitoring	● Pressure ● Deformation ● Cracks	Dispatch of Automatic repair robots (Nanotechnology, 3D Printing)	● Manual inspection once a week
Power System	● Voltage ● Current ● Energy storage	Load balancing, Backup power activation	● Manual inspection on energy abnormalities
Water Circulation System	● Water quality ● Flow ● Pressure	Automatic purification and Pump control	● Monthly manual water quality inspection
Security System	● Fire ● Toxic gases ● Intrusion	Automatic alert, Isolation, Firefighting	● Human intervention in emergencies ● Usage of Automated Access Control System

5.2.3 Automation of network security

	Component	Function
Front-end monitoring layer	● Intrusion Detection Systems (IDS)&Intrusion Prevention Systems (IPS): Deployed at key nodes of the network, including the base's communications entry points and key locations on the internal network. ● Firewall: Used to control and filter network traffic to and from the base, ensuring that only authorized traffic can pass through. Set strict access control rules	● Monitor network traffic in real time to detect and defend against potential threats. ● Block unauthorized access and malicious activity.
Data collection layer	● Security Information and Event Management (SIEM): Deployed on base core servers, centralized collection and analysis of log data from various security devices and systems. ● Traffic analysis tool: Analyzes network traffic in real time to identify abnormal behaviors and potential threats.	● Aggregate and analyze security data to generate alarms and reports. ● Provide actionable security intelligence to support automated responses
Automatic response layer	● Response Engine: Automatically executes response measures based on predefined rules and policies（Include isolation, blocking, patching and updating, configuration tweaking, notification and reporting）, like an automated security team. ● Scripts and Automation tools: Use automated tools (such as Ansible, Puppet) to perform security configuration and updates.	● Based on the detected threats, the system automatically takes response measures, such as isolating devices and blocking IP addresses. ● Automatically fix vulnerabilities and apply security patches
Management and control layer.	● Centralized Management Console: Unified management and monitoring of all security tools and systems. ● Policy Engine: Defines and manages security policies to ensure they are consistently applied across the network	● Provides a unified security management view to simplify operation and monitoring. ● Ensure that security policies are applied consistently throughout the base network.
Feedback and improvement layer	● Periodic review mechanism: Periodically review system performance and security policies. ● Feedback collection system: Collect feedback to continuously optimize the safety automation system.	● Continuous improvement of safety automation system based on actual operation and feedback. ● Ensure systems can adapt to new threats and changing environments.

Design details

Communication delay consideration

Due to the delay in communication between Mars and Earth, the system design must take into account the impact of the delay on real-time monitoring and response. Therefore, minimize dependence on the Earth and rely more on local processing and decision-making.

Physical access restriction

At a Mars base, physical access to equipment is more difficult. The system design needs to be highly automated and able to be managed and maintained remotely.

Environmental reliability

The system must be able to operate reliably in extreme environments, including high radiation and temperature fluctuations. Choosing durable hardware and a redundant

5.3.1 Livability and convenience

Express Service		-auto-delivery vehicles sends packages to the location residents offered -remind the residents to take the packages -automatic charging in public parking lots -controlled by Express Service Administration -each community has several of it depend on the population *Fig 5-3-1 Auto-delivery vehicles [Heziruo, Krita]*
Household Robot		-do some basic housework (such as surface cleaning and laundry) -bring stuffs to the residents -controlled by the "Easier Life" House Assistant System -paired with each house *Fig 5-3-2 Household robot [Heziruo, Krita]*

5.3.2 Productivity and reduction of manual labor

Routinely Infrastructural Working and Checking	Check 3.2, all of the work will be done by robots.
Public Transportation System	Automatic driving vehicles mentioned in 3.2.7
Personal Working Laptop	Can only connect to the workplace local network. (can't surf the Internet) Light and easy to carry Enough to run most of the working software
AI Assistant	Help collect information on the Internet Help check mistakes such as grammar or format.

5.3.3 Personal communication devices

Mentioned in 5.4.1 and apps in 3.2.6

5.3.4 Network

Aresam Web: works like World Wide Web on Earth, connecting devices all over the Aresam. For each router, the standard bandwidth will be 300 Mbps. Also, there will be some signal towers and signal base stations for network service in public areas. Some places, like offices and residences, don't connect with the outer server to avoid information breaches and improve efficiency. There will be a center server in the Aresam to communicate with the Earth, which can send and receive messages from the Earth. For the way to communicate with the Earth, please refer to 5.5.

