



Reinterpreting poles as digital assets to enhance value of road infrastructure

by
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Under the supervision of
Prof. Kumaresan

Opportunity Identification

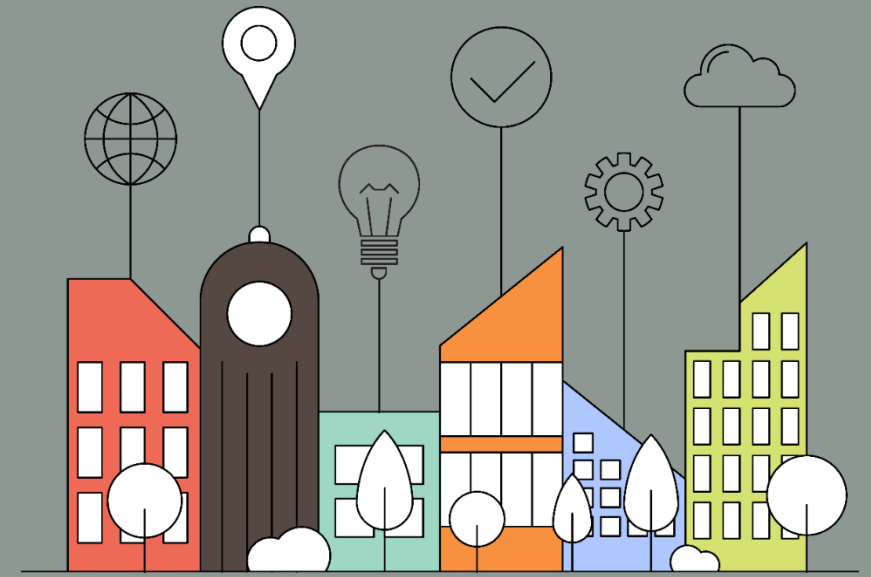
Urban areas are expected to house 40% of India's population and contribute 75% of India's GDP by 2030. Development of Smart Cities is a step in that direction





“A total number of 100 Smart Cities have been distributed among the States and Ut’s. Central Government proposes to give financial support to the Mission to the extent of Rs. 48,000 crores over five years i.e. on an average Rs. 100 crores per city per year.”

A **smart city** is an urban area that uses different types of electronic Internet of things (IoT) sensors to collect data and then use these data to manage assets and resources efficiently.



Roads in India

56,03,293 Kms

Total roads length in Indian (2017 estimate)

Type of roads in India

1. Border roads
2. National highways
3. State highways
4. District roads
5. City roads
6. Village roads



Table 1.1 Indian road network as administered by various government authorities (as on 31 march 2016)

Road classification	Authority responsible	Length(Kms)	Share of network length
National Highways	Ministry of Road Transport and Highways	101,011	1.80 %
State highways	Public Works Department of State/Union Territory	176,166	3.14 %
Other PWD roads	Public Works Department of State/Union Territory	561,940	10.03 %
Rural roads	Panchayats, JRY and PMGSY	3,935,337	70.23 %
Urban roads	Municipalities	509,730	10.10 %
Project roads	Various State/Union territory government departments, and SAIL, NMDC and BRO	319,109	5.70 %
Total		5,603,293	100 %

Types of information on roads

Surveillance

- Monitoring municipal assets
- Selective vehicles detection
- Motion detection

Traffic data

- Traffic congestion data
- Traffic patterns
- Parking data
- Journey time measurement
- Speed detection

Disaster monitoring

- Flood detection
- Rainfall monitoring
- Cyclone detection



Environmental data



TEMPERATURE



MOISTURE / HUMIDITY



RAIN GAUGES



WET&DRY SAMPLER



ROAD CONDITION
MONITORING



WIND SPEED &
DIRECTION



PRESSURE



GAS CONCENTRATION



SOLAR RADIATION

Design brief

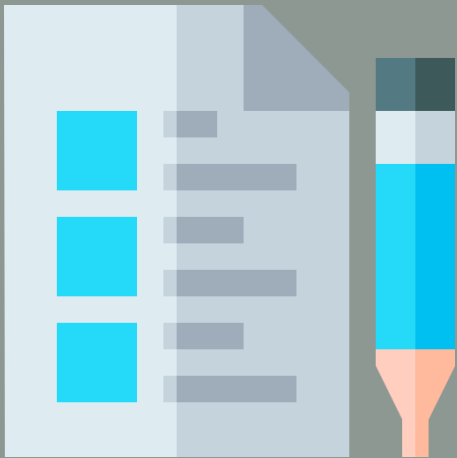
1. Client Profile

Ministry of Housing and Urban Affairs (MoHUA), Government of India. Key stakeholders include public works department and municipal corporations.

2. Project overview

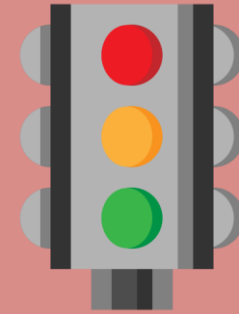
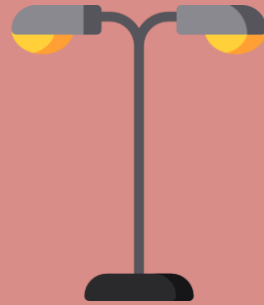
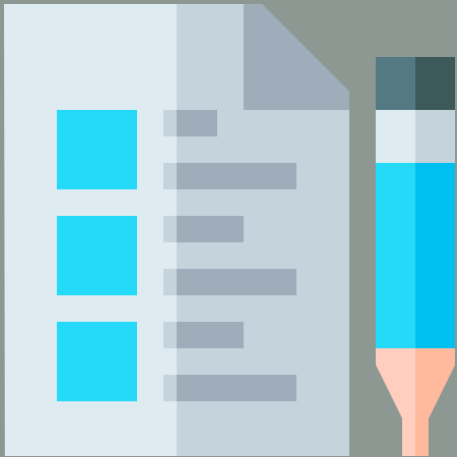
What ?

Designing poles to **accomodate equipment** for real time data gathering on roads to make **infrastructure more responsive** according to the specific needs and **reduce energy expenditure** for equipment operation.



Why ?

Poles span across most parts of the country but serves limited applications like Lighting or Signage



3. Key competitors

PHILIPS

SIEMENS



4. Design requirements

- a. Modularity
- b. Increased usability
- c. Aesthetics
- d. Scalable
- f. Security

5. Primary user

Service/ Maintenance personnel



Field study





Field study





Product Research

1. Competitor product analysis
2. Product autopsy
3. Mind mapping
4. Future forecasting

Competitor product analysis



Obama energies pole

- Emergency call
- App based wireless control
- Facade lighting
- Public addressing system



Philips pole

- Smart LED lighting
- Reduced maintenance
- Environmental sensors
- Vehicle charger

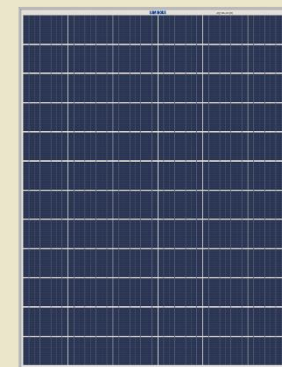
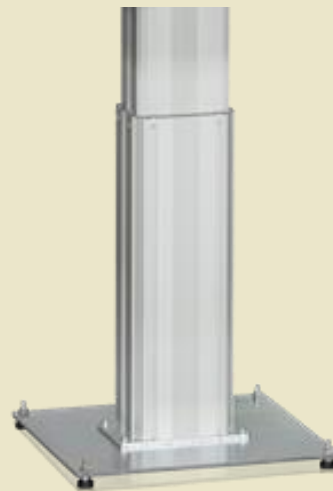
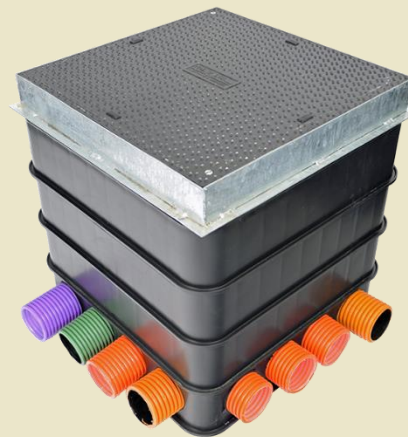


Energesia pole

- Improved wireless connectivity
- Water detection
- Variable message board
- Video surveillance

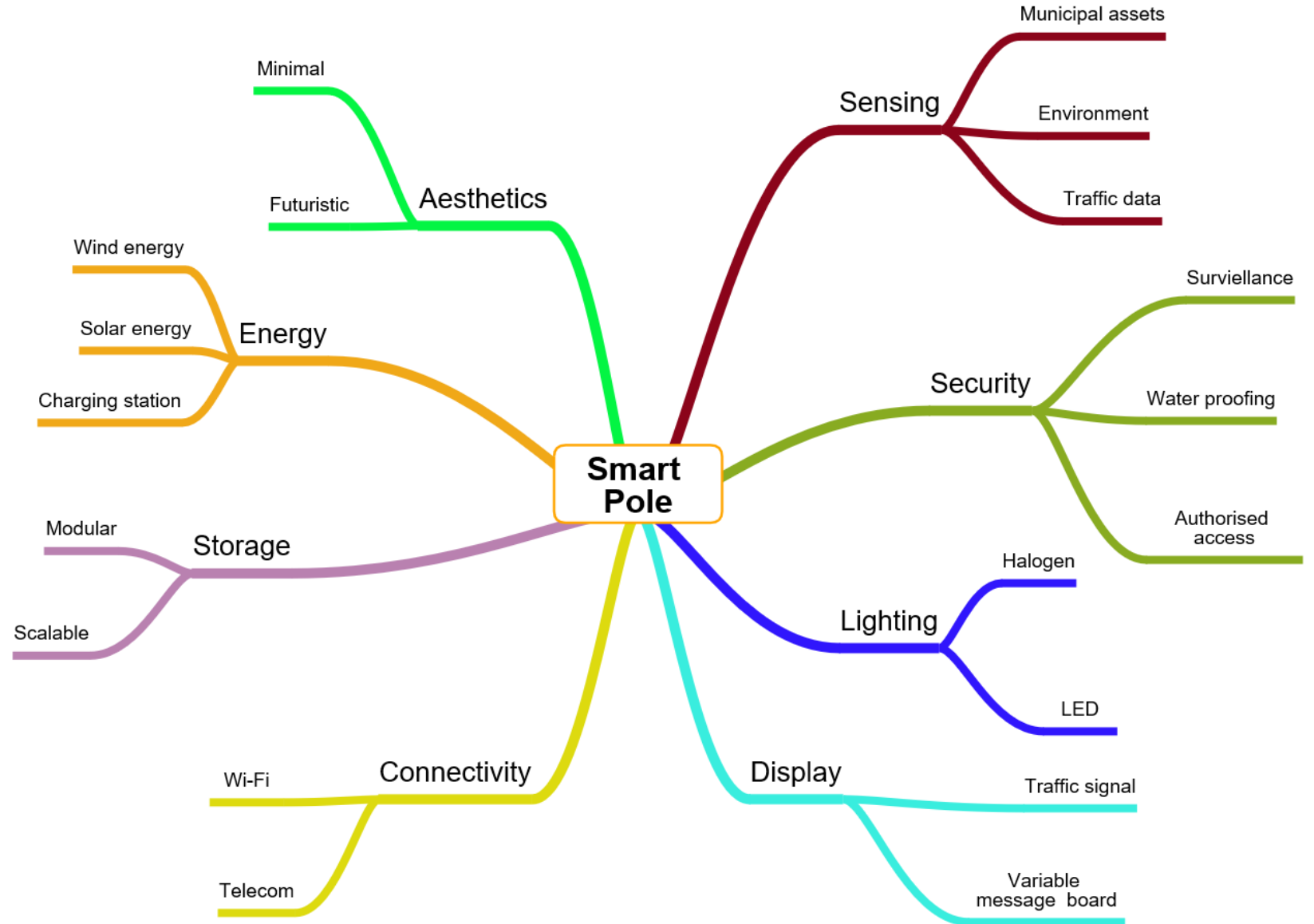


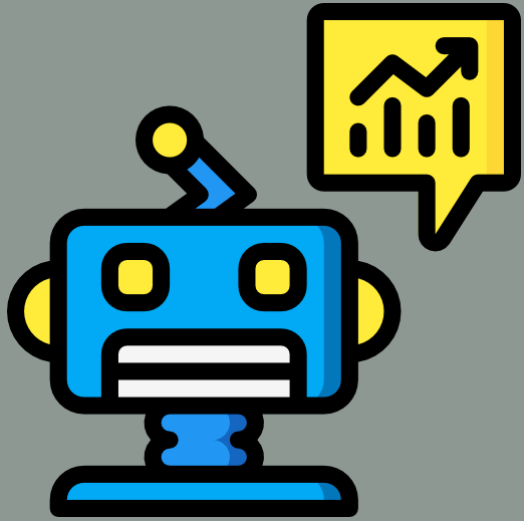
Product autopsy





Mind map





Future forecasting

- Intelligent Lights
- Drone charging stations
- Parking sensors
- Way finding
- Connected vehicle monitoring
- Clean energy



Components of the smart pole

- a. Environmental sensors
- b. Microcell
- c. Cameras
- d. Emergency audio devices
- e. Energy harvesters
- f. Variable message displays
- g. Kinetic tiles
- h. Public addressing system

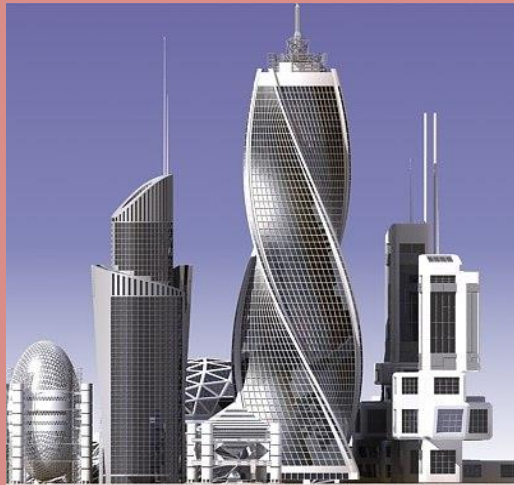


Concept Design

Mood Board

Keywords :

