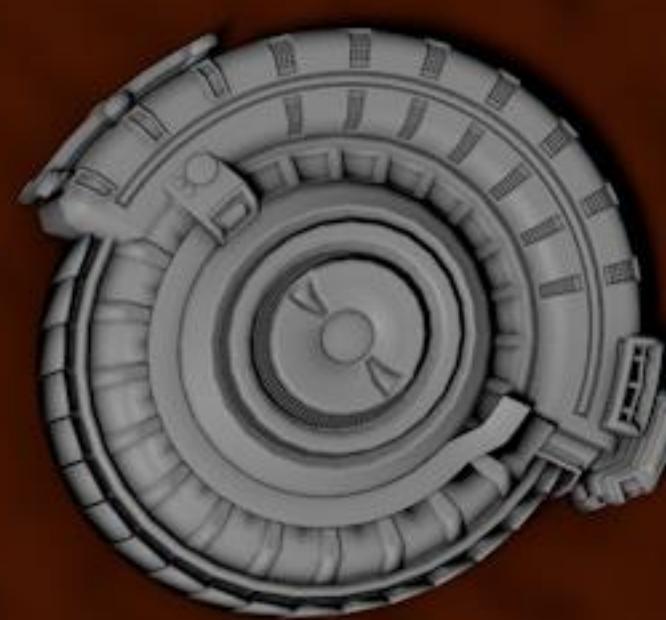
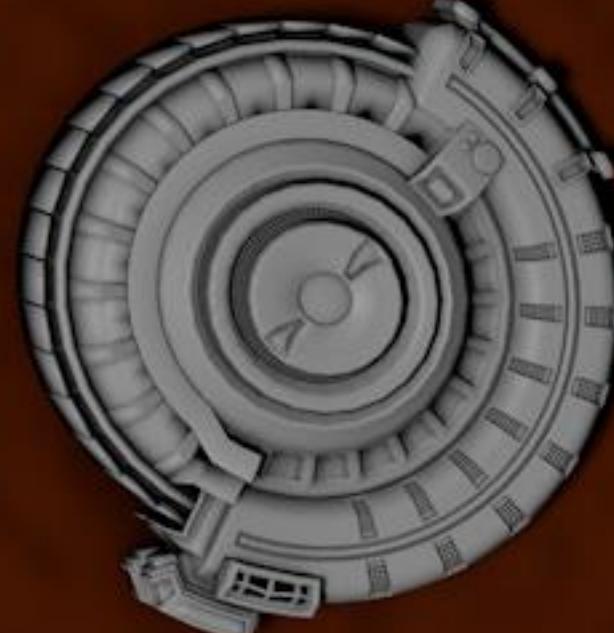
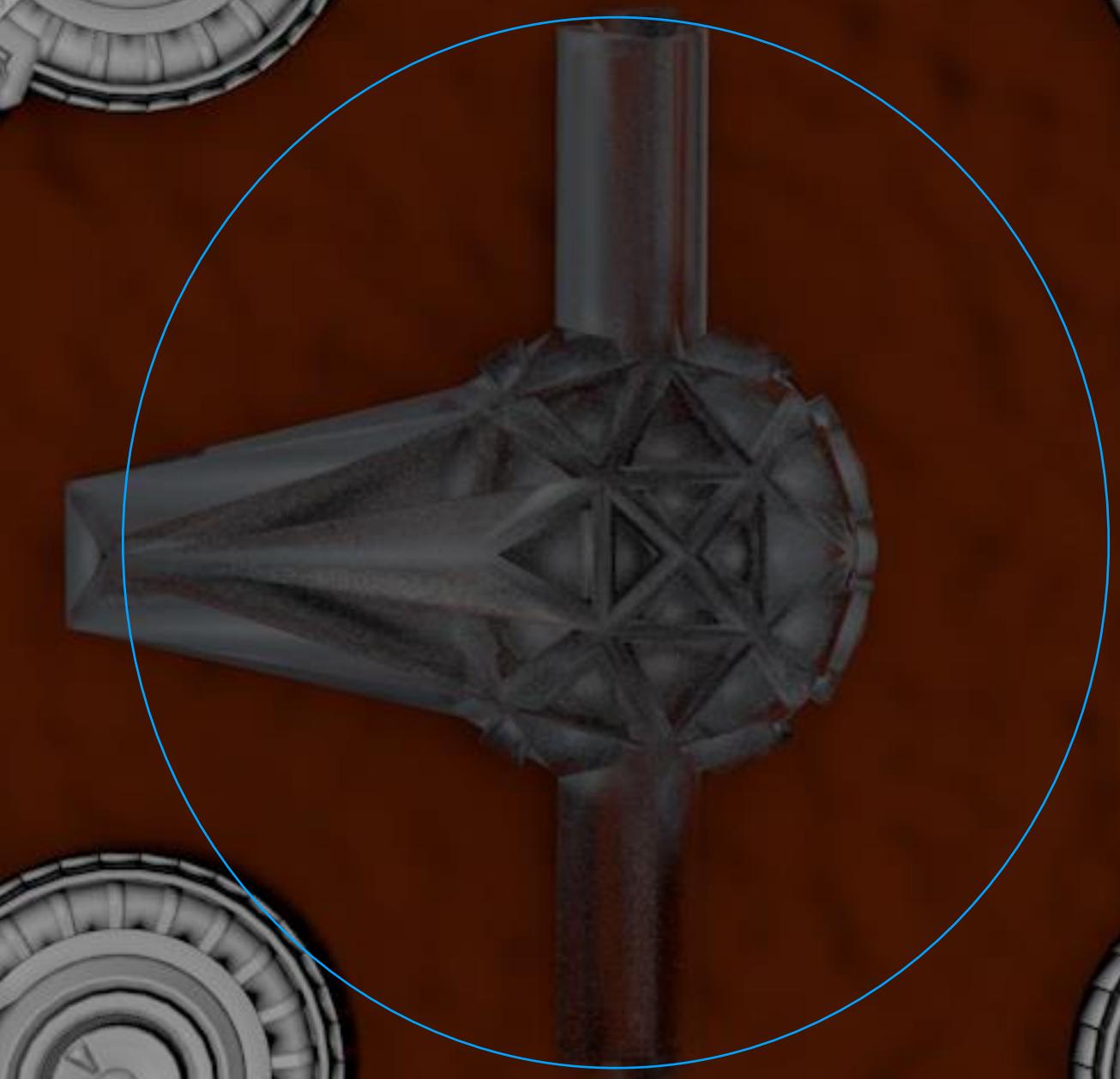
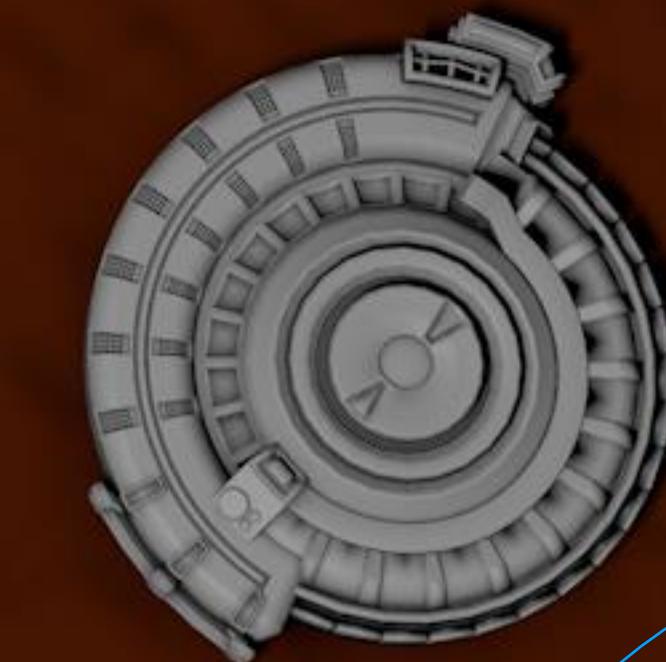
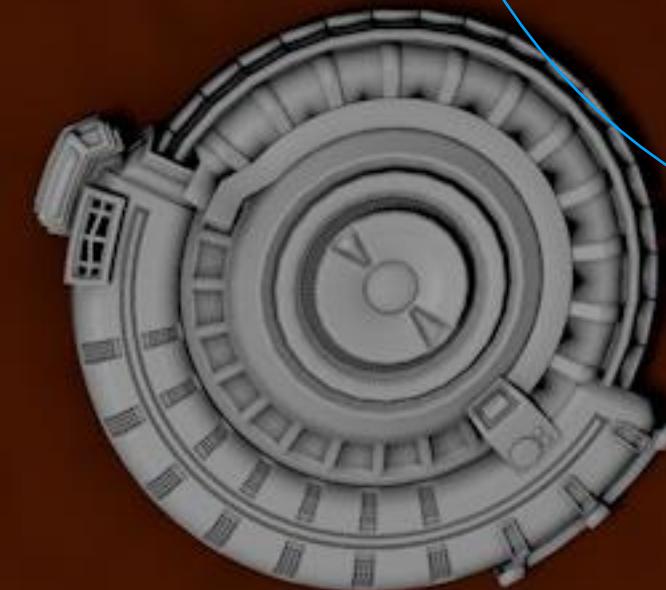
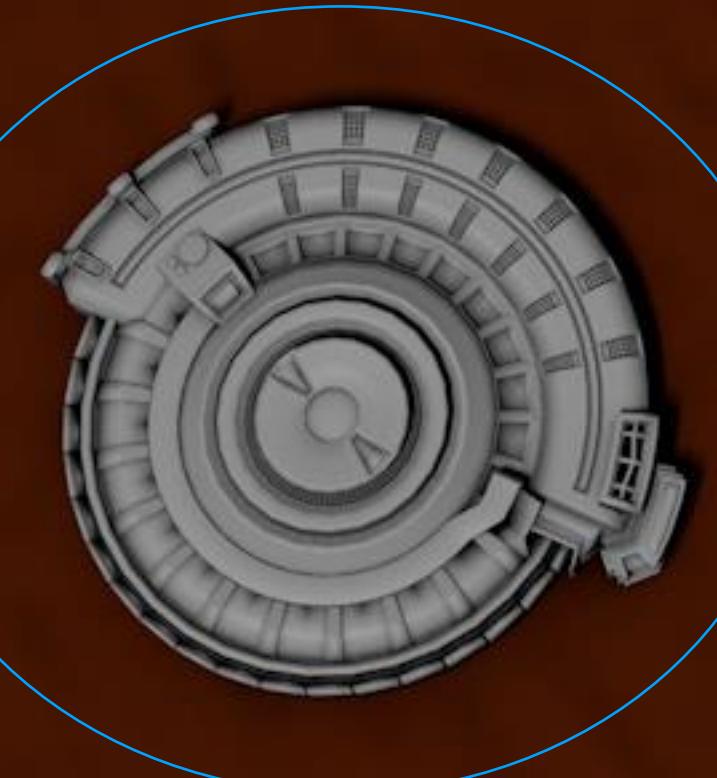
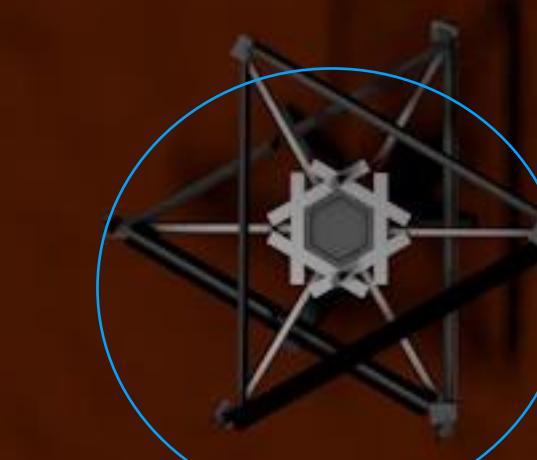
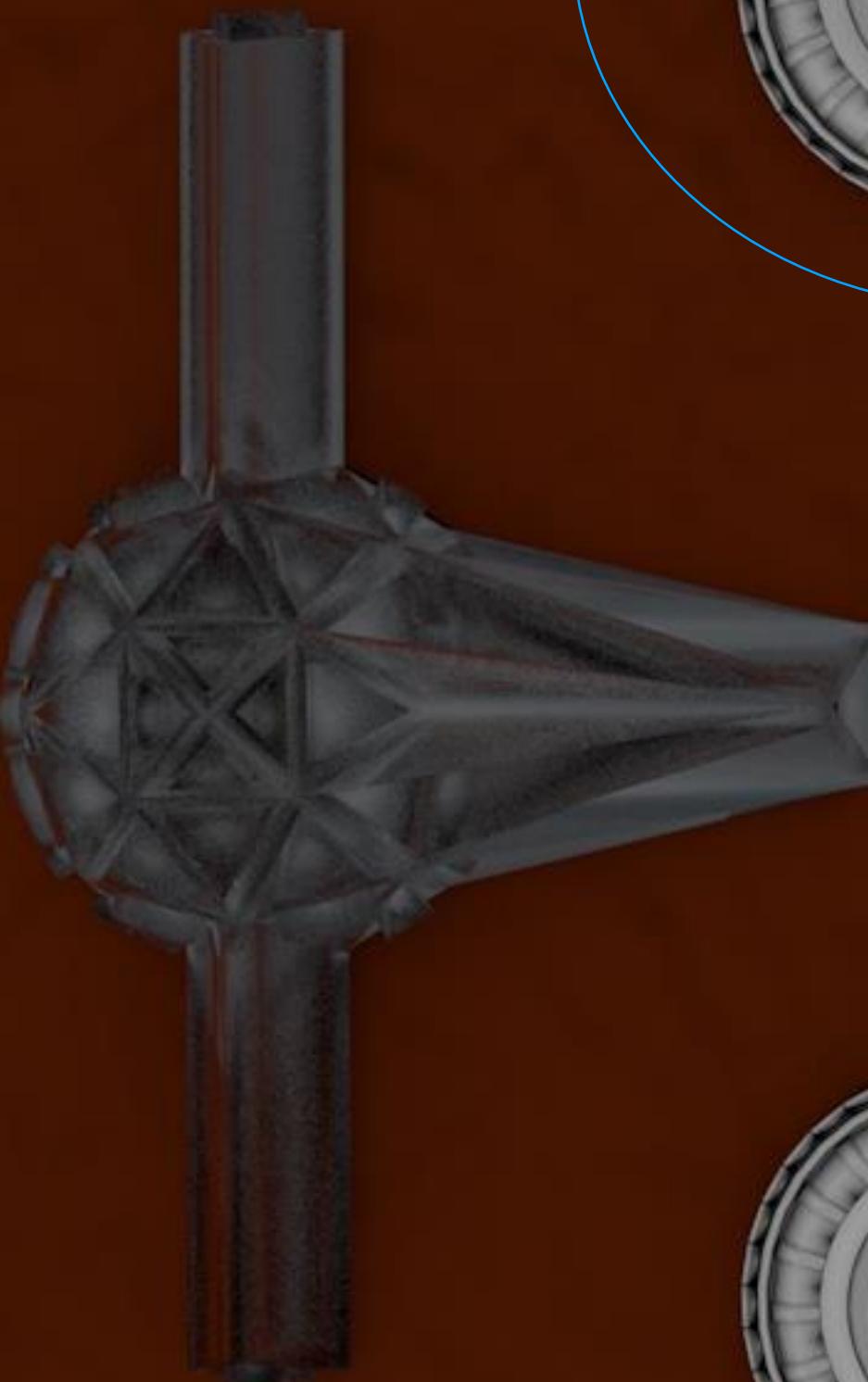
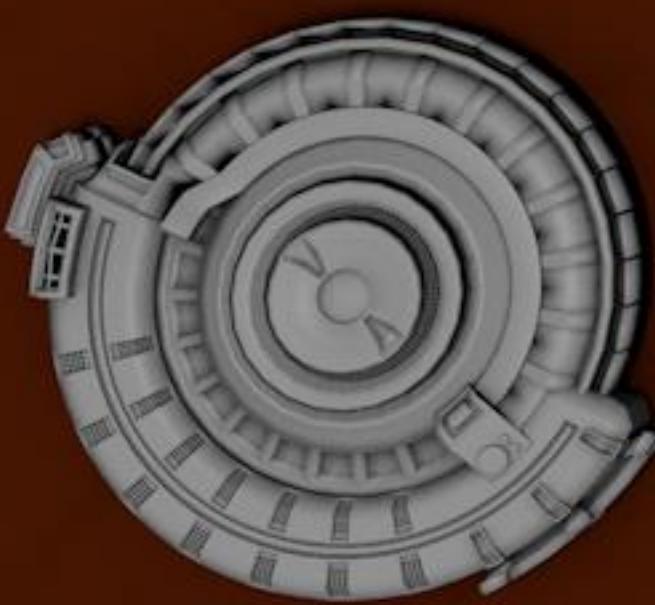
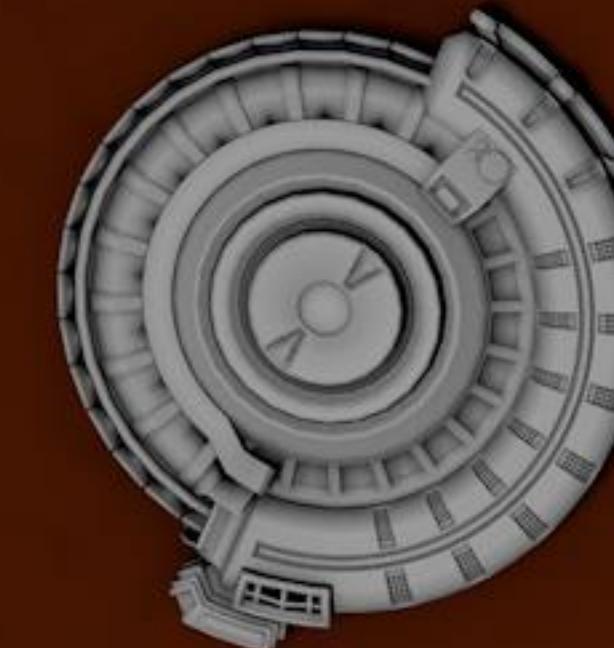


ROCKDONNELL  
Holmes.om

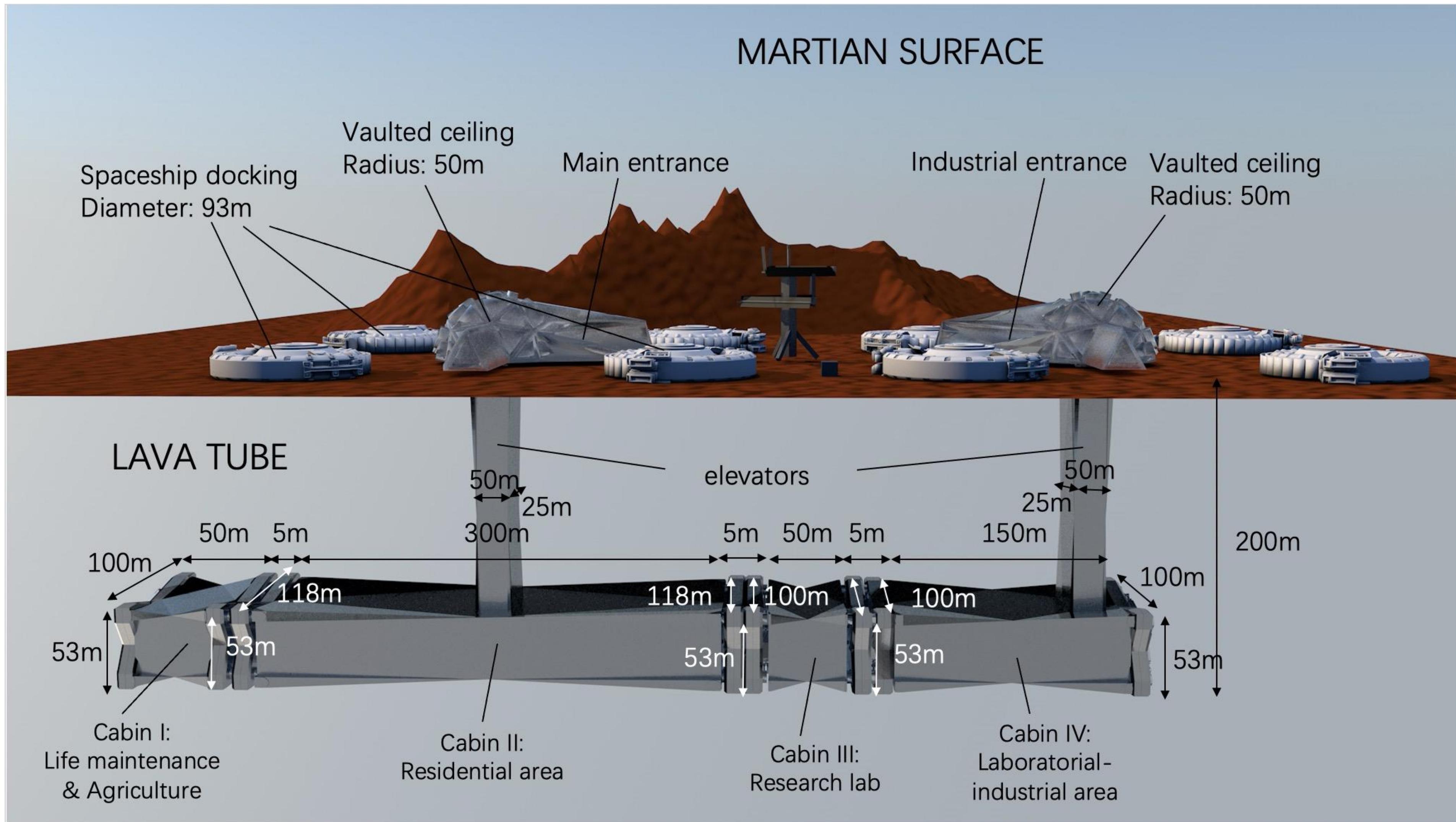
BNDS Space Design class of 2023

# 1 EXECUTIVE SUMMARY

# 2 STRUCTURAL DESIGN

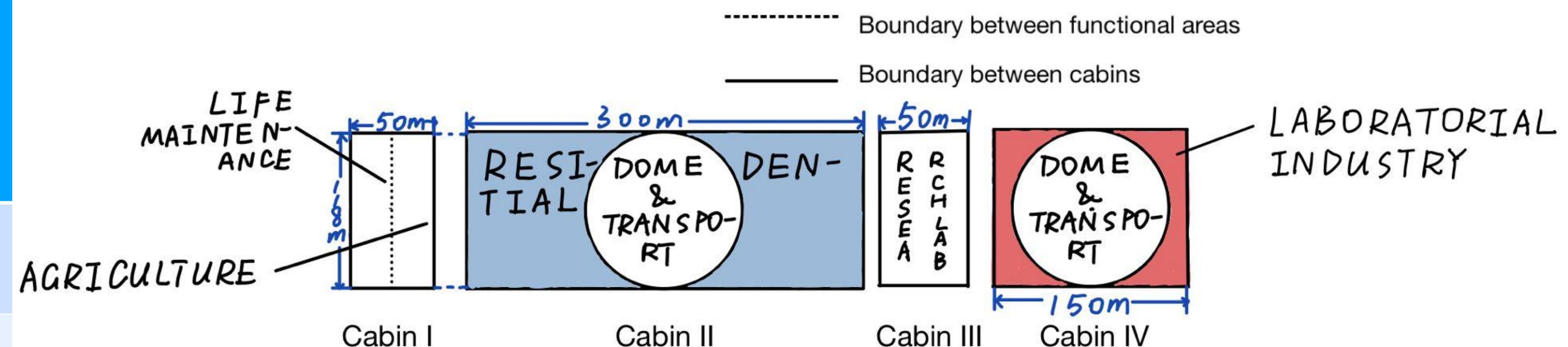


## 2.2 Interior Arrangements



## 2.2 Interior Arrangement: Overall

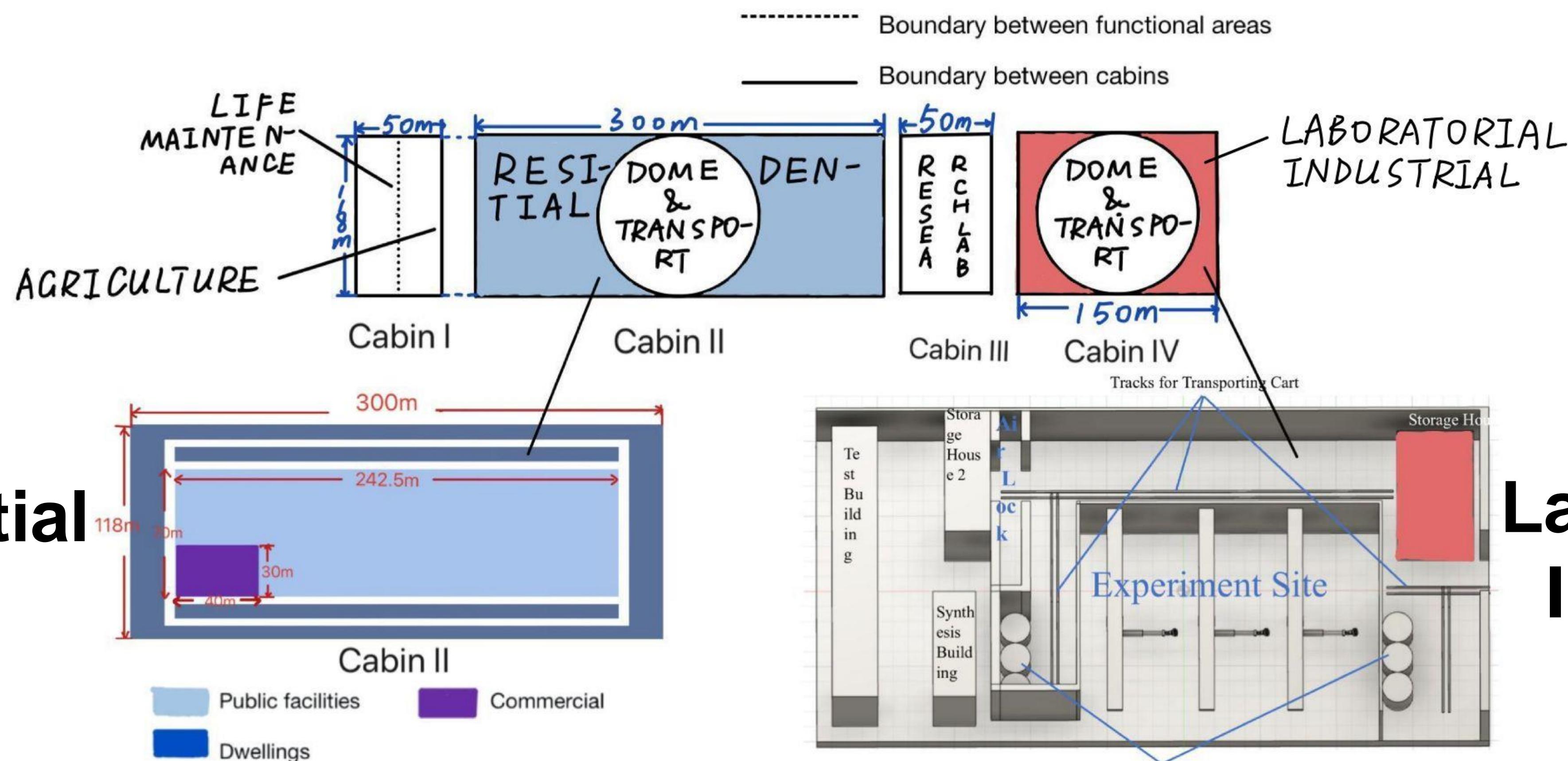
Functional Areas	Surface Area( $m^2$ )	Volume( $m^3$ )
Agricultural Area	$2.95 \times 10^3$	$1.475 \times 10^5$
Life Maintenance	$2.95 \times 10^3$	$1.475 \times 10^5$
Residential Area	$3.54 \times 10^4$	$1.475 \times 10^6$
Research Lab	$3.54 \times 10^3$	$1.475 \times 10^5$
Industrial Area	$7.08 \times 10^4$	$3.54 \times 10^6$



- Life maintenance& agriculture→The same cabin
- Residential& Industrial areas below the transportation system→convenience
- Research lab between residential area and industrial area—ensure safety
- Residential Area(Cabin II): dwellings, commercial, public facilities
- Industry Area(Cabin IV&V): manufacture& warehouses

