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Street Furniture for Powai  
Special Focus on Lake Front Road  
Submitted in partial fulfillment of the requirements  
of the degree of Master of Design

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Industrial Design Centre  
Indian Institute of Technology Bombay  
2014

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## Declaration

I declare that this written submission represents my ideas in my own words and where others' ideas or words have been included, I have adequately cited and referenced the original sources. I also declare that I have adhered to all principles of academic honesty and integrity and have not misrepresented or fabricated or falsified any idea/data/fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited or from whom proper permission has not been taken when needed.



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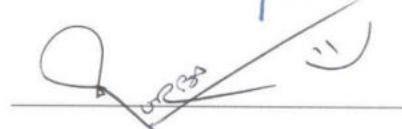
## Approval sheet

This project entitled "Street Furniture for Powai Special Focus on Lake Front Road" by Tu'umay Allene, Roll Number 126132002, is approved in partial fulfillment for the degree of Master of Design in Product Design at Industrial Design Center, (IDC) Indian Institute of Technology, Bombay.

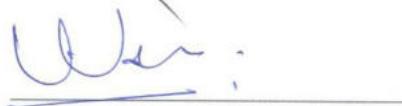
Project Guide



Internal examiner



External examiner



Chair person



Date

24/06/2014

Place

IDC/IIT-B

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## Abstract

Public spaces are crucial components of the city in terms of the physical as well as social function they serve. These spaces not only form the image of the city and the way it perceived but also become places where people interact under collective identity. Public places are more than street, parks, maidans, beaches, play grounds, they also include water-fronts stations, markets and other places designed or designated for public uses.

The basis of this project was to design a set of Street furniture for 'Powai' lake front road which stretches 2.2 kms from Indian Institute of Technology, Bombay, main gate to Larsen & Tourbo fly over. The main goal of this project is to create clean 'Powai' lake side and maintain it as a recreational area. This has been achieved by creating good urban open spaces for users and erect/build an iconic street furniture where it is needed. These furniture has been selected after the case study held to identify the problems faced around 'Powai' lake front.

Since maintenance is a big deal for street furniture, it has taken in to consideration that the maintenance cost would be at net zero cost by using limited advertising price displayed on the furniture.

In this project more than seven furniture have been developed for 'Powai' lake front namely Benches, Bus stops, Vending kiosk, Litter bin, Public convenience, Light poles, Ballads and Information boards. These products have same family look by form, shape, color, material used for all the furniture, and the concept used to reflect the Powai-ness of the products which are derived from the design elements in the place, 'Powai'. These are repetition of elements, combination of lines and arcs, free flow of forms and shapes and the nature in Powai lake are some of the elements. Finally Bus stop with vending kiosk is detailed as a final output.

## 1. Introduction

The concept of street furniture was widely introduced by Romans using stone or wood milestone makers, horse troughs, tethering posts and way makers on their ubiquitous roads. Beyond this street furniture and its growth has been linked to the development in transport along sides increasing population and urbanization. (Architectural street furniture n.d.)

Street Furniture is intrinsically linked to all forms of transport. As technological advances were made and the population grew, new ways of controlling were necessary. (CIS Street Furniture 2010)

Street furniture is a general name for all public amenities visible on the streets and roads which are installed and maintained at public expenses for various purposes such as to create urban-ness of the city/town and as a land mark for a specific area. In addition to this they provides us with interesting information and valid insights in to some of the ways that local authorities, central government, designer, planners, architects or even occasionally charitable associations intervened in the government to make it more pleasant or convenient for the city residents.

According to Dr. Stuart Mitchell (History Department, The Open University) the category of street furniture covers a huge number of different objects. It includes benches, traffic barriers, bollards, post boxes, phone boxes, street lamps, traffic lights, traffic signs, bus stops, tram stops, taxi stands, public lavatories, fountains, watering troughs, memorials, public sculptures, and waste receptacles. They all may be suggestive of town development, technological change, or road management. According to his study on "High Street History: Street furniture" underlines that to think about why street furniture was erected in the first place: this can help us to understand the motives of people in the past. These great relics of pre- motorized transport are often indicators of economics activity in the past since they were frequently placed in market places. They also remind us that animals used to play a much greater part in City life than they do Now. (Mitchell 2007)

## 1.1 Role of street furniture in public open spaces

Public spaces are crucial components of the city both in terms of the physical as well as social function they serve. Those spaces Not only form the image of the city and the way it is perceived but also become places where people interact under collective identity. Public places are more than street, parks, maidans, beaches, play grounds, they also includes waterfronts stations, markets and other places designed or designated for public uses, be it public gatherings for recreational, political and social uses or merely as movement corridor connecting different parts of the city. (Bhavan 1995)

In Mumbai, the impression one gets of the city of the sea, which resists encroachment that provides roads checked by traffic and building massed on both sides of the road. Public spaces in which the community can express itself through recreation and common use have almost disappeared. (Bush 1995)

The order of public places is organic in nature. It takes in to consideration the behavioral aspects of different people as well as their historic and cultural referenced and associations. One important aspect in design of public place is to consider how such places can be easily accessible and free from barriers, vandalism and misuse. There are various physical elements which constitute a public place design; fabrication and maintenance of those require a system approach. (Prof. Ravi Hazra 1995)

Over all street furniture is very important for public spaces that can serve their function as a public use. Thus, Public open space without street furniture (OOH) is meaningless.

## 1.2 Objective

The objective of the project is to

- Create attractive public open space around Powai lake
- Provide essential street furniture services and conveniences for users who come to Powai lake face road for recreation & leisure
- Take special consideration in design of enhanced public open space in Powai lake front
- Define the item of street furniture required for the place and their location

## 1.3 Scope of the project

Street furniture is to be designed for 'Powai' Lake Front road from IIT B main gate to L&T fly over, in order to maintain the place as a recreation area and create good urban open spaces by planting an iconic street furniture where it is needed. Defining the item of street furniture required for the place and their location to increase functionality and minimize the cost. The maintenance cost for the furniture is aimed at net zero cost by using an advertising price displayed on the furniture.

Since Street furniture advertising is having a high marketing share and gives an aesthetic look to the city, this project is also follow similar technique advantages as street furniture maker companies like Laqshya Media Pvt Ltd, JCDecaux group, Pioneer publicity corporation Pvt. Ltd, and Times innovative media Ltd. Which are followed similar thing and doing their works in different part of the world.

### 1.3.1 Types of street furniture

The international bid Noticed by Mumbai metropolitan region development Authority (MMRDA) for the Erection of Street Furniture, Now they call it "Out of Home Furniture"

(OOH) in Bandra-Kurla Complex on the basis of Design, Build, Operate, Maintain and Erect (DBOME) were presented on 5<sup>th</sup> December 2013. Some companies such as Laqshya Media Pvt. Ltd, JCDecaux group, pioneer publicity corporation pvt. Ltd and Times innovative media Ltd have presented their proposals for this bid. In the bid, MMR-DA has listed 13 items listed as follow.

|                       |                        |
|-----------------------|------------------------|
| 1. Benches            | 8. Litter bins         |
| 2. Information boards | 9. Direction board     |
| 3. Multipurpose booth | 10. Flag pole          |
| 4. Vending kiosk      | 11. Public convenience |
| 5. Bollards           | 12. Pole mounted CIP   |
| 6. Bus queue shelter  | 13. Tree guard         |
| 7. Bicycle stand      |                        |

According to their use in public space, Street furniture can be categorized in three groups.

In this project, Street furniture for 'Powai', it is aimed to design a set of street furniture in 'Powai' Lake front road to solve the major problems related to public spaces.

**A. Primary:** Those street furniture are the most and basic types of furniture primarily street furniture in public use. Those include:

- Boom barrier
- Boundary marker
- Bus bulb
- Benches

**B. Secondary (Desirable):** Those are important but Not critical to have

- Advertising column
- Armored booth
- Beach furniture
- Callbox
- Red light camera
- Emergency telephone
- Finger-post
- Taxicab stand
- Telephone booth
- Town sign
- Traffic barrier
- Traffic calming
- Traffic counter
- Traffic enforcement camera
- Traffic light
- Traffic Light tree

- Litter bins
- Information boards
- Direction board
- Multipurpose booth
- Flag pole
- Vending kiosk
- Public convenience
- Bollards (Amsterdammertje)
- Pole mounted CIP
- Bus queue shelter
- Tree guard
- Bicycle stand / Bicycle parking rack
- Public convenience /Portable toilet
- Post box
- Street light
- Street sign
- Police box
- Park furniture
- Bench (seat)
- Traffic sign
- Utility pole
- Grit bin
- Letter box
- Stamp vending machine
- Pillar box
- Worboys Committee
- Receptacle
- Collection plate (postal)
- Comparison of European road signs

**C. Optional:** good to have but Not compulsory

- Cigarette
- Fire hydrant
- Four-quadrant gate
- Gatepost
- Grating
- Guard rail

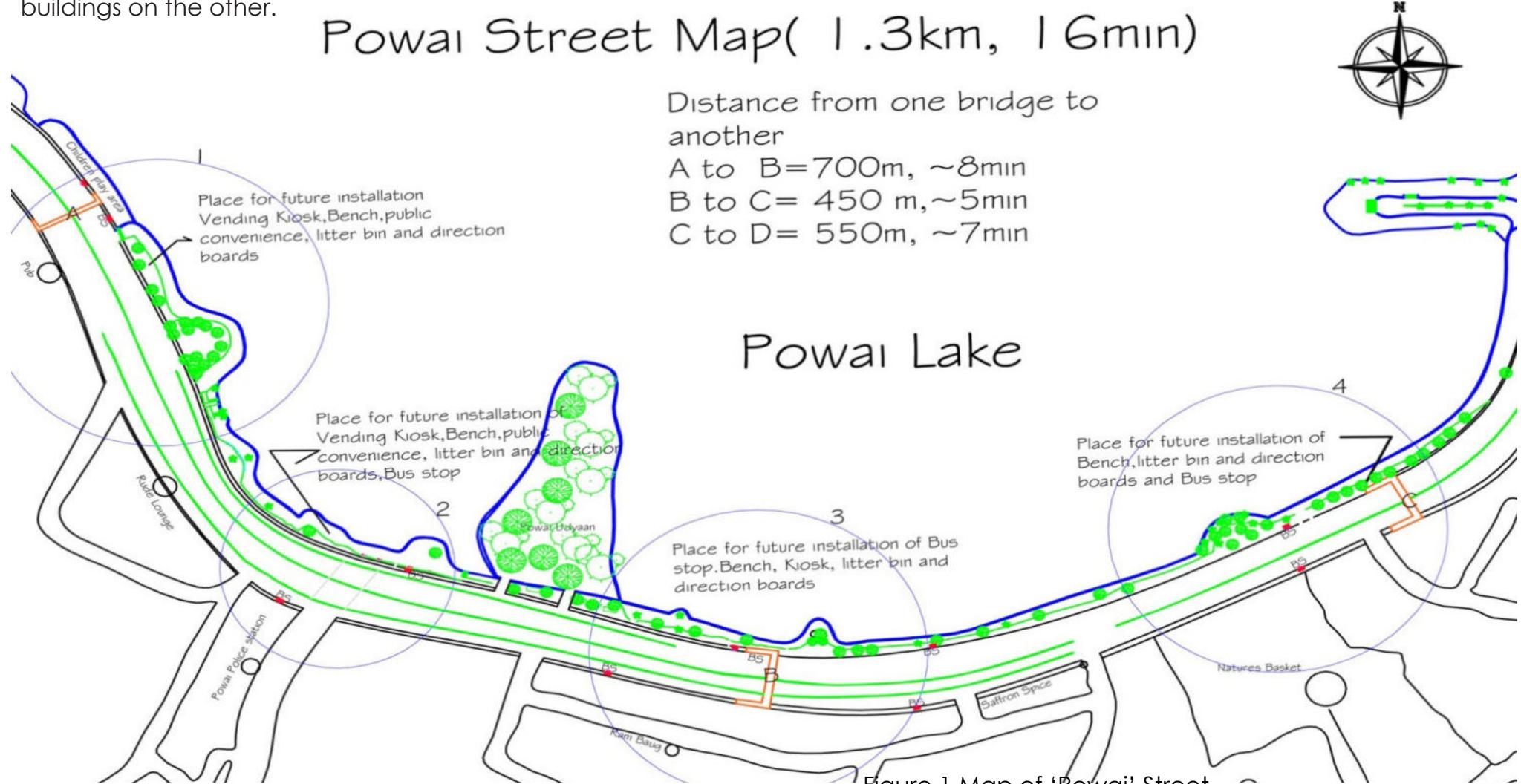
- Lamp box
- Ludlow wall box
- Manhole
- Manhole cover
- Milestone
- Newsstand
- Parking meter
- Park let
- Parting stone
- Clever Bins
- Coal hole
- Parking chair
- Pu-teal
- Curb cut
- Pay and display
- Pay-by-plate parking
- Pay-phone
- Portuguese pavement
- Red telephone box
- Regulatory sign
- Roadblock
- Serving area interface
- Sewer gas destructor lam
- Sidewalk
- Stobie pole
- Street clock
- Village lock-up
- Village sign
- Vinyl strapping
- Wall box
- Wallace fountain
- Waste container
- Zero Kilometer Stone (Budapest)
- Zero Milestone

## 2. Case studies

### 2.1 Powai

#### 2.1.1 Powai lake front road

This study covers distance between IIT B YP gate and L&T flyover which is about 2.2kms stretch. This area has one Side Lake and buildings on the other.





A. View to IIT B



D. View to Hiranandani



G. Play ground in powai lake side



B. Different types of birds



C. View from Hiranandani flats to Powai lake



E. Powai during festival



F. Sun Set in Powai



H. View to ward Renaissance hotel

Powai lake has a good view to different directions around the lake.

Figure 2 Views around Powai street

Images from, <http://www.virtualtourist.com>, accessed in 15,06,2014

## A. About 'Powai'

According to industrial research and consultancy center (IRCC) IIT Bombay the name "Powai" has been the home to five temples. A small locality called 'Panchakutir' (meaning five abodes) is still present in 'Powai'. One of these temples is devoted to Goddess 'Padmavati'. It is believed that the word 'Powai' came from the temple. Its etymology is drawn from 'Padma Aai', which means **mother Padma**, in the local language 'Marathi'. (IRCC, IIT B n.d.)

Perhaps the best-known landmark of 'Powai' is the 'Powai' Lake, a 123-year-old lake that was originally used to supply water to the city of Mumbai, and is today used as an industrial sewage outlet. The 'Jogeshwari-Vikhroli' Link Road, one of the city's busiest thoroughfares linking the western and eastern suburbs, passes through 'Powai', and the place also hosts thousands of devotees every year during the 'Ganesh Chaturthi' festival for the 'Visarjan' processions. (wikipedia.org n.d.)



Figure 3 Padma Aai temple in IIT 'Powai'

In 1943, four years before India's independence, the freedom fighter 'Chandrabhan'

Sharma arrived in Mumbai and happened to lease and subsequently Bought 'Powai' Estate from Sir Yusuf, **the then owner**, for a paltry sum. At that time, 'Powai' comprised five villages: **Saki, Kopri, Tirandaz, 'Powai' and Pasauli**. In the late 1950s, a portion of 'Powai' was given to the government to set up an Indian Institute of Technology (IIT). The Prime Minister, Jawaharlal Nehru, personally visited the area and during a meeting, Chandrabhan Sharma motivated him to give the land free of cost for this purpose.

The 'Powai' area has grown tremendously in the past decade and it is presently a residential, commercial and retail hub for the eastern suburbs of Bombay. Besides the 'Powai' Lake, 'Powai' is host to some important landmarks of Mumbai, such as:

- Indian Institute of Technology, Bombay (IIT Bombay),
- Hiranandani Gardens Township (Neoclassical architectural style)
- Construction, engineering and manufacturing conglomerate Larsen & Toubro group of companies are some
- The National Institute of Industrial Engineering (NITIE)
- Various Government colonies of Income Tax Dept, Customs, Coast guard etc.
- Gopal Sharma Group of Schools
- 'Powai' plaza.

'Powai' Street is bordered by 'Powai' Lake in one side and buildings to the opposite side. In this street people used to recreate themselves toward the lakeside but this area is Not used as a recreation area yet. People use this area with their relatives to recreate themselves after office hours. However, the place is highly affected by dumping of huge garbage; people are using it as a recreation area in uncomfortable situation.

## B. Why street furniture for 'Powai'

Since the site is lakeside, people went to this area for invigorate themselves and to get fresh air. But the lakeside does Not have anything to stay there. Lakeside is the best place for recreation, especially cities like Mumbai; it takes a fortune to find such a place like the lakeside of 'Powai'. Many people would love to hangout in this area but unfortunately there is standard street furniture. There are some more reasons why it is needed to design street furniture for 'Powai'.

1. 'Powai' is as a landmark for the expensive flats, the Hiranandani Township, and famous institute, IIT Bombay, but this lake is Not used as a recreating are for those communities.
2. To minimize the waste material dumping in to the lake
3. To create the feeling being in lakeside
4. Maintain 'Powai' Lake safe and comfortable to stay around
5. Serving the users to get fresh air blowing from the lake
6. The grass on the lake looks moving when air is blowing over it. This creates a smooth movement (buoyancy) when we look from the lakeside and this creates fresh mind and fun.
7. Looking nature how birds/ducks search their food (fish and other amphibians) from the lake.
8. There is No place to hang out around 'Powai' area, the only choice is 'Powai' Lake.
9. Because of security and safety issues in this area so lighting, security cameras (CCTV cameras) are needed.



### C. Current street furniture in 'Powai' lake front road and their problems

Powai as an urban public space and lake front it does not have proper street furniture . there are some furniture in the street lake face road as follow.



**A. Benches:** - People seat on a concert fence (concrete wall) constructed to indicate the border of the lake serve as barrier structures to prevent access for cattle and people in to the lake. But it becomes very hot during day time that users cannot sit on it. It is known that sitting on a hot stone can be a cause for disease called "Hemorrhoids" which is a serious health problem.



Figure 4 Benches and seats in 'Powai' Lake

**B. Litter bin:** - In this area there is a huge collection of garbage but the litter bins kept along the street are Not in use. This is because people did Not have habits of properly disposed of waste and underestimating the negative effects. In addition to this the litter bins which



Figure 5 Litter bins in 'Powai' Lake



Figure 6 open defecation in 'Powai' Lake and urinated corners



A



B

Figure 7 Compo and bus stop shelter

are located over there are Not properly maintained. Since it is difficult to collect the wastes from the litter bins, the wastes are burnt inside the bins.

**C. Public convenience:** In 'Powai' lake, some people used to pee either around the streets in some corners of the street or in to the lakeside.

**D. Bus stops/Bus queue shelter:** - there are seven Bus stops between IIT YP gate and L and T fly over. Three of them have shade the rest four do Not have. There are two types of bus queue shelters in this street. These are the common type bus stop in all over Mumbai with barrier in the front and the second one with electrical advertisement in the shade which does Not have rails in front of it. Since the campo is kept without shade people are exposed to harsh sun burn while they are waiting for the buses. The seats in the bus queue shelter are used mostly by old and physically challenged people.

**E. Direction Boards:** - Massive iron columns for small direction board



A

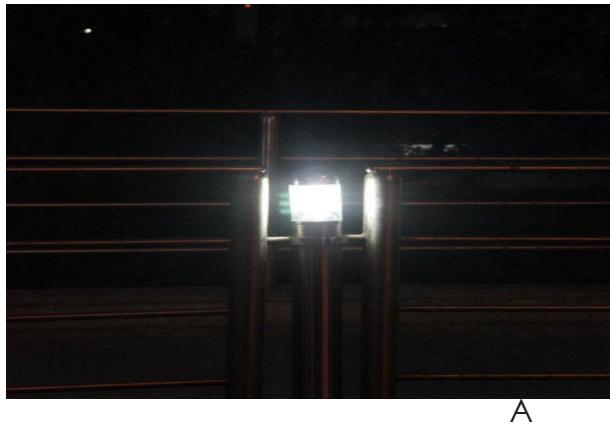


B



C

Figure 8 Direction boards



A



B



C



D

Figure 9 Bollards in 'Powai'

**F. Bollard:** - bollards do Not have reflective light to show signals for the vehicles as well as pedestrians

**G. Vending kiosk:** -

- No vending kiosks around the area
- Users buy snacks from hawkers
- This increase the uncontrolled dumping of waste in to the lake



A



B



C

Figure 10 Vendors/ Hawkers

**H. Land marks on the site:** -There are some elements that people use them as a land mark in 'Powai' Street. These are apartment buildings, hotels and the lake face seats. All the elements share a common that is repetition of elements vertically and horizontally.



A



B



E

Figure 11 Land marks around the lake

#### D. How people behave 'Powai' lake front rode

A. Most of the visitors to this place are couples (Male and female) who seats on the concrete seat around the lakeside.



C



D



A



B

B. People staying alone, they sometimes sleep on the concert barrier (fence)



C



A



B



D



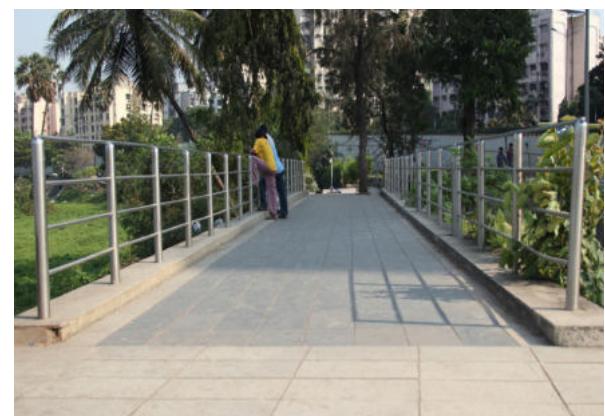
C



D

Figure 13 People sleeping on the concrete barrier

C. People come to this area mostly in the evening either in group, in pair and very few people come alone.



E

Figure 12 Seat in pairs on the concrete barrier



A



B

Figure 14 People sitting in Group and individually on the lake face

## E. The spirit of 'Powai'

When we think about 'Powai', there are things which come to our mind that makes us remember the lake as well as the entire street. Those things tell us the 'Powai'-ness of 'Powai'. Those are:

**A. The water body:** - the lake creates a wave; the reveal of the lake combined with the reflection of the buildings and trees around the lake give the blurred visual. Straight lines are broken because of the reveals.



Figure 15 Reflection of the water body

## B. The buildings around the lake

The apartments around 'Powai' Lake such as Hiranandani, which have repeated elements in both vertical and horizontal directions are unique to this area.

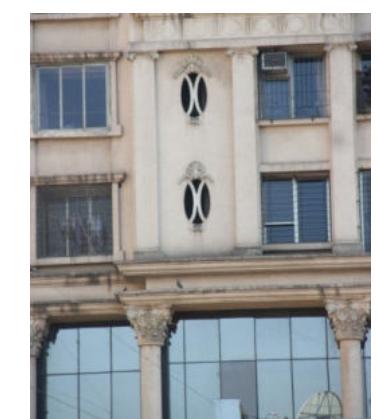


Figure 16 Hiranandani and other building as an element

### C. The street connecting the two directions west and east

Since the street in 'Powai' is the junction of the western and eastern highways, the traffic flow in this street is another element for the site.

**D. The grass round the lake:** 'Powai' Lake is surrounded by plants/ leaves shown in figure 18.



A



B



C

Figure 17 Street in 'Powai' and 'Powai' area



Figure 18 Grass in lake side in 'Powai' lake

**E. "Powai" lake is a man made lake from 'Vihar' lake.** It depicts the growth / develop of the lake originally from the nearby lake. This shows as facilenes of the lake.

In general the design languages that can be taken from the street are as follow.

- Free flow form/shape like the stretch in 'Powai'
- Combinations of arcs and lines
- Repetition of elements
- Joyful and recreation
- Reflection and movement

## 2.2 Hiranandani

Hiranandani Gardens is a neo classical architectural marvel nestled amidst the verdant 'Powai' hill, strategically located opposite the serene 'Powai' Lake, where more than 4000 families stay. Sprawled majestically over 250 acres, Hiranandani Gardens is Mumbai's finest residential township that has redefined the standards of elegant living. Intelligently planned, crafted with precision and embellished with care, it fulfills the delicate dreams of many, giving rise to a new perception of life and life style. (Hiranandani Garden 'Powai' n.d.)



A



B



C



D

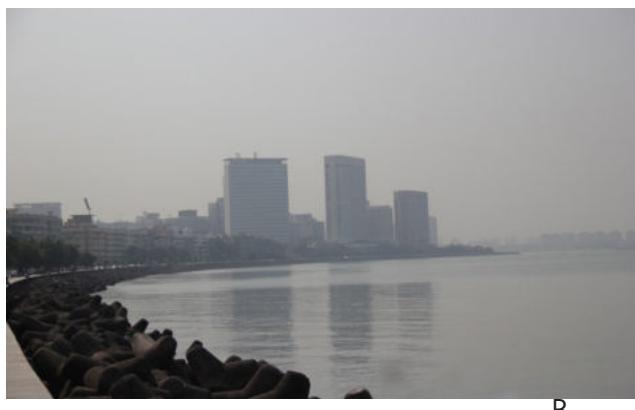


E



F

Figure 19 Hiranandani garden



## 2.2 Marine drive

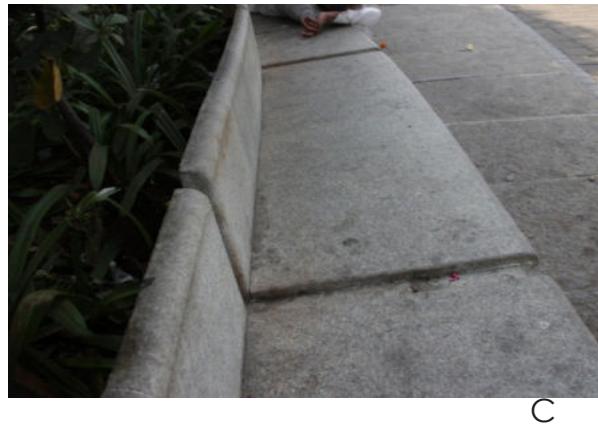
This street is one of the beautiful urban areas in Mumbai which has a wide public spaces sea face and buildings on the opposite side of the street. This street covers 4.2kms; out of which 3.3km has concrete seat to the sea side as shown in figure.

**A. Benches:** - People sit in this area on the 3.3 km concrete (stone) seat built to the sea side and have a seat to the street face. There are also some benches with shade in order to protect the people from the harsh sun.



Figure 20 Marine drive sea face

**B. Public convenience:** - The public convenience located in the mid way of the street is only one for both males and females as shown in figure 22. But that was closed because of improper usage by the public. There are other services around the area below the bridge where users can get the service by paying 2rps per Person.



C



A



D



B



C

Figure 21 People stay in marine drive seaside

Figure 22 Public convenience in marine derive



A



B

Figure 23 Tree guards and people shade in the tree

### C. Tree Guards

Those are made up of concrete clock and steel.

**D. Vending kiosk:** - It is a temporary structure on a sidewalk way which you sell items such as newspapers and candy and other fast foods. In addition to this it is used for advertisements and announcements. This could be made digital but the kiosk in marine drive is operated manually and provide the people with water for drink and some snacks.



Figure 24 Vending kiosk in marine drive

**E. Elements:** - Those wave breaker (concrete molds) in marine drive are an iconic elements used to break the wave which comes from the sea. The street names for the places are also other iconic elements in this area.



A



B

## 2.3 Worli Sea face

This area is another similar place to marine drive and 'Powai' Lake with sea face in one side and building on the other side with different types of street furniture.

**A. Benches:** Concrete benches and wooden benches are available in this area. But users prefer to seat on the concrete fence facing the seas shown in figure 26 'C'. The good thing about this area is that sport furniture is provided for those who are jogging in the area. Facilities such as parallel bar, Pull up bar are made available for users.



C

Figure 25 Wave breakers and the street names of marine drive



A



B



A



C



B



D

Figure 26 Benches in Worli sea face

**B. Public convenience:** - No public convenience in this area, but there is public toilet which is far from the public spaces.



Figure 27 Public convenience around Worli sea face

**C. Sport equipments:** - For people jogging during the evening, some sport equipments such as pull up, sit-up, are provided in the street as shown in figure 28.