1. Trend setting
2. Sci fi
3. Futuristic

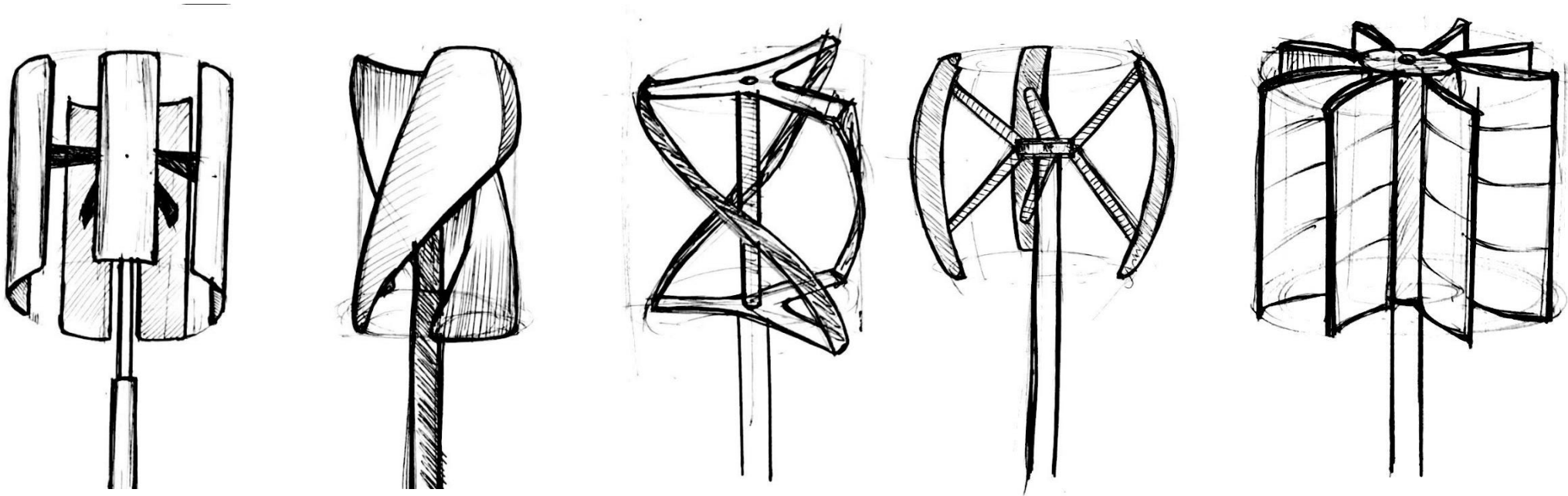


Product collage

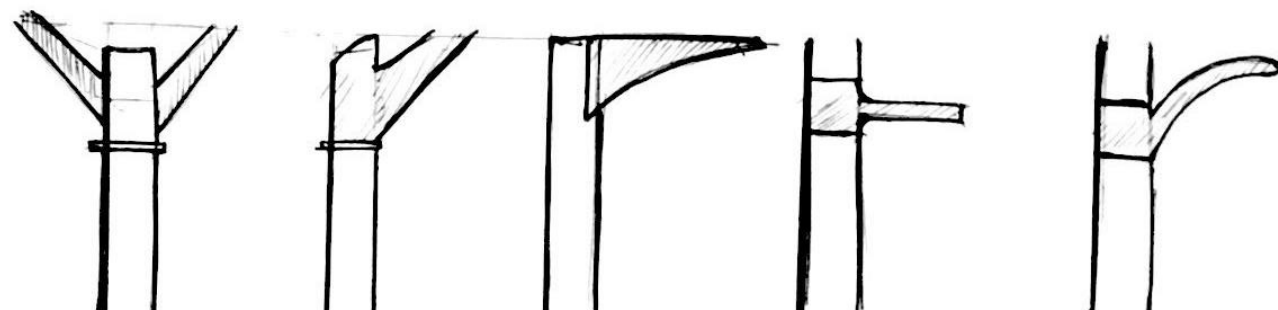
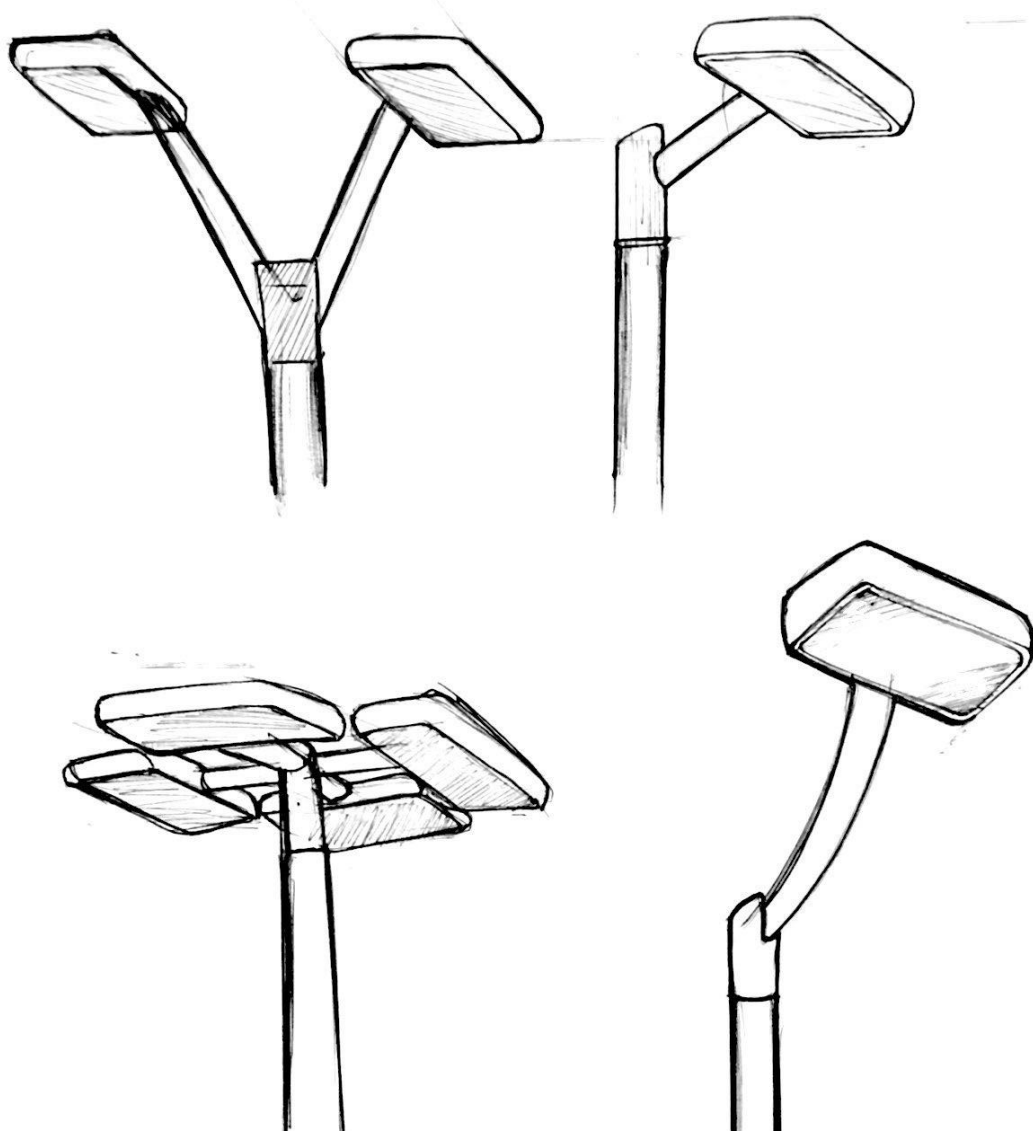




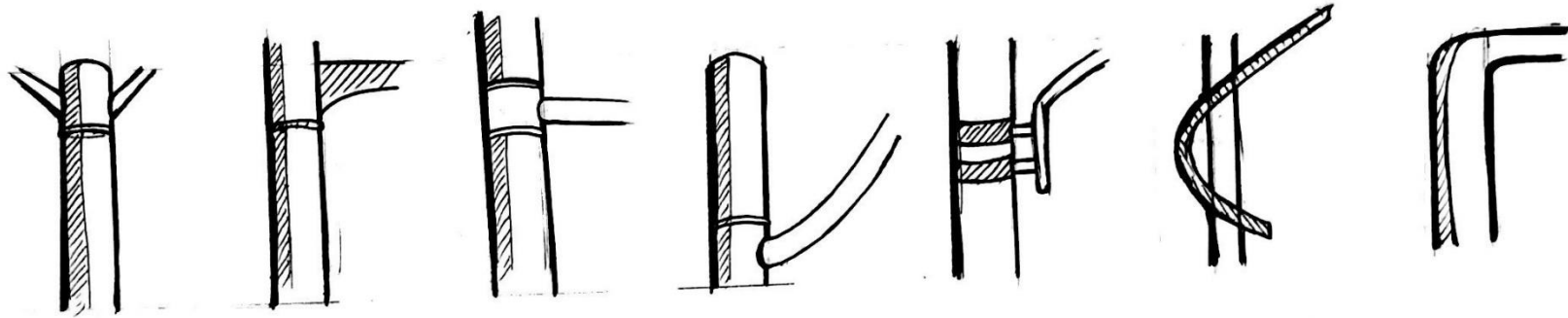
Sketches



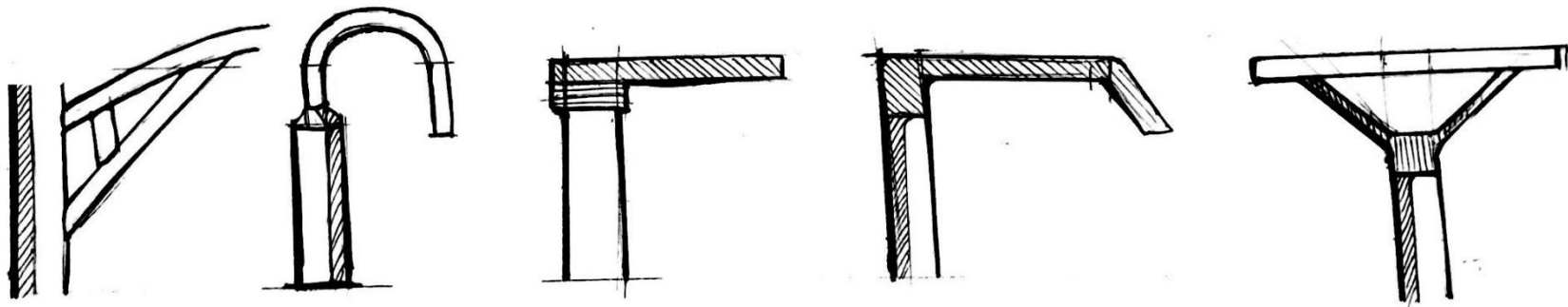
Vertical axis wind turbine



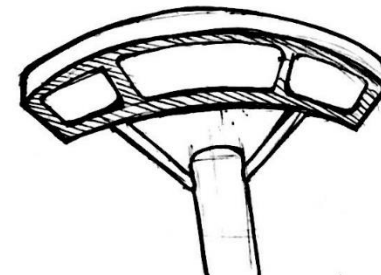
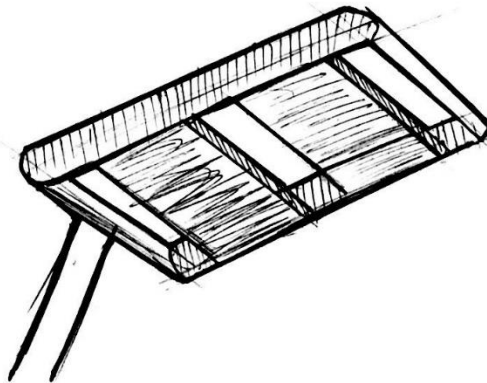
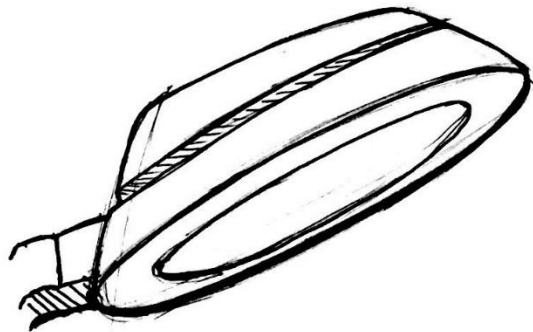
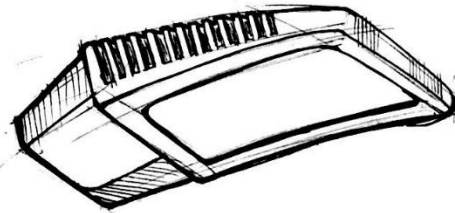
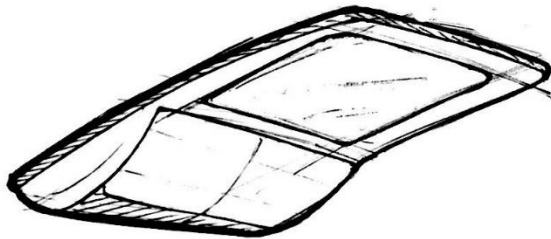
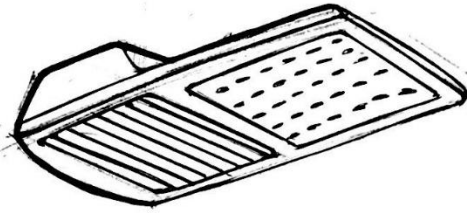
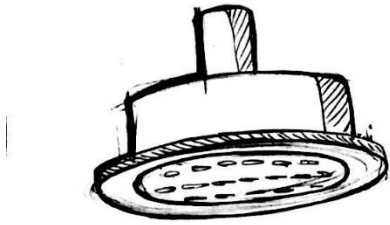
Light head joinery



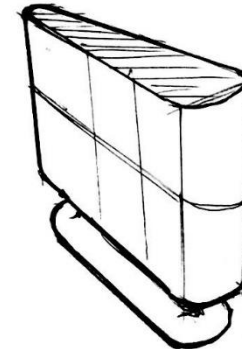
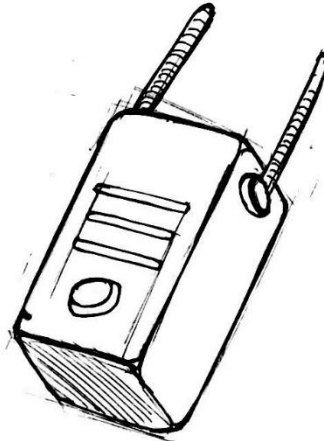
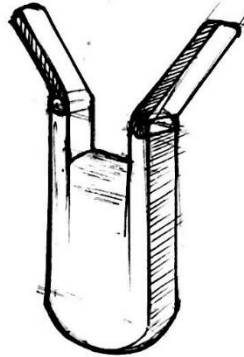
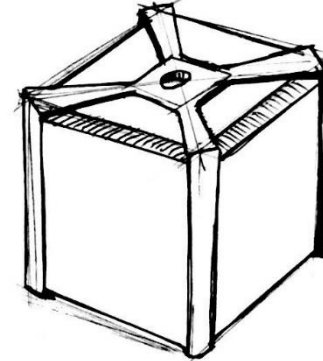
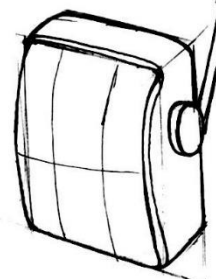
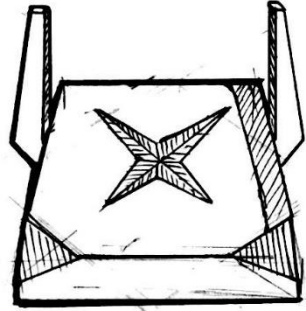
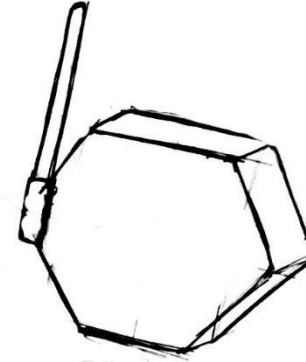
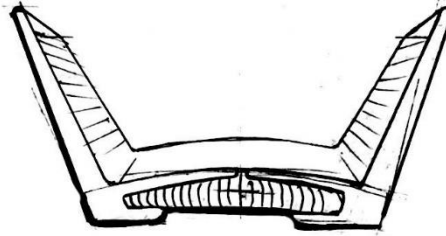
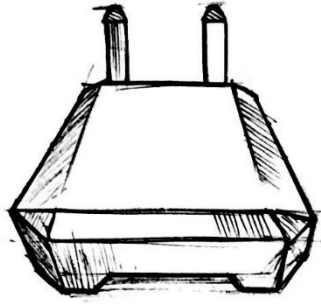
Light head joinery



