P3 Report

Docking, Locking & Charging Solution for shared Micro-Mobility (Yulu)

DEP702 M.Des Project-3

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Approval Form

This is to certify that the Industrial Design Project entitled "**Docking, Locking & Charging Solution for Shared Micro-Mobility (Yulu)**" by Amit Kumar is approved for partial fulfillment for the Master of Design degree in Industrial Design.

Prof. Avinash Shinde[Project Guide]:

Signature of the Chair Person:

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Acknowledgement

I would like to use this opportunity to give thanks to those who helped me going through this Course project. I would like to extend my respect to all the people who helped me in accomplishing this task.

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Abstract

This report examines the docking, locking, and charging solution for Yulu, a prominent shared micro-mobility provider. It evaluates the existing infrastructure, locks, and charging facilities, focusing on usability, durability, and security. The operational implications, such as user experience and vehicle distribution, are analyzed. Finally, potential enhancements are proposed, such as smart docking systems, advanced anti-theft mechanisms, and dynamic charging infrastructure. This study sheds light on the challenges and opportunities in the shared micro-mobility sector, providing insights for service providers to improve their operations and enhance customer satisfaction.

Keywords: shared micro-mobility, docking, locking, charging, Yulu, usability, security, user experience, operational challenges, enhancements.

Contents

Introduction

The Need to Travel

Since the dawn of time, humans have been traveling for various reasons such as to find food and resources, to explore new lands, to trade, to migrate, and to conquer.

Travel has been an essential part of human history since the dawn of time. It has allowed individuals to explore new lands, discover new cultures, and broaden their horizons. The reasons for travel are as varied as the individuals who embark on these journeys. From adventure seekers to business travelers, from backpackers to luxury vacationers, people love to travel for a multitude of reasons. One of the most compelling reasons for travel is the opportunity to explore new places and cultures. When we travel, we expose ourselves to different ways of life, beliefs, and customs. We learn about the history and geography of the places we visit and experience the diversity of the world firsthand. By immersing ourselves in new cultures, we gain a deeper understanding of the human experience and broaden our perspectives.

Another reason why people love to travel is the opportunity to escape from the routine of daily life. Whether it’s a weekend getaway or a long-term trip, travel allows us to break free from the monotony of our daily routines and experience new adventures. We get to explore new places, try new foods, and engage in activities that we may not have the chance to do at home. Travel can be a form of self-discovery, helping us to connect with ourselves and the world around us.

Travel is also an opportunity to create lifelong memories with loved ones. Whether we travel with family, friends, or our significant others, the memories we make together can be cherished for a lifetime. Traveling together allows us to bond over shared experiences and create a deeper sense of connection.

Business travelers also find travel essential in today's global economy. In an interconnected world, it's becoming increasingly important for businesses to establish a global presence. Travel allows business professionals to connect with colleagues and clients in different parts of the world, develop new partnerships, and gain a deeper understanding of the markets they serve.

Despite the many benefits of travel, it's important to acknowledge that it can also be challenging and even risky at times. Traveling to unfamiliar places can be daunting, and it's important to take precautions to ensure our safety and well-being. However, with proper planning and preparation, these challenges can be overcome, and the rewards of travel can far outweigh the risks.

Travel is a fundamental part of the human experience. It allows us to explore new places, broaden our horizons, and create lifelong memories with loved ones. Whether we travel for adventure, relaxation, business, or personal growth, travel is an essential part of our lives. It's an opportunity to break free from routine, learn about different cultures, and connect with the world around us. So, next time you have the chance to travel, embrace it with open arms and enjoy the journey.

Modes of Transportation in India

India has three modes of transportation: Land, Water and Air. Most Indians commute mostly by road based vehicles, and the country has some of the most highly used road transportation infrastructure in the world.

After the United States, India has the second-largest and one of the busiest road networks in the world, carrying 8.225 billion people and more than 980 million tonnes of freight yearly as of 2015. As of 2020, India's rail system was the second busiest and fourth-largest in the world, moving 8.09 billion people and 1.20 billion tonnes of freight yearly. According to IATA data, India's aviation industry is the world's fastest-growing sector for both military and civil aircraft.

India has the ninth-largest waterway network in the world, made up of rivers, canals, backwaters, and creeks. The amount of cargo handled (in tonne kilometres) by inland waterways is 0.1 percent of the country's overall inland traffic, showing the extreme underutilization of this mode of freight transportation in India. According to the 2011 Indian census, 4.70 percent of households in India had automobiles or vans, compared to an overall two-wheeler ownership rate of roughly 21 percent. With an annual growth rate of 10.5% and a current manufacturing volume of over 4.6 million cars, India's automobile industry is expanding quickly. Future growth in vehicle production is anticipated to be significantly higher than recent years .

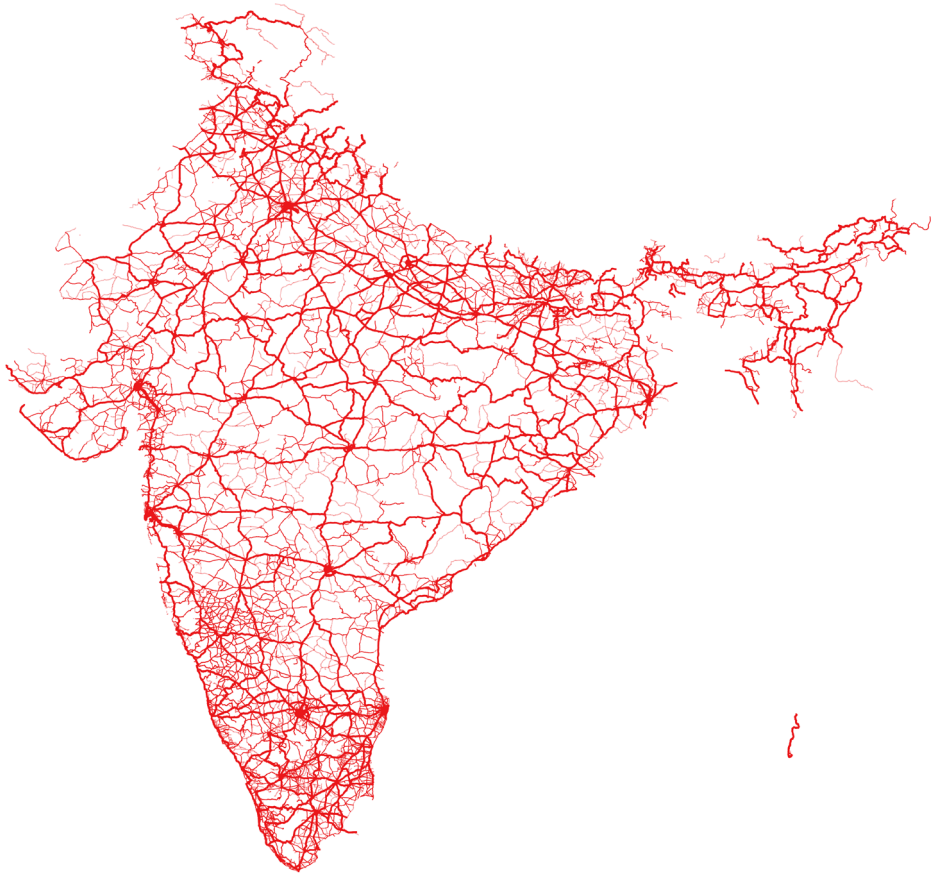


fig. 1 India major road network map ©Wikipedia

India's Transport Problems

Even with the current size of the urban population, Indian cities are facing a multitude of issues such as severe congestion; deteriorating air quality; increasing greenhouse gas (GHG) emissions from the transport sector; increasing road accidents; and an exploding growth in the number of private vehicles (largely motorcycles). With the urban population projected to more than double in the next generation, the situation could easily get out of control and thwart India's economic development efforts unless remedial measures are soon taken.

In a move to recognise and act upon urban mobility issues, in 2006 the federal government of India introduced the National Urban Transport Policy (NUTP), setting the policy framework for providing sustainable mobility for the future (see Figure 1). In 2015 the government unveiled its new plan to upgrade 100 cities into 'smart cities' and to 'renew' 500 cities.

Growth of Private-vehicle Ownership

The growth of vehicles has been much faster than that of the population. The number of registered vehicles increased from 55 million in 2001 to 142 million by 2011, with a currently-estimated 195.6 million in 20162. Seventy-five per cent of these registered vehicles (147 million) are motorcycles. Furthermore, the physical infrastructure hasn't been able to keep pace with the growth in demand. The urban road length has increased from 252,001km in 2001 to 411,840km by 2011. In the last decade registered vehicles per million population has increased by 219% while urban road infrastructure per million only increased by 124%.

This rapid motorisation has led to severe congestion, longer journeys and higher per capita trips. Indian roads are also popular for heterogeneity of vehicles sharing the same road space. There are around 32 different vehicle types in India such as bicycles, cycle-rickshaws, auto-rickshaws ('tuk-tuk'), motorcycles, cars, buses and trucks.

Congestion

The rapid growth in private-vehicle ownership has led to increased congestion problems in cities. The average speed of a vehicle on Indian roads is just 17-19km/h between 9:00 and 21:00, with the slowest times witnessed during the evening hours. The average speed of traffic in key Indian cities is just 17-23km/h while the average cycling speed is 15-16kmph.

Air Pollution

In the Global Burden of Disease 2010 (GBD) study, 'outdoor air' pollution is among the top 10 risks worldwide and the top six risks in the developing countries of Asia. Air pollution has greater impact on developing countries such as India, as 1.4 million people lost their life due to air pollution; US$ 505 billion towards welfare losses; and US$ 55.4 billion towards lost labour.

How Modern India Travels?

fig. 2 Division of percentage of People commuting to work daily. ©Indiaenvironmentportal.org.in/ 2011 Census

Declining share of Public Transport

The share of public transport is decreasing in India. The federal government has recently published the results of the mode of transport people take to commute to work for the latest Census 2011 data in March 2016. According to the survey more than 50% of the workforce (excluding domestic and agriculture) continue to work at home or travel to their workplace by foot in the absence of adequate transport facilities. Citizens are largely dependent on private transport. The share of public transport is just 18.1% of work trips.

The data indicates that there is lack of public transportation facilities and citizens are largely dependent on private modes of transport, such as bicycles (26.3 million) and motorcycles (25.4 million) in rural and urban India. More people use motorcycles than travel by bus (22.9 million). In 2015 the number of daily trips using a motorcycle for commuting was 35 million (excluding personal trips); this is based on the increase in vehicle registration.

Developement of Smart Cities

The federal government of India has launched two flagship programmes – 100 Smart Cities and Atal Mission for Rejuvenation, and Urban Transformation (AMRUT) for 500 cities that have a population of 100,000 or more, with funding of $8 billion and $8.3 billion, respectively. The smart cities initiatives focus on core infrastructure service, whereas, AMRUT will adopt a project approach to ensure basic infrastructure services.

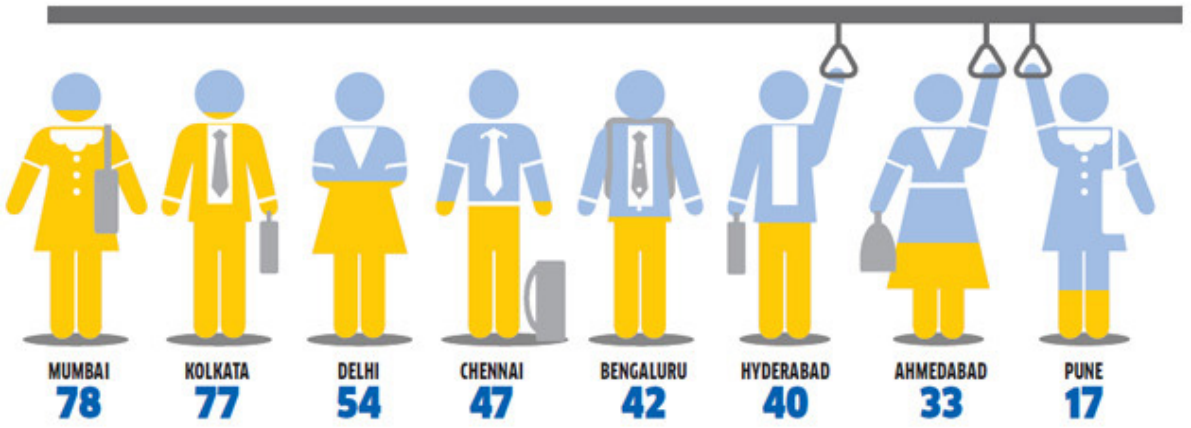


fig. 3 Percentage of people using public transport in major Indian cities ©Economic times

A ‘smart city’ is an urban region that is highly advanced in terms of overall infrastructure, sustainable real estate, communications and market viability. It is a city where information technology is the principal infrastructure and the basis for providing essential services to residents. Until now the federal government has shortlisted the establishment of ‘109 smart cities’ in India. The key idea of smart cities is the alliance of public services with an integrated public transport system. Information Technology, therefore, will play a crucial role in both integrating and automating these services. The 20 cities in the first stage will receive INR 2 billion (US$ 30 million) in 2015-2016 and INR 1 billion (US$ 15 million) every year for the following three years; a total of INR 5 billion (US$ 75 billion). State governments and respective urban local bodies will also contribute the same amount. Many foreign countries, including Japan, France, Germany, Singapore etc. have come forward to support the federal government’s plan to develop smart cities.

Smart cities cannot be built without smart public transport. Under the smart cities programme, the cities are required to build efficient urban mobility and public transportation by creating walkable localities, as well as promoting a variety of transport options. However, there is no clear guideline for developing a sustainable public transportation system. An urban transport system is subject to planning, execution and development by the states and union territories; hence, under the smart cities programme each city can prepare its ‘Smart City Vision’ document, highlighting the city’s vision and funding proposal.

Can Shared Micro-Mobility be a Solution?

Shared Micro-mobility refers to a transportation model in which individuals share vehicles or modes of transportation instead of owning their own. Shared micro-mobility, such as bike-sharing, scooter-sharing, and other forms of small-scale transportation, can indeed contribute to addressing urban transport problems like congestion, pollution, and sustainability. Here are some reasons why shared micro-mobility can be a part of the solution:

- **Reduced Congestion:** Shared micro-mobility options take up less space on the road compared to private vehicles. By encouraging people to use bikes or scooters instead of cars for short trips, shared micro-mobility can help reduce traffic congestion in urban areas.

- **Environmental Benefits:** Shared micro-mobility options are typically powered by electricity or human effort, making them more environmentally friendly compared to fossil fuel-powered vehicles. By promoting the use of these options, cities can reduce greenhouse gas emissions and improve air quality, leading to a cleaner and healthier urban environment.

- **Last-Mile Connectivity:** Shared micro-mobility services can provide convenient last-mile connectivity, bridging the gap between major transit hubs and final destinations. By integrating with existing public transportation systems, they can improve overall accessibility.

- **Flexibility and Affordability:** Shared micro-mobility offers flexible options for short trips. Users can access these services on-demand, reducing the need for personal vehicle ownership. This affordability and convenience can make sustainable transportation more accessible to a wider range of people, including those who may not have access to private vehicles.

- **Health Benefits:** Cycling and scooting are forms of physical activity that can promote personal health and well-being. Encouraging people to use shared micro-mobility options can contribute to a more active population, leading to potential health benefits and a decrease in sedentary lifestyles.

However, it's important to note that shared micro-mobility alone cannot solve all urban transport challenges. It should be seen as part of a comprehensive and integrated transportation system that includes various modes of transportation, efficient public transit, well-designed infrastructure, and supportive policies. Collaboration between all the sectors is crucial to ensure successful implementation and operation of shared micro-mobility services while addressing potential issues such as safety, parking, and equitable access.

Challenges to Shared Micro-mobility

This service faces many hinderances from Technological, Infrastructural to Vandalism, Theft and Damange. Few recent headlines (page 10) from newspapers talk about same issues.

Printed from
THE TIMES OF INDIA

Vehicle damage, thefts hurt urban mobility firms in Bengaluru

TNN | Jun 16, 2019, 11.38 AM IST

BENGALURU: Bicycle and scooter rental firms, whose entry into the city has aided last-mile connectivity through shared mobility, say they have been hit by rampant vandalism, thefts and misuse. From stealing vehicles parts like batteries, tyres, headlights and mirrors to pilfering petrol, and from parking vehicles irresponsibly on flyovers and roads to damaging them, lack of civic sense is marring urban mobility in Bengaluru, allege companies.

Companies like Bounce, Yulu, Vogo and Drivezy, who are in the business, say offenders are getting away despite promises by civic authorities and police. According to Yulu, around 300 of its bicycles were vandalised, damaged and stolen between January 2018 and May 2019, while two electric scooters were damaged between March and May 2019.

News / Cities / Pune / Bicycle-Sharing System: PMC seeks police protection for bicycles to check thefts, vandalism

Premium

Bicycle-Sharing System: PMC seeks police protection for bicycles to check thefts, vandalism

The Pune Municipal Corporation has sought police protection for the bicycles stationed at various places in its jurisdiction for use by the public and sought participation from more agencies as the number of bicycles dwindle due to theft and vandalism.

Written by Ajay Jadhav Follow
Pune | July 31, 2018 08:29 IST

NewsGuard

LIVE BLOG

JAC 12th Arts, Commerce Result 2023 Live: Jharkhand Board +2 result today at jac.nic.in, jacresults.com
46 seconds ago

Delhi News Live Updates: Delhi govt announces Rs 10 lakh compensation for kin of Shahbad Dairy murder victim
21 mins ago

GSEB HSC 12th Arts Commerce Result 2023 Live: How to check Gujarat Board general stream result
35 mins ago

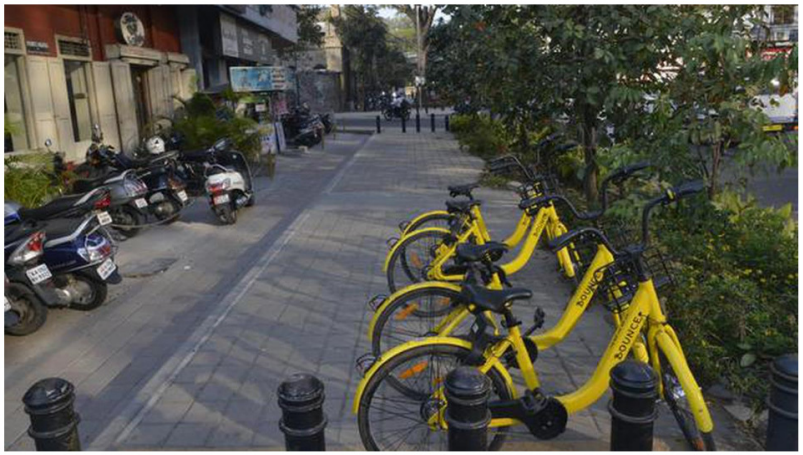
E-bikes are here, now we need user etiquette

Challenges for last-mile connectivity platforms include haphazard parking, theft and vandalism

April 19, 2019 11:07 pm | Updated 11:07 pm IST

K.C. DEEPIKA

COMMENTS SHARE READ LATER



Some cycles parked on St. Marks Road.

News / Cities / Mumbai / Minor caught for stealing 26 bicycles worth lakhs

Minor caught for stealing 26 bicycles worth lakhs

Based on CCTV footage, police tracked down the and traced him to his residence.

By: Express News Service
Mumbai | April 13, 2021 01:20 IST

NewsGuard

"During questioning, the minor confessed to have stolen 26 cycles. He used to sell these cycles to random people, saying his parents are ill and needed money for treatment. (Representational)

LIVE BLOG

CSK vs GT Live Score, IPL 2023 Final: Clouds begin to assemble over venue as rain threat looms over reserve day
22 mins ago

JAC 12th Result 2023 Live Updates: Steps to check Jharkhand Board Class 12th Arts, Commerce score at jac.jharkhand.gov.in
35 mins ago

Bengaluru News Live Updates: Siddaramaiah keeps Finance, Shivakumar gets Irrigation, Bengaluru development in Karnataka portfolio allocation
2 hours ago

Delhi News Live Updates: Man accused of stabbing a 16-year-old girl in Delhi arrested by the police
3 hours ago

fig. 4 Few headlines from Newspapers covering the severity of the problem

E-bikes on city streets targetted by thieves, who filch batteries

By Shashank Rao

May 17, 2023 12:53 AM IST

The BEST undertaking has been operating 1,000 such e-bikes across the city for the past few months. The thieves have been removing the plastic covers from the bikes and filching the batteries, which has become a headache for the authorities. This is one of the reasons why e-bikes are seen haphazardly parked or lying on the corner of a road or footpath.

Anand Malligavad @AMalligavad · May 26, 2022

This **Yulu Cycle** is thrown in Shikaripalya Lake,Near Electronic City phase 1, by removing all electronic equipments in it...IT IS NOT THE WAY OF GROWING NAMMA BENGALURU ...we need to change quickly 🙏

21 98 678

Vandalized Bounce Bikes In Bangalore Show The Challenges Of Running A Business In India

FEBRUARY 6, 2020 OFFICECHAI TEAM

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There are several challenges to running a mobility startup — there's government regulations to get around, there's safety of users to be kept in mind, and there's a need to maintain a delicate balance between demand and supply of your vehicles. But Bangalore-based mobility startups are discovering that there's yet another factor that they must consider while running their operations — the behaviour of the very people they're intending to serve.

A series of pictures showing vandalized Bounce bikes in Bangalore has gone viral. The

Micro-mobility firms allege threat from autorickshaw drivers in Bengaluru

Christin Mathew Philip / TNN / Updated: Jul 27, 2019, 09:17 IST

177 PTS SHARE AA

YOU'RE READING

Micro-mobility firms allege threat from autorickshaw drivers in Bengaluru

Be an effective CEO with IIM Lucknow's programme

Many shared mobility firms alleged that they have been hit by rampant vandalism, thefts and misuse,

Initial Design Brief

“Development of docking of shared Micro-mobility vehicles. For decreasing vandalism, theft and other issues, that can be integrated in current transporatation ecosystem."