## 2.2 Interior Arrangement: Overall & specified

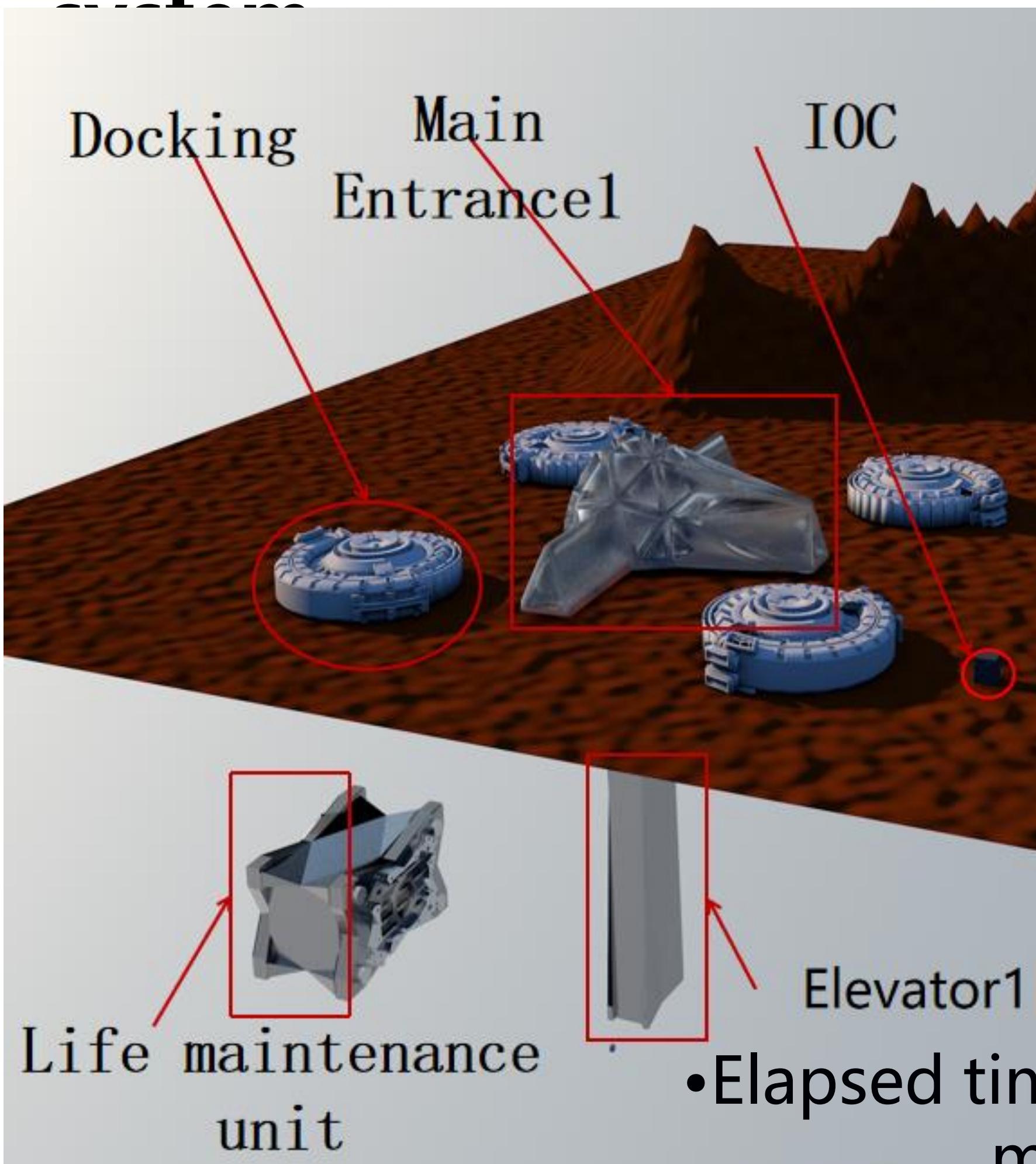
### Residential Area



### Laboratorial Industrial Area

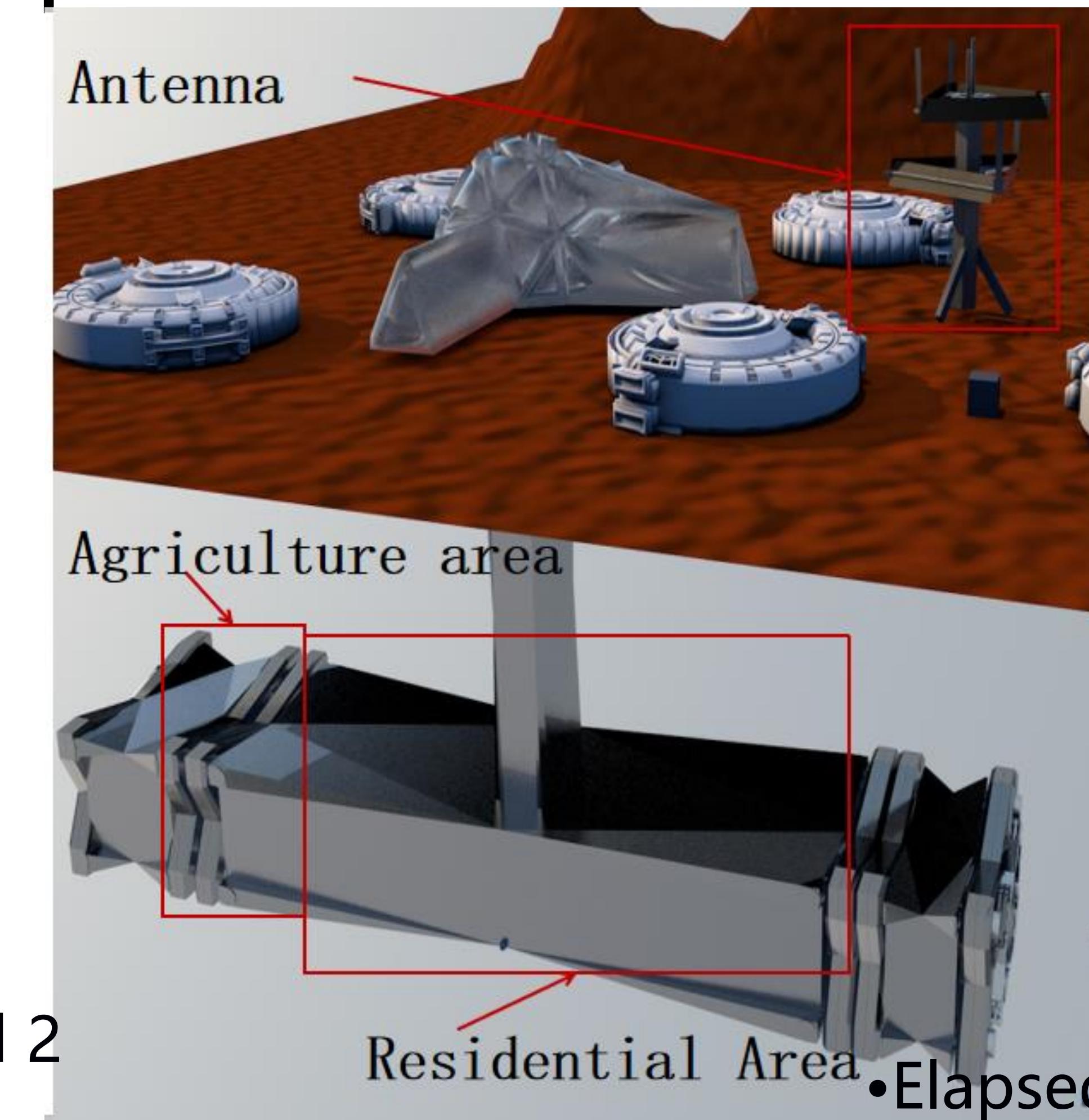
## 2.3 Phase 1

**Main focus: construct a fully-functional life maintenance system**



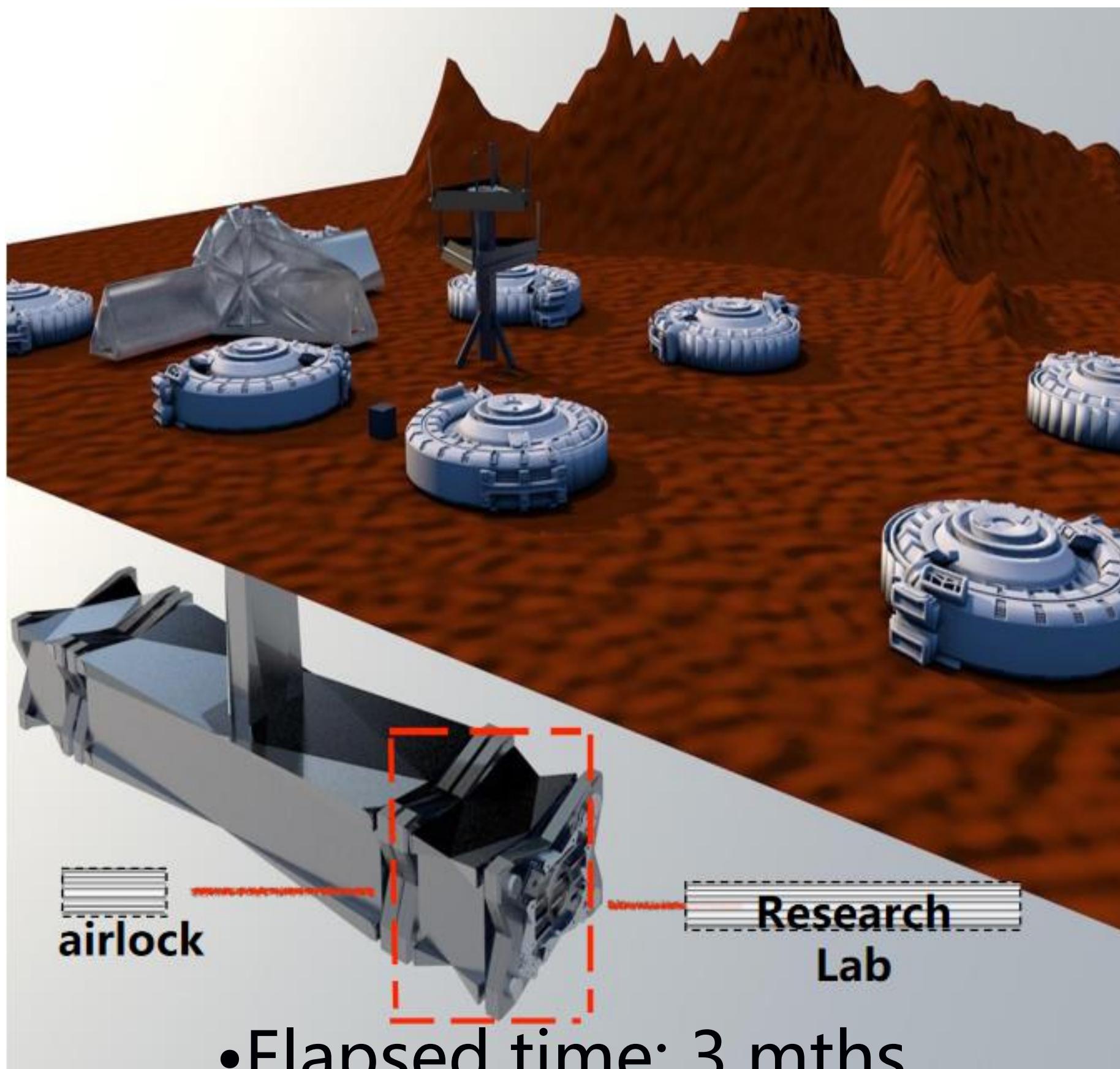
## Phase 2

**Main focus: Accommodation for permanent residents.**



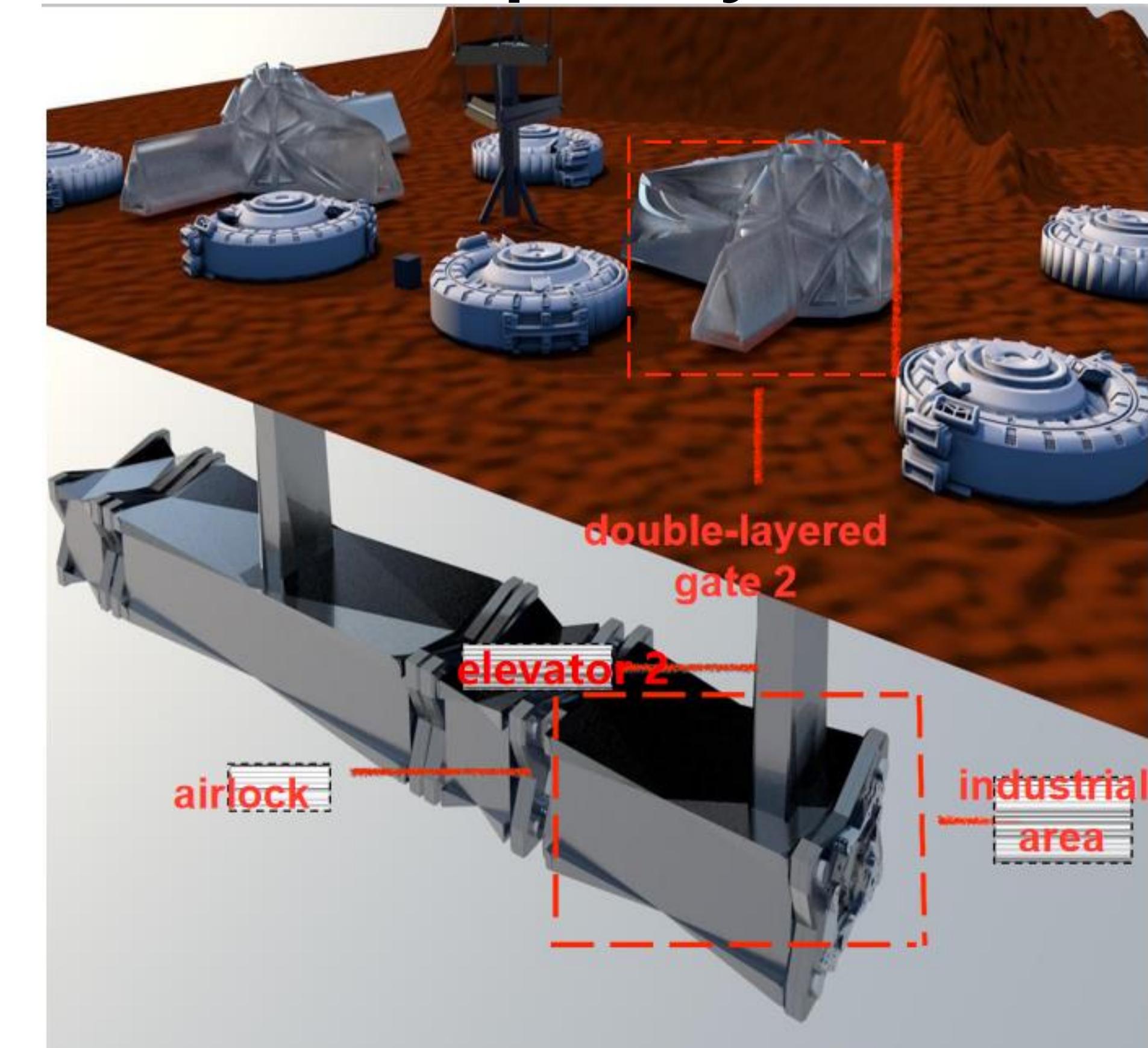
# Phase 3

**Main focus: professional scientific research laboratory**

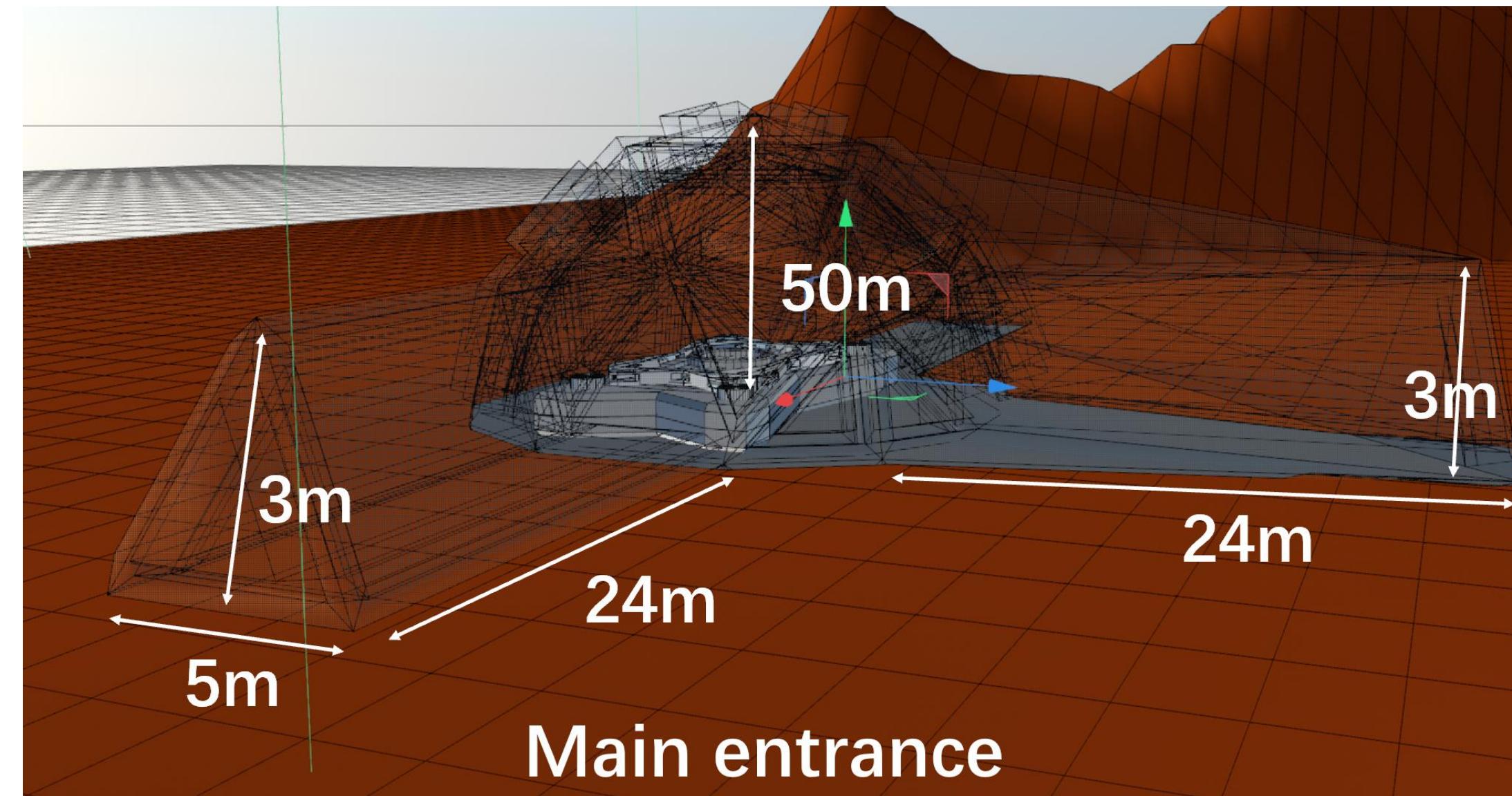
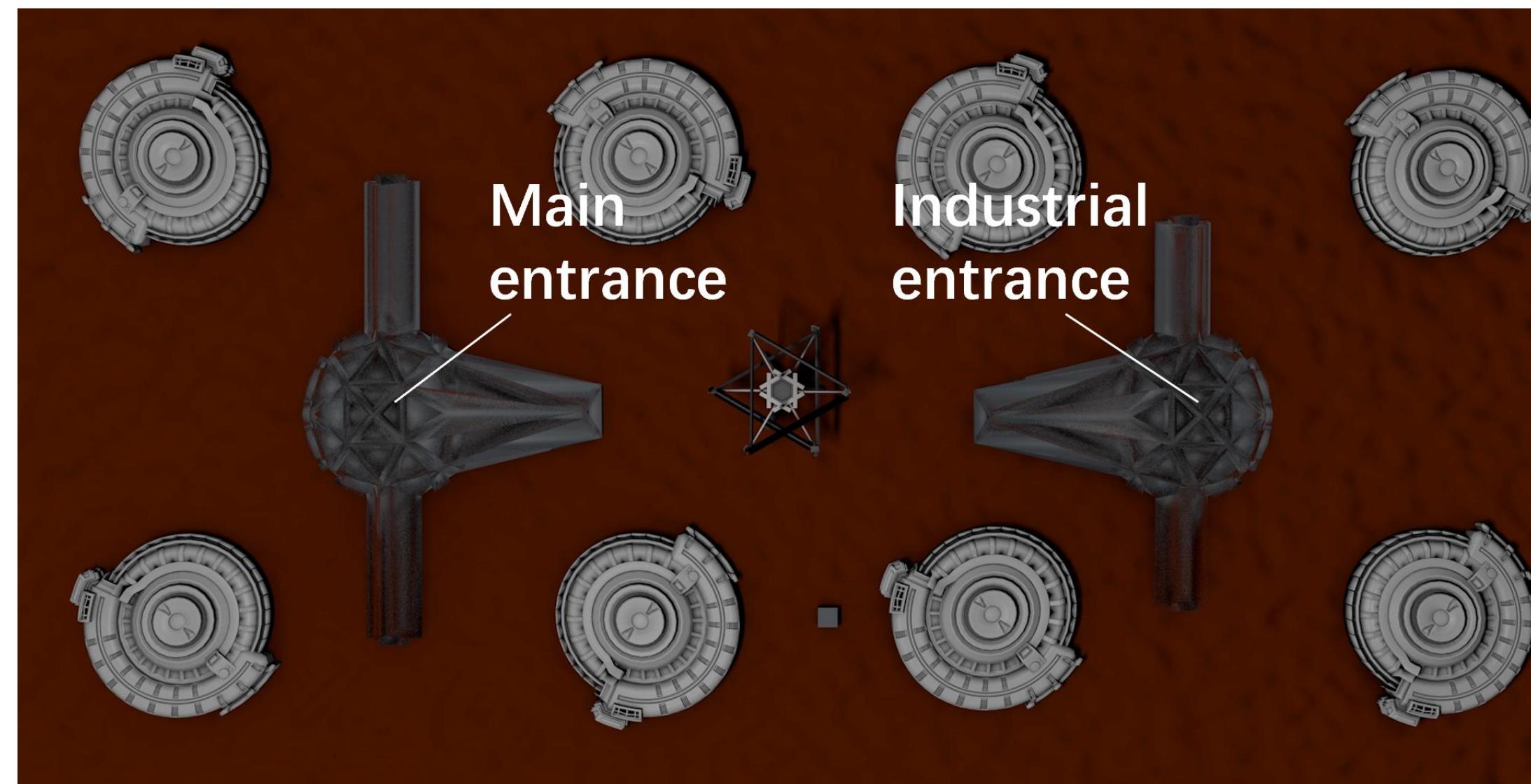


# Phase 4

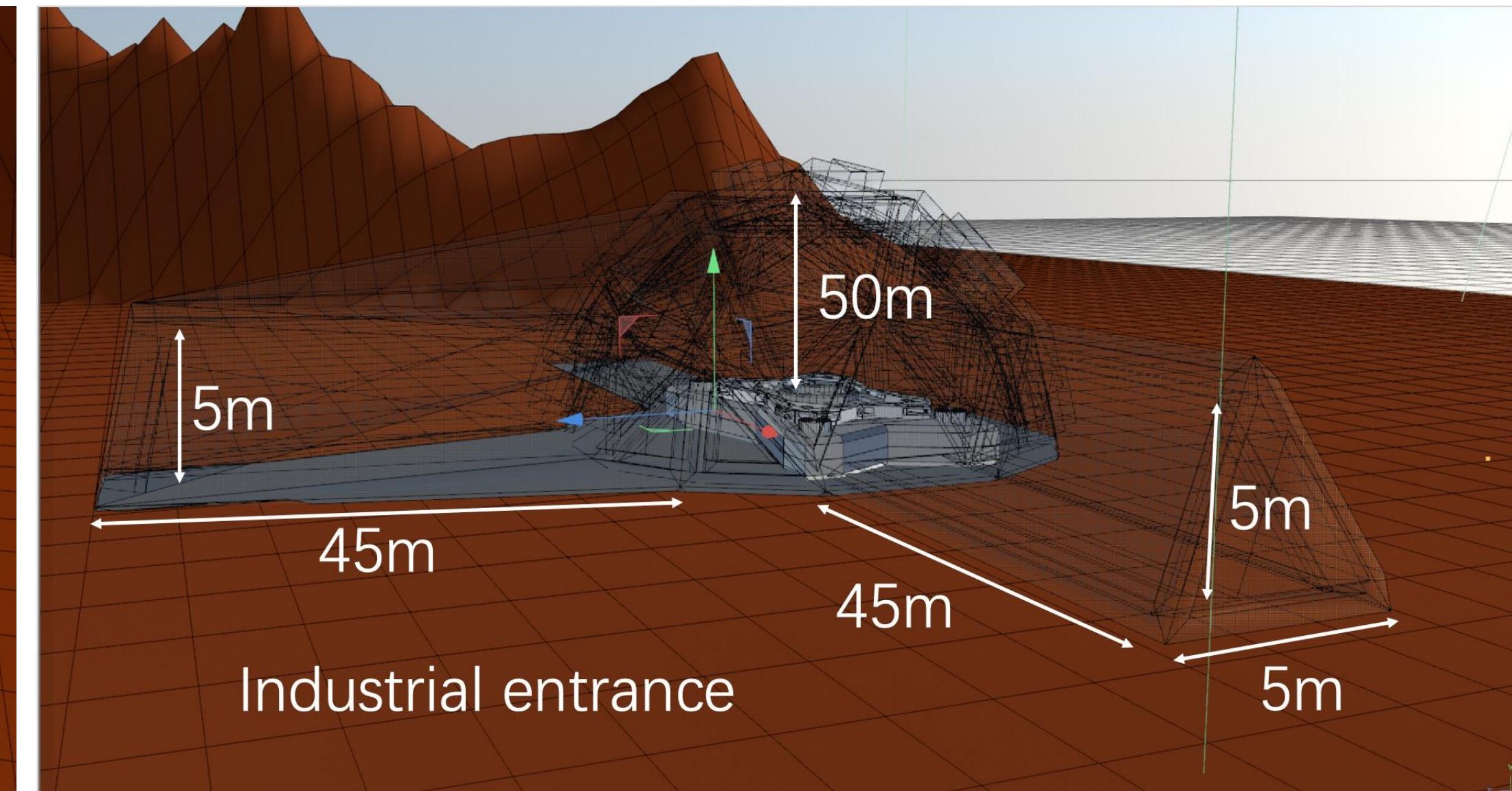
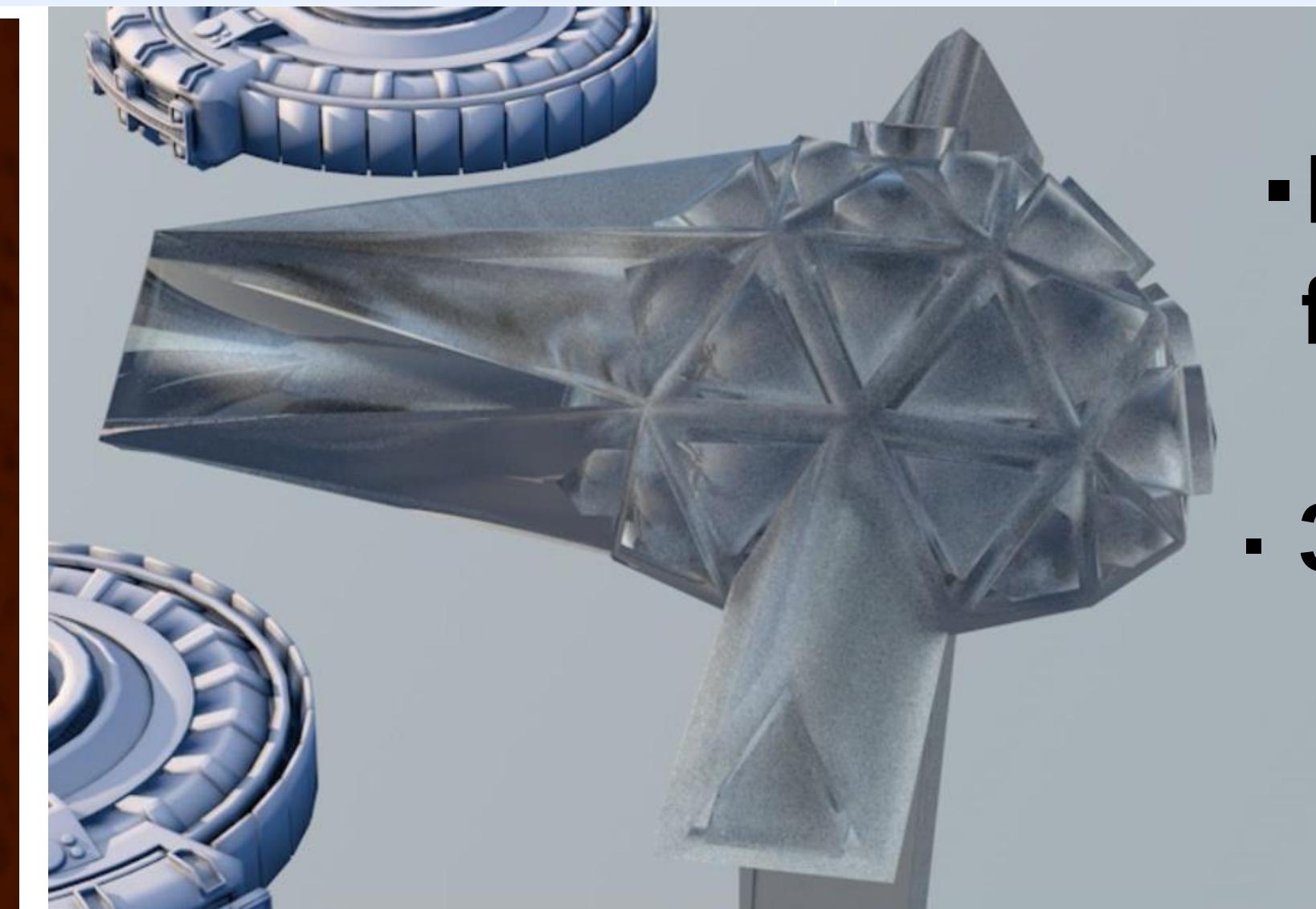
**Main focus: Refine industrial capability.**



# 2.4 Entrance & Exit



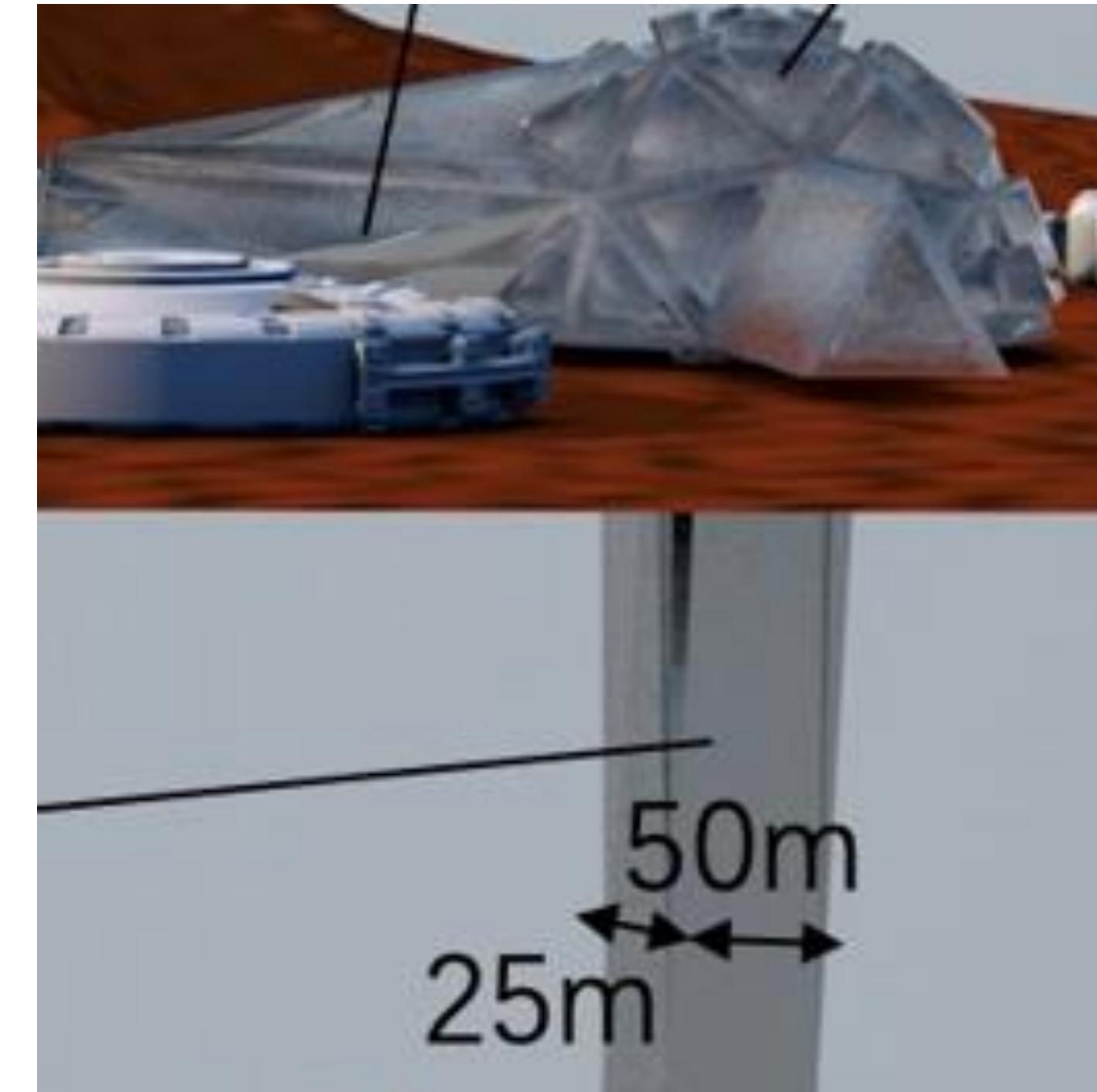
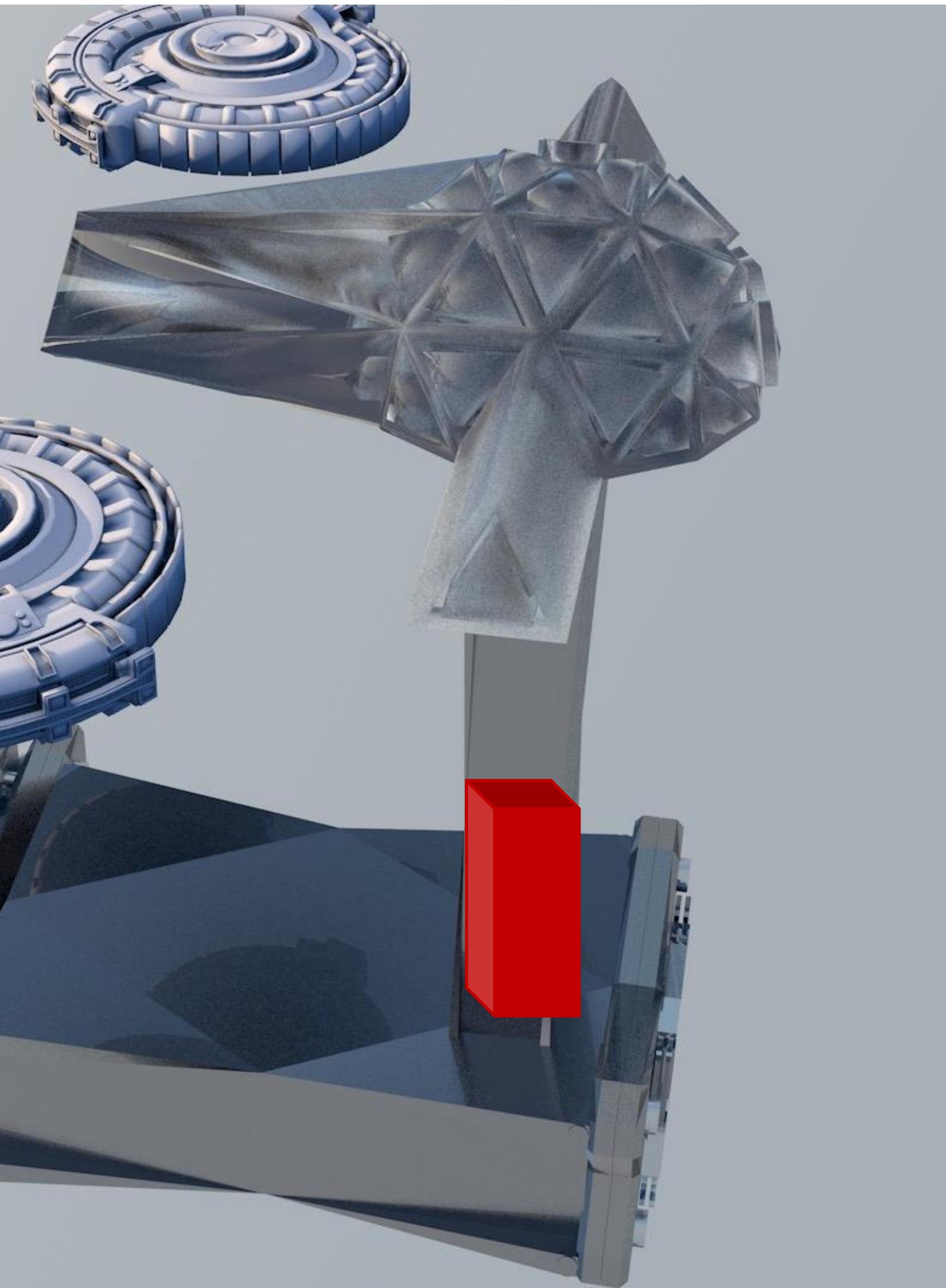
Entrance/ Exit	Function
Main Entrance( above II)	Transport residents/tourists and small vehicle
Industrial Entrance(above IV)	Transport CASSSCs containing materials to be processed



- Each is extended from the vaulted ceiling
- 3 gates / entrance

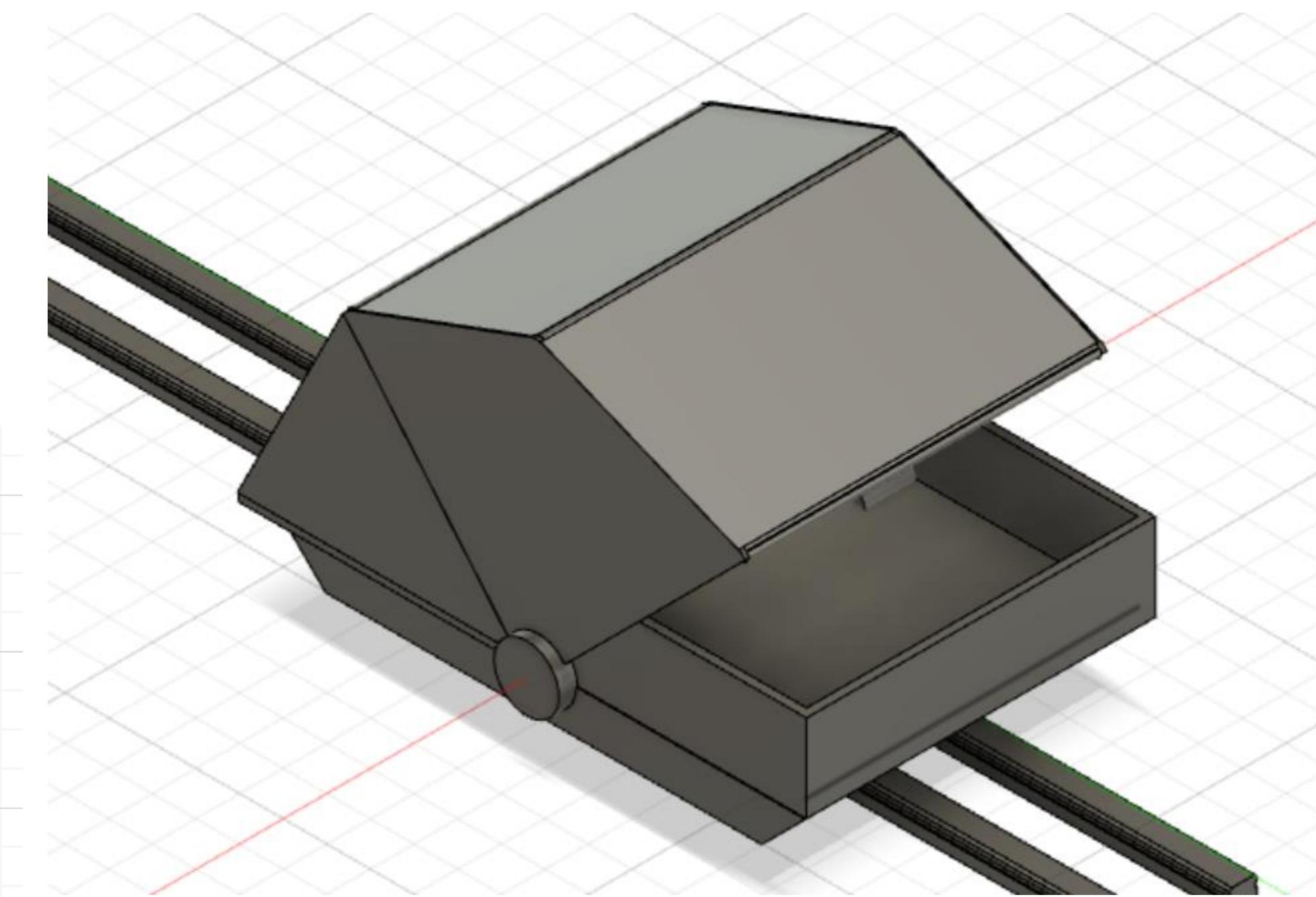
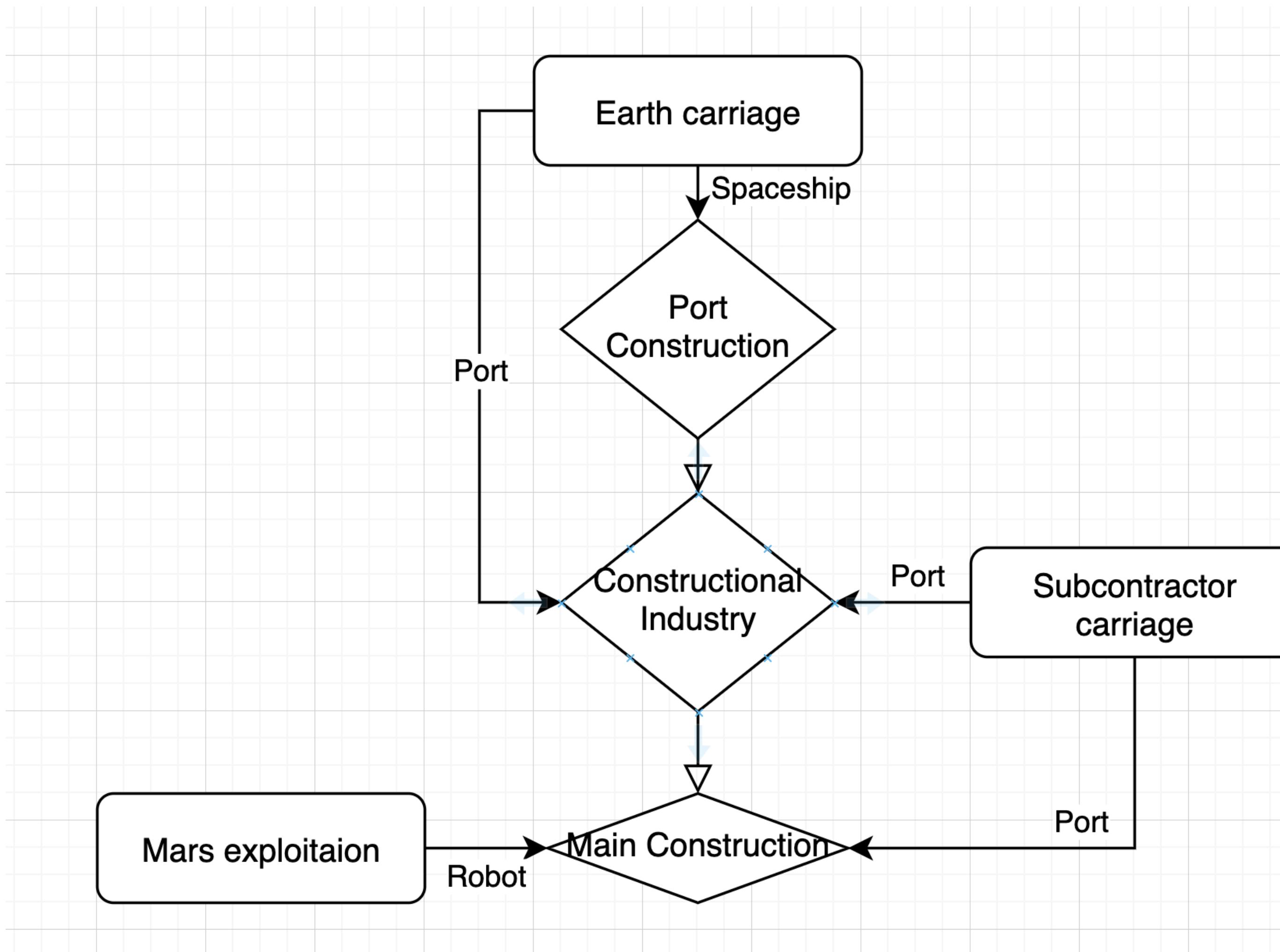
## 2.4 Entrance& Exit: Transportation