Light heads

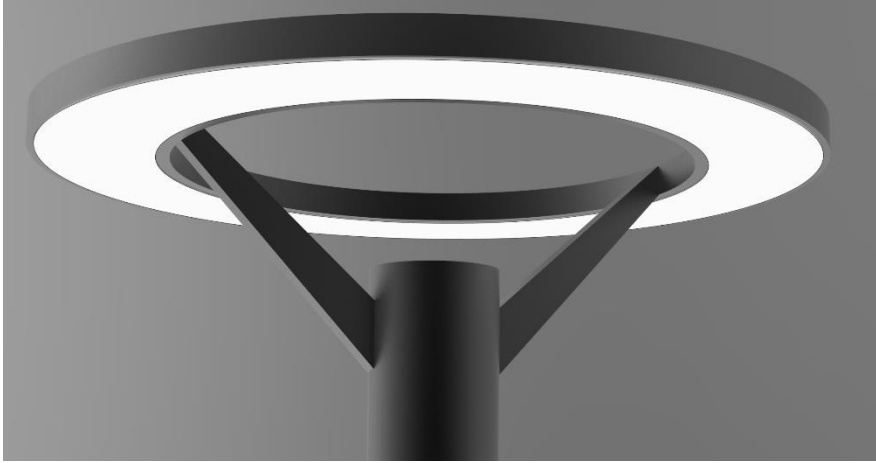


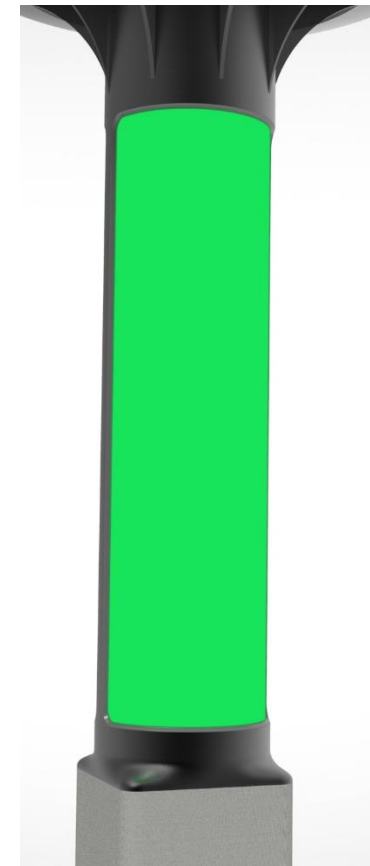
Mini cell towers





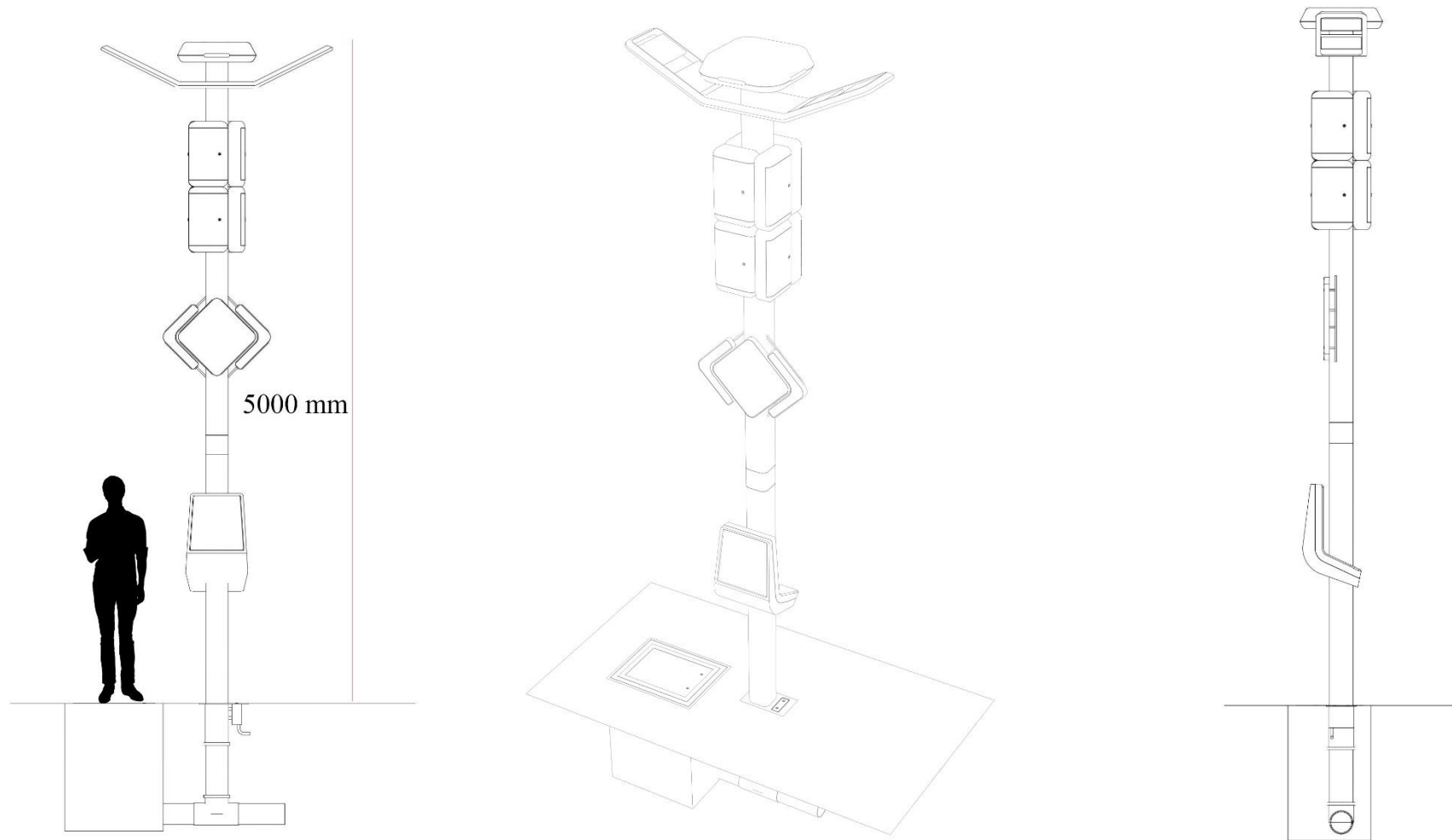
3D Models

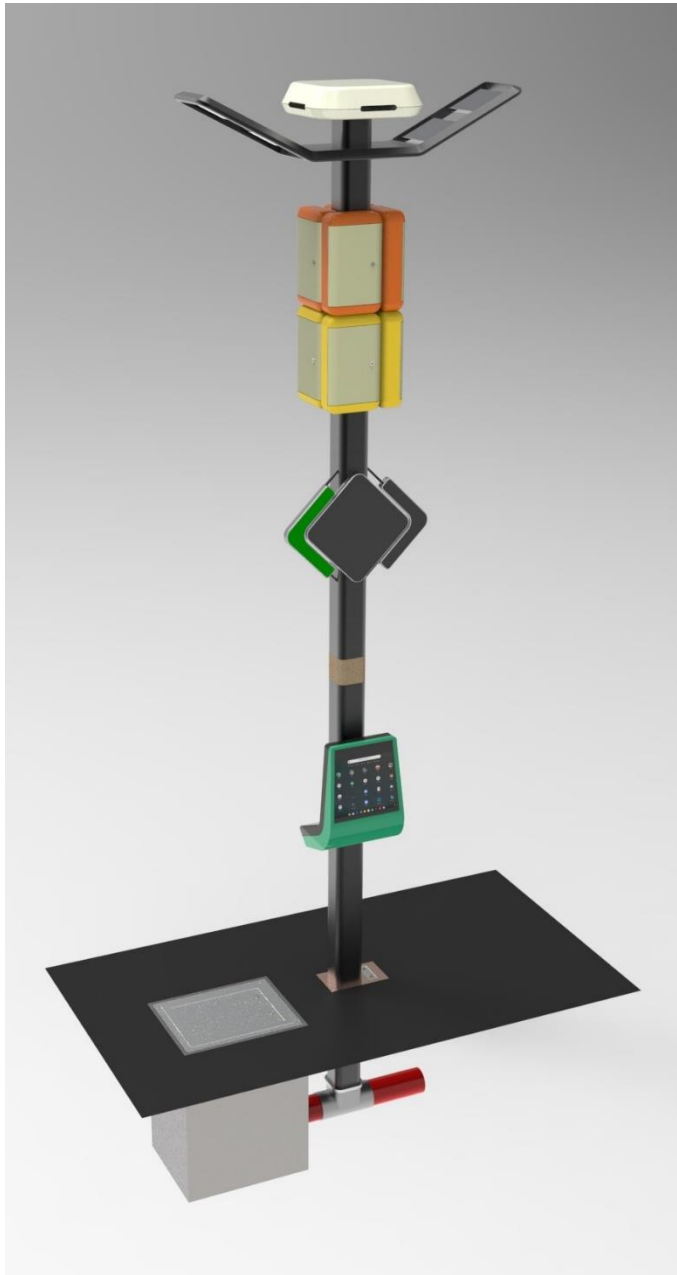


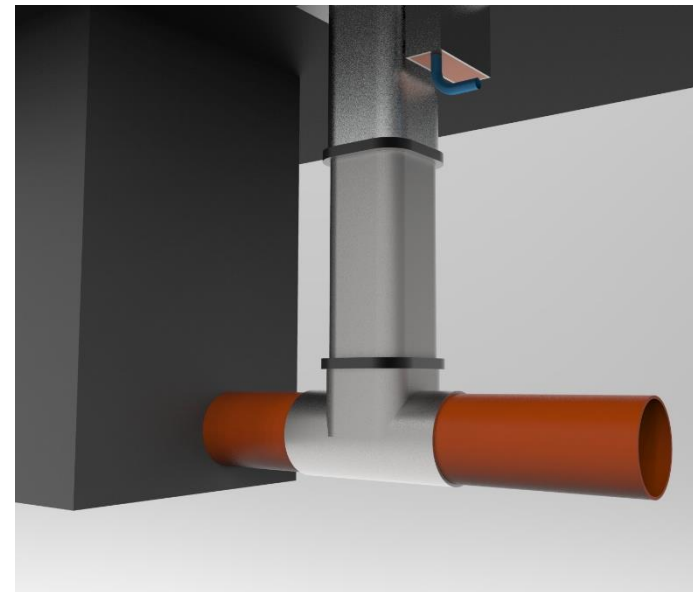
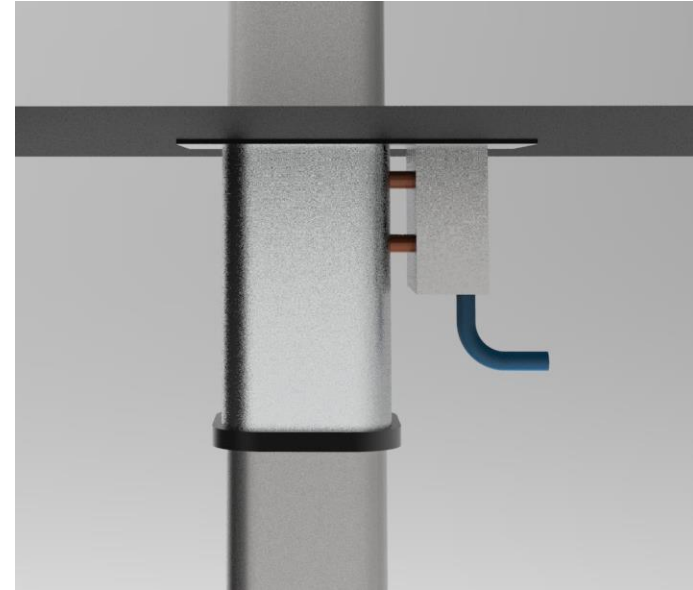
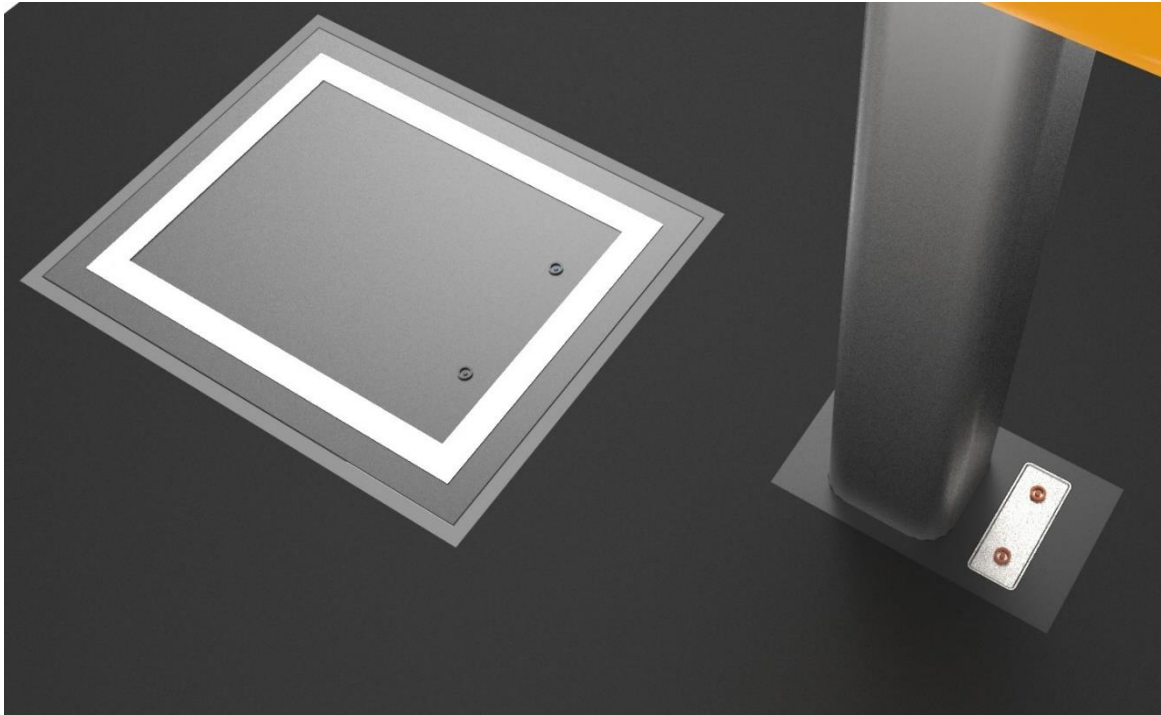