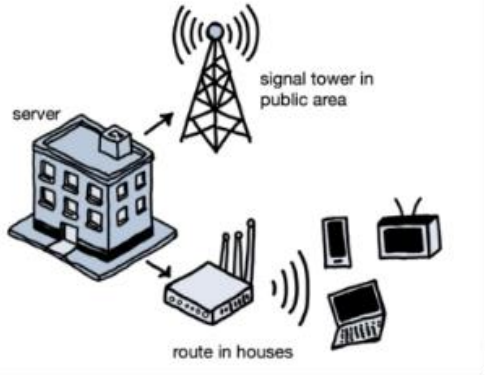
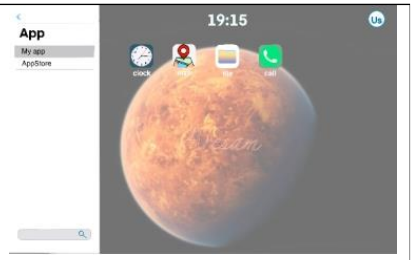
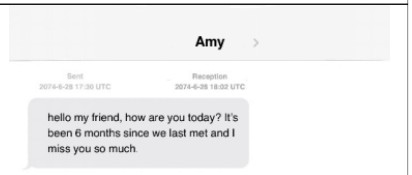


***Fig 5-3-3** Network [Heziruo, Krita]*

5.4.1 Fixed functions and applications

Navigation bar	Navigation bar involves app, message, news, bowser, video and setting	 *fig5-4-1 Navigation bar [Songjiaqi, Procreate]*
App	Click the word ‘App’ on the navigation bar to enter it, it has “My App” (to check and access the app already download) and “Appstore” (download new app and update) two part. Default pre-install apps involve map, clock, file and call (only available on settlement)	 *fig 5-4-2 App [Songjiaqi, Procreate]*
News &video	Regular updates. Click in to find the latest content that exists locally. The regular mode of the “search” can only find content that exists locally, while the remote mode can find the latest content on Earth	None
Message	The message arrives as soon as possible. Send and receive time automatically recorded (left and right time stamps)	 *fig 5-4-3 Message page [Songjiaqi, Procreate]*
Map	The default display on Mars settlement, can be switched to Earth	None

5.4.2 process of accessing earth data

Step	Description
Data Request	User Request: Aresam residents use devices to access local applications or browser and make data requests. Local Server: The request is first sent to Aresam’ s local server. The local server checks if the requested data is already cached.
Local Cache Check	Cache Hit: If the requested data is in the local cache, the server returns the cached data, providing a quick response. Cache Miss: If the data is not in the local cache, the server forwards the request to Earth's data repository.
Data Transmission	Request Transmission: Due to the communication delay between Earth and Mars (6 to 45 minutes), the request is sent to Earth, processed, and the data is transmitted back to Aresam’ s local server. Data Reception: The local server receives the data and stores it in the cache for future quick access.
Data Return	If the requested data is in the local cache, the user receives an immediate response. If the data needs to be fetched from Earth, the user will receive it after the delay.

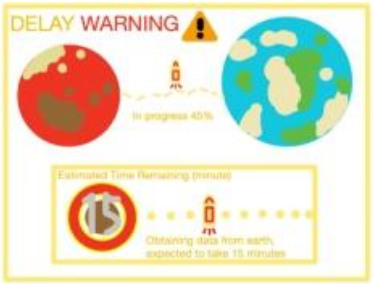
5.4.3 Process of publishing data to earth

Step	Description
User Publishes Data	User publishing: Aresam residents publish data via devices to websites or data repositories on Earth. Local cache: The local server temporarily stores data in the local cache and confirms to the user that the publish request has been received.
Data Transmission	The local server sends the published data to Earth's server. Communication delay is 3 to 23 minutes one-way.
Earth Receives	Earth's server receives and processes the data, then sends a confirmation back to the Aresam local server.
Publication Confirmation	The local server updates the cache and notifies the user of the successful publication.