Research

Shared Micro-Mobility in Brief

- **Definition and Concept of Shared Personal Micro-Mobility:** Shared Micro-mobility refers to the utilization of shared transportation modes, such as carpooling, ridesharing, bike-sharing, and scooter-sharing, to facilitate the final leg of a commuter's journey. It aims to address the challenges faced in accessing public transportation and provide a convenient and efficient solution for commuters. By leveraging technology and shared resources, shared Micro-mobility optimizes transportation efficiency, reduces congestion, and improves the overall commuting experience.

- **Comparison with Public Transportation:** Public transportation systems, such as buses and trains, play a significant role in urban mobility. However, they often have limitations in terms of fixed routes, limited coverage, and inflexible schedules. Shared Micro-mobility complements public transportation by providing flexible and on-demand options that bridge the gap between transportation hubs and the final destination. It enhances accessibility, particularly in areas with inadequate public transportation coverage, and offers greater convenience and flexibility for commuters.

- **Complementary Nature of Shared Micro-Mobility:** Shared Micro-mobility and public transportation are inherently complementary. Public transportation systems excel in transporting large numbers of people over longer distances,

while shared Micro-mobility focuses on providing efficient and convenient transportation for shorter distances. By integrating these two modes, commuters can experience seamless connectivity, with shared mobility options facilitating the first and last-mile of their journeys. This integration optimizes overall travel times, reduces the need for private vehicle ownership, and improves the overall efficiency of the transportation system.

- **Factors Influencing Commuters' Choice of Micro-Mobility:** Several factors influence commuters' choice of Micro-mobility options. Distance plays a significant role, as shorter distances may be more conducive to walking or cycling, while longer distances may require shared modes of transportation. Cost is another important factor, as shared Micro-mobility can provide cost-effective alternatives to private vehicle ownership or traditional taxi services. Convenience, time savings, safety, and reliability are additional considerations that influence commuters' choices. Understanding these factors helps in designing and implementing shared Micro-mobility solutions that align with commuters' preferences and needs.

- **The Audience for such services -** The working class, travelers or students commuting on a regular basis to locations where taking public transport adds more hassle to life or isn't entirely available.This service is also meant for people who don't want to hire a private taxi in tourist destinations and want to explore the place themselves.

fig. 5 Trending Electric Last mile mobilty options. Left to right - E-Bicycle, Segway Hoverboard, Electric Skateboard, E-Scooter, E-Monowheel, Handle Segway.

- **Where are these services available and most viable -** Shared personal mobility services are available in many cities and countries around the world. Bike-sharing programs have also emerged in majorly all of the Indian Metropolitan cities. The availability of these services varies depending on the regulations and infrastructure in each location, but they are becoming increasingly popular as a way for individuals to get around without owning a vehicle.

Shared Micro-mobility is a concept that complements public transportation systems by providing flexible and convenient transportation options for the final leg of a commuter's journey. By integrating shared mobility services, urban areas can optimize transportation resources, reduce congestion, and enhance the overall commuting experience. Understanding the factors influencing commuters' choices and comparing shared Micro-mobility with traditional public transportation systems provides insights into the potential benefits and opportunities for integration.

Other Benefits of Shared Micro-Mobility

- **Environmental Sustainability**: Shared Micro-mobility not only offers benefits for the environment but also contributes to improving the health and well-being of individuals. By promoting active modes of transportation such as walking and cycling, shared Micro-mobility encourages physical activity, which is essential for maintaining a healthy lifestyle. Regular physical activity reduces the risk of chronic diseases, including cardiovascular diseases, obesity, and diabetes. Moreover, active transportation options contribute to reducing air pollution and greenhouse gas emissions, leading to cleaner and healthier urban environments.

- **Improved Accessibility for All:** Shared Micro-mobility promotes accessibility for individuals with limited mobility or disabilities. Bike-sharing and scooter-sharing programs often offer specially designed bicycles and scooters that cater to the needs of people with disabilities. These inclusive options enable individuals with limited mobility to travel conveniently and independently, enhancing their sense of empowerment and well-being. Furthermore, shared mobility options that prioritize accessibility contribute to creating more inclusive and equitable transportation systems, ensuring that everyone has equal access to transportation services.

- **Economic Efficiency and Cost Savings:** Shared Micro-mobility can offer economic advantages for both individuals and cities. The cost-effectiveness of shared mobility options compared to private vehicle ownership or traditional taxi services is far better as the money leveraged to avail these services is significantly low. There is potential cost savings for individuals, such as reduced fuel and maintenance expenses, as well as the economic benefits for cities, including reduced infrastructure costs and increased revenue from shared mobility providers.

- **Flexibility and Personalized Commuting Experience:** Shared Micro-mobility provides commuters with flexibility and a personalized commuting experience. This chapter discusses how shared mobility services offer on-demand options, flexible routes, and customizable preferences to meet the diverse needs of commuters. It explores the potential for technological advancements, such as app-based platforms and dynamic routing algorithms, to further enhance the flexibility and convenience of shared Micro-mobility.

- **Reduced Sedentary Behaviour:** Private car use often contributes to sedentary behaviors, as individuals spend significant amounts of time sitting while commuting. In contrast, shared Micro-mobility encourages active modes of transportation, such as walking or cycling, which reduce sedentary behavior. By incorporating physical activity into daily routines, shared mobility options help individuals meet recommended activity levels and counteract the negative health effects associated with prolonged sitting. The promotion of active transportation contributes to healthier lifestyles and reduces the risk of sedentary-related health conditions.

Target Audience

The intended recipients of these services are individuals belonging to the working class, as well as frequent commuters such as travelers or students, who face additional inconveniences in their daily lives or encounter limited access to public transportation when traveling to certain destinations. Additionally, this service caters to those individuals who prefer independent exploration of tourist destinations rather than hiring private taxis.

Target Area

Shared personal mobility services are available in many cities and countries around the world. Bike-sharing programs have also emerged in majorly all of the Indian Metropolitan cities. The availability of these services varies depending on the regulations and infrastructure in each location, but they are becoming increasingly popular as a way for individuals to get around without owning a vehicle.

Challenges and Potential Solutions in service

- **Regulatory and Policy Challenges:** In the Indian context, the integration of shared Micro-mobility faces regulatory and policy challenges. The existing regulatory framework is not adequately addressing the unique characteristics and requirements of shared mobility services. Uncertainty regarding licensing, insurance, and liability issues are hindering the growth and sustainability of these services. To overcome these challenges, policymakers need to develop clear and supportive regulations that promote fair competition, ensure passenger safety, and address concerns related to insurance coverage and

liability. Collaborative efforts between government bodies, transportation authorities, and shared mobility providers are essential to create an enabling regulatory environment for shared Micro-mobility.

- **Infrastructure Requirements:** India's urban areas often face infrastructure limitations, including inadequate parking facilities, lack of designated spaces for shared vehicles, and limited charging infrastructure for electric options. These challenges will impede the seamless operation and expansion of shared Micro-mobility services. To address this, cities need to invest in developing appropriate infrastructure. This includes establishing dedicated parking spaces for shared vehicles, creating charging stations for electric modes, and designing bike-sharing stations at strategic locations. Public-private partnerships will play a crucial role in addressing infrastructure needs and ensuring the successful integration of shared Micro-mobility into the existing urban infrastructure.

- **Safety and Security Considerations:** Ensuring the safety and security of both passengers and providers is crucial for the widespread adoption of shared Micro-mobility in India. Background checks for drivers, user identification systems, and emergency response mechanisms are essential components to establish trust and confidence in shared mobility services. Collaborations between shared mobility providers and law enforcement agencies can help implement safety measures, including driver training programs, vehicle inspections, and

real-time monitoring systems. Technological innovations, such as GPS tracking and panic buttons, can further enhance passenger safety. Public awareness campaigns can also educate users about safety precautions and promote responsible usage of shared mobility services.

- **Technology Integration and Innovation:** The Indian market offers significant opportunities for technological integration and innovation in shared Micro-mobility. Leveraging emerging technologies such as smartphone applications, artificial intelligence, and data analytics can optimize route planning, demand prediction, and fleet management. Developing user-friendly and intuitive apps that provide real-time information on vehicle availability, routes, and fares can enhance the user experience and encourage greater adoption of shared mobility options. Partnerships between shared mobility providers and technology companies can drive innovation, improve operational efficiency, and offer customized solutions for the Indian context.

- **Strategies for Overcoming Challenges:** To overcome the challenges associated with shared Micro-mobility in India, a multi-pronged approach is required. Stakeholder collaboration involving government bodies, transportation authorities, shared mobility providers, technology companies, and the public is essential. Pilot programs can be implemented to test and refine shared mobility solutions, considering the unique characteristics of Indian cities. Continuous monitoring, evaluation, and adaptive planning are crucial to address emerging challenges and make necessary adjustments. Public awareness campaigns can educate the public about the benefits and responsible usage of shared Micro-mobility, fostering greater acceptance and support.

Key Players in the Domain

Since 2014, a lot of Companies have sprung up in this domain and few have been able to capture the market better than others.

Yulu : Yulu operates in Bengaluru, Delhi, Gurugram, Mumbai, Pune, and Bhubaneswar with 18,000 single-seater vehicles across 2.5 million users.

Yulu has raised $19.9 in million funding as of Feb 2021.In January 2019, Yulu launched a new fleet of 2,000 e-vehicles called the Miracle, followed by introducing its IoT charging box which enables a cost-effective battery-swapping network. In November 2019, Yulu upgraded the Miracle by adding a bag holder, shock absorbers, and an improved footrest. In April 2020, Yulu launched 8,000 more Miracle e-vehicles with further improvements. In April 2020, due to the Coronavirus outbreak, Yulu introduced a 'Last-sanitized' timestamp to their app in order to assure utmost safety. In June 2020, Yulu introduced a 24/7 chat support to their app to improve customer support.

As of November 2020, Yulu has covered 27 million kilometres, helped burn 4 million calories and saved 2.3 million kilograms of carbon emissions. Yulu miracle had 5x times the number of rides in comparission to other options.

Yulu's main competitors are Bounce and Vogo. The difference is that their vehicles are proper, fuel-powered scooters that can be used for short distances or rented for the long term.

fig. 6 Current lineup of Yulu in Shared Micro-Mobility consisting of both EV & Non-EV options

Bounce: Bounce operates in Bangalore, Vijayawada and Hyderabad. Incubated in Bangalore bounce started as an Electric vehicle manufacturer which later also expanded into the shared mobility domain.

Backed by global investors, such as Falcon Edge, Sequoia Capital, Accel, B-CAP, and Qualcomm, Bengaluru-headquartered Bounce rolled out its first consumer electric scooter Infinity E along with its battery-swapping network Bounce Infinity in December 2021.

Bounce's swapping stations work on the lines of a fuel station with charged and ready-to-go batteries that delivery personnel can easily swap with their near-empty batteries in a few minutes.

fig. 7 Bounce Battery swapping Hub

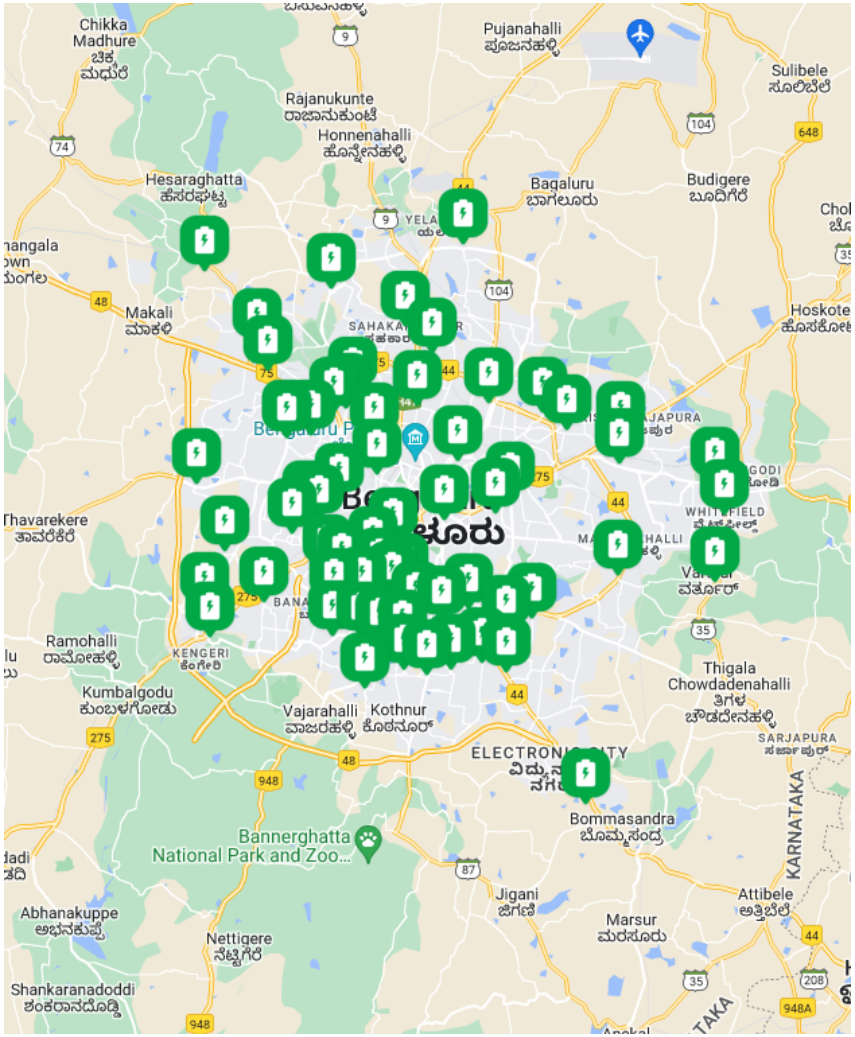


fig. 8 Bounce Battery swapping Stations in Bangalore

fig. 9 MYBYK Parking Hub in Nagpur

MYBYK: In May 2014, MYBYK was established in Ahmedabad, Gujarat, under the leadership of Arjit Soni, with support from both the private sector and the Amdavad Municipal Corporation. Initially, the project commenced with 200 bicycles and 4 stations, operating in conjunction with the Ahmedabad Bus Rapid Transit System (BRTS). The strategically located bicycle stations were situated at BRTS stations, enabling commuters to conveniently utilize bicycles for their to and fro movement between the BRTS station and their residences or workplaces.

Subsequently, MYBYK expanded its services to Jamnagar, Mumbai, and Udaipur, effectively operating with a fleet of 5,500 cycles. In 2022, MYBYK collaborated with Nagpur Metro to provide last-mile connectivity, establishing hubs at metro stations in Nagpur.

Furthermore, in 2022, MYBYK extended its services to Indore, the largest city in central India, in partnership with Atal Indore City Transport Service Limited. Initially deploying 1,000 cycles, they have an approved plan to further increase the fleet by 3,000 bicycles.

The bicycle can be hired through mobile app, which is available for all the operating systems.

Reliance Industries Limited, ISRO, Baxter, TATA, ONGC, Suzuki Motors Gujarat, SRF Chemicals Ltd., Baxter, Wonder cement and Adani Shantigram Township are B2B clients of MYBYK.

VOGO: Short for "Vehicle on the Go" VOGO was Launched in 2016. VOGO Automotive Pvt. Ltd. is a tech-enabled personal mobility solution provider that offers convenient, affordable and reliable two-wheelers to daily commuters.

Headquartered in Bangalore, the firm is Leveraging cutting-edge IoT technology to offer 'keyless' rides that require minimum human interaction.

With a mission to equip every commuter with the "freedom to GO", VOGO has introduced several industry-first initiatives including a 1-click booking experience for riders and a 4-step sanitisation process to ensure customer safety.

At present, they are operational in Bangalore, Hyderabad, Mysore, Udupi and Mangalore with a 20,000-strong fleet spread across 500+ dock stations. They Boast that their 3.5M customers have completed 12M rides so far.

fig. 10 VOGO E-Scooters parked in Hiranandani, Powai, Mumbai

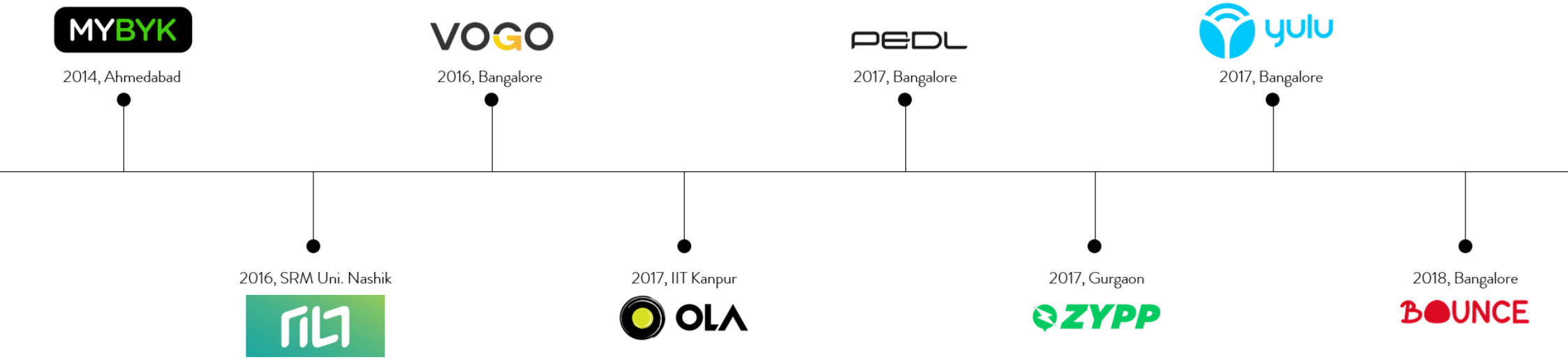


fig. 11 Incubation timeline of Key Players in Shared Micro-mobility in India


Miracle

Field Visit

During my field visit, I had the opportunity to interact with a group of students from Delhi University who specifically came to try out Yulu bikes. Their firsthand experiences provided valuable insights as they had just finished using the Yulu bikes.

One student mentioned, “My hand pains a lot, and I feel strained after using it for 20 minutes.” This indicates a potential issue with the ergonomics or comfort of the bike’s handlebars.

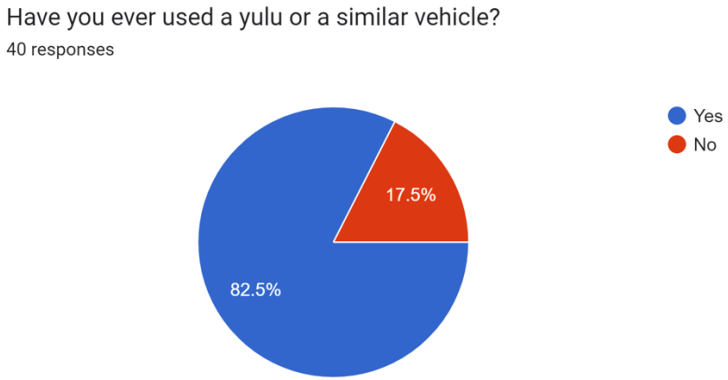
They also expressed that due to limited availability, they had to share two bikes among three people. Additionally, there were concerns raised about the braking system in many of the bikes, indicating a potential safety concern. However, they found the speed of the bikes to be acceptable.

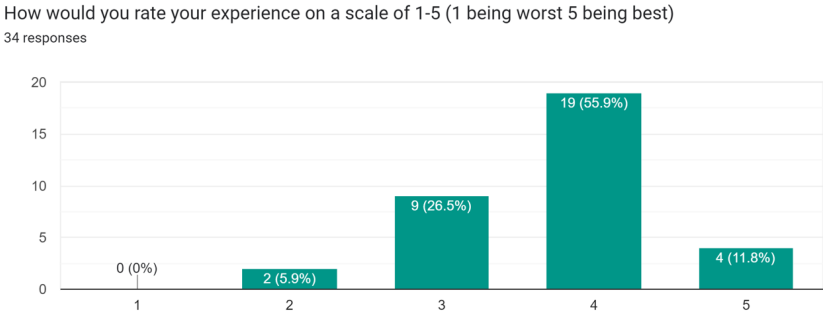
Maintenance was highlighted as another issue, suggesting a need for improved upkeep and regular servicing of the bikes. Furthermore, there were mentions of connectivity issues with the IoT (Internet of Things) features, indicating a need for more reliable and consistent connectivity.

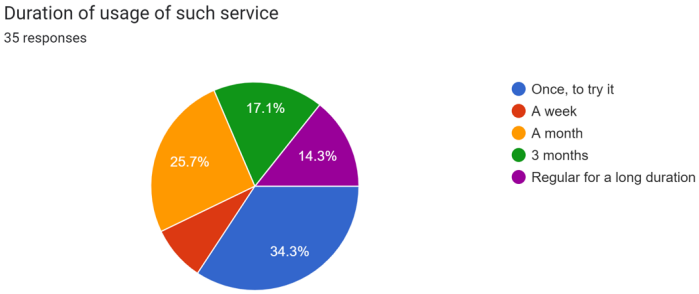
Interestingly, they noted that some users leave the bikes without proper consideration for others. Despite the mentioned issues, they still regarded Yulu bikes as a good option for exploring the city with friends.

Interviews & Questionnaire

By conducting interviews across different locations, valuable insights were gathered regarding the prevalent issues and challenges associated with the service. This exercise proved instrumental in comprehending the underlying nature of these problems, thereby facilitating the formulation of a comprehensive design brief. The aim was to address a wider range of industrial concerns pertaining to the service, resulting in an improved and more refined design approach.