Figure 28 Sport facilities



**D. Bus stops:** - The bus stop in Worli sea face is similar to the bus stop in entire city of Mumbai.



Figure 29 Bus stop in Worli sea face

**E. Elements in Worli Sea face:** - The Bridge passes through the sea and very unique buildings are some of the elements of Worli sea face;



Figure 30 Some elements of Worli sea face

### 3. Studying similar furniture around the world

#### 3.1 Benches:



A



B



C



D



E



G



H



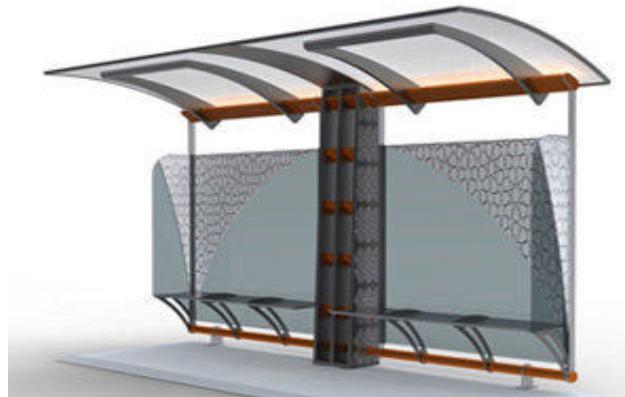
F



I

Figure 31 Mood board for benches (source from Internet)

### 3.2 Bus Queue shelter/ Bus stops



A



B



C



D



D



BUS STOP SHELTER



bitann.blogspot.com

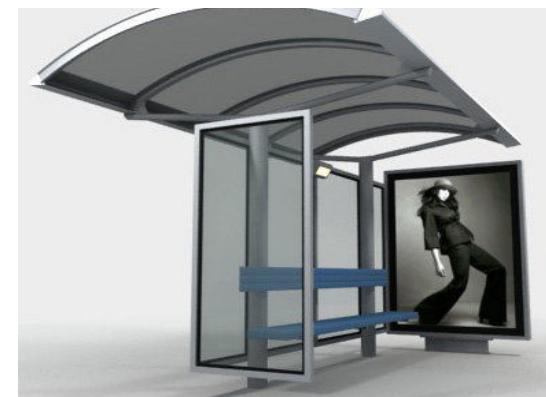


Figure 32 Mood board of Bus queue shelter

### 3.3 Litter bin



A



B



C



D



E



F



G



H



I



J



K



L

Figure 33 Mood board of litter bins

### 3.4 Public convenience



A



B



D



E



F



G



H



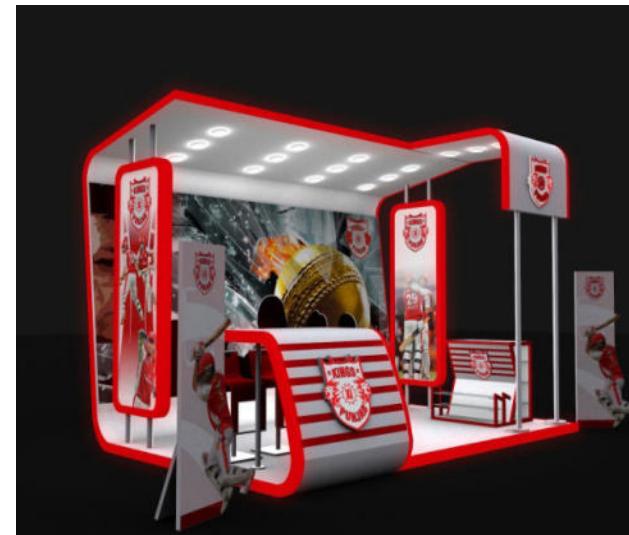
I

Figure 34 Mood board of public convenience

### 3.5 Vending kiosk



A



B



C



D



E



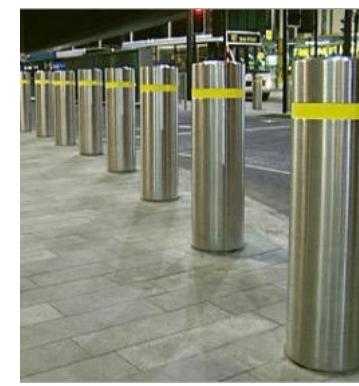
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Figure 35 Mood board of vending kiosk

### 3.6 Bollards



A



B



C



D



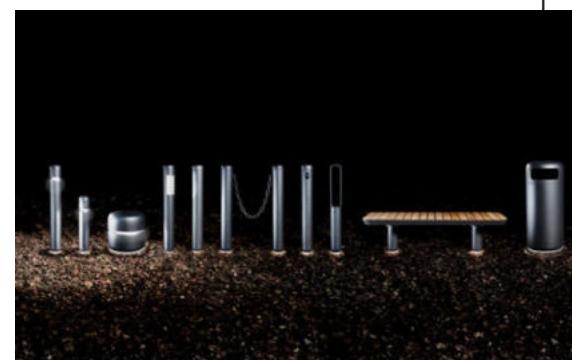
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G



H



F



J

Figure 36 Mood board of bollards

## 4. Problem Identification

Uncontrolled and huge dumping of degradable and Non degradable waste materials in to the lake are the major problems which makes the lake highly polluted and have bad smell. But still people/commuters stay around the lake to refresh and to interact with their friends, partners and relatives. People used to seat on the concrete stone barrier (lakeside promenade) in the lakeside. But it gets hot during day time. There are some litter bins, but most of these bins are not used by the people because the bins are planted away from the seats where the people seat and there is No habit of putting garbage in the bins.

The following observations are collected during the case study conducted in 'Powai' street lake front road.

1. The street has good view during the evening; reflection of the building on the lake creates a pleasant view to the eye. But there is No proper seat (bench) for the user who wants to stay there.

2. The site as recreation area does Not have shade and plantation to protect the people from harsh sun burning during the day time.
3. Uncontrolled waste management especially plastic bags of snack packaging used by the people saying there. These include chocolate, biscuits, ice-cream cups; plastic tea cups and chewing gum plastics are the common wastes in this place.
4. This place is crowded by people especially in the evening. Some People sit around the lakeside to recreate with their loves one and others are walk, jog and wait for buses in both side of the street.
5. Few and substandard bus queue shelter. Especially during day time, people are exposed to a harsh sun while they are waiting for buses.
6. The site is Not comfortable for elderly and people with disabilities because it does Not have ramp to picnic around.

7. No public convenience in the site, commuters/users used to urinate in some corners and/or into the lake
8. Not comfortable place and few benches in this area for people to stay over
9. People are supposed to wait minimum of 10 minute for the next bus. Sometimes bus may delay for about 30 to 40 minutes because of traffic jam.
10. Buses are always in duty from 5am till 12am mid night.
11. No vending kiosk, hawkers/ vendors are selling snacks by roaming around the lakeside promenade
12. The information boards especially bus stand poles/compo are corroded and are Not visible from a distance and are Not understandable to new bus users because of the crowded fonts written on the board.
13. Most of these shelters does not have litter bin beside them and passengers throw the garbage randomly everywhere.
14. People seat on the bollards and handrails of the Bus queue shelter which is found in front of it while they are waiting for the buses.
15. The street furniture available along the street is Not regularly maintained.

Based on the problems facing in 'Powai' Lake, the following selected furniture will be develop and design in this project. Finally one furniture is detailed out of those selected "Out of home furniture" which are listed as follow:

**A. Benches:** The main function of Bench is to provide a resting opportunity to pedestrians or a seat for those observing a specific location or point of interest / monument. The minimalist and functional design of benches combined with their aesthetic add comforts to the urban landscape. Seats should ergonomically design to provide maximum comfort for users.

**B. Bus stops:** The main function of Bus Queue shelter is to offer pedestrians comfortable space with shade to wait for Buses and also for Queue system to function in public space. In addition to this they serve as land mark for a specific area. Bus Queue has to be including information about the buses and lines, enough surface for advertisement and seat for waiting passengers.

**C. Litter bin:** The main function of Litter Bins is to provide a hygienic process of waste disposal in public spaces or roadsides by pedestrians and motorists. The design provides for separate disposal of organic or Non-organic and wet or dry wastes. The design of litter bin and color ensures that it merges with the natural background while still being visible to users without being obtrusive.

**D. Public convenience:** The main function of the public convenience is to provide comfort and opportunity to use restroom facilities for commuters with distinct & separate facilities for men & women either for free or very less reasonably price in streets.

**E. Vending kiosk:** The main function of the vending kiosk is to give space to the authorized person to sell approved products to commuters on the streets like water, soft drinks, snacks, newspaper, magazine, flowers and similar products that commuters' can use while they are picnic in that area. To ensure this vending kiosk will have a spacious open inner space for storage & system for locking when not in use.

**F. Bollards:** The word "bollard" may have come from French /Norman word "Boulard" which was small wooden or iron post used to tie up ships when in dock. Nowadays they are simply known as mooring bollards. (CIS Street Furniture 2010) Bollards are posts, short poles, or pillars with the purpose of preventing the movement of vehicles onto sidewalks or grass, to obstruct the two wheeler to drive on the foot path and also helps the vehicles in night to avoid the street dividers thought it's reflect light and frequently introduced as a way of controlling the flow of increasing traffic on dangerous road.

## 5. Design brief

Design a set of “**Street furniture for 'Powai'**” special focus on Lake Front with following considerations,

- Sturdy, easy for maintenance,
- Free of traffic accidents,
- Environmental friendly, theft and vandal proof,
- Simplistic,
- Modern,
- Iconic ( family look)
- Ergonomically designed for Indian population
- Self financed for maintenance through advertising at zero cost to the city on build and operate basis sponsored by some companies.

Each furniture has briefed in item wise as follow.

### 5.1 Benches

- Ergonomically designed for easy use and accessible by different

people, comfortable and environmental friendly

- Aesthetic and stable, simple, elegant and practical
- Vandal and theft proof, strong and corrosion resistant Easy to maintain

### 5.2 Bus stops

- Environmental friendly
- Practical ,vandal proof ease of maintenance
- Modular, Lighter, strong and corrosion resistant
- Ergonomically designed for easy use and accessible by different people
- Unique, modern and memorable
- Friendly and approachable

### 5.3 Litter bin

- Easy to clean and empty the wastes maintain
- Clean look, elegant, modern,

simple, practical and accent in the urban environment

- Lighter and rust resistant
- Ergonomically designed for easy use and accessible by different people
- Easy to maintain and convenient/ inviting to use

rary

- Aesthetically appealing, unique, modern, memorable and functional
- Easy to maintain and inviting
- Strong and corrosion resistant
- Secured, safe and convenient to use

#### 5.4 Public convenience

- User and environmental friendly
- Aesthetically appealing , Contemporary, easy to use and maintain
- Ergonomically designed for easy use and accessible by different people
- Approachable and convenient / invite to use
- Safe and secure

#### 5.6 Bollards

- Unique, modern, aesthetically appealing, contemporary, simple and elegant
- Theft and vandal proof, Stronger and rust proof
- Ergonomically designed for easy use and accessible by different people
- Iconic, durable, Easy to maintain and stable

#### 5.5 Vending kiosk

- Environmental friendly
- Modular, simple and Contempo-

#### 5.7 Lights

- Multipurpose( lighting, CCTV camera, as a flag pole, advertisement)

- Strong, durable and rust proof
- User and environmental friendly
- Iconic and practical

### 5.8 Direction boards

- Unique, modern, memorable and functional
- Easy and multi lingual information
- Aesthetically appealing , Contemporary and practical
- Vandal and theft proof, rust resistant and stronger

The following elements have to be considered in the design solutions.

### A. Constraints

- Build and operate is taken by sponsoring companies
- Street furniture design is better to adopt the cities and Architecture of the area in order to depict the history and is good mean adopt objects to urban.
- Fixed/ Non movable

- Area/ space available in the place limits the design idea
- Manufacturability and maintainability is Not personal, it needs regular and periodic maintenance
- Materials selected for OOH furniture is limited because of the condition and weather of the place.

### B. Zoning of street furniture

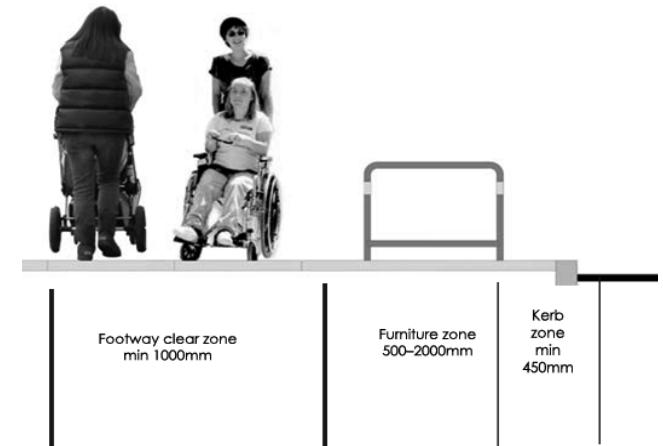


Figure 37 street furniture guide line

### C. Ergonomic dimension for Indian population

The "Indian Anthropometric for ergonomic" design practice by Deb Kumar Chakrabarti, National Institute of design

and "Residential Interior design for elderly", A guide book for ergonomic dimensional reference for designing home interior, By Lavanya Bachwal and Gaur G. Ray, Industrial design center (IDC, IIT Bombay) are taken as a reference for ergonomic consideration.

Table 1 Indian Anthropometric dimension for ergonomic design (in mm) (Chakrabarti n.d.)

| No | Combined dimensions ( male and female)                        | Min  | 5 <sup>th</sup> % | 25 <sup>th</sup> % | 50 <sup>th</sup> % | 75 <sup>th</sup> % | 95 <sup>th</sup> % | Max  | Mean |
|----|---|------|-------------------|--------------------|--------------------|--------------------|--------------------|------|------|
| 1  | Stature(top of the head, standing in erect stretched posture) | 1288 | 1463              | 1555               | 1619               | 1673               | 1771               | 1950 | 1614 |
| 2  | Normal standing height  | 1276 | 1439              | 1541               | 1610               | 1671               | 1714               | 1939 | 1607 |
| 3  | Popliteal( ground to underside of thigh) Seating Height       | 305  | 374               | 399                | 419                | 439                | 466                | 540  | 420  |
| 4  | Buttock to popliteal length, Normal sitting                   | 400  | 479               | 520                | 549                | 575                | 613                | 861  | 549  |
| 5  | Buttock to popliteal, Normal sitting                          | 340  | 394               | 429                | 451                | 474                | 509                | 595  | 453  |
| 6  | Mid thigh to thigh external breadth (relaxed)                 | 273  | 289               | 334                | 369                | 394                | 479                | 530  | 371  |
| 7  | Buttock to leg length Normal sitting                          | 539  | 540               | 594                | 654                | 729                | 779                | 780  | 664  |
| 8  | Buttock to leg length while raised on toe                     | 450  | 559               | 609                | 659                | 689                | 759                | 960  | 659  |
| 9  | Buttock to extended (raised on floor)leg comfortable length   | 660  | 739               | 849                | 905                | 979                | 1069               | 1210 | 910  |
| 10 | Buttock to leg full extended length                           | 865  | 941               | 1019               | 1071               | 1119               | 1199               | 1350 | 1071 |
| 11 | Elbow to elbow relaxed  | 330  | 389               | 451                | 494                | 539                | 632                | 821  | 501  |

Other important dimensions are listed blow from the book entitled "Residential Interior design for elderly", A guide book for ergonomic dimensional reference for designing home interior, By Lavanya Bachwal and

Gaur G. Ray, Industrial design center (IDC, IIT Bombay) For elderly and handicap including wheelchair users.

Table 2 Anthropometric dimensions for elderly and handicap including wheelchair users (Ray n.d.)

| No | Parameters                                  | Dimension used in mm minimum |
|----|---|------------------------------|
| 1  | Door open width                             | 800                          |
| 2  | Ramp slop                                   | 5° or 1:12                   |
| 3  | Standing posture handrail in descending     | 900                          |
| 4  | Standing posture handrail in ascending      | 800                          |
| 5  | For wheelchair operation                    | 685                          |
| 6  | Handle grip diameter                        | 40                           |
| 7  | Minimum lower level height for door handle  | 750                          |
| 8  | Maximum upper level height of door handle   | 1250                         |
| 9  | Maximum top level height of the door handle | 1550                         |
| 10 | Keyhole/latch for wheelchair from ground    | 810                          |
| 11 | Key position from ground optimized          | 1100                         |
| 12 | Keyhole location from the side door frame   | 80                           |
| 13 | Hand wash basin height                      | 850                          |
| 14 | Grab rail in toilet                         | 850                          |

## D. Design guidelines for street furniture

**A. Visibility:** - People must be able to see the buses while they are sitting in the queue shelter and the things around the lake. All products should be designed in such a way that they should allow to visible in every direction.

**B. Accessibility:** - This should allow people to use the buses, vending kiosk and public convenience.

**C. Comfort:** - Benches and seats should be comfortable and ergonomically designed.

**D. Information:** - The uniqueness of the furniture and their relation to each other gives information about the place 'Powai'. This can show contemporariness, modernity or shape, form and Color that makes 'Powai' unique place for recreation.

**E. Sign-age:** - schedules, routes and directions should be provided in the area for better use

**F. Visual language:** - Products should convey same message and should look same family. This can be achieved by considering the following elements:

- Using same material for all furniture
- Use common shape/form/ elements in all
- Color chosen for the furniture give family-ness
- Conceptual/semantics applying in all the furniture, such as high tech-ness, modern, classical, contemporary

**Example:** - The modernity expression for the furniture should be reflected as:

- Optimum and elegance in form and detail
- Ergonomic and organic shapes

- Rectangular/Arcs with filleted edges,
- Smooth surfaces/edges, soft look

## **E. Technical aspects of the products**

While working on the street furniture, it has to be taking care of all aspects expected and maintained by MMDRA or sponsoring companies like L&T and Hiranandani.

### **i. Maintenance**

- Design is Nothing without maintenance especially for public furniture (OOH); maintenance should be taken in to consideration while designing especially street furniture.
- Lighter and durable materials make easy to dismantling and relocation of the furniture during maintenance
- Modular nature lends itself to extension the same property where it necessary
- Solar energy is analyzed and considered where ever it is necessary and possible

### **ii. Vandalism, security and safety**

- Fewer and concealed joinery, simplistic design and grouting the product in to the ground in order to make it stable, vandal and theft proof. (Limited 2013)
- The design and material recommended ensure that the structure have rounded edge, fire resistance and skid proof for user safety

## **F. Durability and material consideration**

- Products used near the lakes and seaside can maintain the durability of the products by applying a special layer coating done on steel structure called 'seaside treatment'.

- Ionized aluminum panel, which is suitable for application involving exposure to lakeside environments because of its good corrosion resistance.
- Galvanized steel in internal framed and LED lighting would be provided for durability, being Eco-friendly due to low heat emission and low power consumption.
- All metal furniture and parts would be either polished or powder coating with polyester powder which is environmental friendly and offers a superior finish while adding many performances, properties such as excellent resistance for corrosion, chemical, heat, impact observation, Ultra violet rays, and extreme weather conditions due to the sea side exposure in the site.
- Vitreous enameling and steel treatment mostly used in military equipments
- Natural or processed wood (mixed with fiber and premium hard wood), Iroko, oak etc. 'Iroko' is a suitable weather resistance and durable which can be used in a kiln dried form.
- Precast concrete/ferrocement /composite cement is also a good material for easy construction and cheaper material. It can be molded in any shape.
- Bench can be developed in 'resin quartz', a tough and durable material that can shape into dynamic curvilinear forms.
- Fiber reinforcement plastic (FRP) is a light weight, easily replicable and making. It is available in different colors and finish.
- Metal tube and metal sheet: - it is easily to manufacture and folding and can make in different joinery as per the requirements. It is also easy to dismantle
- Tensile structure for bus stop roofing and sun shade:- it is stretchable looking good easy to maintain, light weight and easy to installation
- Copper alloys (20%) can also be used due to its anti-microbial property

- Polyurethane(PU) elastomer
- Polyethylene(PE)is an ideal material for street furniture
- Furniture are designed to be lighter, stronger and rust resistance

Table 2 possible materials for each furniture

| No | Furniture name     | Possible Materials   | Note  |
|----|--------------------|--|---|
| 1  | Bench              | Steel, stainless steel, marble, copper, cast Iron, precast concrete, resin quartz' |   |
| 2  | Bus queue shelter  | Steel, stainless steel, cast Iron  | <b>Steel</b> :- galvanized, and painted                             |
| 3  | Vending kiosk      | Steel, stainless steel, concrete   | Stainless steel:-   |
| 4  | Litter bin         | Steel, stainless steel, marble, copper, cast Iron                                  | <b>Wood</b> :- highly resistance woods, like Iroko, pine, and larch |
| 5  | Public convenience | Steel, stainless steel, fiber glass  | <b>Concrete</b> :- precast and prestressed                          |
| 6  | Light pole         | Steel, stainless steel, cast Iron,1  |   |
| 7  | Railing            | Steel, stainless steel, marble, copper, cast Iron                                  |   |

## G. Design considerations in general

It is envisaged that the street furniture as well as the entire prescient will be built, erected and maintained by some sponsoring companies such as L&T, Hiranandani, IIT B etc... and will be given limited advertising right to get bay back of cost for erection, and maintenance (ex. MMRDA procedure). Design of the furniture consists the following points.

- Monolithic and fewer joints to avoid accumulation of dirt and water making
- Rounded edge, fire resistant and skid proof for pedestrian safety
- Modular nature products to extend in the same proportion where necessary
- None toxic materials
- Contemporary, practical and vandal proof
- Lighter, stronger and rustproof or resistant materials
- Ergonomically designed for easy use and accessibility by different people
- Innovativeness disable friendliness
- Design of the furniture should be same family
- Cost effectiveness

## 6. Ideation

### 6.1 Mind map

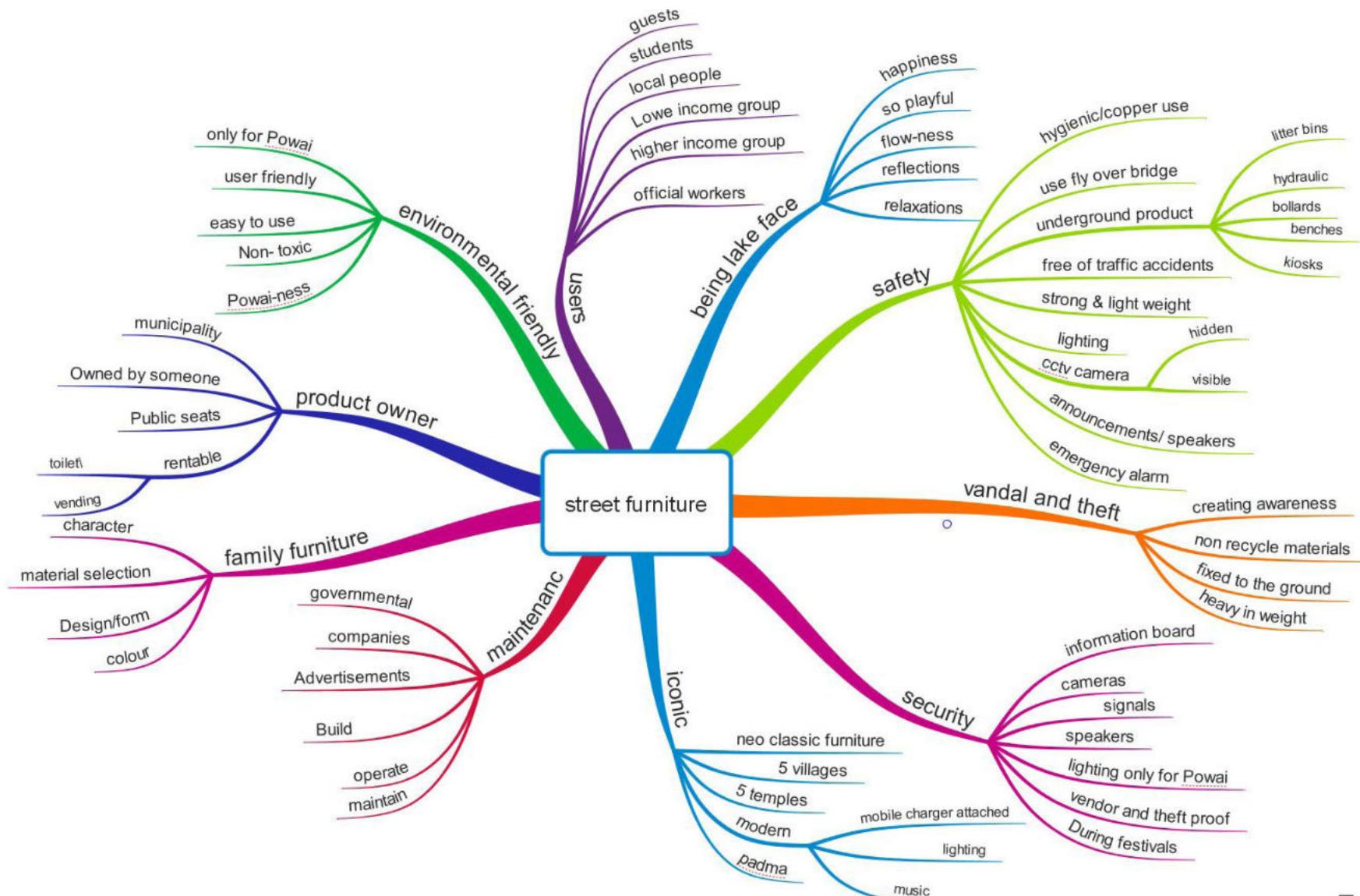


Figure 38 Mind map

## 6.2 Ideas for Benches

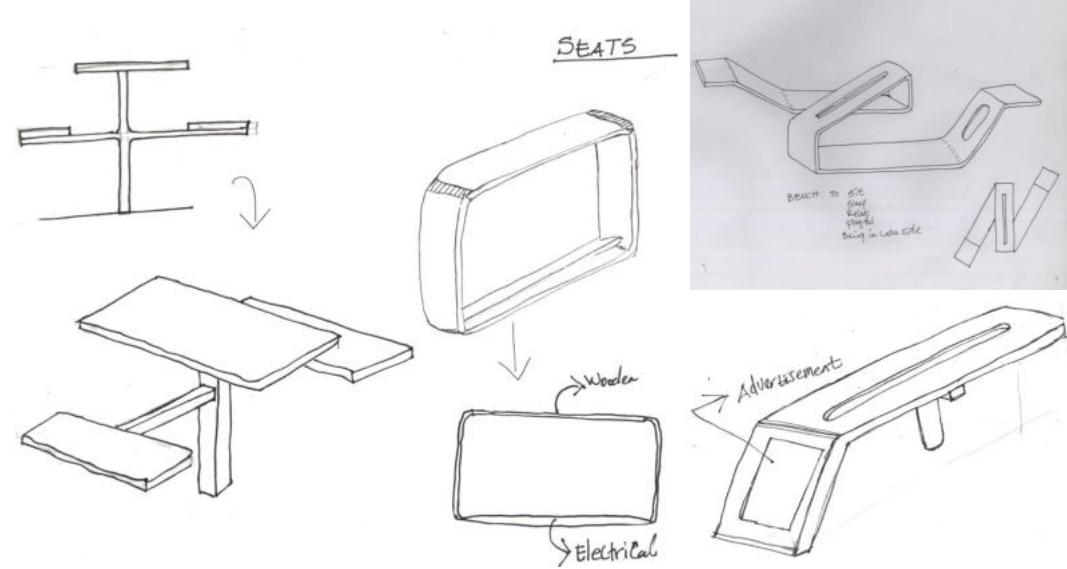
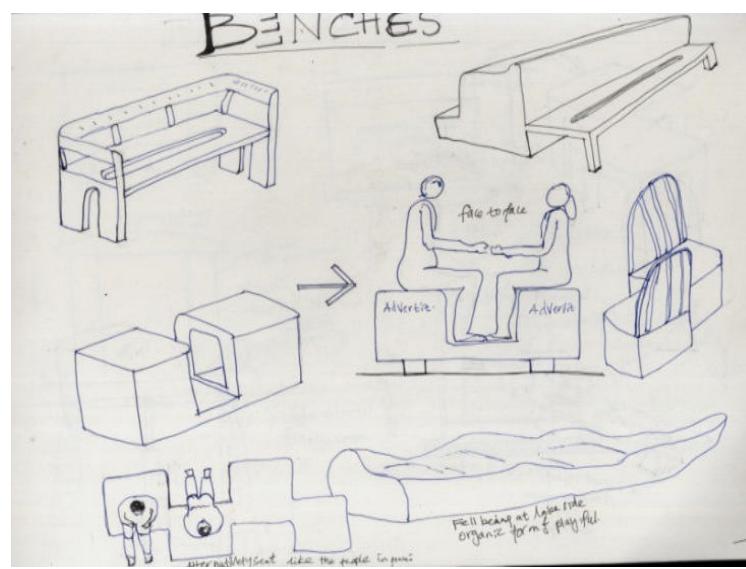
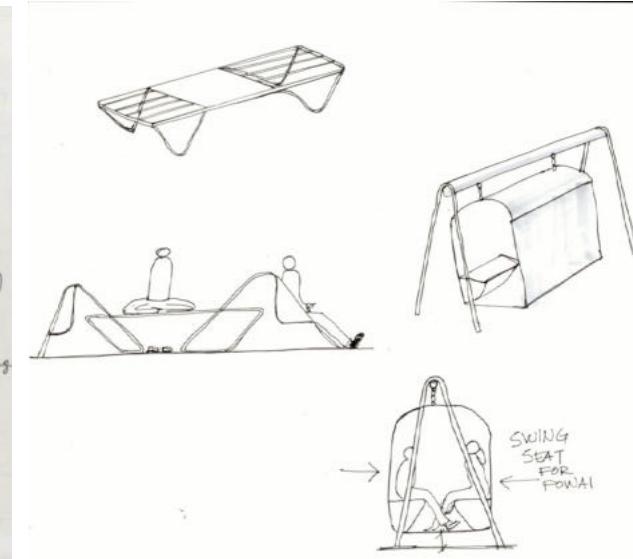
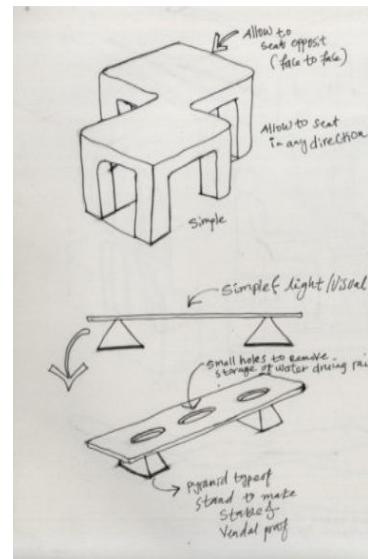
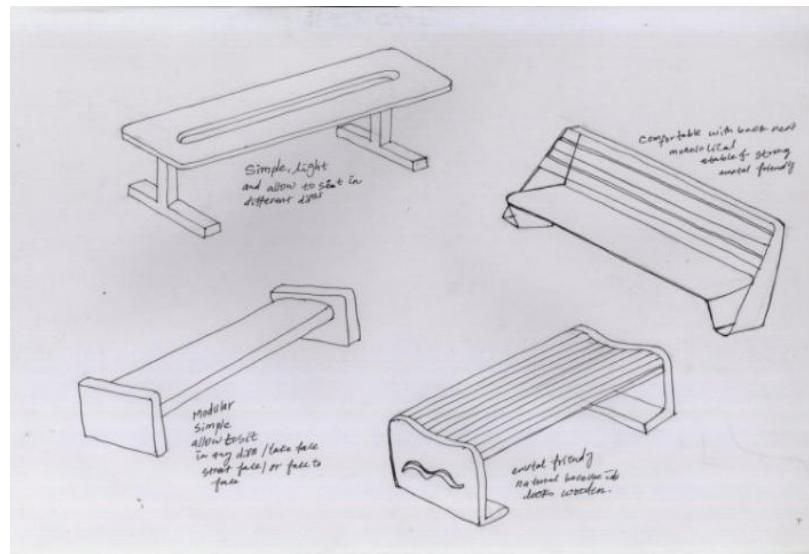