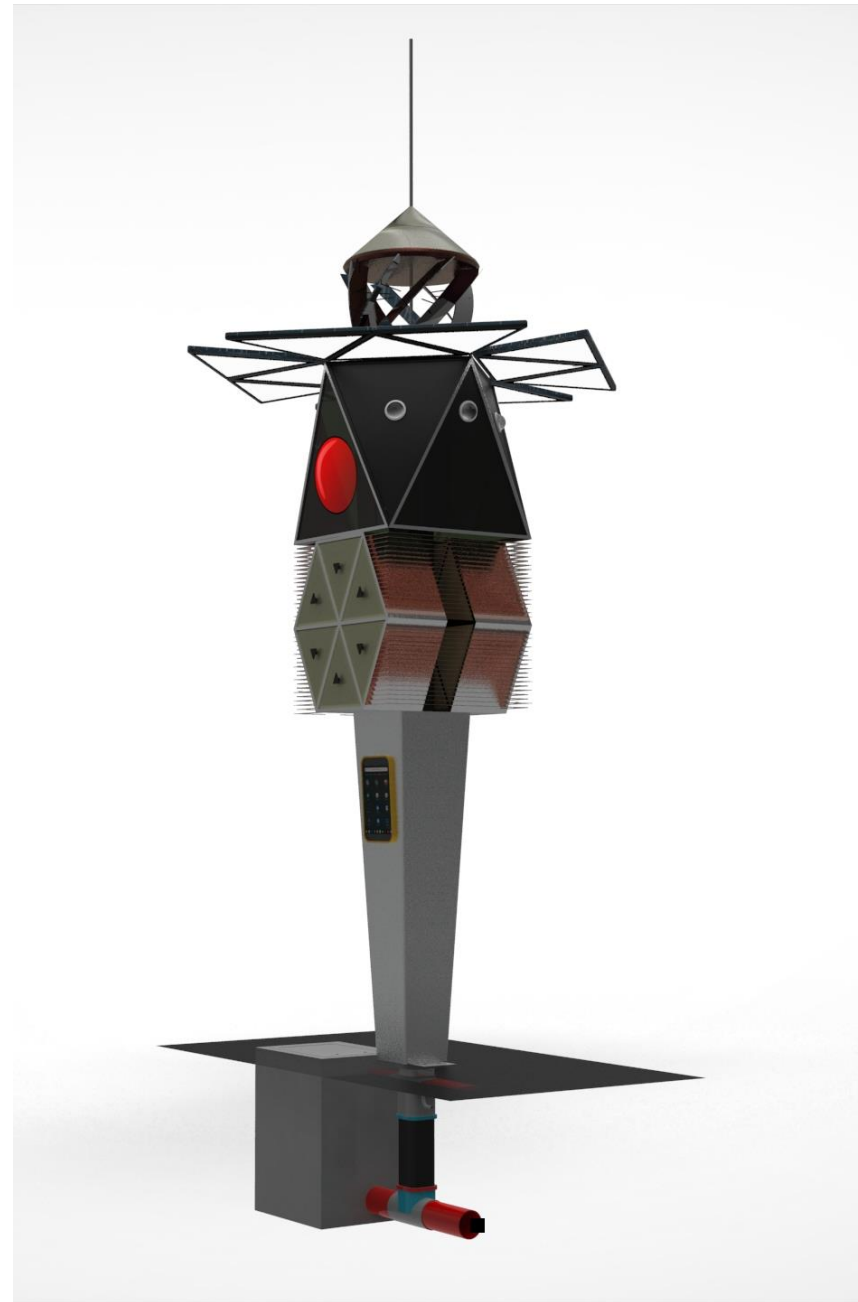
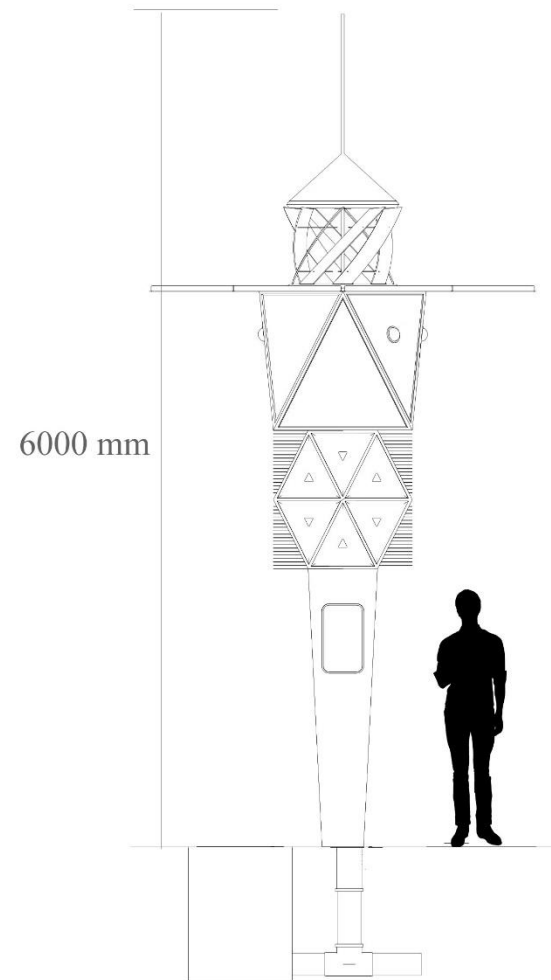
Concept 1

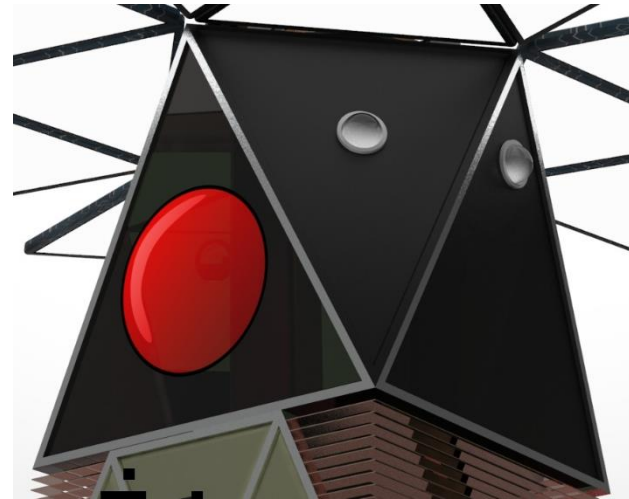
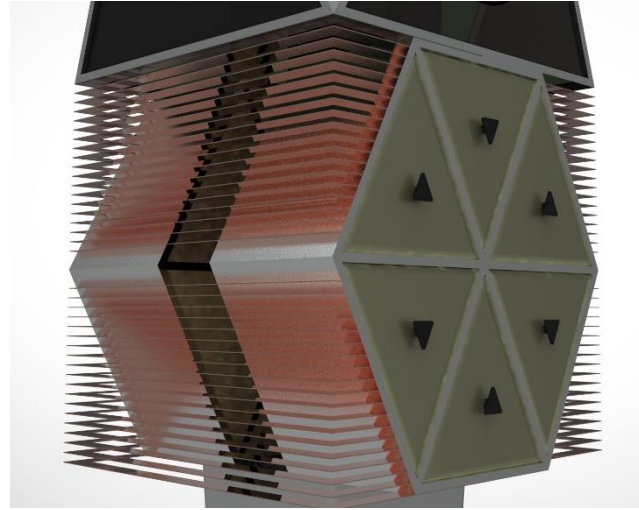
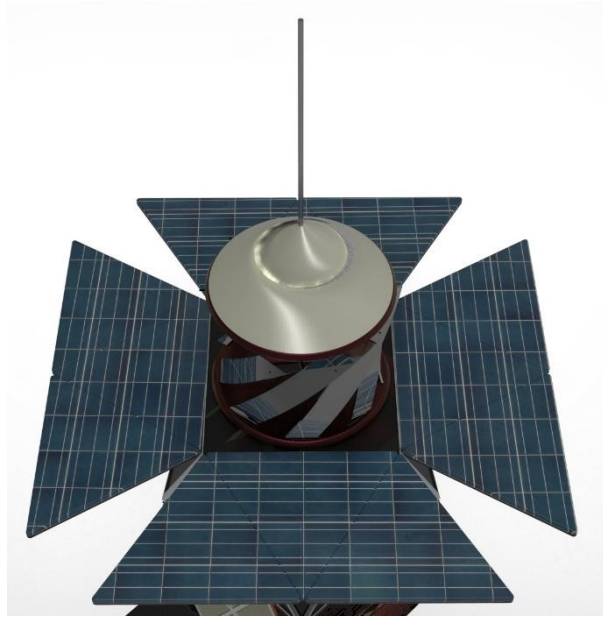




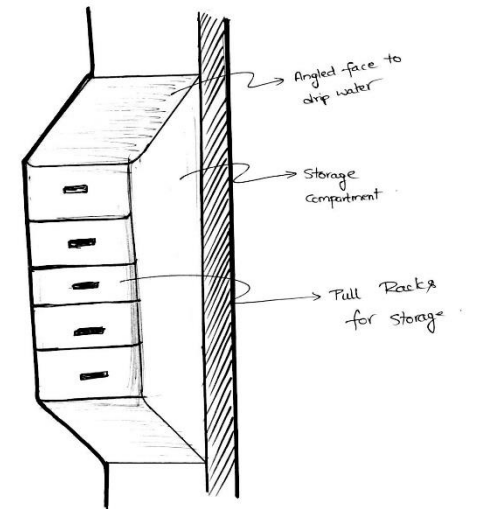
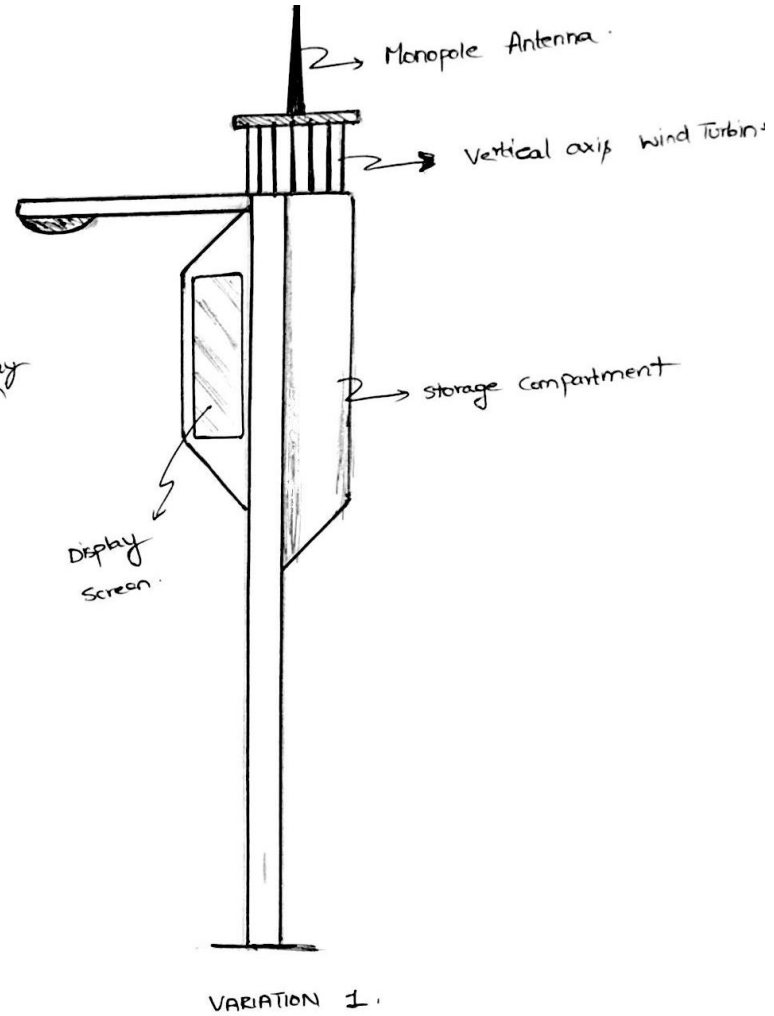
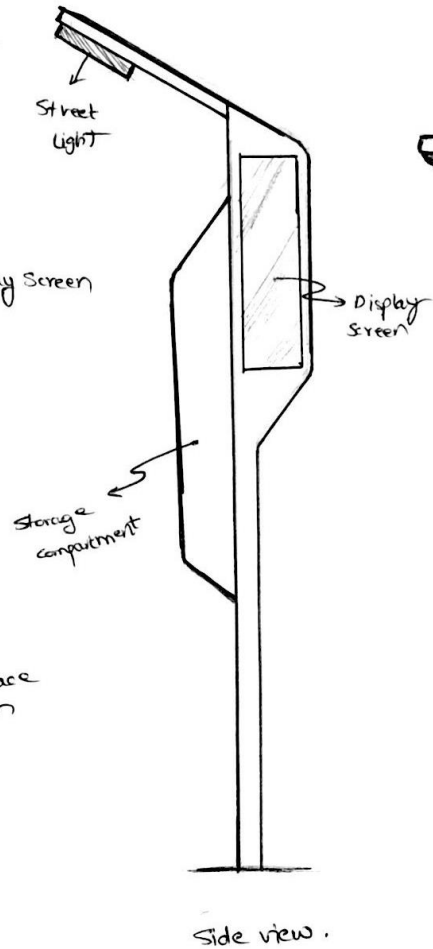
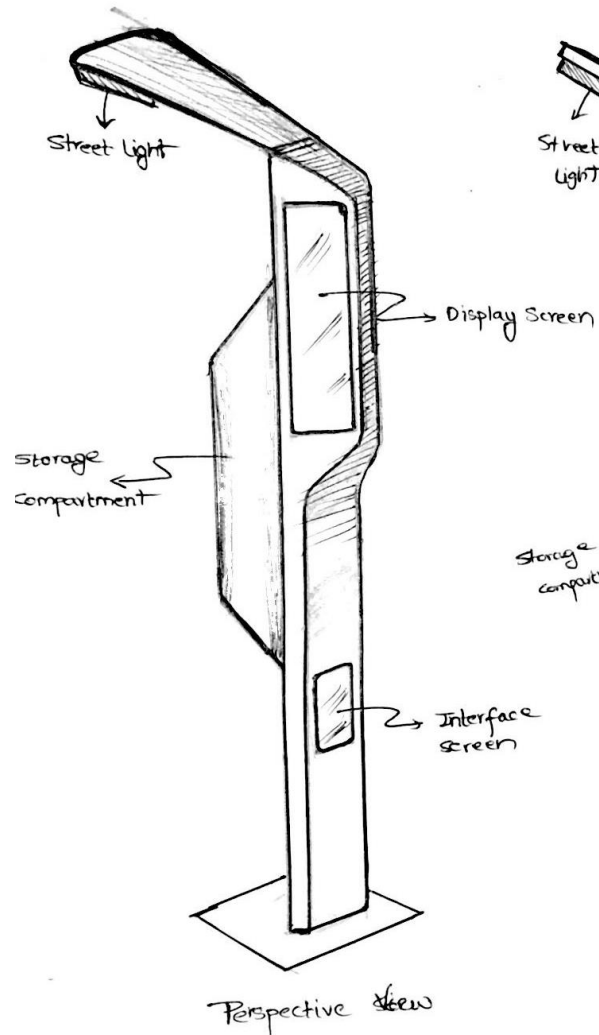