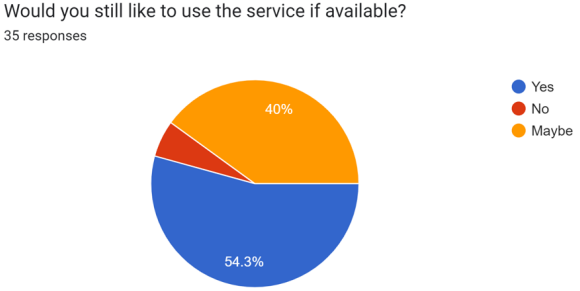


fig. 12 Graphs Denoting peoples responses to various questions around usage of Shared Micro-mobility.

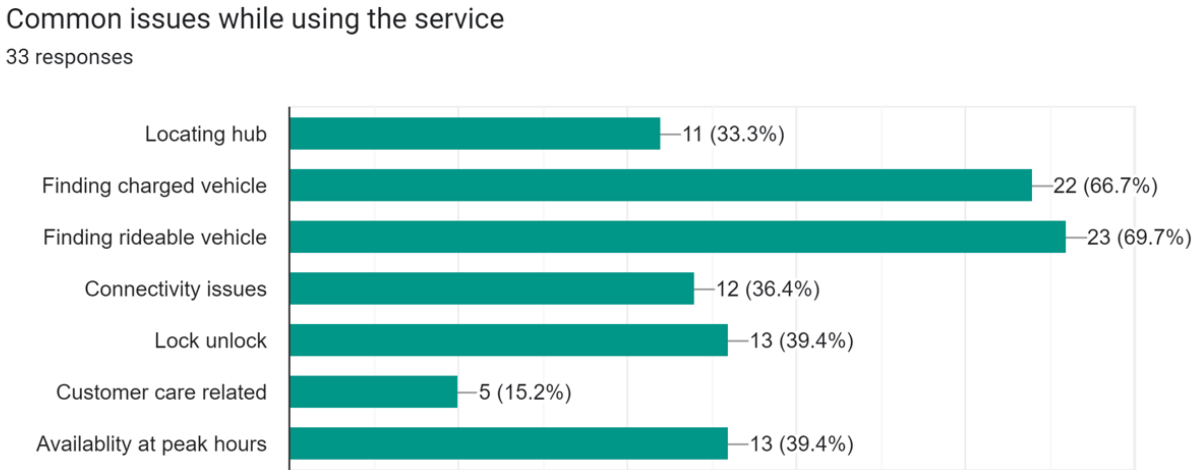


fig. 13 Bargraph Denoting frequency of issues faced by Users

The primary challenge reported by users revolved around the scarcity of available vehicles. The combination of high demand and limited supply led to frustration and inconvenience, particularly during peak hours or in densely populated areas. Users often faced prolonged search times, had to cover long distances, or resorted to alternative modes of transportation, defeating the purpose of utilizing micro-mobility services.

Another significant issue was the reliability of the vehicles' battery life. Electric scooters and bikes rely on regular charging to remain operational. However, due to improper charging practices or insufficient maintenance, users frequently encountered partially or fully depleted batteries. This not only disrupted their experience but also hindered the overall efficiency of the service provider.

To address these challenges, micro-mobility service providers can concentrate on effective fleet management strategies. This entails closely monitoring demand patterns, strategically deploying vehicles in high-demand areas, and implementing efficient charging infrastructure. Regular maintenance and inspection routines are also crucial in identifying and resolving technical issues promptly.

Furthermore, leveraging technological advancements such as smart docking stations and vehicle tracking systems can play a pivotal role in optimizing vehicle availability. Real-time data and analytics enable service providers to streamline operations, enhance the user experience, and ensure a higher proportion of charged and functioning vehicles.

fig. 14 Capturing the glimpses of Shared Micro-mobility in its ecosystem to understand the underlying pain-points.




YULU
ZONE



User Persona

"The service was apt for me to travel daily from PG to the office and vice-versa"

Prateek Pagore, 27
Student IIT Bombay

Used to use Yulu during the lockdown in 2020-21 for travel in **Bangalore**. 1/4 the price of an auto. Even used it to shift his room in 4 rides.

Service	★ ★ ★ ★ ★
Ergonomics	★ ★ ★ ★ ★
Handling	★ ★ ★ ★
Space	★ ★ ★ ★
Availability	★ ★ ★
Horn	★
Range	★ ★ ★ ★

Pros
Cheap and affordable micro-mobility option. Tells the exact range before travel. A good amount of space in front to keep stuff.

Cons
Cannot end the ride in case of issues, need to drag it to the nearest hub. Availability is less during morning/evening. Suspension can be better. Horn not ok please!!

Chitranshu Katiyar, 27

Sales Consultant

Used to use in Bangalore during 2021-22. It was hard to find auto sometimes or they were expensive so used Yulu to come to home from Bus Depot.

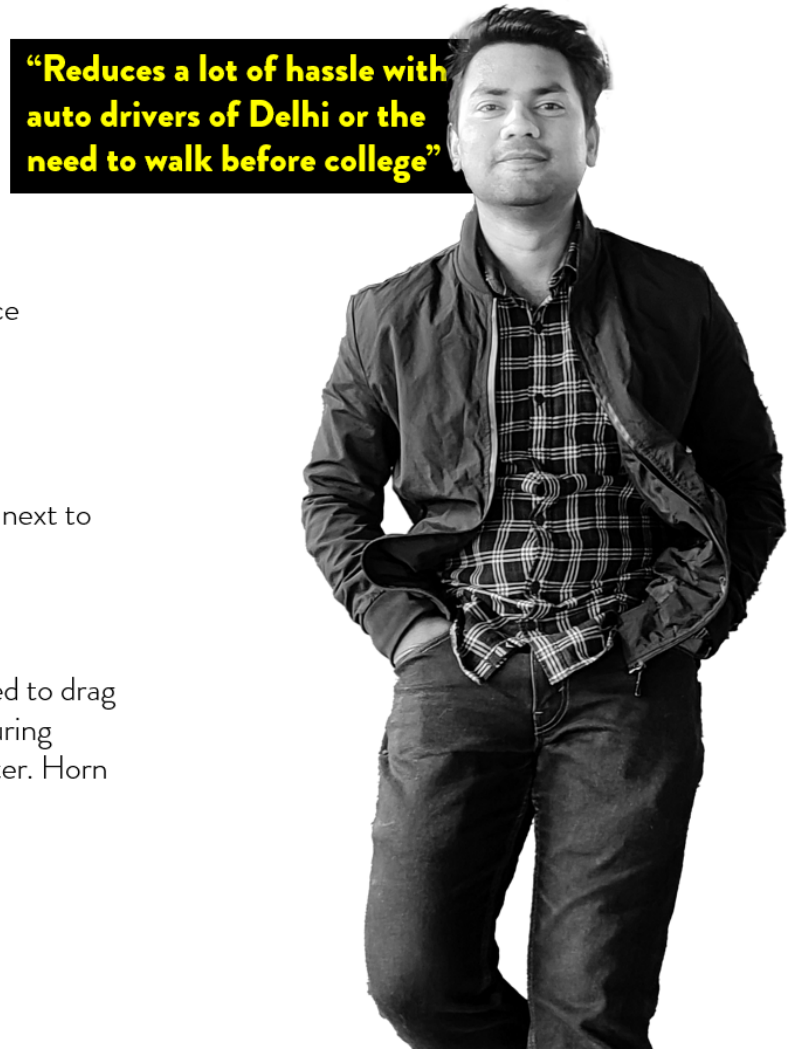
Service	★ ★ ★ ★
Ergonomics	★ ★ ★
Handling	★ ★ ★
Space	★ ★ ★
Availability	★ ★
Horn	★
Range	★ ★ ★

Pros

A great option for shorter distances. Good for aimless travel in local areas.

Cons

Availability is a big issue. Jerks travel from the vehicle to the whole body. Hard to use on slopes in less than half battery



Ankit Kumar, 28

Military Ordinance Manager Civil

Using Yulu in Delhi for 2-3 years. A great option to go freely in my own personal vehicle. Since Covid trying to avoid congested public transport.

Service	★ ★ ★ ★ ★
Ergonomics	★ ★ ★ ★ ★
Handling	★ ★ ★ ★
Space	★ ★ ★ ★
Availability	★ ★ ★ ★
Horn	★ ★
Range	★ ★ ★ ★

Pros

Pocket friendly and readily available right next to the metro station. Easy to operate.

Cons

Cannot end the ride in case of issues, need to drag it to the nearest hub. Availability is less during morning/evening. Suspension can be better. Horn not ok please!!

Similar Initiaves

Although cycling awareness has witnessed a surge in the post-pandemic era, the Public Bike Sharing (PBS) system, prominently promoted by the Directorate of Urban Land Transport (DULT), seems to have encountered significant setbacks attributable to factors such as inadequate execution and the suspension of operations by mobility firms.

DULT had initially envisioned an expansion of the PBS system, primarily targeting the provision of bicycles near Metro stations and residential zones to facilitate last-mile connectivity throughout the city. The plan entailed the establishment of docking/parking stations, while equipping the bicycles with GPS technology. These GPS-enabled bicycles were intended to be made accessible to the public via a mobile application for convenient booking.

In 2017, the state cabinet approved a total budget of 80 crore rupees for the implementation of this initiative, which was intended to be spent over a span of two years. However, the utilization of this allocated fund fell below expectations. Out of the proposed 402 docking stations to be developed, only 100 were actually established. Disappointingly, these stations lacked the necessary physical infrastructure, with only boundary lines demarcating the parking zones. Furthermore, the promised procurement of 6000 bicycles was not fulfilled, as only 1000 bikes were actually obtained for the initiative.

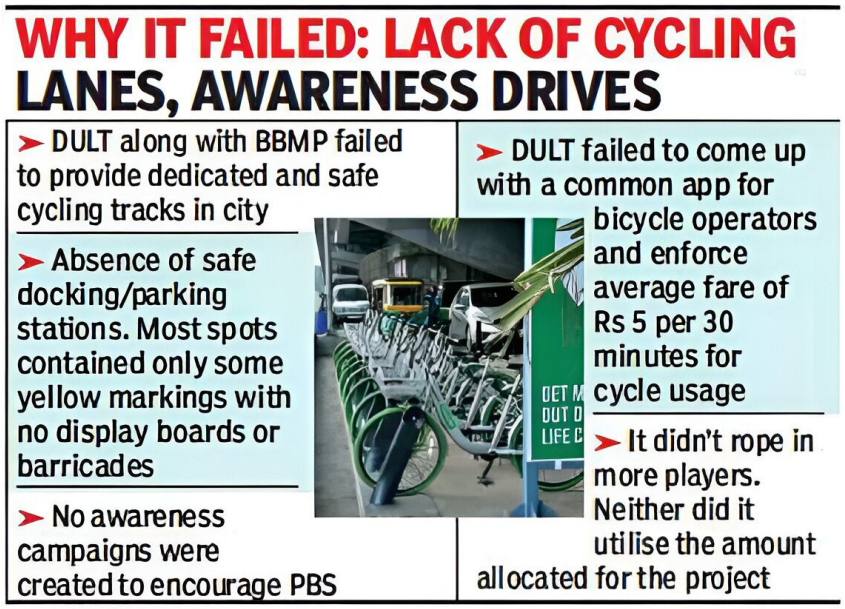


fig. 15 Newspaper clipping on Failure of PBS in Banglore
© The Times of India, India Times

Key Findings

- No stations exist (Only publicly placed in an open area)
- No definite Docking systems
- No security over vandalism
- No defined areas with public needs in consideration
- Swapping stations are fewer
- Availability of charged vehicles at stations
- No provision for charging if vehicles discharge midway
- Scope to incorporate renewable energy into charging station
- Charging vehicles while they stand idle in the station
- Weatherproofing of vehicles
- Standardization of components
- Cost Effective production of vehicles

Through the research conducted, several key issues were identified and emphasized as crucial areas requiring attention to enhance the user experience of this service. These issues encompassed both infrastructural and service-related shortcomings, calling for thorough examination and resolution.

Based on the available timeframe, a scope of work was determined, and the primary issues were categorized to improve the accessibility and convenience of the service for users. These issues predominantly revolved around the implementation of measures to mitigate vandalism and theft, as well as reducing the charging time of vehicles by introducing charging capabilities during periods of idleness in their docking stations, which was previously absent.

Points to be addressed

Primary Issues

- **No stations exist (**Only publicly placed in an open area**)**
- **No definite Docking systems**
- **No security over vandalism**
- **Scope to incorporate renewable energy into charging station**
- **Charging vehicles while they stand idle in the station**

Secondary Issues

- No defined areas with public needs in consideration
- Swapping stations are fewer
- Availability of charged vehicles at stations
- No provision for charging if vehicles discharge midway
- Weatherproofing of vehicles
- Standardization of components
- Cost Effective production of vehicles

Final Design Brief

“Development of docking of shared Micro-mobility vehicles. To provide a safe, convenient, and accessible solution that seamlessly integrates with existing transportation systems, while promoting sustainable transportation practices and reducing carbon emissions."

Storyboarding

Shammi is a young professional who works in the heart of the city. He lives in a suburban area and has to take a bus to reach the office. Today, he woke up early and took the bus to work, enjoying the view outside the window. As he got closer to the office, he realized that he was running late. So, he decided to take a shared electric scooter to cover the remaining distance and ensure he arrived on time for his morning meeting.

With a sense of urgency, Shammi quickly scanned the code displayed on the electric scooter, effortlessly unlocking it. He hopped on and swiftly zipped through the streets, maneuvering through traffic with ease. The wind blew against his face, refreshing him and adding a touch of excitement to his journey. The shared electric scooter provided him with a convenient and efficient solution to reach his destination promptly.

As Shammi arrived at his office, he couldn't help but feel grateful for the advancements in modern transportation. The availability of shared micro-mobility options had made a significant difference in his daily routine. It provided him with a flexible and reliable last-mile solution, bridging the gap between his suburban home and the bustling city center where he worked.

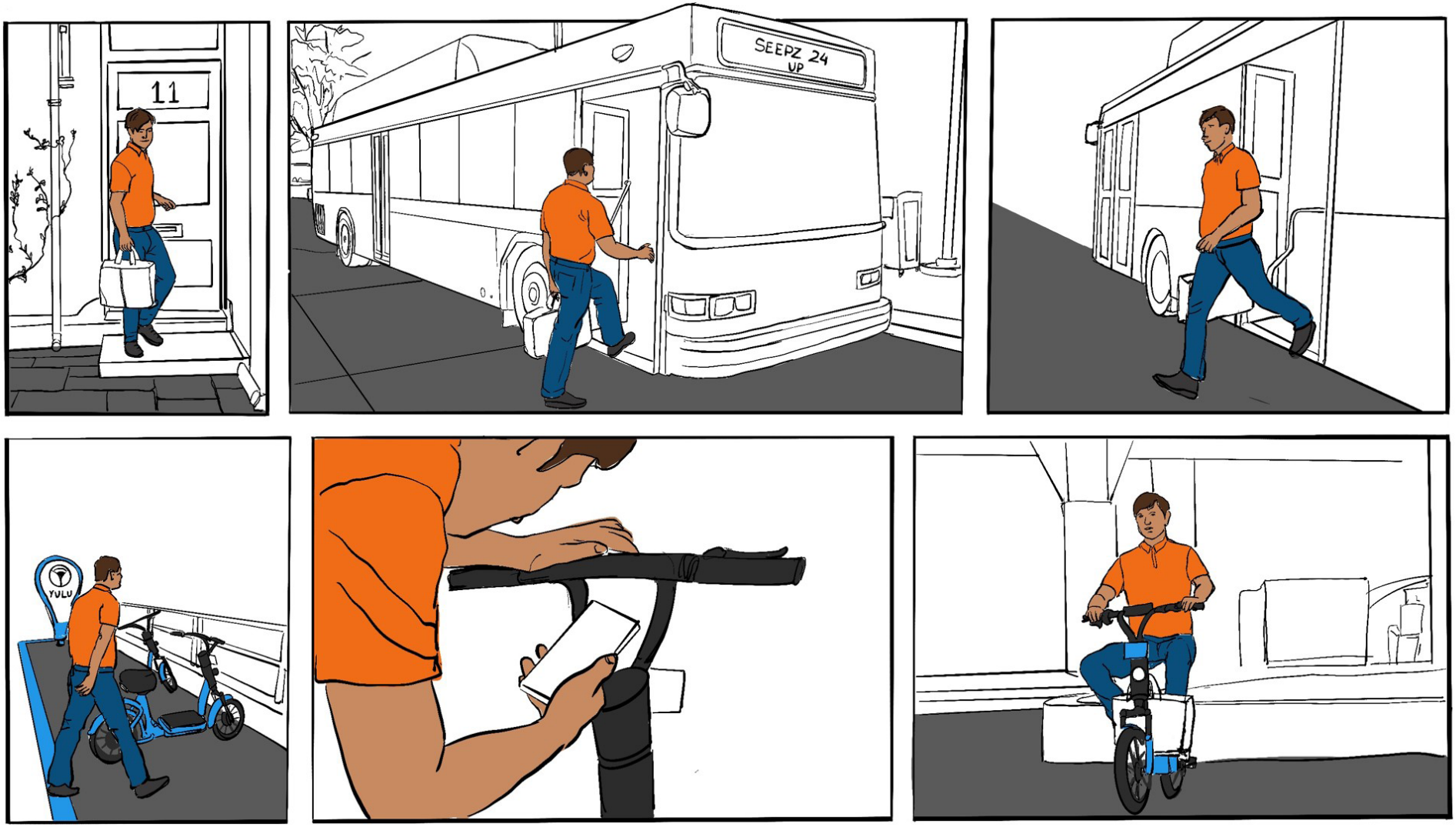
Throughout the day, Shammi had a productive and fulfilling time at work. He accomplished tasks, collaborated with colleagues, and made progress towards his goals. As the evening approached, he wrapped up his work and prepared to head back home. Though tired, he couldn't help but feel a sense of satisfaction for his achievements.

Once again, Shammi opted for the shared electric scooter to reach the bus stop. As he rode through the familiar streets, he reflected on how seemingly small things, like the availability of charged and working micro-mobility vehicles, had made a significant impact on his daily life. These convenient transportation options not only saved him time and effort but also contributed to a more sustainable and eco-friendly way of commuting.

Arriving at the bus stop, Shammi parked the electric scooter and continued his journey home by bus. As he settled into his seat, he contemplated the role of shared micro-mobility in transforming urban transportation. The seamless integration of different modes of transport had made his commute smoother, more efficient, and ultimately enhanced his overall quality of life.

With a renewed sense of appreciation, Shammi looked forward to future advancements in micro-mobility and the potential they held for further improving the daily lives of people like him. The convenience, reliability, and environmental benefits offered by shared electric scooters were a testament to the positive impact such innovations could have on urban dwellers worldwide.

Docking, Locking & Charge Of Shared Micro-Mobility



Yulu Ecosystem

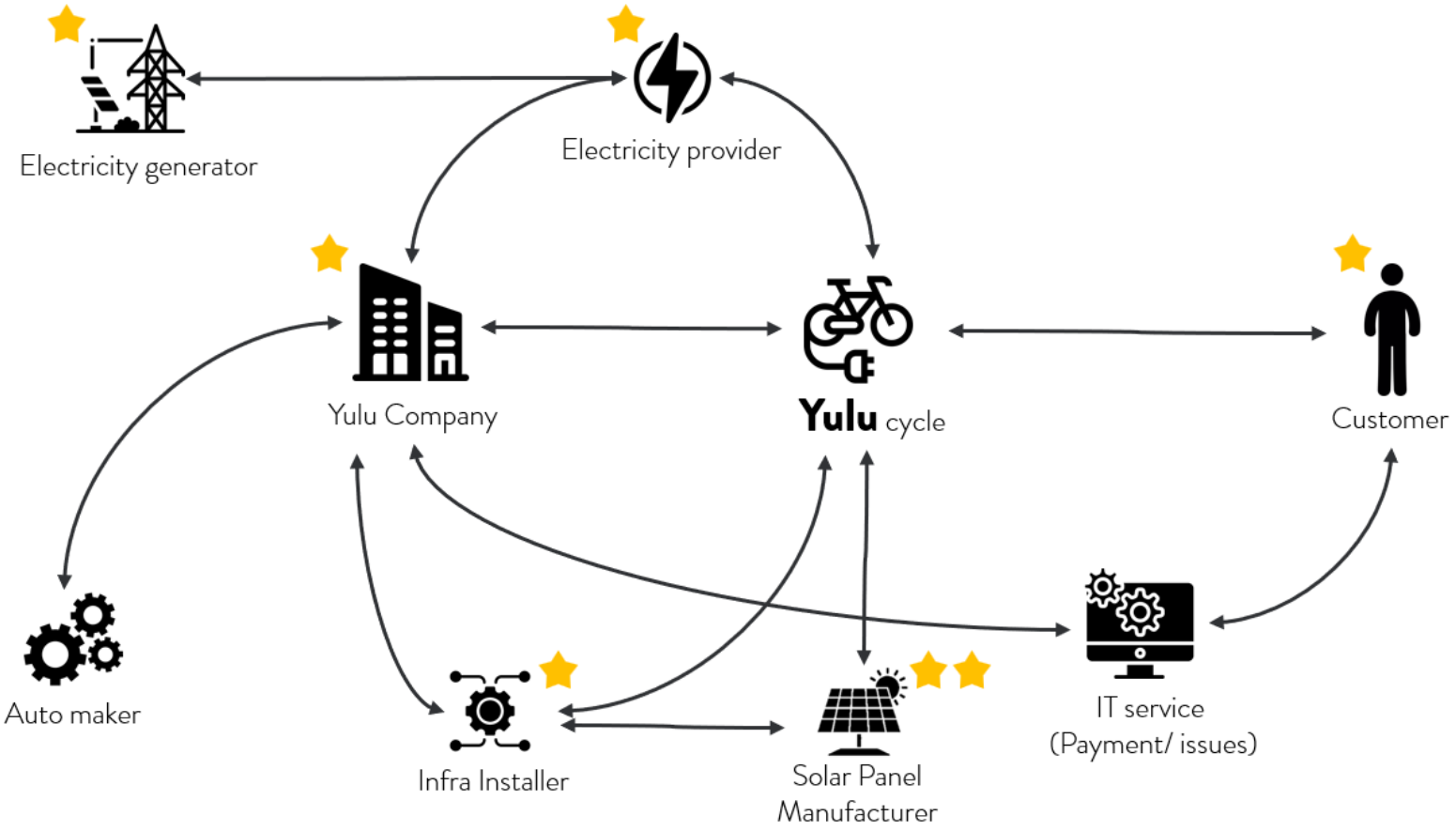


fig. 16 Service Ecosystem of Shared Micro-mobility(Yulu)

The current ecosystem comprises various stakeholders who play pivotal roles in ensuring the smooth functioning of the service.