- Elevators are assigned in pillars below
  - One elevator in one pillar only
  - The elevator travels up/ down→transports people/cargos out/in



# 3 OPERATIONS AND INFRASTRUCTURE

# 3.1 material



**Bulky Breakthrough:** radiation protective, thermal insulative and atmosphere retaining windows  
**Hard Roll:** refine metal from ores  
**Large print:** build industry equipments

# 3.1 material

535 CASSSC

2219Al	Ti-Al alloy	Bare cooper wire	Aluminu m zinc plated steel plate	Color steel composite panels	glass
370000m <sup>3</sup>	370000m <sup>3</sup>	0.08m <sup>3</sup>	450m <sup>3</sup>	7000m <sup>3</sup>	
Mars, Hard Roll	Earth & Mars, Hard Roll	Earth	Earth & Mars, Hard Roll	Earth	Bucky Breakthroughs

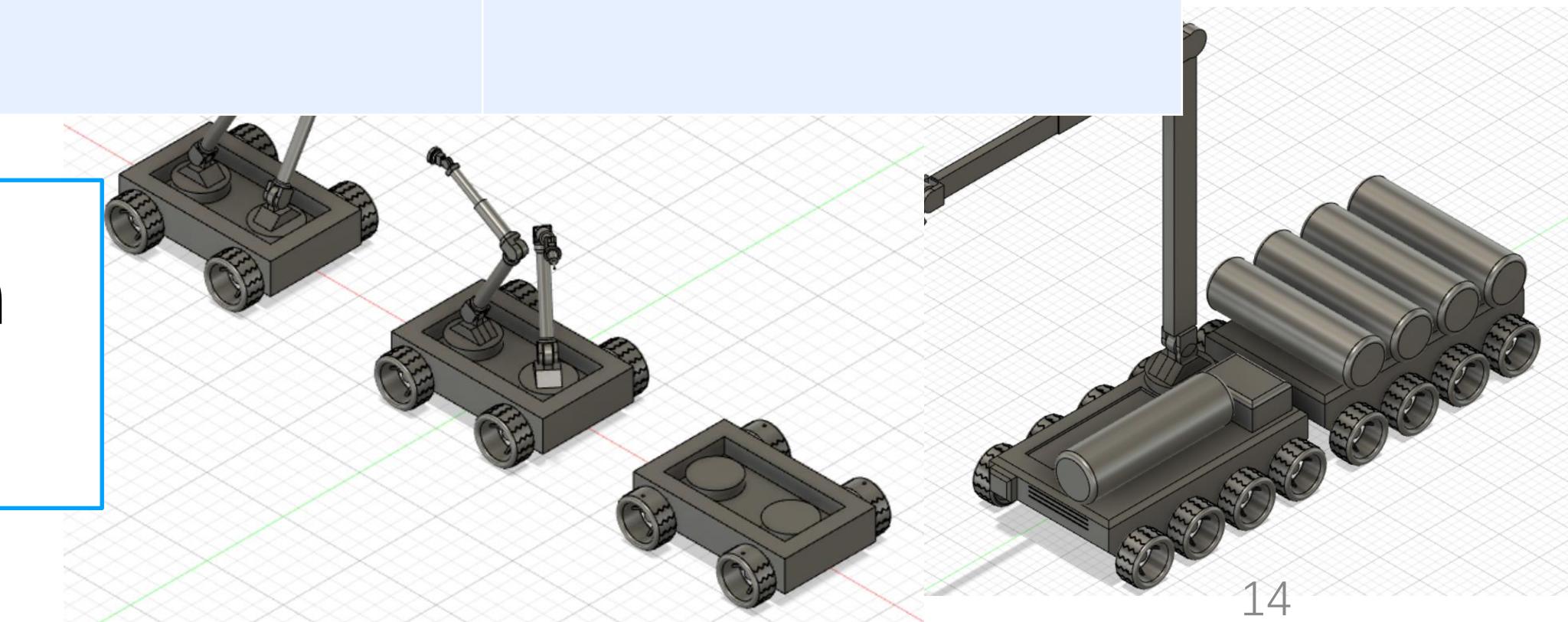
CASSSC

200 houses

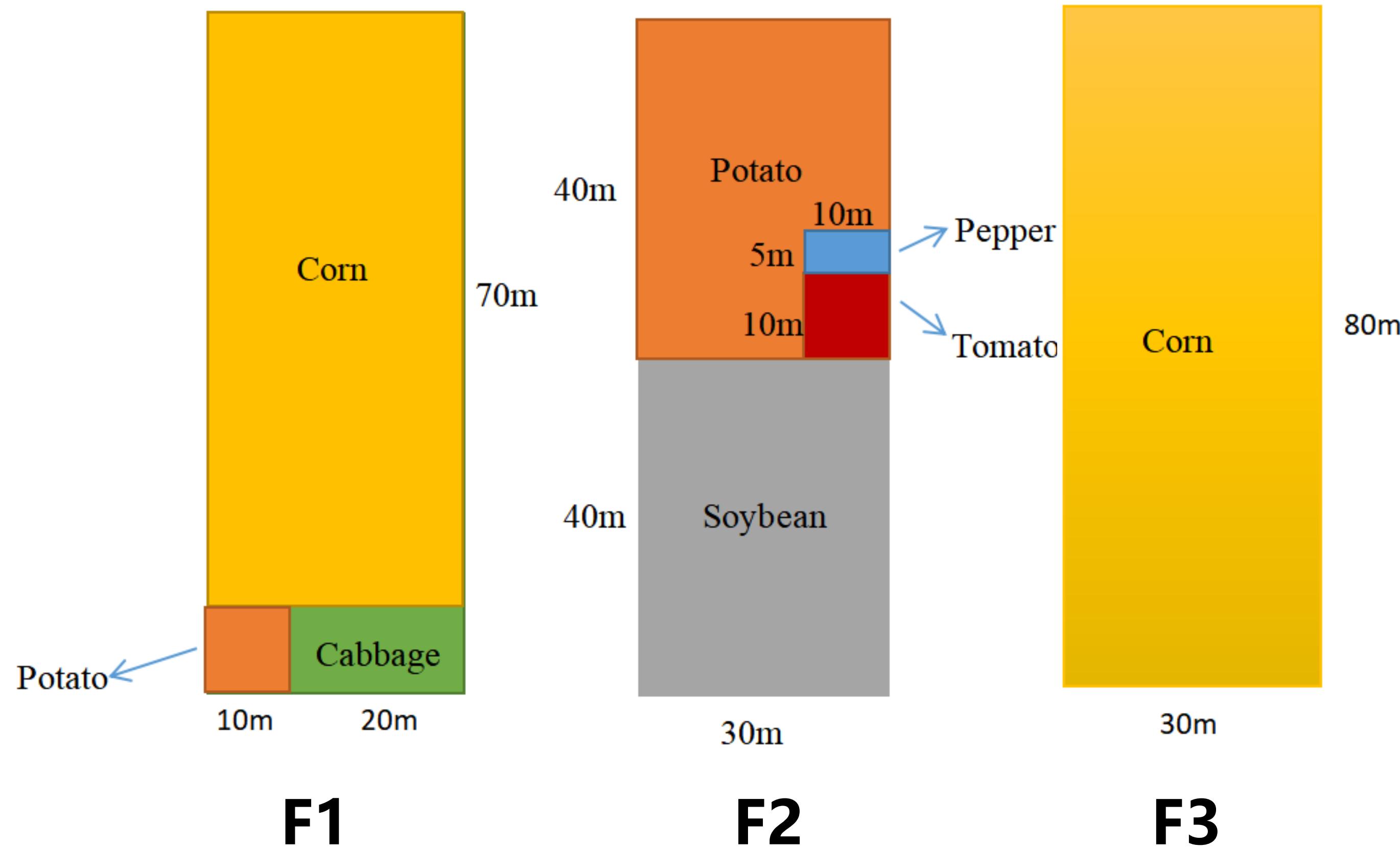
245 houses in total

Other material

45 houses



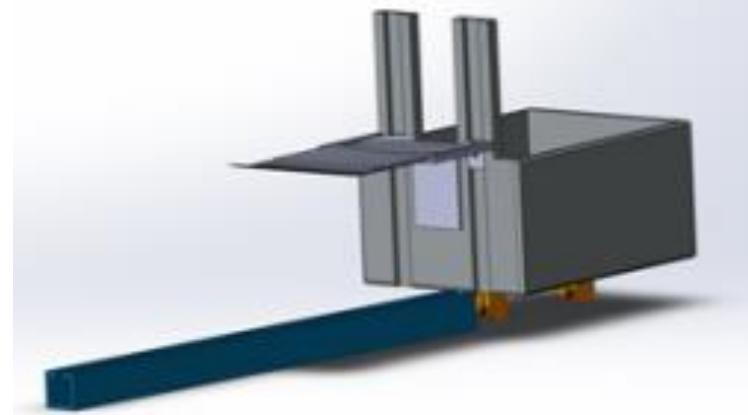
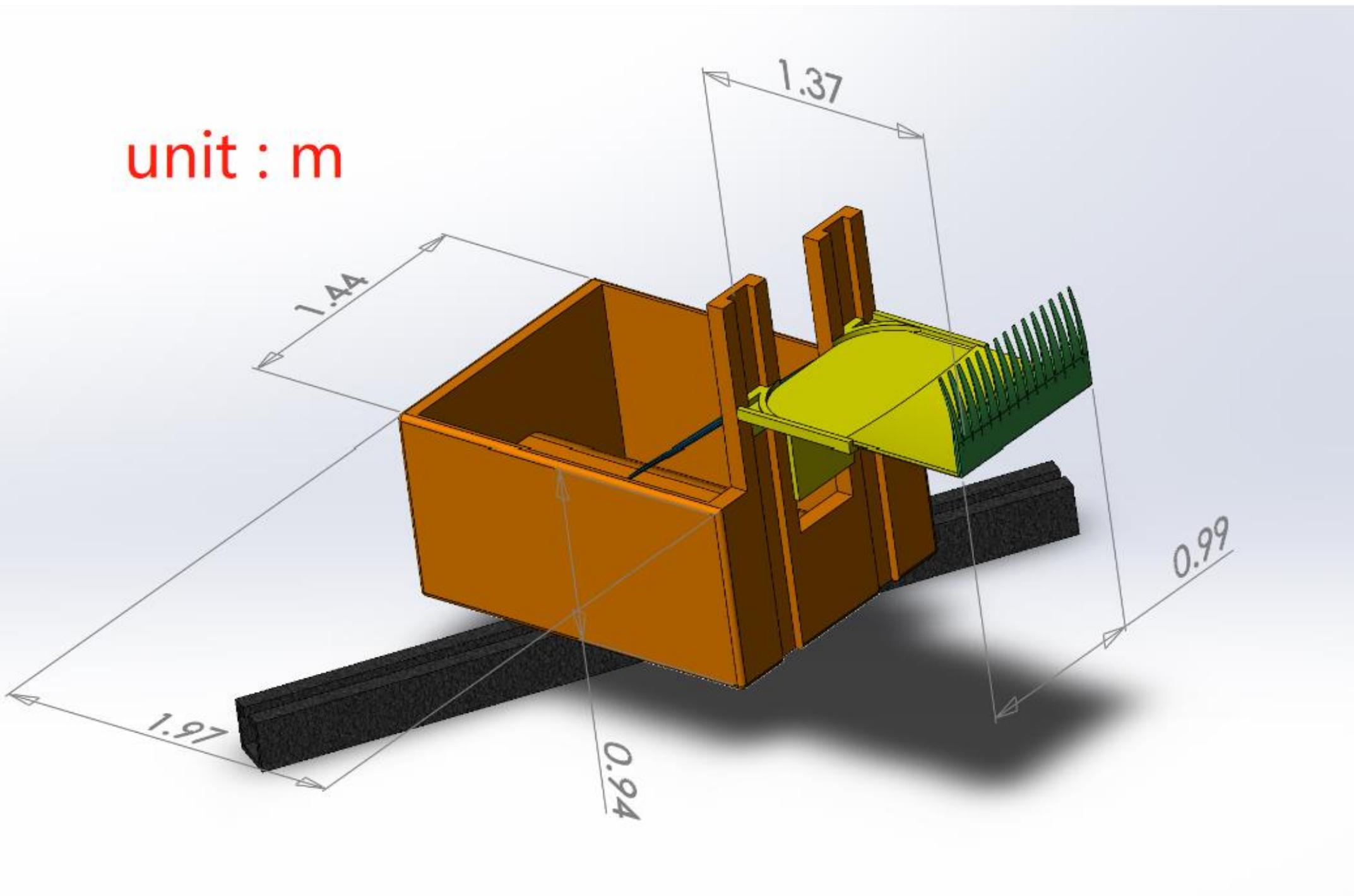
# 3.2.1 Food Production



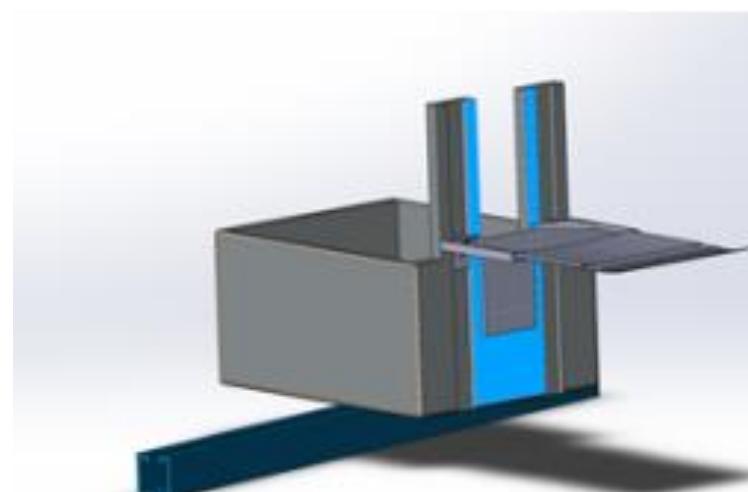
- Vertical Farming
- Hydroponics

	Annual output (kg)	Daily supply per person (g)	Nutrition
Total	210025	1150	
Potato	73000	400	Energy: 76kJ
Soybean	9200	50	Energy: 359kJ Ca: 191mg Mg: 199mg
Chinese Cabbage	27375	150	Vitamin A: 20mg
Tomatoes	18250	100	Vitamin C: 19mg
Corn	73000	400	Carbohydrate: 19.9g
Space pepper	9200	50	Vitamin A: 57mg Vitamin C: 62mg

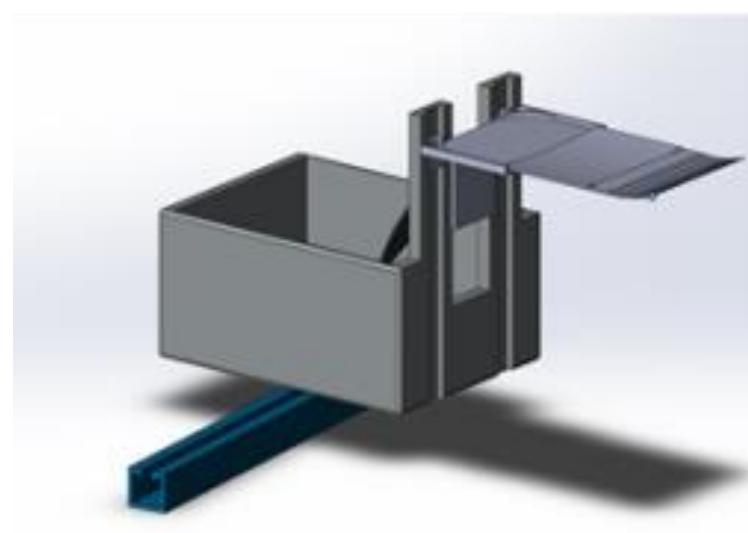
# 3.2.1 Food Production



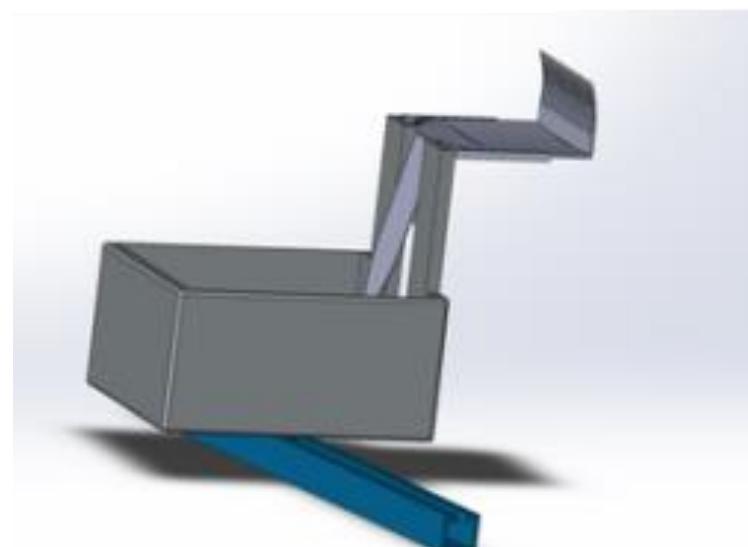
The harvest on track.



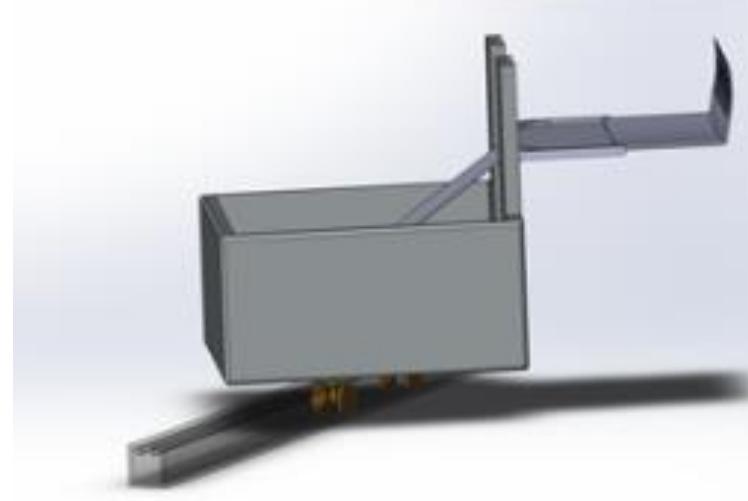
Rise to specific height.



Reach inside the crop box  
Bend & pull back



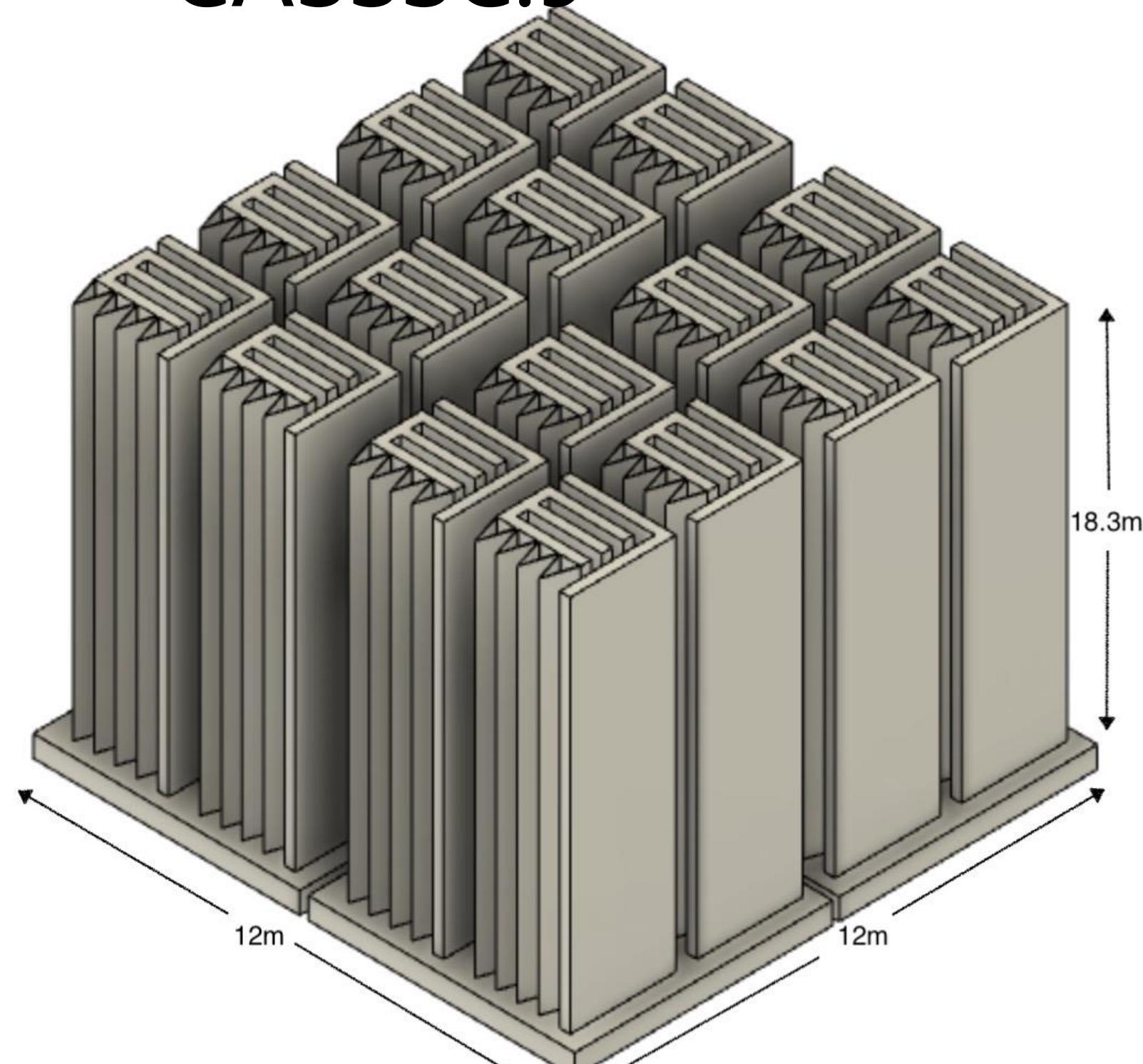
Drop crop-storage boxes



Return to a position  
along a specified track

## 3.2.2 Electrical Power Generation and Distribution

- Subcontractor: Fusion Founders(installed next to battery).
- CASSSC:9



In Life Maintenance Area

Section (daily)	Consumption/kW
Agricultural Area	201.1
Residential Area	400
Industrial Area	100
Research Lab	267
Transportation	67
Emergency(not included in total)	400
Total	1035

- Only provide power to Residential Area in emergency
- Volume of battery(emergency):  $1570 \text{ m}^3$ 
  - Produce while consuming

### 3.2.3 Communication System

Internal

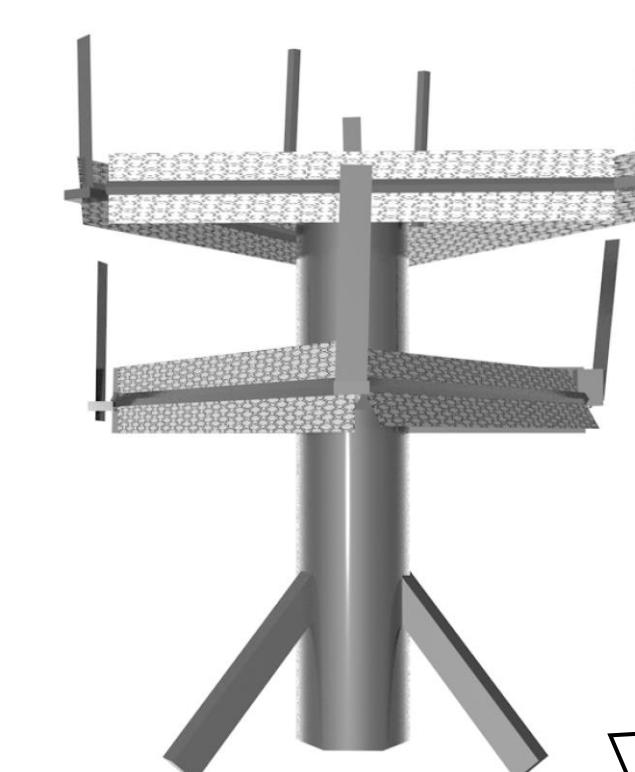
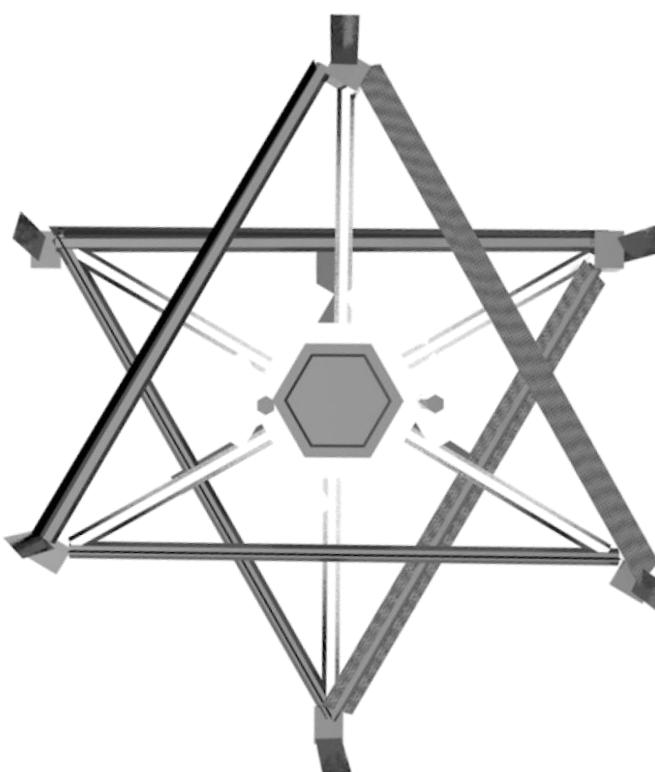
Between individuals:

Network connected

AR glasses

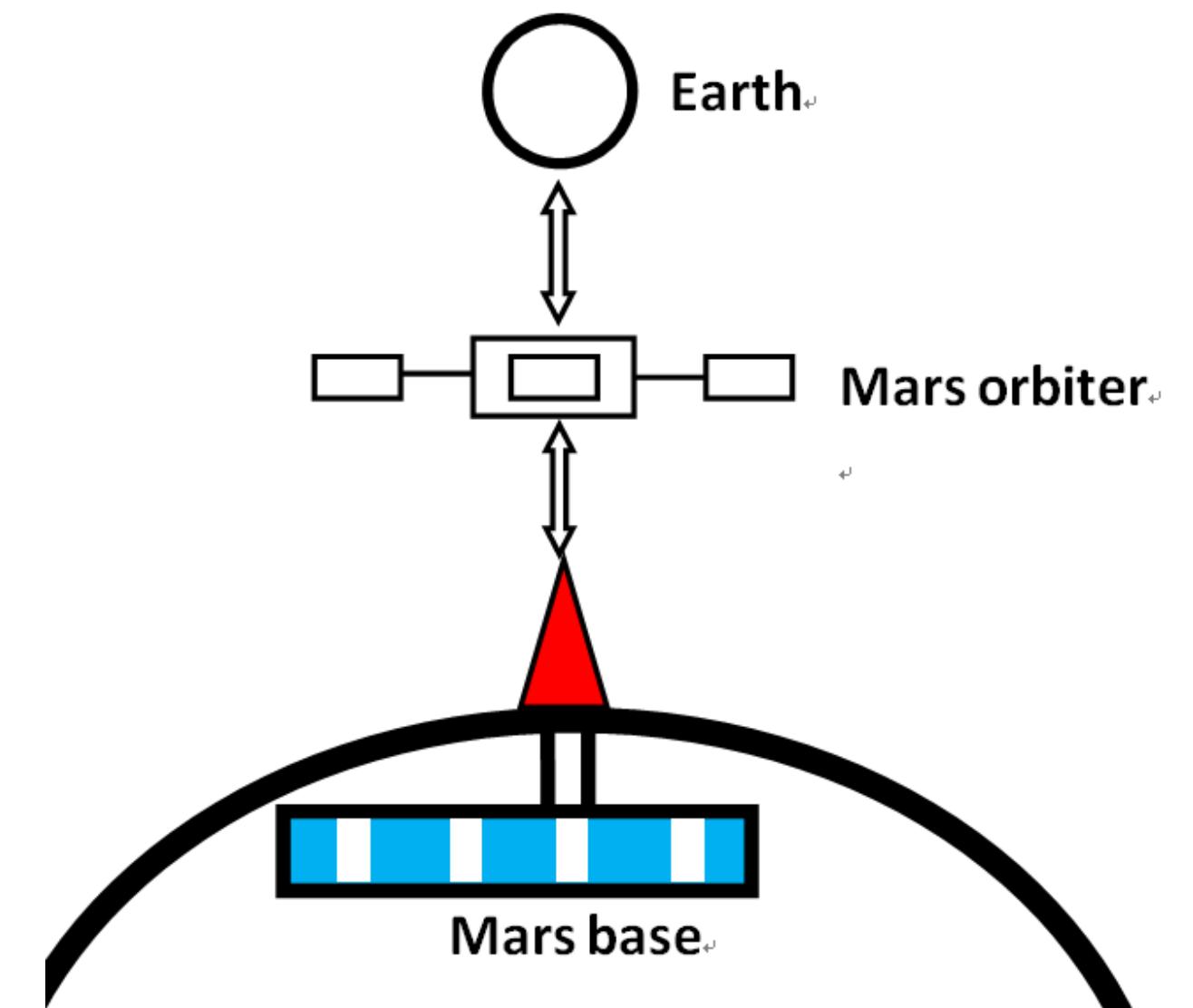
Between mars bases:

Satellite



External: DTN mode

- Electro Protect: components for circuitry
- Orbit Link Communications: augment standard communications channels
- ZAP! Industries: fiber optics



## 3.2.4 Transportation System

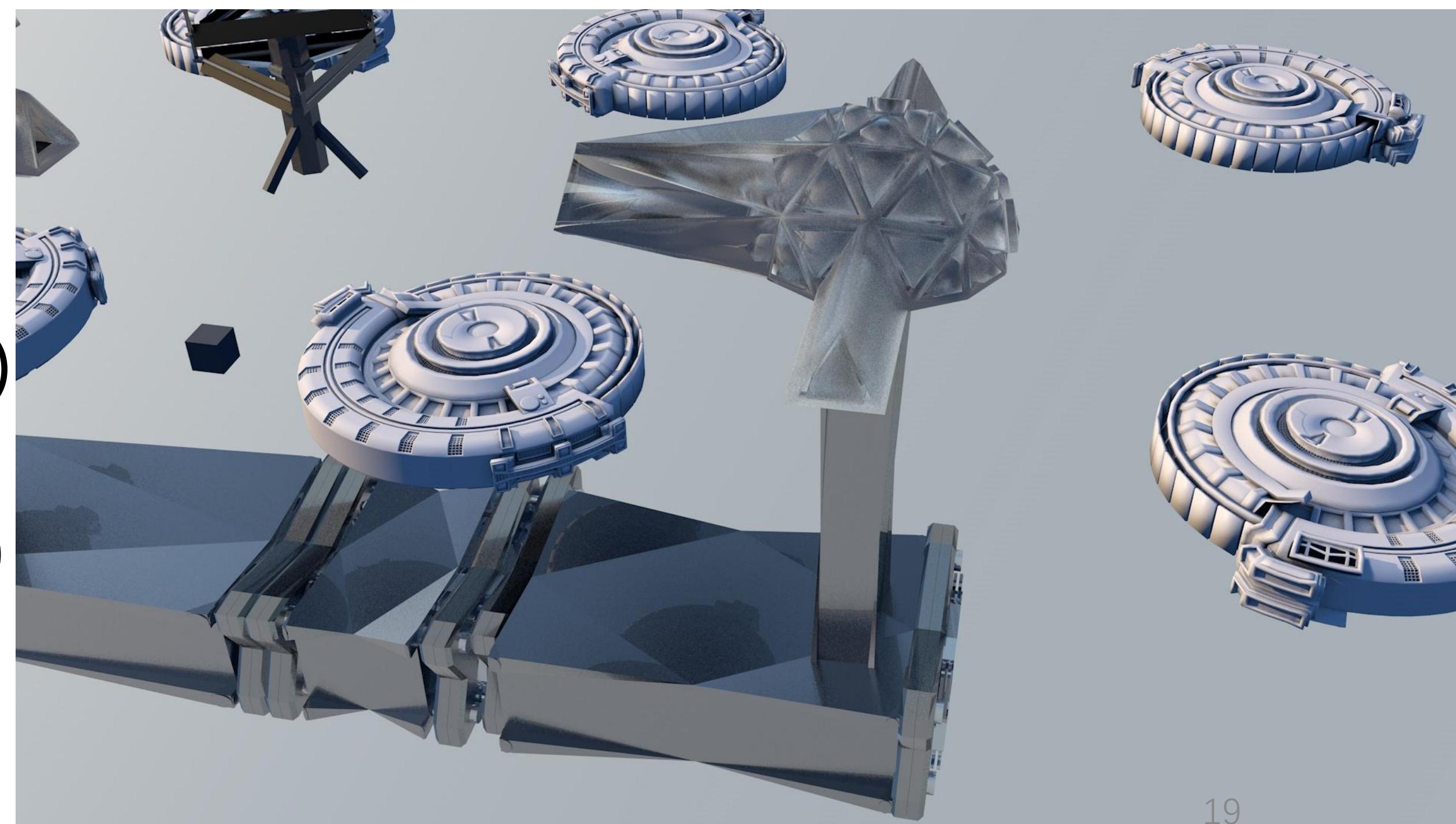
external

- elevated rail (protect the track from dust)
- manned-Rovers with graphene batteries for long endurance that could traverse tough terrains

internal

- complete automatic stations
- pressurized airlocks (at the hatch doors)
- pressurized lid covering the rail outside the station (protect the track from dust)