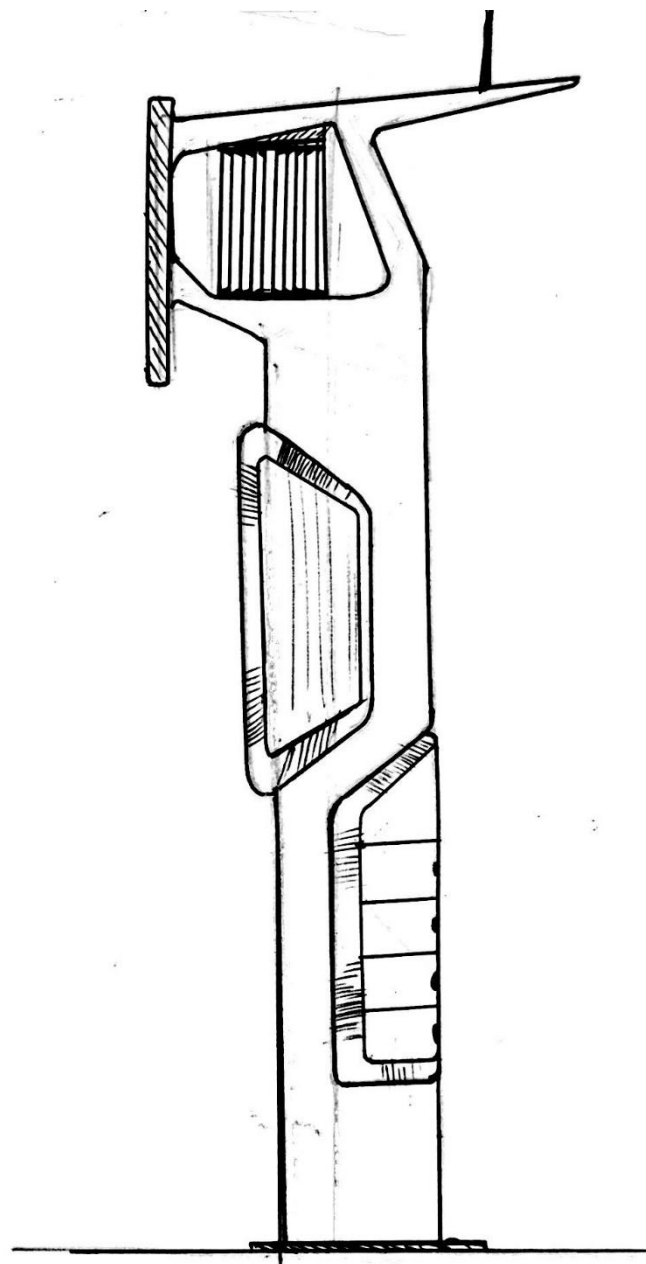
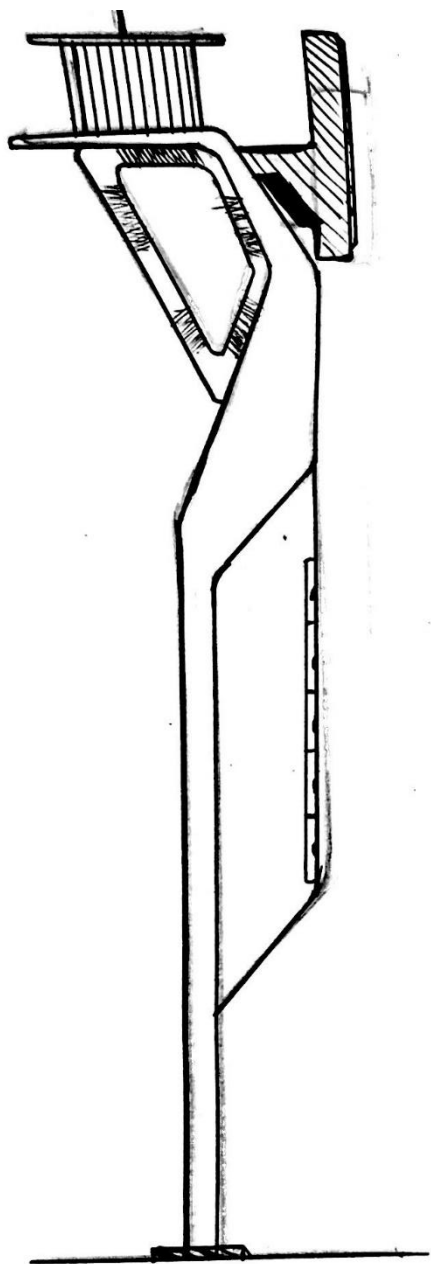
Concept 2

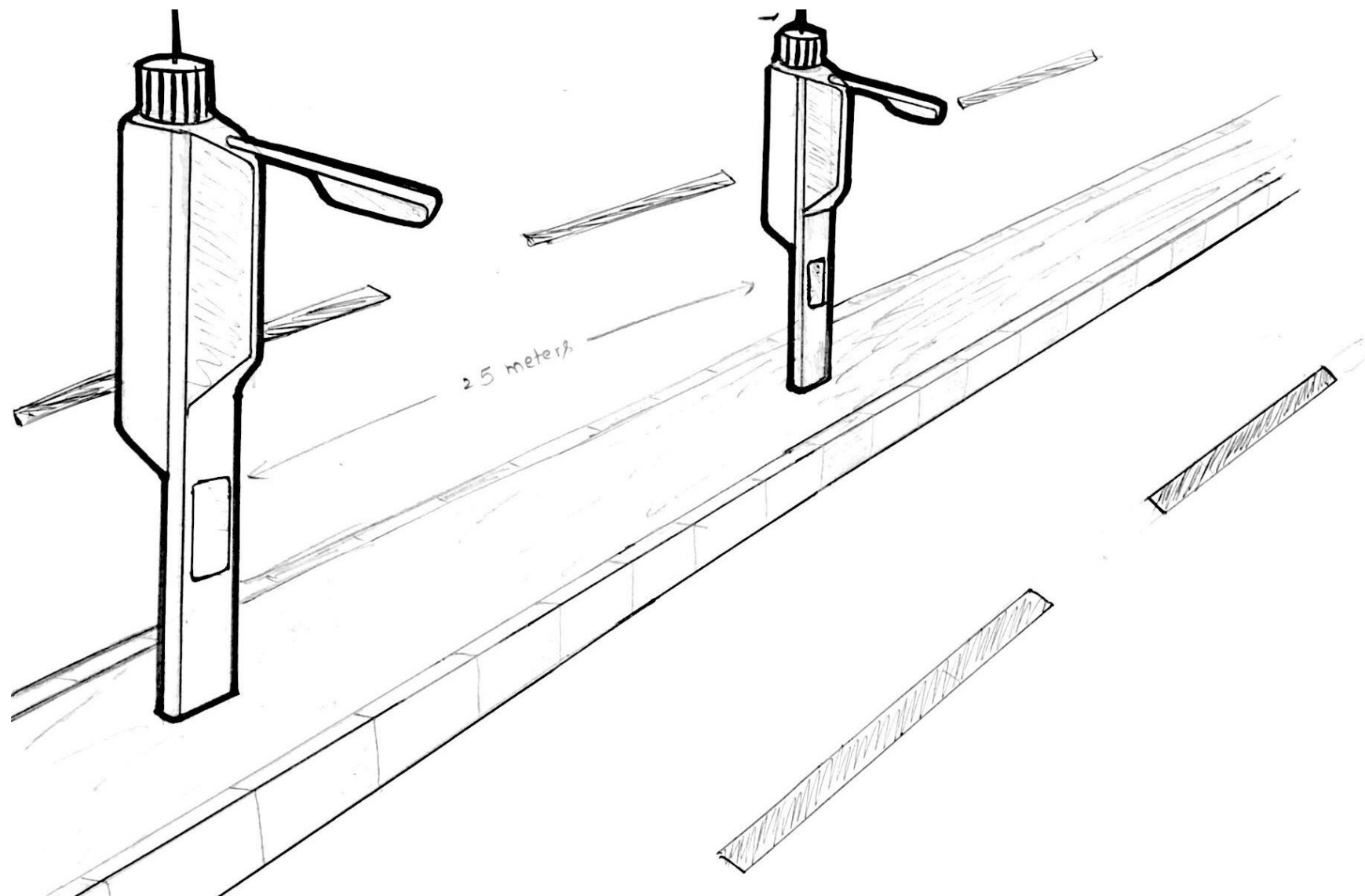




Concept 3







Concepts evaluation:

Concept 1:

1. Manufacturability
2. Cable management

Concept 2:

1. Multiple displays

Concept 3:

1. Aesthetics
2. Modularity



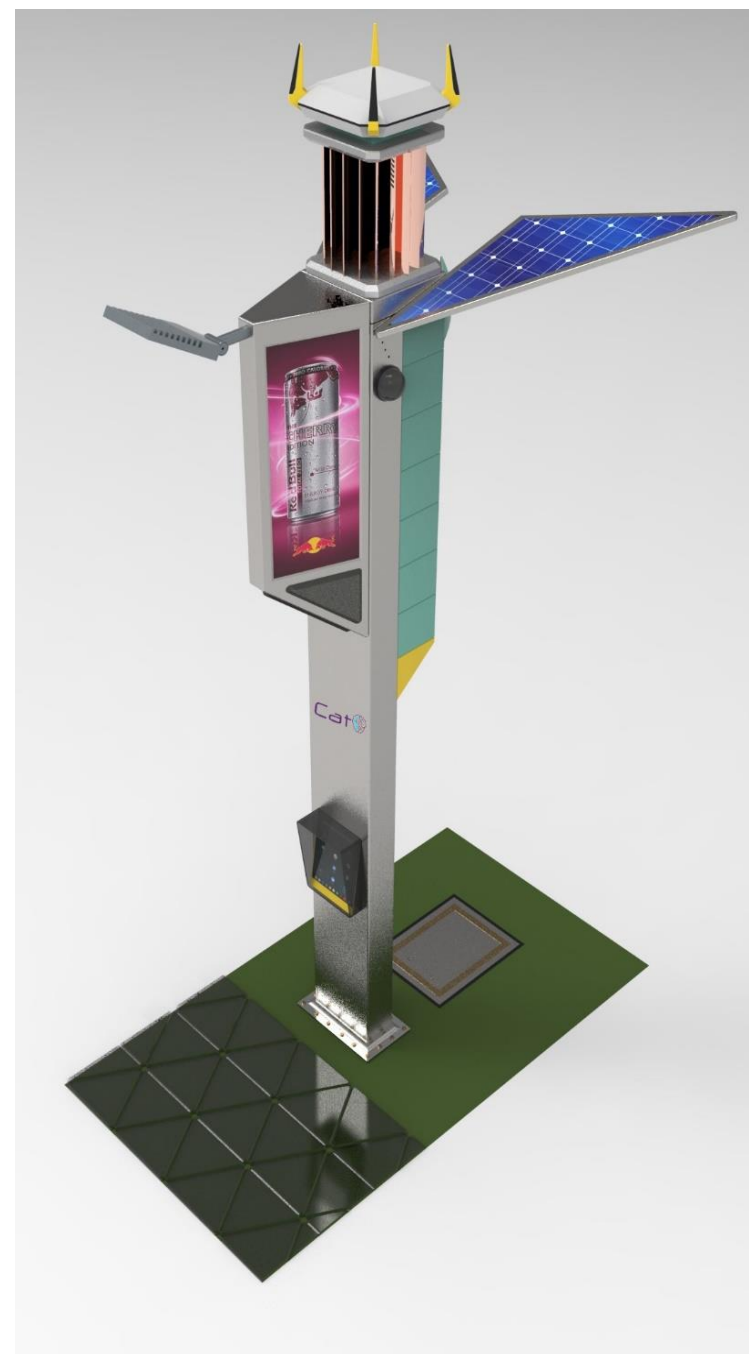
Design development

Volumetric data

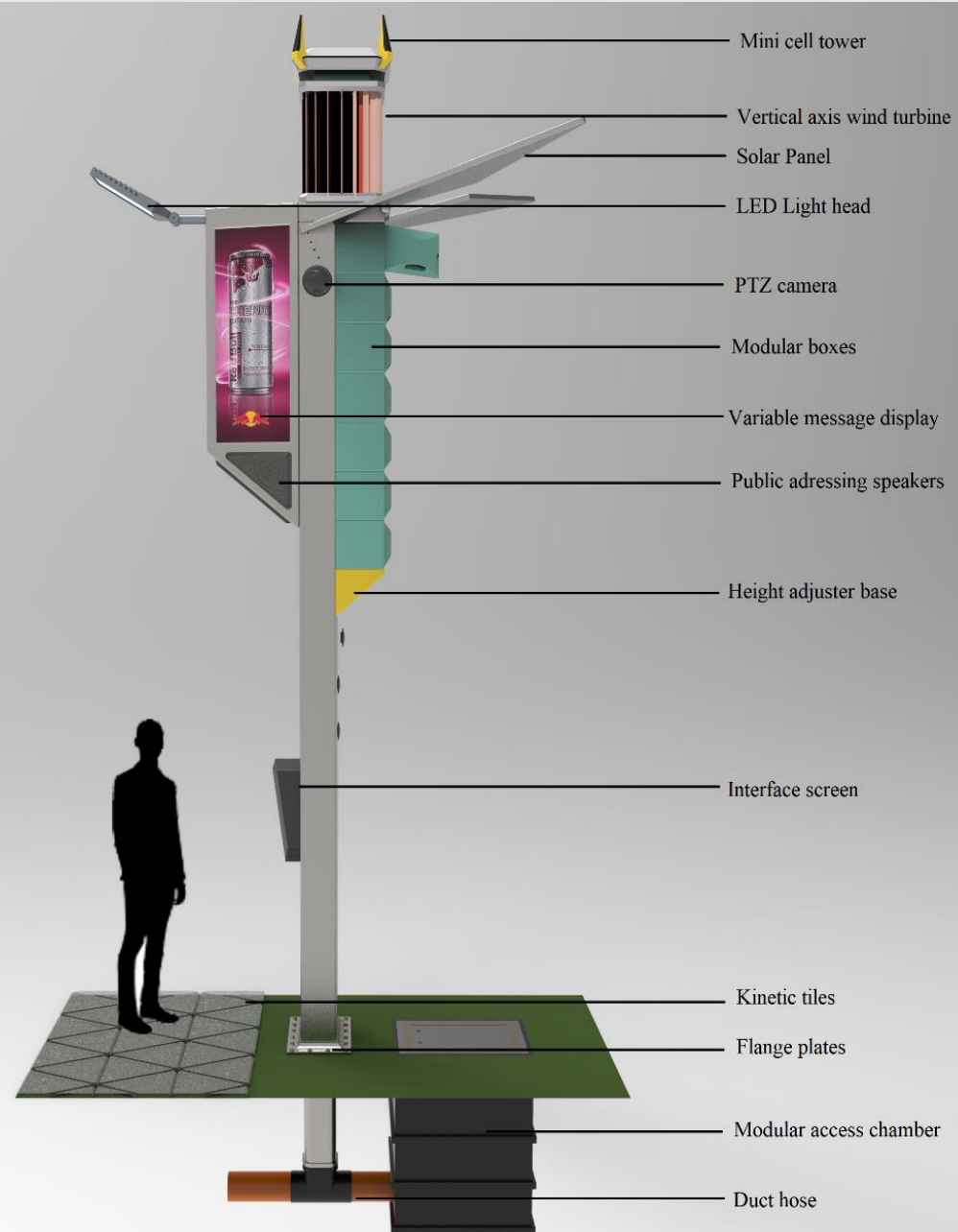
Sl.no	Name of the part	Dimensions L X B X H (cms)
1.	Surveillance camera	15x15x20 cms
2.	Signal head	45X45X5 cms
3.	Omni directional antenna	30x30x15 cms
4.	VAWT (wind turbine)	40x40x60 cms
5.	Storage box	50x30x15 cms
6.	Interface screen	75x50x15 cms
7.	Speakers	20x20x20 cms



Final design



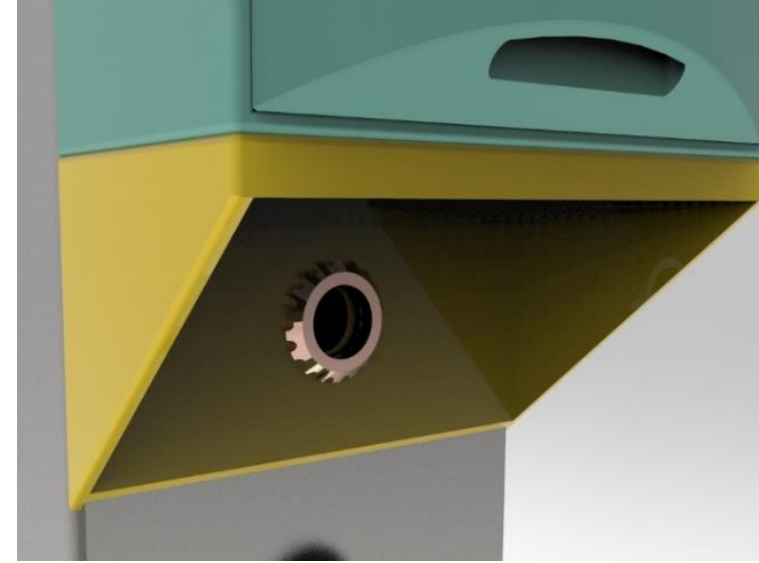
Components of the smart pole



Detailed views of components



**Modular compartment with
single screw fastening**



**Adjustable
holding base**



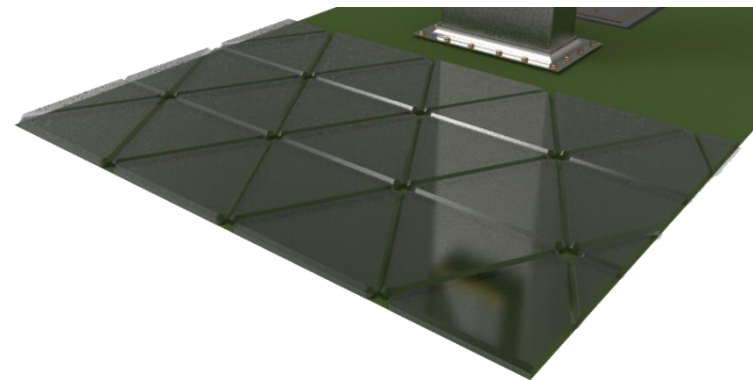
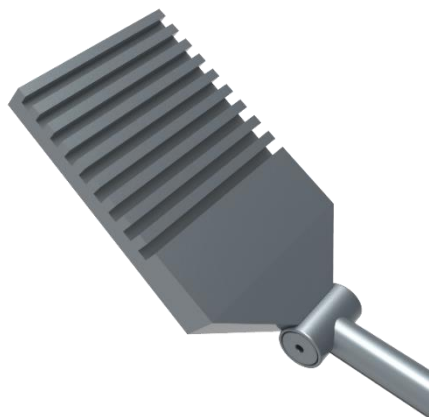
**Lockable compartment
door with washer**