At the center of this ecosystem, the product itself holds a prominent position as the entire service revolves around it. The primary interactions occur between two key stakeholders on a daily basis: the company providing the service and the end user. The introduction of a docking station into the service would enhance its value by introducing an additional touchpoint.

In Figure 12, stakeholders marked with a single golden star represent an increase in value or revenue resulting from the proposed solution. Additionally, the solar panel manufacturer receives two stars, indicating their enhanced involvement in the process compared to their previous absence.

In addition to these stakeholders, there are notable gains for IT services and product manufacturers within the ecosystem. IT services stand to benefit from increased demand for technological infrastructure to support the service, while product manufacturers could experience an upsurge in demand for components or materials required for the product's production and maintenance. These gains contribute to the overall growth and sustainability of the ecosystem.

Stakeholder Mapping

Mapping the stakeholders gives direct insights into relations with different stakeholders involved in running a service.

- **Primary stakeholders:** These are individuals, groups, or organizations that are directly affected by the actions, decisions, or outcomes of a project, business, or organization. They have a high level of interest and influence in the project or business and are crucial to its success.

- **Secondary stakeholders:** These are individuals, groups, or organizations that are indirectly affected by the actions, decisions, or outcomes of a project, business, or organization. They have a lower level of interest and influence than primary stakeholders but are still important to consider in decision-making processes.

- **Tertiary stakeholders:** These are individuals, groups, or organizations that are not directly or indirectly affected by the actions, decisions, or outcomes of a project, business, or organization. However, they can still be interested in the project or business and affect it in some way.

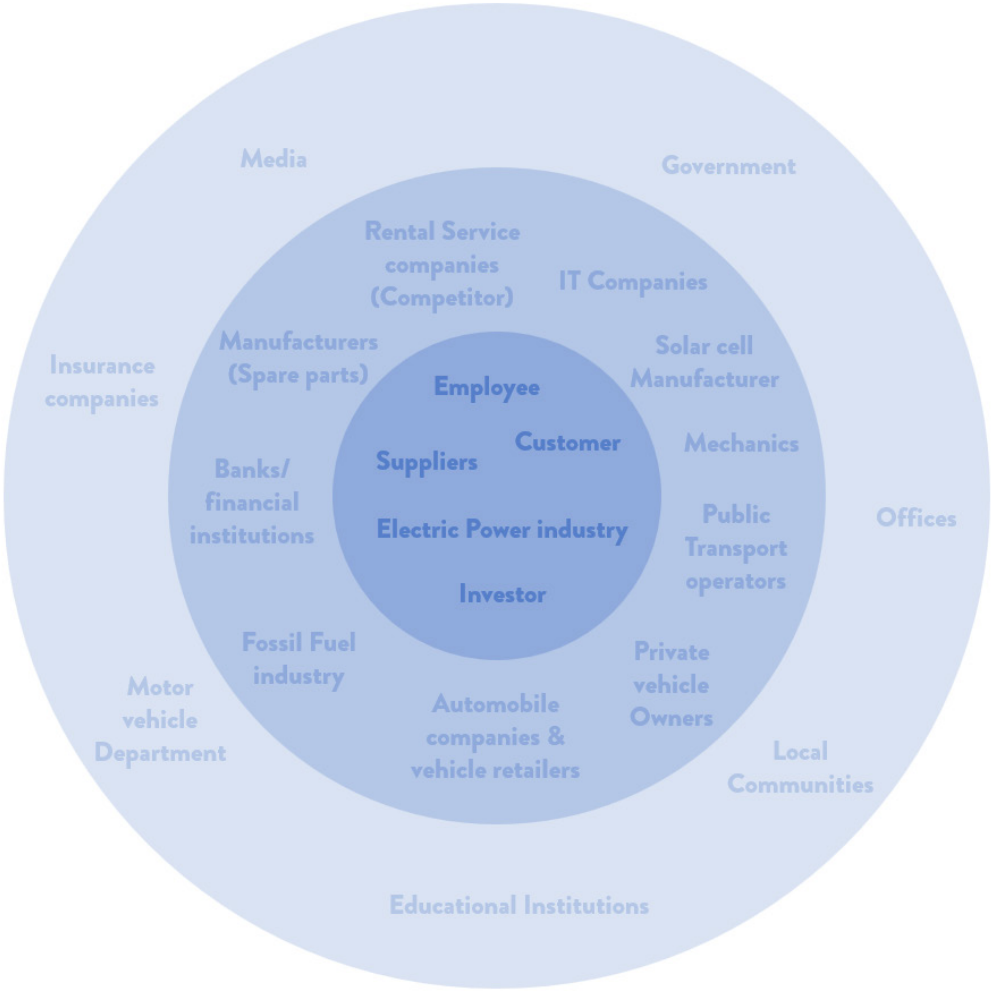


fig. 17 Stakeholder map of Shared Micro-Mobility firms

Business Opportunity

The Diagrams presented on the right side indicate the existing modes of transportation employed for commuting between Location A and Location B. While public transit is accessible, its limited route coverage restricts its suitability for all commuters. Currently, the last-mile transportation options include taxis, auto-rickshaws, and other shared modes of transport.

The introduction of shared Micro-mobility services does not completely resolve the transportation issue; however, it does alleviate some of the pressure on existing services during peak hours, while offering the additional advantage of promoting sustainability.

Moreover, the implementation of Micro-mobility electric vehicle (EV) options simplifies shared personal transportation, providing individuals with a cost-effective means of travel that can be customized to their specific requirements.

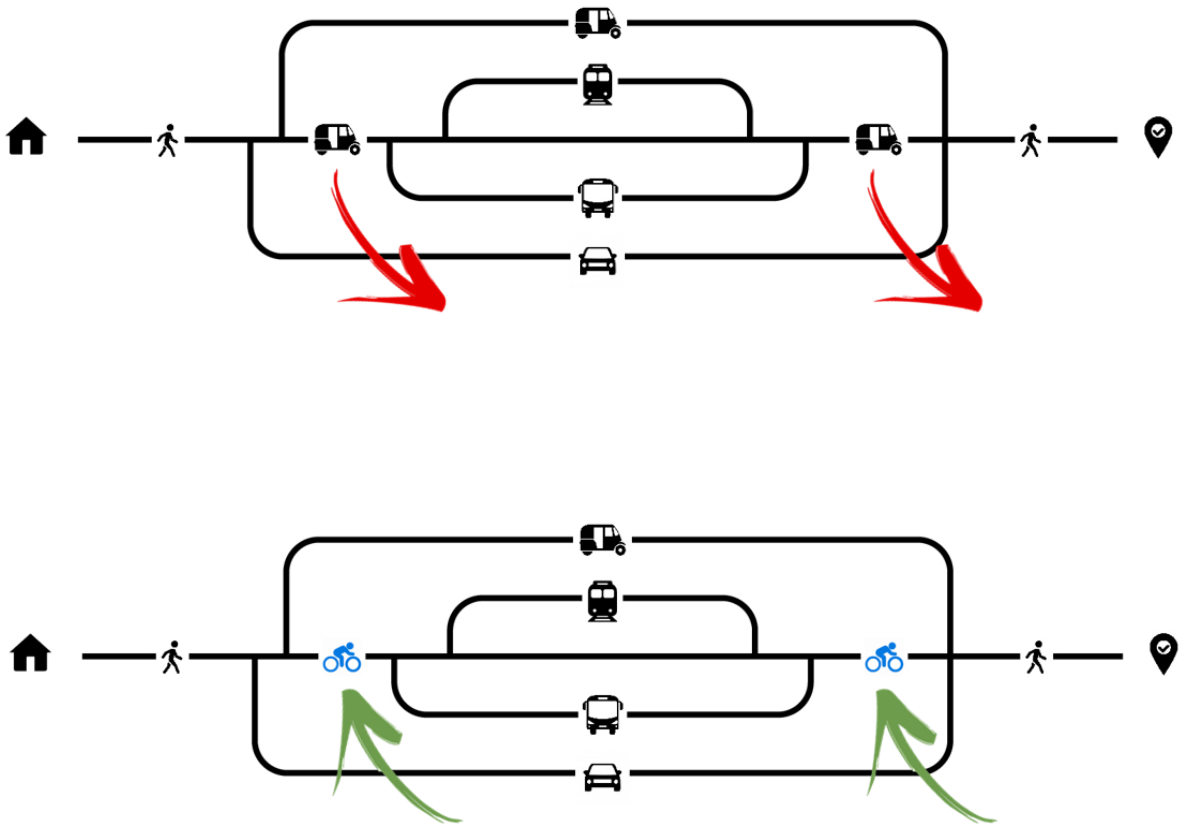


fig. 18 Illustration on journey map of Users and where we propose the use of Shared Micro-Mobility Service

Value Proposition Canvas

The Value Proposition Canvas is a strategic tool used to understand and design a product or service offering. It helps businesses identify and articulate the value they provide to customers.

- **Customer Profile:** On the right side of the canvas, define your target customer segment(s) by identifying their jobs, pains, and gains. Jobs represent the tasks they want to accomplish, pains are their frustrations and challenges, and gains are the outcomes and benefits they desire.

- **Value Map:** On the left side of the canvas, outline your value proposition by focusing on how your product or service alleviates customer pains and creates customer gains. Identify the products, services, or features that address specific customer jobs, alleviate their pains, and provide desired gains.

- **Fit Analysis:** Analyze the fit between the customer profile and the value map. Identify areas where your offering effectively addresses customer needs and pain points. Look for opportunities to enhance or adjust your value proposition to better match customer expectations

Inference

The right side of the canvas is filled with customer profile from which we have identified the jobs to be done.

Docking, Locking & Charge Of Shared Micro-Mobility

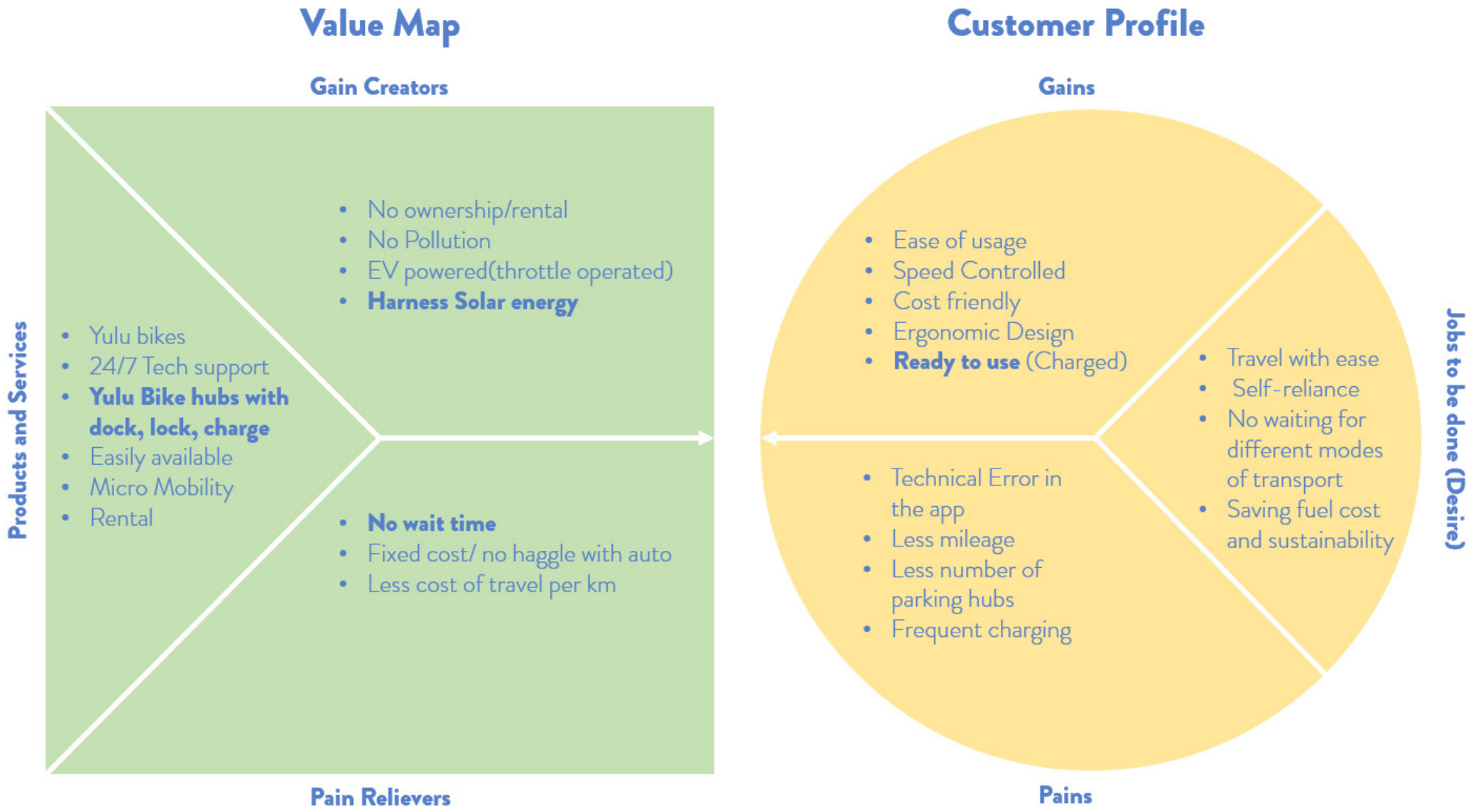


fig. 19 Value Proposition Canvas after with Proposed changes

Design Directions

Design directions are guiding principles or strategic frameworks that define the desired approach and goals for a design project. They serve as a roadmap and provide a clear direction for designers to follow throughout the design process. Design directions encompass various aspects, including visual aesthetics, user experience, functionality, and brand identity. They help align the design team, stakeholders, and clients by establishing a shared understanding of the project's objectives and desired outcomes.

Within this project, design directions were developed by considering the available space and the integration of the proposed service within the existing transportation model. Six key domains were identified, each associated with relevant use cases, namely:

- **Parking hubs:** Designing designated areas for parking the vehicles used in the service.
- **Sidewalk streetlight:** Incorporating the service infrastructure with existing streetlight installations along sidewalks.
- **Retrofitting current bus stops**: Adapting and enhancing current bus stops to accommodate the service and provide seamless intermodal connectivity.
- **Modular multi-vehicle system:** Designing a modular system that can accommodate various types of vehicles for efficient and flexible operations.
- **Installational design:** Developing a comprehensive design approach and creating a visually appealing Installational artwork that also serves as a docking, locking and charging station.
- **Near Public Park:** Exploring the integration of the service near public parks to facilitate convenient access and mobility options for park visitors.

These identified domains served as focal points for designing and implementing the proposed service, ensuring its successful integration within the existing transportation framework.

Design Consideration

In order to effectively incorporate the service within the proposed design directions, it was necessary to conduct further research to understand the available locations.
This research encompassed a comprehensive examination of the various locations, considering not only their design aspects but also their feasibility, potential for enhancing the service, and other relevant factors. By conducting this in-depth study, valuable insights were gained to inform the decision-making process and ensure the successful integration of the service in terms of both design and operational viability.

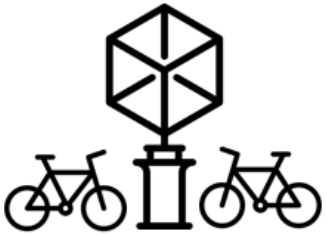
Parking Hubs

Sidewalk Streetlight

Near Public Parks

Retrofitting the Current Bus stop

Modular Multi-vehicle



Installation Design

fig. 20 Possible Design Directions based on Areas of Implementation

Design Directions If Implemented

fig. 21-26 Left to right, Parking Area in Galleria, Powai;
Parking Area outside Powai Plaza;
Streetlight on Curb of a road;
Famous Studio Bus stop Worli, Mumbai;
Installational Cycle stand, Washington ©David Alpert;
BMC Park, Powai.

Design Guidelines for Streets

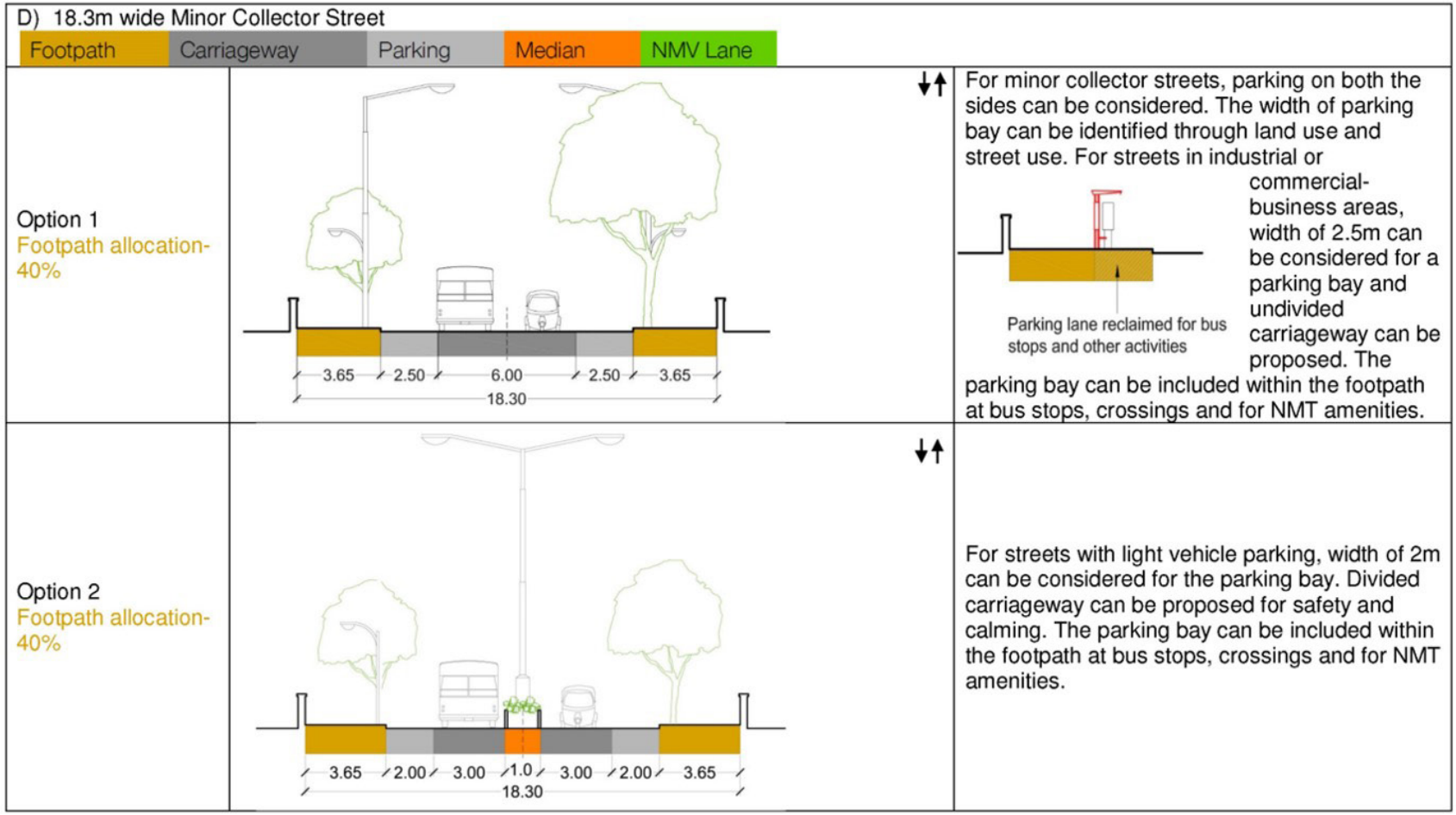


fig. 27 Newspaper clipping on Failure of PBS in Banglore
© NACTO

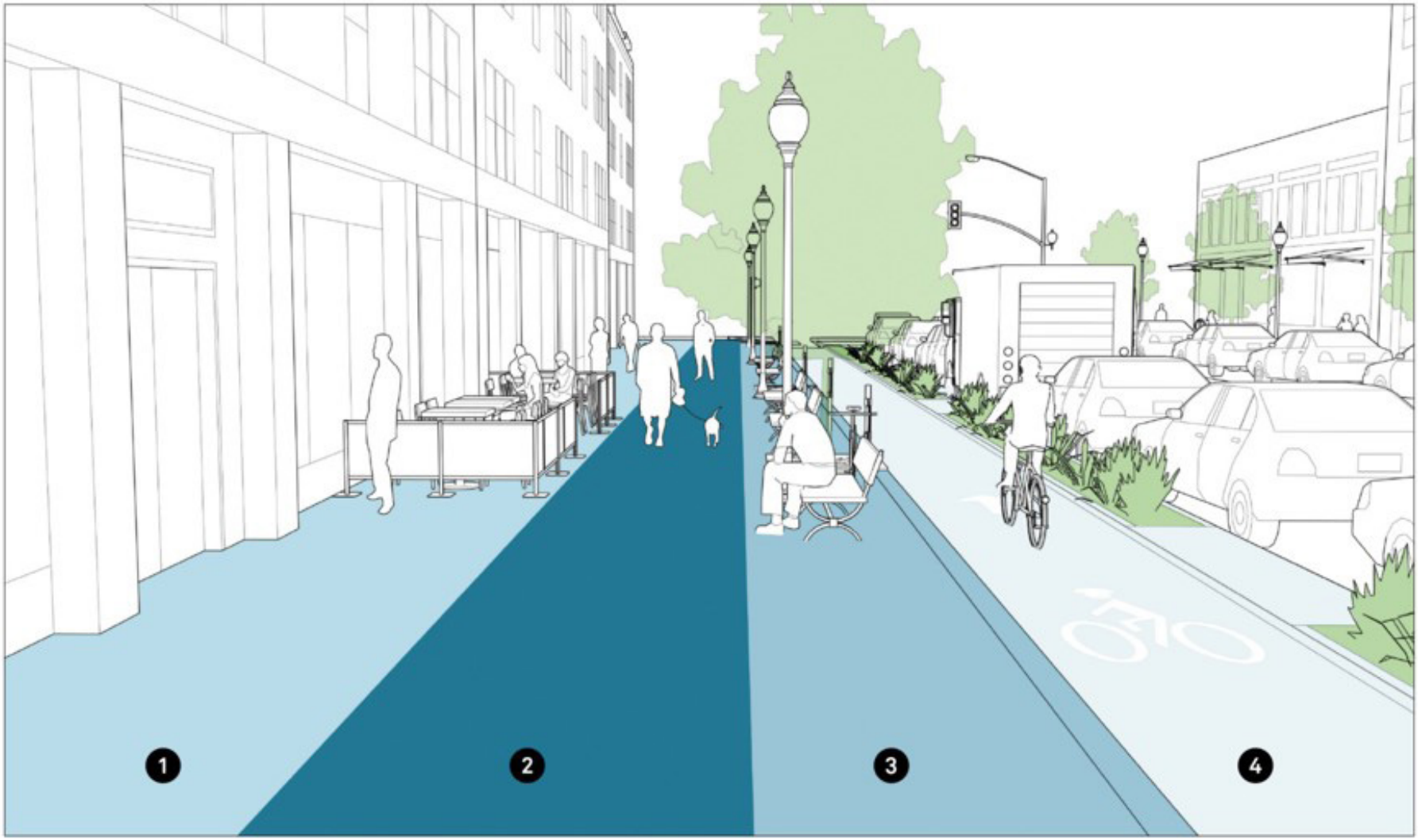


fig. 28 Divisions of an Urban Streetscape based on space available 1)Frontage Zone 2)Pedestrian through Zone 3)Street Furniture/Curb zone 4)Buffer Zone © NACTO