**High transporting efficiency, complete automatic, relative low cost  
CASSSC:30**



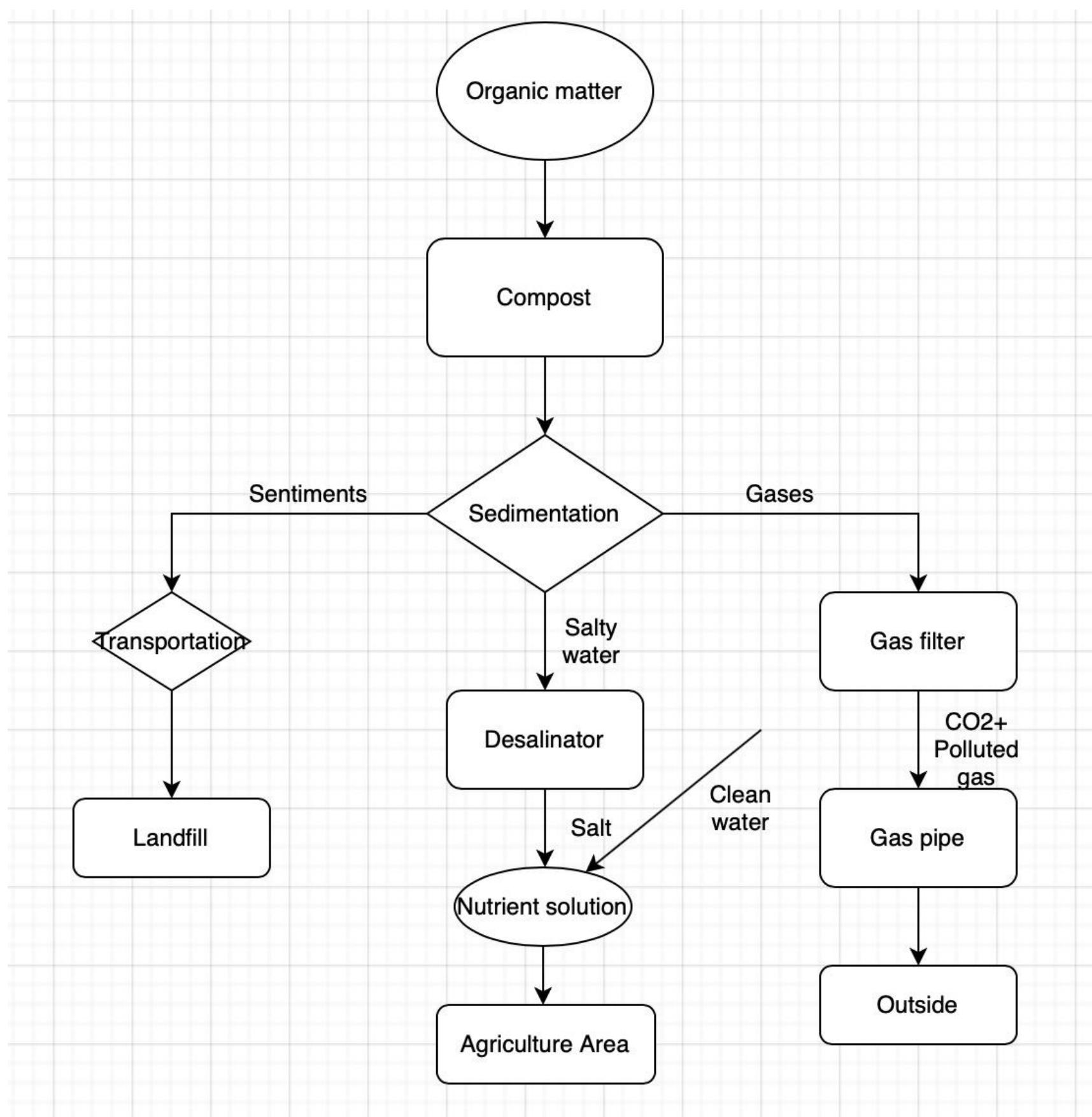
# 3.2.5 Atmosphere Composition and Pressure

District	Air Partial Pressure/atm	Composition	Volume/m <sup>3</sup>
Residential area	0.624 atm N <sub>2</sub> 0.1714 atm O <sub>2</sub> 0.004 atm CO <sub>2</sub> 0.0006 atm H <sub>2</sub> O	78.0% N <sub>2</sub> 21.425% O <sub>2</sub> 0.5% CO <sub>2</sub> 0.075% H <sub>2</sub> O	1364493m <sup>3</sup> N <sub>2</sub> 374798m <sup>3</sup> O <sub>2</sub> 8747m <sup>3</sup> CO <sub>2</sub> 1312m <sup>3</sup> H <sub>2</sub> O
Agricultural area	0.624 atm N <sub>2</sub> 0.160 atm O <sub>2</sub> 0.008 atm CO <sub>2</sub> 0.008 atm H <sub>2</sub> O	78.0% N <sub>2</sub> 20% O <sub>2</sub> 1% CO <sub>2</sub> 1% H <sub>2</sub> O	117000m <sup>3</sup> N <sub>2</sub> 30000m <sup>3</sup> O <sub>2</sub> 1500m <sup>3</sup> CO <sub>2</sub> 1500m <sup>3</sup> H <sub>2</sub> O
Research lab	0.624 atm N <sub>2</sub> 0.1714 atm O <sub>2</sub> 0.004 atm CO <sub>2</sub> 0.0006 atm H <sub>2</sub> O	78.0% N <sub>2</sub> 21.425% O <sub>2</sub> 0.5% CO <sub>2</sub> 0.075% H <sub>2</sub> O	206700m <sup>3</sup> N <sub>2</sub> 56776.25m <sup>3</sup> O <sub>2</sub> 1325m <sup>3</sup> CO <sub>2</sub> 198.75m <sup>3</sup> H <sub>2</sub> O

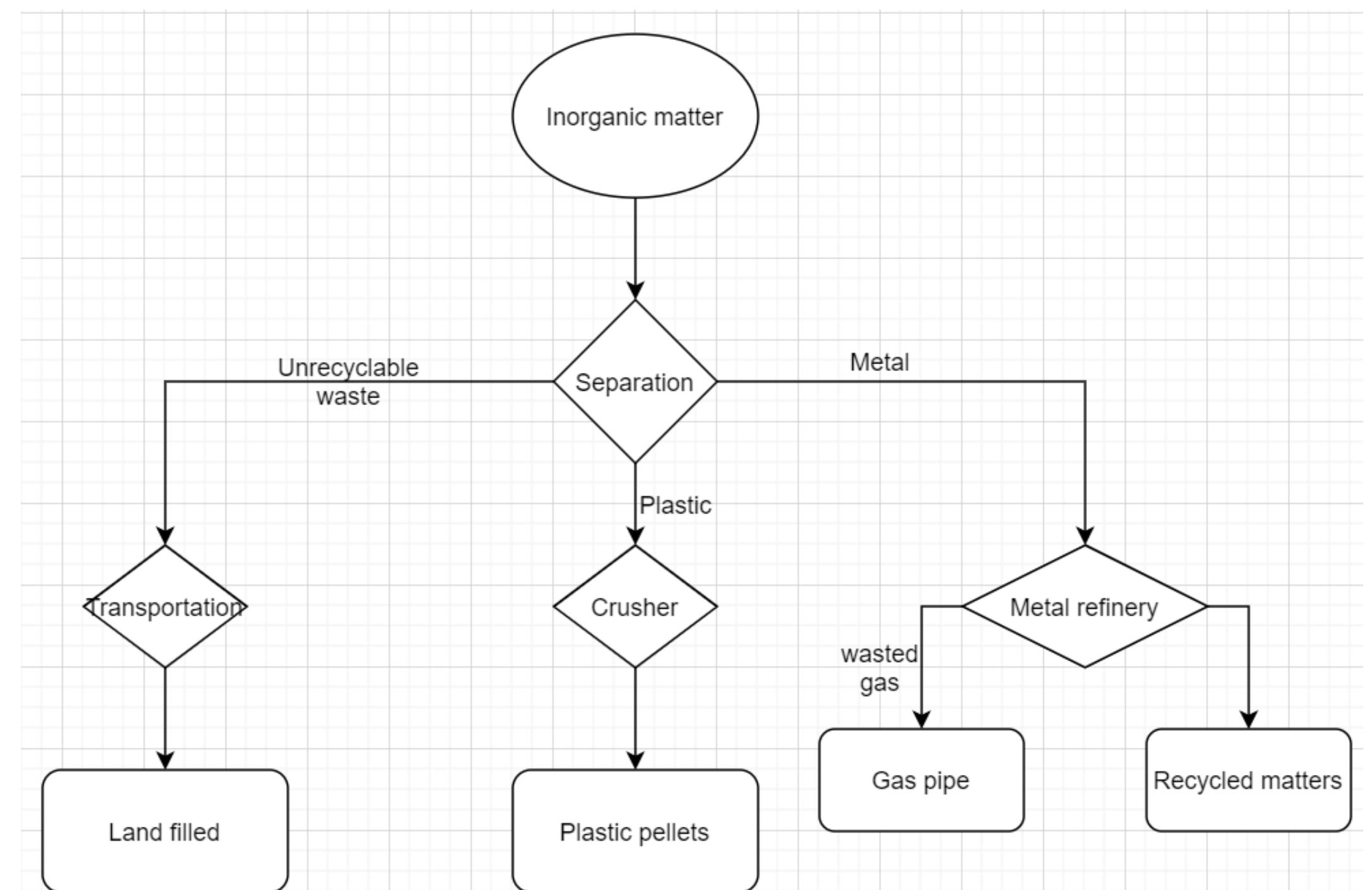
- Air pressure: 0.8 ATM: low cost, harmless
- Initial atmosphere will be provided by Stuff of Life
  - Specialization (productive)
  - CASSSC: 16

# 3.2.6 Household and Industrial Solid Waste Management

Organic matter: .



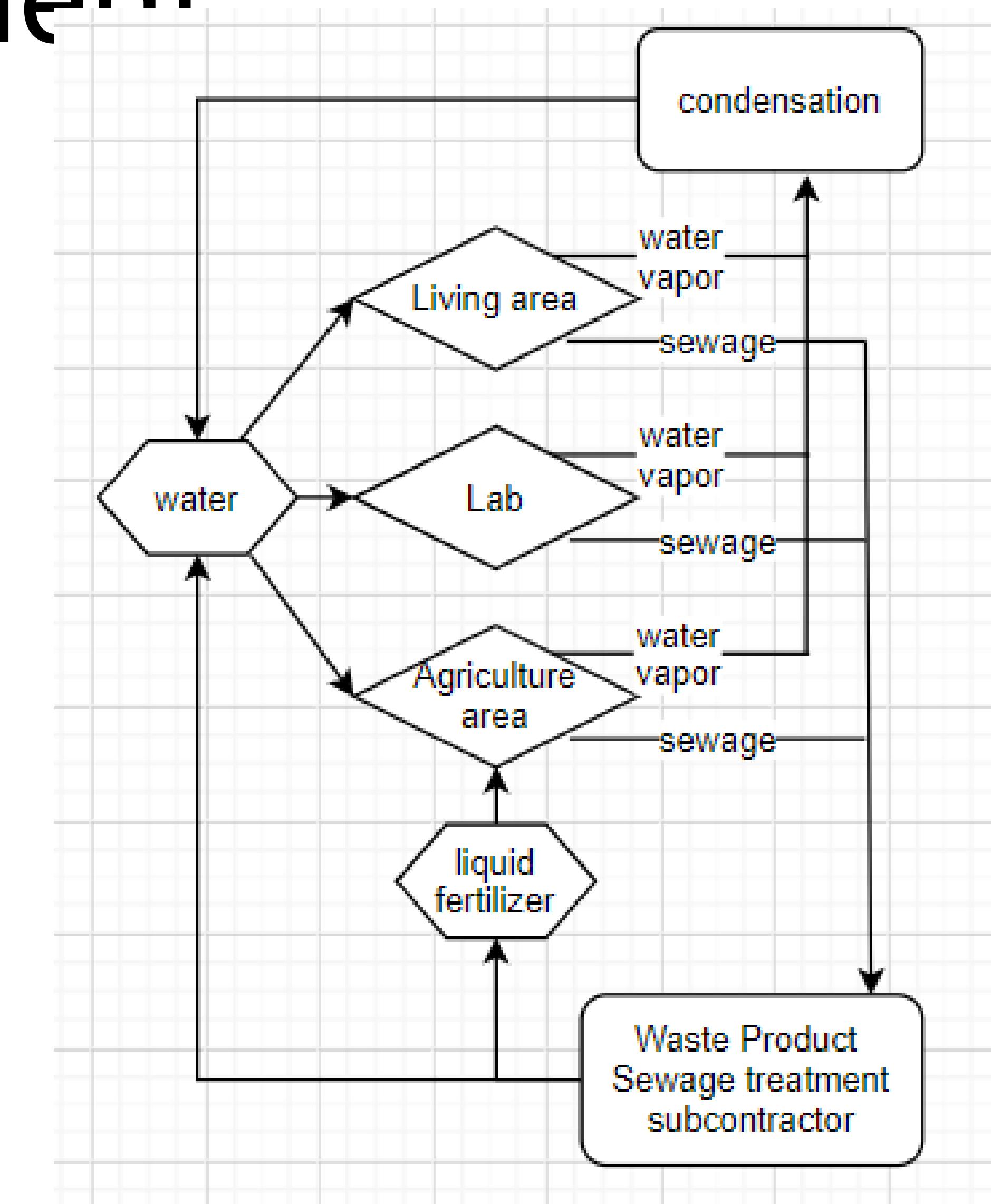
Inorganic matter:



Separate to different states of matter

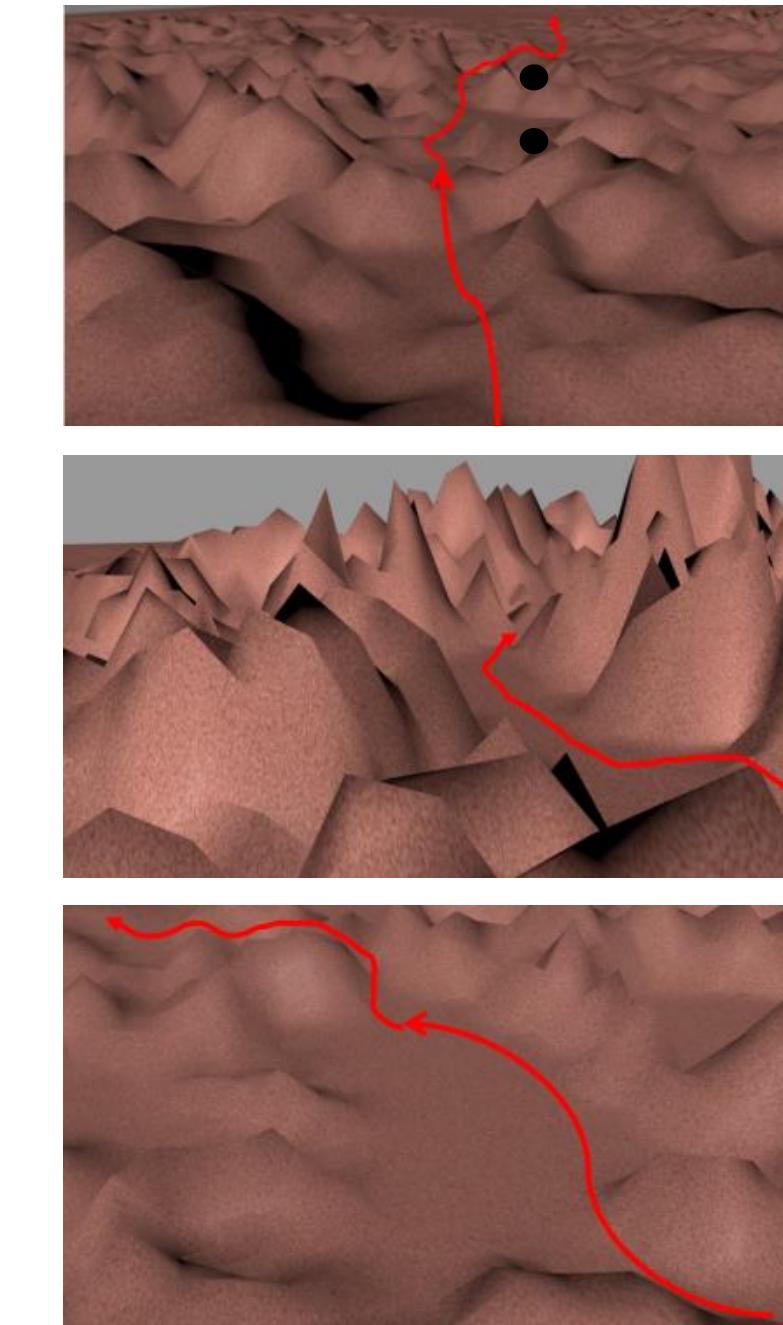
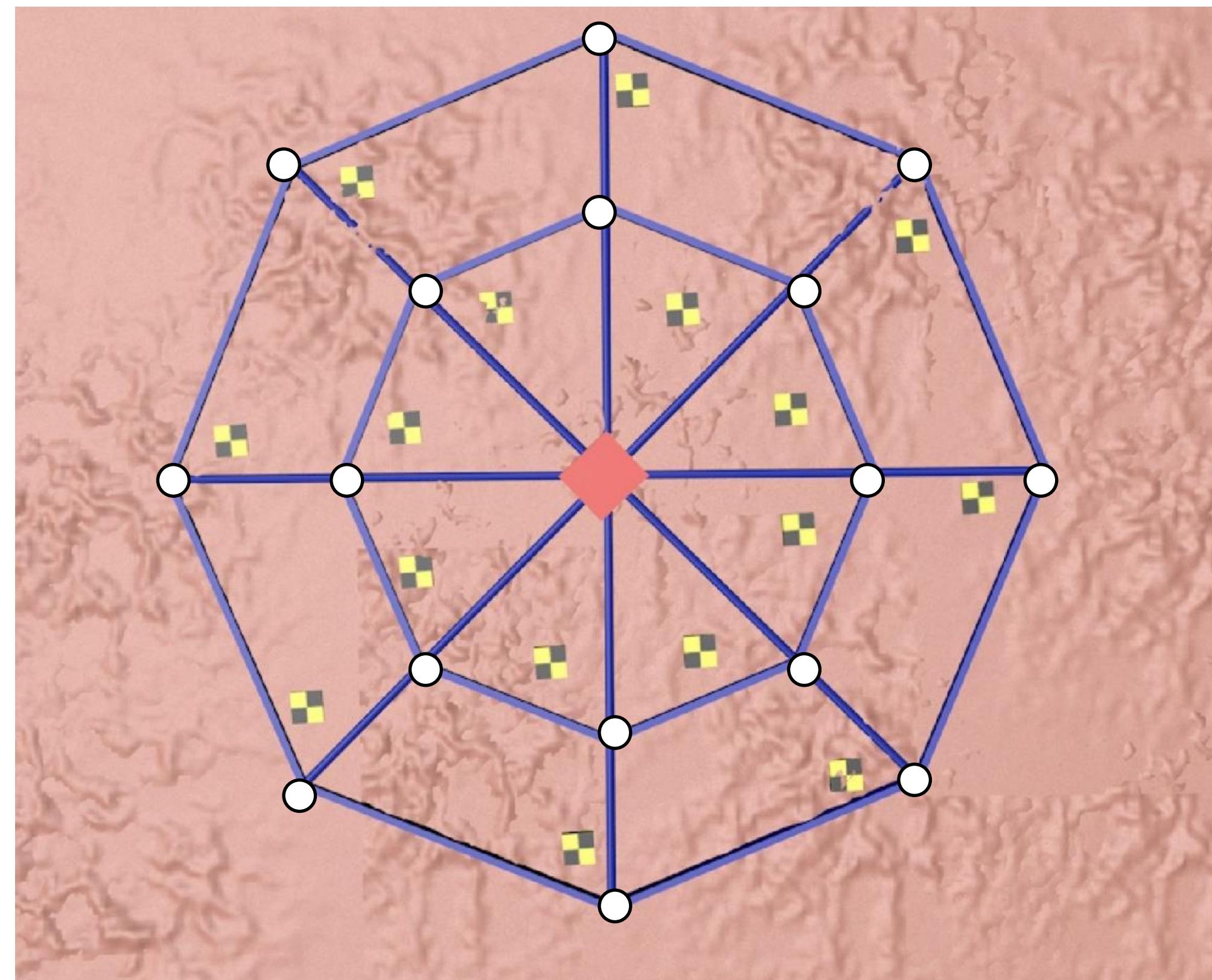
## 3.2.7 Water Management

- Water tank for residential area:  
600m<sup>3</sup>
- Water tank for food production:  
40m<sup>3</sup>
- Diameter of pipeline:0.5m
- CASSC:9
- Subcontractor: Waste products- convert sewage into fresh water and fertilizer.



### 3.3 Mars harvest operations route

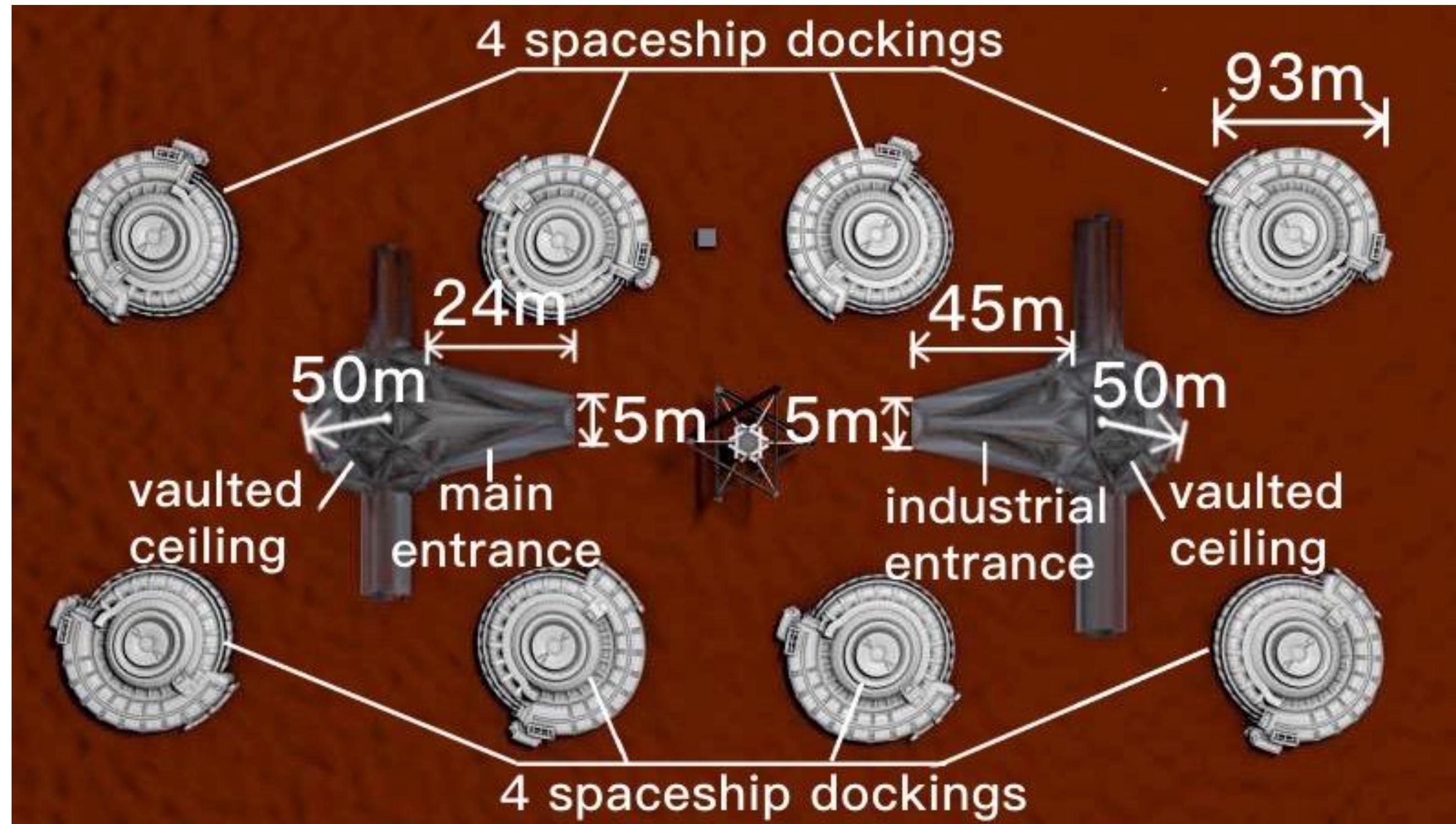
#### Landforms



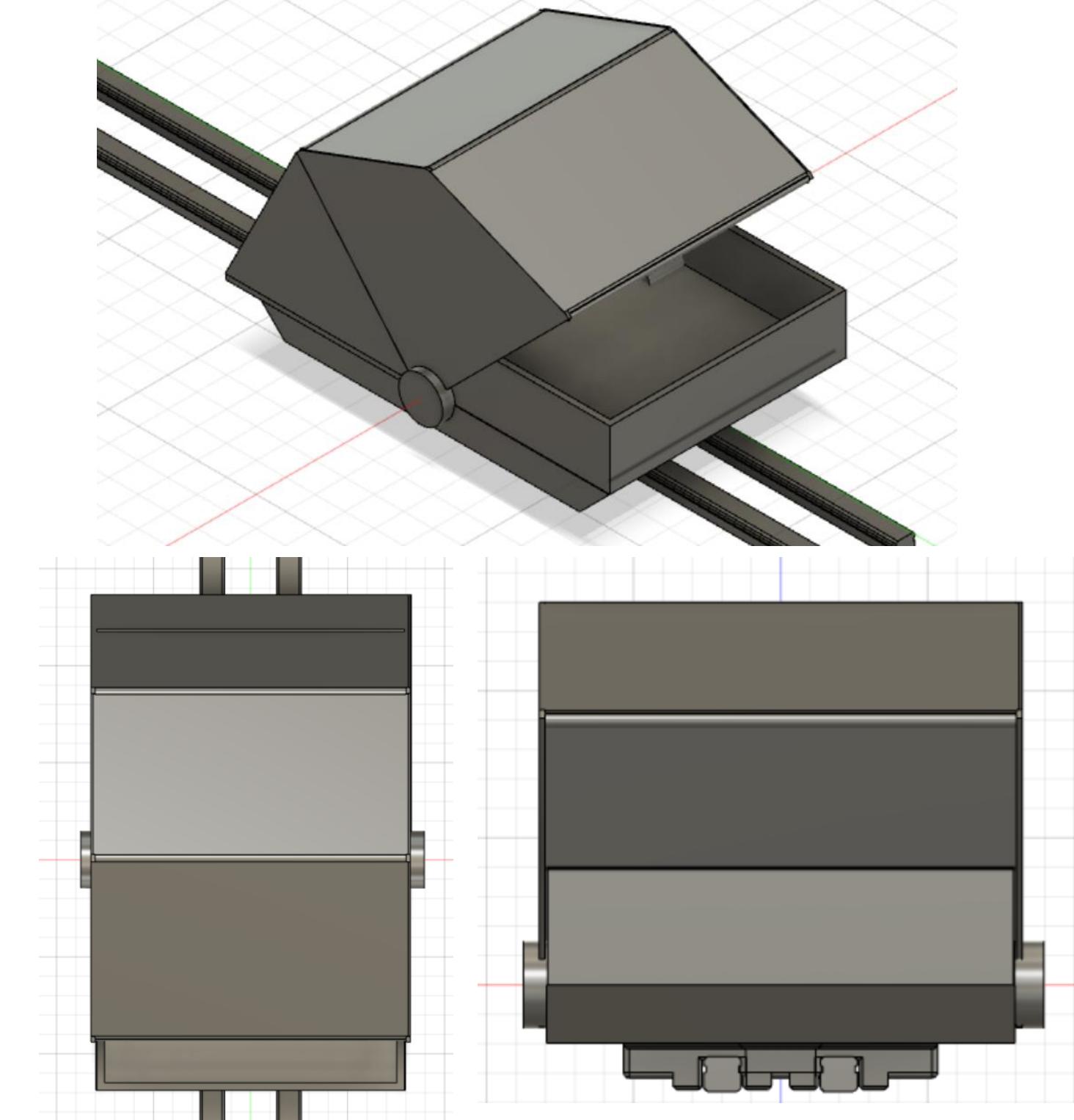
<b>Ke</b>	Scheduled route
<b>y</b>	Joint
<b>■</b>	Mars base
<b>■■</b>	Emergency point

# 3.4

## plan of surface docks and base entrances

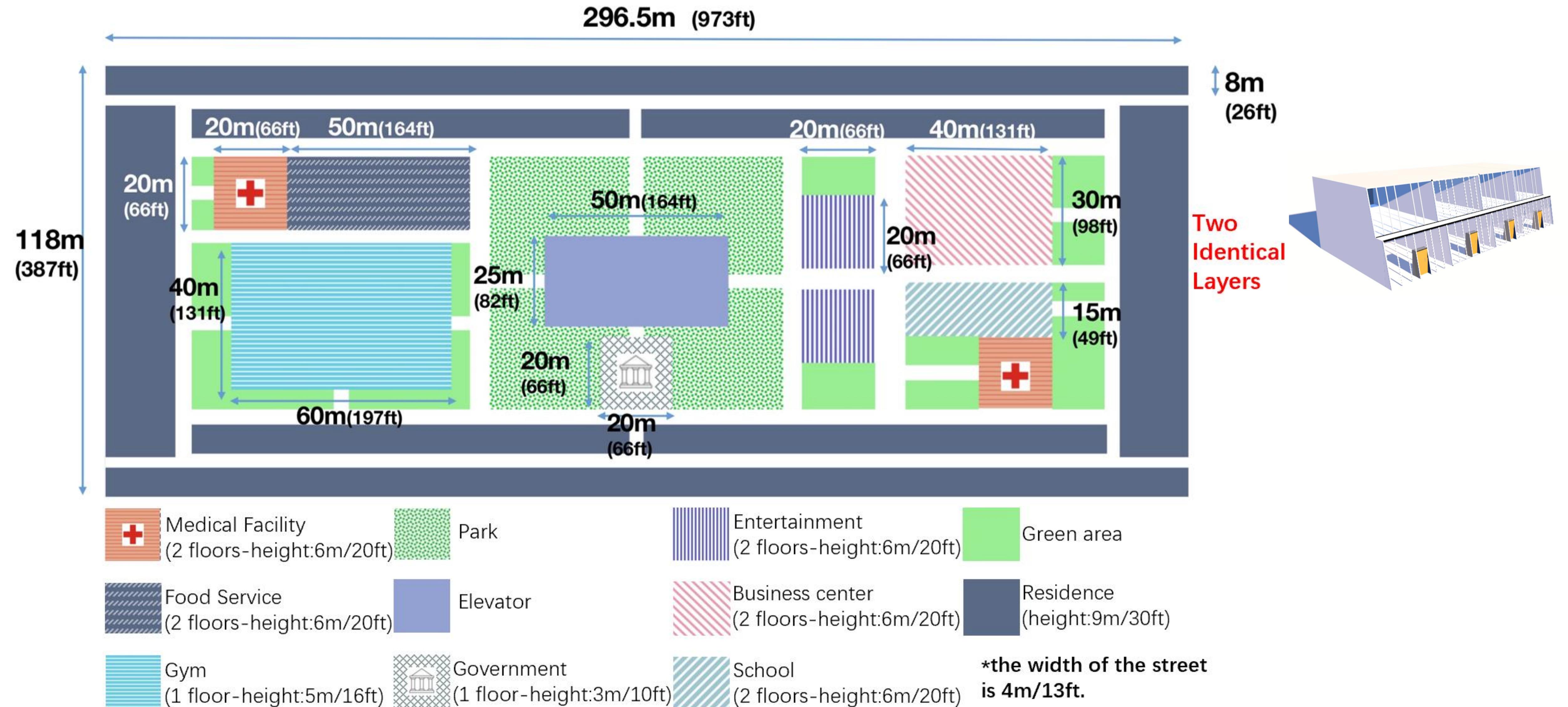


Transportation vehicles:  
railcars  
Connects external docks and internal base with tracks



# 4 HUMAN FACTORS AND SAFETY

# 4.1.1: Interior Design Plan



# 4.1.2 Supplies and Consumables:

Types of Supplies and Consumables	Quantities of Supplies and Consumables	Means of Distribution	Types of Supplies and Consumables	Quantities of Supplies and Consumables	Means of Distribution
Food	2500*400 calorie /day	From: Life Maintenance Department To: Food service By: Rails (Automation)	Clothing	1000 suits /2 Earth year	From: Elevator To: Business center By: Rails (Automation)
Medical Supplies	40 sets /Earth year	From: Elevator To: Medical facilities By: Rails (Automation)	Household Supplies	Bathroom Amenities: 400 sets /Earth month  Beddings: 100 sets /5 Earth years	
Office Supplies	60 sets /Earth year	From: Elevator To: Business center By: Rails (Automation)	Greening supplies	80m^2 /Earth month	From: Elevator To: Greening By: Rails (Automation)
Laboratory Supplies	15 sets /Earth year (Basic ones)	From: Elevator To: Labs By: Rails (Automation)	Water	(See Auto Depart.)	From: Life Maintenance Department To: All the places where it's needed By: Pipeline transportation
			Sanitation Supplies	Note: Specific Robots (Do not need Replacements—>Repairment)	N/A