5.4.4 Data Type

Data Type	Sync Frequency	Description
Static Content (HTML, etc.)	Weekly sync	Ensures consistency of the website's basic structure and style.
Dynamic Content (news, etc.)	Hourly sync	Ensures users receive the latest information
Large Files and Multimedia	User-demand driven sync	Syncs based on user demand to save bandwidth.
Critical Data	Real-time or hourly sync	Ensures continuity of user experience
Secondary Data	Daily sync	Updates data that is accessed less frequently on a regular basis.

5.4.5 Delay Identification methods

Identification Method	Description	Diagram
Delay Warning	Displays a delay warning when data requests or publications require Earth communication, indicating expected delay time.	 *Fig 5-4-4 Delay warning [Songjiaqi, Notability]*
Progress Indicator	Provides a progress bar or estimated remaining time for data transmission status.	
Automatic Retry	Automatically retries data transmission if issues occur, notifying the user of the retry process.	None

To identify and deal with latency issues, the system can take the following actions:

Logistics Tool

A. Mentality of designing

The main function of logistics tools is to track and manage warehouse inventory and transportation processes, so the presentation of key data is particularly important. The tracked data needs to be comprehensive and not redundant, the user interface should be simple, and its access should be controlled.

A. Detailed design

Data field

- CASSSC ID: unique identifier of the goods.
- Contents: The specific contents of the goods, such as medical supplies, food, scientific equipment, etc.
- Location: The specific location of the goods in the warehouse.
- Origin: the place of departure of the goods.
- Destination: The destination of the goods.
- Ownership: The owner of the cargo, such as NASA, ESA, SpaceX, etc.
- Special Handling: Special handling requirements of goods, such as temperature control, breakability, etc.
- Scheduled Ship Date: The scheduled ship date of the goods.
- Current Status: The current status of the goods (in transit, waiting for delivery, etc.)
- Assigned Personnel: The person who is responsible for the goods.
- Last Updated: The date when the data was last updated.

User interface

Use spreadsheet form, design intuitive, simple interface. The fields are presented as columns, with each item's information occupying one row. Add field names at the top of the spreadsheet for easy user input and viewing.

Logistics Tool

Data management
Provide filtering and sorting functions to facilitate users to quickly find information about specific goods. Periodically back up data to ensure data security.

Security and permission control
Set access to the spreadsheet to allow only authorized personnel to view and modify it. Use password protection and encryption to protect sensitive information.

Expandability
Reserve additional fields and functional interfaces at design time to facilitate the future addition of new data types and functional requirements.

Automation
Barcode/QR code scanning: Improve the efficiency of cargo entry and tracking by integrating barcode or QR code scanning capabilities.