Covering for screw holes



LED light head



Kinetic tiles



Interface screen



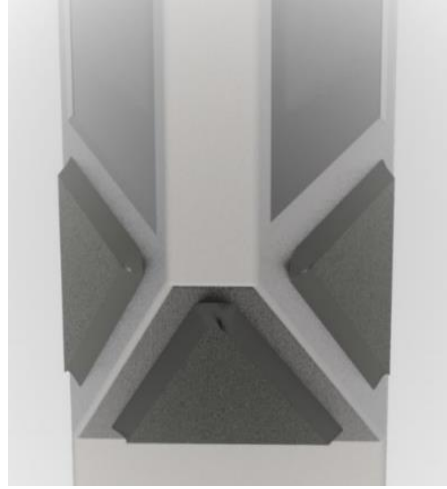
Ducting chamber



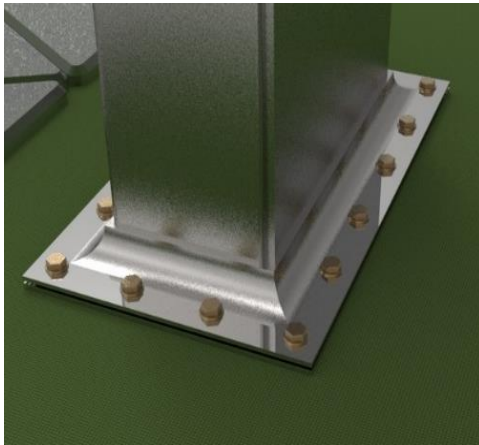
Ducting hose



Ducting chamber cover



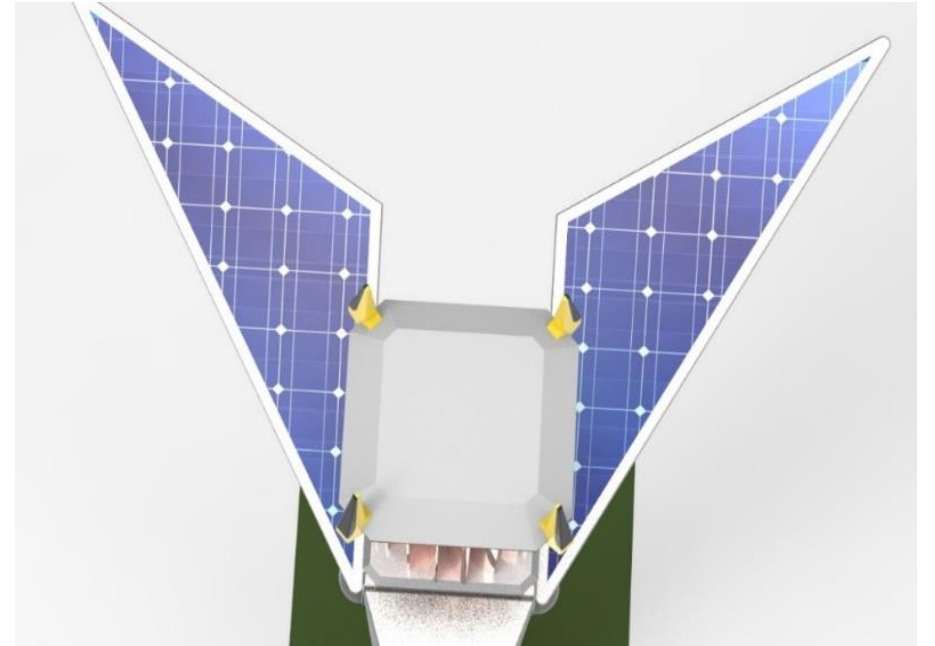
Public addressing speakers



Flange plate

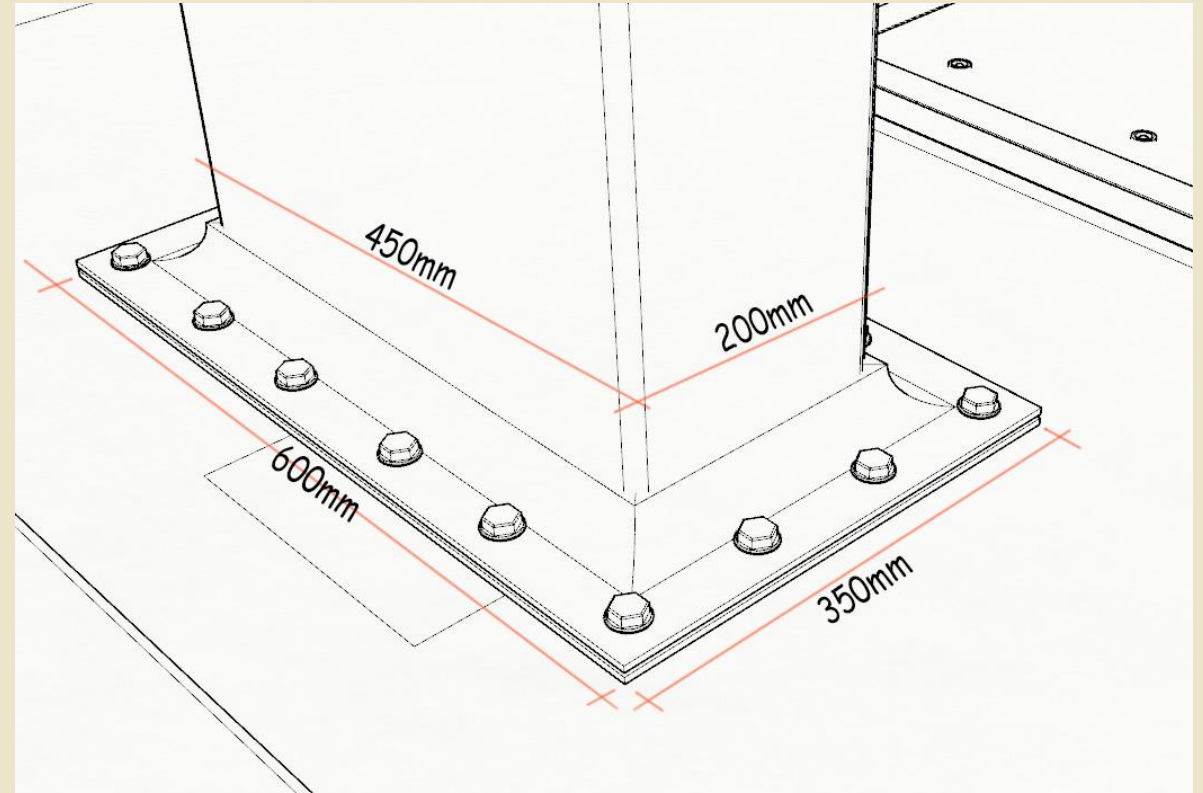
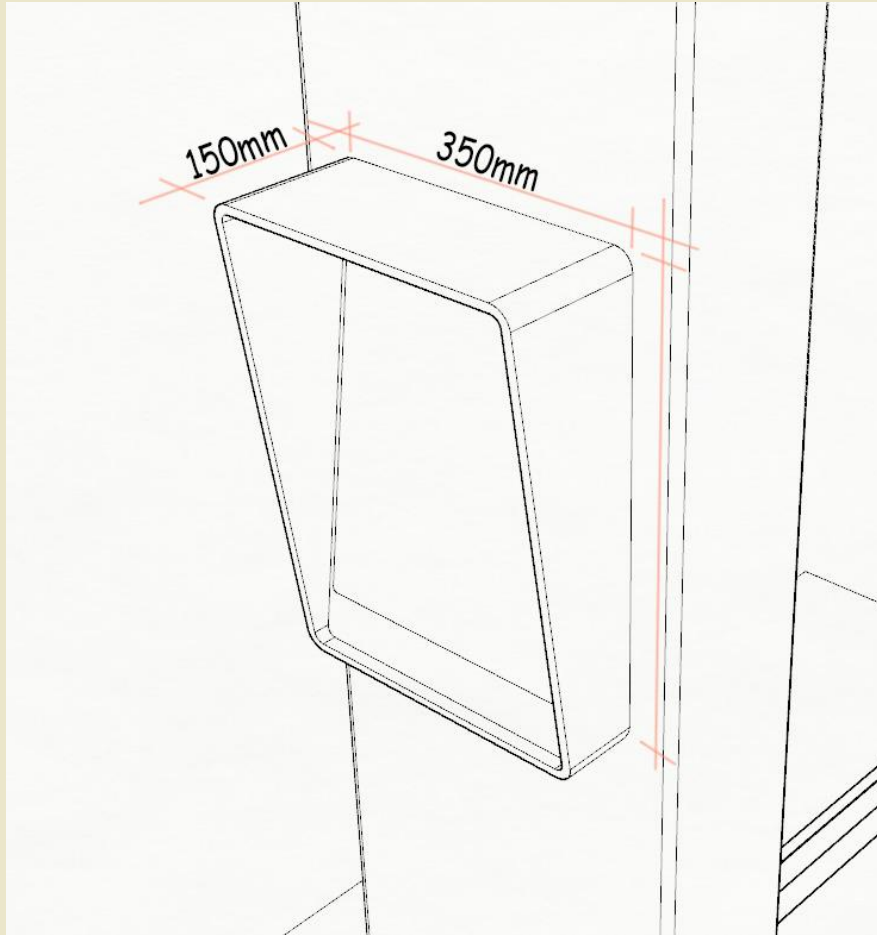


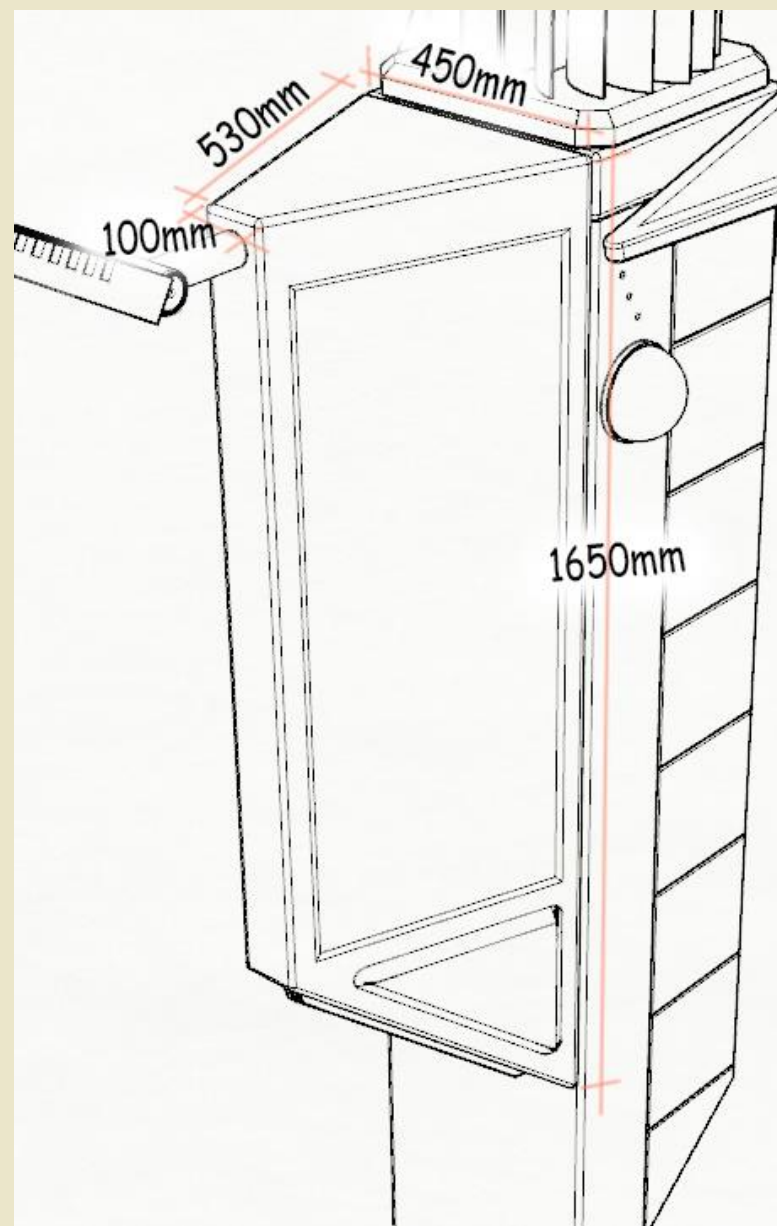
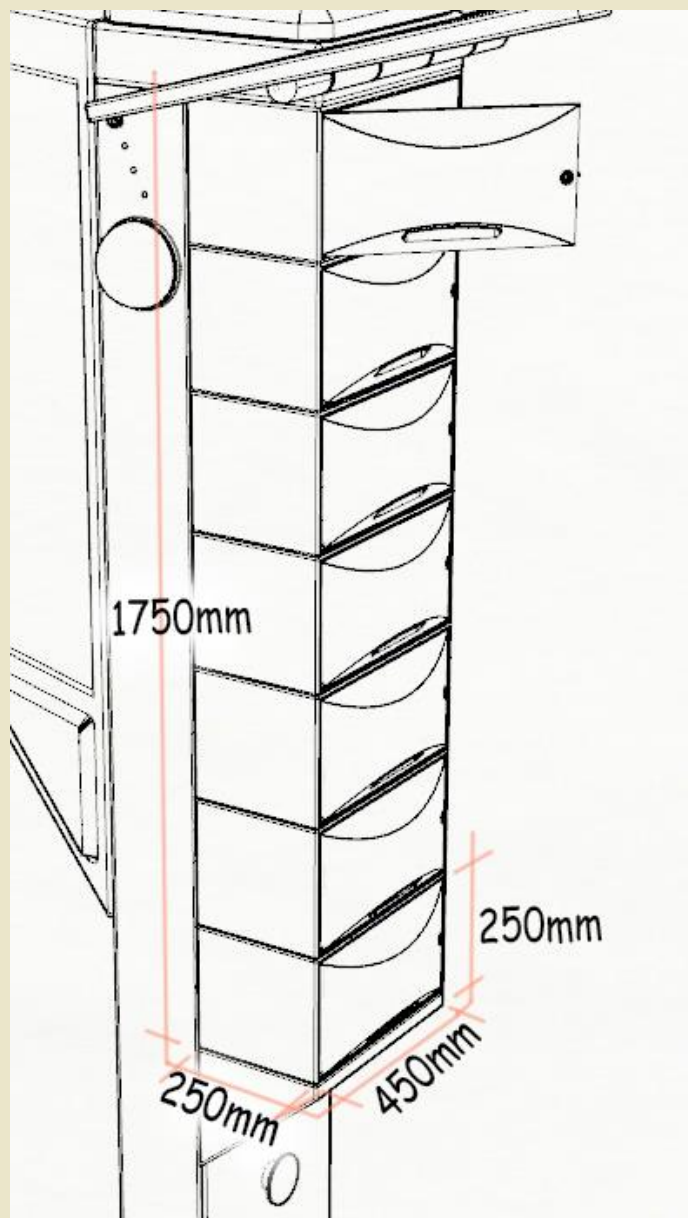
Dome camera