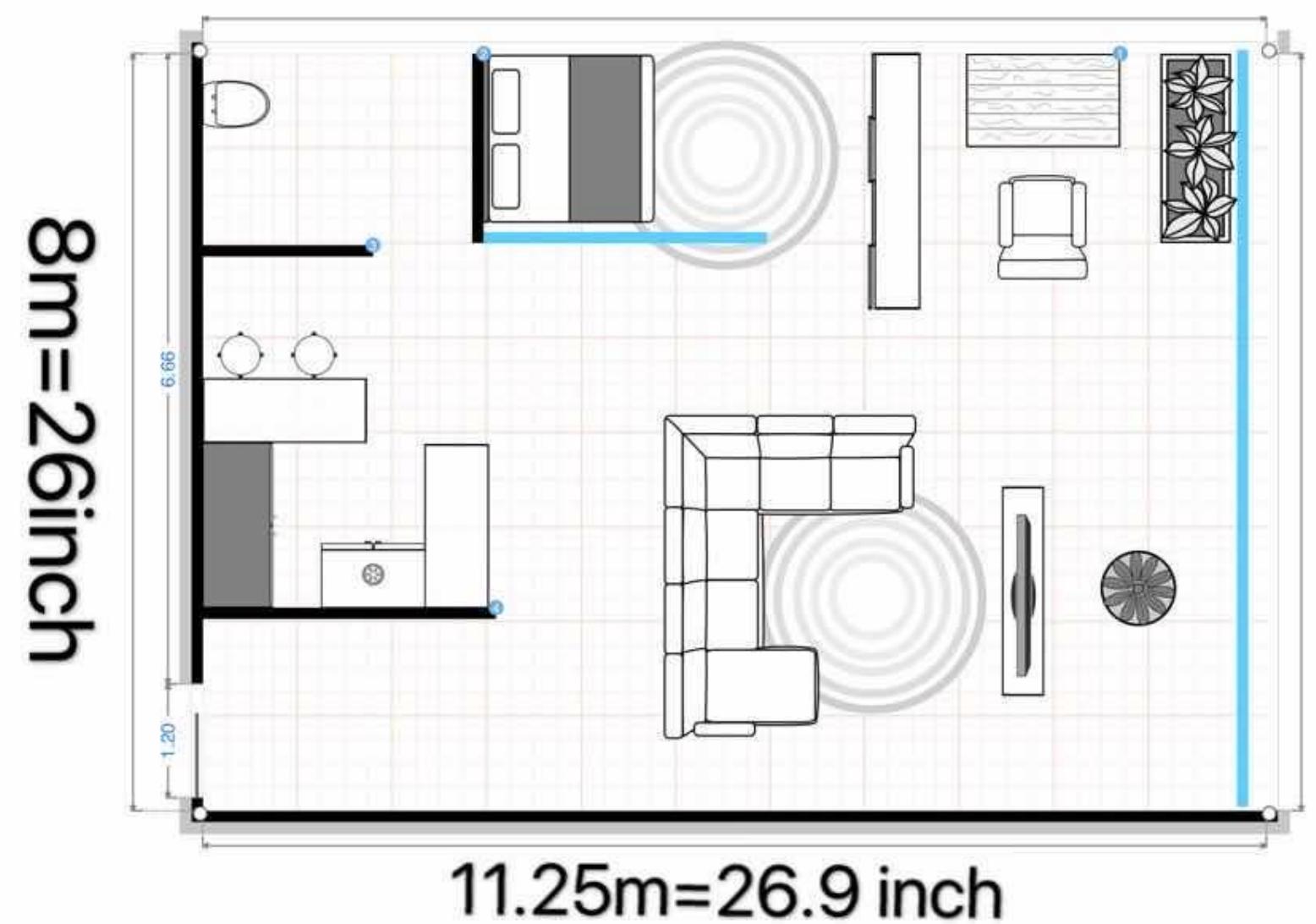
## 4.2.1 Internal floor plans



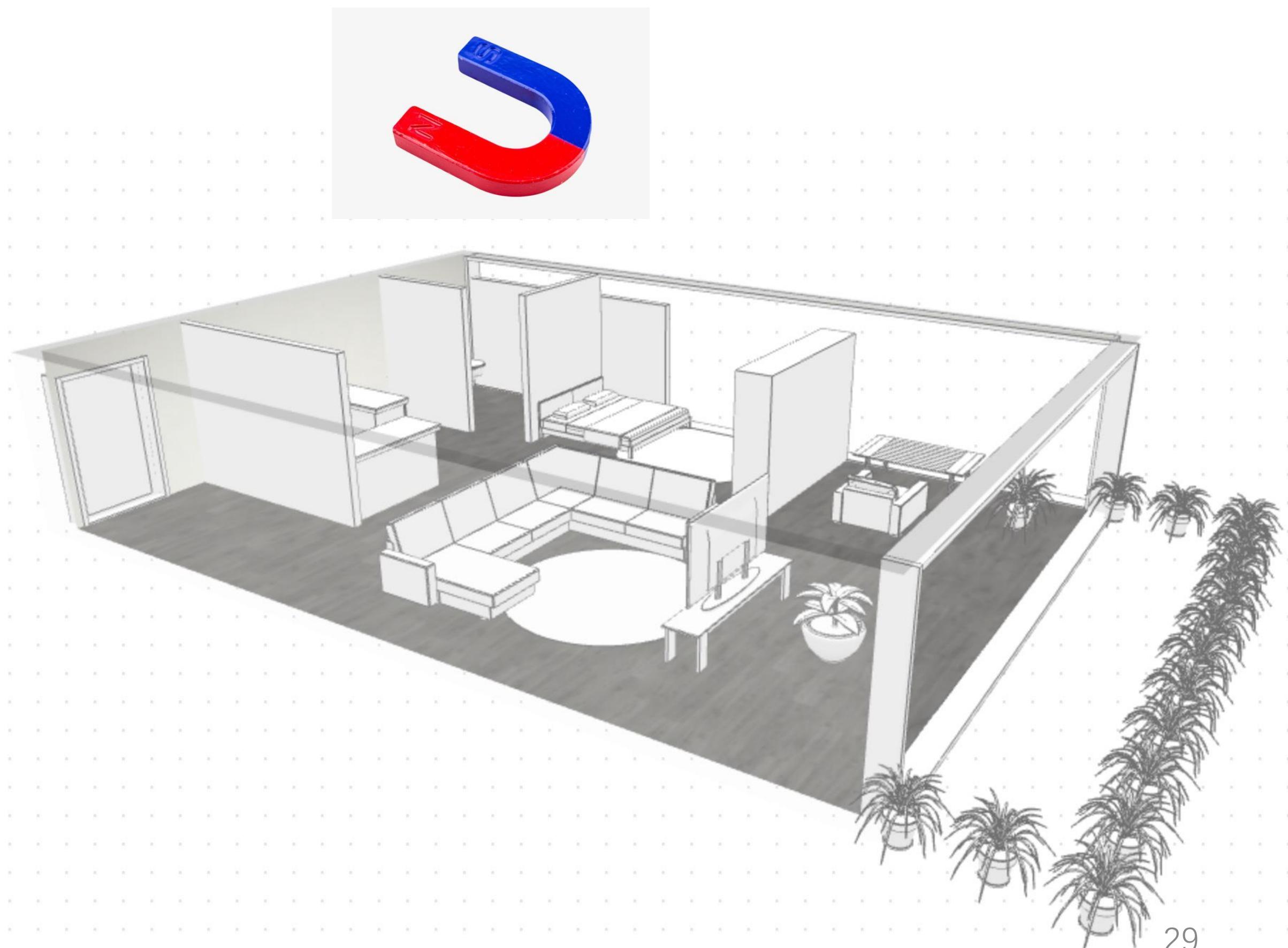
- For individuals :  
90 square meters (1 occupant)
- For small families:  
110 square meters (2-3 occupants)  
130 square meters (2-4 occupants)

## 4.2.1 Internal floor plans

- For individuals: 90 square meters
- 1 occupant-2 occupants
- Furniture fixation plan

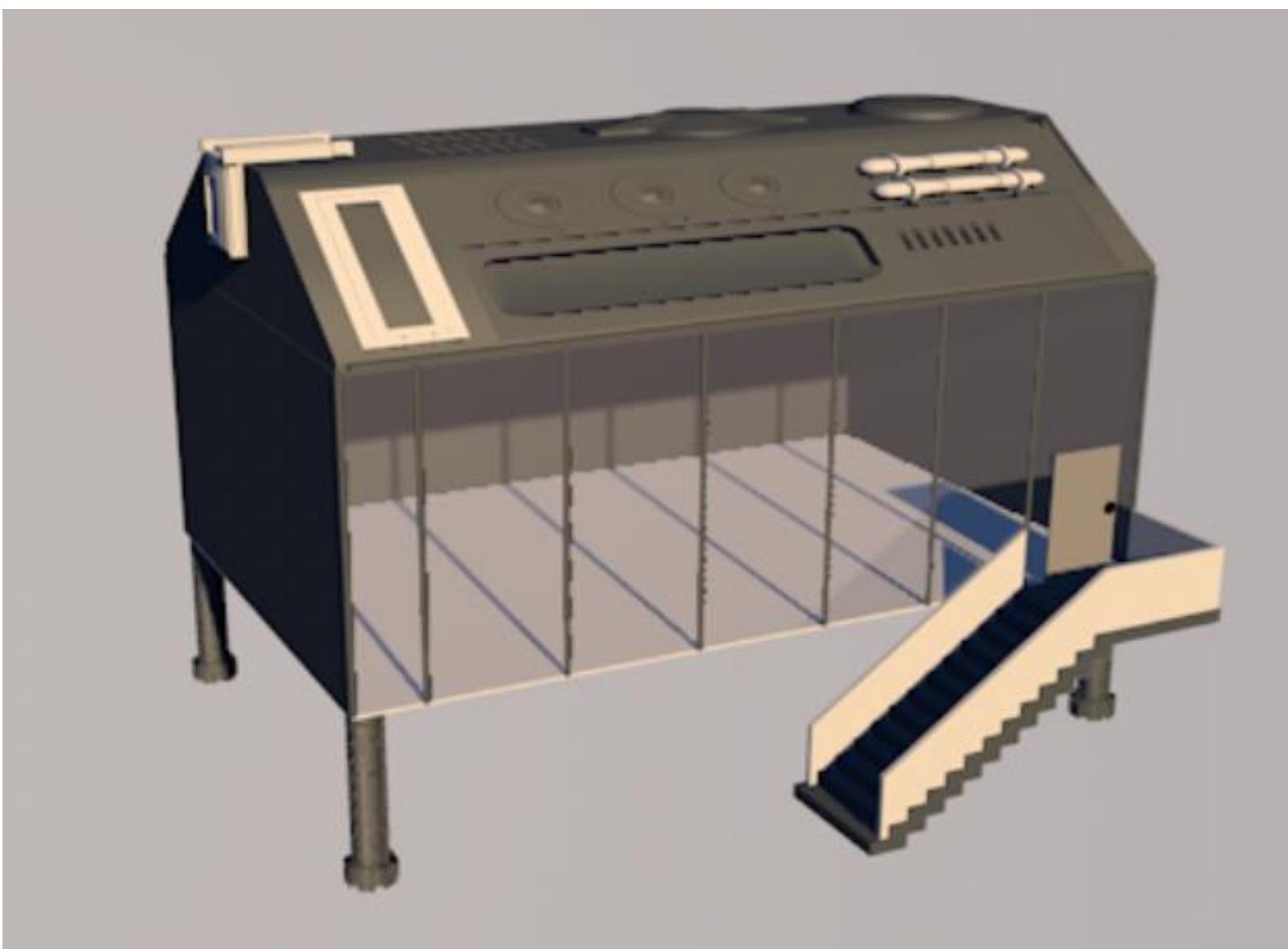


unit:meter

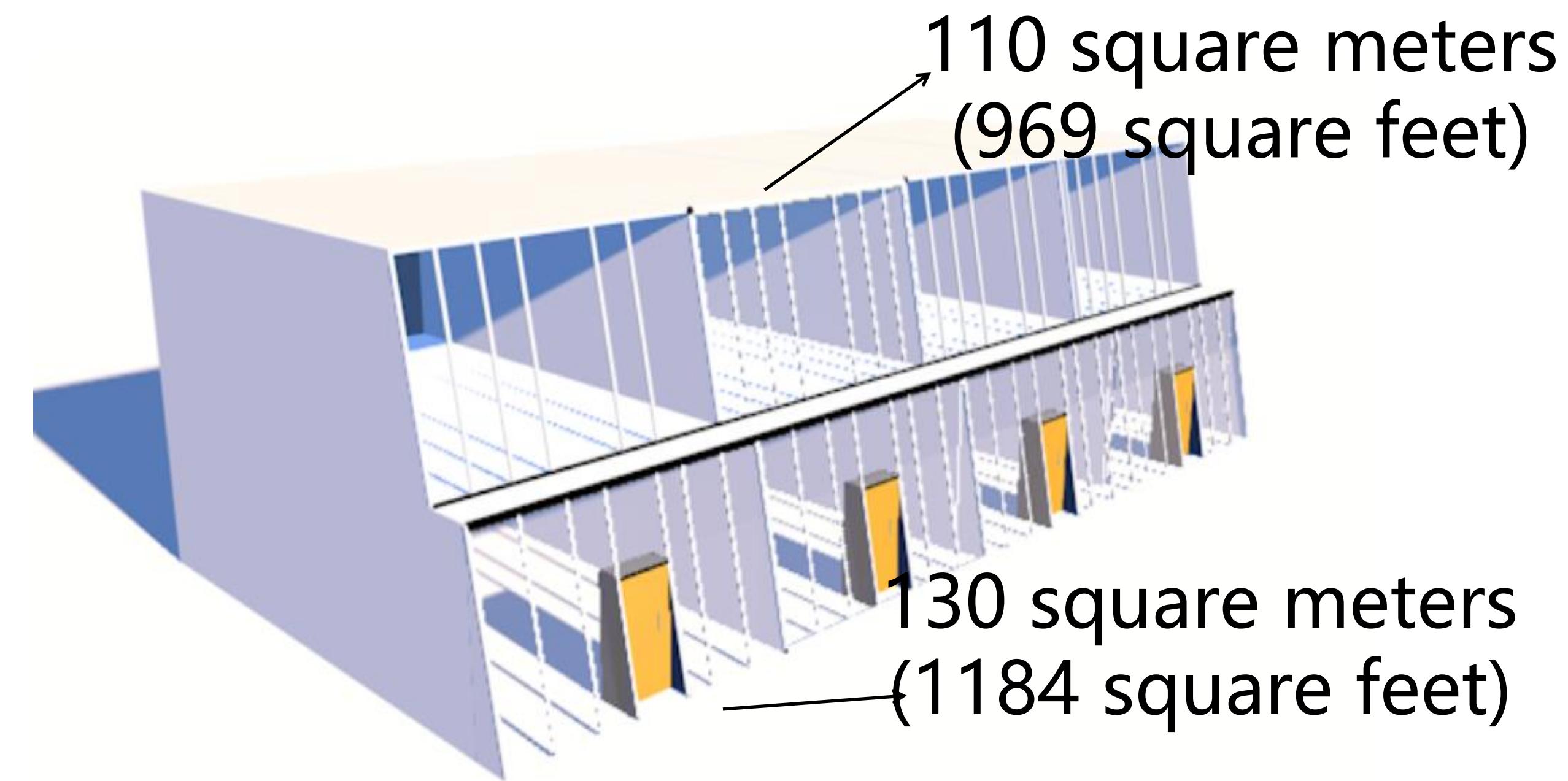


## 4.2

- For individuals: 90 square meters (1-2 occupant)
- Cargo Accommodation in Standard Space Shipping Container units

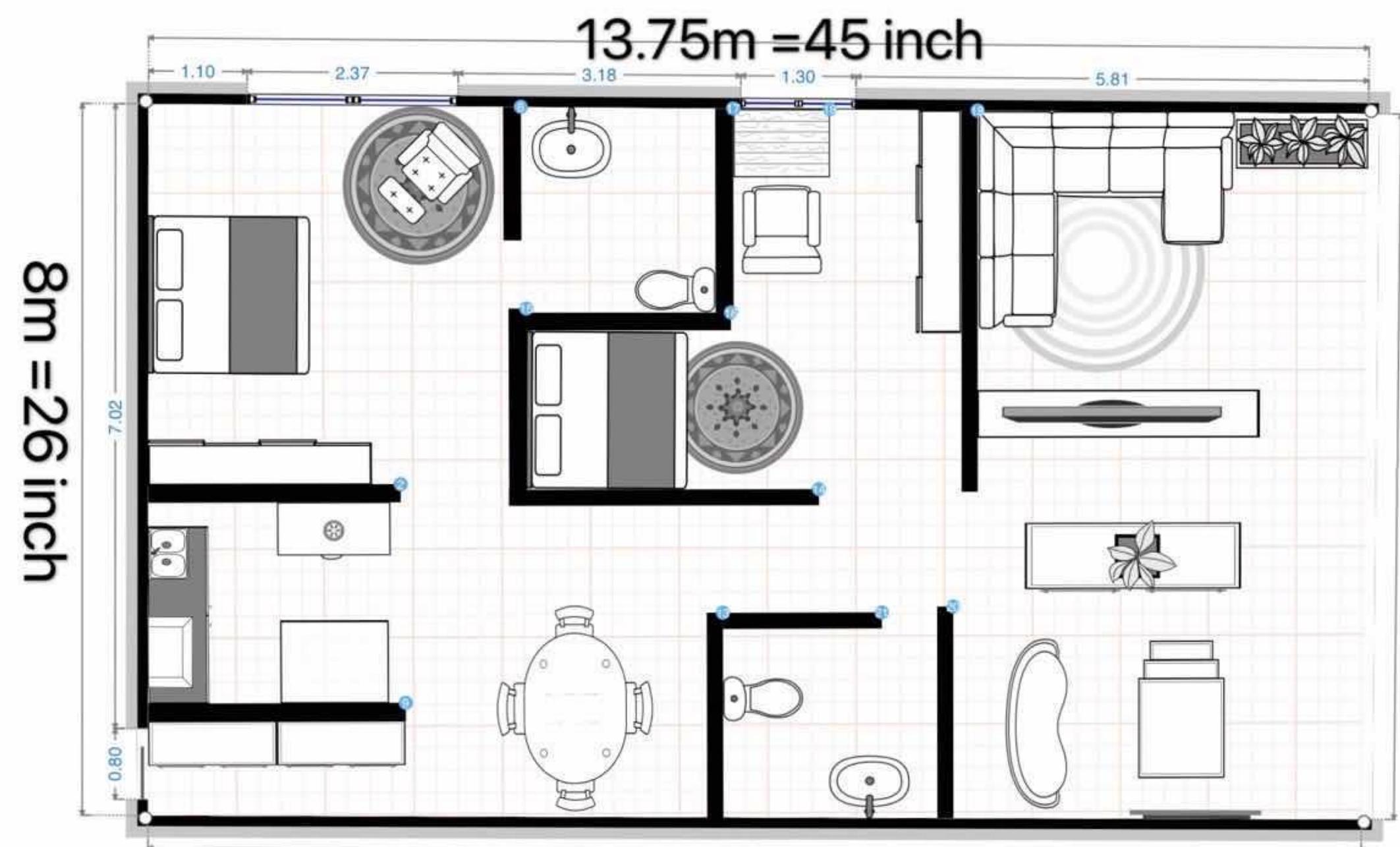


- For small families: 110/130 square meters(2-3 occupants)

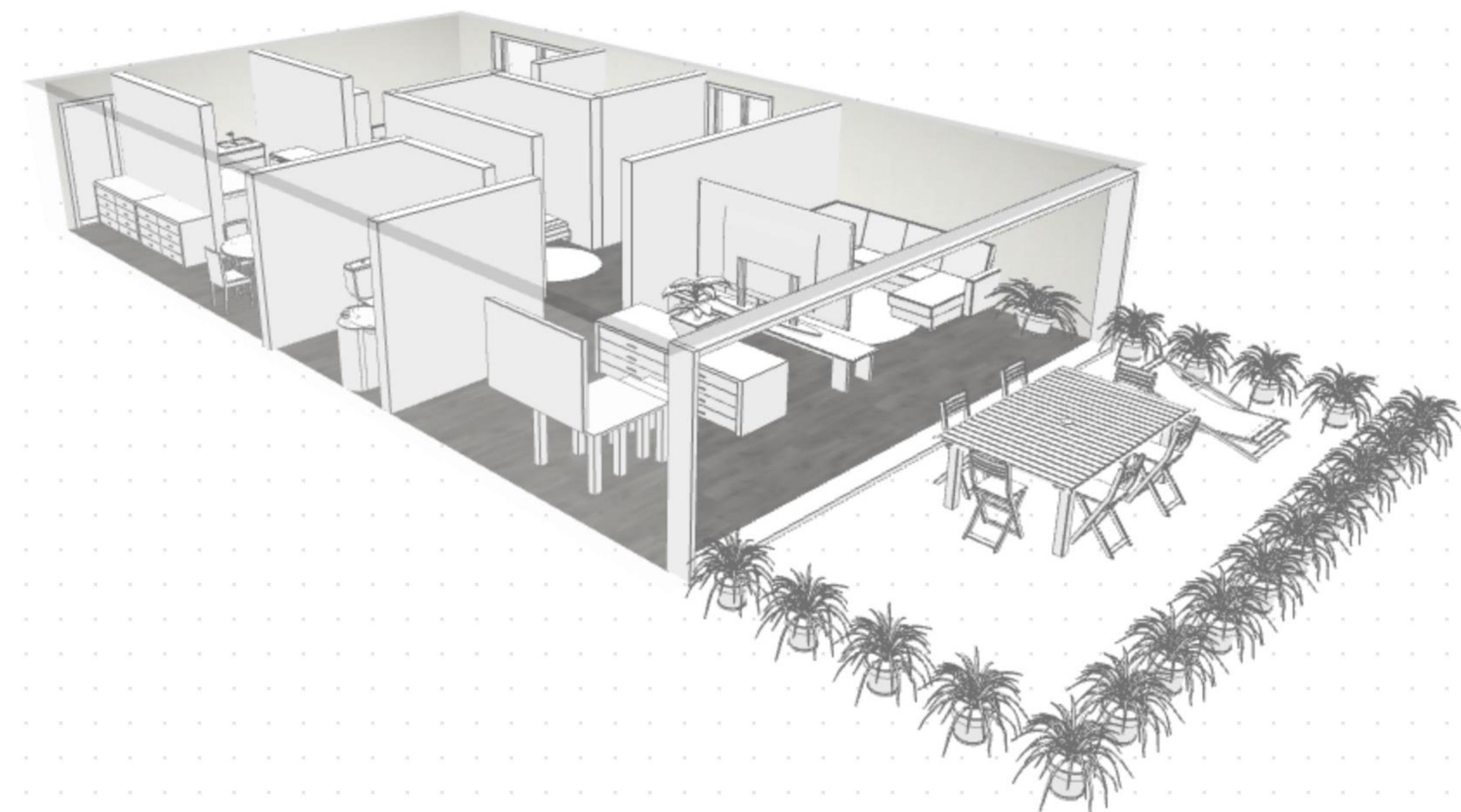


## 4.2.1 Internal floor plans

- For small families: 110 square meters
- 2-3 occupants



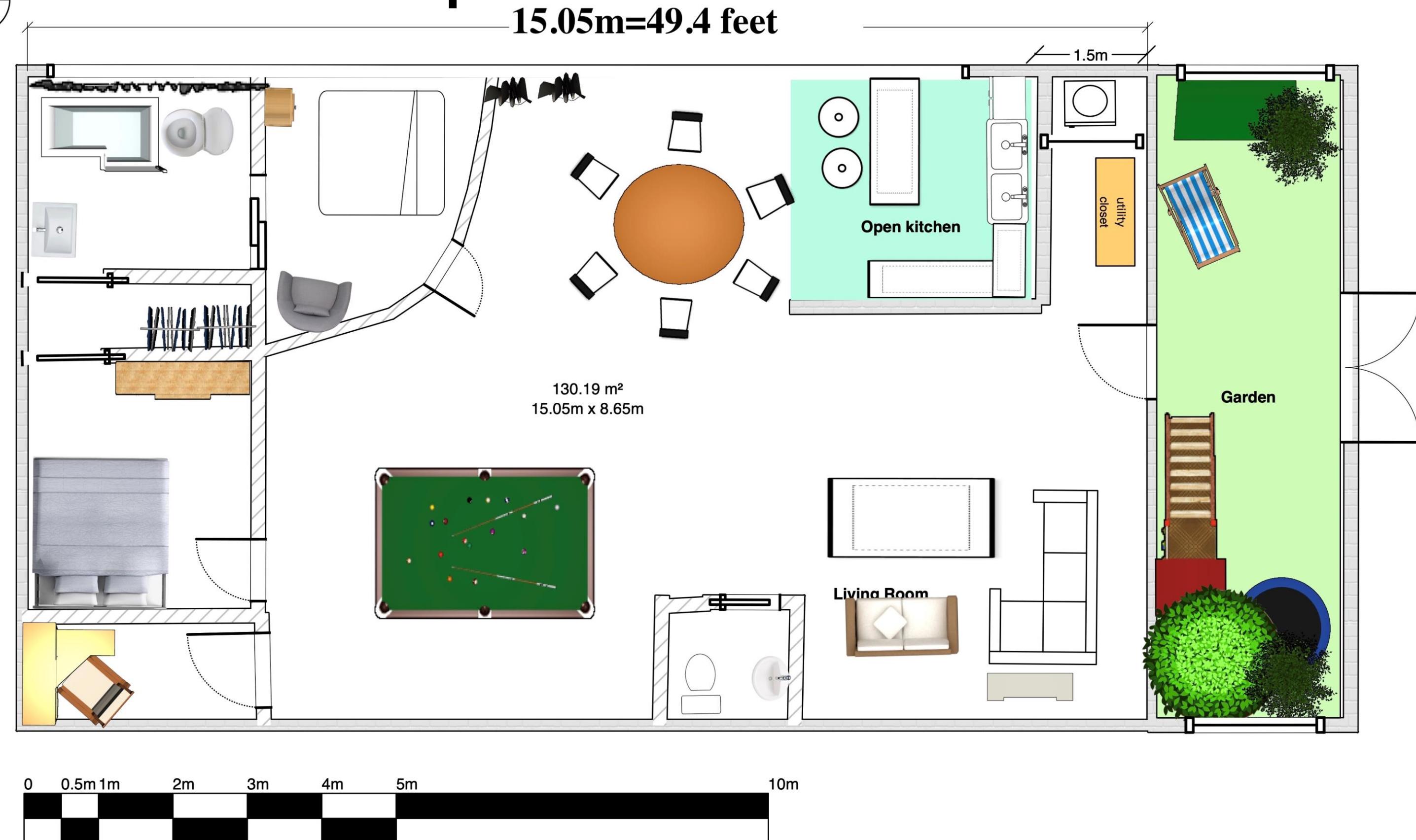
unit:meter



## 4.2.1 Internal floor plans

- For small families: 130 square meters

- 2-4 occupants



## 4.2.3 sources of the furnitures

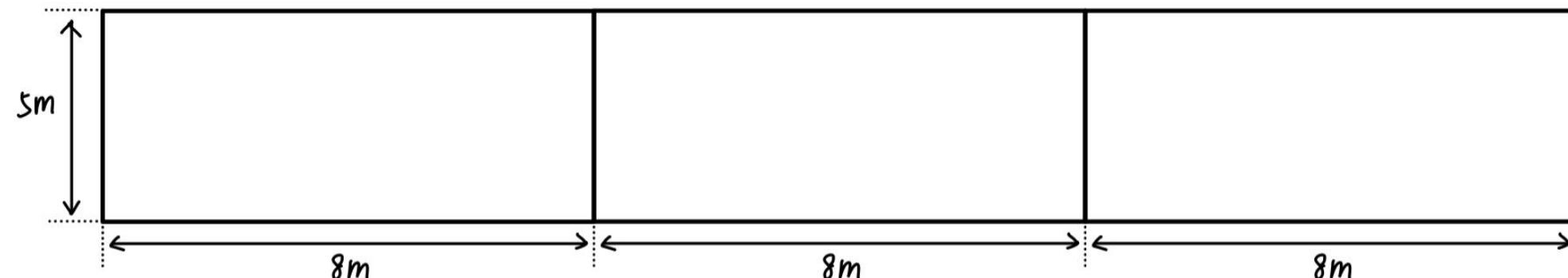
All furnitures are imported from lunar

Area of houses	Closet	Sofa	Bed	Table	Toilet	LED Screen
90 m <sup>2</sup>	1	1	1	1	1	1
110 m <sup>2</sup>	2	2	2	2	2	1
130 m <sup>2</sup>	2	2	2	2	2	1
Total number	392	392	392	392	392	296

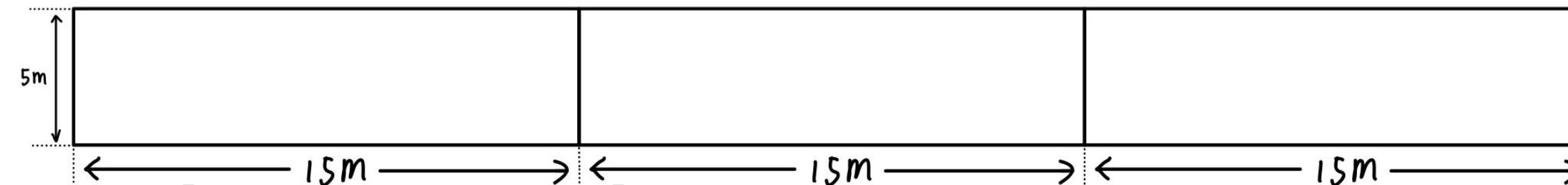
# 4.3.1 Dust Removal System

**Dust Prevention System (top view)**

Main Entrance (height = 3m)

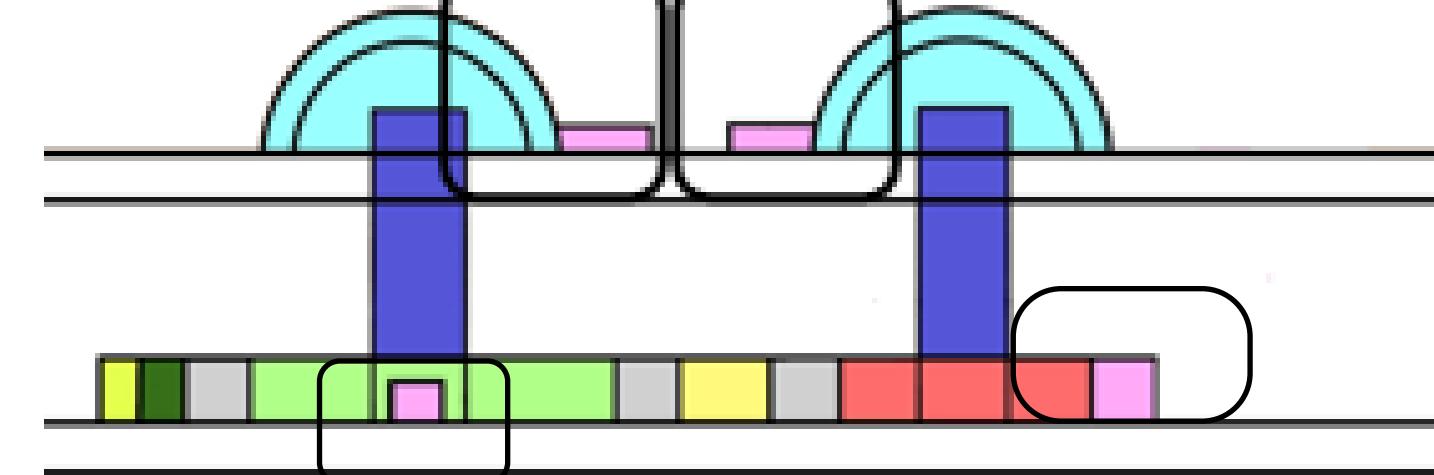


Industry Entrance (height = 5m)

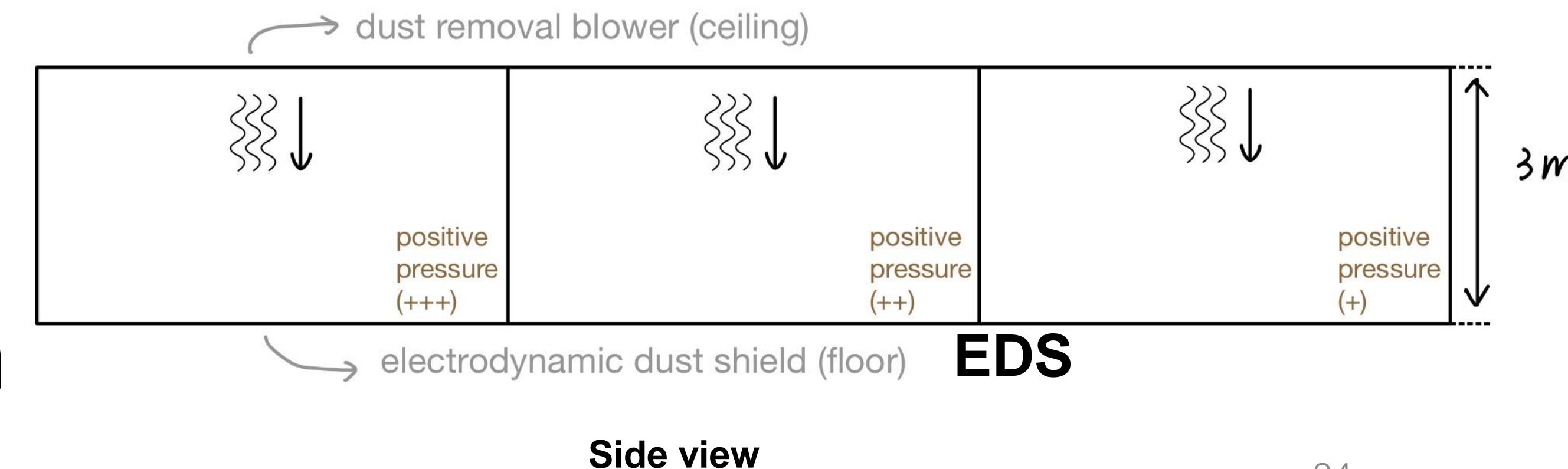


- 3 distinct dust removal chambers
- 15-second influx surge
- EDS Collections
- Positive Pressure Protection