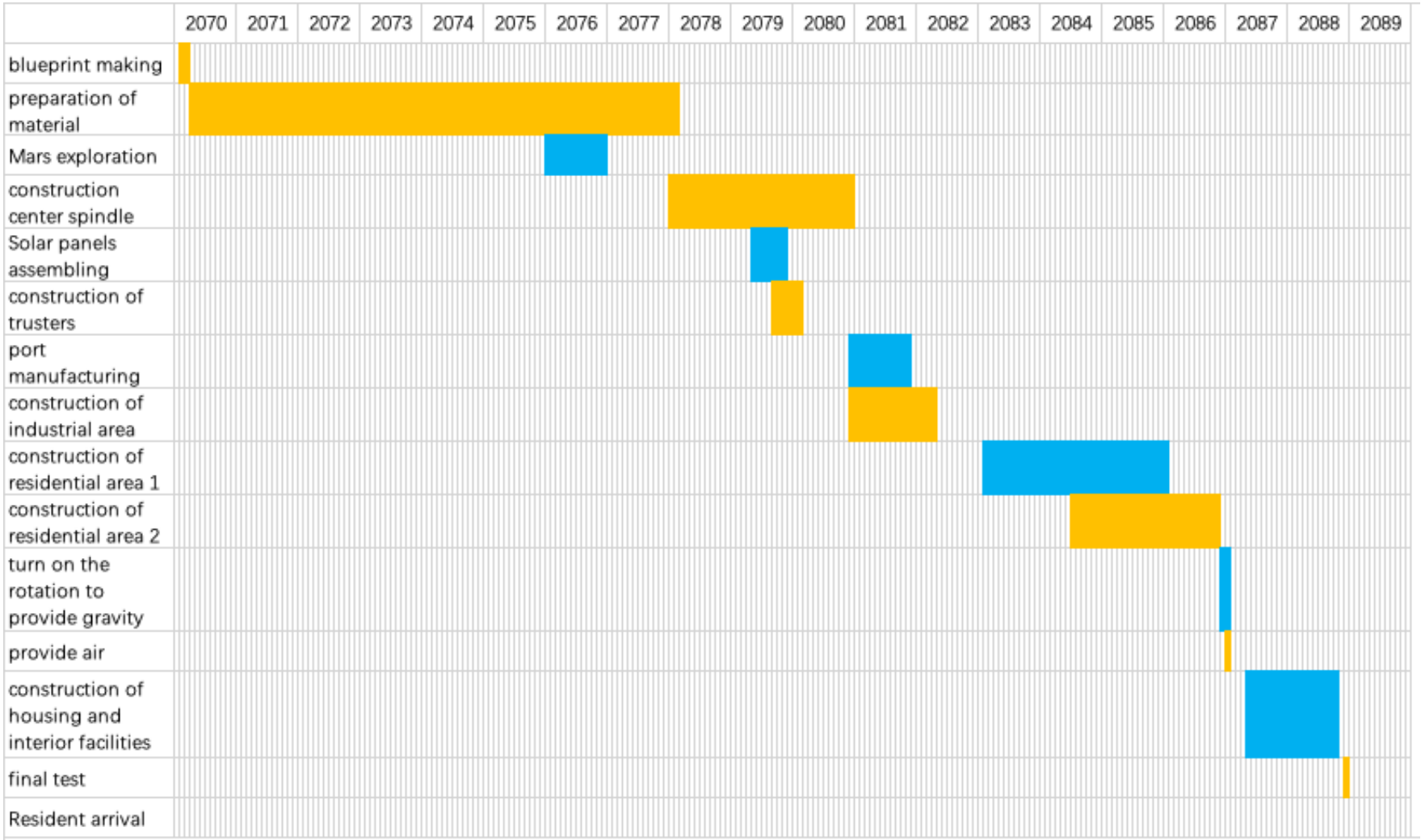
Notifications and Alerts
Notification system: Set up automatic notification function, when the status of the goods has changed or the shipment date is about to arrive, to send notifications to the relevant personnel.
Alarm system: Abnormal situations will send an alarm and prompt tone, such as abnormal temperature, lost goods or delayed transportation, etc., to take timely measures.

A. Example: Logistics form

Fig 5-5-1 *Logistics form [Wangzhiru, Procreate]*

Design and Construction Schedule

Fig 6-1-1 *Design and Construction schedule [Wangzhiru, Excel]*



Costs

6.2.1 Costs While Constructing Exterior Structures

Type	Cost per unit ($)	Quantity	Cost ($)
Grade 5 Titanium Alloy (Ti-6A1-4V)	150,000	231,538 ton	34,730,700,000
Aluminum Alloy 7075	62,000	33,051 ton	2,049,162,000
Aluminum Oxynitride (ALON)	150,000	96,693 ton	14,503,950,000
Nickel-based superalloy	400,000	1 ton	400,000
Construction machines	140,030	600	84,018,000
Cable	Provided by Subcontractors	N/A	Provided by Subcontractors
Solar cells	Provided by Subcontractors	4,887,000	Provided by Subcontractors

Total costs: $51,368,230,000

6.2.2 Costs While Constructing Interior Structures

Type	Cost per unit ($)	Number	Cost ($)
House Type 1	247,676	580	143,652,080
House Type 2	83,073	350	29,075,550
House Type 3	111,841	500	55,920,500
House Type 4	88,204	275	24,256,100
Hospital	20,000,000	6	120,000,000
Restaurant	750,000	18	13,500,000
Police Station	3,000,000	6	18,000,000
School	10,000,000	12	120,000,000
Shopping mall	10,000,000	6	60,000,000
Lab	10,000,000	12	120,000,000
Construction machines	14,003	500	7,001,500