Types of Bus Stops

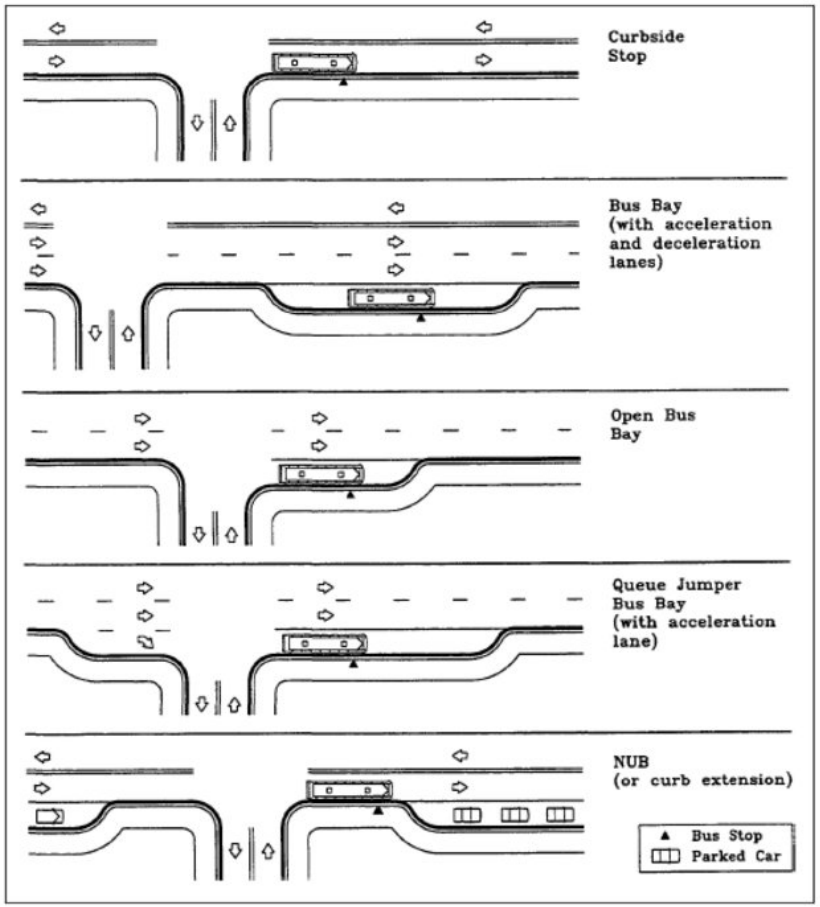


fig. 29 Divisions of an Urban Streetscape based on space available

fig. 30 BRT Bus stop in Ahemdabad(Top),
Modern surbside bus stop Worli, Mumbai(Bottom)

fig. 31 Curbside bus stop with very less space in rear for public use. Powai, Mumbai

Choosing the Bus Stop

Figure 2 shows alternative bus stop designs including curbside bus stops and bus bays. The choice of bus stop design is dependent on many factors related to the roadway and intersection geometry, adjacent land use, bus operation, and passenger and pedestrian related information. Curbside bus stops represent a simple and easy bus stop design requiring little modification to the roadway to accommodate the bus stop. The curbside design is similar to a bus bulb as the bus may stop in the travel lane with this design. Even if a parking lane is present upstream or downstream of the curbside bus stop, the bus may or may not pull off of the travel lane. In this bus stop design, bus patrons may also be required to enter the roadway, if the bus does not fully pull into the curb.

Bus-bays are an alternative bus stop design that allows the bus to fully exit the travel lanes to pick up or discharge bus patrons. For this reason, bus bays are primarily used on high-volume or high-speed roadways. The high-volume and high-speed conditions under which bus bays are installed create problems for buses reentering into the adjacent travel lanes. Where these conditions exists, bus bulbs may represent an improvement over bus bays as bus bulbs eliminate the problems associated with buses reentering the traffic stream.

Types of Parking in India

In India, there are various types of on-street and off-street parking options available. Here are some common types:

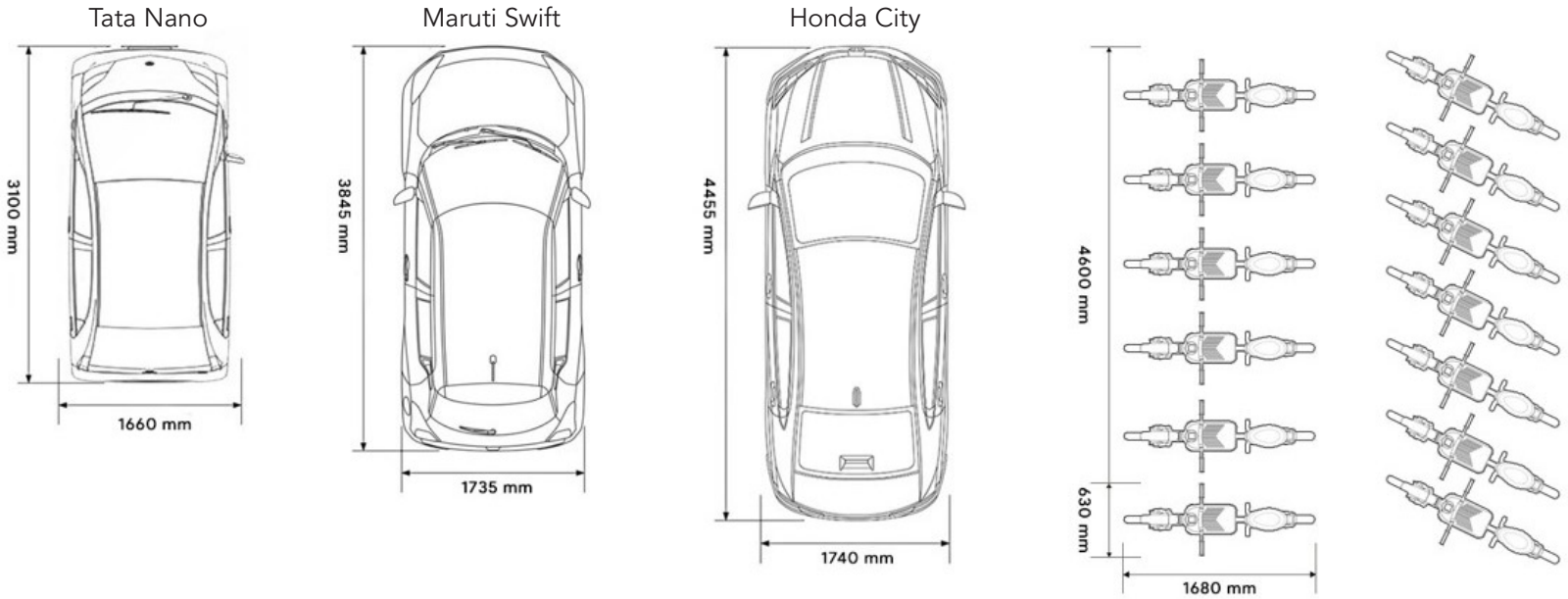
On-Street Parking

- **Parallel Parking:** This is the most common form of on-street parking where vehicles park parallel to the curb or road edge.
- **Angle Parking:** In certain areas, angle parking is implemented where vehicles are parked at an angle to the curb. This allows more cars to be accommodated in a limited space.
- **Diagonal Parking:** Similar to angle parking, diagonal parking involves parking vehicles at an angle to the curb. It is often used in wider streets or parking lots.
- **Pay-and-Park Zones:** Some cities have designated pay-and-park zones on the streets where users need to pay a fee to park their vehicles for a specified duration. Parking tickets or tokens are issued to indicate the paid duration.
- **No Parking Zones:** There are areas where parking is strictly prohibited, such as near intersections, pedestrian crossings, or other designated areas. These are marked as "No Parking" zones. Still sometimes people tend to park there.

Off-Street Parking

- **Parking Lots:** Off-street parking lots are common in commercial areas, shopping complexes, and public spaces. These are dedicated spaces for parking vehicles, and they can be either open-air or multi-level parking structures.
- **Parking Garages:** Multi-level parking garages are often found in congested areas where vertical space is utilized to accommodate more vehicles. These garages may have multiple levels and ramps for easy access.
- **Underground Parking:** In some urban areas, underground parking facilities are available. These are constructed below ground level, providing additional parking capacity without occupying surface space.
- **Private Parking Spaces:** Many residential buildings, office complexes, and commercial establishments provide private parking spaces for their residents, employees, or customers. These spaces can be open or covered.
- **Valet Parking:** Some hotels, restaurants, and high-end establishments offer valet parking services. Customers can hand over their vehicles to valet attendants who park and retrieve the vehicles on their behalf.

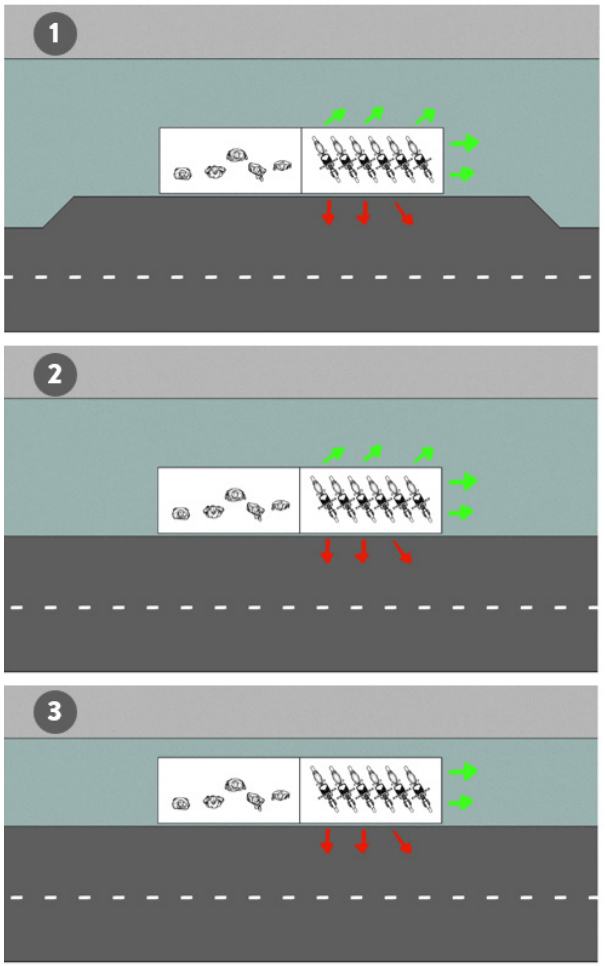
Parking Ratio



The parking ratio denotes the number of Micro-mobility vehicles that can be accommodated within the same space typically occupied by a personal vehicle. To provide a comparative reference, consider the example of Tata Nano, a small hatchback, which can be substituted by approximately 4-5 Micro-mobility options in terms of parking capacity. Similarly, a parking space intended for a Maruti Swift, can accommodate around 5-6 Micro-mobility vehicles. In the case of Honda City, a sedan, approximately 6-7 Micro-mobility options can be parked within the same space.

Furthermore, when considering a parking hub-based solution, there are additional constraints to be taken into account. Installing dedicated infrastructure solely for docking purposes may not be economically or logistically feasible, as it requires individual installations at each hub location. Additionally, the frequency of parking hubs is typically lower compared to that of bus stops, which further adds to the constraints of implementing a parking hub-centric approach.

Maneuvering



Enhancing the accessibility of the service also involves considering the maneuverability of the vehicles within the Indian street context. The diagram on the left showcases three potential configurations:

1. Bus Bulbs: In this setup, the bus stop is equipped with bus bulbs on both sides, and there is sufficient space available at the rear.

2. Bus Stop in Traffic: In this scenario, the bus stop is positioned directly on the road, and buses are integrated into the flow of moving traffic.

3. Limited Space: Here, the available space is limited, and the sidewalk provides minimal room for pedestrians. Maneuvering the vehicles in such areas poses additional challenges.

fig. 32 A Bus stop with very less clearnace at the rear side

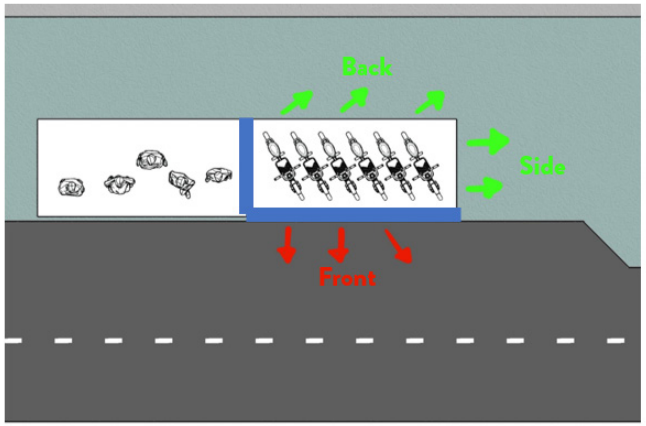


fig. 33 Usable side to take the vehicle out for usage.
The blue line denotes the probable space for dock.

Parts Of Yulu

In the search for a suitable docking location, a thorough examination of the Yulu E-Scooter's components was conducted. The following are the key parts available in the vehicle. Considering the ease of handle-based movement for users, it was determined that docking in the front would be more practical and user-friendly.

By placing the docking station in the front, users can conveniently access and maneuver the vehicle. This configuration allows for seamless docking and undocking, ensuring a smooth user experience. Considering the ergonomics and user preferences, the front-based docking approach was deemed the most viable option for the Yulu E-Scooter.

1. Battery indicator
2. Phone holder
3. Throttle
4. Bell
5. Headlight
6. Front Suspension
7. Battery deck
8. Hub motor
9. Seat
10. Rear light
11. Rear Suspension

fig. 34 Parts of Yulu ©Yulu

Sensors for Locking

Sensors play a crucial role in the hardware components required for locking and charging functionalities. Ensuring safety is a key consideration, and one proposed safety feature involves initiating charging only when the dock detects the presence of a vehicle. This helps prevent potential hazards, such as children placing their hands in the dock and risking electrocution. Based on this need, the following sensors were considered:

- **Proximity Sensors:** These sensors detect the presence or absence of an object within a certain range. They can use various technologies such as infrared, capacitive, or ultrasonic sensing.

- **Laser Sensors:** Laser sensors use laser beams to detect the distance, position, or shape of objects. They are often used for precise measurements and object detection in industrial applications.

- **Magnetic Sensors:** Magnetic sensors detect changes in magnetic fields to identify the presence or movement of objects. They can be used to detect metallic objects or monitor the position of magnetic markers.

- **Optical Sensors:** Optical sensors utilize light to detect objects. They can be based on various principles, such as reflection, interruption of light beams, or image processing.

- **Ultrasonic Sensors:** Ultrasonic sensors emit high-frequency sound waves and measure the time it takes for the waves to bounce back after hitting an object. This information is used to determine the object's distance and presence.

- **Capacitive Sensors:** Capacitive sensors detect changes in capacitance when an object comes in proximity. They are commonly used for touch-sensitive applications or object detection in industries.

- **Infrared Sensors:** Infrared sensors detect infrared radiation emitted or reflected by objects. They are frequently used for presence detection, motion sensing, or temperature measurements.

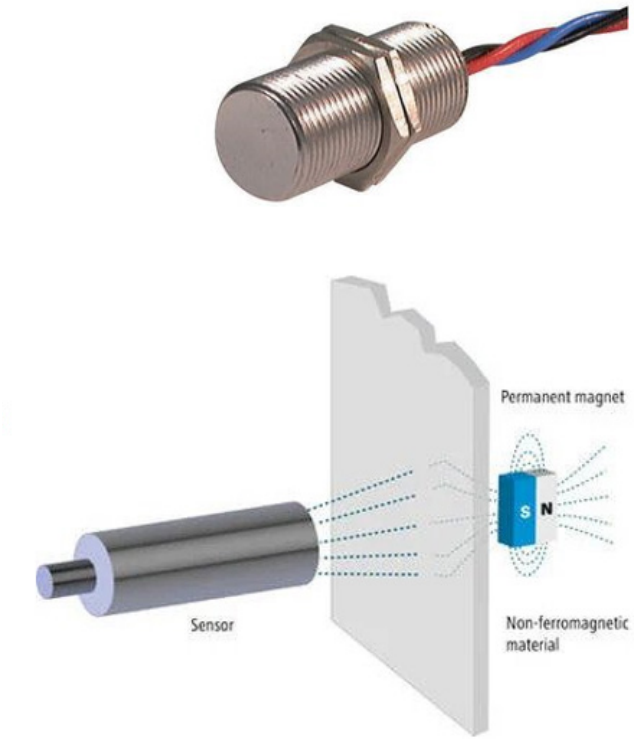


fig. 35 Magnetic Sensors

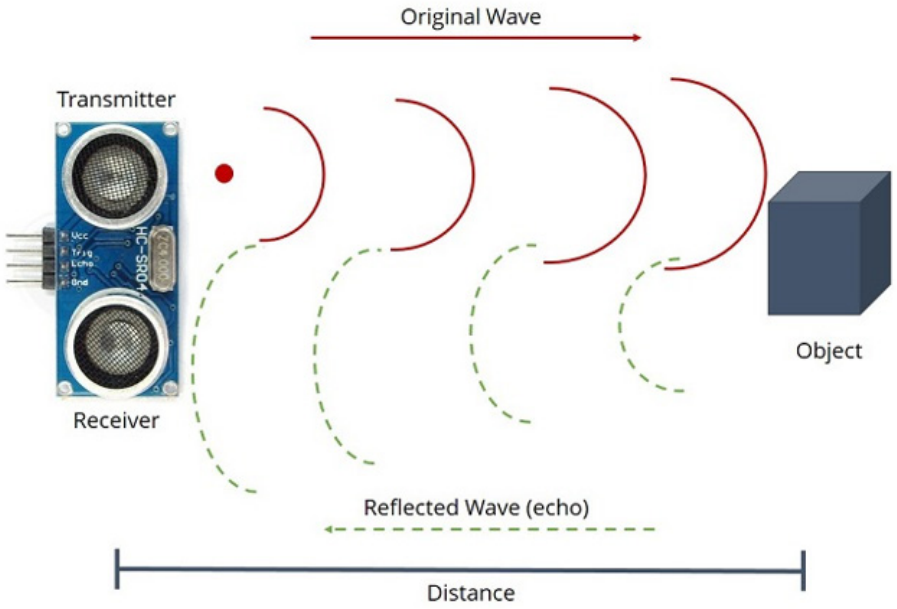


fig. 36 Ultrasonic Sensors

Solar Panels

There are several types of solar panels available, each with its own unique features and characteristics. Here are some of the most common types:

1. **Monocrystalline Solar Panels:** These panels are made from a single crystal structure and have a uniform black or dark blue appearance. Monocrystalline panels are known for their high efficiency and space-saving design, making them ideal for installations with limited roof space.