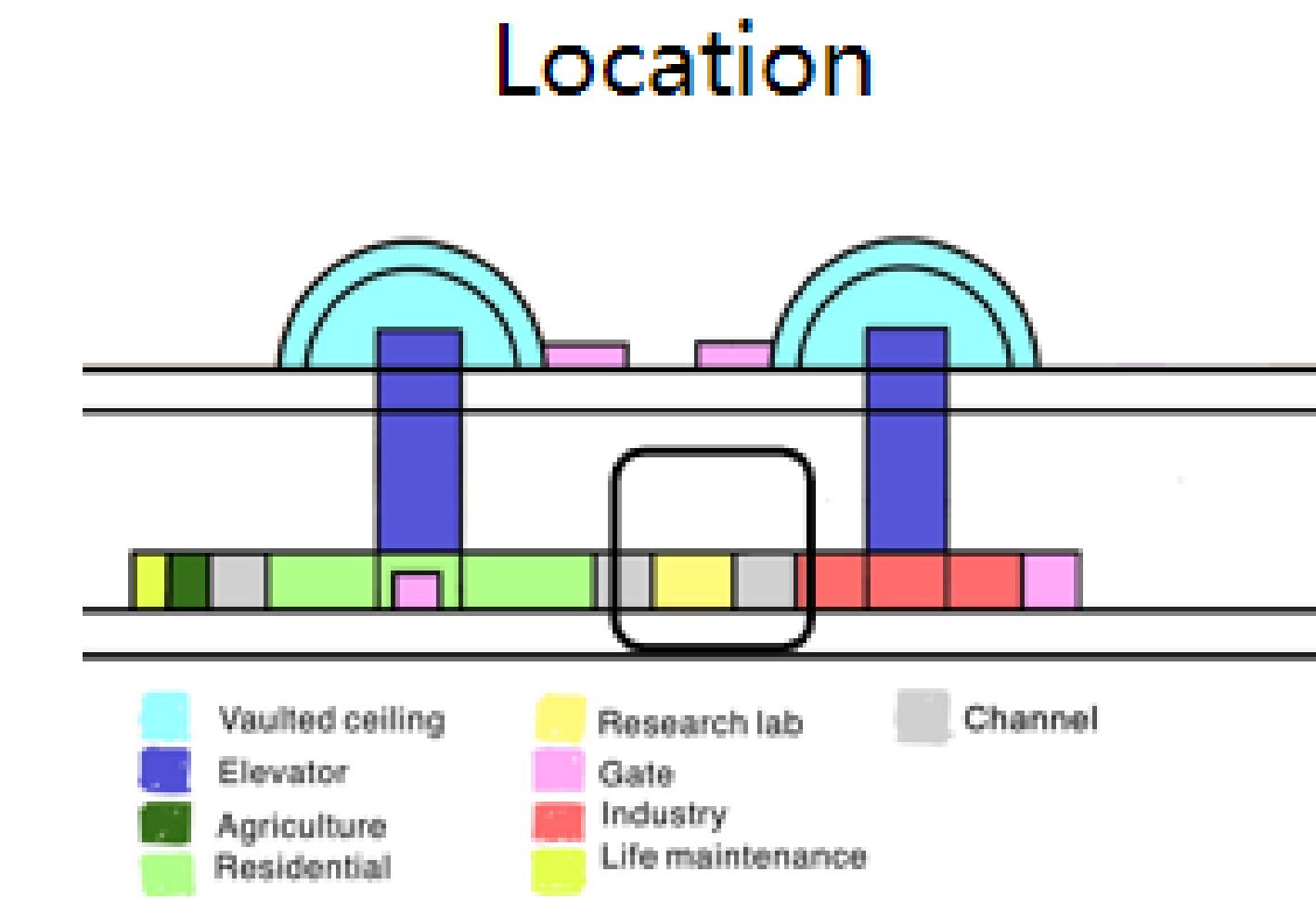
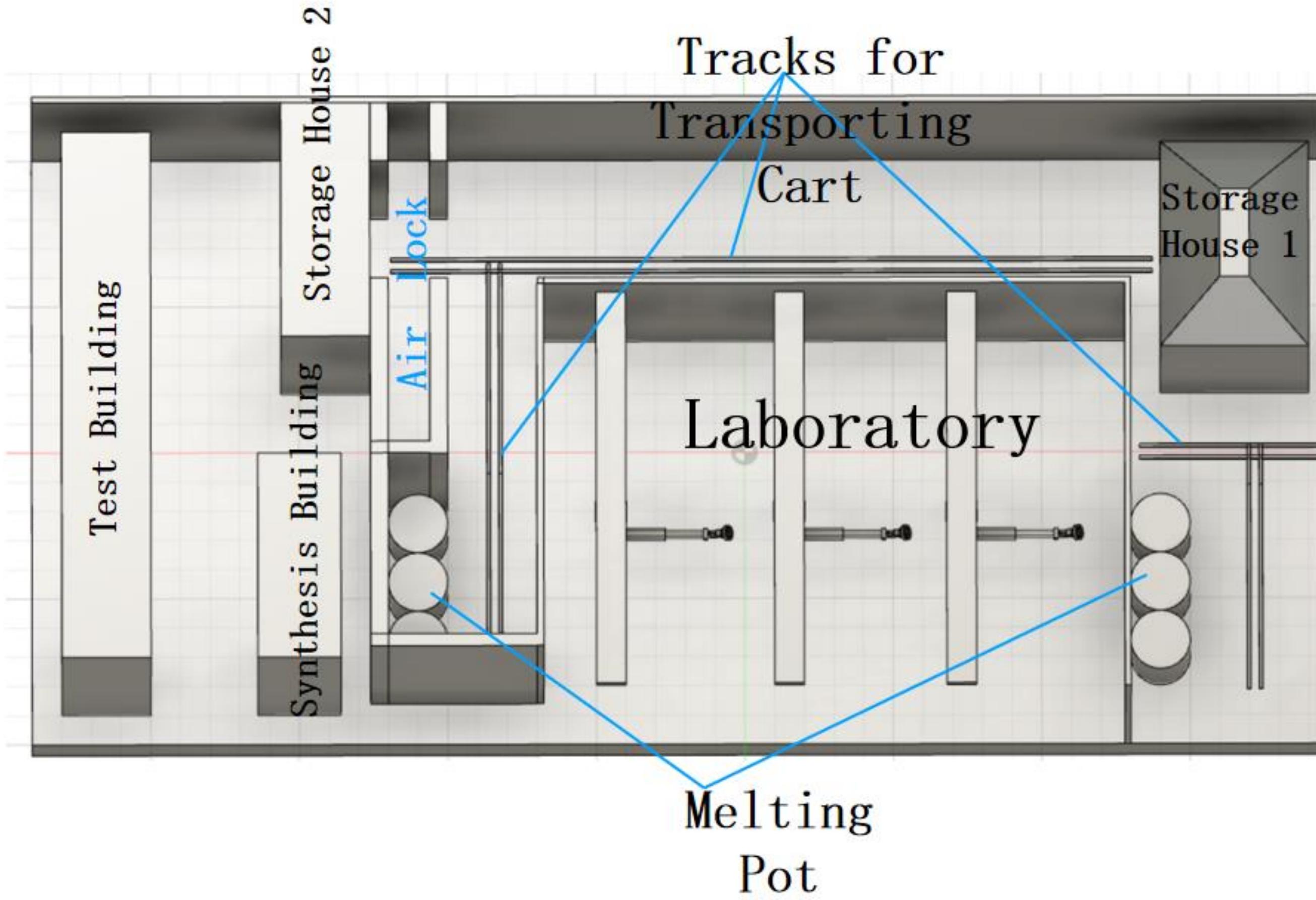
**Location**



Vaulted ceiling	Research lab	Channel
Elevator	Gate	
Agriculture	Industry	
Residential	Life maintenance	



## 4.3.2



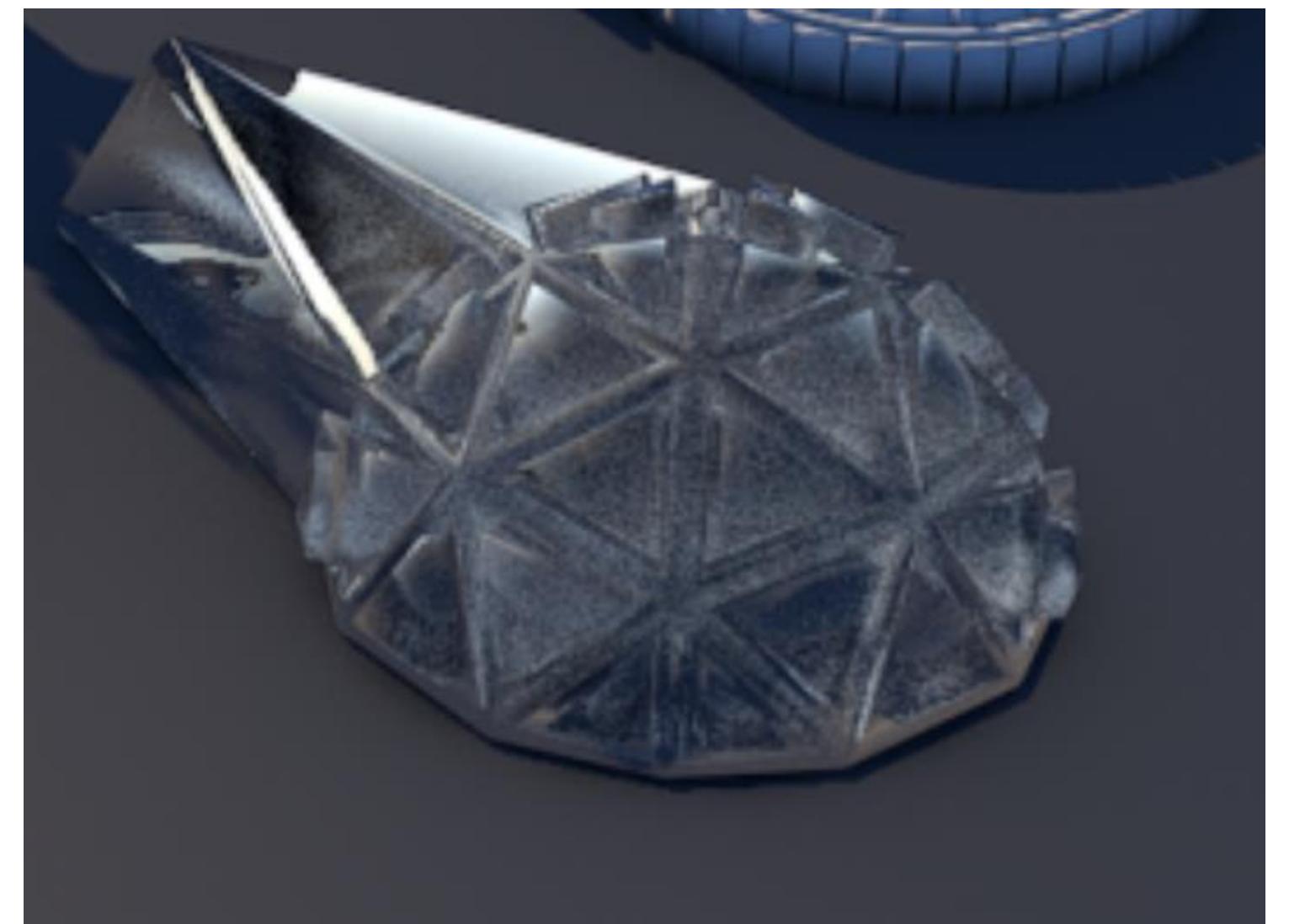
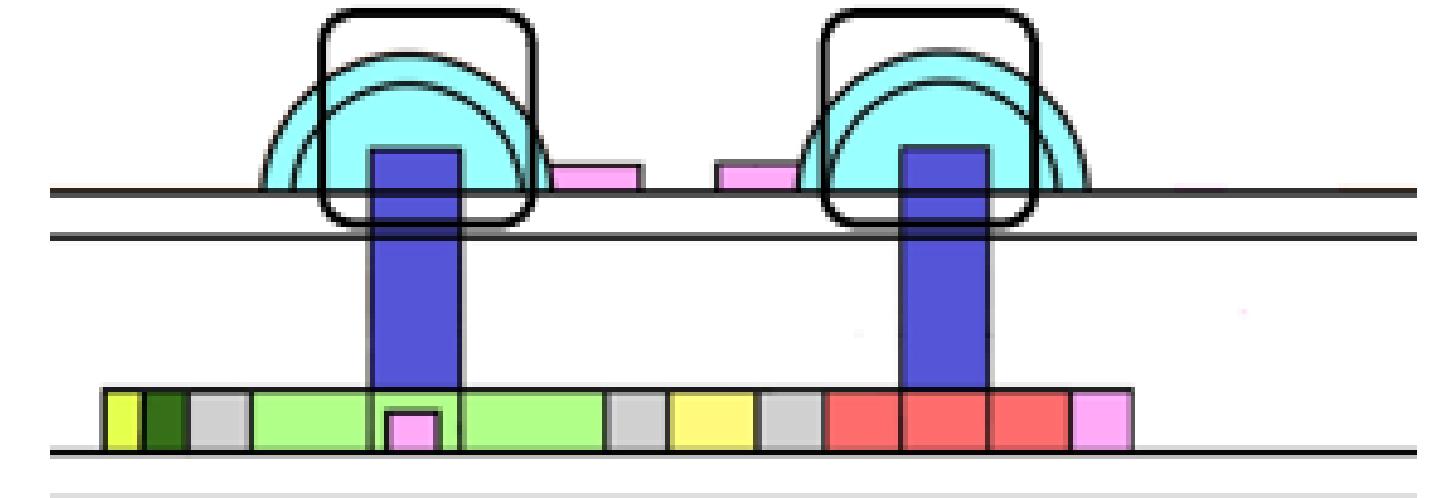
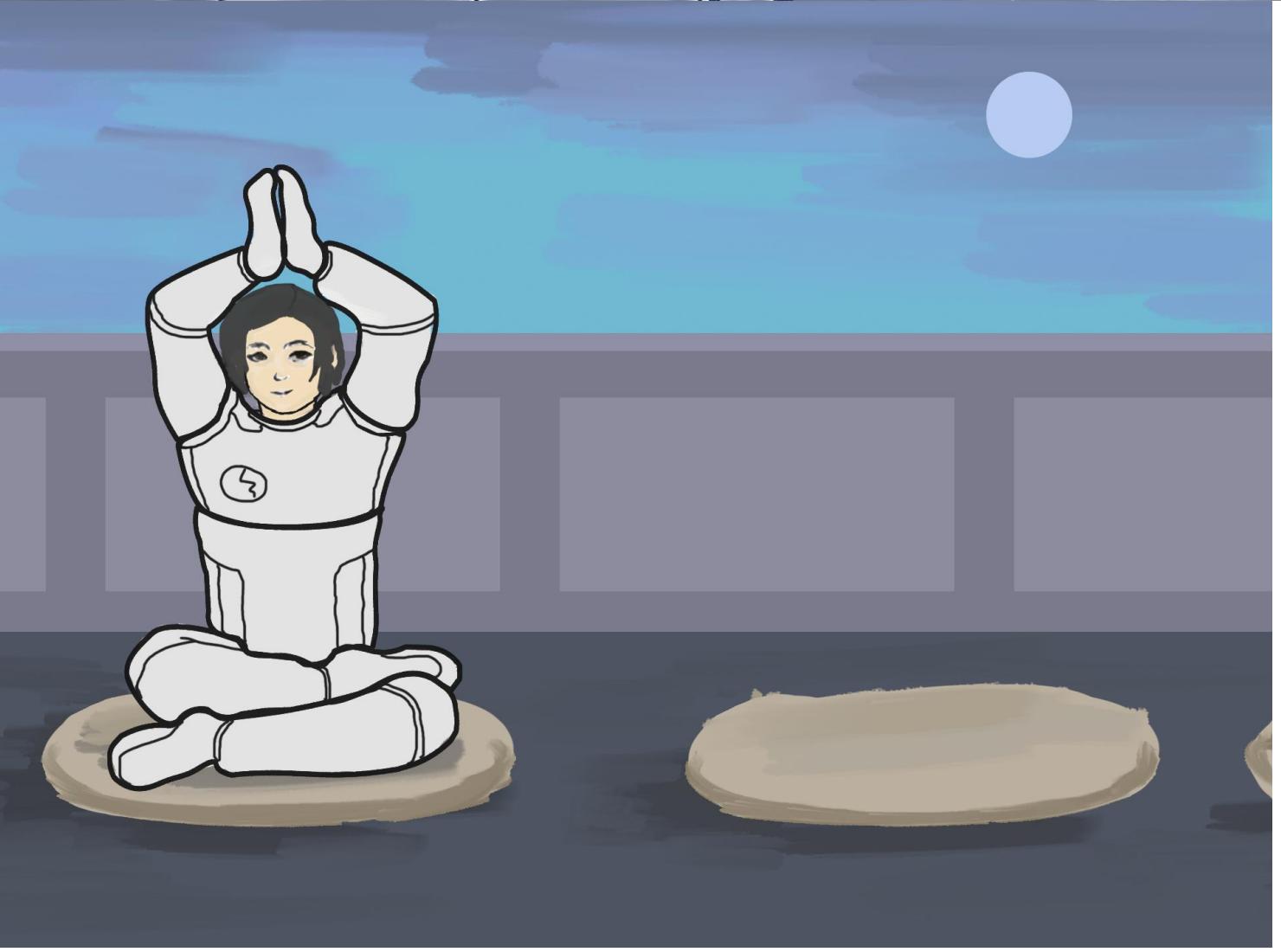
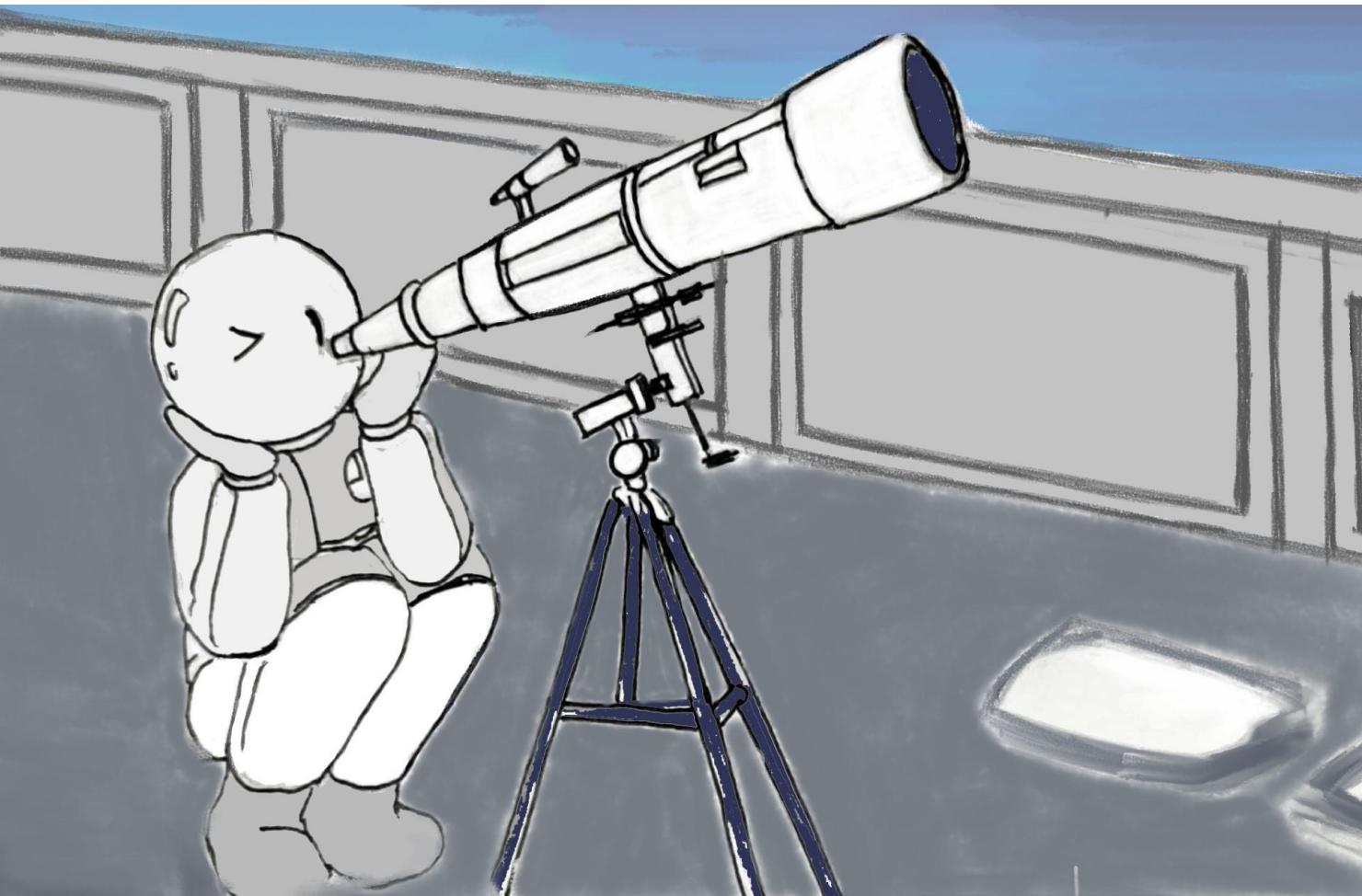
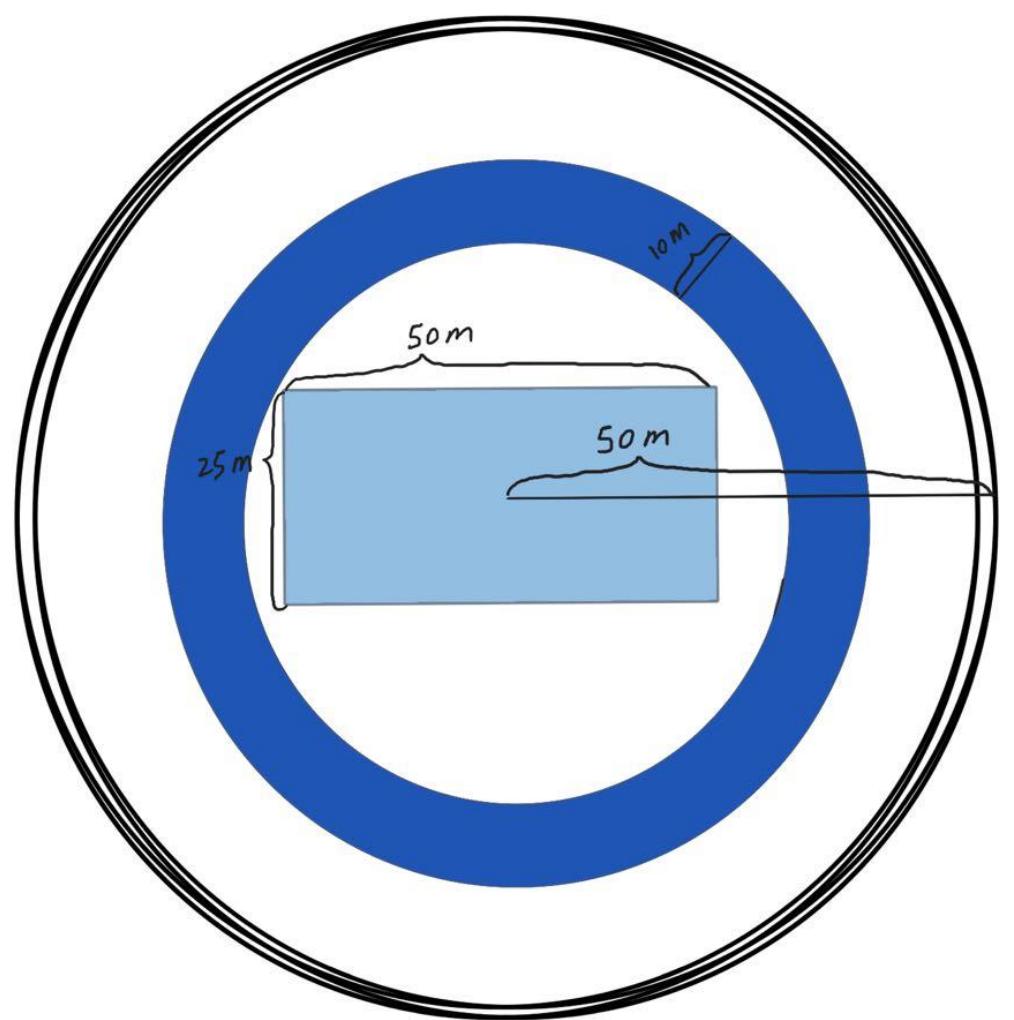
## 4.3.3 Sampling & outside working

- Simplified labs outside
- Sampling sites in different terrains

# 4.4 Recreational Activities

## Observation Deck

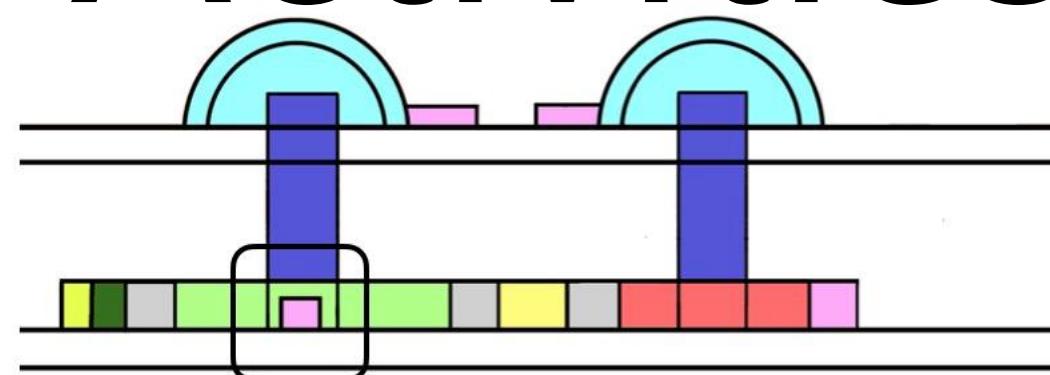
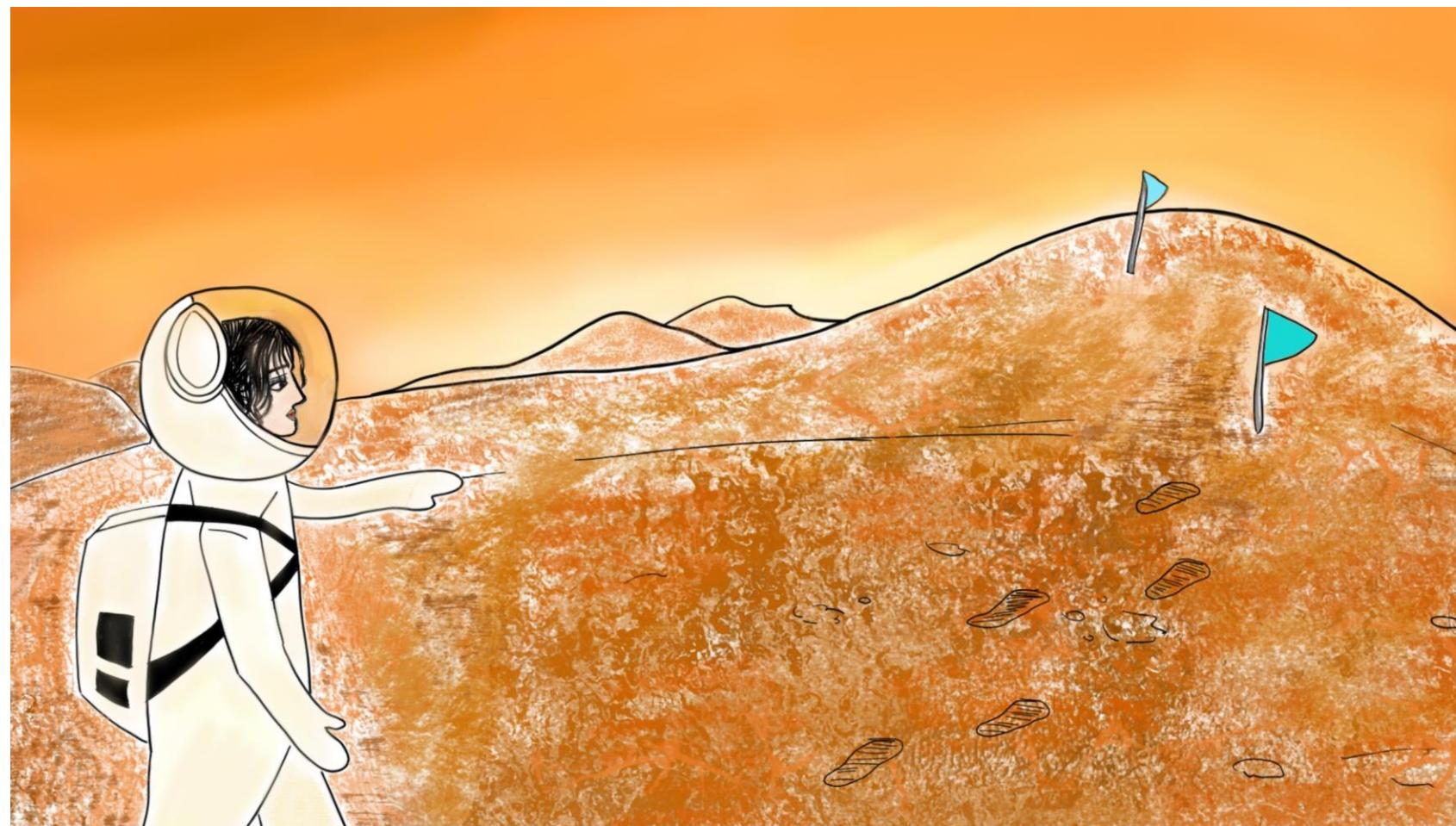
- On the surface,  
inside the glass dome