Total Cost: $711,405,730

6.2.3 Costs After Construction

Table 6-2-3 *Cost of consumables per year [Bianjuncheng, Word]*

Type	Number of CASSSCs (per year)	Cost ($)
Meat	6	38,880,000
Eggs	2	3,240,000
Milk	18	16,200,000
Dry Plant Produce	20	41,040,000
Vegetables	22	44,550,000
Fruit	8	32,400,000
Water	1	2,890,490
Toothbrush	1	1,200,000
Cup	1	510,000
Towel	1	1,500,000
Bath Cream	1	3,600,000
Pillow	2	2,550,000
Toilet Paper	10	15,000,000
Computer	1	18,000,000
Pen	1	1,800,000
Book	1	27,000,000
Clothing	4	75,000,000
Detergent	5	18,000,000

Total Cost: $343,360,490

Table 6-2-4 *Cost of vehicles [Heziruo, Word]*

Type	Number	Cost ($)
Crawler	600	925,650
Bicycle	2800	322,800
Public Transport	84	646,620

Total Cost: $1,895,070

Table 6-2-5 *Cost of atmospheric control [Heziruo, Word]*

Type	Quantity	Cost ($)
Oxygen	60,171,429L	18,051
Nitrogen	16,200,000L	1,620
Carbon Dioxide	77,143L	38

Total cost: $19,710

Table 6-2-6 *Cost of maintenance [Heziruo, Word]*

Type	Quantity	Cost per unit ($)	Cost ($)
Robot Cleaner (interior)	10,000	10,000	100,000,000
Robot Cleaner (exterior)	500	20,000	10,000,000
Robot Detector (exterior)	100	15,000	1,500,000
Robot Detector (interior)	8,000	12,000	96,000,000
Fire-Fighting Robot	600	50,000	30,000,000
Maintenance Robot	800	25,000	20,000,000
Emergency Robot	200	40,000	8,000,000

Total cost: $265,500,000

6.2.3 Costs After Construction

Table 6-2-7 *Cost of staff [Heziruo, Word]*

Type	Number	Cost per person per year ($)	Cost ($)
MarsPort Personnel	50	50,000	2,500,000
Scientific research Personnel	100	70,000	7,000,000
Construction Personnel	100	60,000	6,000,000
Maintenance Personnel	20	55,000	1,100,000

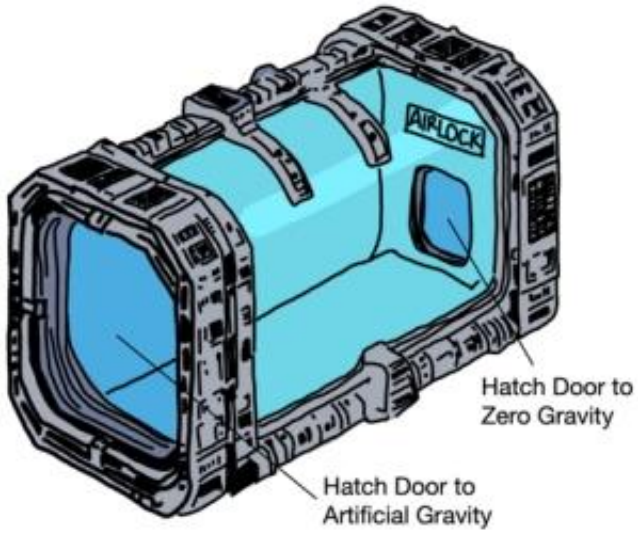
Total cost: $16,600,000

6.2.4 Subcontractors' Contract

Table 6-2-3 *Subcontractors [Bianjuncheng, Word]*

Type	Subcontractors
Cable	ZAP! Industries
Solar cells	ZAP! Industries
Machines	3D Logistics, Bottom Cleaners, Dirtbuilders, Fusion Founders, Nano Solutions, Wheels of Fortune, ZAP! Industries.

7.1.1 Gravity Transition



On Aresam, the primary method for passenger gravity transition is through airlocks. Three sets of airlocks are distributed along the walls of the Stanford Torus, as shown in Figure 2-1-15. The internal structure of each airlock is shown in Figure 7-1-1. The airlock system includes hatch doors that connect to both gravity environments, also, a pressure control panel to regulate air pressure, gravity transition controls to ensure a smooth adaptation for passengers, and safety handrails to maintain stability during the transition.