2. **Polycrystalline Solar Panels:** Polycrystalline panels are made from multiple crystal structures, which gives them a characteristic bluish color. They are less expensive to produce than monocrystalline panels but generally have slightly lower efficiency. However, advances in technology have reduced the efficiency gap between the two types.

3. **Thin-Film Solar Panels:** Thin-film panels are made by depositing one or more layers of photovoltaic material onto a substrate such as glass, plastic, or metal. They are more flexible and lightweight than crystalline panels, allowing for easier installation in certain applications. However, thin-film panels generally have lower efficiency and require more surface area for the same power output.

4. **Bifacial Solar Panels:** Bifacial panels can generate electricity from both sides of the module, capturing sunlight reflected from the ground or other surfaces. They are typically made of crystalline silicon and have transparent backsheets or glass to enable light penetration from both directions. Bifacial panels offer the potential for increased energy production, especially in installations with highly reflective surfaces.

5. **Concentrated Solar Panels:** Concentrated solar panels use lenses or mirrors to concentrate sunlight onto a smaller photovoltaic surface, which increases the amount of energy that can be generated. This technology is often used in large-scale solar power plants where tracking systems follow the sun's movement to maximize the concentration of sunlight.

Energy Calculations

To determine the charging duration of a battery utilizing a solar panel, two factors need consideration: the power output of the solar panel and the battery's capacity.

First, we calculate the power output of the solar panel. The panel has dimensions of 1.5 square meters and an efficiency of 20%. Assuming optimal sunny conditions, the estimated solar irradiance is approximately 1000 watts per square meter. Hence, the power output of the solar panel can be determined as follows:

Power output = Solar panel area * Solar irradiance * Efficiency

= 1.5 sqm * 1000 W/sqm * 0.20
= 300 watts

Next, Calculating the charging time for the battery. The battery possesses a capacity of 10 amp-hours (AH) and operates at a voltage of 36 volts. To convert the capacity from amp-hours to watt-hours, multiply it by the battery voltage:

Battery capacity = 10 AH * 36 V
= 360 watt-hours

To determine the charging time, divide the battery capacity by the power output of the solar panel:

Charging time = Battery capacity / Power output
= 360 Wh / 300 W
= 1.2 hours

Therefore, utilizing a 1.5 square meter solar panel with 20% efficiency on a bright sunny day, it would take approximately 1.2 hours to fully charge a 36V 10AH battery.

Location - Mumbai

The total area of **Mumbai** is **157 km²**

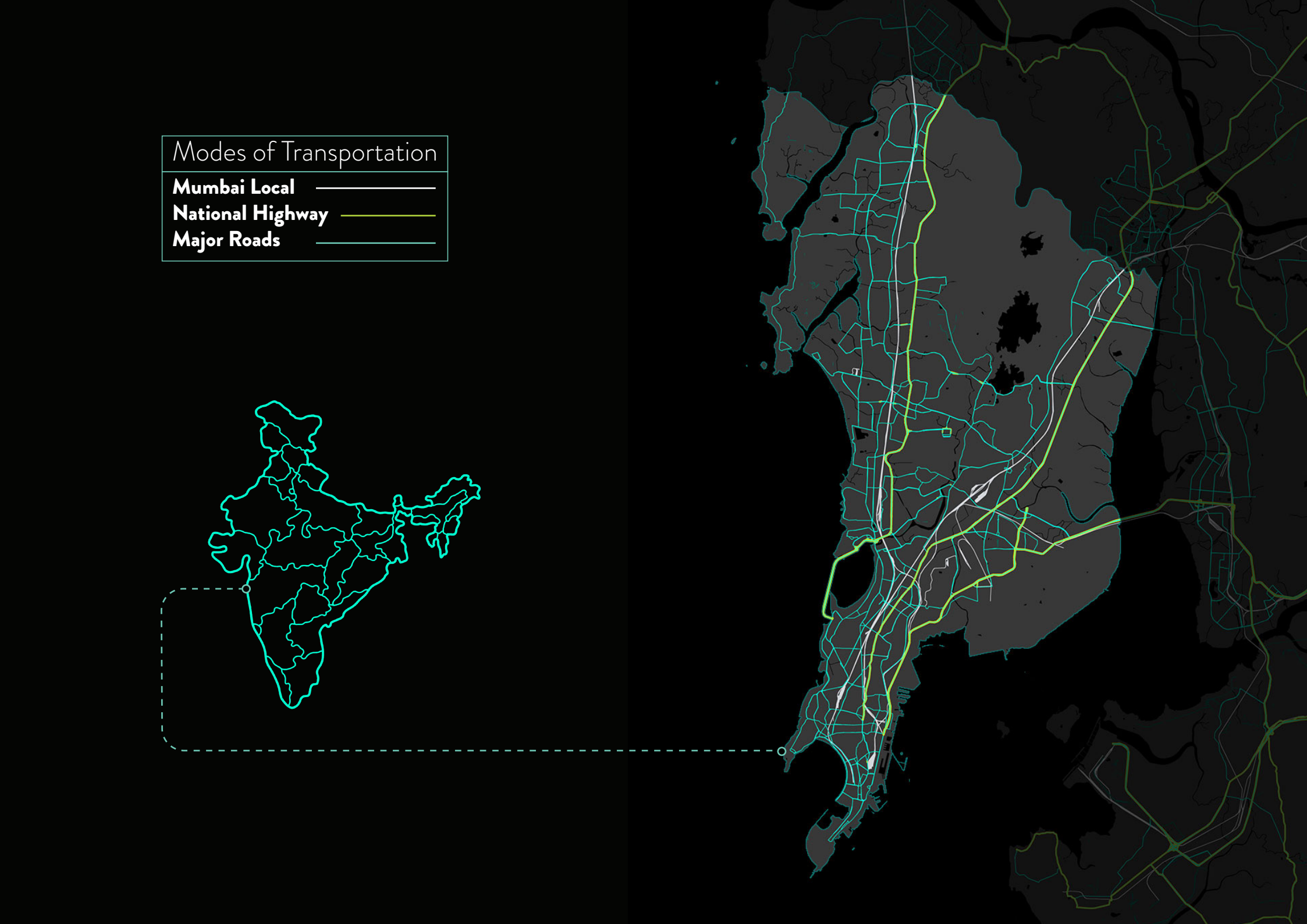
142 Local stations in and around Mumbai.

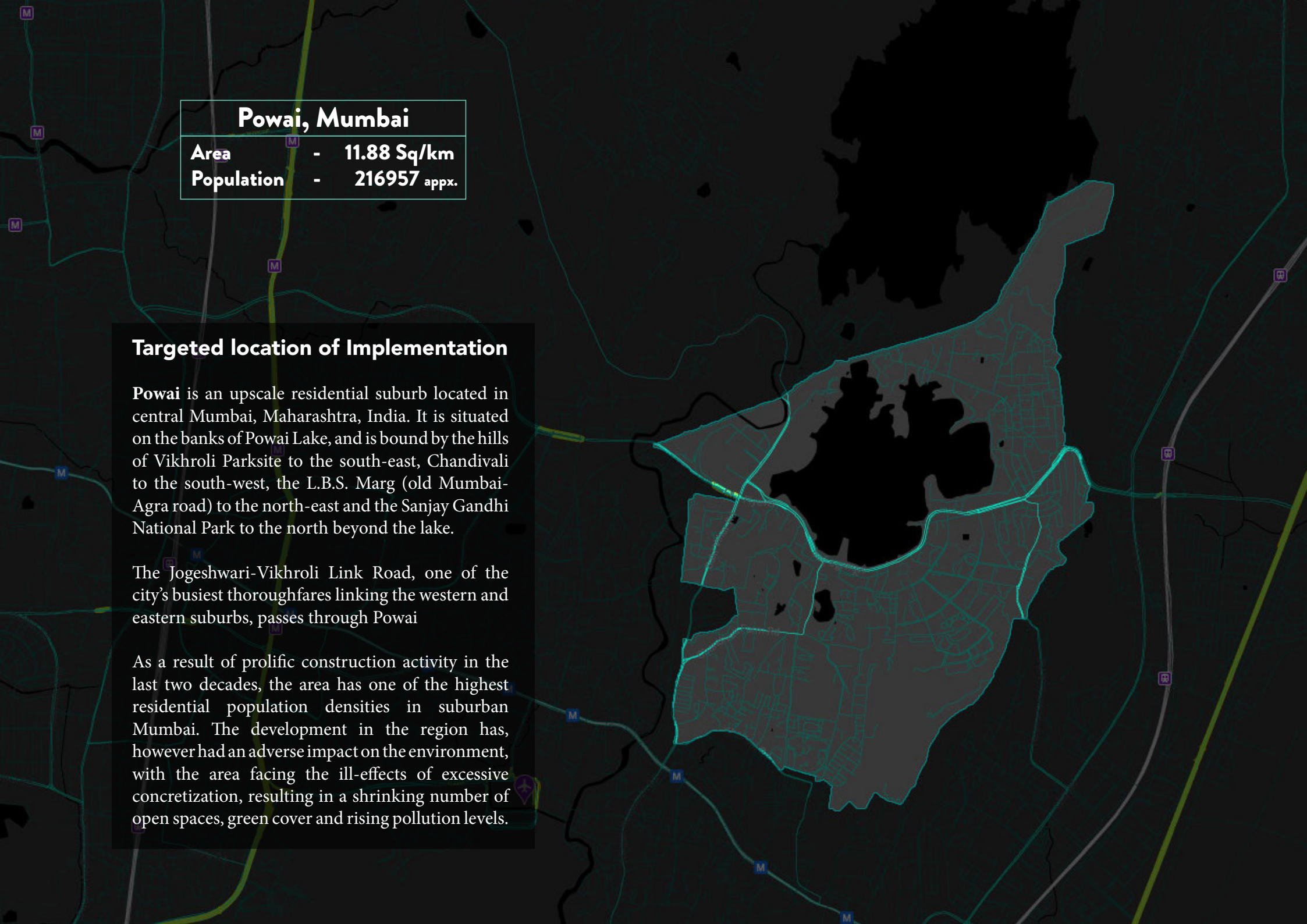
3731 Bus Stops in Mumbai, on over 338 routes.

And a total of **20,961,000 people** reside in this Metro city.

2,20,000 Auto Rikshaw and **18,000 Kali-pili** are needed to make traveling easier for folks.

Yet it gets **hard to travel** at times in rushed hours.


Modes of Transportation
Mumbai Local
National Highway
Major Roads



Powai, Mumbai		
Area	-	11.88 Sq/km
Population	-	216957 appx.

Targeted location of Implementation

Powai is an upscale residential suburb located in central Mumbai, Maharashtra, India. It is situated on the banks of Powai Lake, and is bound by the hills of Vikhroli Parksite to the south-east, Chandivali to the south-west, the L.B.S. Marg (old Mumbai-Agra road) to the north-east and the Sanjay Gandhi National Park to the north beyond the lake.

The Jogeshwari-Vikhroli Link Road, one of the city's busiest thoroughfares linking the western and eastern suburbs, passes through Powai

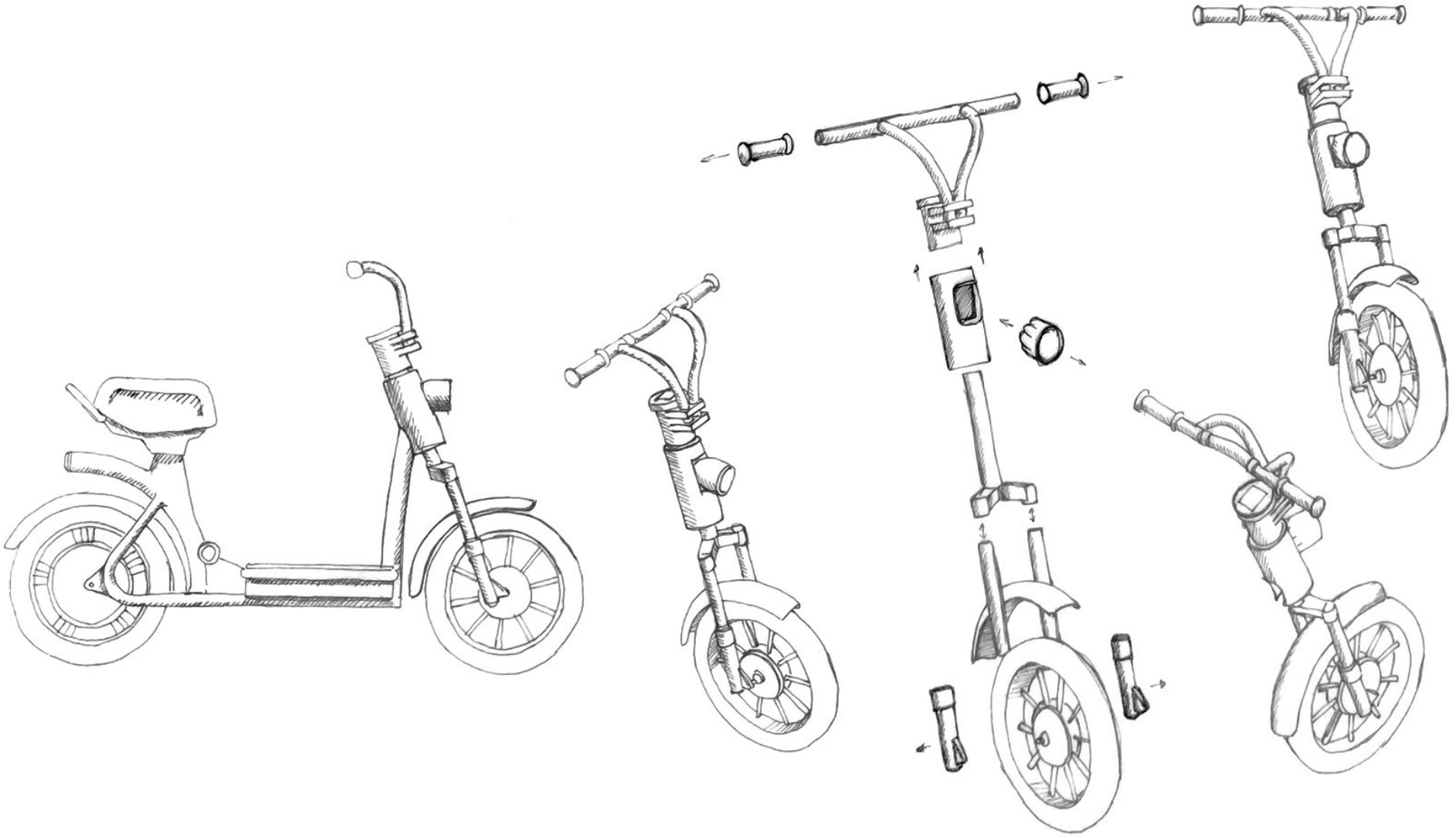
As a result of prolific construction activity in the last two decades, the area has one of the highest residential population densities in suburban Mumbai. The development in the region has, however had an adverse impact on the environment, with the area facing the ill-effects of excessive concretization, resulting in a shrinking number of open spaces, green cover and rising pollution levels.


th Center - Best
Tuition Classes
कुएमाथ सेंटर
बेस्ट मठ टेशन...
Cult Hiranan
Gardens, Mum
Close
Powai
The Space next to roads and parks can be used to implement these ideas as per the suggestions from NACTO
Add to project
3D
60 m
Camera: 662 m 19°07'02"N 72°54'48"E
72 m


बृहन्मुंबई महानगरपालिका
मुंबई सुशोभीकरण प्रकल्प
कायापालट मुंबईचा
निर्धार सरकारचा, कायापालट मुंबईचा
प्रगतीचा आलेख
हाती घेण्यात आलेली कामे
११७५
पूर्ण झालेली कामे
८३०
समाविष्ट कामे
आकाश मार्गिका (स्कायवॉक)
वाहतूक बेटं
समुद्रकिनारे
उद्याने
डिजीटल जाहिरात फलक
signpost
INDIA
बेस्ट


NEW WAY
FZ-S
VERSION 2.0

Ideation



Moodboard

Parametric

Organic

Layered

Modular

Curvy

Modern

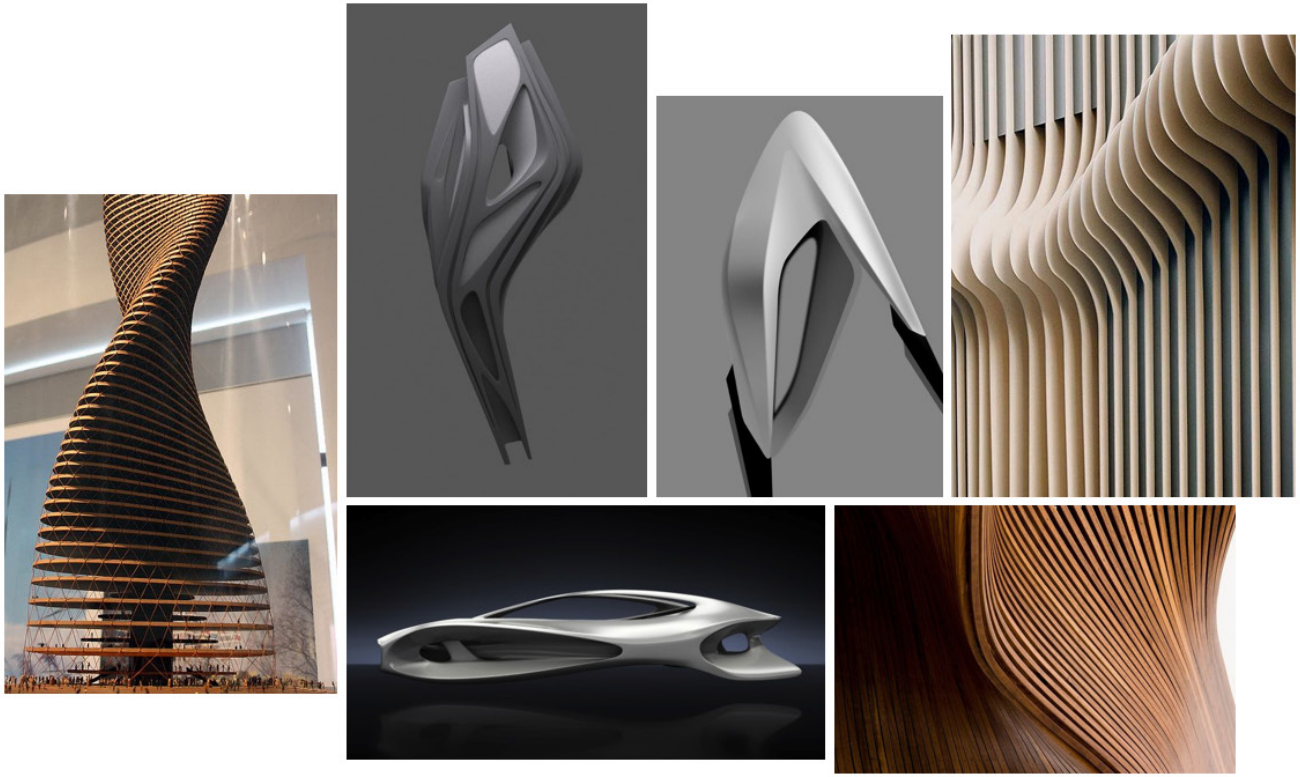
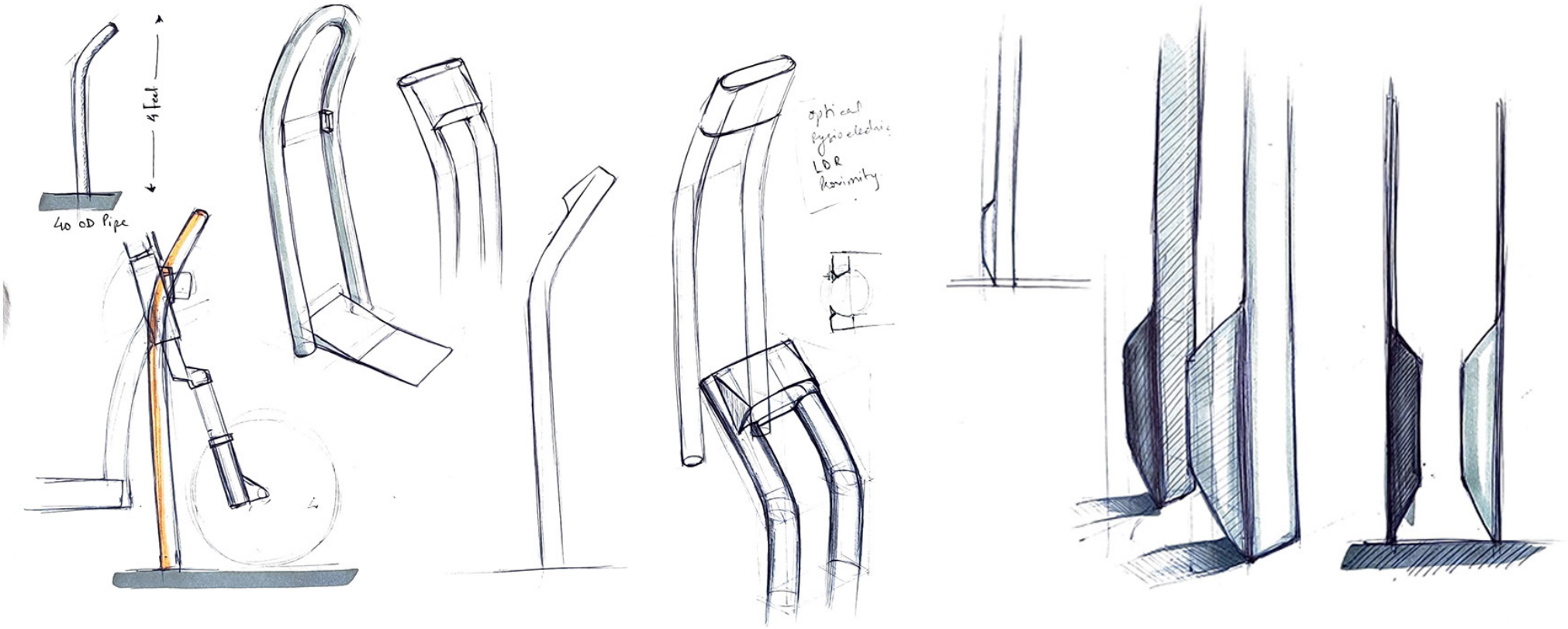
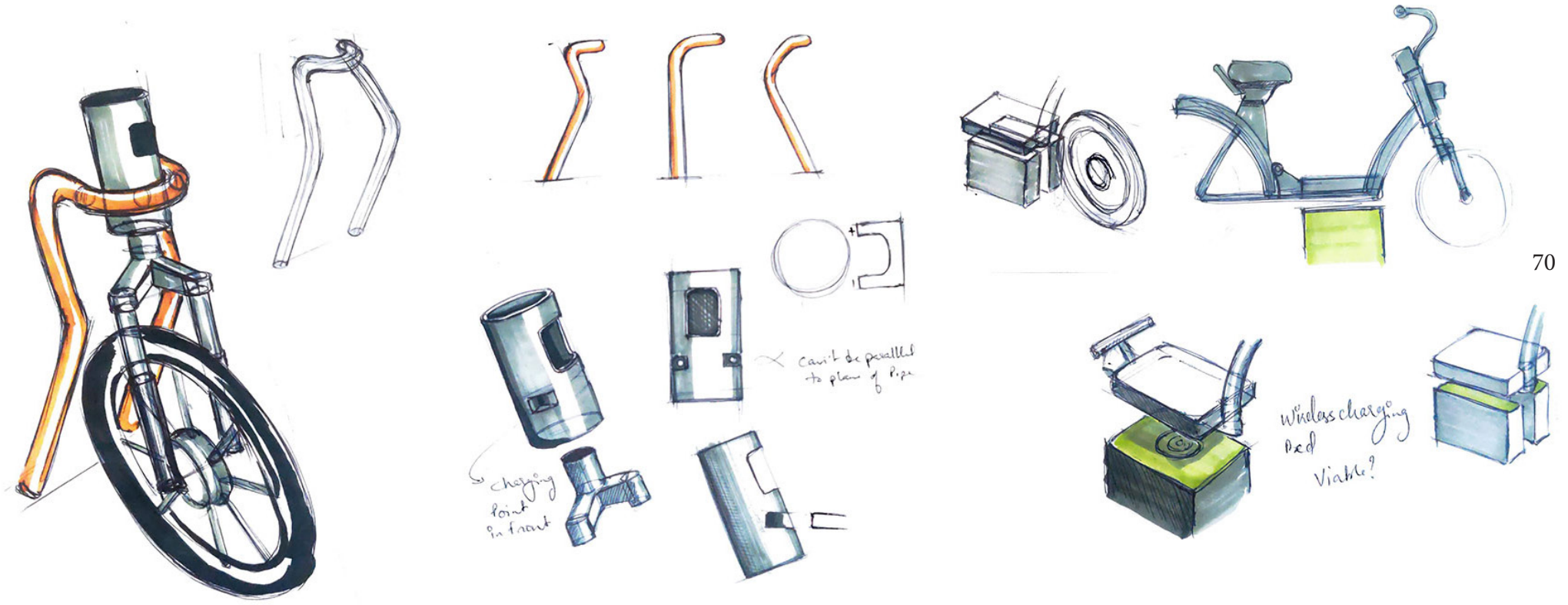