# 4.4 Recreational Activities

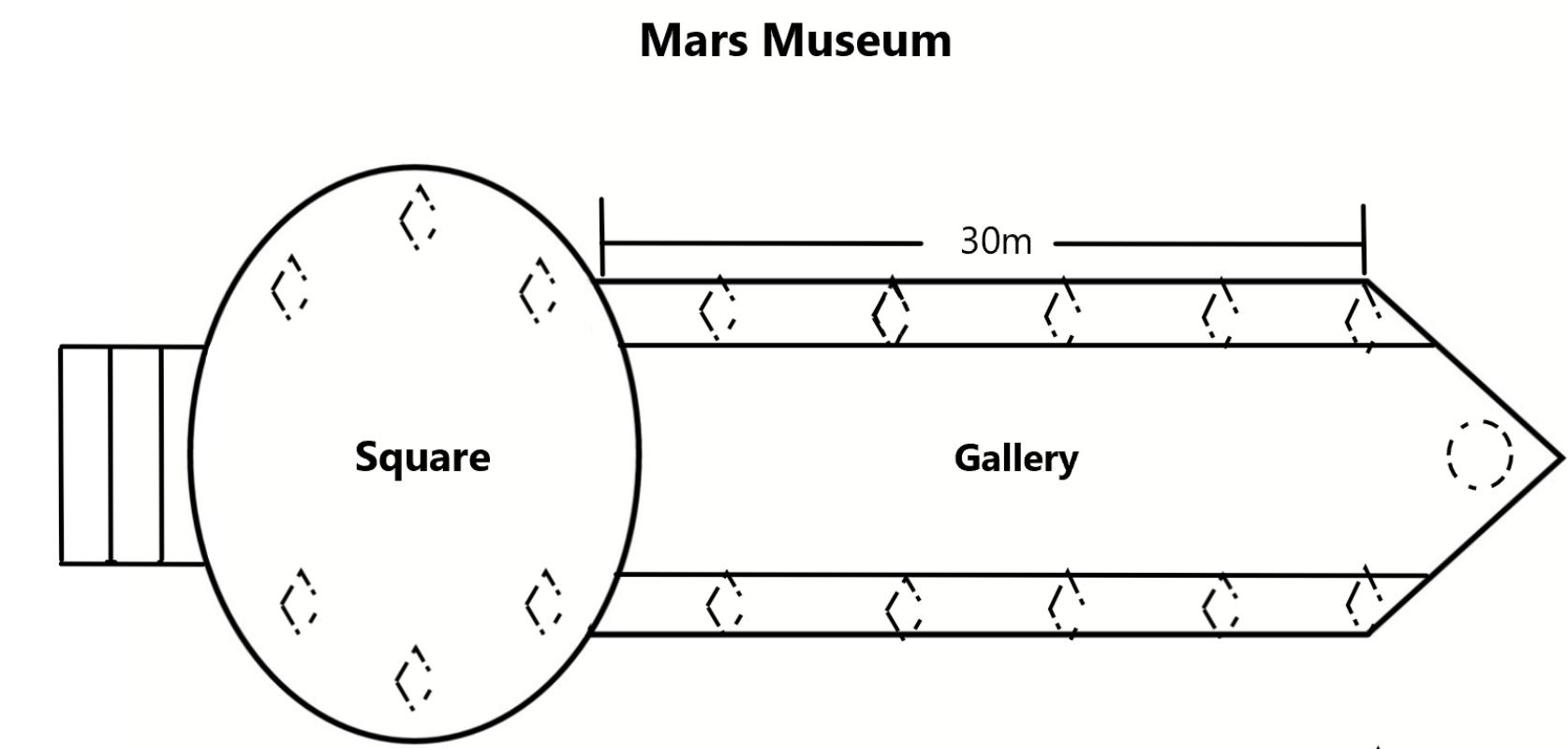
## Mars Museum

- Outside the base
- Orienteering
- On the surface



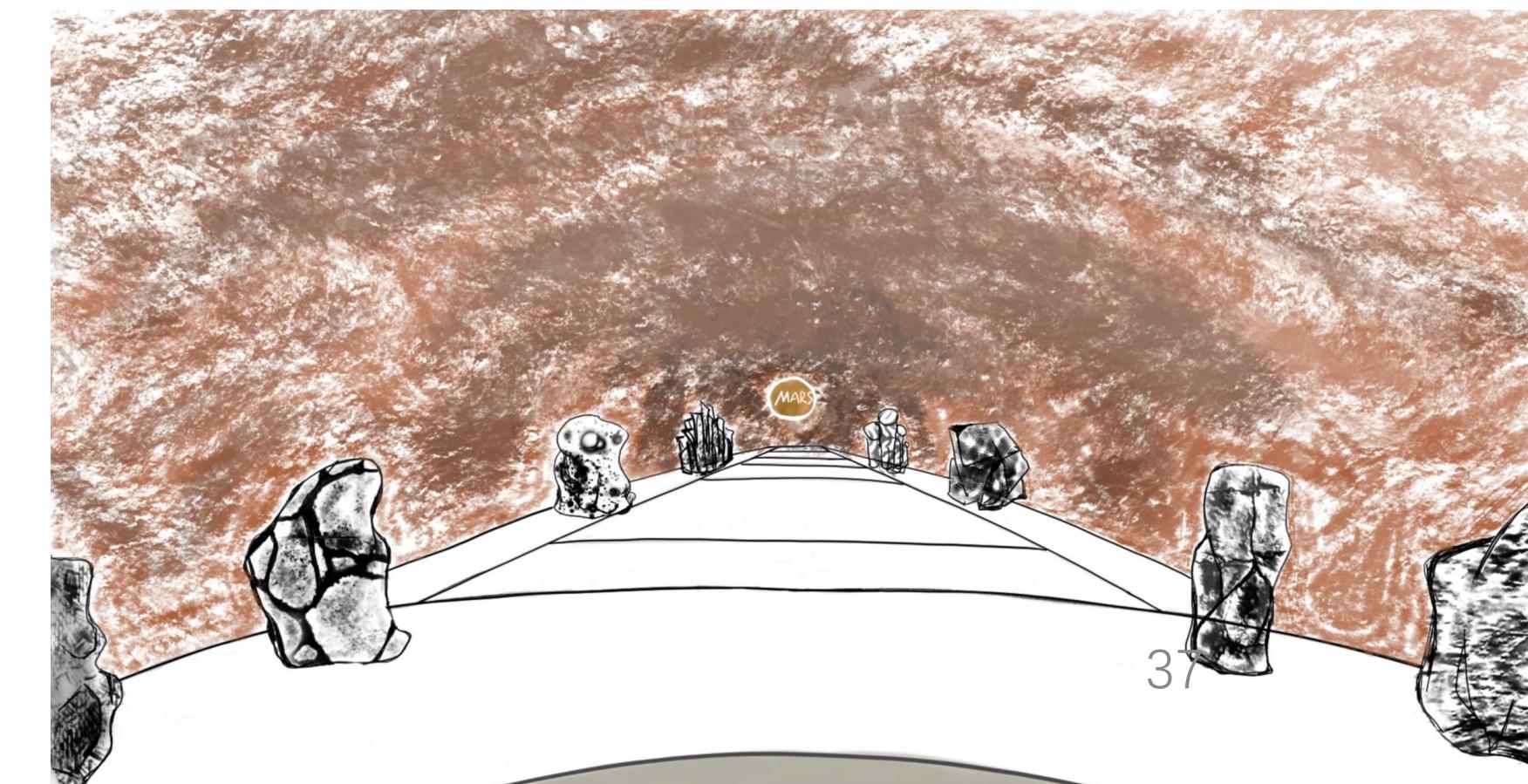
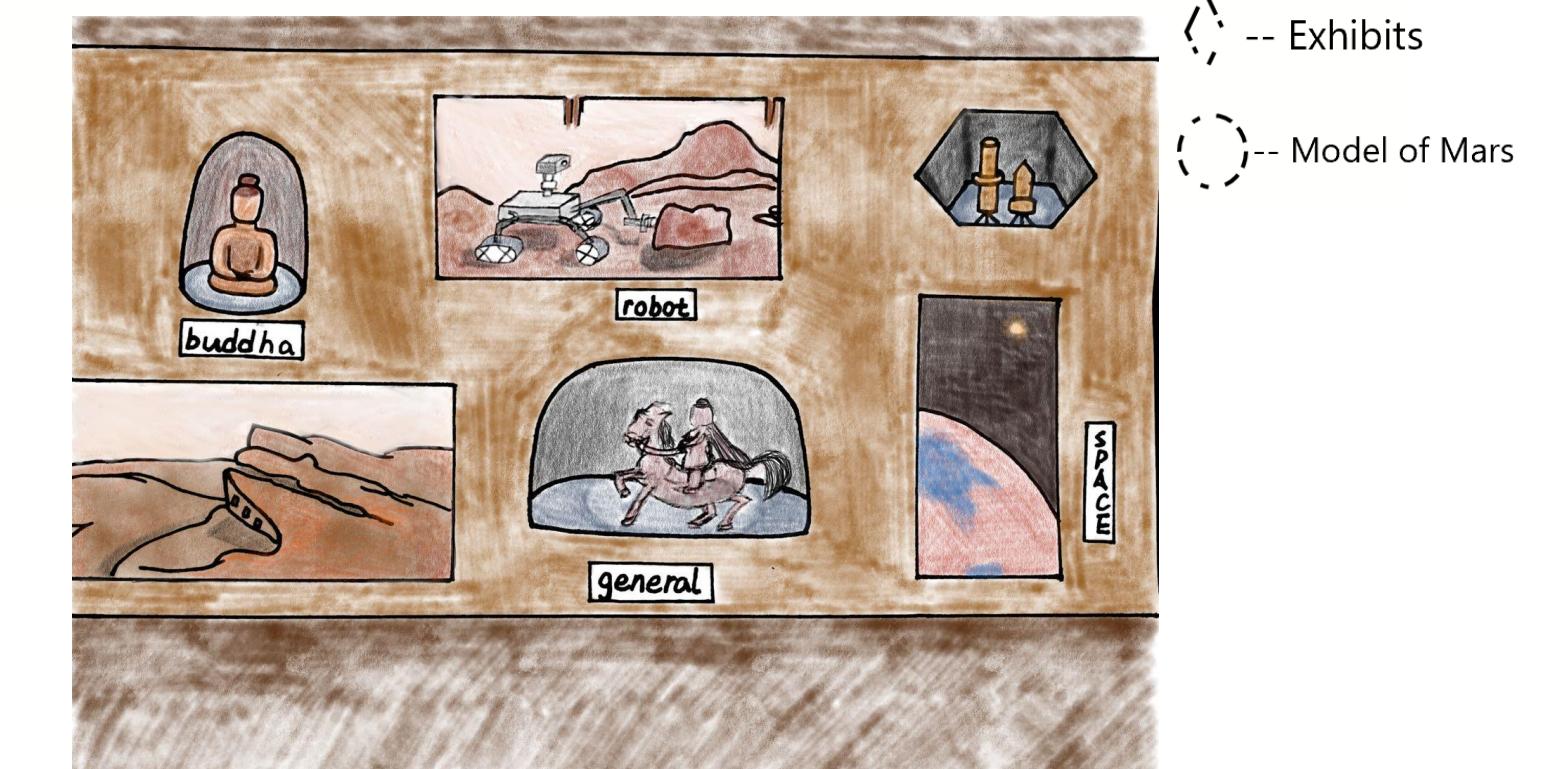
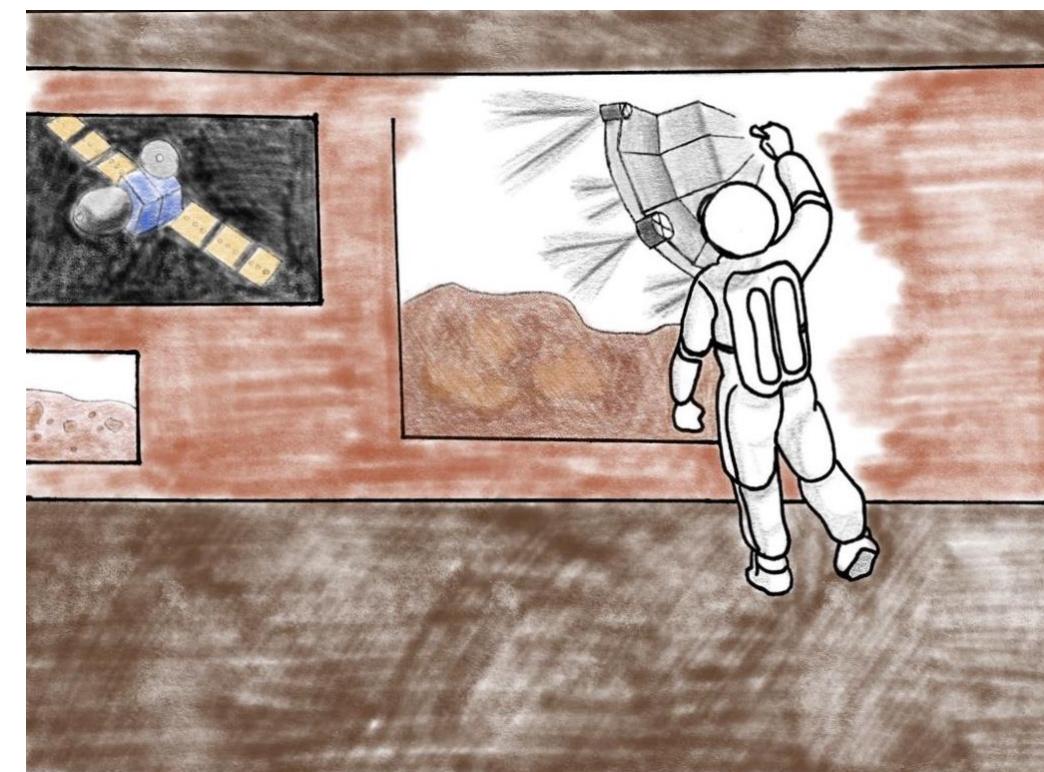
Exit on both sides(front and back)

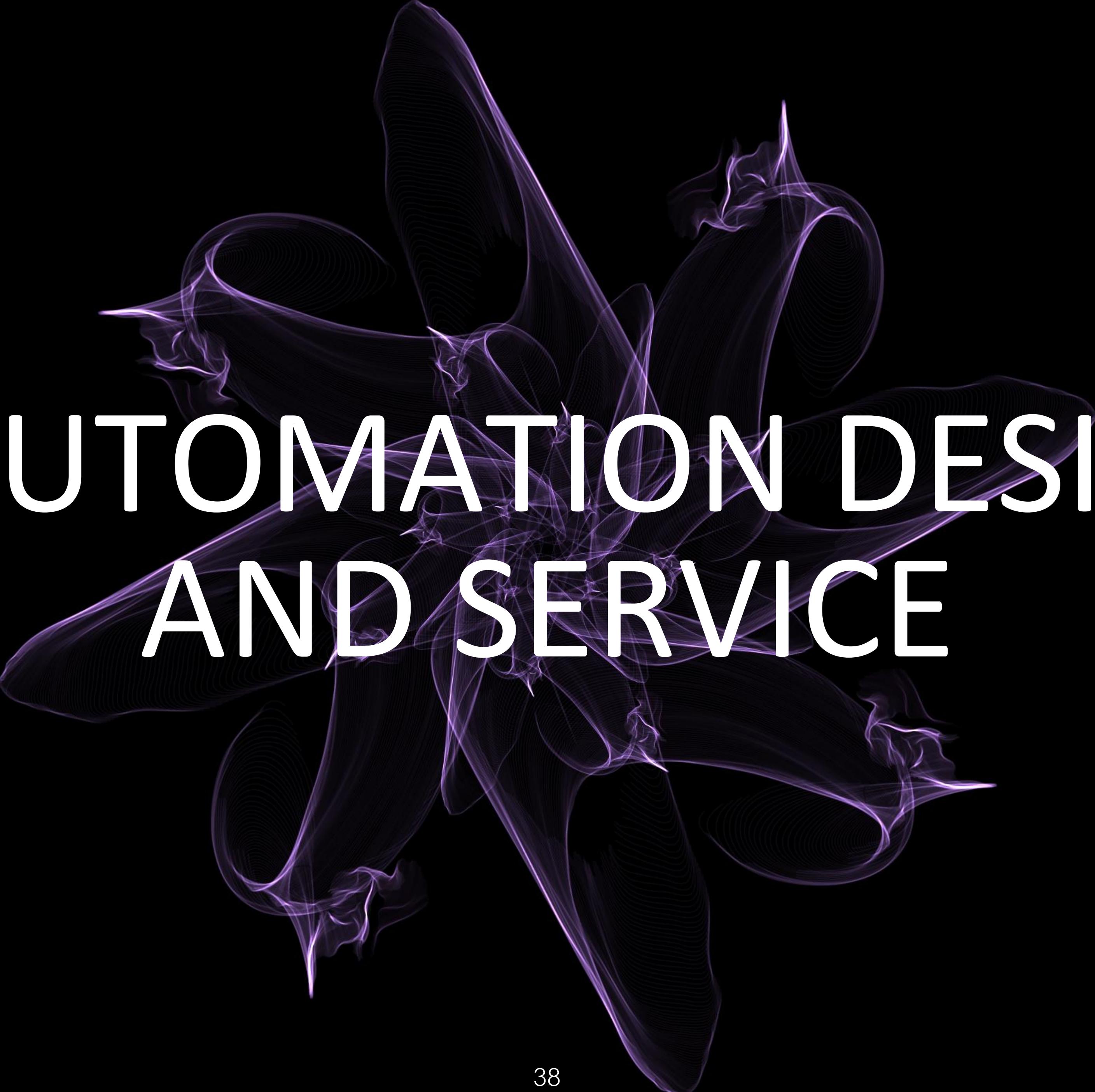
With dust removal chambers



## Interactive Mural

- Outside the base





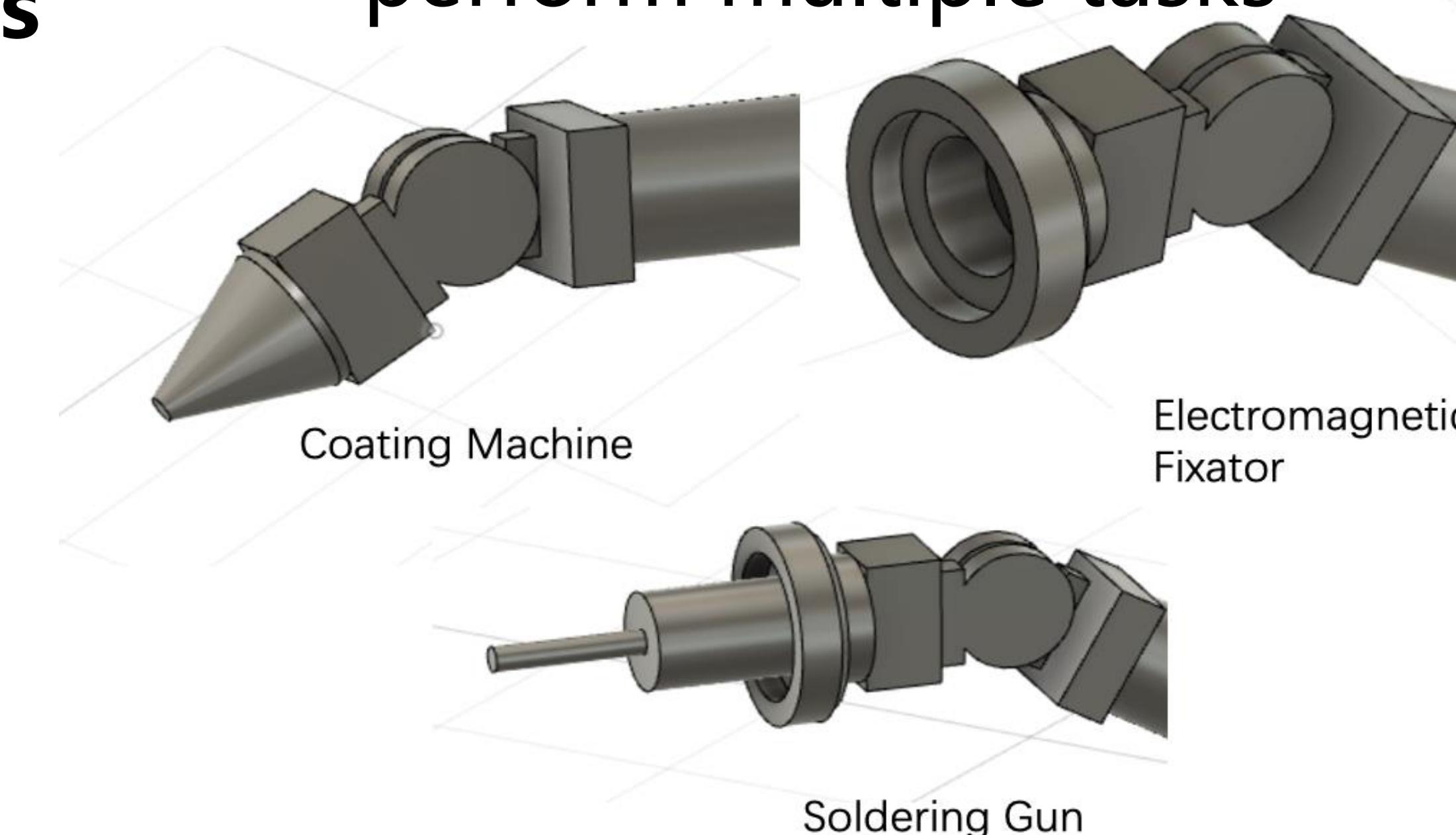
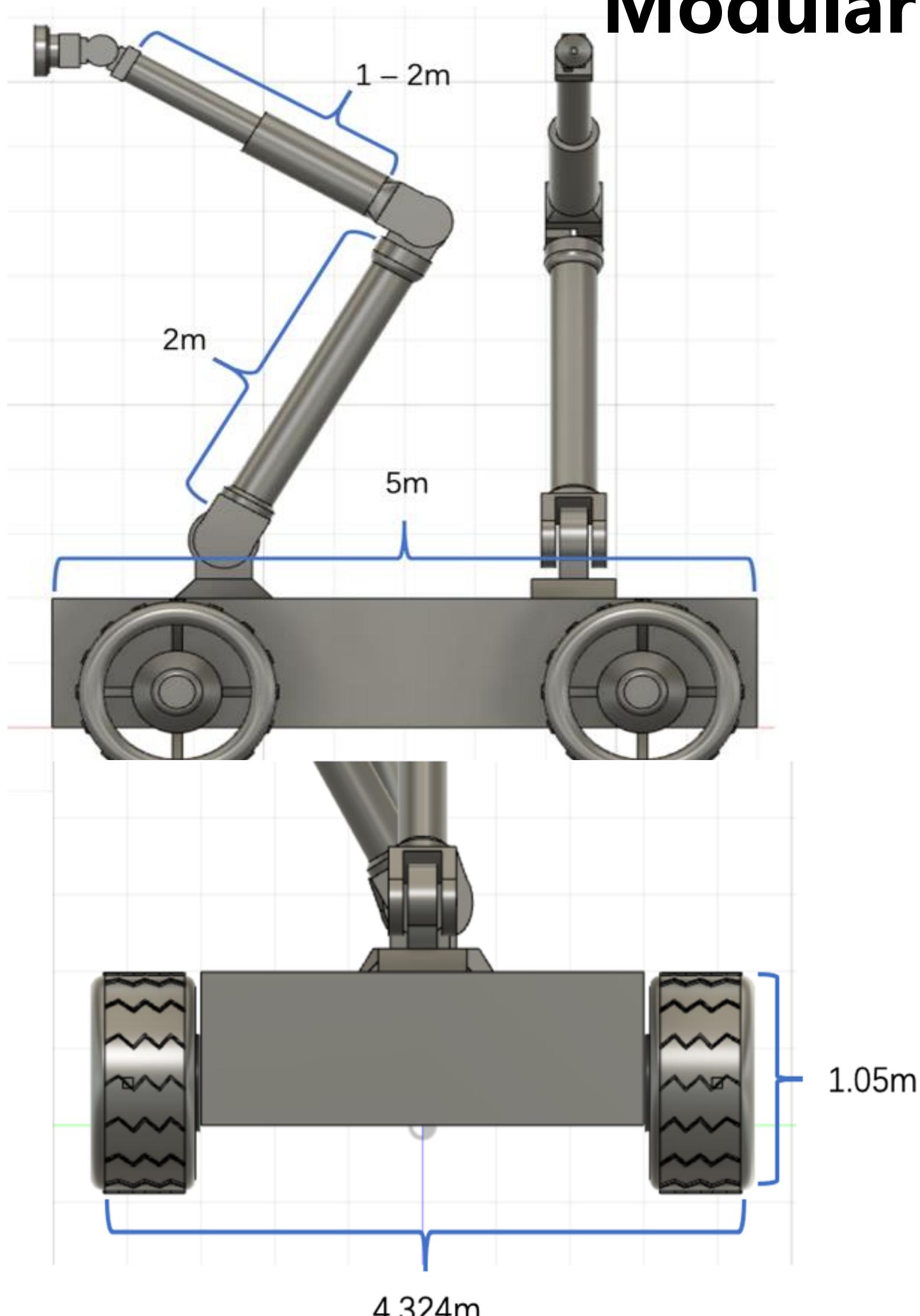
# 5 AUTOMATION DESIGN AND SERVICE

# 5.1 Construction Automation

**Construction Robot A**

Dedicated in interior construction; Able to perform multiple tasks

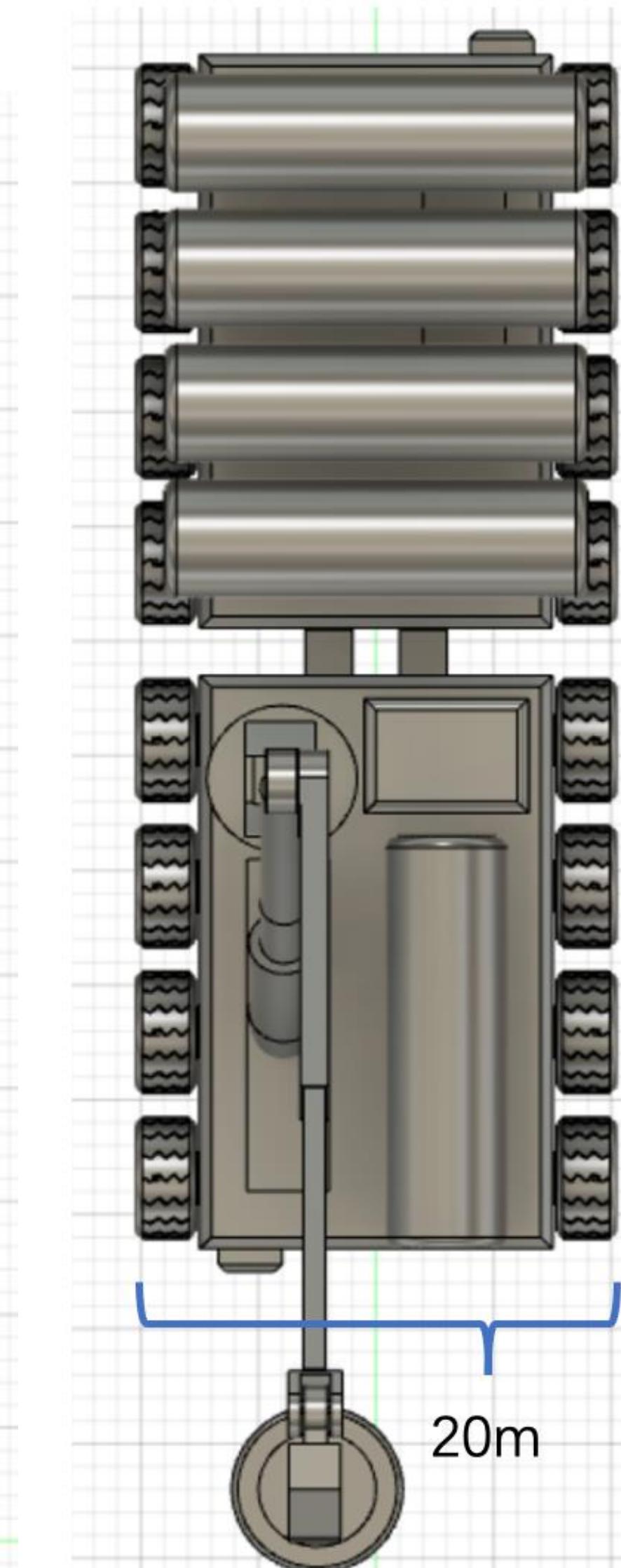
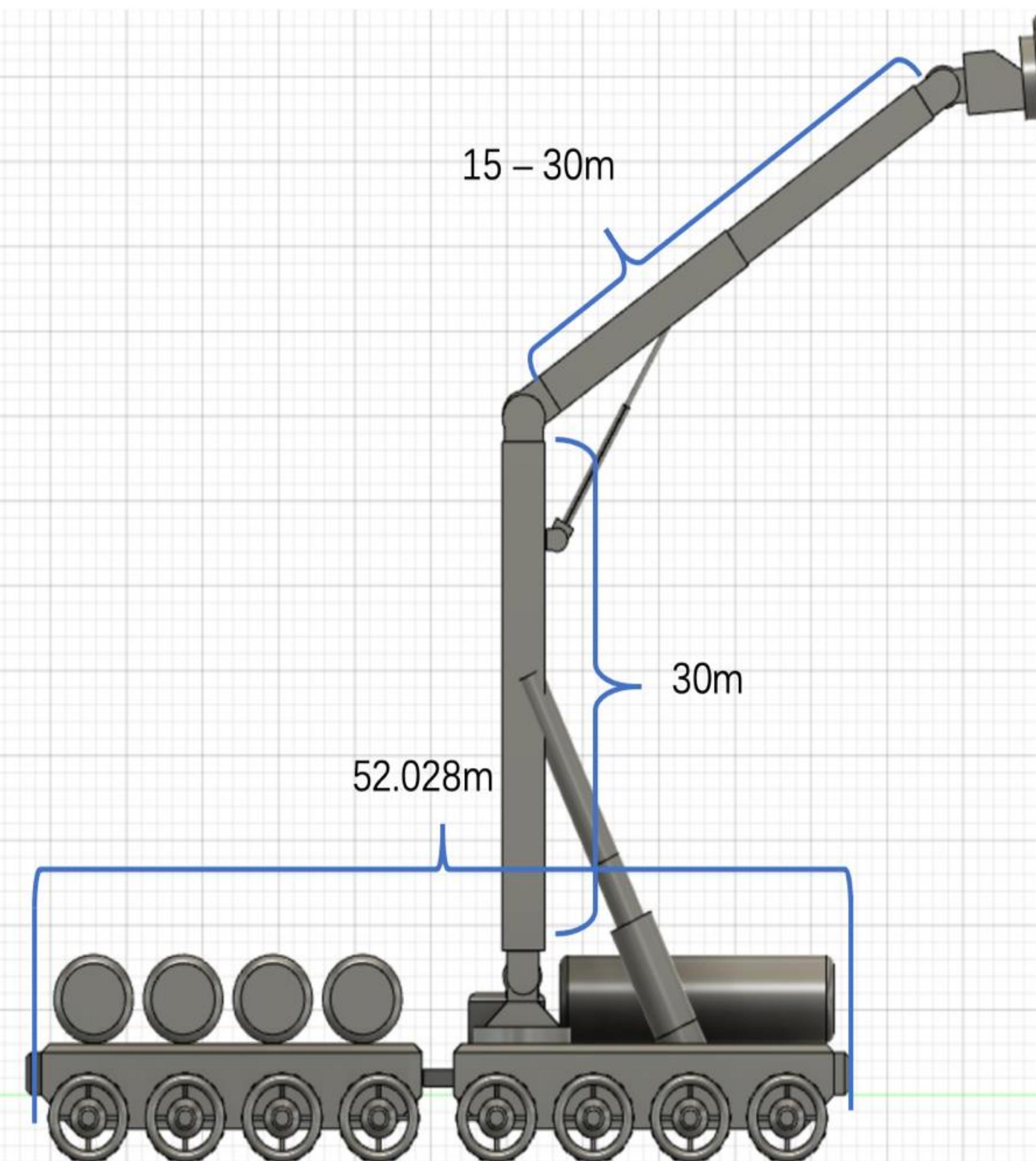
**Modular Units**



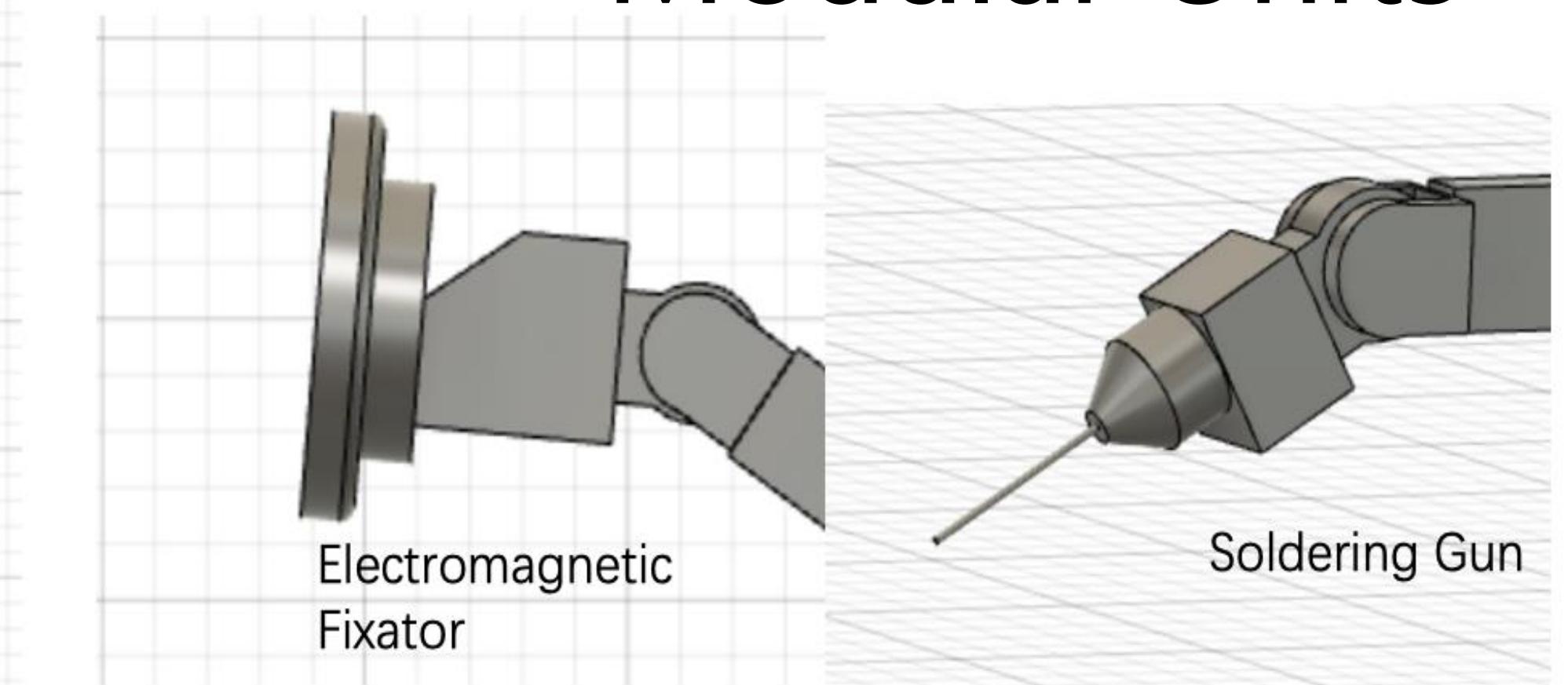
Property	Perimeter
Material	Aluminum-Iron Alloy
Mass	30kg
Amount	100

# 5.1 Construction Robot B

Exterior Construction; 2 tasking units (Listed below)



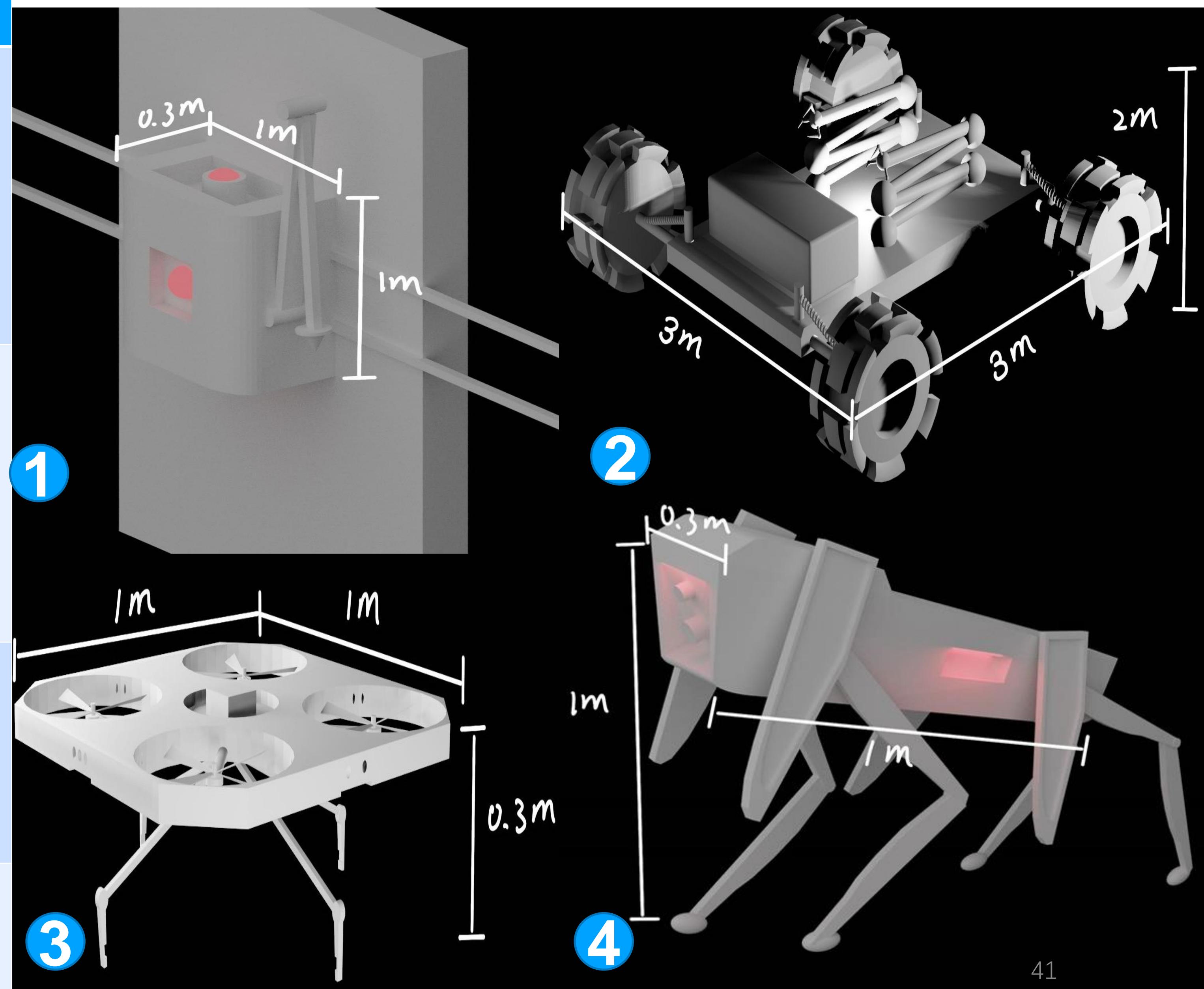
Modular Units



Property	Perimeter
Material	Aluminum-Iron Alloy
Mass	1020kg
Amount	4

# 5.2 Maintenance & Emergency Reaction

Robots	Functions	Location & Source
Outer Surface Patrolman	Monitor the factory conditions 24/7 Fix Minor Harms	Operate on specific maintenance rails Built on Mars
Fixer	Check Industrial Areas Once A Week Repair Significant harms	Operate on designated tracks Built on Mars
Anti-Fire	Find Source of fire And put it out	Averagely distributed in All chambers Built on Mars
The Goat	Medic robots Provide fast medical aid	Stored in warehouses Built on Mars



# Emergency system

**Basement  
Function**

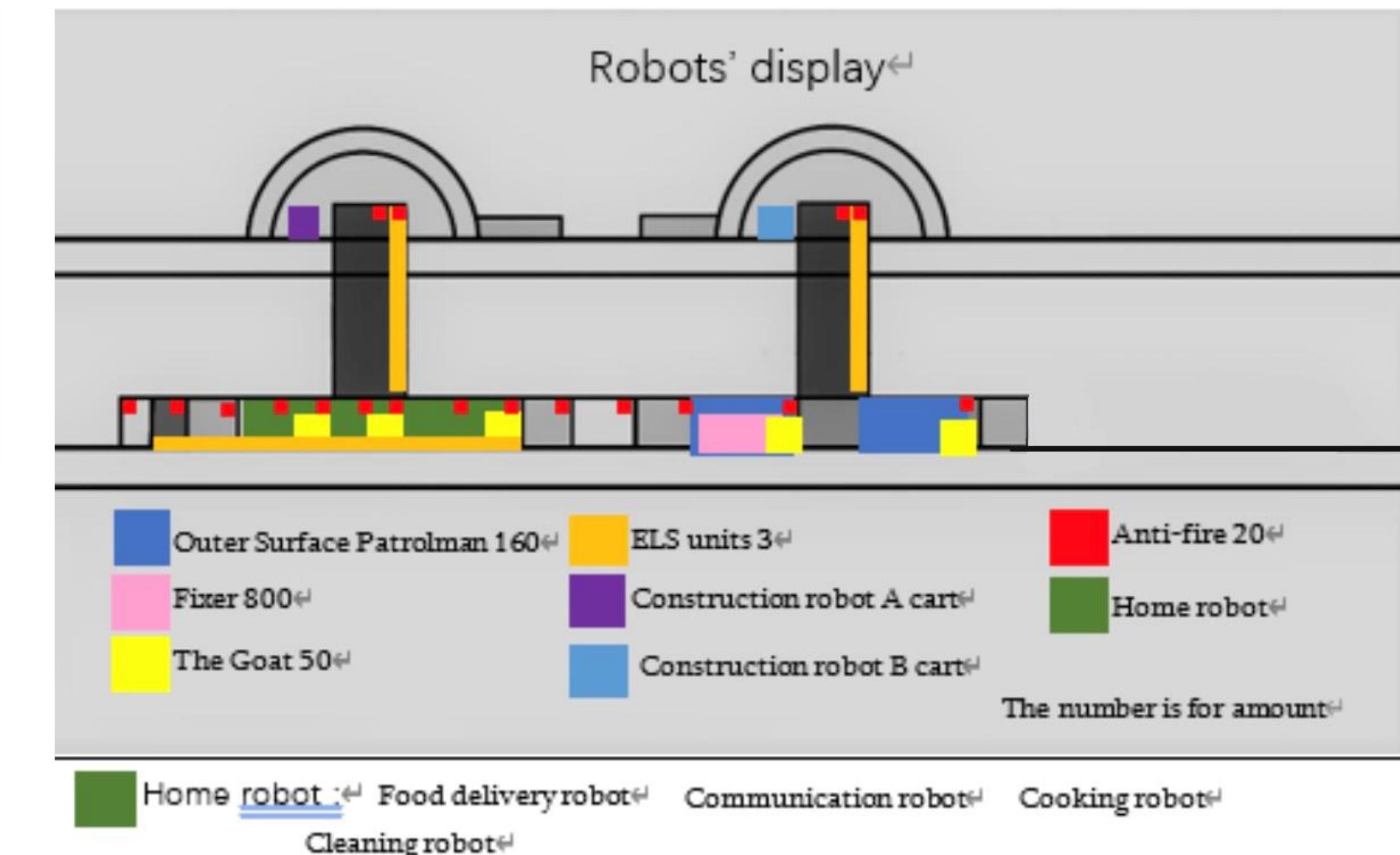
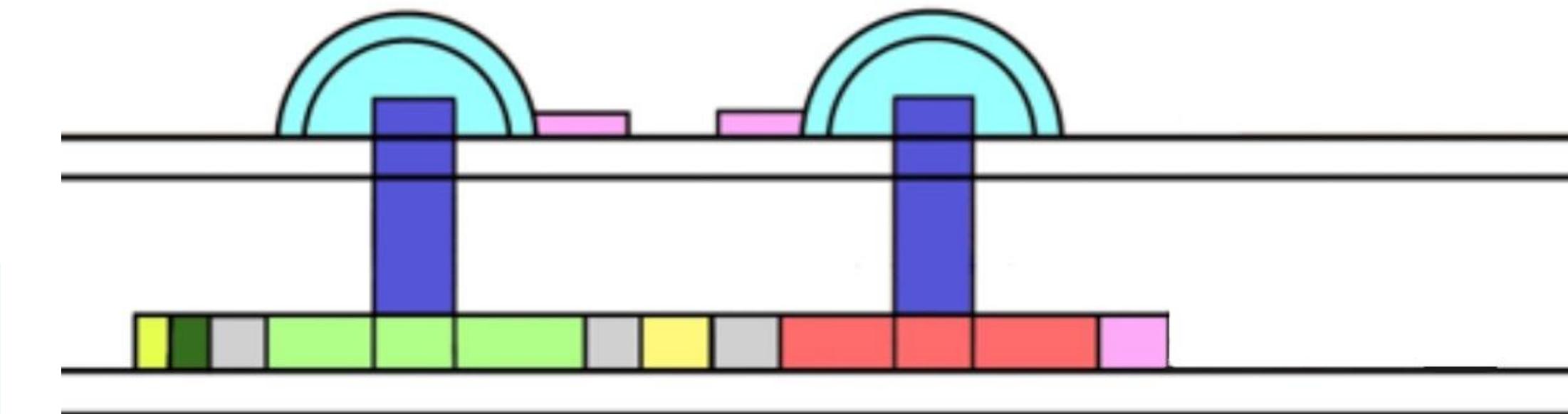
**Personal safety**