Fig 7-1-1 *Airlock [Heziruo, Krita]*

7.1.2 Hotels

Our hotel lobby and the public area at the entrance of the apartment is equipped with a reception, catering area, rest area, luggage depository, and bus waiting area. These amenities are provided to offer weary travelers convenient access to food, transportation, and luggage storage services.

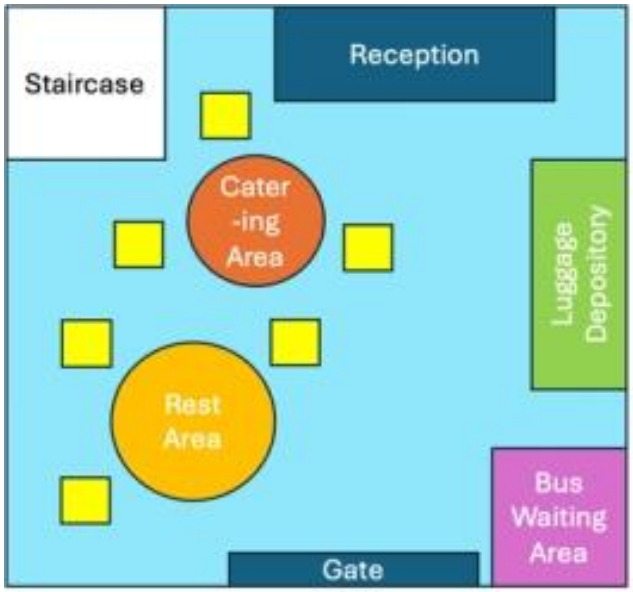


Fig 7-1-2 Hotel lobby [Heziruo, ppt]

7.1.3 Recreational Activities

Table 7-1-1 *recreational activities [Lijianyang, ppt]*

Sports and Fitness	Cultural and Artistic facilities	Entertainment and Leisure Facilities	Social and Community Activities	Health and Welfare Facilities
Fitness Center: • Gym: Treadmills, strength training equipment, stationary bikes, etc. • Fitness Classes: Yoga, Pilates, aerobics, Tai Chi, etc. • Personal Training: Professional personal trainer services. Sports Arenas: • Sports Ground: For team and individual sports like football, basketball, tennis, etc. • Swimming Pool: Featuring a zero-gravity swimming experience. • Ice rink: For indoor winter sports. Outdoor Simulation Area: • Artificial Lawns and Trails: For walking, running, cycling, etc. • Climbing Wall: Simulating outdoor rock-climbing experiences.	Library and Reading Room: • Well-stocked Library: Offering various books, magazines, and newspapers. • Quiet Reading Rooms: Suitable for personal quiet reading and research. Art Center: • Art Gallery: Displaying works by residents and artists. • Craft Studio: Providing space for painting, pottery, sculpture, and other artistic creations. Music and Theater Facilities: • Theater and Live house: Hosting concerts, theatrical performances, and live performance art. • Recording and Practice Rooms: For music enthusiasts.	Cinema: 3D and IMAX Theaters: Screening the latest movies and classic films. Gaming Center: • Video Game Room: Providing the latest video games and virtual reality experiences. • Virtual Reality Room: Allowing residents to experience whatever they want in the virtual world. Shopping and Dining Area: • Shopping mall: Offering various brands and stores to meet residents' shopping needs. • Restaurants and Cafés: Providing a variety of food options, from fast food to fine dining.	Activity Rooms and Multi-Purpose Halls: For hosting community events, parties, and gatherings. Social Clubs: For different interest groups and club activities. Gardens and Parks: Offering natural environments for residents to relax and walk. Children's Play Area: Safe indoor and outdoor play facilities.	Health and Beauty Center: • Spa and Massage Center: Offering various relaxation and care services. • Beauty Salon and Hairdressing: Providing beauty and hairdressing services. Mental Health Center: • Counseling and Therapy Rooms: Providing psychological counseling and therapy services. • Relaxation and Meditation Rooms: Helping residents relax and meditate.

Cargo Facilities

The different types of interfaces at MarsPort and HighPort are introduced in section 2.4, with a focus on conventional interfaces coordinated with robotic arms. The storage locations for goods in warehouses and on decks are mentioned in sections 3.4 and 3.5. The movement of casssc is primarily achieved through the use of robotic arms in conjunction with tracks. The overall automated maintenance of Aresam is detailed in section 5.2.1.