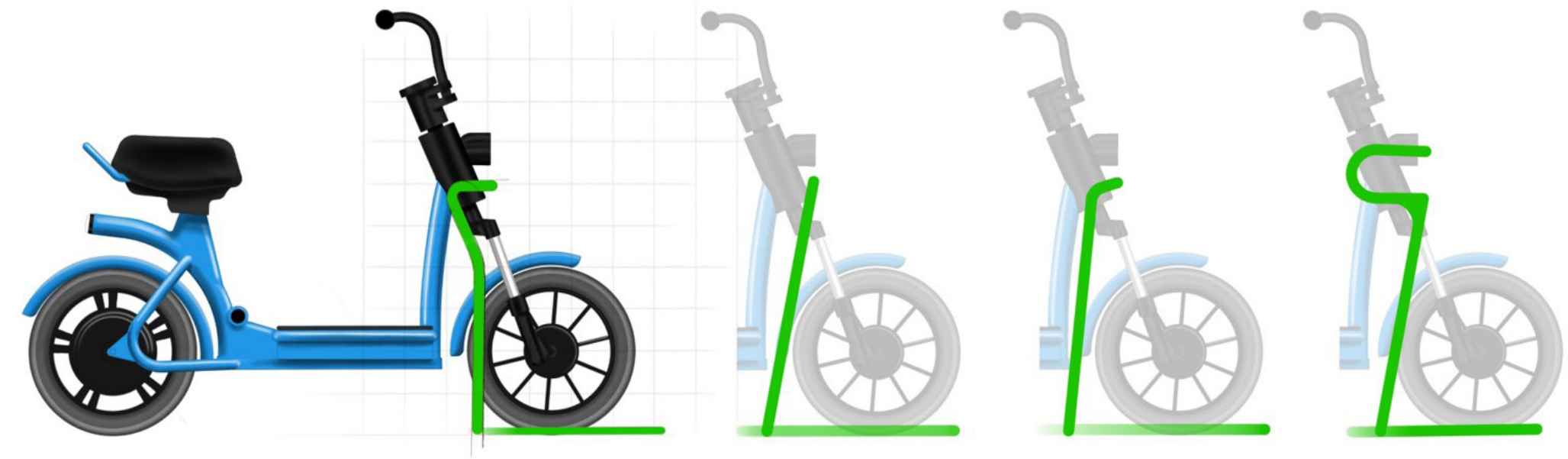
fig. 37 Parametric designs Moodboard ©Pinterest

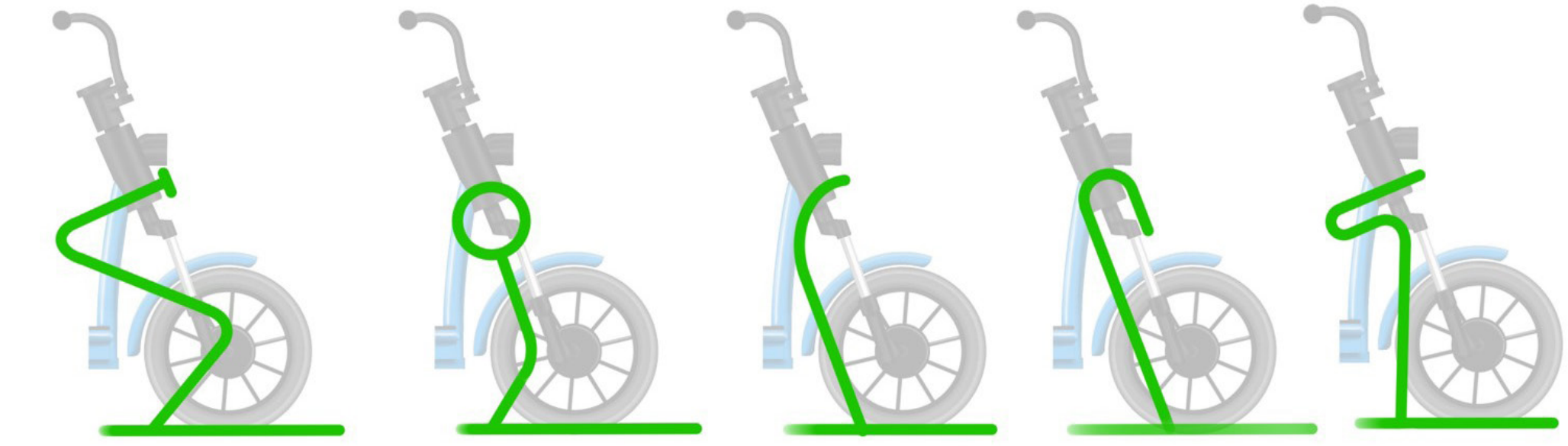
Ideation

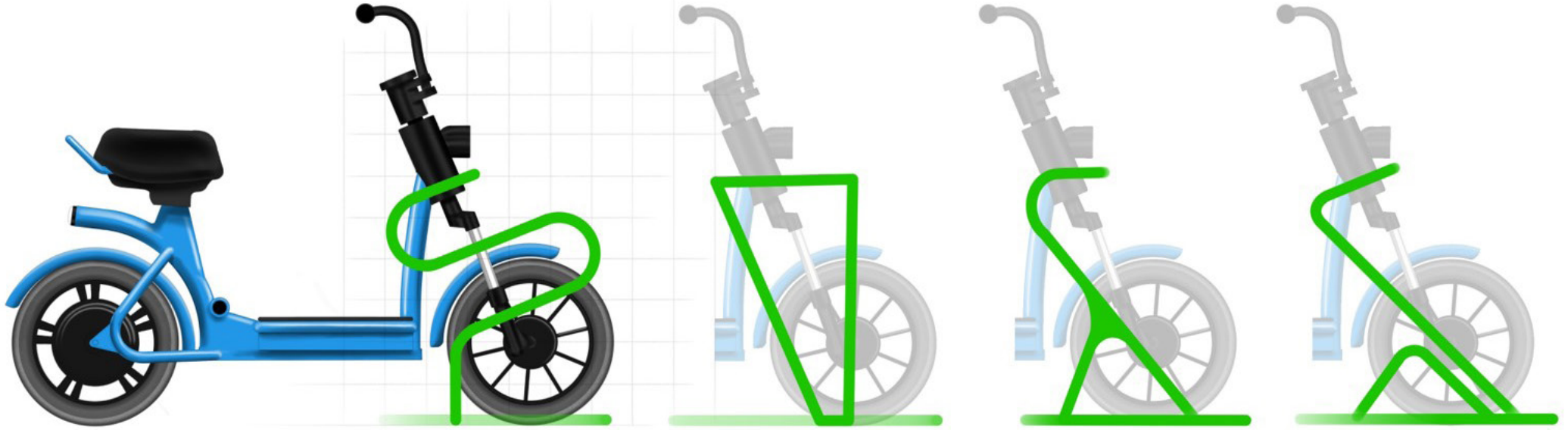


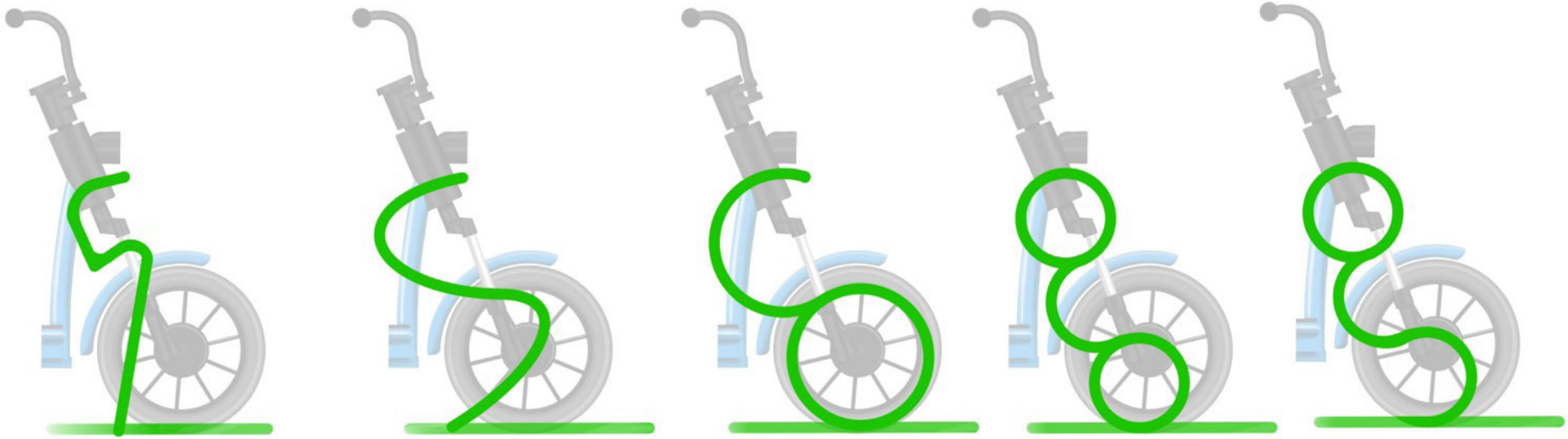

charging
Point
in front
Wireless charging
Pad
Viable?

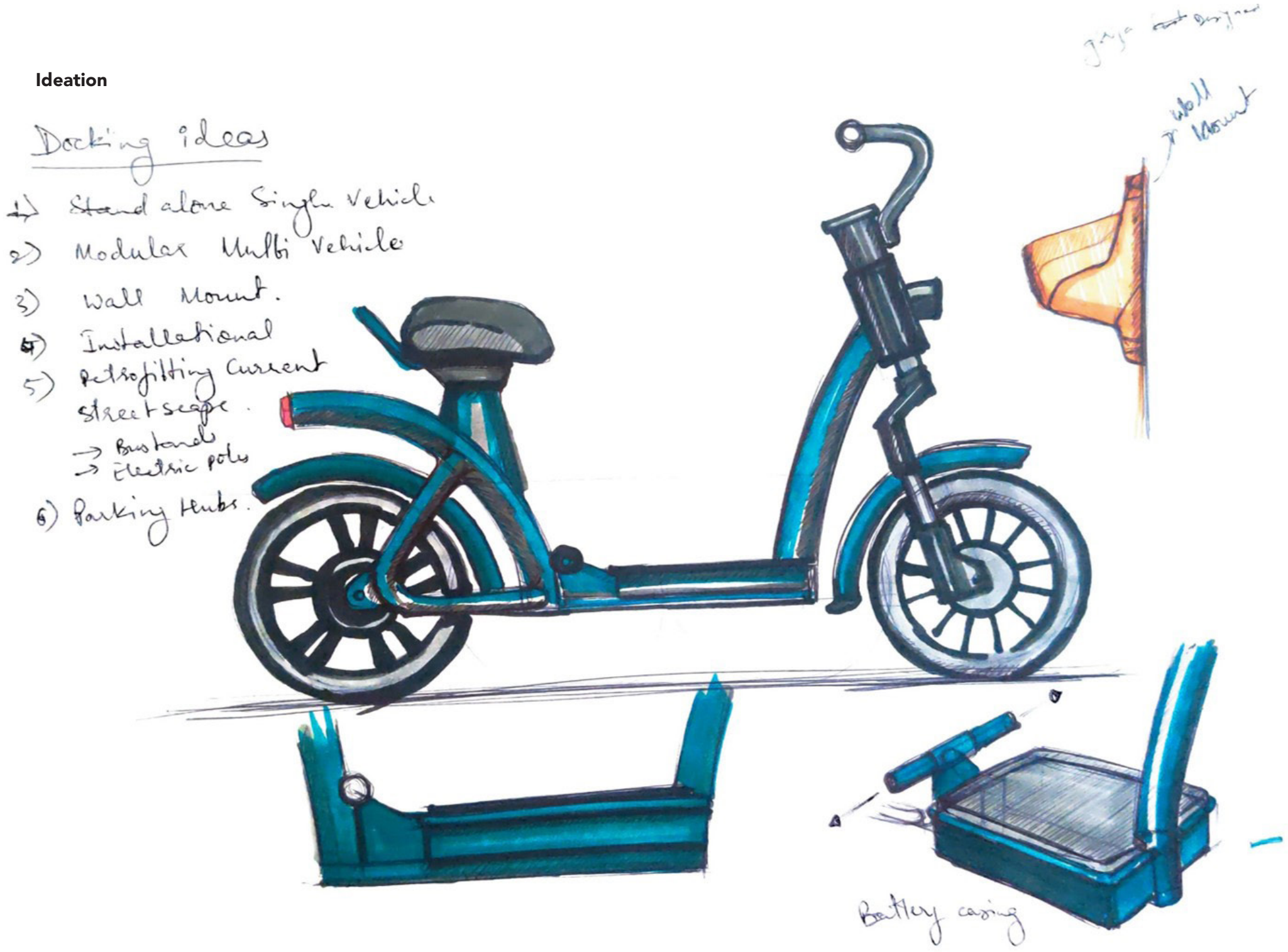
Ideation

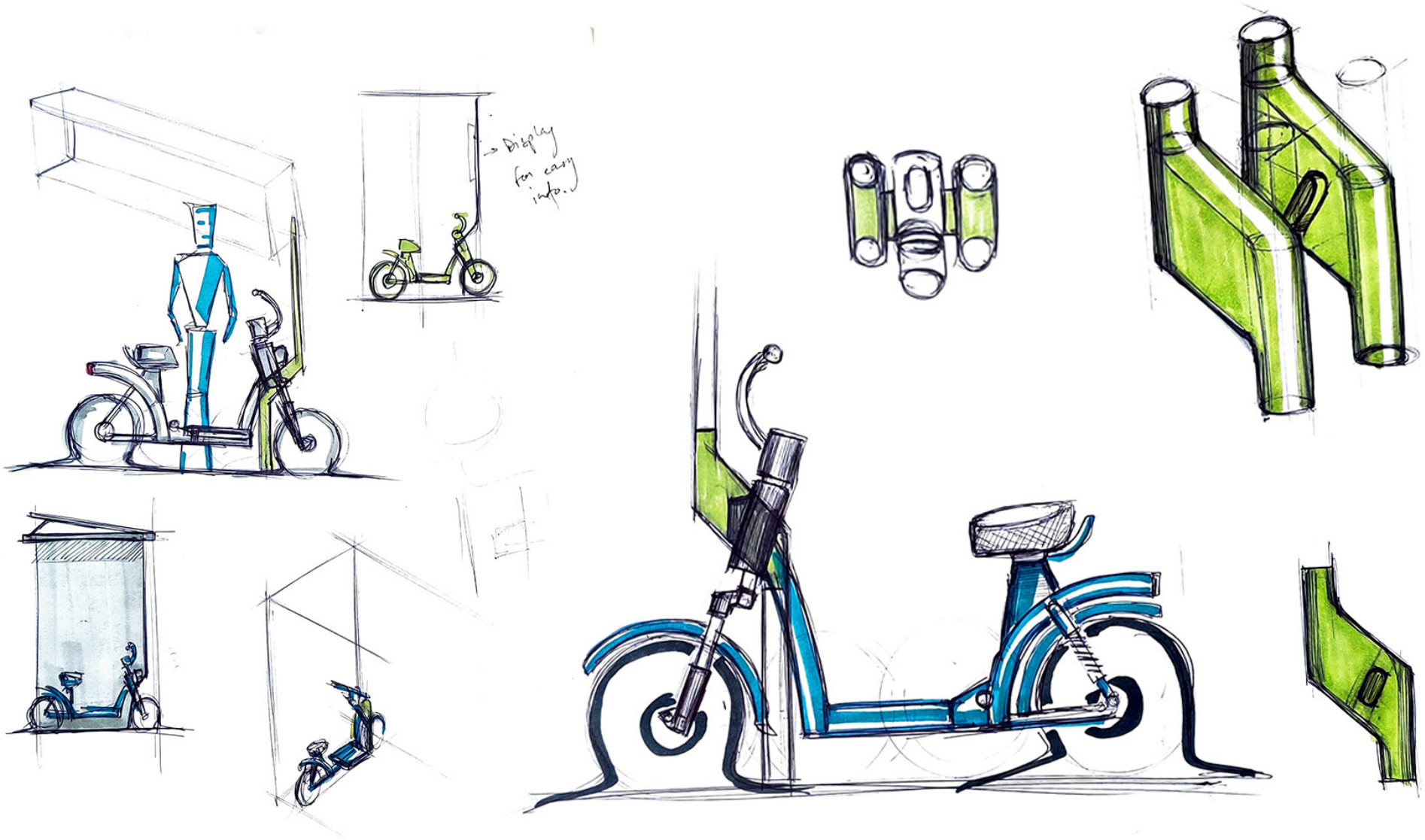




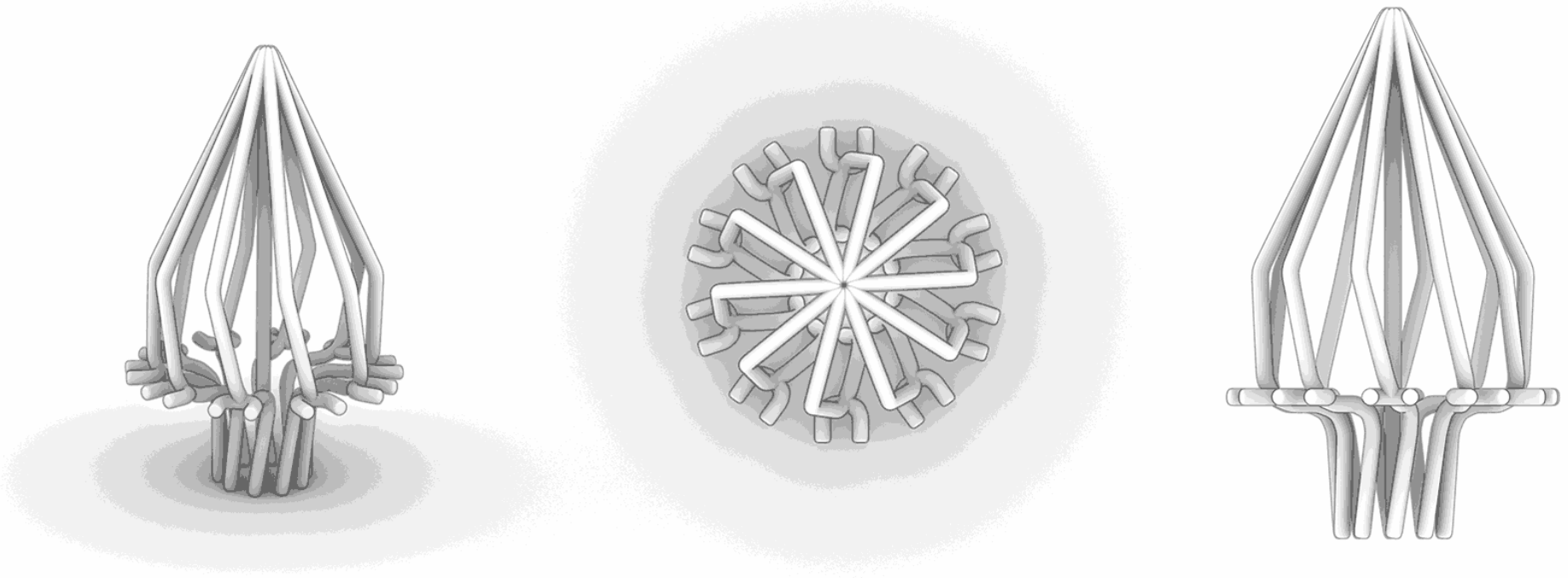




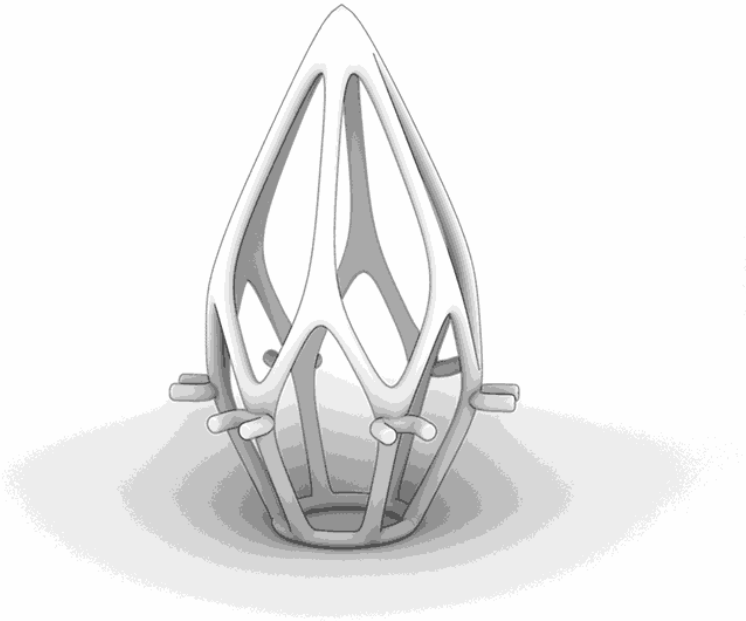

Docking ideas
1) Stand alone Single Vehicle
2) Modular Multi Vehicle
3) Wall Mount.
4) Installational
5) Retrofitting Current streetscape.
→ Bus stand
→ Electric pole
6) Parking Hubs.
Battery casing