Figure 39 Benches

## 6.3 Ideas for Vending kiosk

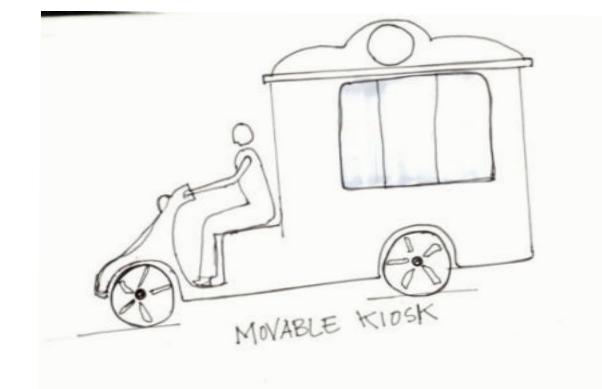
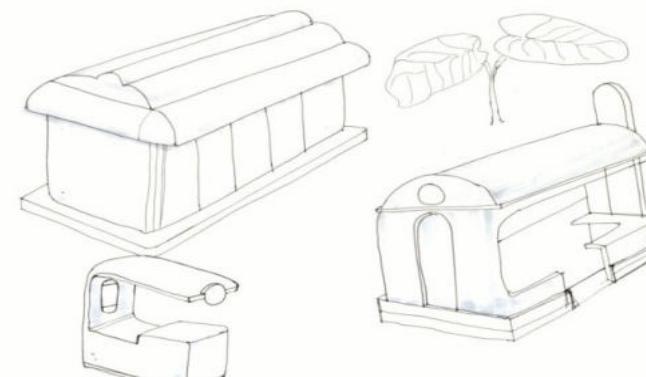
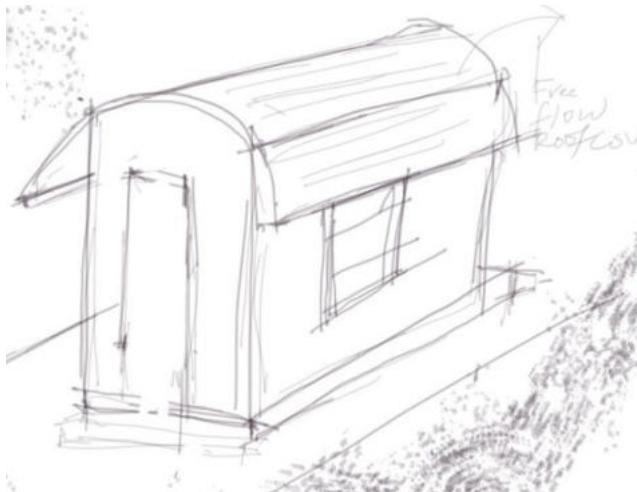
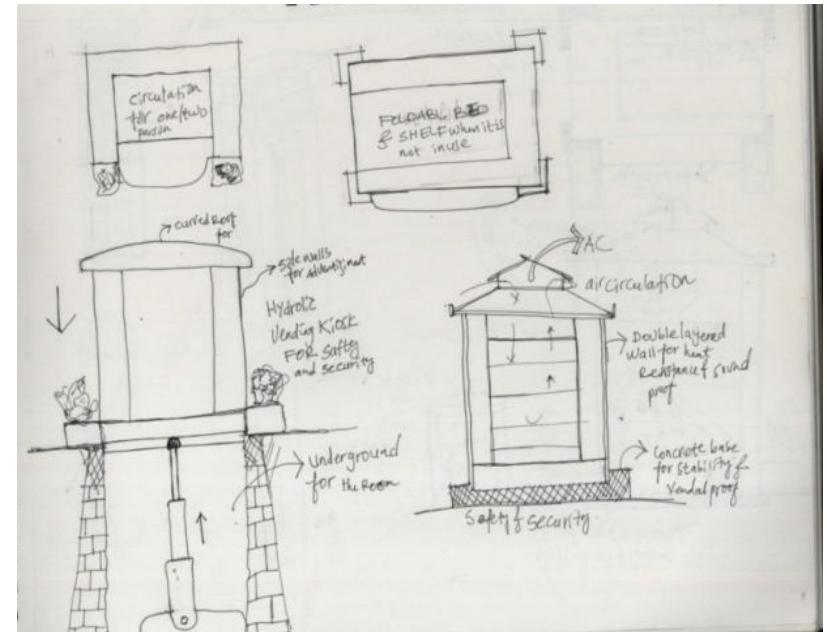
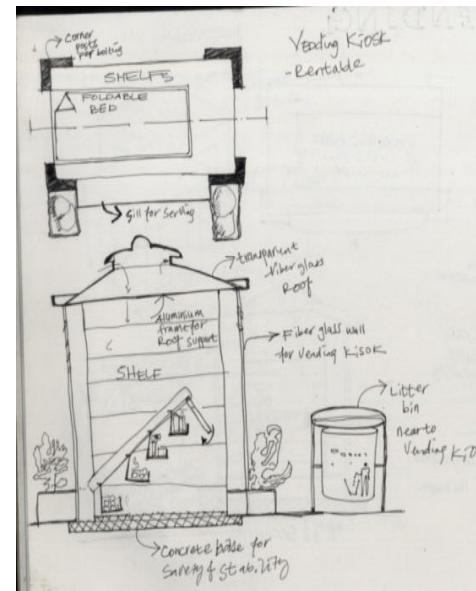
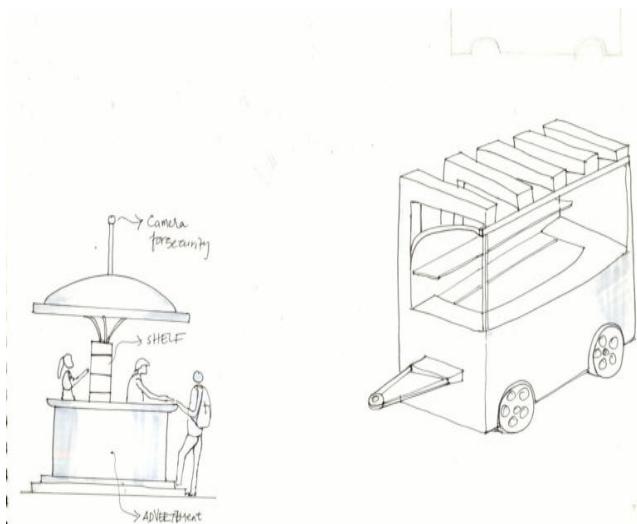


Figure 40 Vending kiosk

## 6.4 Ideas for Litter bins

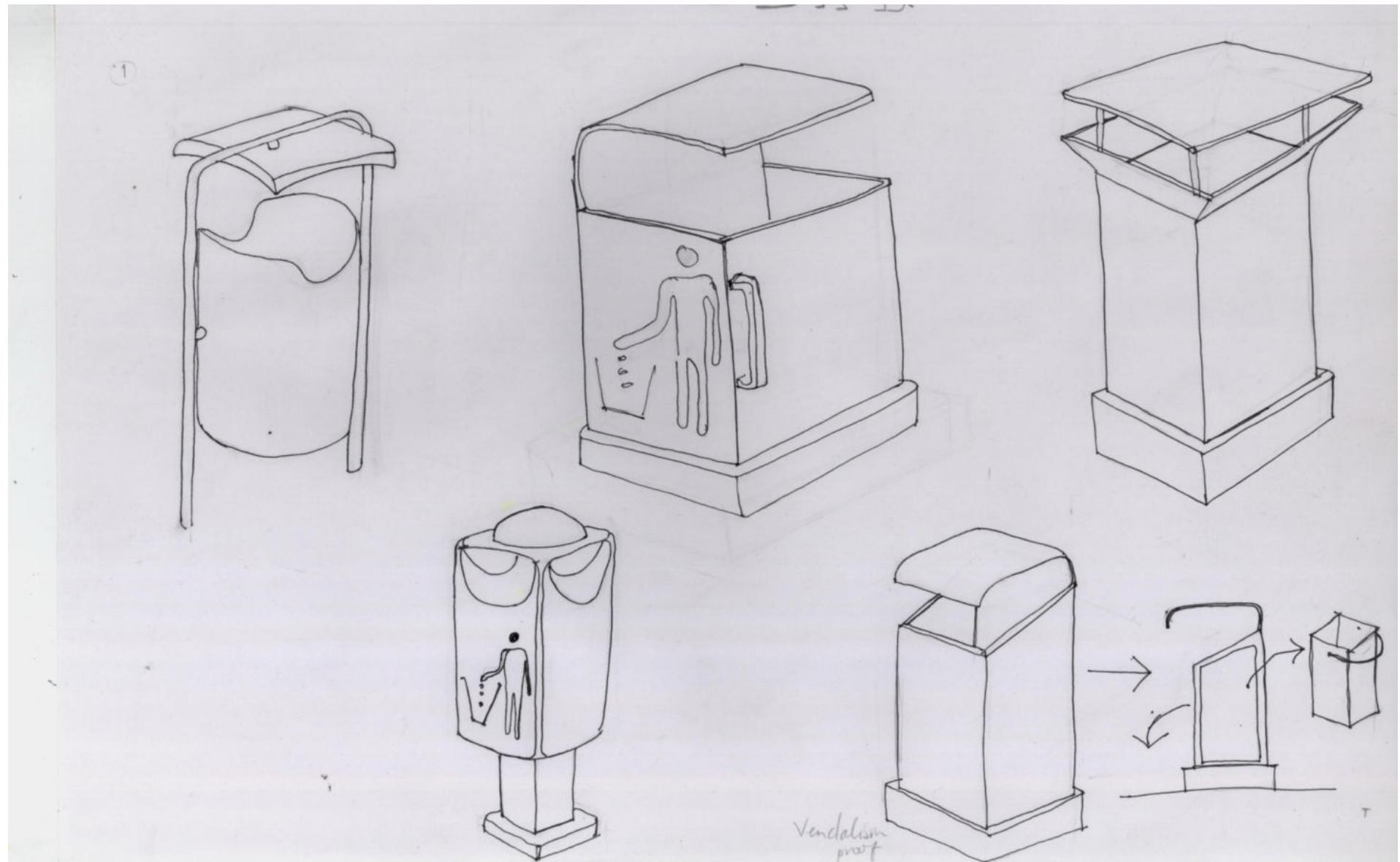
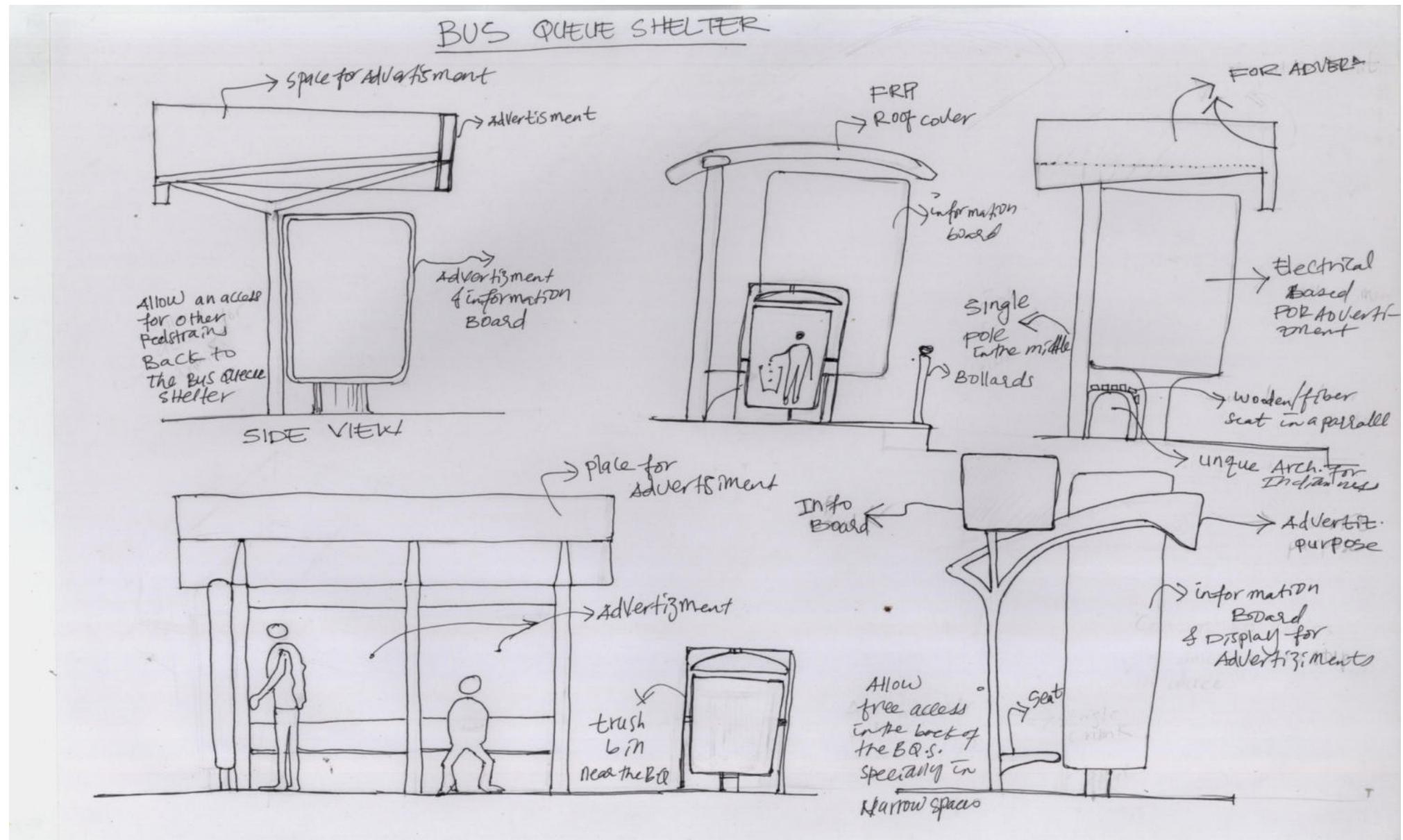


Figure 41 Litter bin

## 6.5 Ideas for Bus Queue shelter



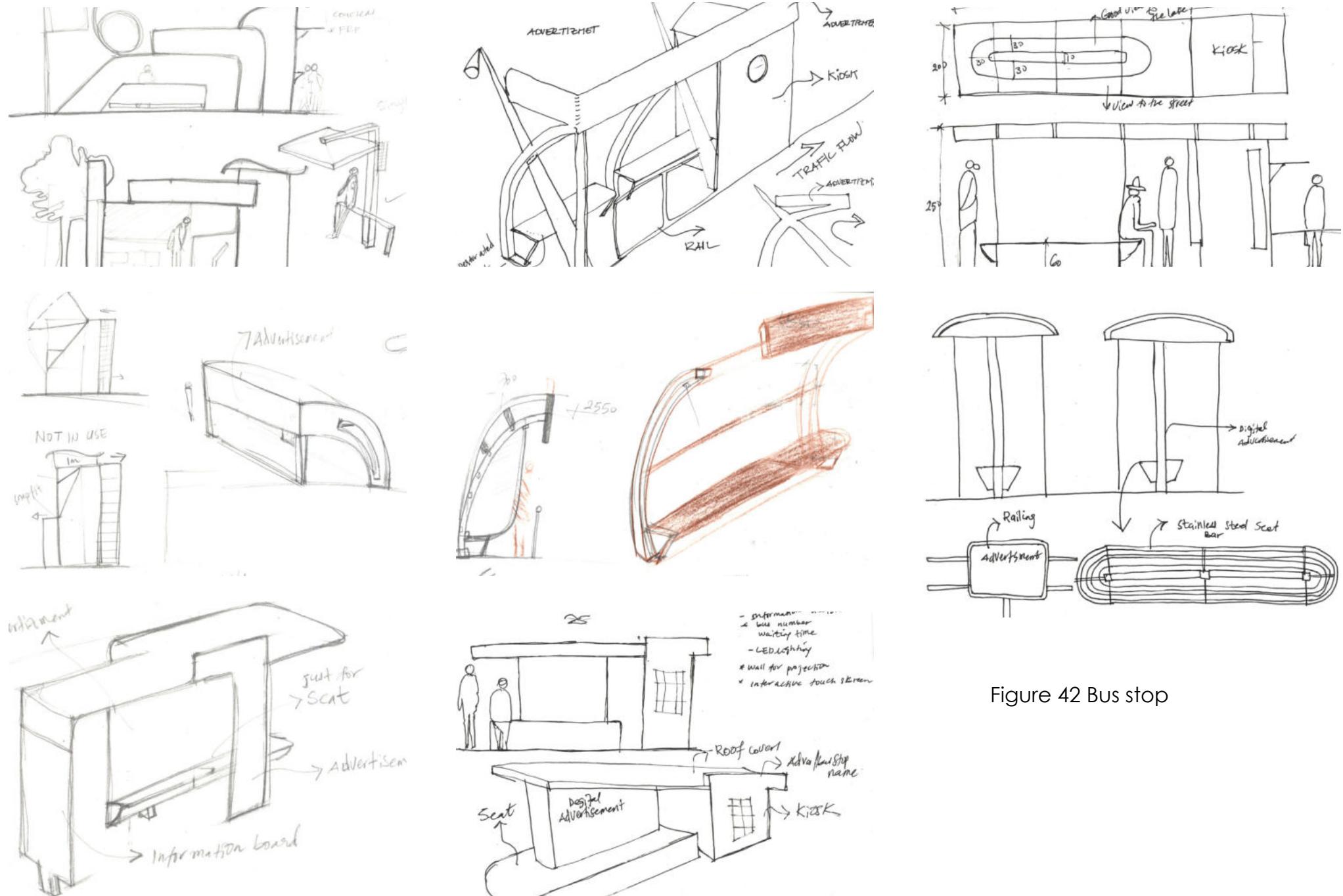


Figure 42 Bus stop

## 6.6 Ideas for Public convenience

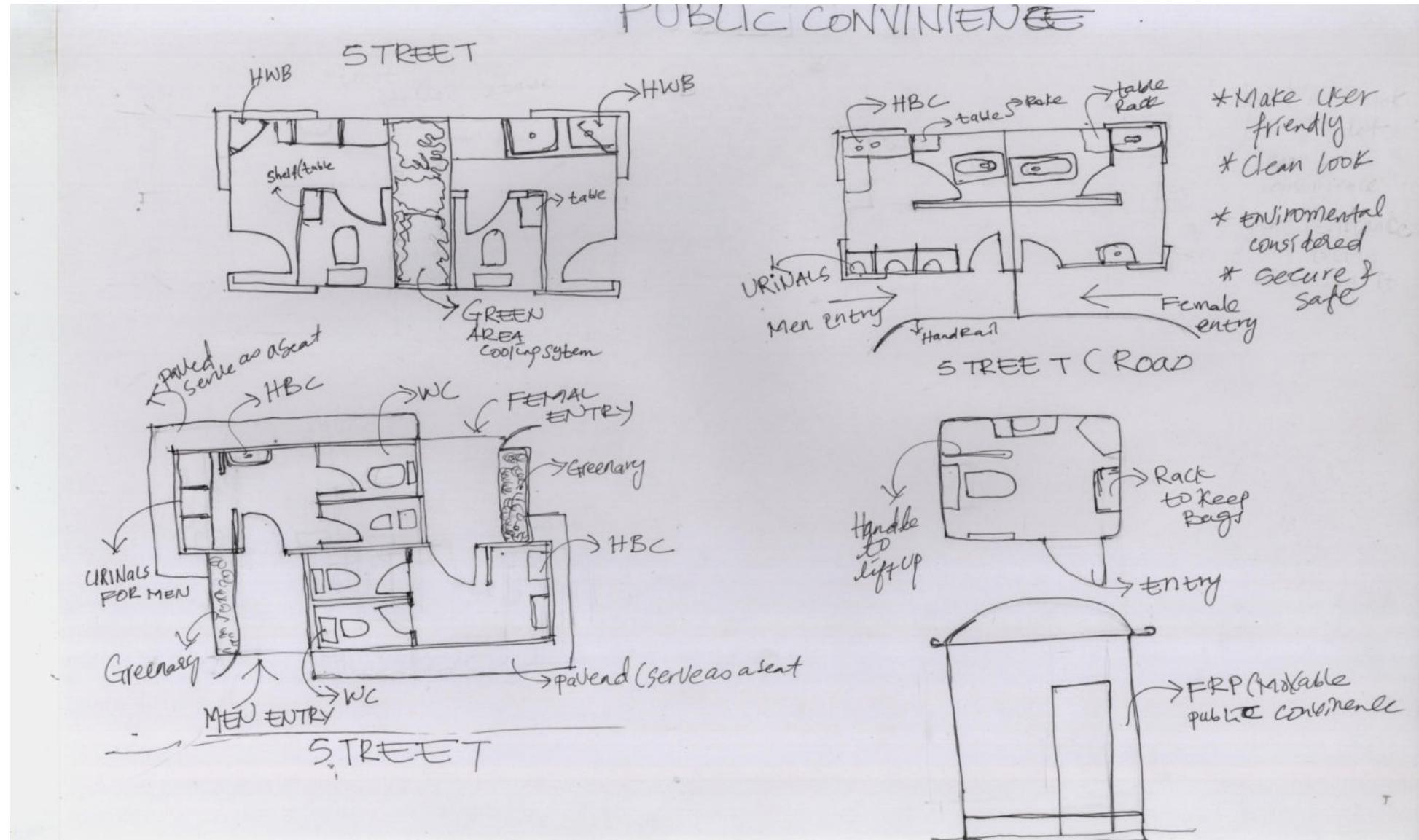


Figure 43 Public convenience

### 6.7 Ideas for Lighting

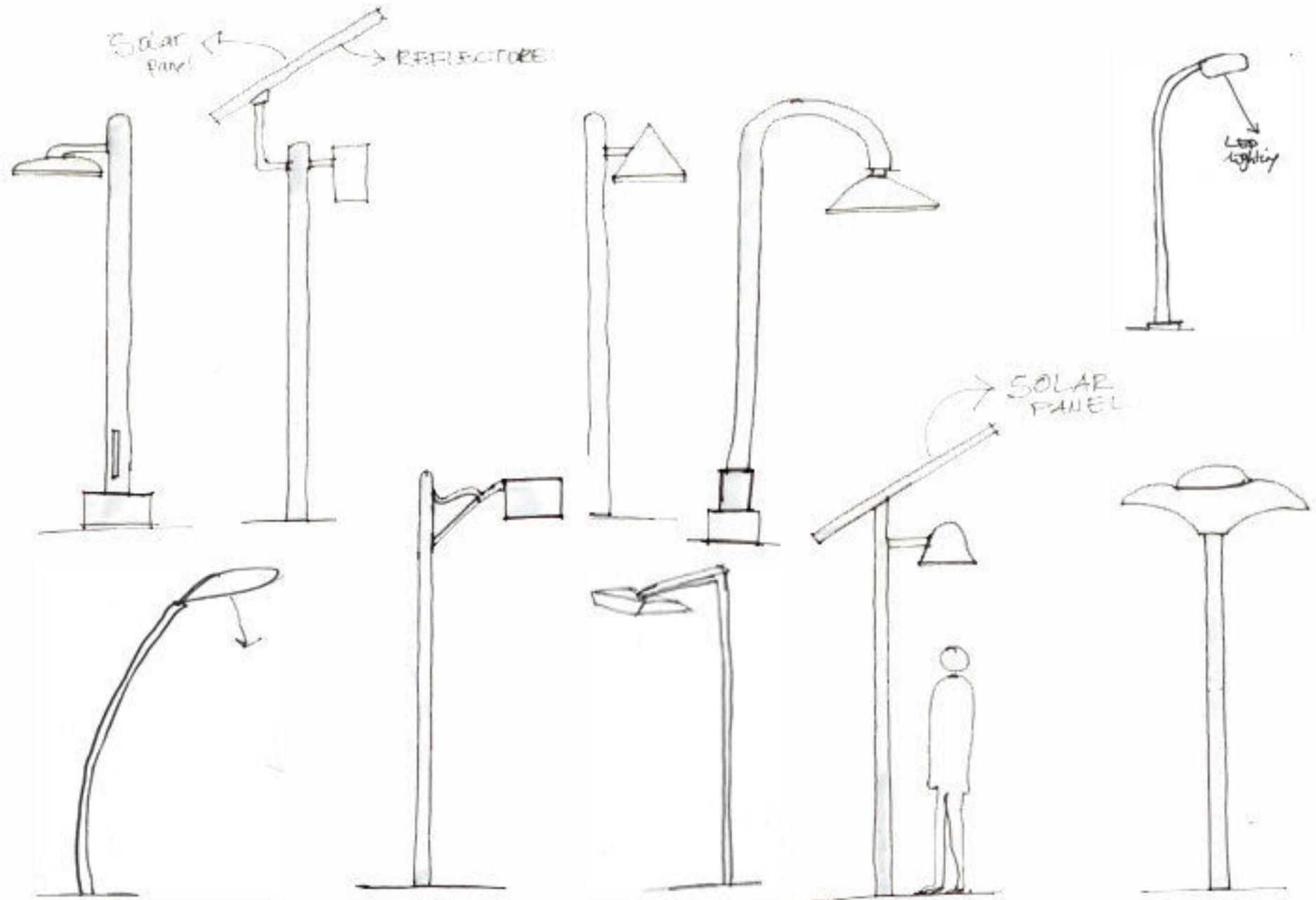


Figure 44 Lighting

## 6.8 Ideas for Bollards

## 8. Bollards

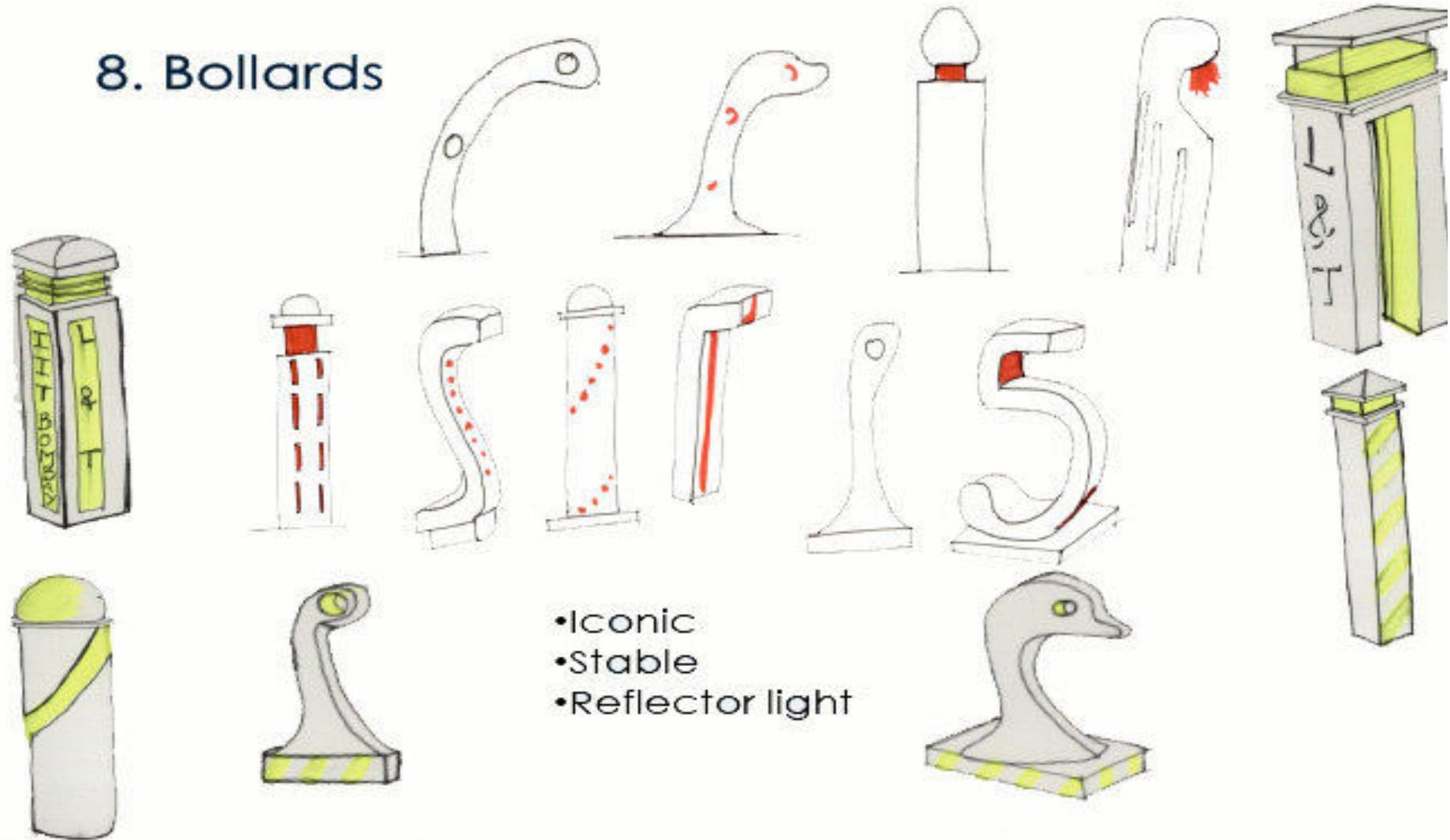


Figure 45 Bollards

## 6. 9 Ideas for Direction boards

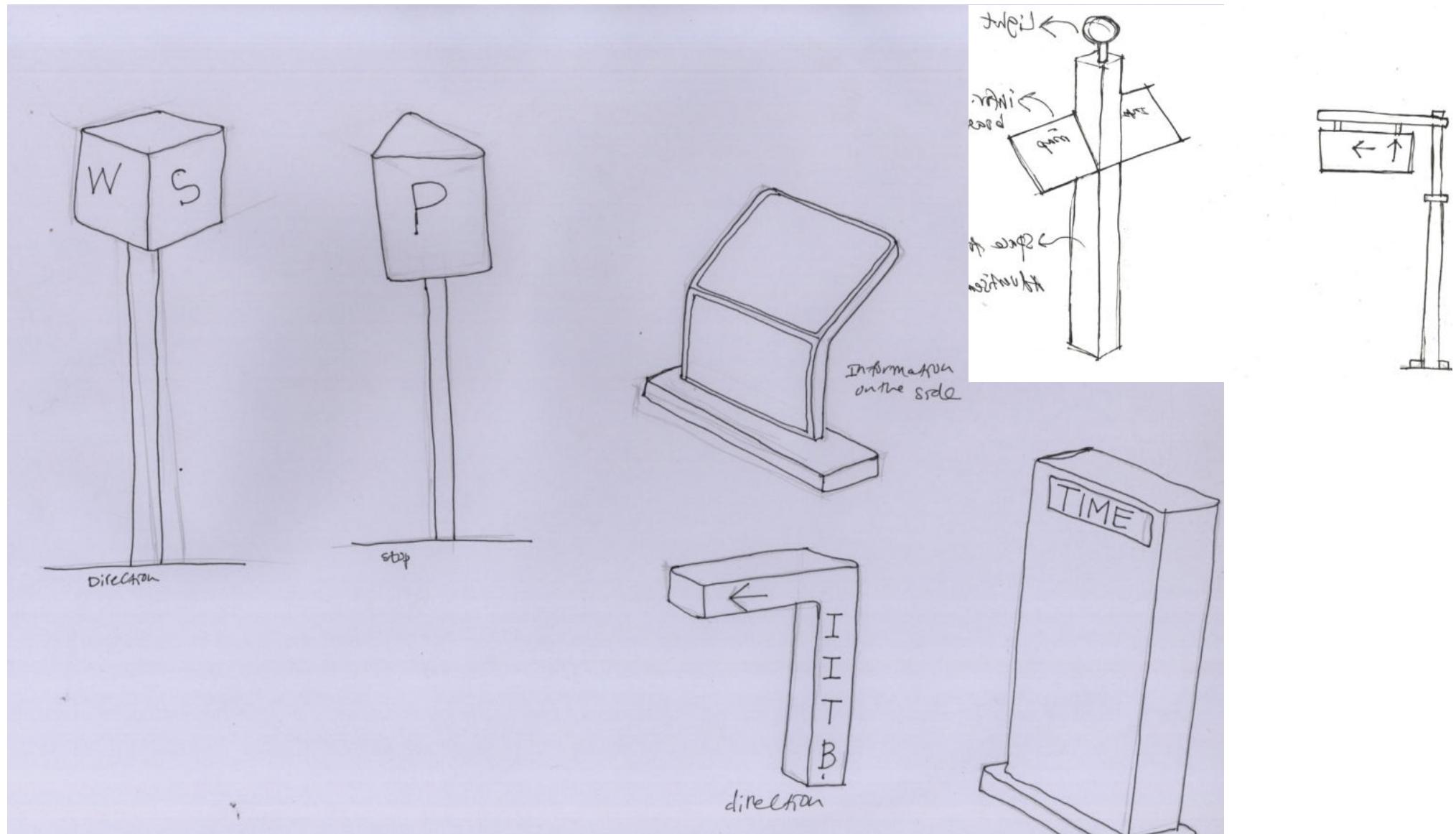


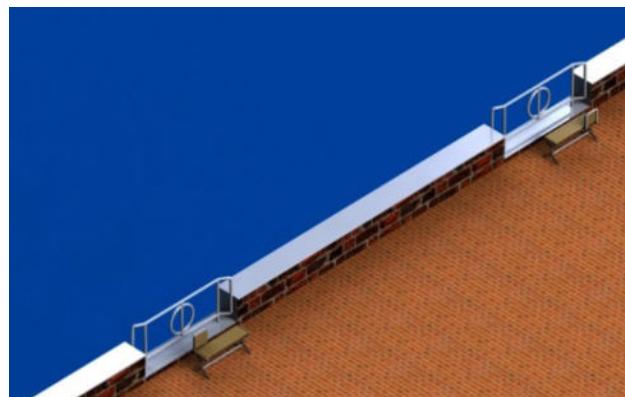
Figure 46 Direction Board

## 7. Concept development

### 7.1 Benches

#### Concept 1. On the barrier of the lake

The concrete barrier seat gets hot during day time which is difficult to sit on it. The optional solutions are Cover the stone with wooden materials, cut the barrier and provided a bench on the floor projected seat from the concert barrier and using a canvas shade as shown in figure below.