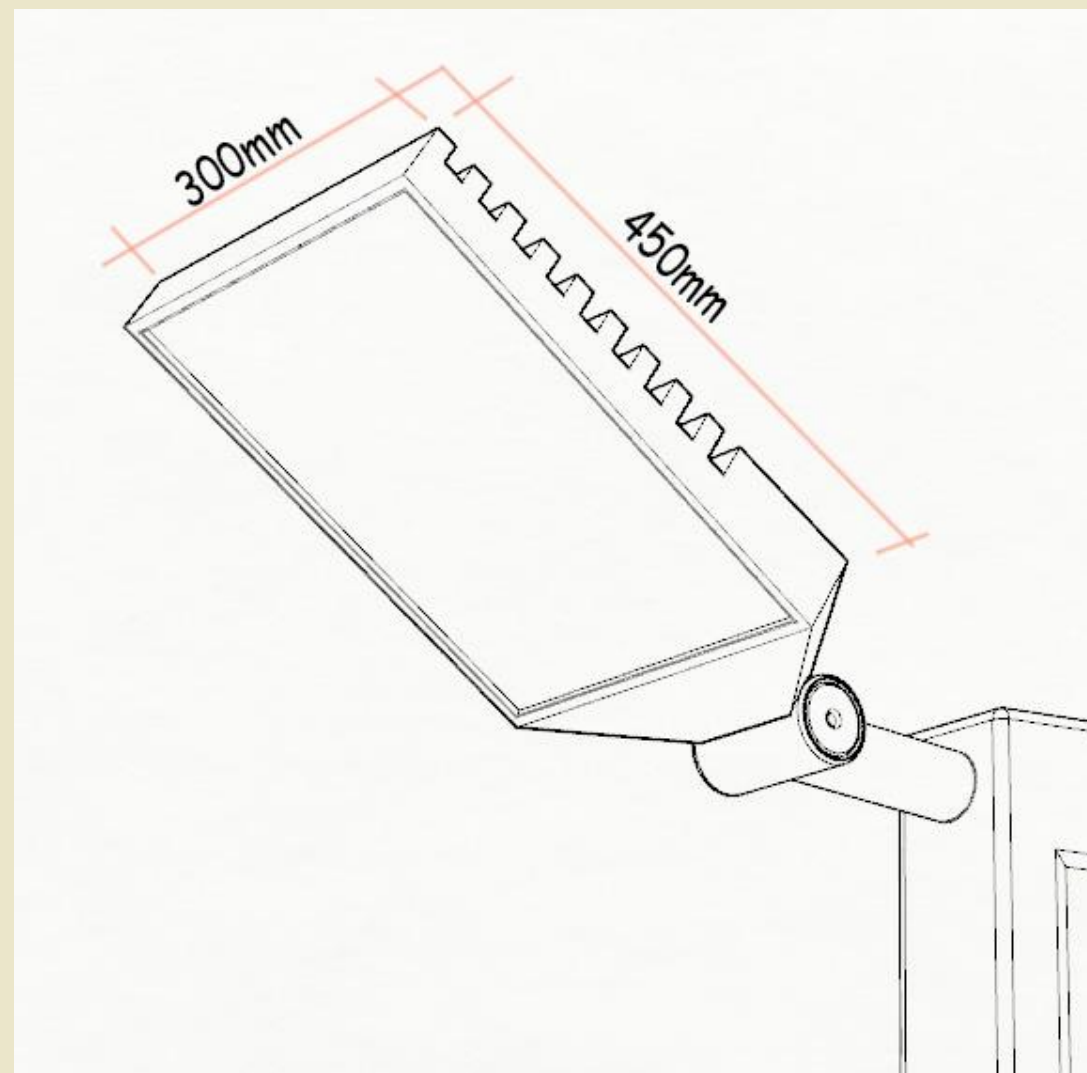
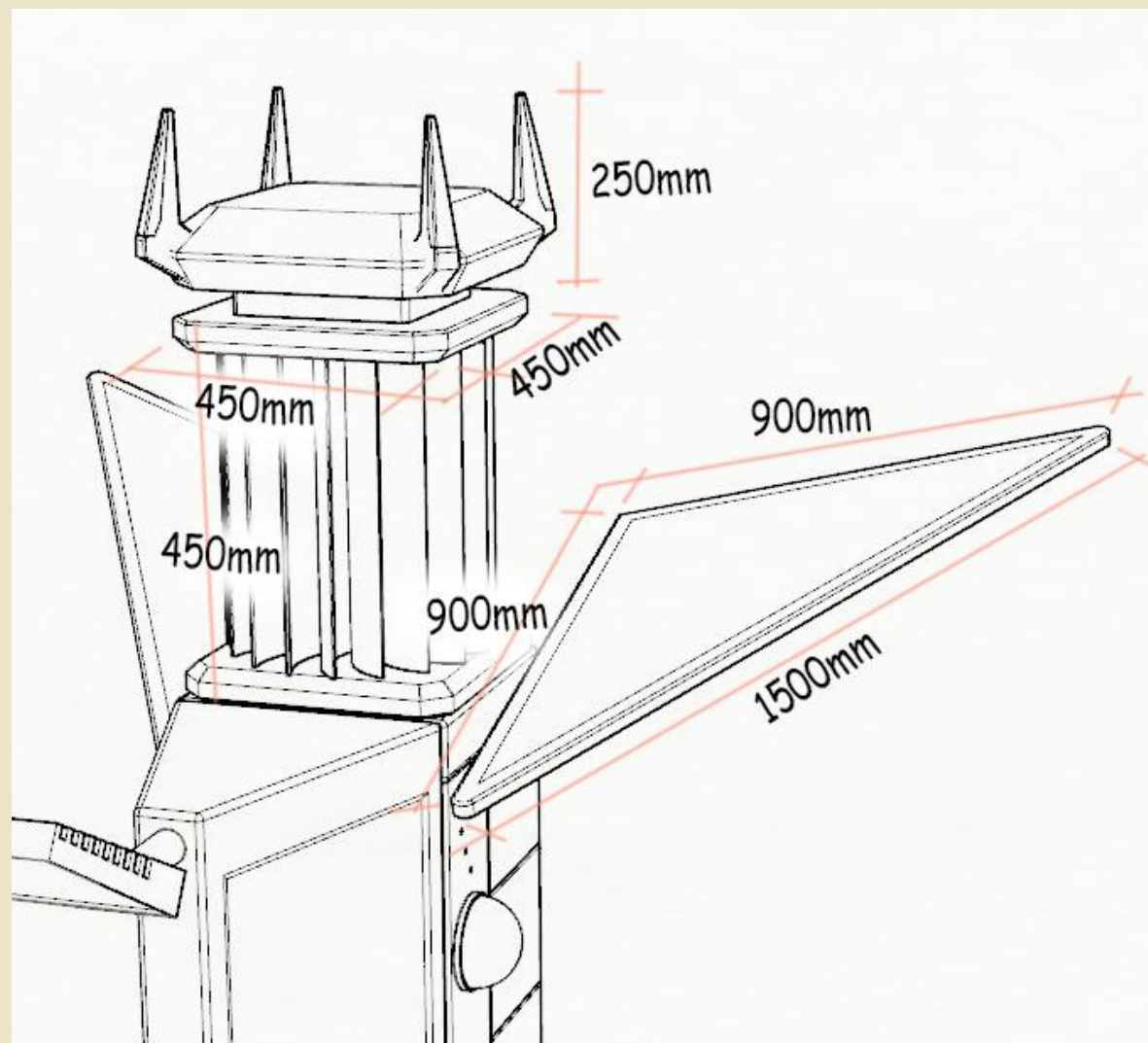


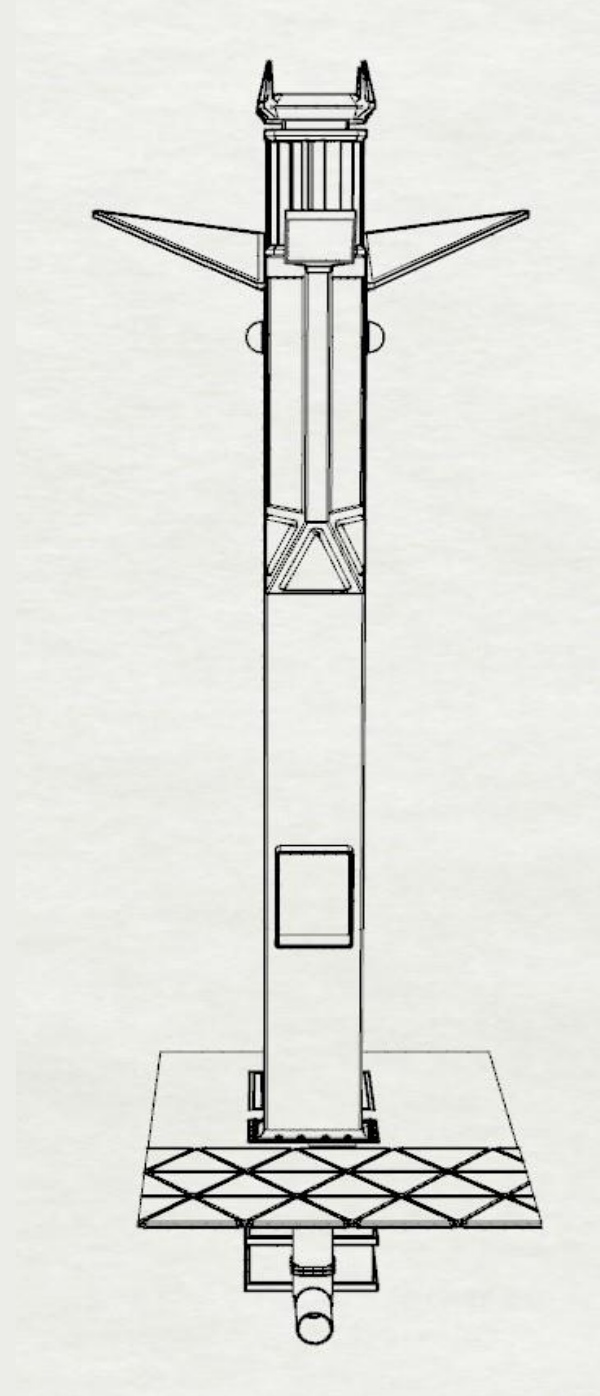
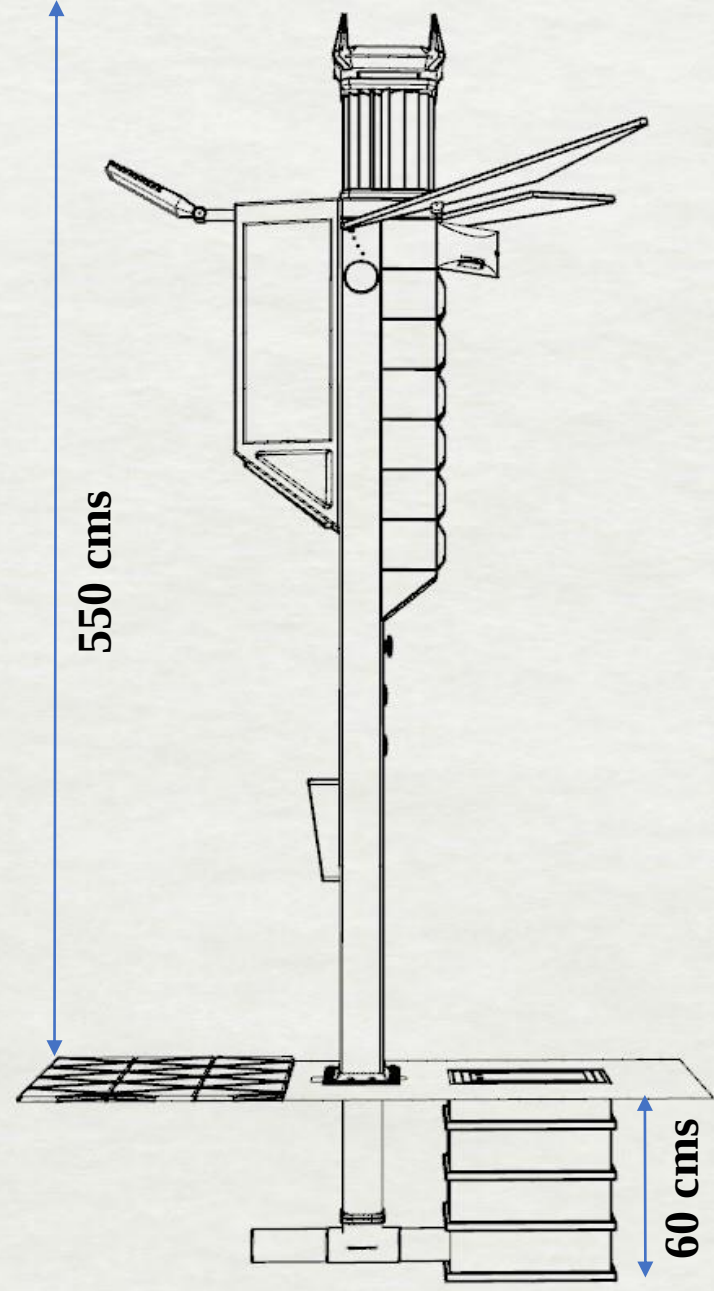
Solar panels