Backup System

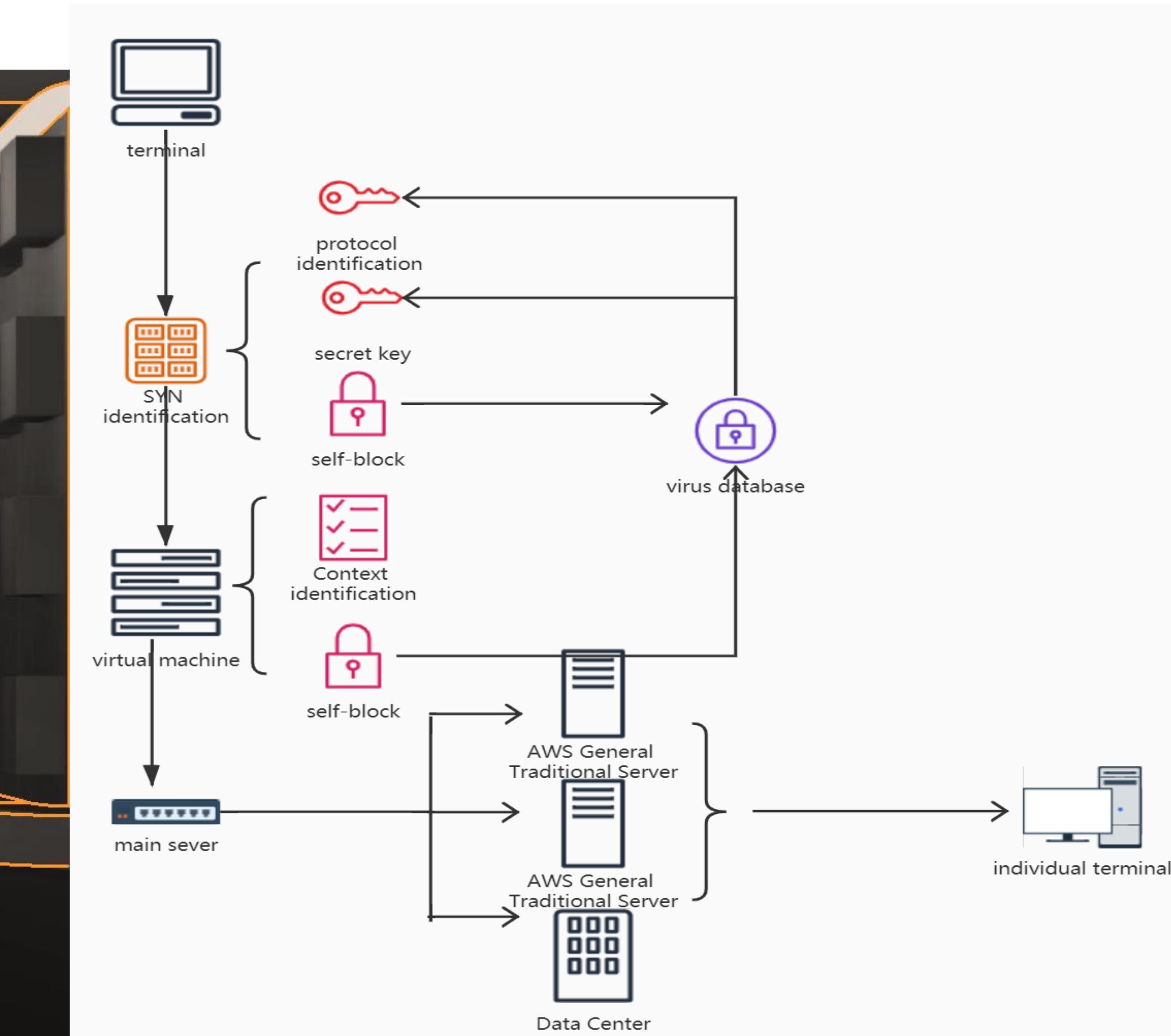
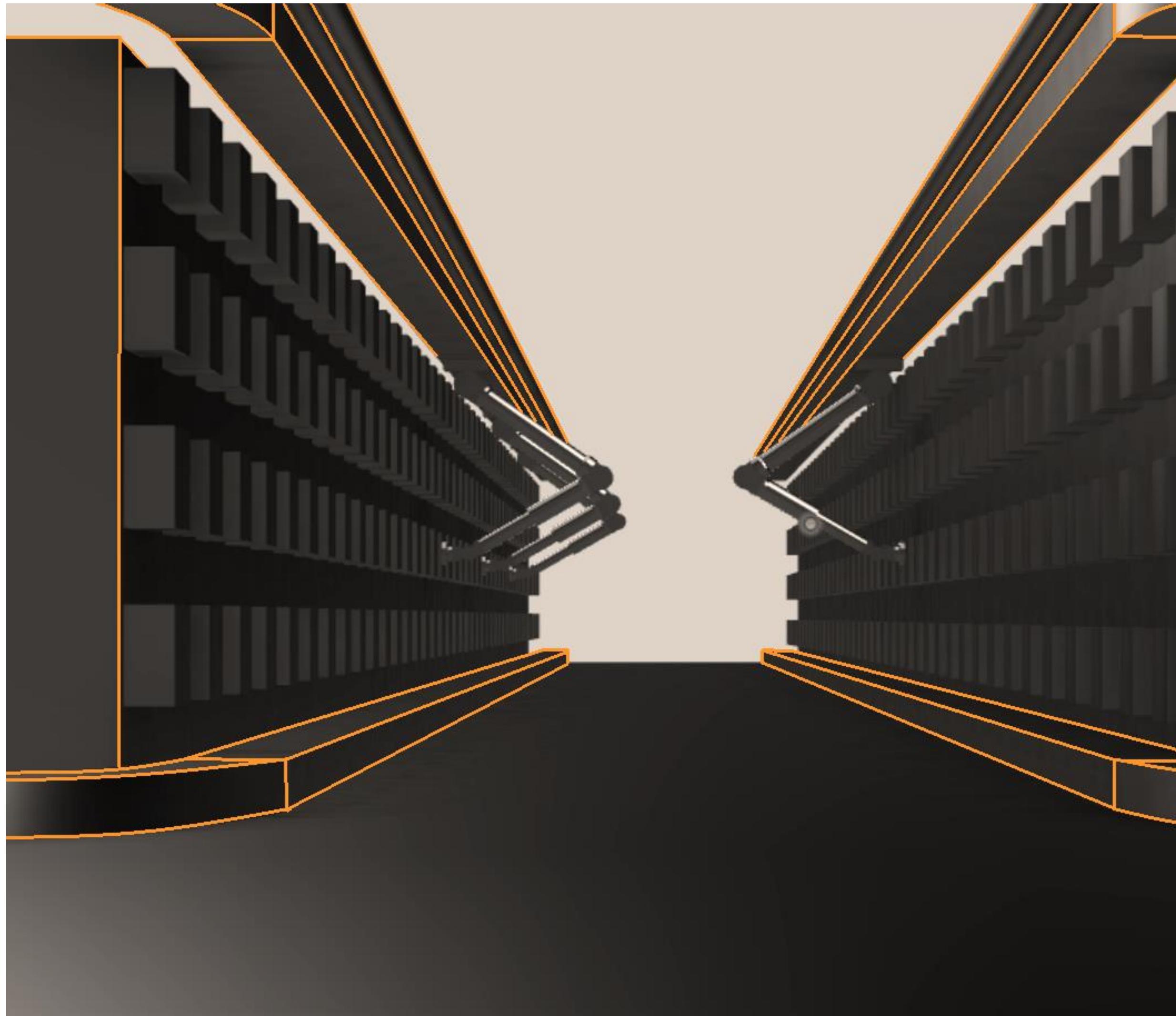
Life Supporting  
Units

Function: Excess  
Battery

Function: Personal  
Oxygen Supply



# Computer system



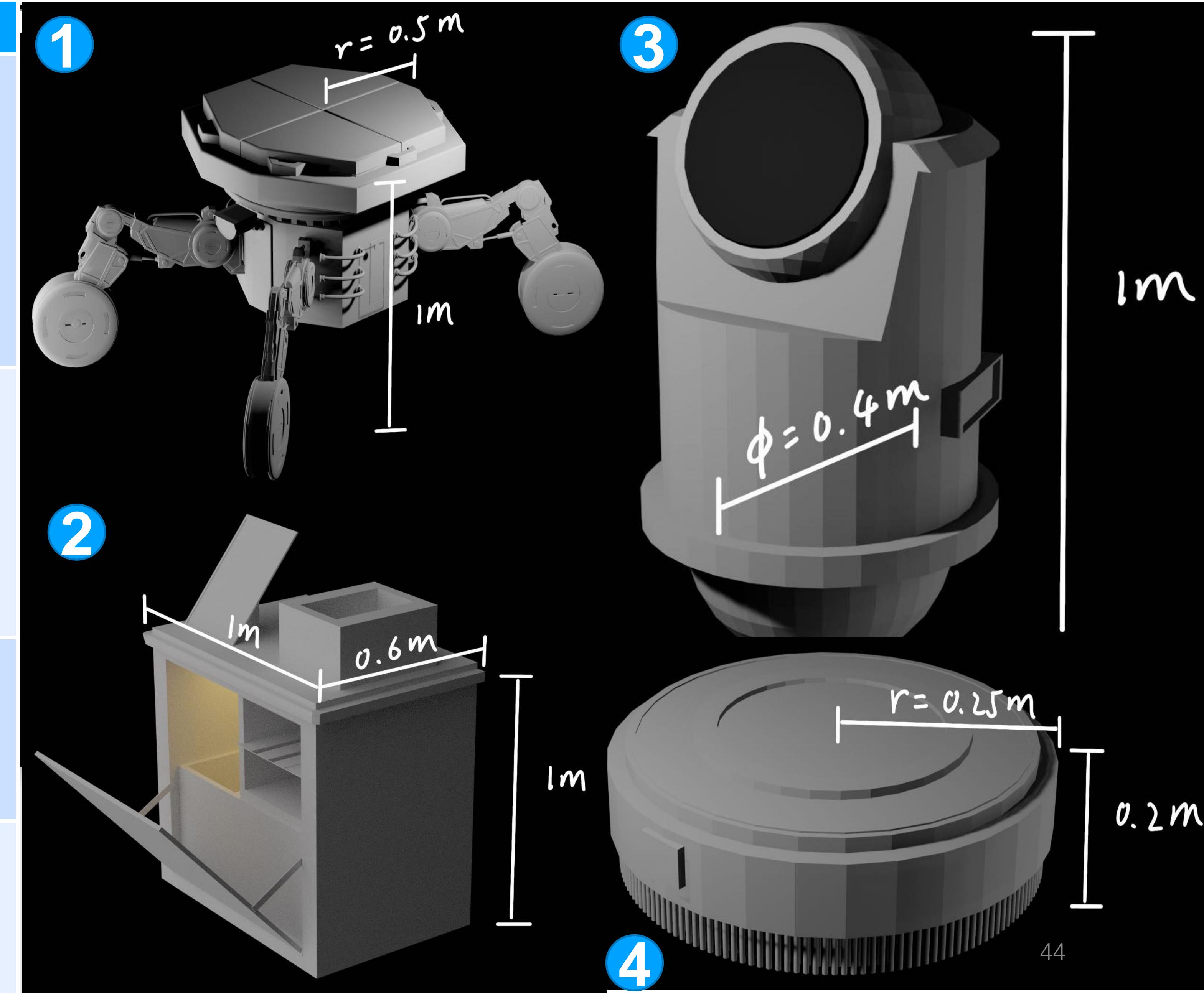
# 5.3.1 Home robots

Robots	Functions	Number
Food Delivery Robots	Delivery food with great efficiency	50

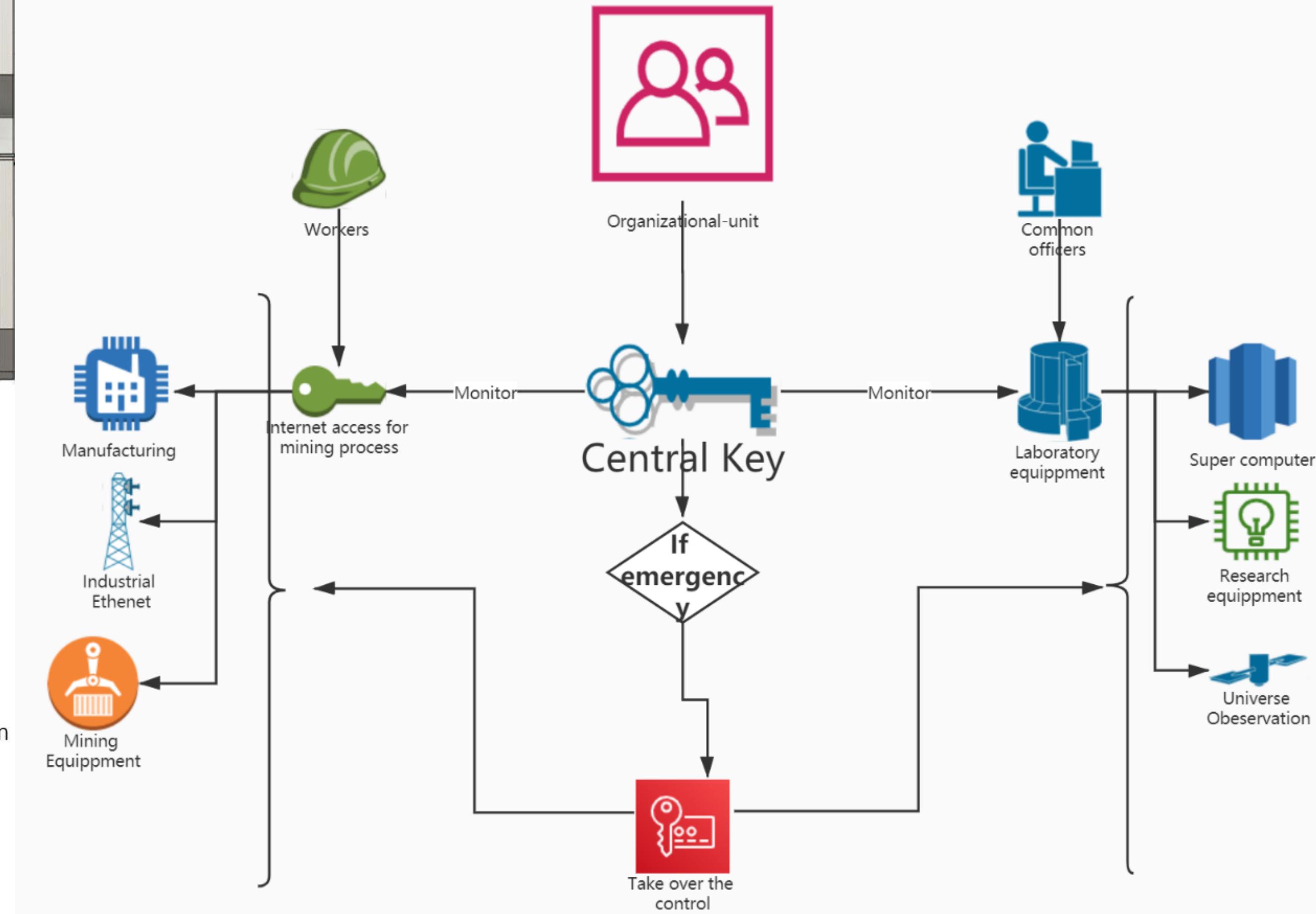
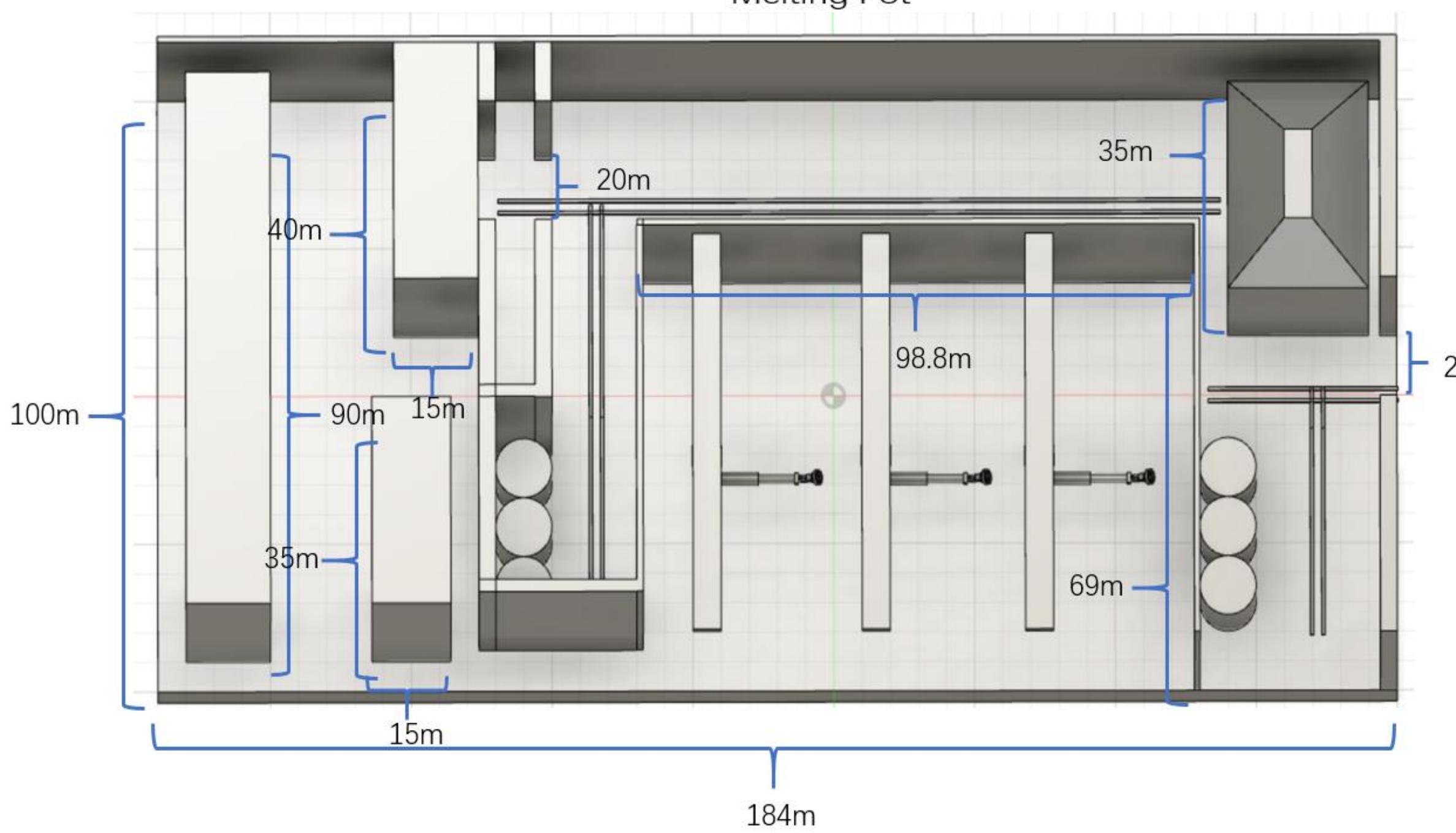
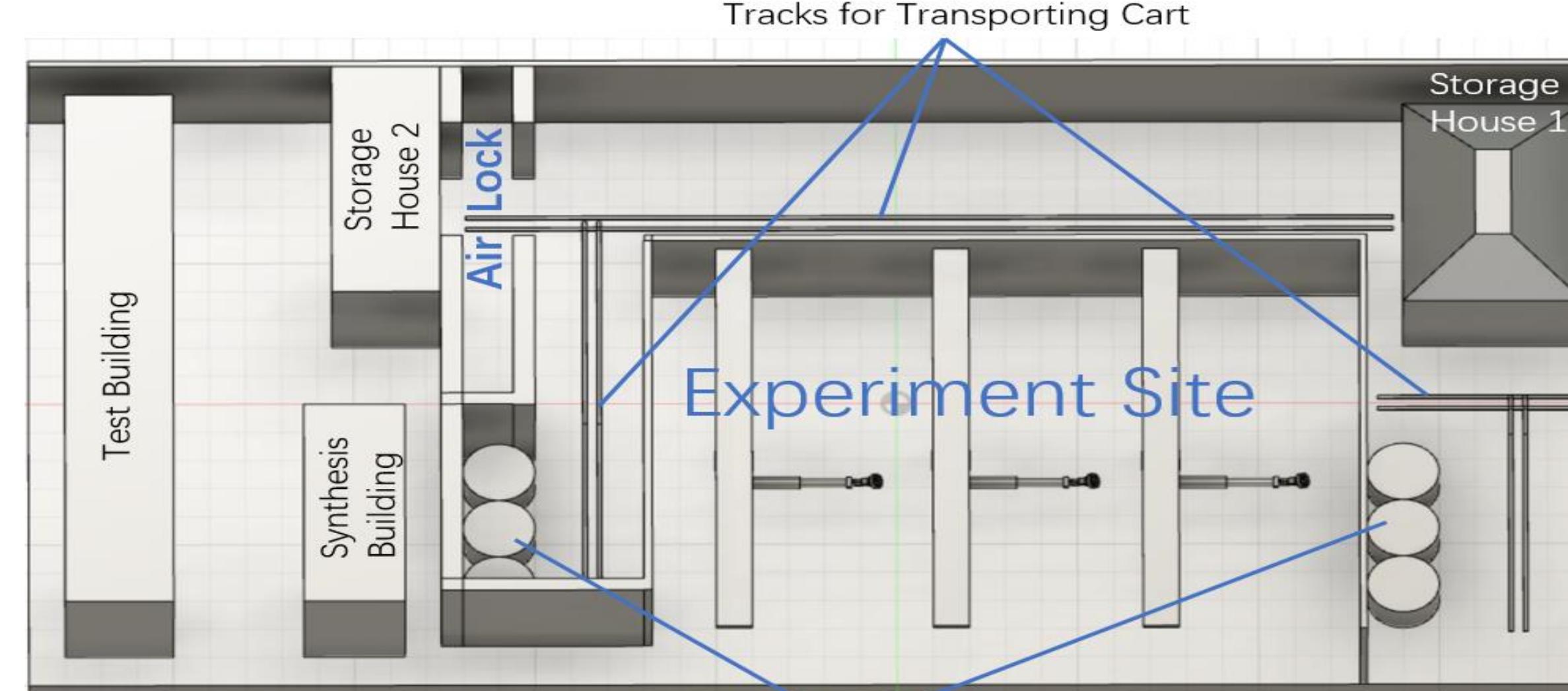
Robots	Functions	Number
Cooking Robots	Make delicious cuisine automatically	50

Robots	Functions	Number
Communication robots	AI friends	100

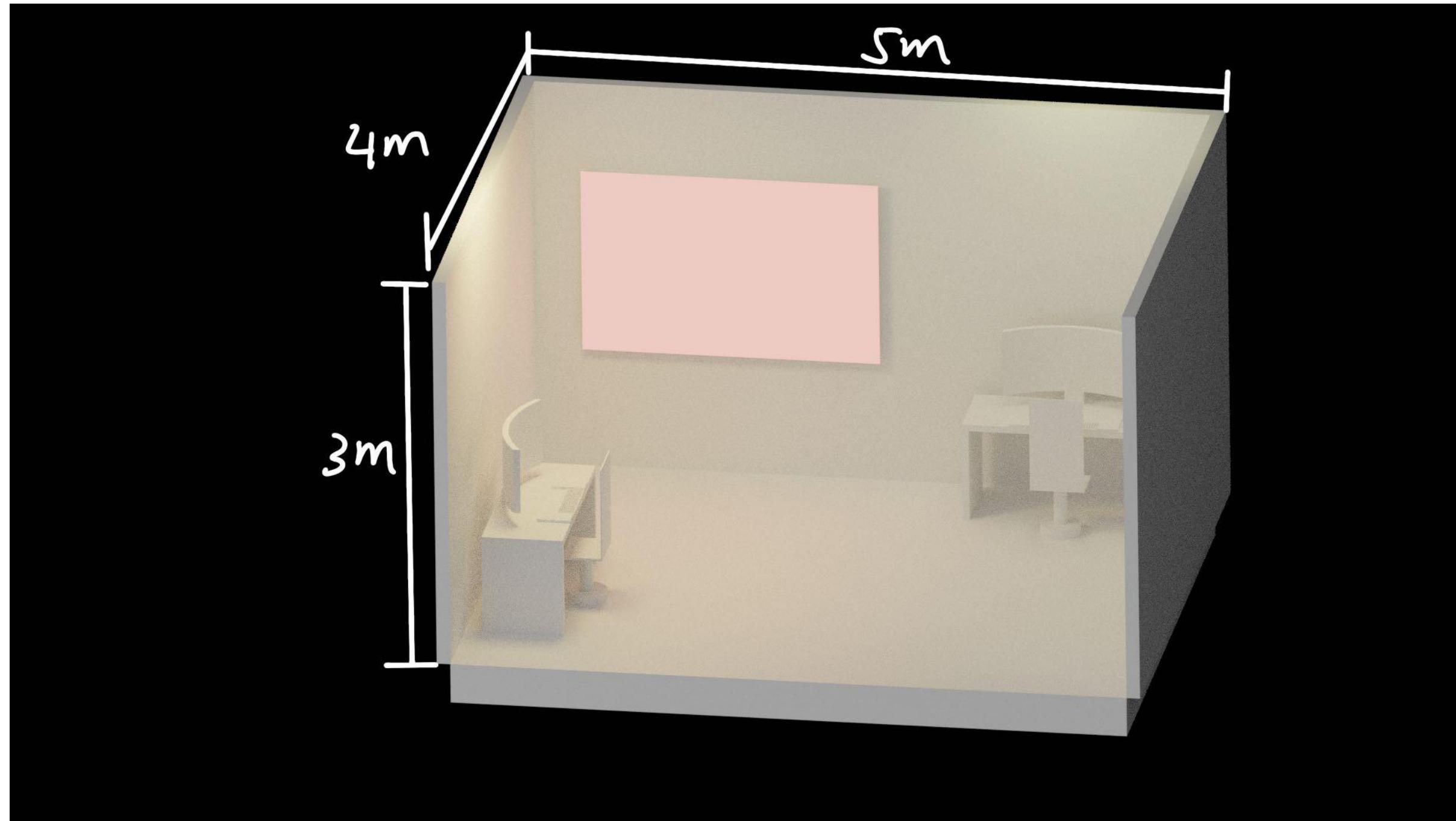
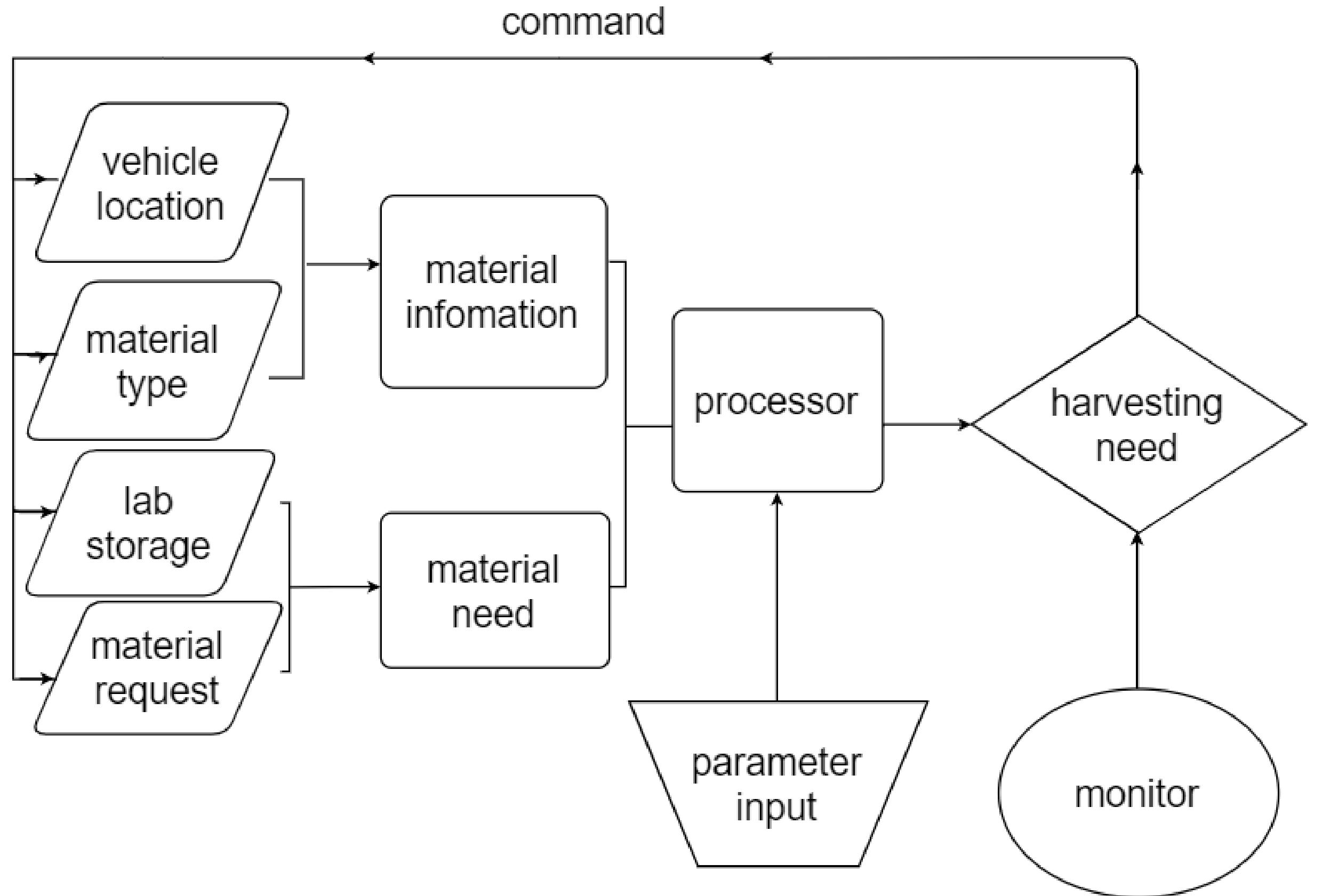
Robots	Functions	Number
Cleaning Robots	Maintain sanitation	300



# 5.3.2 Lab Automation



# 5.4 Control System



# 6 SCHEDULE AND COST

# 6.1 Schedule

PHASE	Material	Volume/m^3	Quantity/CASSSCs	Total Mass (pound)	Purchasing Cost/dollar	Transport Cost (1 pound*750 dollar)	Total Cost/ dollars
<b>PHASE 1</b>							
Robot Production (Earth)	Fixer	288		28444	$2.75 \times 10^4$	21333000.00	21360500
Robot Production (Earth)	The Goat	45		10000	9650	7500000.00	7509650
Docking Construction	mgo	30564.55	161	2444444.44	1650000	1833333330.00	1834983330
Docking Construction	TiAl	152822.77	801	13000000000	870000000	975000000000.00	97587000000
IOC Construction	CASSSCs		10			0.00	
Engineer Departure				16000		12000000.00	12000000
Double-layered Gate 1 Construction	Aluminum alloy	180	1	1278000	766800	958500000.00	959266800
Elevator 1 Construction	Aluminum alloy	92625	485	6600000000	3975000000	495000000000.00	4.95398E+11
Exterior Construction (Life Maintenance & Agriculture)	Aluminum alloy and bare copper wire	48088.8	252	3000000000	2100000000	225000000000.00	2.2521E+11
Life Maintenance Construction	Battery/graphene	1570	9	7919778	17819500000	5939833500.00	2.37593E+11
Atmosphere Provision	Titanium alloy	149	1	1490500	2682900000	1117875000.00	3800775000
Water Provision							
Phase 1 Total							1.06242E+12
<b>PHASE 2</b>							
Exterior Construction (Residential)	Aluminium alloy	375000	1964	2,662,500,000	9,984,375,000	199687500000.00	2.00686E+12
Residential Area Construction	Aluminium alloy	7450	40	1,129,250	466,925,830	846937500.00	1313863330
Agriculture Area Construction	Aluminium alloy					0.00	
Airlock Construction (Between Residential & Lab)	Aluminium alloy	12500	66	443,750,000	1,664,062,500	332812500000.00	6.67289E+11
Exterior Construction (Lab)	Aluminium alloy	62500	328	88,750,000	332,812,500	66562500000.00	66895312500
Research Lab Construction	Aluminum alloy and bare copper wire	62500	328	443,750,000	1,664,062,500	332812500000.00	334,476,562,500
Research Lab Construction	Aluminium alloy	104166	546	150,000	5,000,000	112500000.00	117,500,000
Phase 2 Total							3.07695E+12
<b>PHASE 3</b>							
Airlock Construction (Research Lab & Industrial 1)	Free						
Double-layered Gates 2 Construction	Aluminum alloy						
Elevator 2 Construction	Aluminum alloy	92625	485	6600000000	3975000000	495000000000.00	4.95398E+11
Exterior Construction (Industrial 1)	Ti-Al alloy and bare copper wire	91518	480	151812500	910875000	113859375000.00	1.1477E+11
Industrial Area 1 Construction	Ti-Al alloy	55000	288	187500	26500000	140625000.00	167125000
Phase 3 Total							6.10335E+11
<b>PHASE 4</b>							
Residents and Staff Arrival				53333		39999750	39999750
Phase 4 Total							39999750
<b>Operation</b>							
<b>Total costs</b>							
<b>Total number of CASSSCS</b>							
Unnecessary Equipment	Hard Roll						
Robots and Engineers R							
Electricity, Water, and A							
Testing							
Residents and Staff Arr	Large print						
Operation							

refine metal from ores  
build industry equipments

# THANKS