A

- Openness for more view to ward the lake



B

- Simple
- Fit to other places

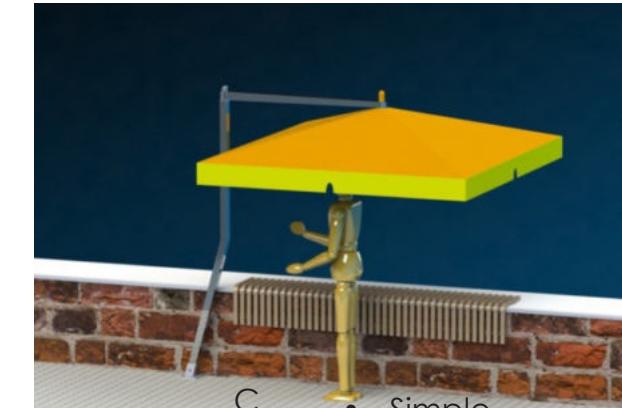


D

- Simple,
- Usable



F

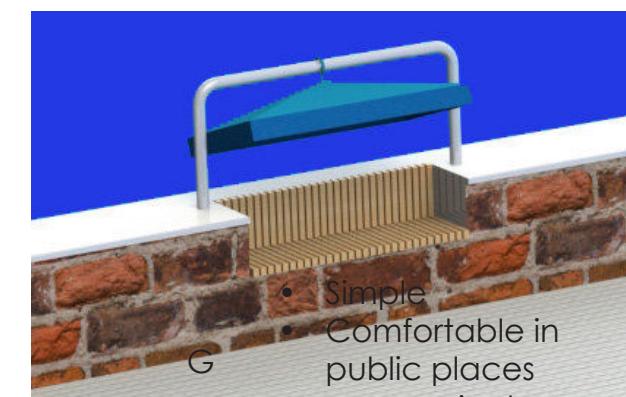


C

- Simple
- Economical
- Usable



E. Playful but unsafe



G

- Simple
- Comfortable in public places
- economical



Figure 47 benches on the Barrier

### Concept 2. Single seat

A. Spring stand which allows the racking on the seat and easy to lift up for elderly people



Figure 48 Benches with spring leg

B. the projected seat on the barrier can also be installed on the street.



Figure 49 Similar bench but fitted in other way

C. Adjustable backrest which allows to sit in different directions.



Figure 50 Bench with adjustable back rest

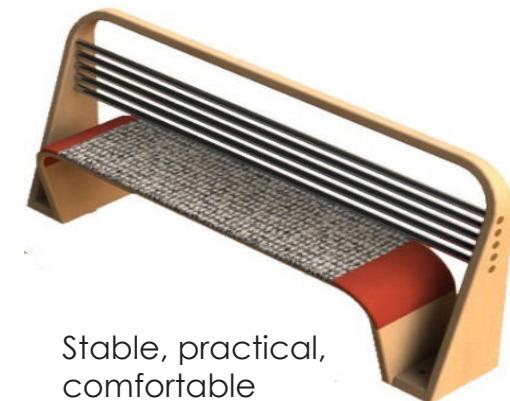
### Concept 3. Group seat benches with back rest

Wooden and perforated stainless steel benches are used in this seat types. This is because those materials did Not get hot during the day time.



A

Elegant, and unique



B

Stable, practical, comfortable



C



D



E

Stable, Allow to sit in different directions



F



H

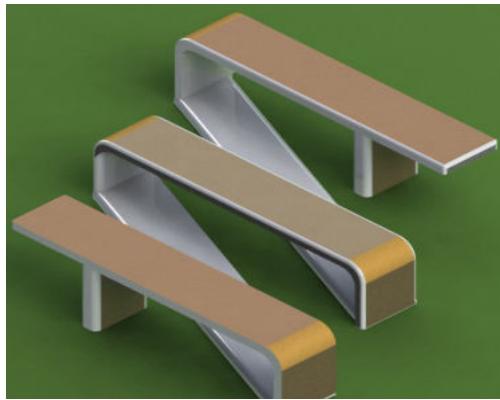


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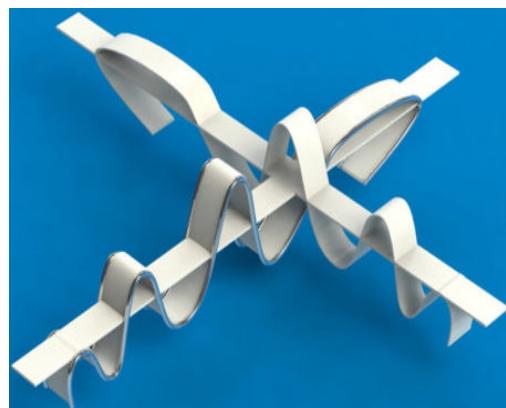
Figure 51 Benches used for group seat

#### Concept 4. Modular seating arrangement

Those ideas allow users to sit in different positions and arrangements



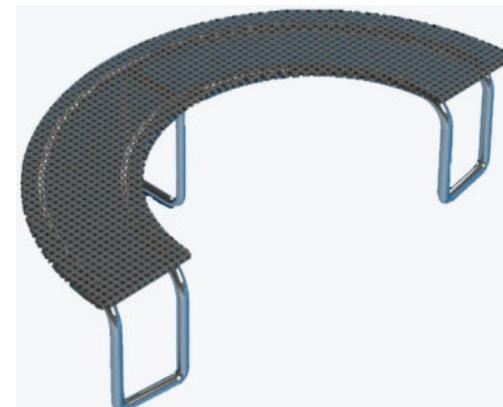
A



B



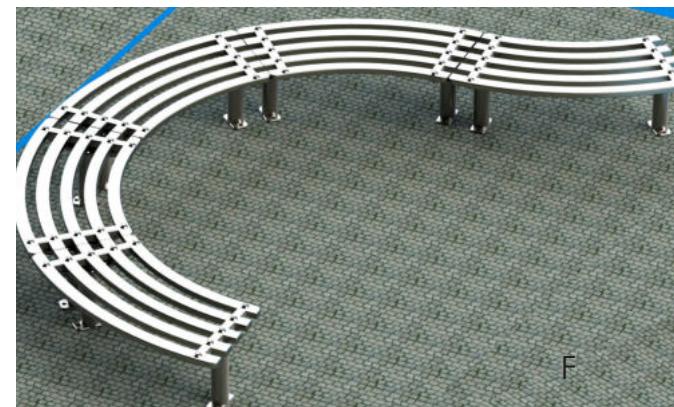
C



D



E

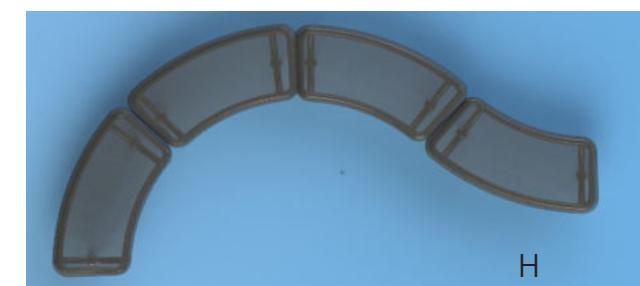


F

Simple, Durable,usable, practical and Modular that can be assembled in different shapes



G



H

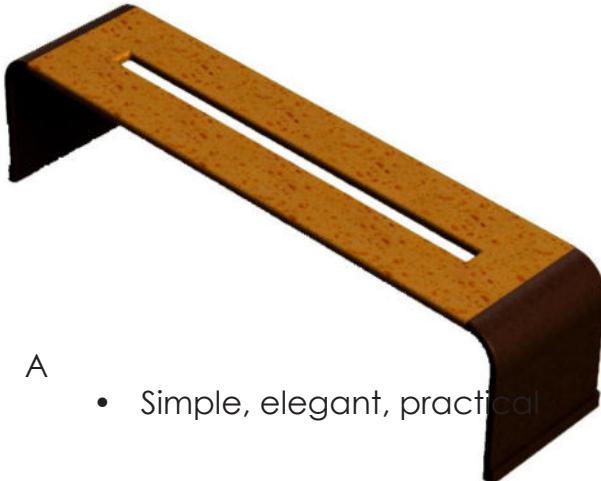


I

Figure 52 Concepts benches used to sit in group

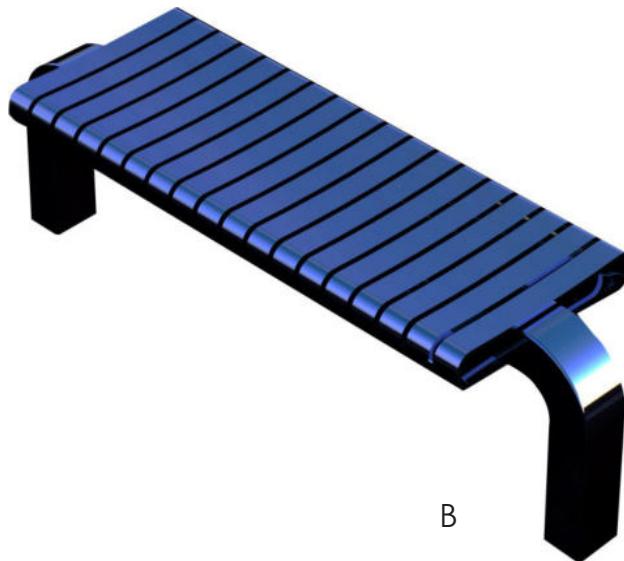
### Concept 5.

Group seat benches that can be used in Bus stop and on the seating areas



A

- Simple, elegant, practical



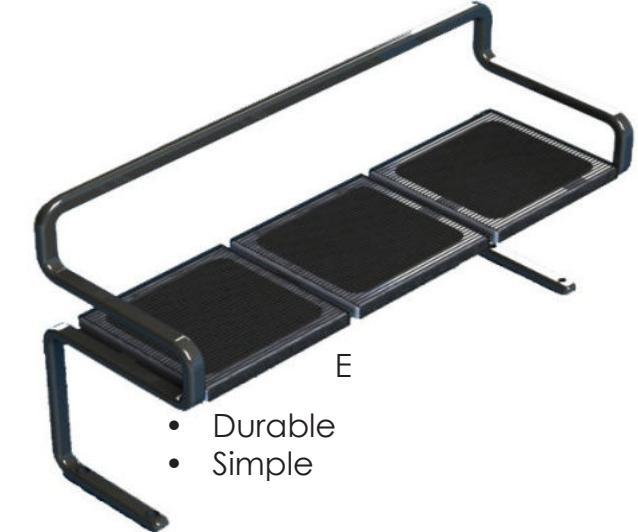
B

- Practice
- Durable
- Corrosion restart



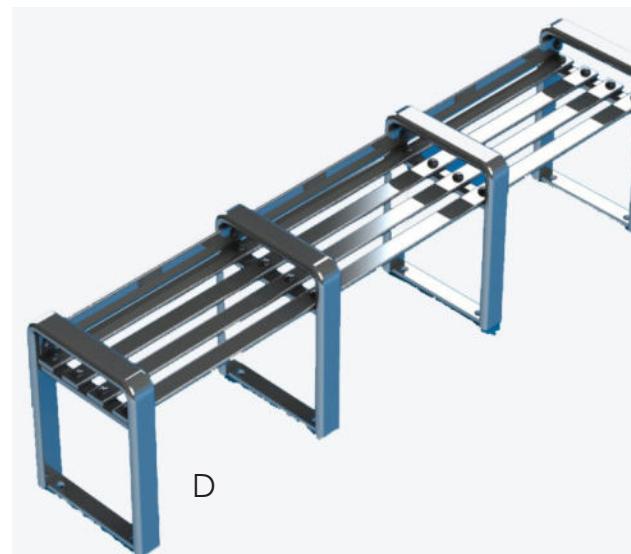
C

- Simple ,
- Can be used in bus stop
- Durable and practical



E

- Durable
- Simple



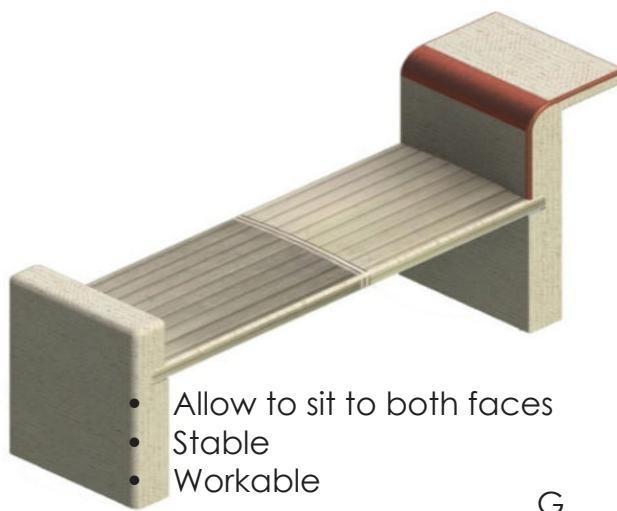
D

- Simple ,
- Can be used in bus stop
- Durable and practical



F

- Usable
- Durable
- Ergonomic

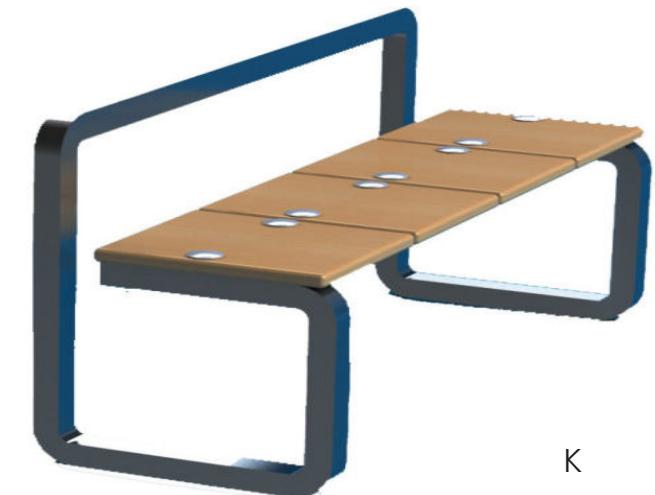


- Allow to sit to both faces
- Stable
- Workable

G



I



K

- Economical, minimal



H

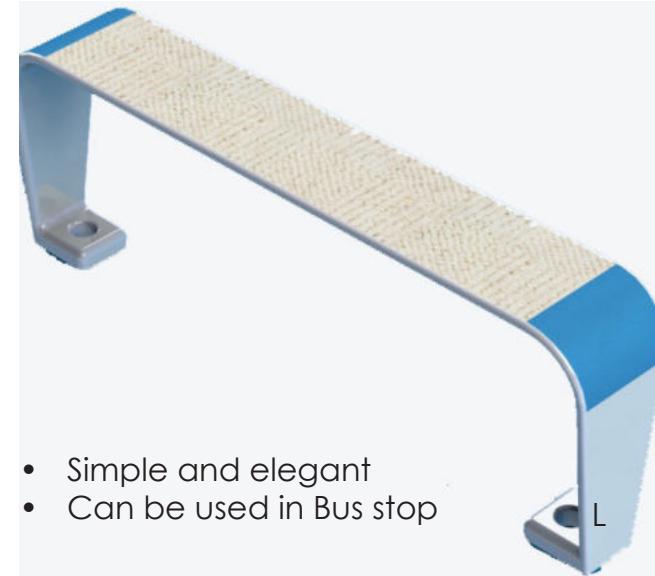
Iconic, Provide space for advertisement

Can be used in bus stop



J

- Simple and elegant
- Can be used in Bus stop
- Allow to sit in both directions



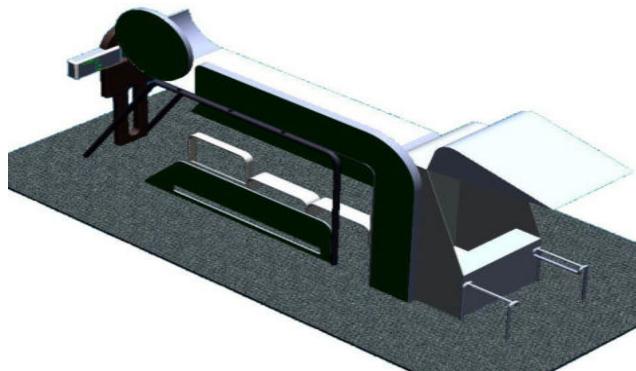
L

Figure 53 Benches used in bus stop and on the street

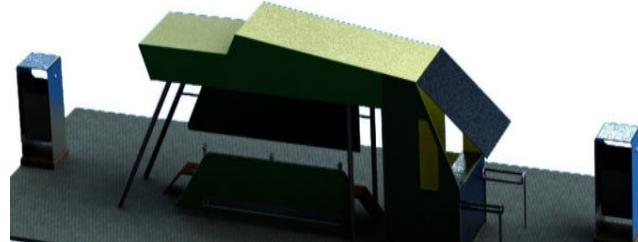
## 7.2 Bus queue shelter

### Concept 1.

The concrete is to mimic the bus it self as a bus stop with provided large space for advertisement. But it looks heavy with sharp corner.



A



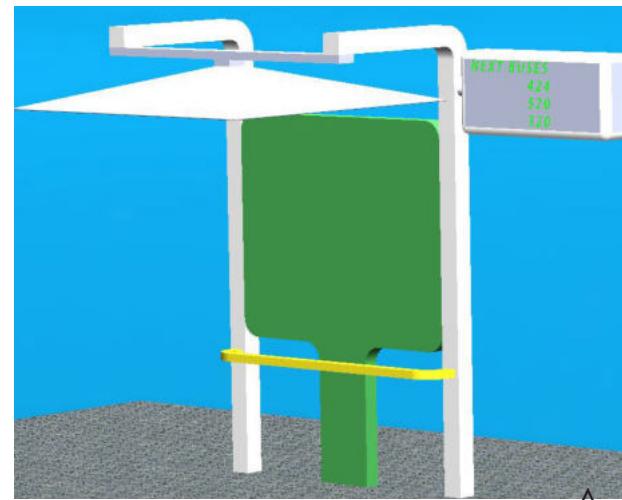
B

The concept is to simulate bus and bus stop, but it looks massive

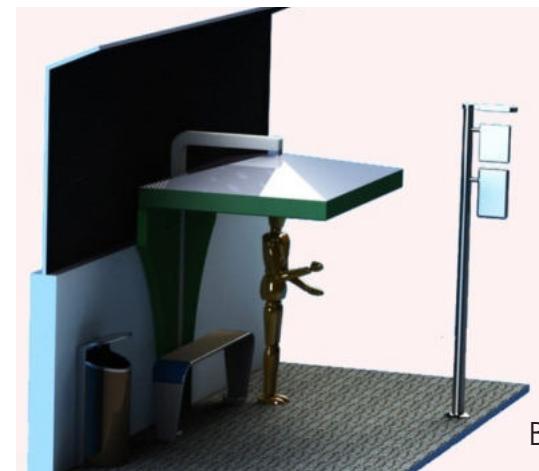
Figure 54

### Concept 2

Simple and elegant bus stop which can applied in very narrow spaces like in IIT B fence.

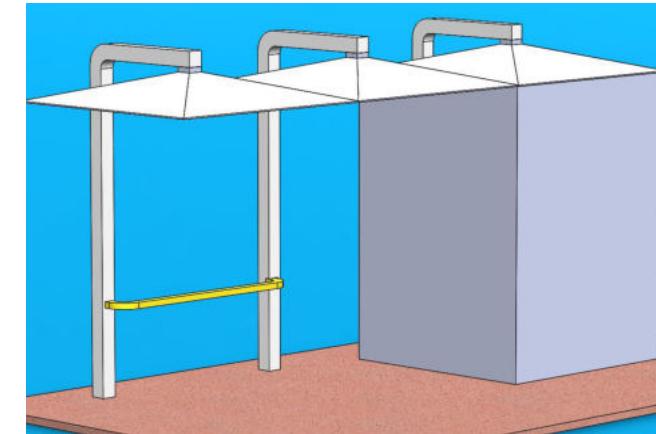


A



B

Simple, Modular and Good solution for narrow spaces like near IIT B fence

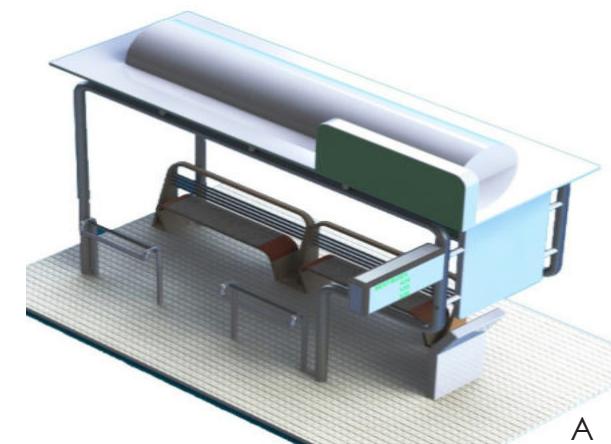


C

Figure 55

### Concept 3.

In this concept is to create a bus stop with kiosk which looks simple and elegant by providing electronic boards for advertisement



A



B



C

Simple, Practical, friendly, more open space, provided space for Advertisement .

But it look old style and hard feeling

Figure 56

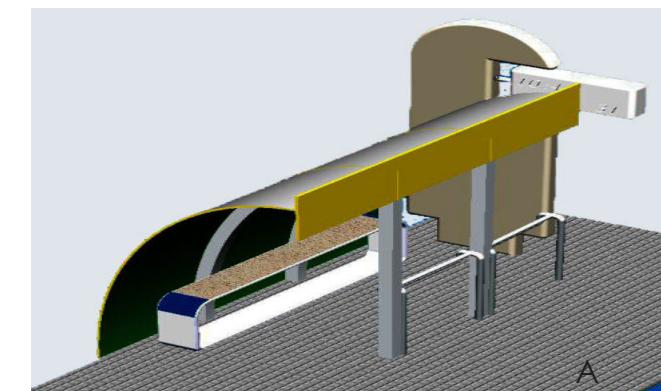
#### Concept 4.

Modular bus stop with large space for advertisement.

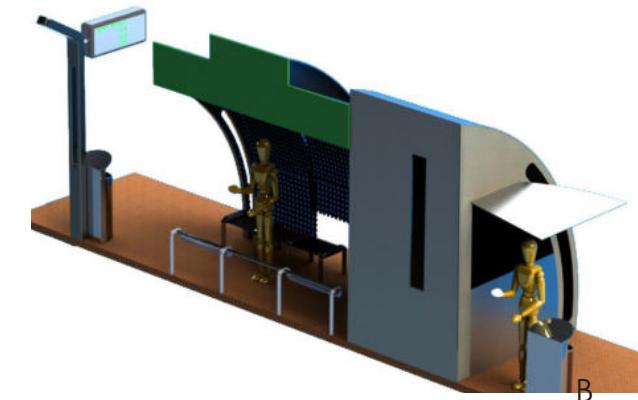


#### Concept 5

A concept with combination of rectangular and circular elements repeated as the elements around 'Powai' lake where elements are repeated in some intervals. Most of them are combination of line and arcs. Since this bus stop is modular , it can be place in different place in the site in different sizes.



A



B

Figure 57

B

Figure 58

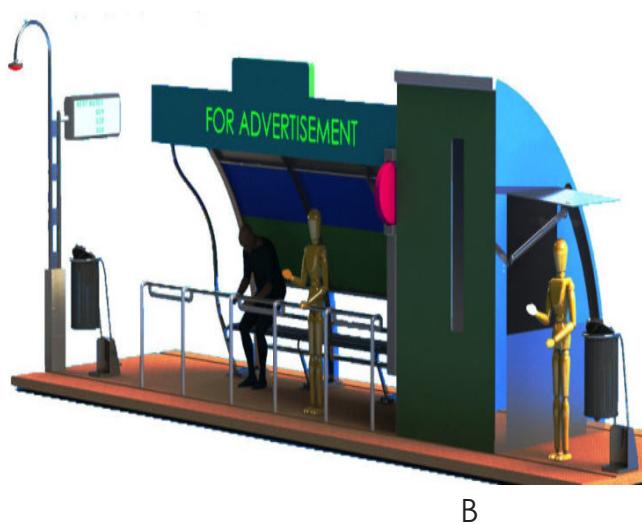


Figure 59



### Concept 6

Polycarbonate roof cover bus stop which is interactive, elegant, more open, modern, aesthetically appealing and allow people to see in to the lake face.



View from lake side



View from street side

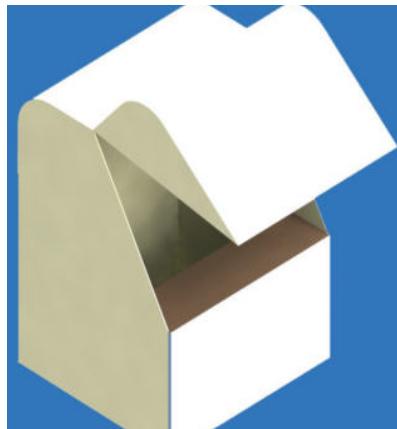


Figure 60

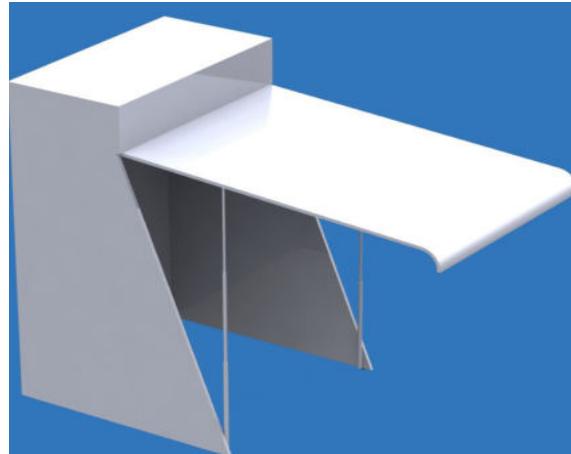
## 7.3 Vending kiosk

### Concept 1:-

With fold-able door used as a shade while customers served



A



B

Figure 61

### Concept 2.

Mechanically operated and adjustable shelf which helps to minimize the space while the kiosk is Not in use.

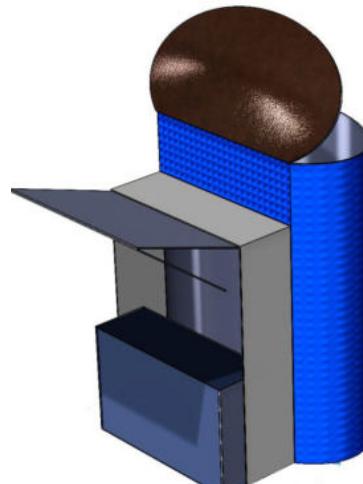
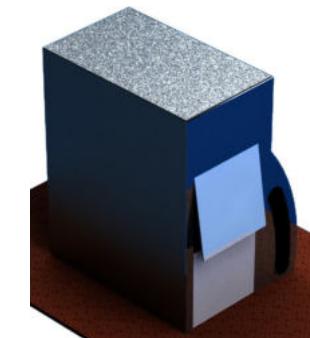


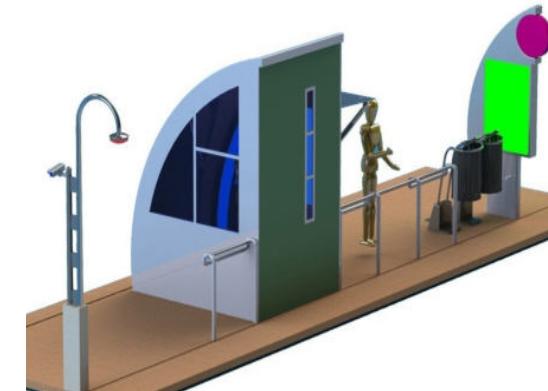
Figure 62 Adjustable vending kiosk

### Concept 3.

This concept is a combination of lines and curves as a design concept like 'Powai' Lake. The kiosk is double layered with vacuum in between with externally stainless steel and internally wooden material to maintain the kiosk cool.