Dimensional drawings

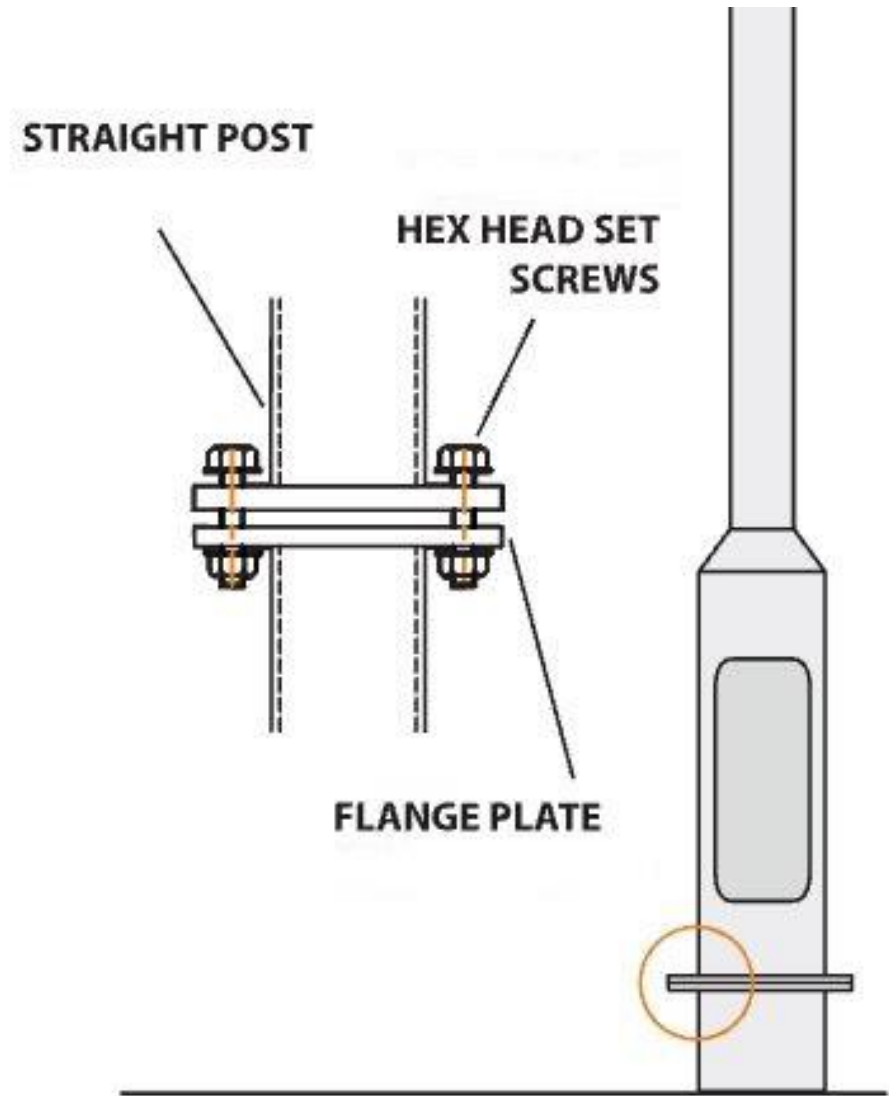








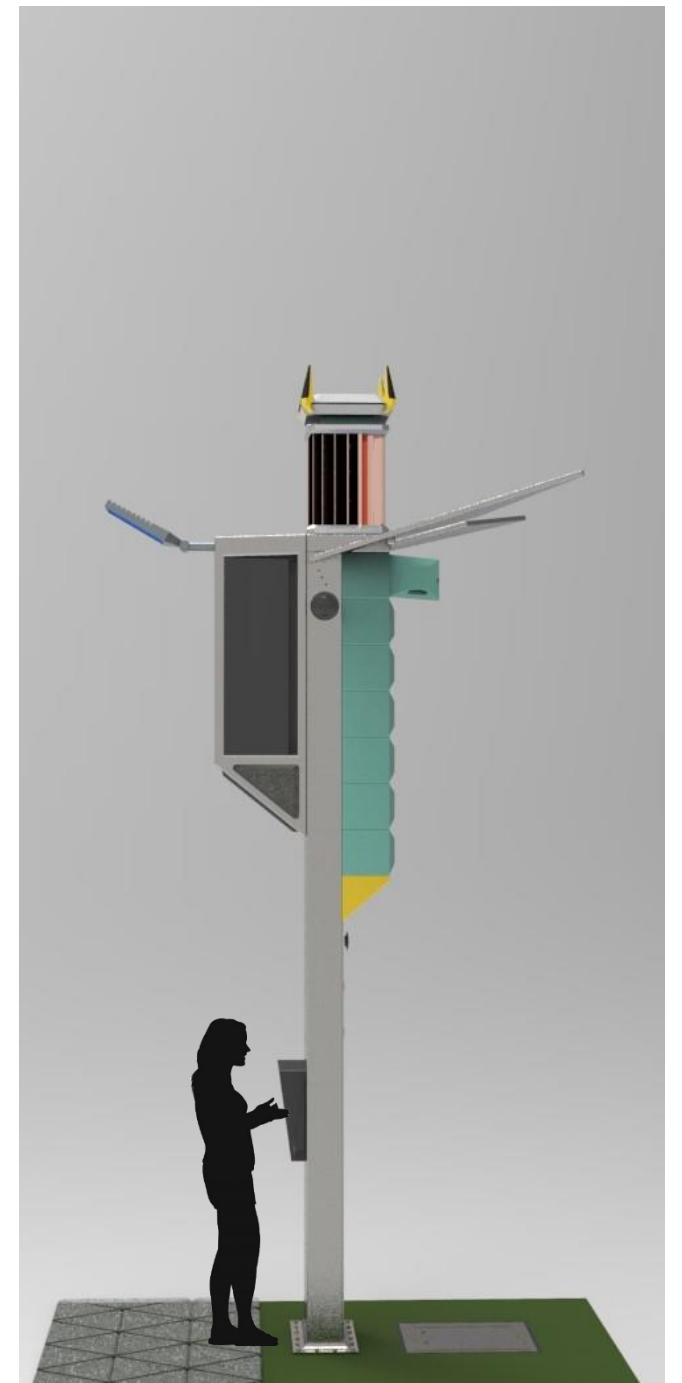
Pole mounting



Product Interaction:



Access To designated personnel through RFID tags



Maintenance issues addressed:

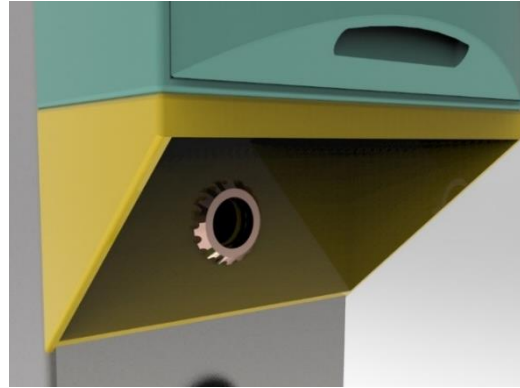
1. Isolation of client equipment



2. Cable management



3. Easy installation and removal of modular boxes



4. Scope for additional equipment



Pole placement

1. Poles with microcells are setup 500 meters apart, to ensure enough " Handoff ", better connectivity in dense urban environment.
2. It's better to have more number of macro cell sites with lesser transmitted power so as to reduce radiations.
3. Lighting poles are setup at 50 meters apart
4. Pole planting depth 60 cms; Pole width 45 cms; Pole wall thickness 0.6 cms





3.10 Branding and customization

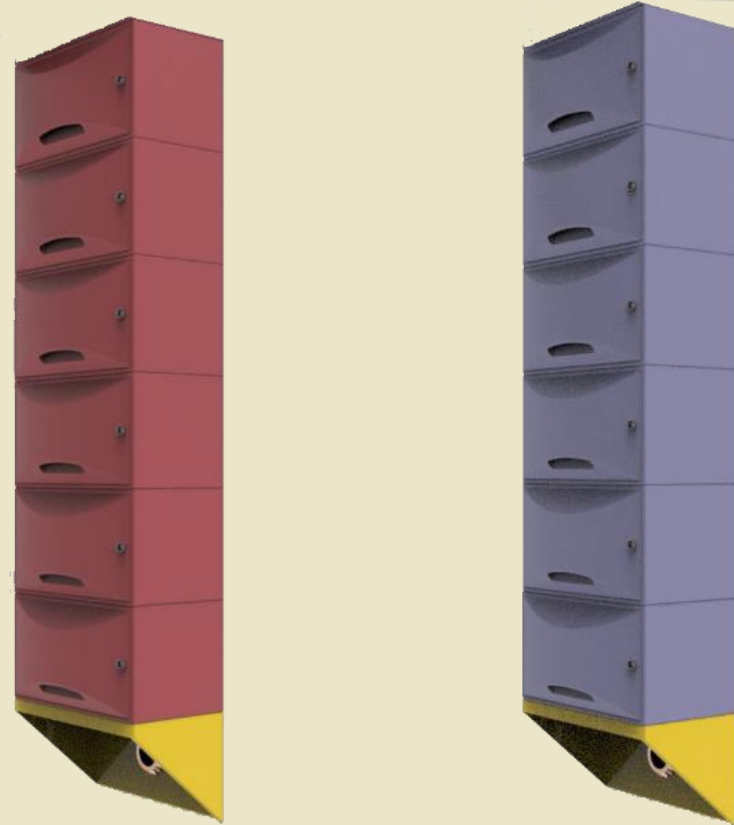
Name: Cato is a Latin name meaning *Intelligent*. It's a four letter catchy word and is unique.

Logo:



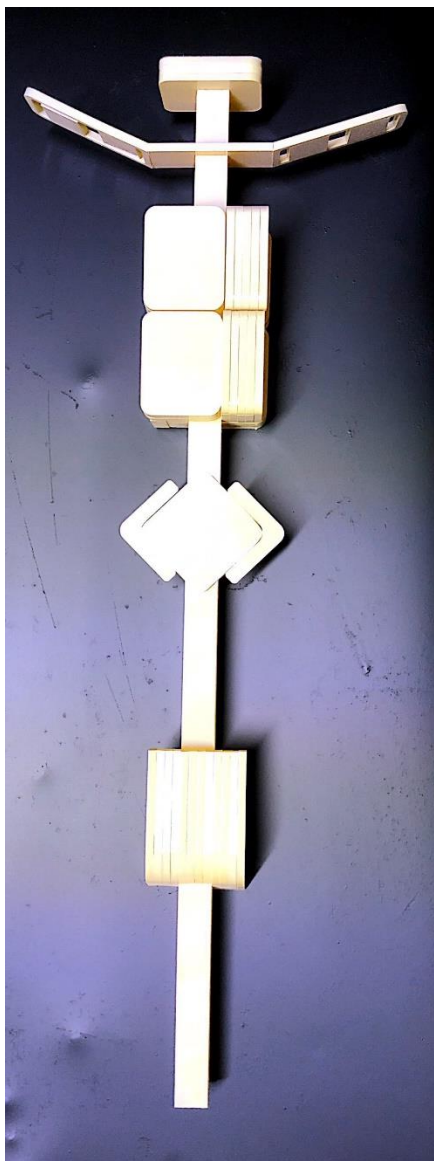
Customization options:

The modular boxes on the pole are made of ABS, giving the customer wide range of colors to choose from.



Pole with Vinyl wrapping





**Form model
for
concept 1**



**Form model
for
concept 2**

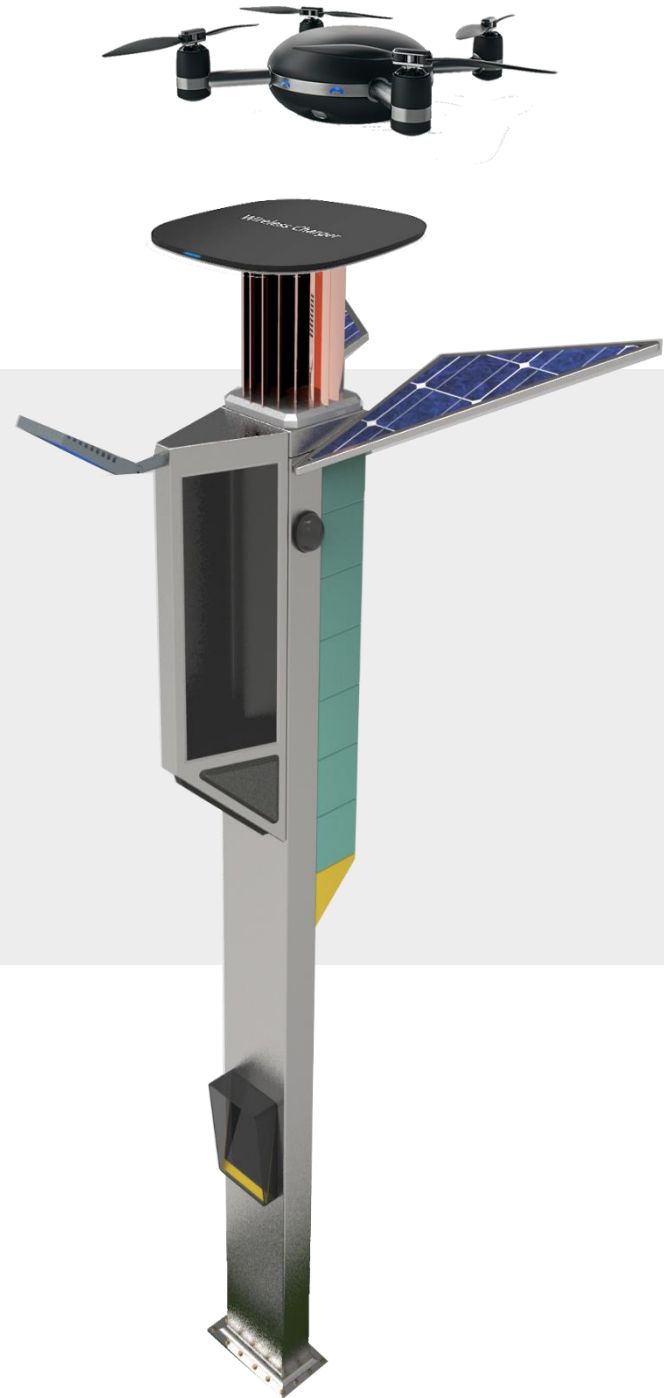
Materials and manufacturing

Sl.no	Name of the part	Material	Manufacturing process	Remarks
1.	Pole	Steel	Extrusion	Light weight and Durability (6 meter pole weighs 20 kg)
2.	Pole finishing	Acrylic poly siloxane	Spraying	Inert and nonflammable
3.	Ducting chamber	Polypropylene	Injection molded	High stiffness
4.	Spiral duct hose	Poly vinyl chloride	Extrusion, winding and joining	Good tensile strength
5.	Brackets	Galvanized steel	Stamping	Strength

Applications



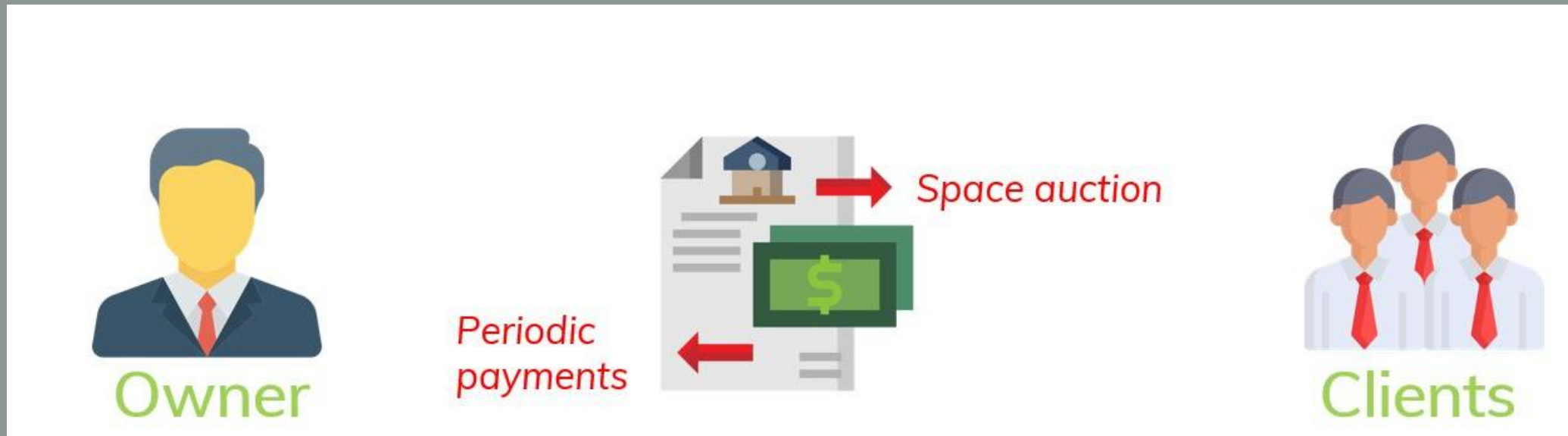
Drone charger



Electric vechile charger



Mode of operation



- Ministry of road transport and highways
- Public works department
- Municipal corporations

- Telecommunication operators
- Advertisement agencies
- Law enforcement organizations
- Environment organizations
- Research labs



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