A



B

Figure 63

### Concept 4:

Movable kiosk which can be fitted to a corners and the vendor can easily sell by moving around the lake where people seat.

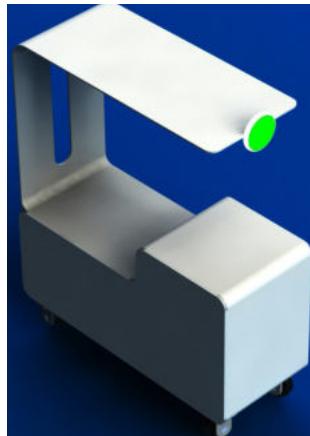


Figure 64 Movable vending kiosk

## 7.4 Public convenience

In Public spaces public convenience may misused by users because those places are hidden places. People may use the for prohibited customs like using drug, un-social behaviors like sex and miss-use while urination. This leads the room for uncomfortable environment. So there has to be someone taking care of the room. This can be a source of business by give and tack mode. Thus the place will keep cleaning and people can use this by paying money to the keeper.

### Concept 1

This inspires the use of toilet in the field.

A spiral plan toilet used for urinal only.

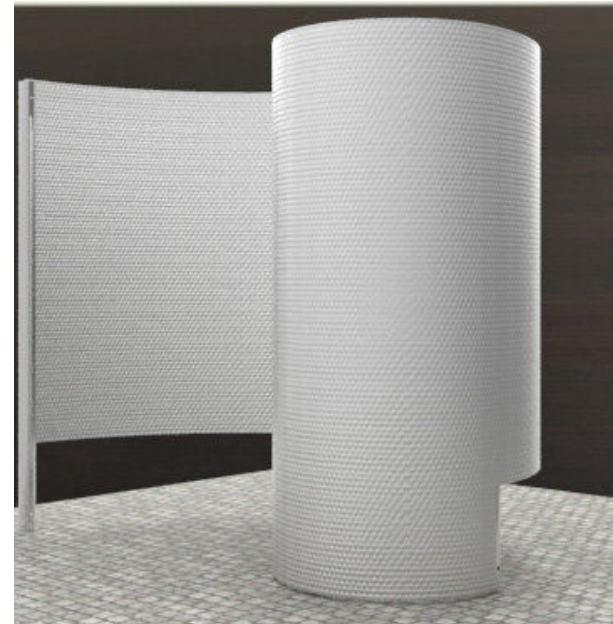


Figure 65

### Concept 2

Movable circular with subtracted portion to provide urinal and WC inside for both sexes.



Figure 66

### Concept 3

People can use this by putting some money to open the door when they want use it. This has to be stay closed for some time. If the user stays long time inside the room, the door will au-

tomatically open after showing alarm. The openings (door and window) should Not allow to see inside and the users would Not see the toilet fixtures directly when they opened the door.



A



B

Figure 67

### Concept 4

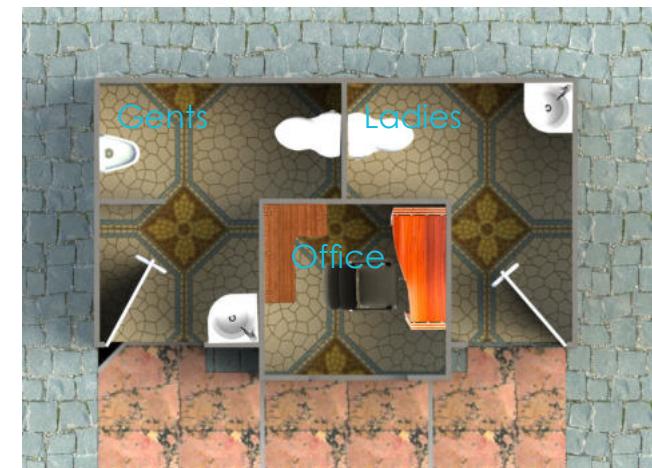
A concrete wall toilet separate room for ladies and gents.



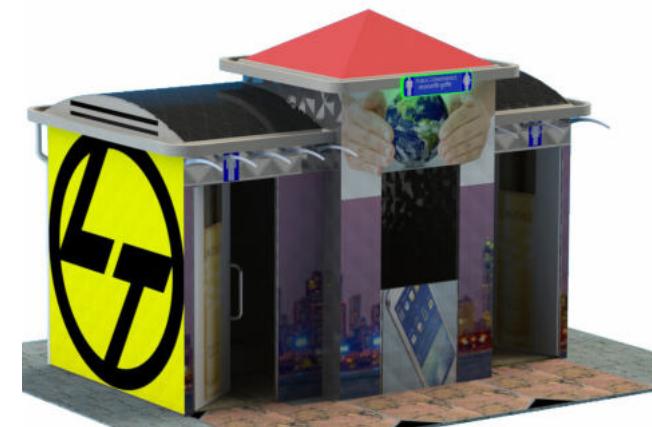
Figure 68

### Concept 5

The concept is to create clean, safe and comfortable space for public use. People can use this by putting some money to open the door or paying to the keeper when they want use it and this has to be stay closed for some time. It has an office for a person who taking care of the toilet to be cleaned and check every time after people use the toilet. This can be a good business generating by take and give mode.



A



B

Figure 69

## 7.5 Litter bins

### Concept 1

The idea is mimicking basket ball and apply in litter bin that can collected the wastes thrown from far.

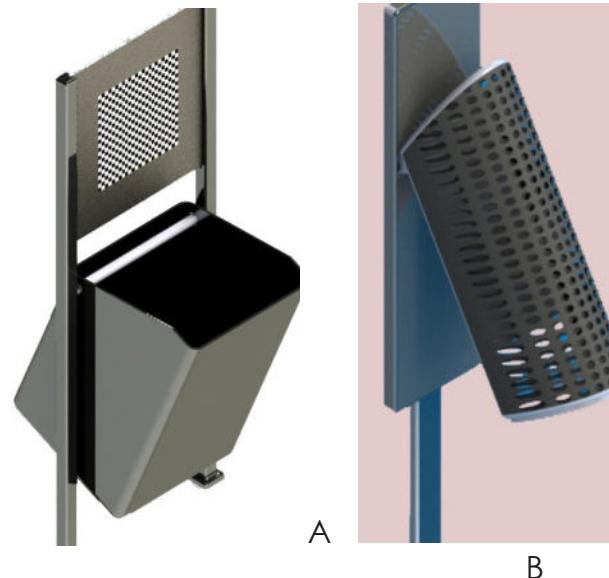


Figure 70

### Concept 2.

Easy to clean and approachable products.

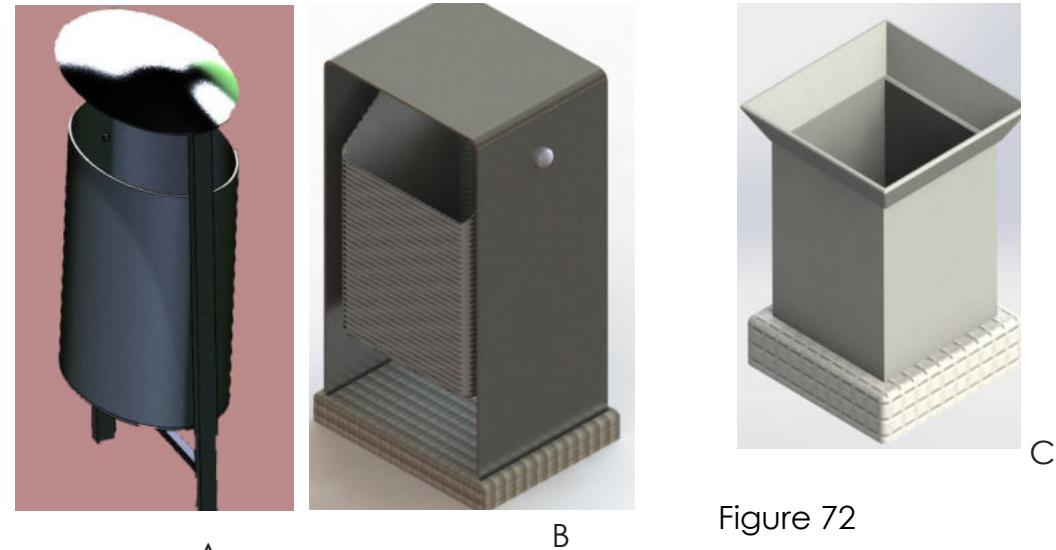


Figure 71 A

B

Figure 72 C

### Concept 3

#### Concept 3.

Provide big opening for a litter bin that allows to putting the garbage in to the bin easily. This can be cleaned by providing a side door.

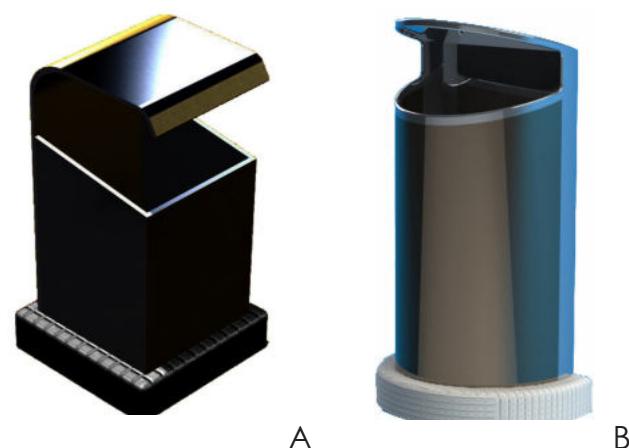


Figure 73

B



**Concept 4.**

A family looks, modern and simple to use.

The mechanism to use this litter bin is step the foot rest then the cover will rotate and opened to put the garbage and closed by gravity.



A



C

Figure 74



B

**7.6 Light poles****Concept 1**

A. Light pole with solar panel.

B. Light pole with space for advertisement



A

B

Figure 75

**Concept 2**

Lighting on the lake side which have same family to the bollards.

It simple, elegant and modern

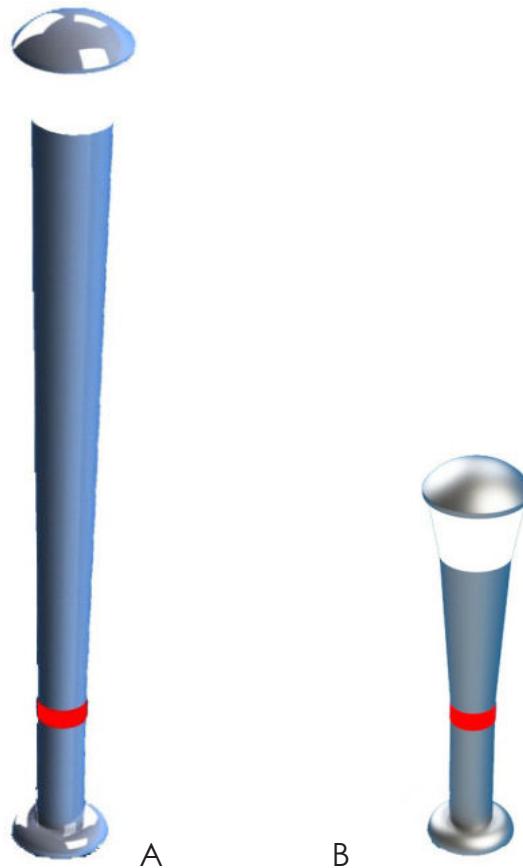


Figure 76

**Concept 3**

Light pole with LED lighting system. Which looks elegant and modern.



Figure 77

**Concept 4**

Light pole with CCTV camera for security and provides space for advertisement.



Figure 78

## 7.7 Bollards

### Concept 1

Elegant, simple, and usable bollard with different reflecting light

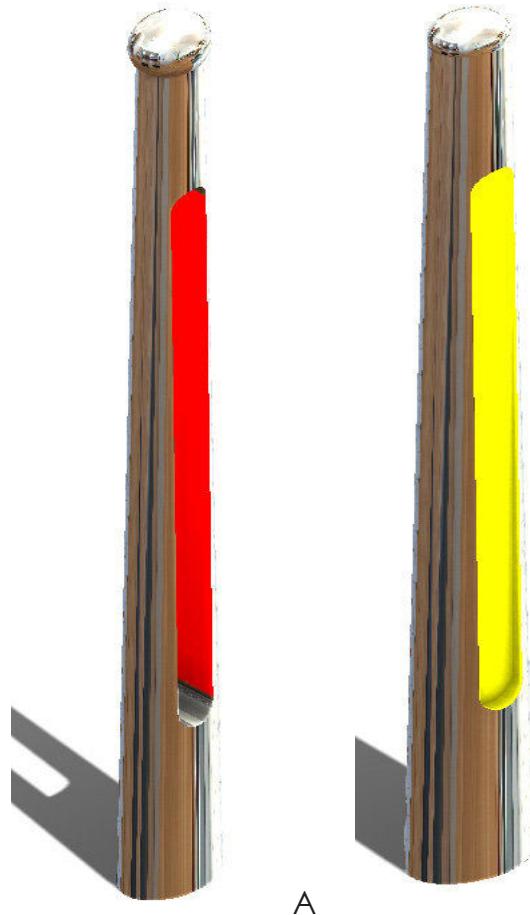


Figure 79 Bollards

### Concept 2

Elegant and simple Ballard with company name as an advertisement.



Figure 80 Bollards

### Concept 2

Elegant modern, simple and usable and esthetically appealing Bollards.

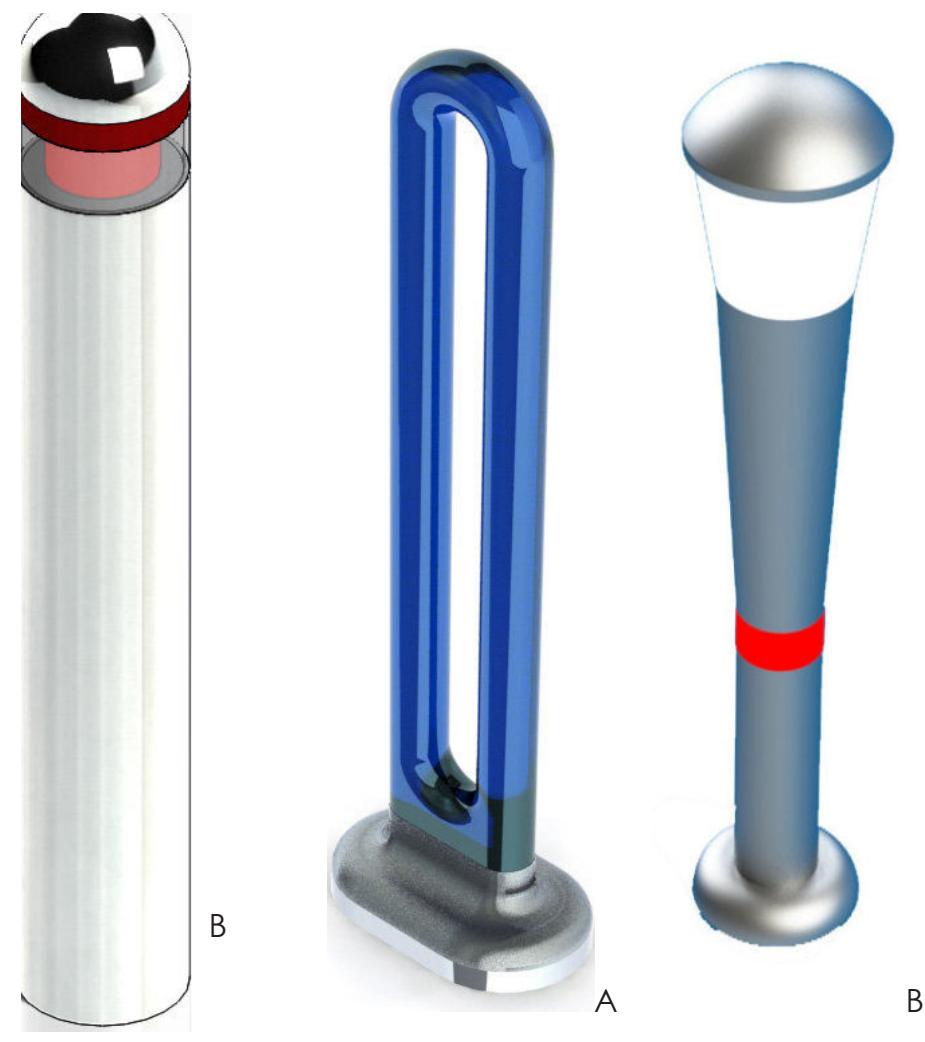


Figure 81 Bollards

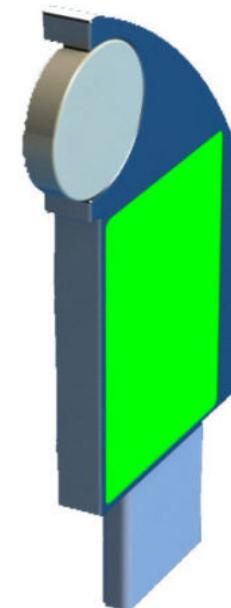
## 7.8 Information Boards



A



C



E



B



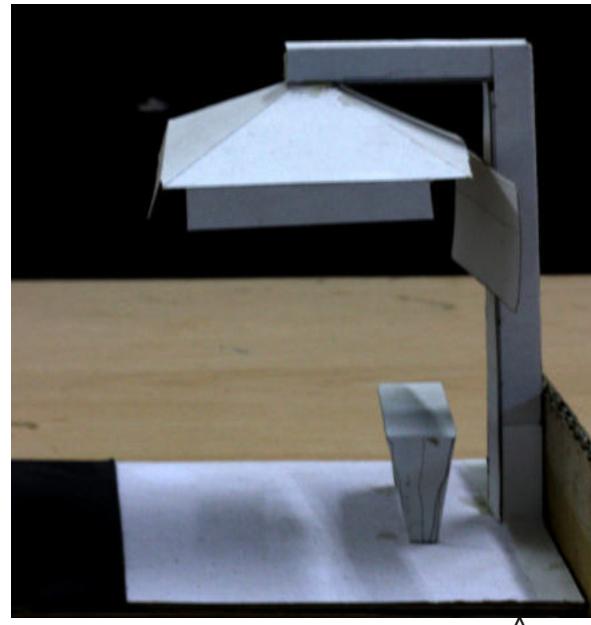
D



F

Figure 82 Direction Boards

## 7.9 Mock-up Models



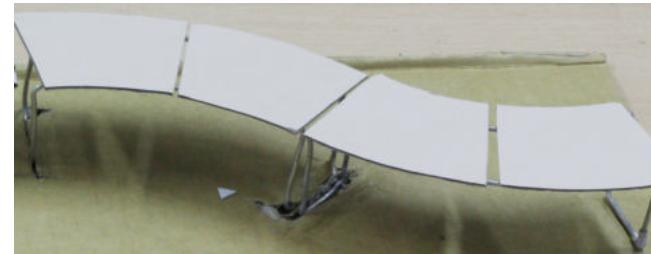
A



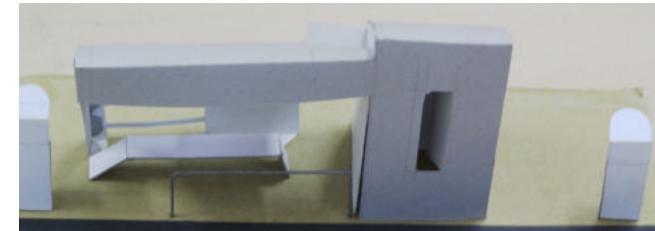
C



B



D



E

Figure 83 Mock-up Models



A



B



C

Figure 84 Mock-up Model of the final model

## 8. Concept evaluation

### 8.1 Selection criteria

The selection criteria used to select best product is the lists used in design brief in each products. The more which fulfill the design brief will be selected. The following table shows the selection criteria to select best furniture out of the concepts listed above.

Table 3 Concept evaluation

| Benches |            |                              |   |                              |                      |   |                               |
|---------|------------|------------------------------|---|------------------------------|----------------------|---|-------------------------------|
| No      | Bench type | Sturdy, easy to maintenance, | Environmental friendly, theft and vandal proof, | Simplistic, Modern,practical | Iconic( family look) | Ergonomically, comfortable and environmental friendly | Aesthetic and stable, elegant |
| 1       |            | Yes                          | Yes   | Yes                          | No                   | Yes   | No                            |
| 2       |            | Yes                          | Yes   | Yes                          | No                   | Yes   | Yes                           |
| 3       |            | Yes                          | Yes   | Yes                          | No                   | Yes   | No                            |
| 4       |            | Yes                          | Yes   | Yes                          | No                   | Yes   | No                            |
| 5       |            | Yes                          | Yes   | Yes                          | No                   | Yes   | No                            |
| 6       |            | Yes                          | Yes   | Yes                          | No                   | Yes   | No                            |
| 7       |            | Yes                          | Yes   | Yes                          | Yes                  | Yes   | Yes                           |
| 8       |            | Yes                          | Yes   | Yes                          | No                   | Yes   | No                            |

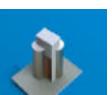
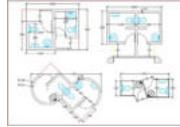
|    |  |     |     |     |     |     |     |
|----|--|-----|-----|-----|-----|-----|-----|
| 9  |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 10 |  | Yes | Yes | Yes | Yes | Yes | Yes |

### Bus Queue shelter

| No | Bus Queue shelter type | Environment-<br>friendly | Practical ,van-<br>dal proof ease of<br>maintenance | Modular, Lighter,<br>stronger and rust<br>resistant | Unique, mod-<br>ern and memo-<br>rable | Friendly and approach-<br>able | Enough space<br>for advertise-<br>ment |
|----|------------------------|--------------------------|---|---|--|--------------------------------|--|
| 1  |                        | Yes                      | Yes   | No  | No                                     | Yes                            | Yes                                    |
| 2  |                        | Yes                      | Yes   | Yes   | No                                     | Yes                            | No                                     |
| 3  |                        | Yes                      | Yes   | Yes   | Yes                                    | Yes                            | No                                     |
| 4  |                        | Yes                      | Yes   | Yes   | Yes                                    | Yes                            | Yes                                    |
| 5  |                        | Yes                      | Yes   | Yes   | Yes                                    | Yes                            | Yes                                    |
| 6  |                        | Yes                      | Yes   | Yes   | No                                     | Yes                            | No                                     |

### Public convenience

| No | Public convenience Types | User and environ-<br>mental friendly | Aesthetically , Contemporary, easy | Ergonomically | Approachable and |
|----|--------------------------|--------------------------------------|------------------------------------|---------------|------------------|
| 1  |                          | Yes                                  | Yes                                | Yes           | No               |

|   |   |     |     |     |    |
|---|---|-----|-----|-----|----|
| 2 |  | Yes | Yes | Yes | No |
| 3 |  | Yes | Yes | Yes | No |
| 4 |  | Yes | Yes | Yes | No |
| 5 |  | Yes | Yes | Yes | No |

### Litter bin

| No | Litter bin Types  | Easy to clean and empty the wastes maintain | Clean look, elegant, modern, simple, practical and accent in the urban environment | Vandal and theft proof | Lighter and rust resistant | Ergonomically designed for easy use and accessible by different people | Easy to maintain and convenient/ invite to use |
|----|---|---|--|------------------------|----------------------------|--|--|
| 1  |   | No  | Yes  | Yes                    | No                         | Yes  | No   |
| 2  |  | Yes   | Yes  | Yes                    | Yes                        | Yes  | No   |
| 3  |  | Yes   | Yes  | Yes                    | Yes                        | Yes  | No   |
| 4  |  | Yes   | Yes  | Yes                    | No                         | Yes  | No   |

|   |   |     |     |     |     |     |     |
|---|---|-----|-----|-----|-----|-----|-----|
| 5 |  | Yes | Yes | Yes | Yes | Yes | Yes |
| 6 |  | Yes | Yes | Yes | No  | Yes | No  |
| 7 |  | Yes | Yes | Yes | No  | Yes | No  |
| 8 |  | Yes | Yes | Yes | Yes | Yes | Yes |

### Bollards

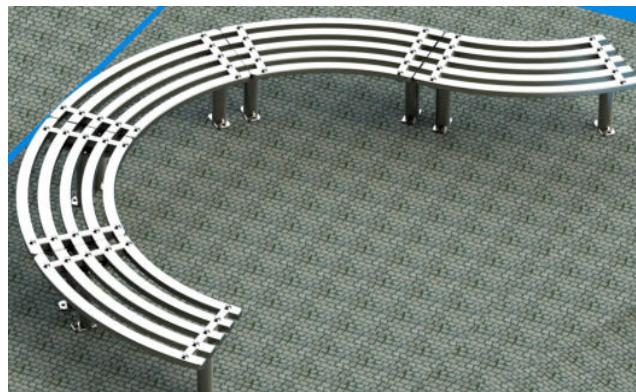
| No | Bollards  | Unique, modern, aesthetically | Theft and vandal proof, Stronger and rust proof | Ergonomically designed | Iconic, durable |
|----|---|-------------------------------|---|------------------------|-----------------|
| 1  |   | Yes                           | Yes   | Yes                    | Yes             |
| 2  |  | Yes                           | Yes   | Yes                    | No              |
| 3  |  | Yes                           | Yes   | Yes                    | No              |
| 4  |  | Yes                           | Yes   | Yes                    | Yes             |

| Vending Kiosk |                        |                          |                                  |                                 |                               |
|---------------|------------------------|--------------------------|----------------------------------|---------------------------------|-------------------------------|
| No            | Vending kiosk concepts | Environmental friendly   | Modular, simple and Contemporary | Aesthetically appealing, unique | Easy to maintain and inviting |
| 1             |                        | Yes                      | Yes                              | Yes                             | No                            |
| 2             |                        | Yes                      | Yes                              | Yes                             | No                            |
| 3             |                        | Yes                      | Yes                              | Yes                             | Yes                           |
| 4             |                        | Yes                      | Yes                              | Yes                             | No                            |
| Light pole    |                        |                          |                                  |                                 |                               |
| No            | Light pole types       | Multipurpose( lighting.) | Strong, durable and rust proof   | User and environmental friendly | Iconic and practical          |
| 1             |                        | Yes/2                    | Yes                              | Yes                             | Yes                           |
| 2             |                        | Yes                      | Yes                              | Yes                             | No                            |
| 3             |                        | Yes                      | Yes                              | Yes                             | No                            |
| 4             |                        | Yes                      | Yes                              | Yes                             | No                            |

## 8.2 Selected concepts

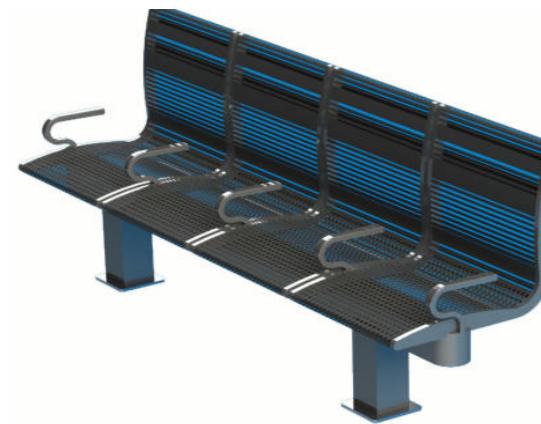
### 8.2.1 Benches

A. This bench allows arranging in different positions on the site. This can be used in circular arrangements, free flow arrangement and straight seats that can fit in the site.



A. Bench which can arrange in different positions

B. This can be used in bus stops and on the street. Since it is perforated stainless steel, it does not get hot during the day time because of the holes on the seat.



B. Bench which can be used in bus stop and on the lake face

Figure 85 Pre final concept of benches

### 8.2.2 Bus stop



A



A



C

Figure 86 Pre final concepts of bus stop

### 8.2.3 Litter bin

Modern, user friendly and easy to use perforated stainless steel litter bin which has the same family look with the rest furniture.

### 8.2.4 Vending kiosk

Double layered stainless steel vending kiosk with foam inside to protect the emission of heat and for sound proof.

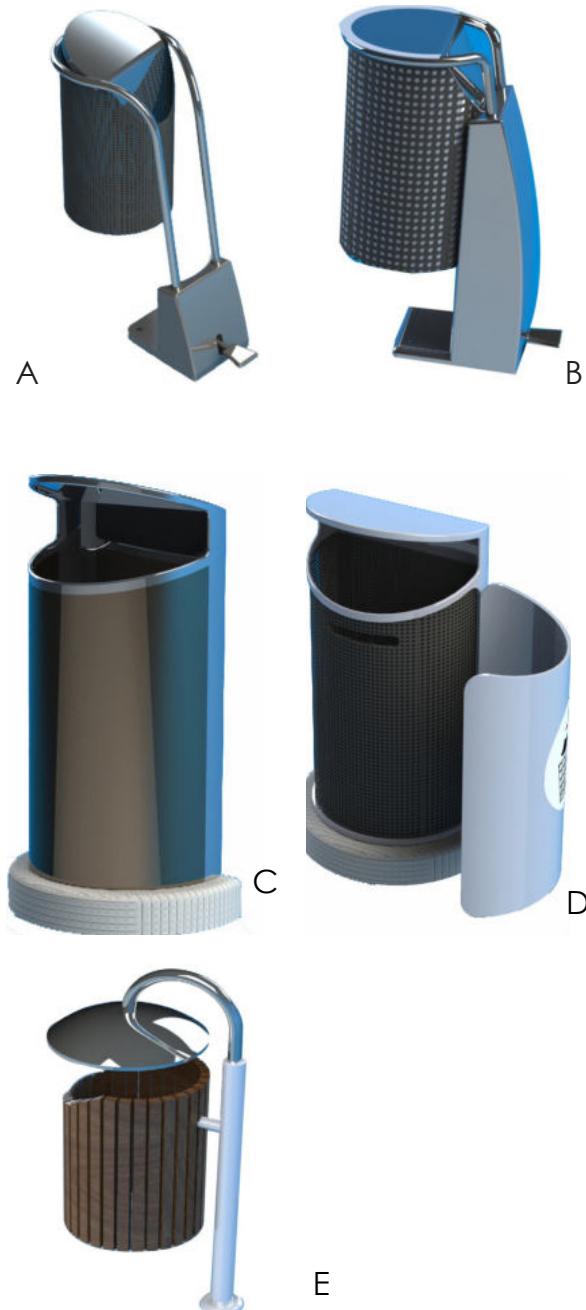


Figure 87 Pre final concept of litter bin

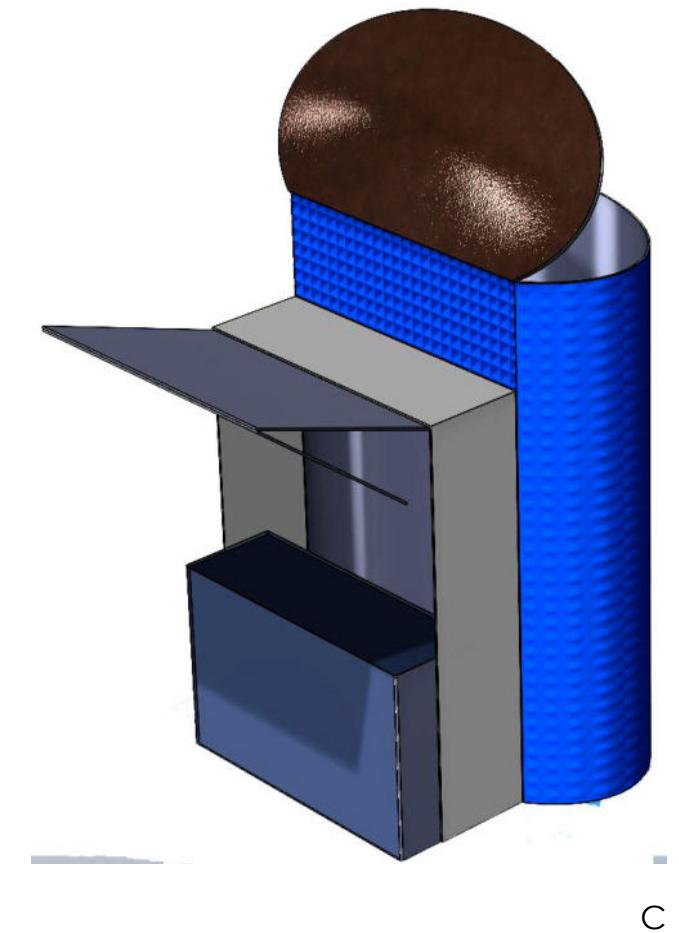


Figure 88 Pre final concept1 of vending kiosk

### 8.2.5 Public convenience

This vending public convenience is operated by adding coins in to open the door.



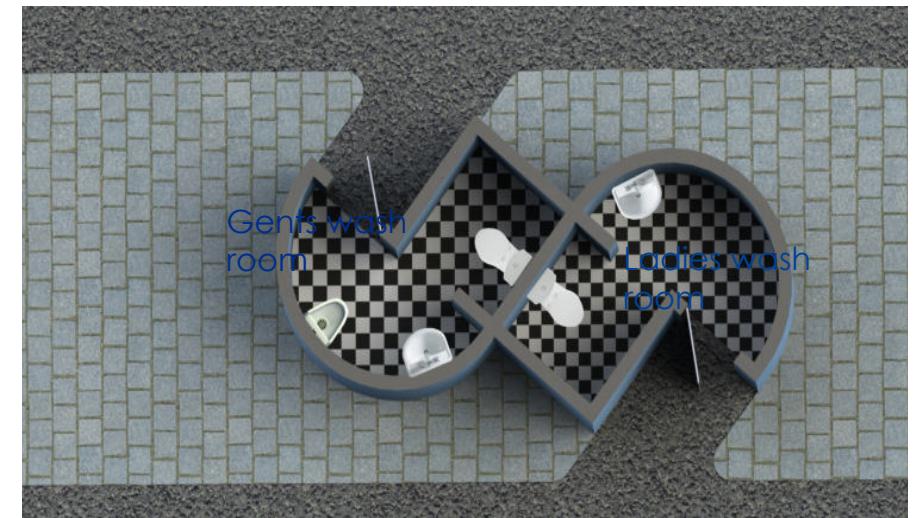
A



B



C



D

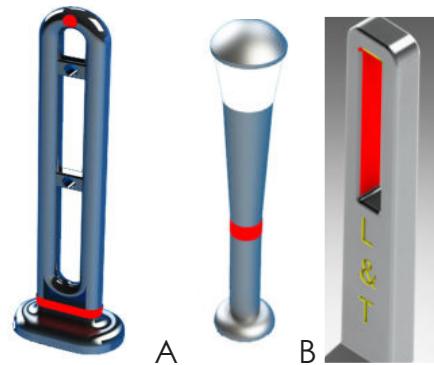
Figure 89 Pre final public convenience

### 8.2.6 Direction Boards



Figure 90 Pre final concept of information boards

### 8.2.7 Ballards



C Figure 91

### 8.2.8 Lighting



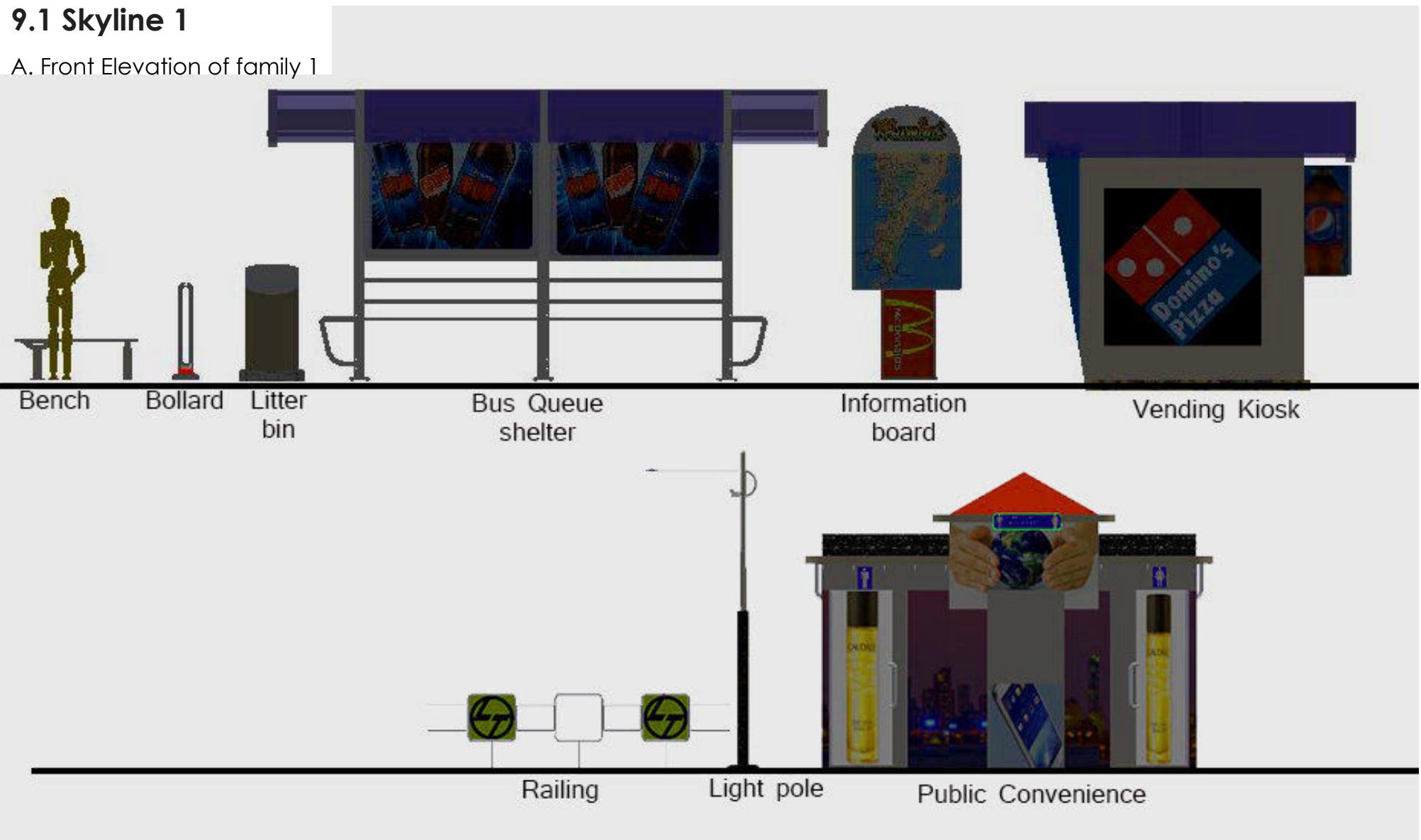
Figure 92

## 9. Grouping of products to a family

Grouping of products(furnitures)to a same family is according to their features, materials selection, colors, forms, shapes and concept of the products(furniture) which looks same family.

### 9.1 Skyline 1

A. Front Elevation of family 1



## B. 3D Views of family 1

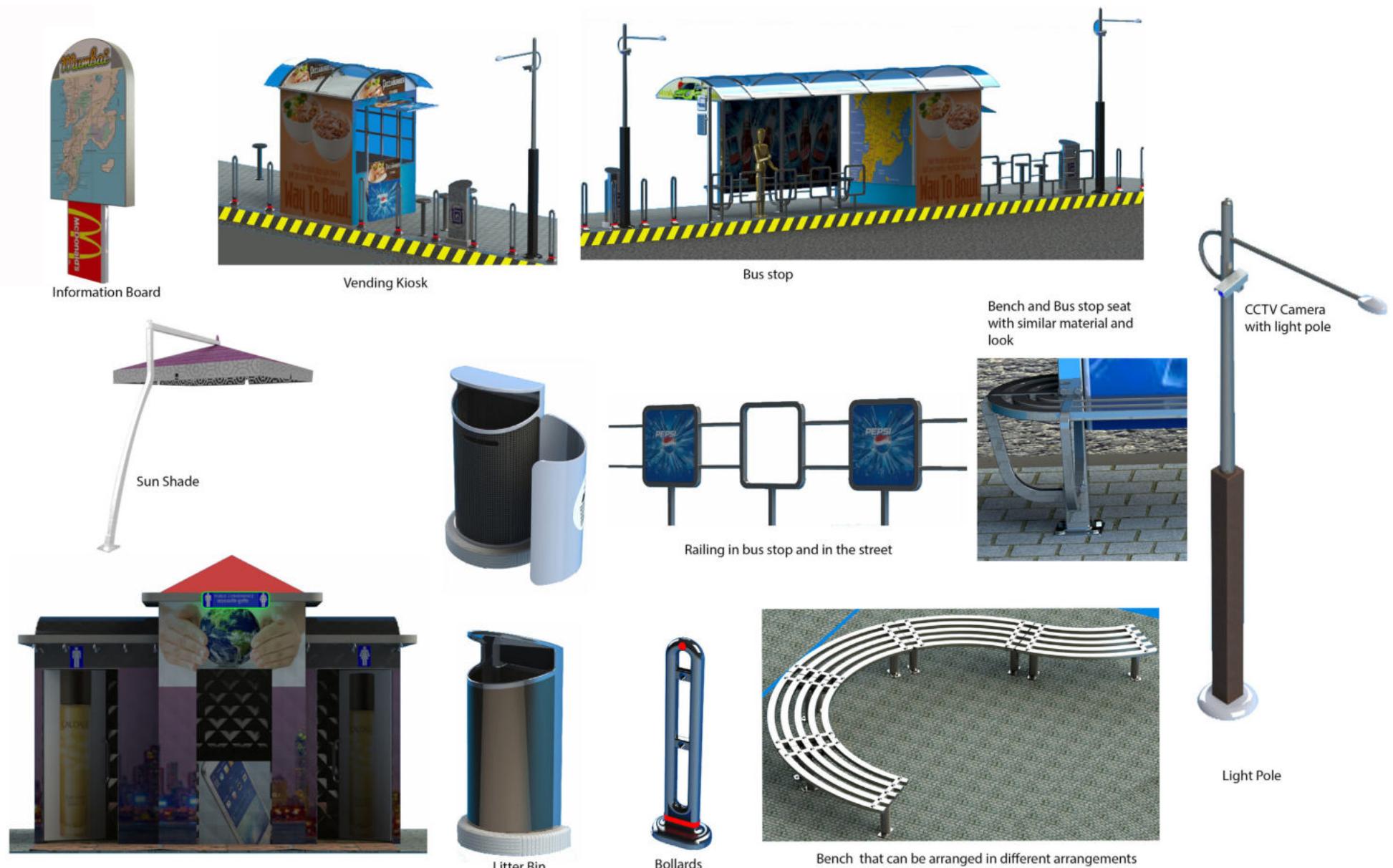
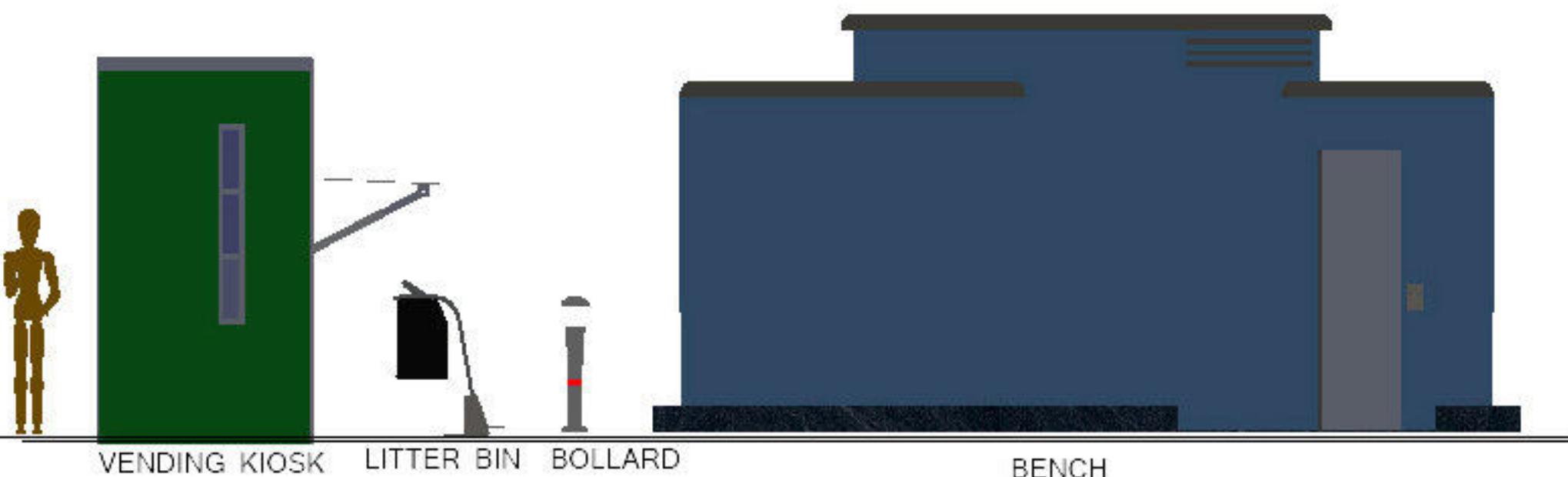


Figure 93 Skyline 1

## 9.2 Skyline 2

### A. Elevations of family 2



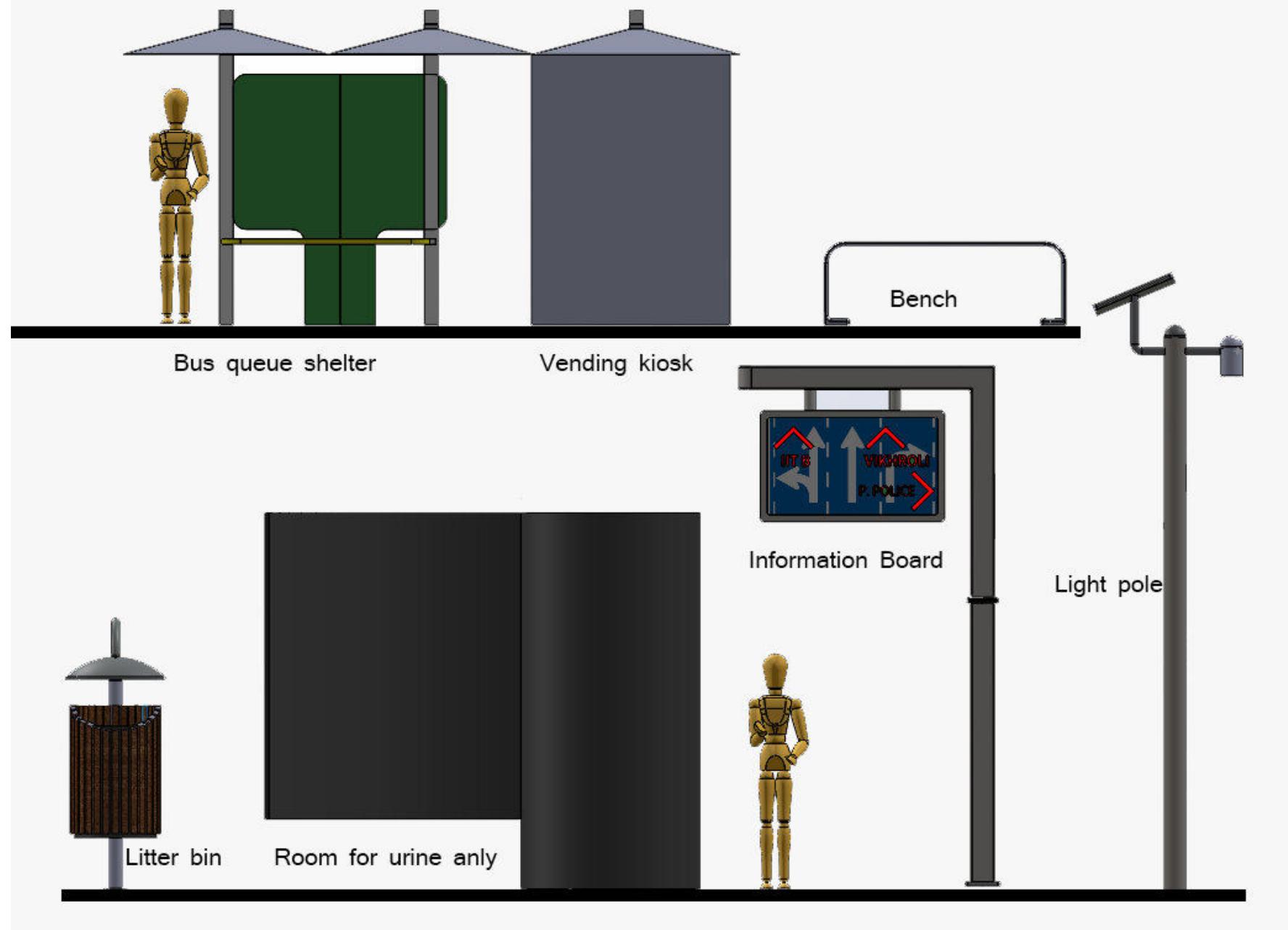
## B. 3D Views of family 2



Figure 94 Skyline 2

## 9.3 Skyline 3

### A. Elevations of family 3



## B. 3D Views of family 3



BUS QUEUE SHELTER



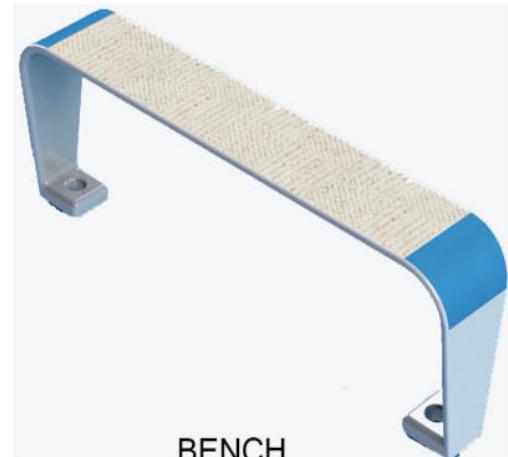
BOLLARD



INFORMATION BOARD



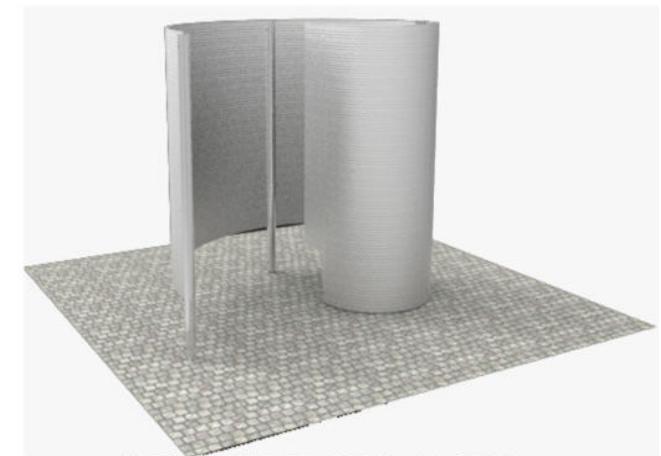
LIGHT POLE



BENCH



LITTER BIN



TOILET FOR URINE ONLY

Figure 95 Skyline 3

## 9.4 Evaluation of family products

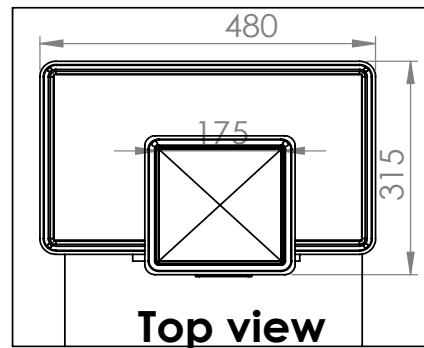
The following table shows the evaluation of the three family products according to the description on design brief and design language for Powai-ness.

Table 4 final selection of family products

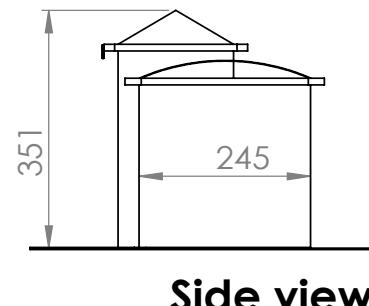
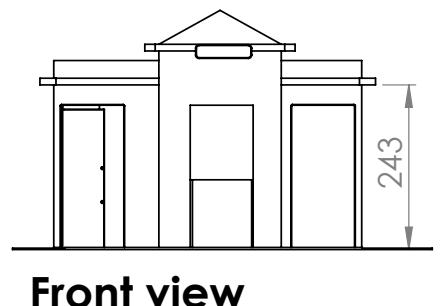
| Selection criteria                                | Skyline 1 | Skyline 2 | Skyline 3 |
|---|-----------|-----------|-----------|
| Family looking                                    | Yes       | Yes       | Yes/2     |
| Simplistic  | Yes       | Yes/2     | Yes       |
| Easy to maintain and erect(modular nature)        | Yes       | Yes/2     | Yes       |
| Usability and practical                           | Yes       | Yes       | Yes       |
| More open space for users                         | Yes       | Yes/2     | Yes       |
| Modernity   | Yes       | Yes       | Yes/2     |
| More space for advertisement                      | Yes       | Yes/2     | No        |
| Approachable and interactive                      | Yes       | Yes       | Yes       |
| Minimum use of space in actual construction(site) | Yes       | Yes/2     | Yes       |

According to the selection criteria given in table 4, skyline 1(family 1) got more yeses. So, the products in skyline 1 are the final products to be installed in powai lake face road. After this the bus and the vending kiosk in skyline 1 will be detailed, modeled, and rendered as a final output. The rest of the products from skyline 1 (final products) are listed below with their dimensions and views for the future installation.

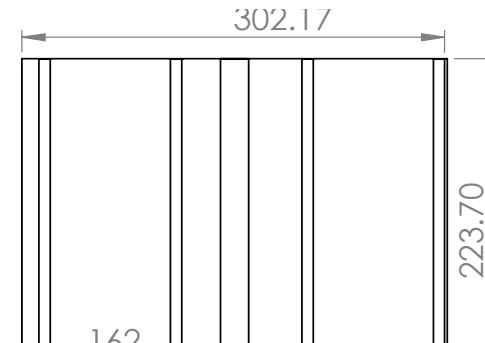
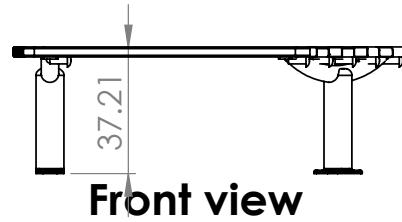
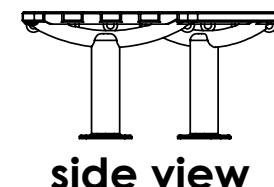
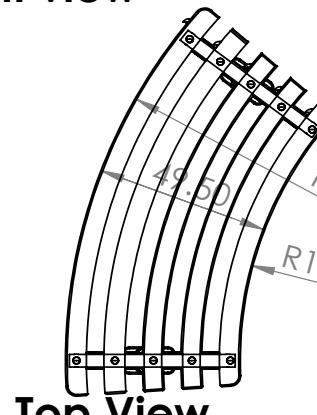
## 9.5 Final products with their dimensions



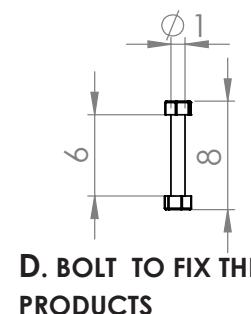
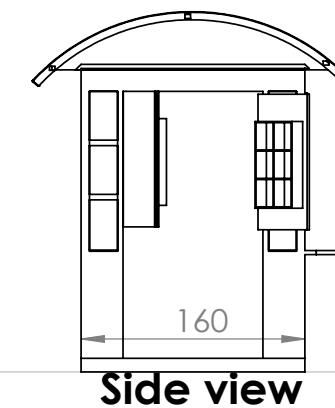
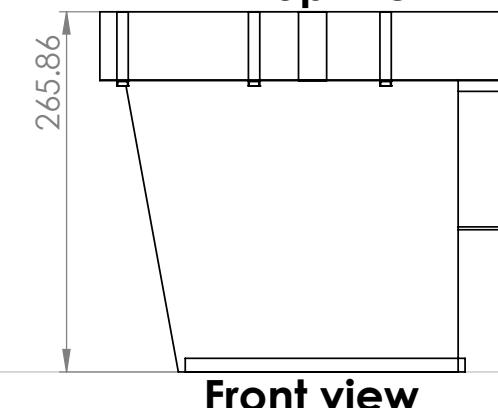
**A. Public convenience**



**C. Bench**



**B. Vending Kiosk**



2D drawings of Public convenience, Vending kiosk and bench with bolt to fix the products with concrete block

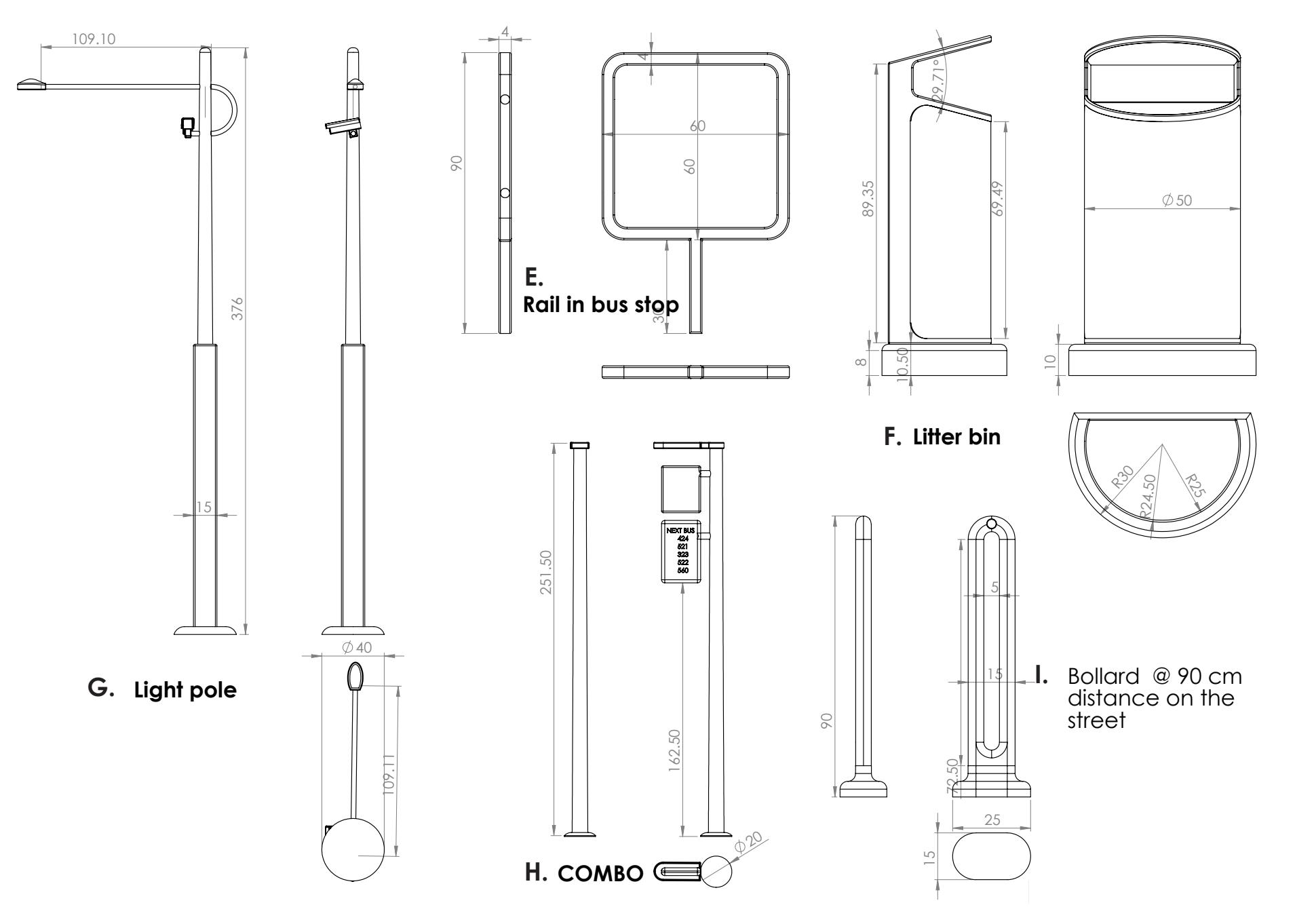


Figure 96 Final concepts with their dimensions

## 10. Final concept and details

### A. Final rendering of bus stop with vending kiosk



## B. wire framed mood of the final concept

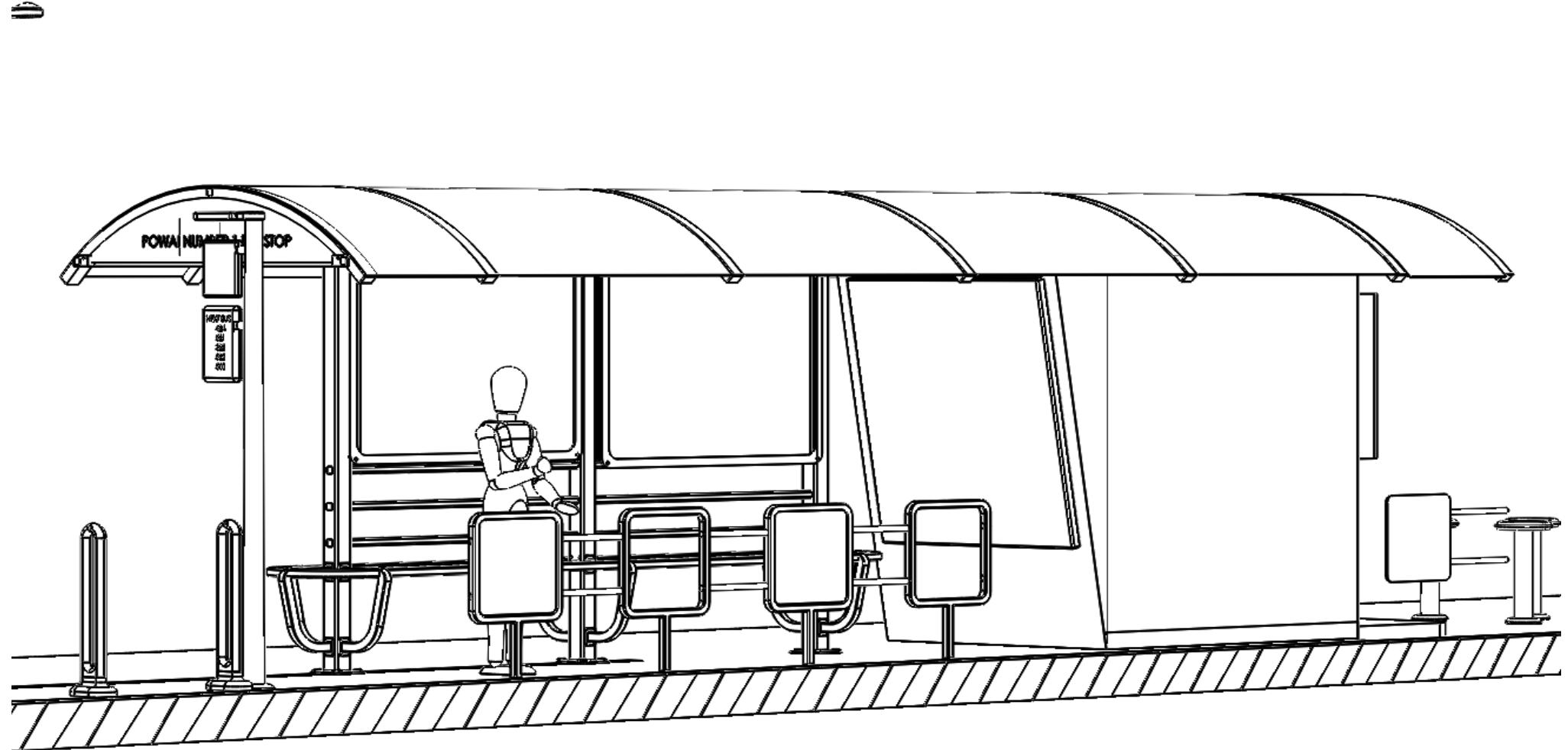


Figure 97 Bus stop and vending kiosk in 3D

## 10.1 Final concept of Bus stop

### A. Final rendering of bus stop



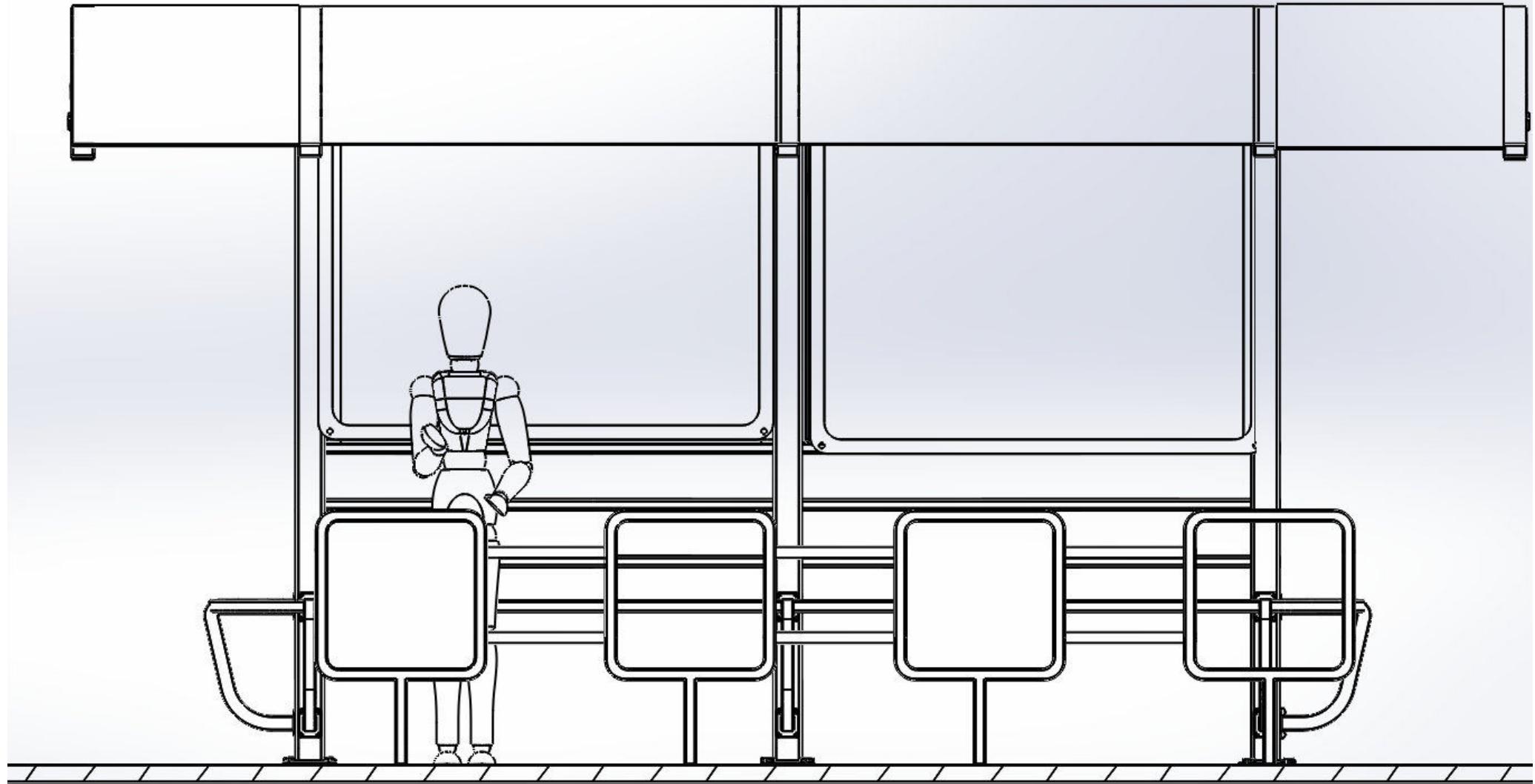
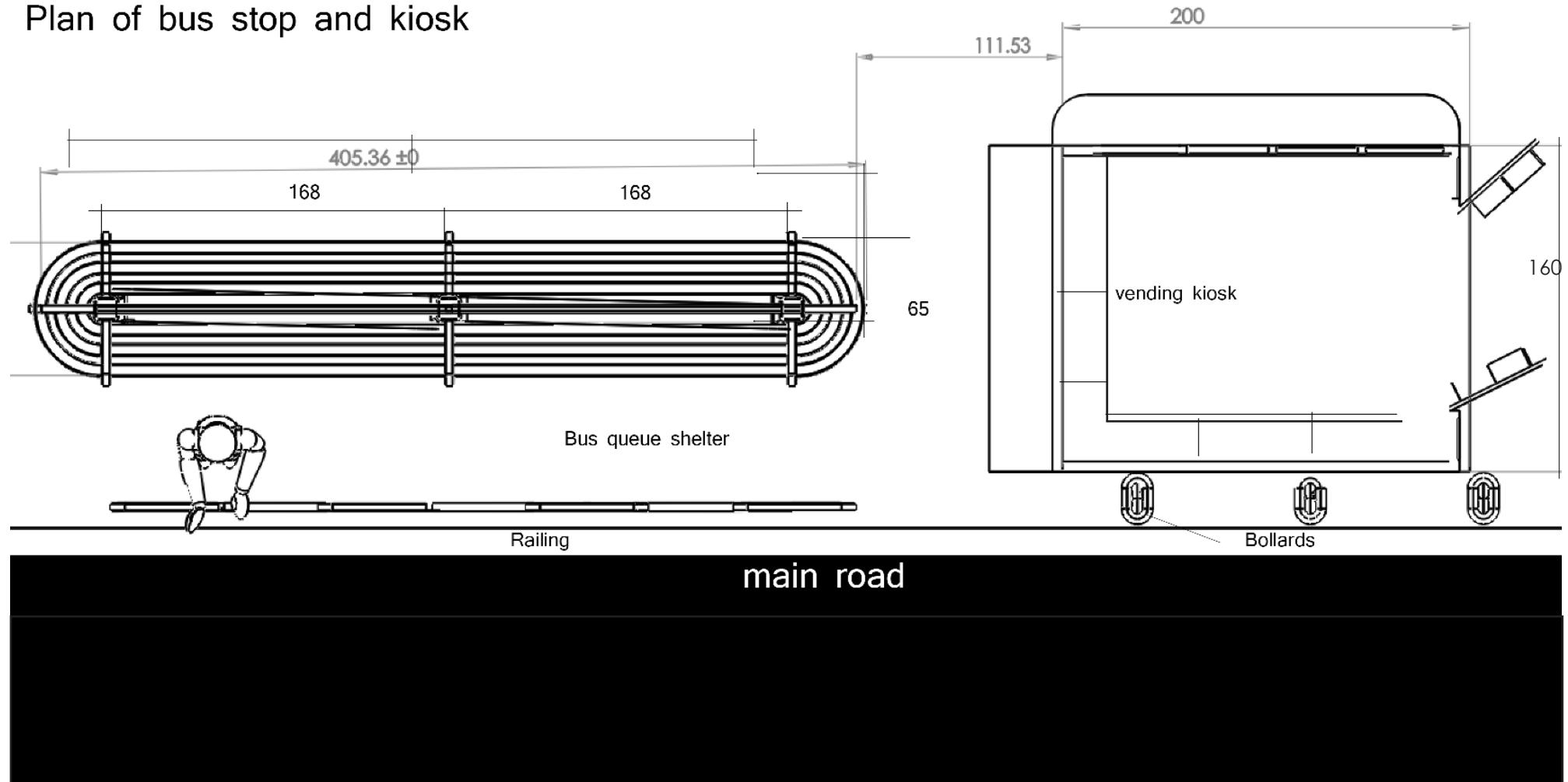
**B. Final concept of Bus stop in a wire-frame mood**

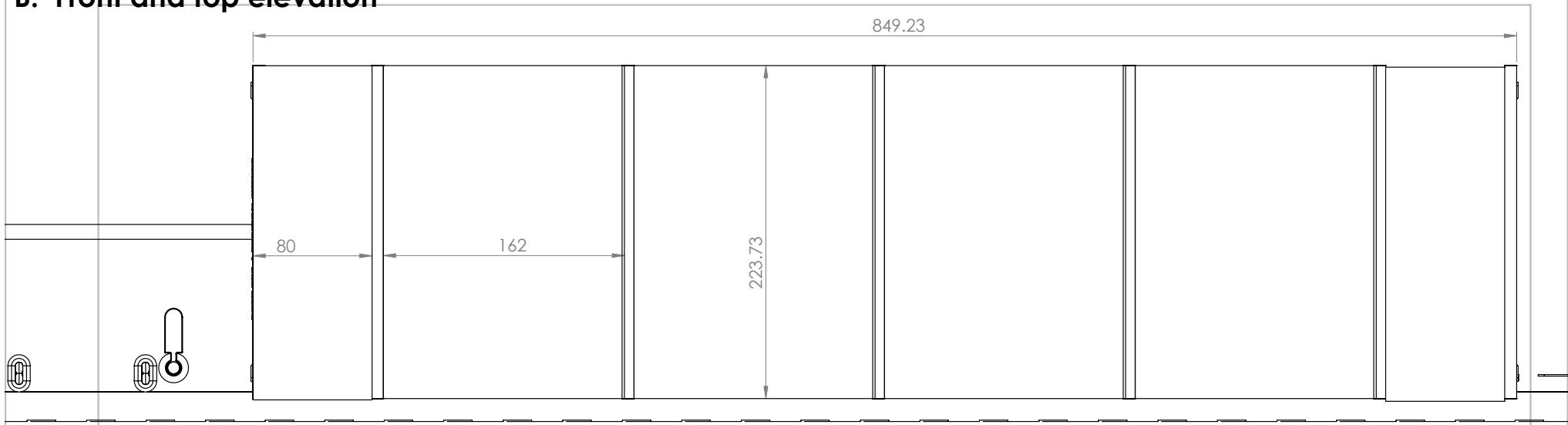
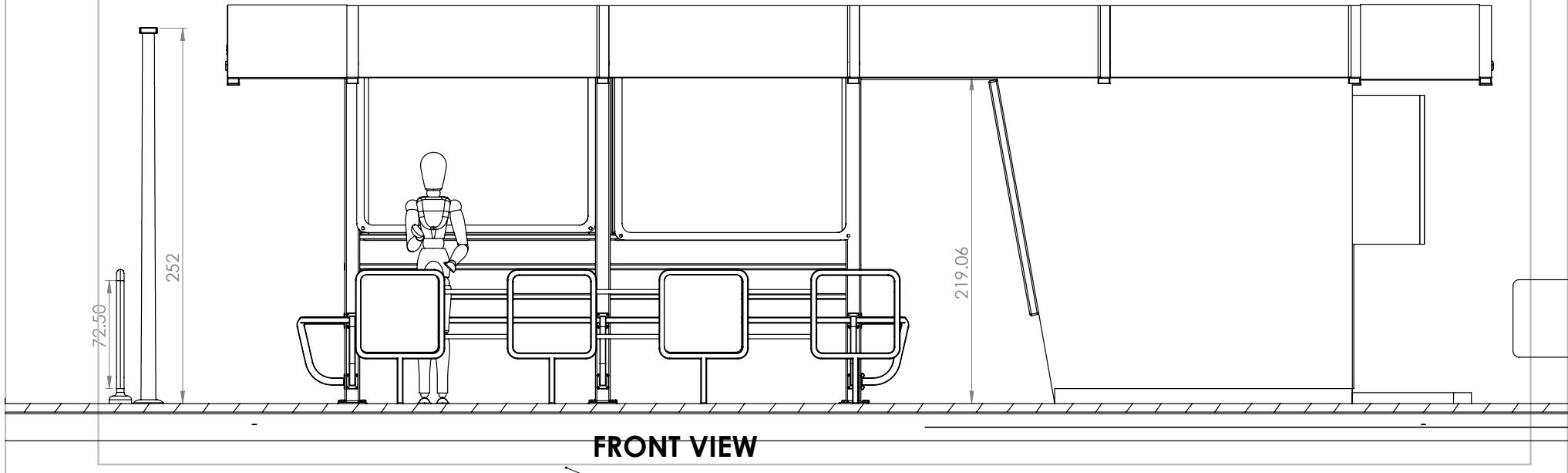
Figure 98 Bus stop in 3D and wire framed

## 10.2 Plan and elevation of bus stop and vending kiosk

### A. Plan of bus stop with vending kiosk

Plan of bus stop and kiosk



**B. Front and top elevation****TOP VIEW**

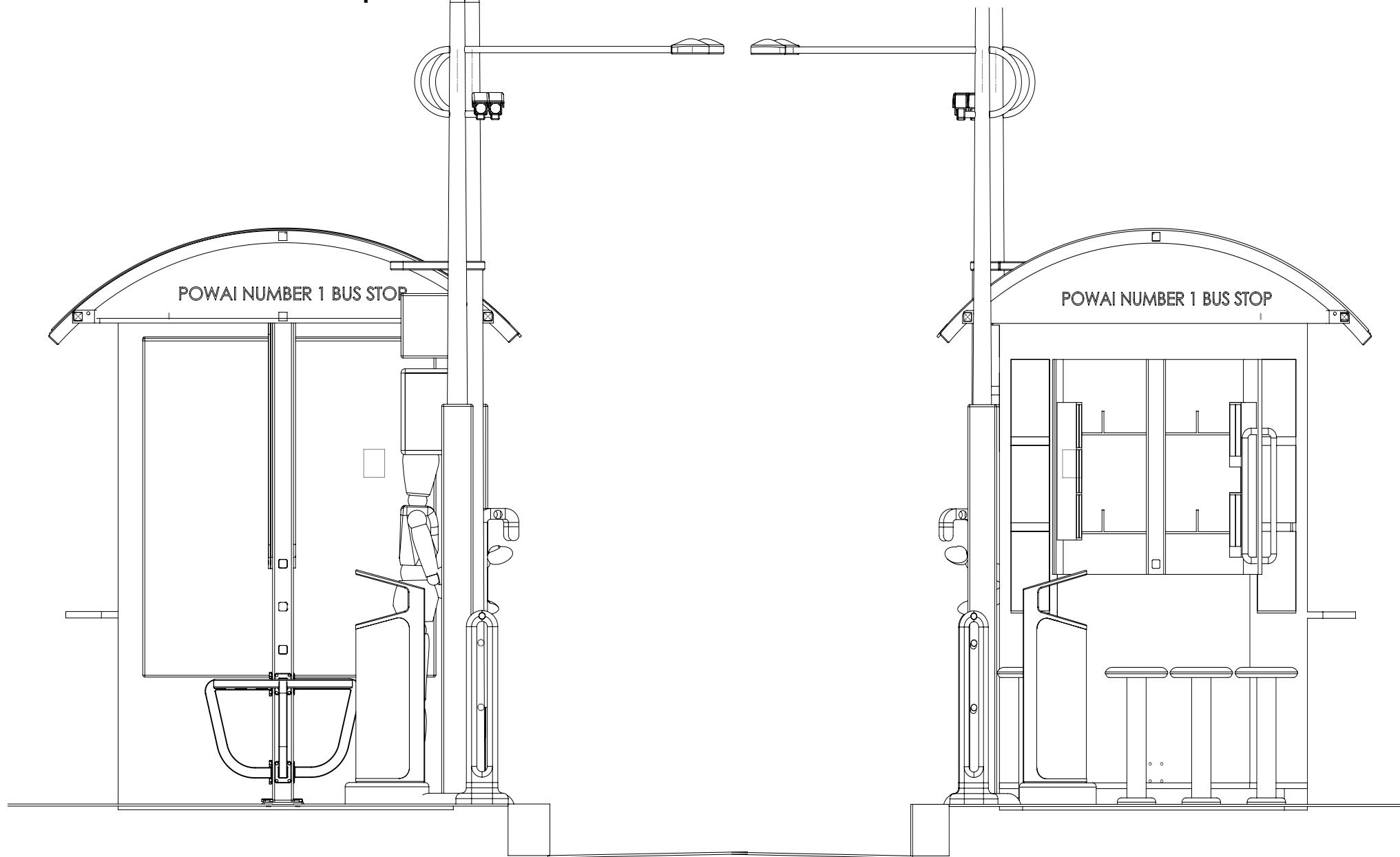
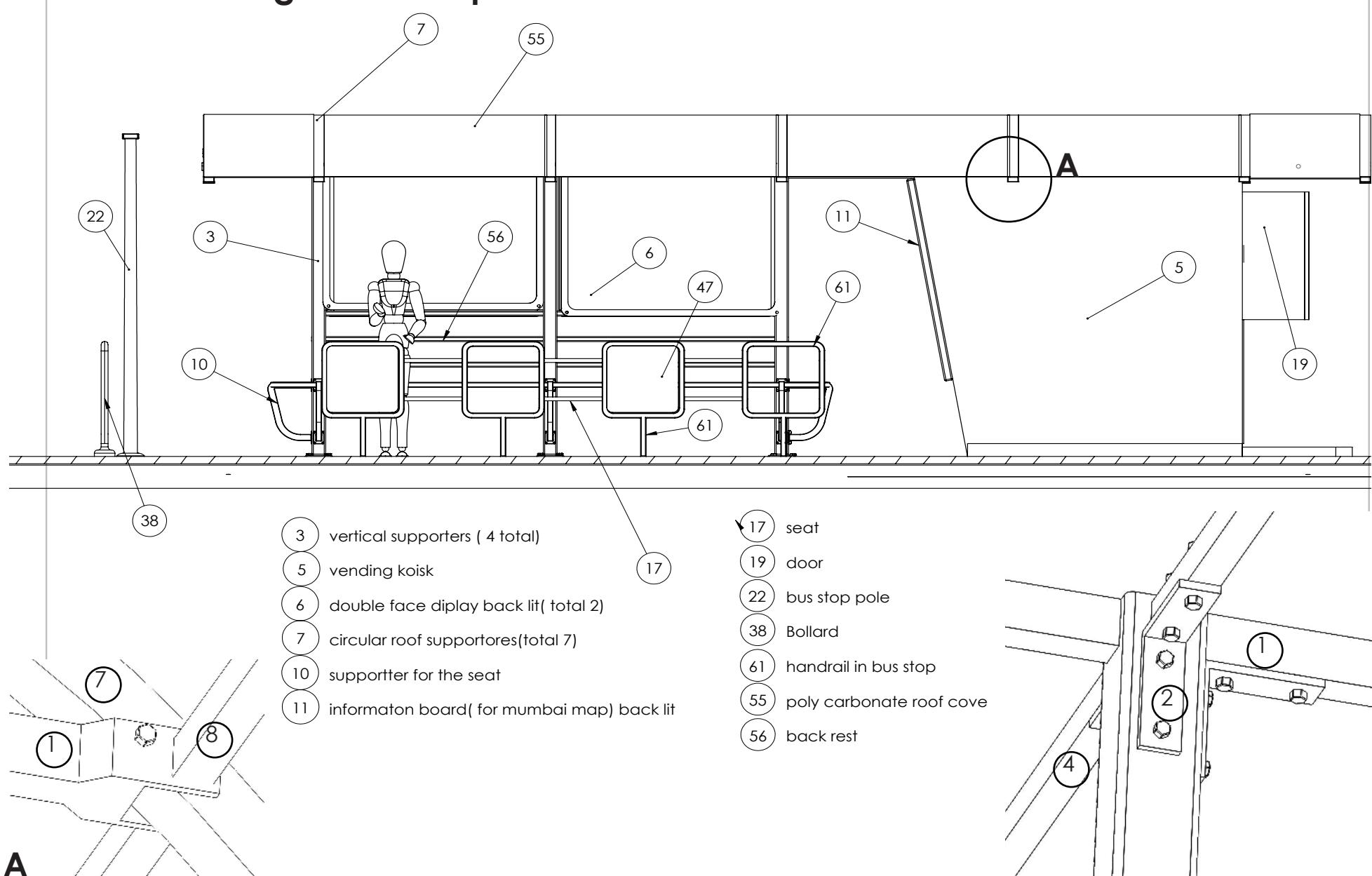
**C. Side elevations of bus stop and kiosk**

Figure 99 2D elevation drawings of bus stop with vending kiosk

## 10.3 Part drawings in bus stop and kiosk



## A. Part drawings of the bus stop

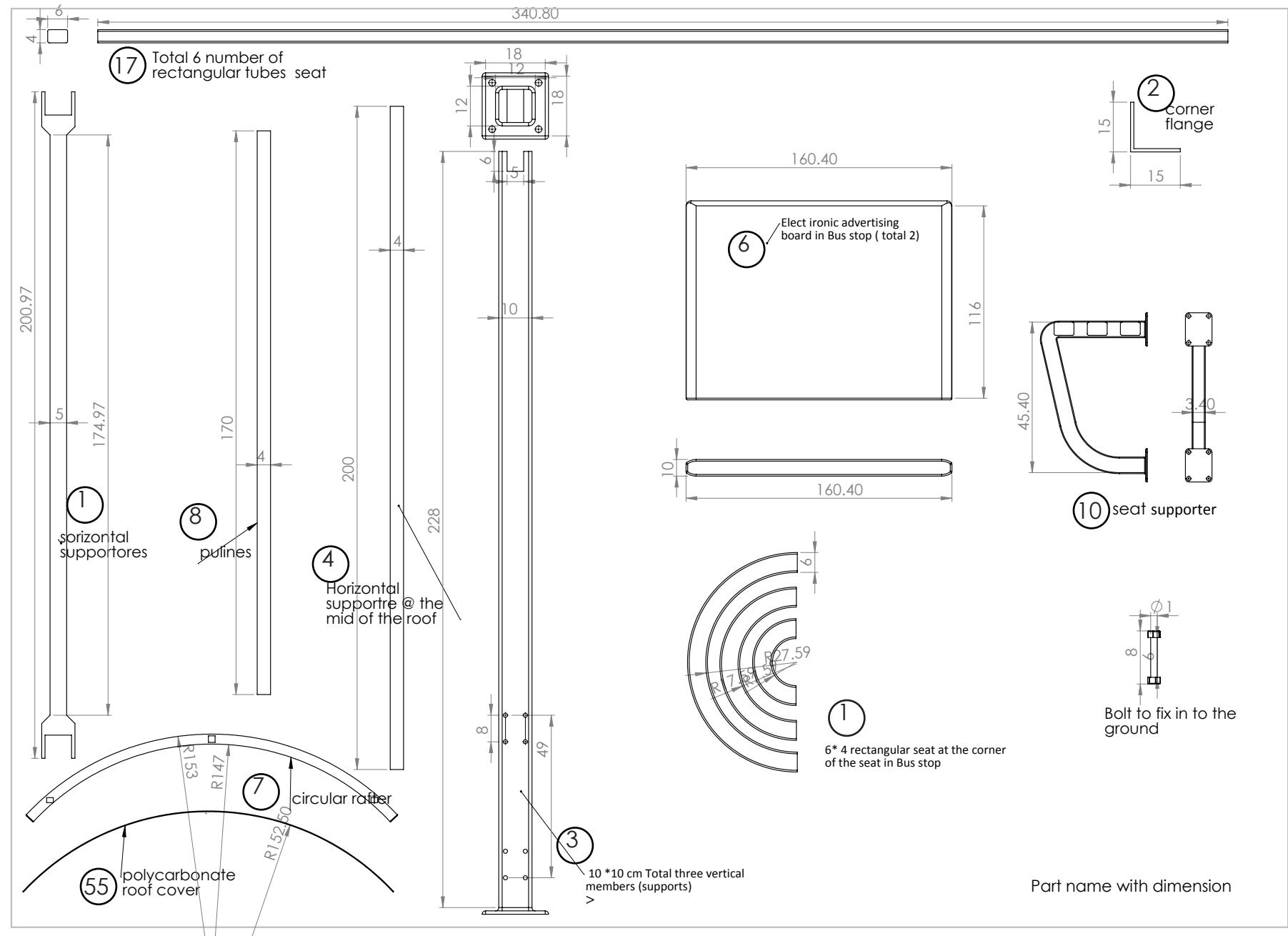


Figure 101 Part drawings

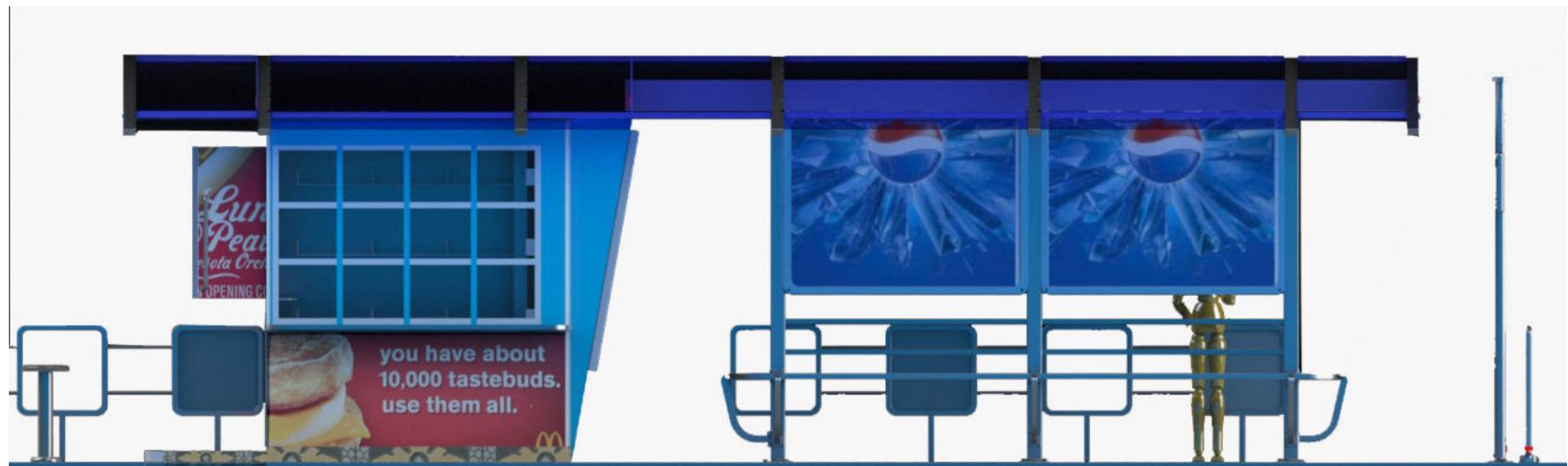
## 10.4 Material selection

Stainless steel is a type of alloy steel that resists rust and other forms of corrosion and has an attractive appearance. It has a unique self-healing property due to the alloying elements used, a thin, transparent layer is formed on the surface. In addition to this stainless steel does not require any coating or other corrosion protection to remain bright and shiny even after decades of use. In case the surface is scratched or damaged otherwise, this thin layer, which is only a few atoms thick, immediately rebuilds with the assistance of oxygen from air or water.

Table 5 Material selection and quantity of furniture

| No | Furniture name     | Dimension in cm                        | Quantity on the stretch  | Materials   | Space for advertisement |
|----|--------------------|--|--|---|-------------------------|
| 1  | Bench              | 50 seat with radius of bend            | 35   | Stainless steel grouted to a concrete base  | No                      |
| 2  | Bus queue shelter  | 160* 200 modular nature                | Bus stop only 2 and bus stop with vending kiosk 3              | Roof cover: polycarbonate and the rest of the parts are galvanized steel                          | Yes                     |
| 3  | Vending kiosk      | 160 *200                               | 3( combined with bus stop                                      | Double layer stainless steel thermo Cole in inside in between for heat resistance and sound proof | Yes                     |
| 4  | Litter bin         | 50*90                                  | In every benches and bus stops plus @300m on the lake side ~25 | Stainless steel external body and perforated steel in side to collect the garbage                 | Yes                     |
| 5  | Public convenience | 480* 300                               | 3  | Double layer stainless steel thermo Cole in inside in between for heat resistance and sound proof | Yes                     |
| 6  | Light pole         | Height of 375                          | At a distance of ~25 cm  | Stainless steel grouted to a concrete base  | Yes                     |
| 7  | Information Boards | 260 cm high near to bus stop and kiosk | 5  | Stainless steel grouted to a concrete base and electronic display                                 | Yes                     |
| 8  | Bollards           | 15*90                                  | Distance of 90 cm in entire stretch where needed               | Galvanized steel grouted to a concrete base   | No                      |

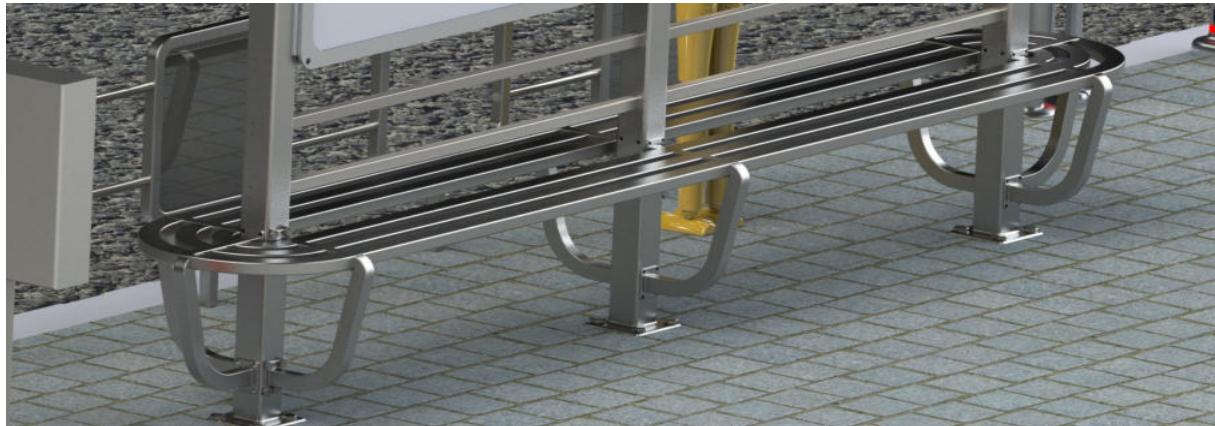
## 10.5 Details of the bus stop with vending kiosk



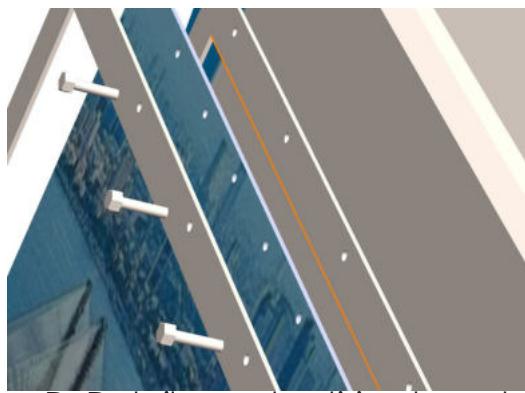
A. View from the lake face



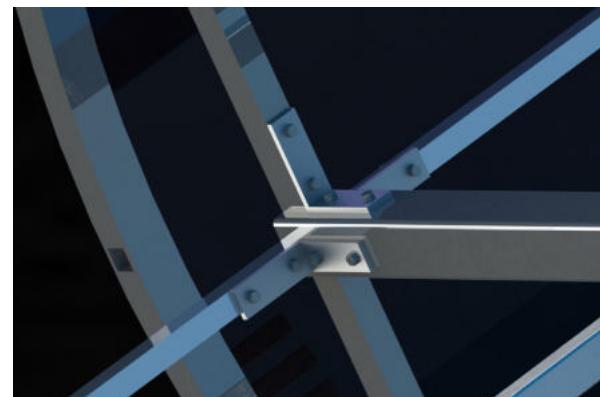
B. View from street side



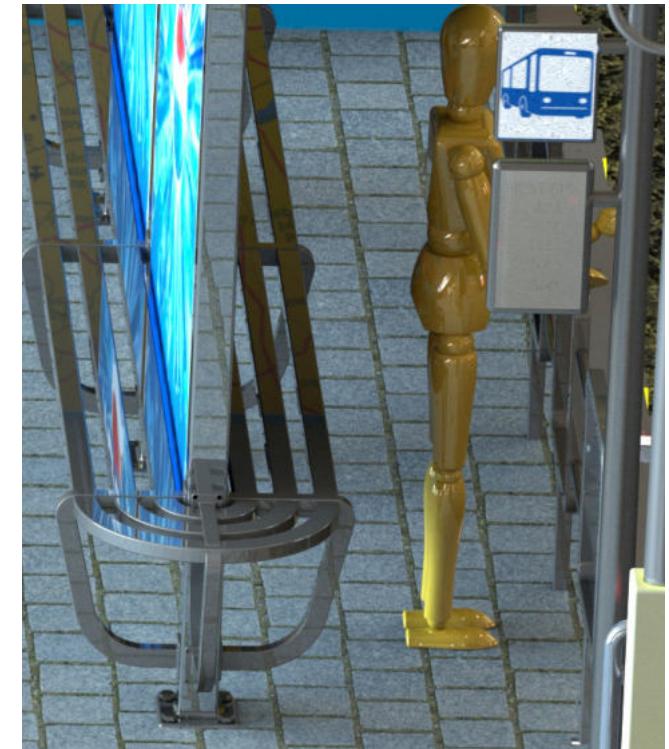
C. Seat on the bus stop



D. Detail on advertising boards



E. Roof detailing



F. Seating from side view



G. Eave detail



H. Railing in bus stop and on the side of the streets

Figure 102 Detailing in 3D

## 10.6 Product layout on the site

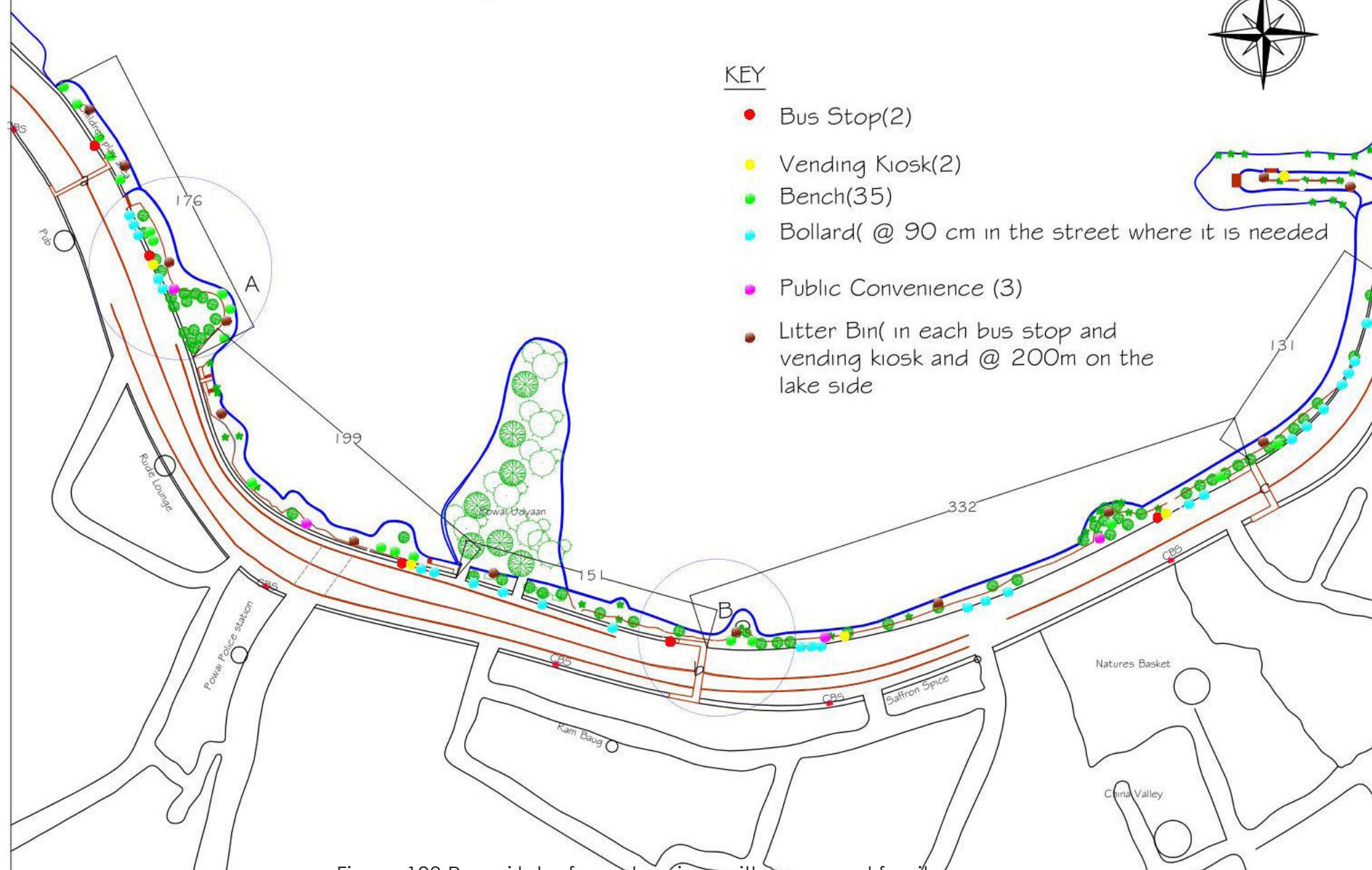


Figure 103 Powai lake face showing with proposed furniture

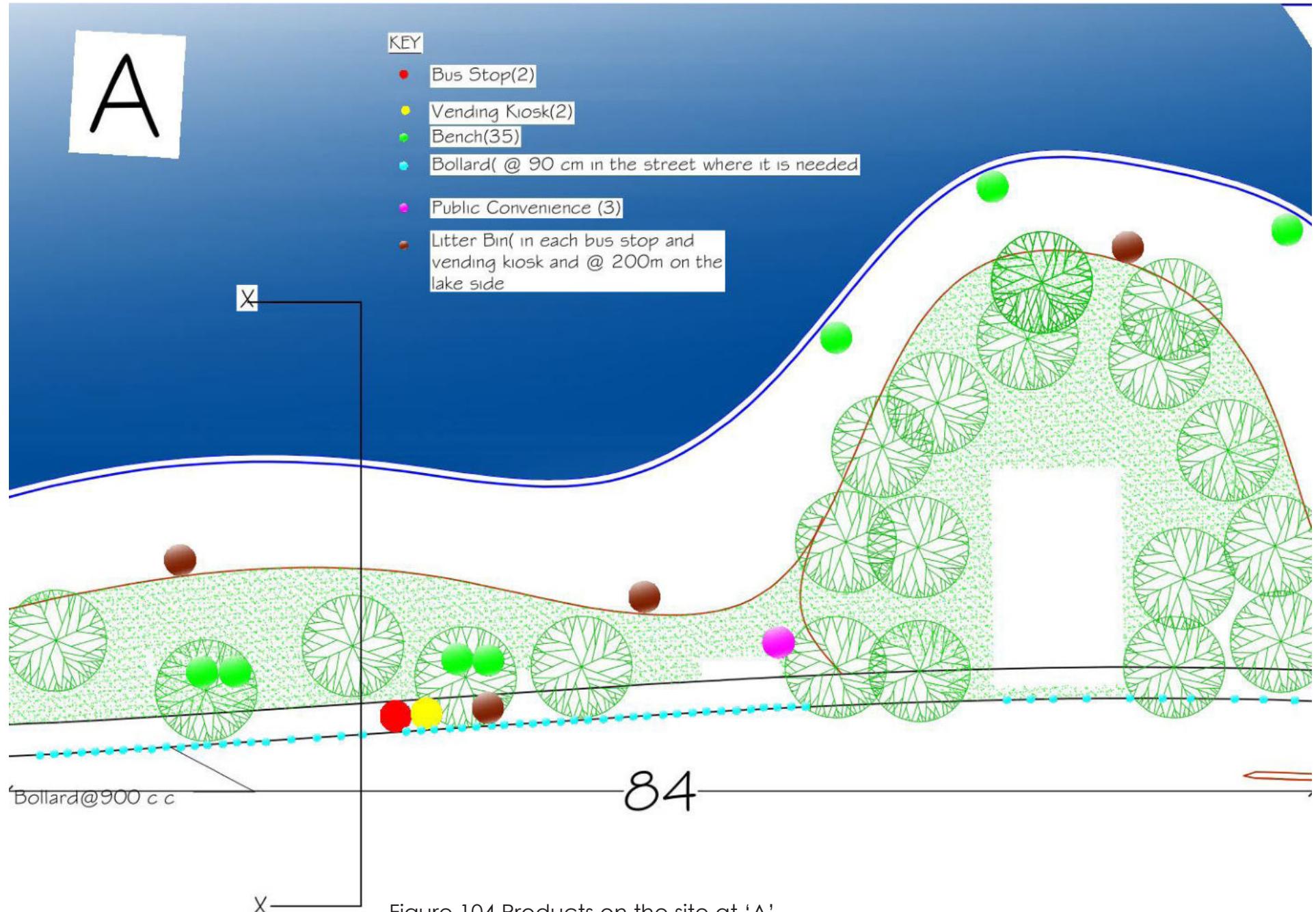
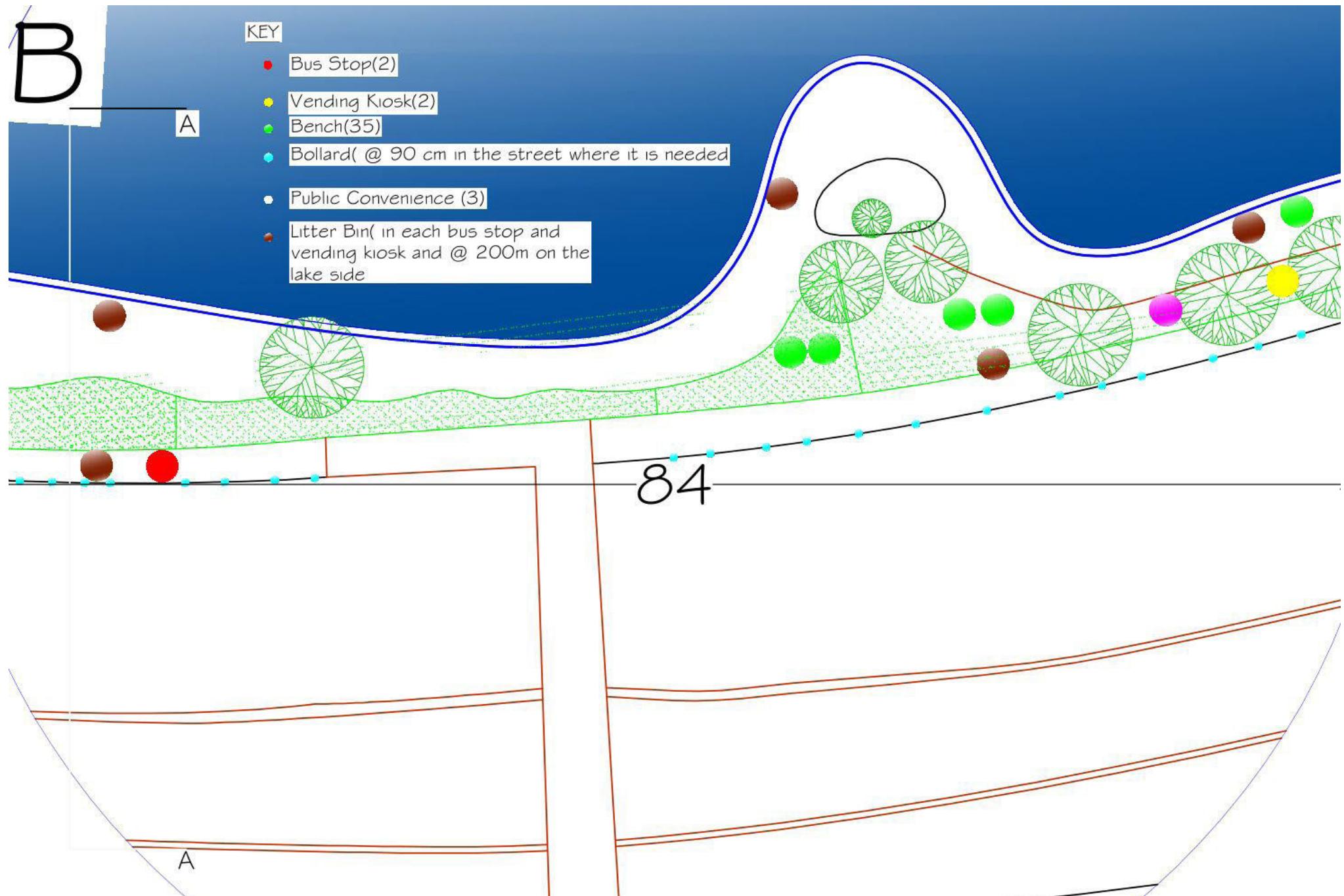


Figure 104 Products on the site at 'A'



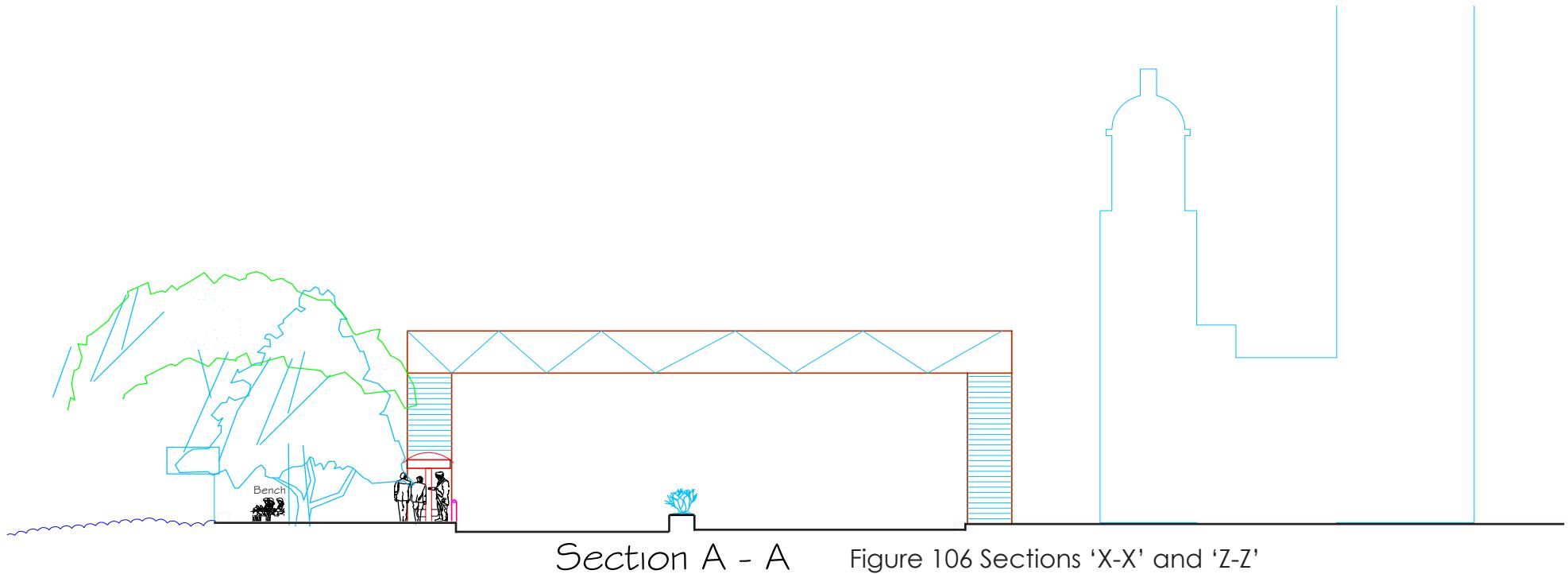
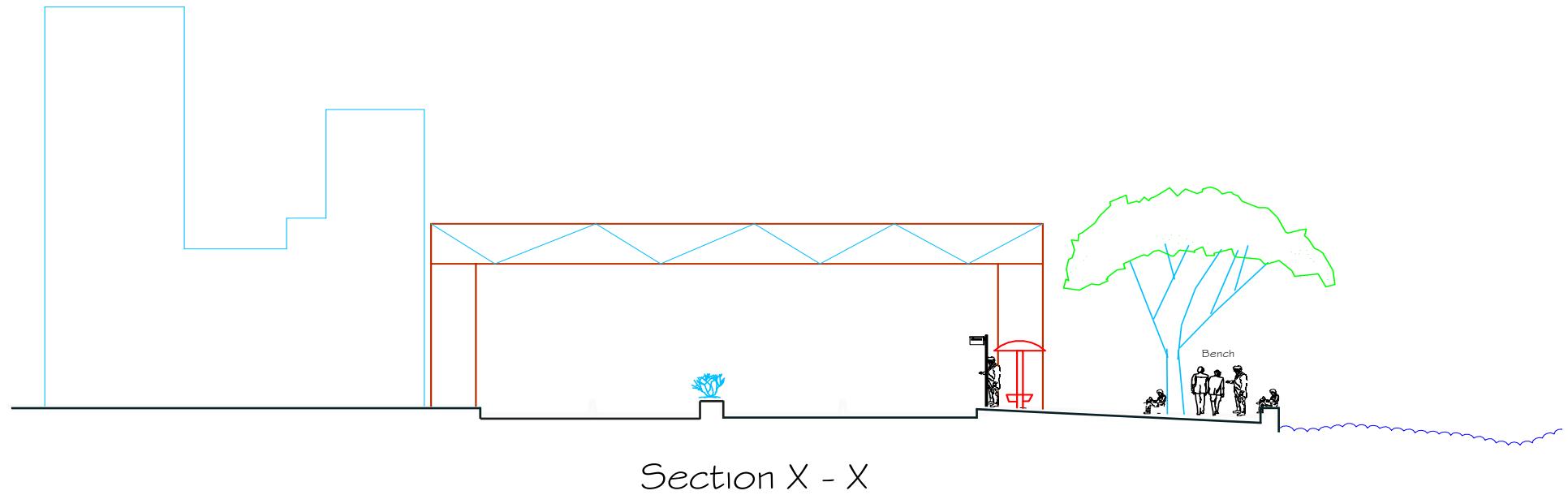
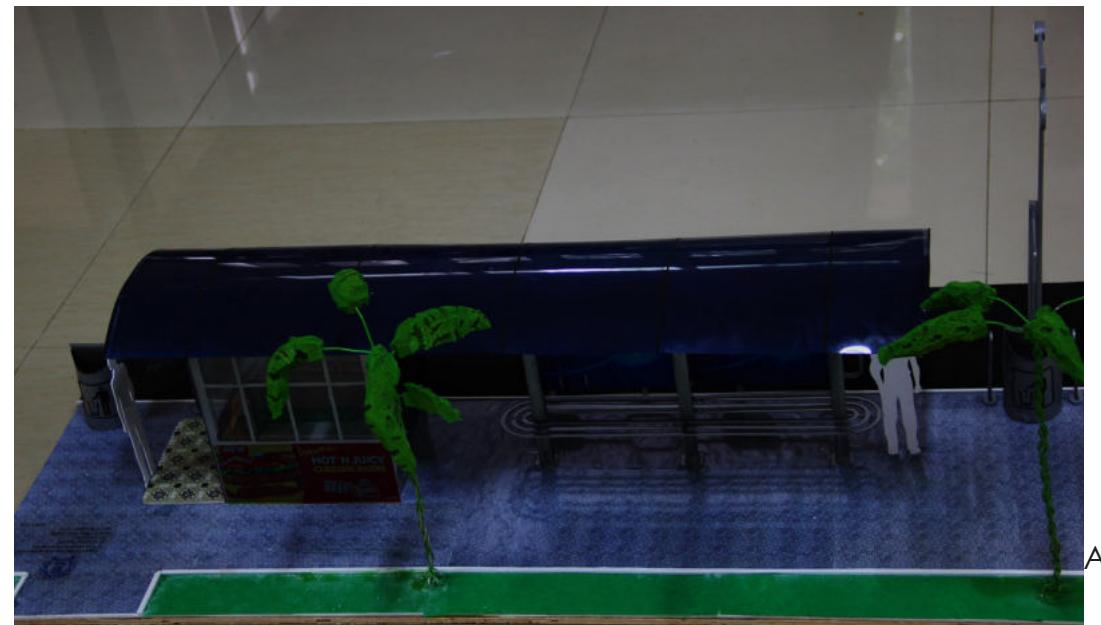
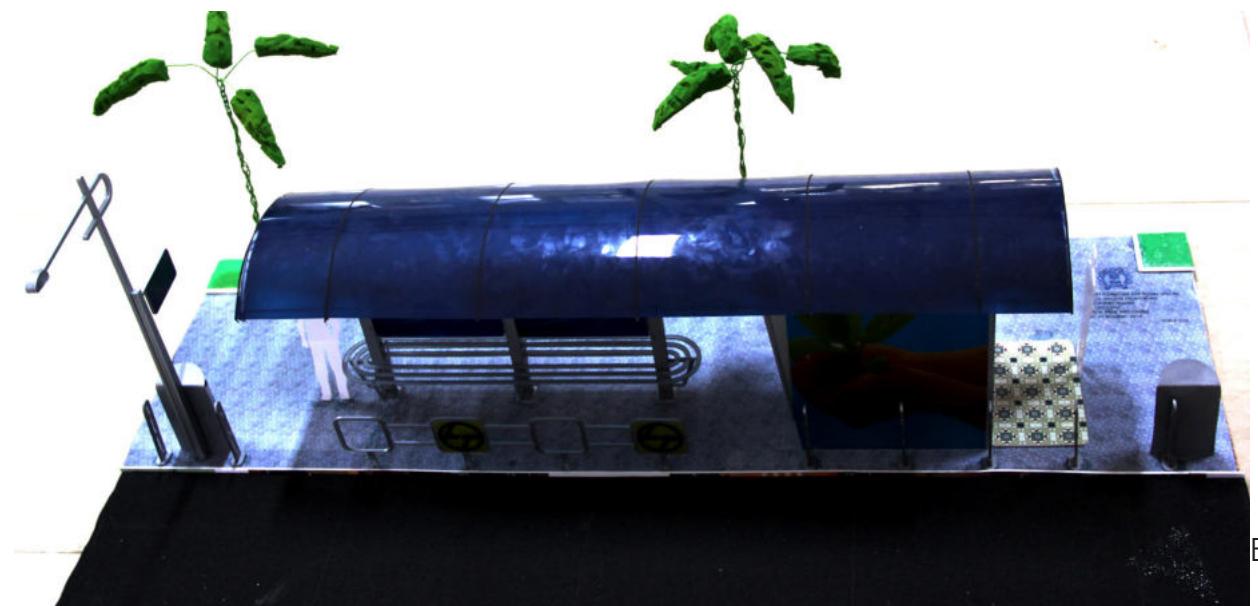


Figure 106 Sections 'X-X' and 'Z-Z'

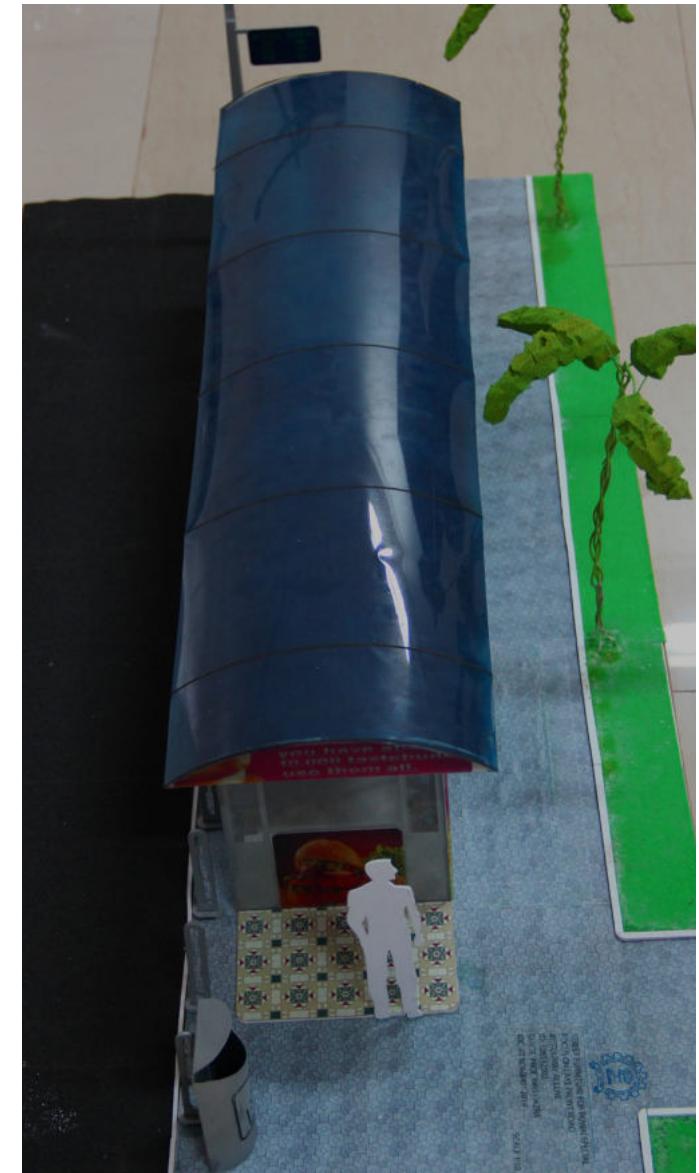
## 10.7 Final model of bus stop with vending kiosk



A



B



C

Figure 107 Final model

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