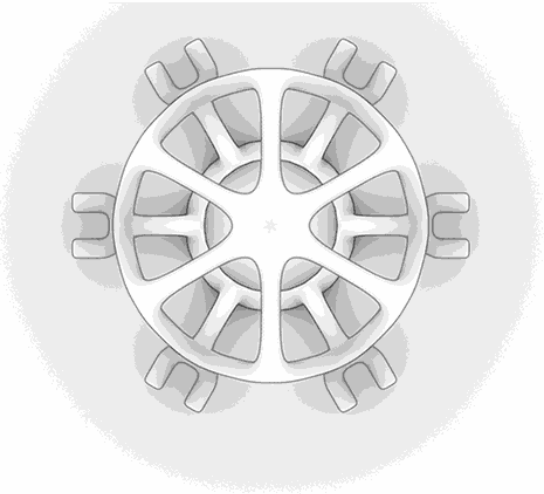

→ Display for easy info.

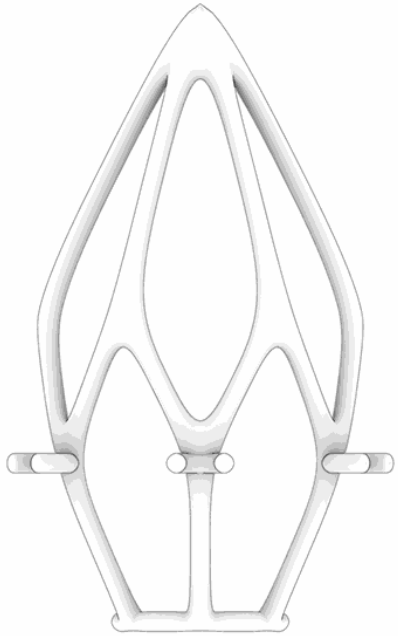
Installational Concept



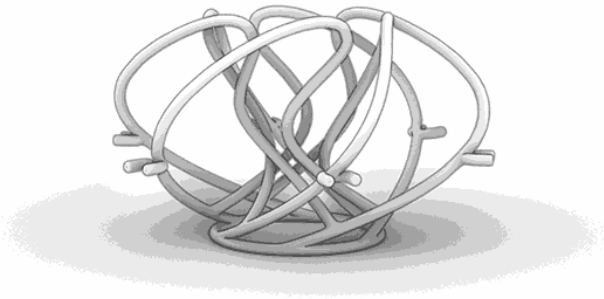
Installational Concept

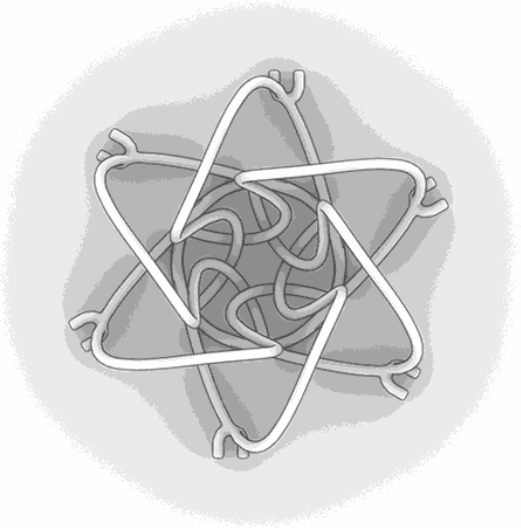


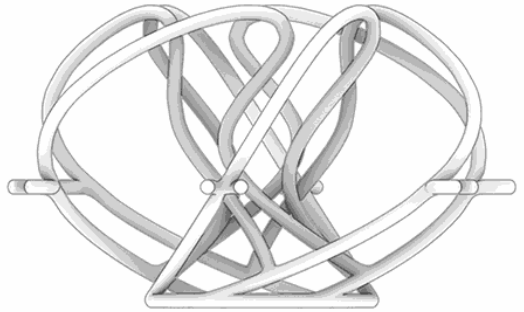


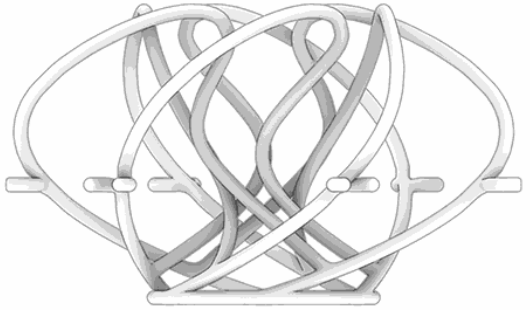


Installational Concept

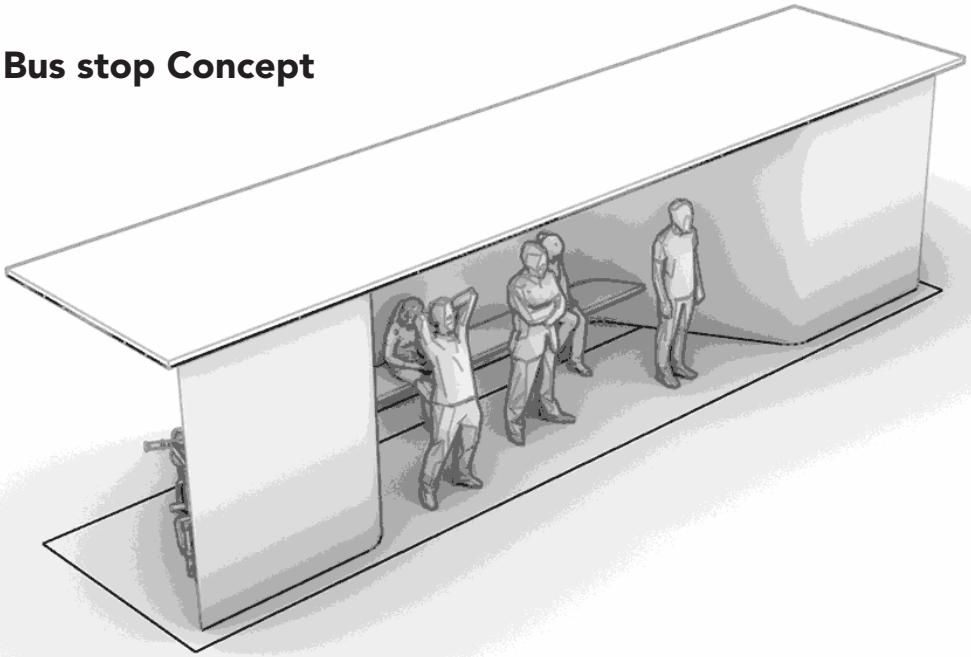


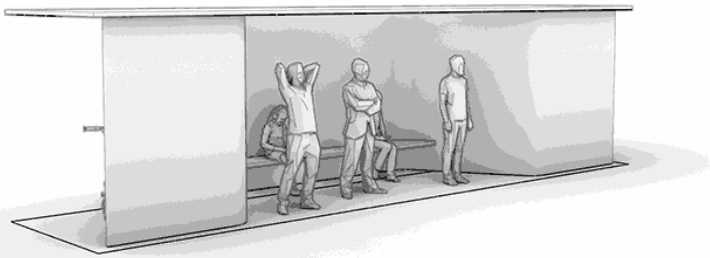


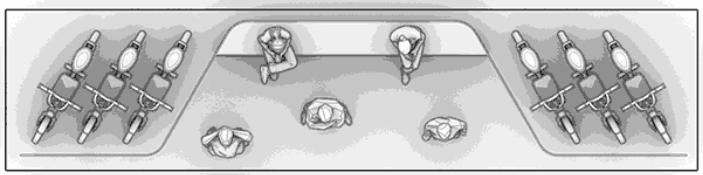


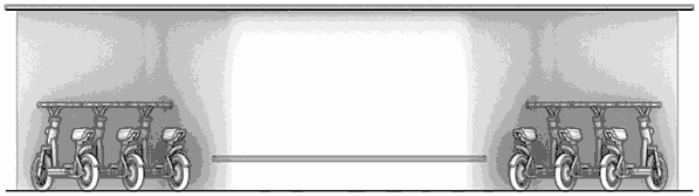


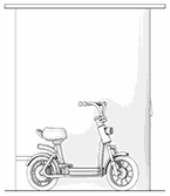
Bus stop Concept

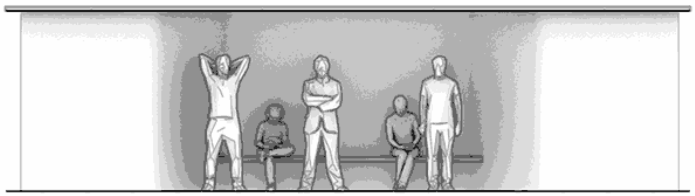




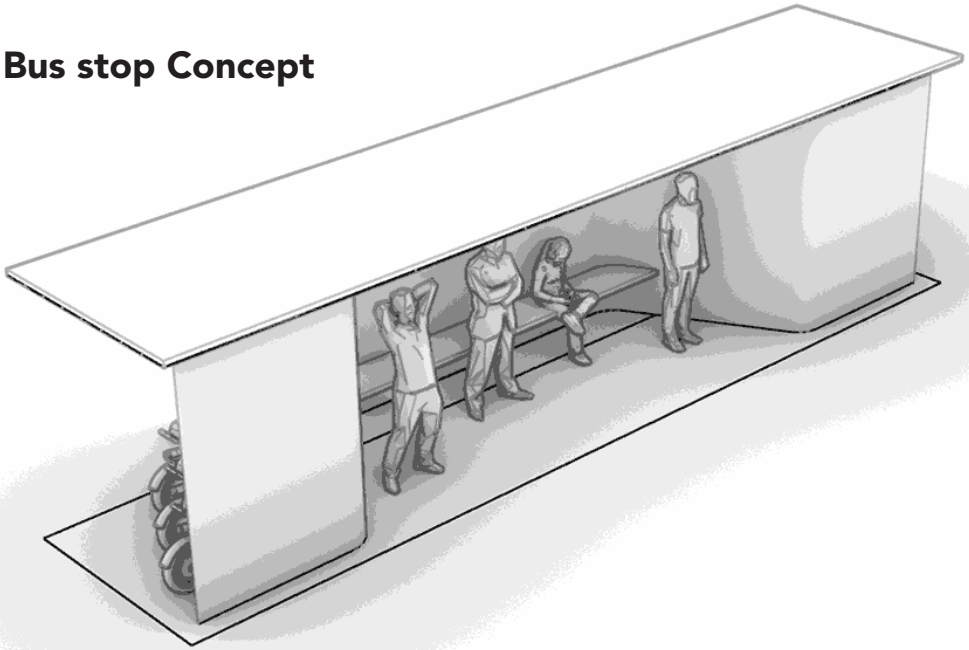


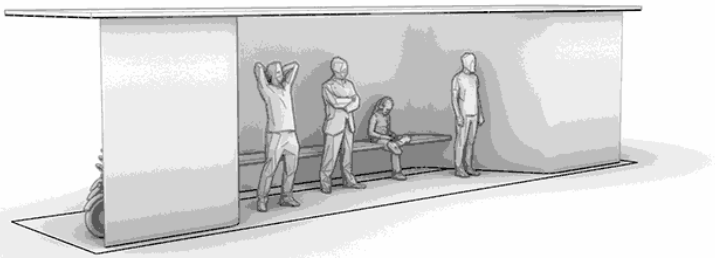


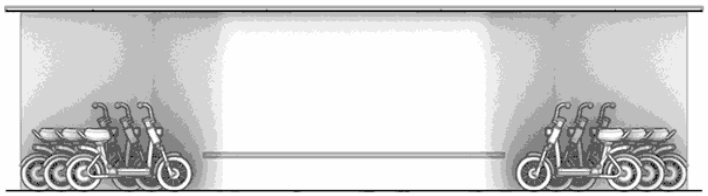


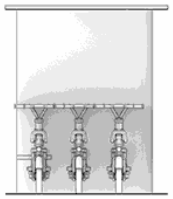


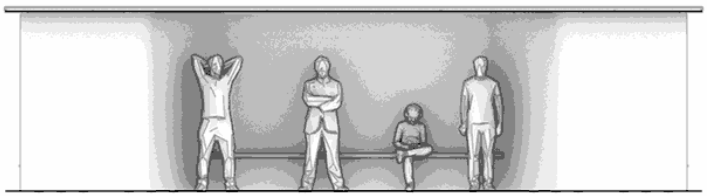
Bus stop Concept



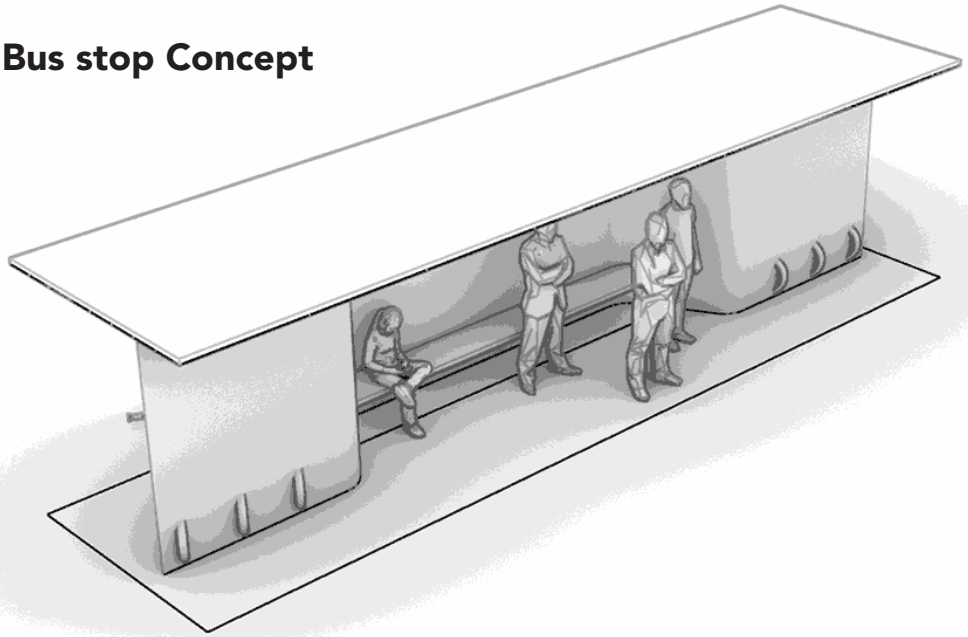


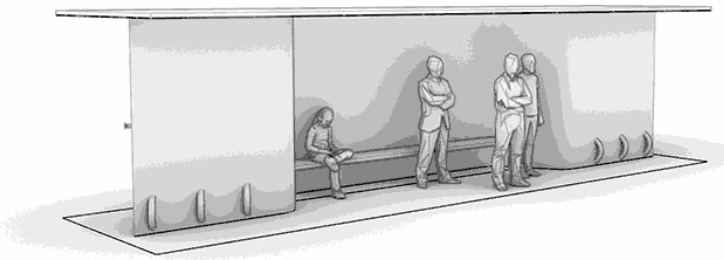


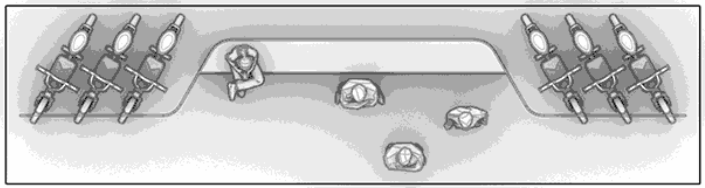


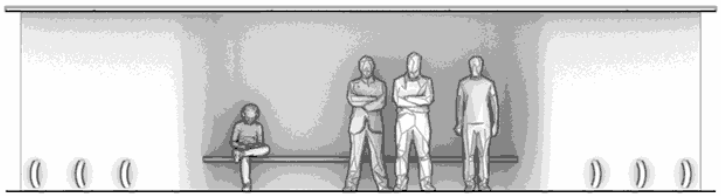


Bus stop Concept

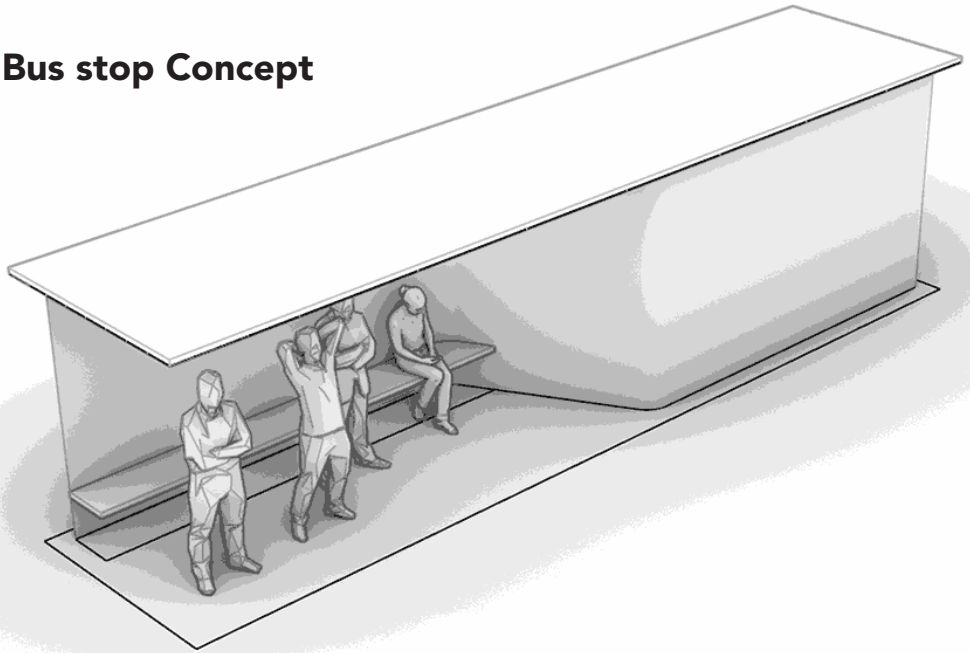


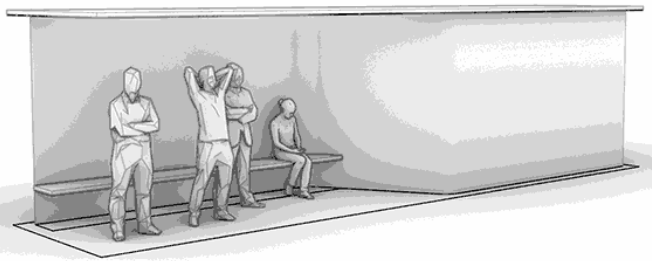


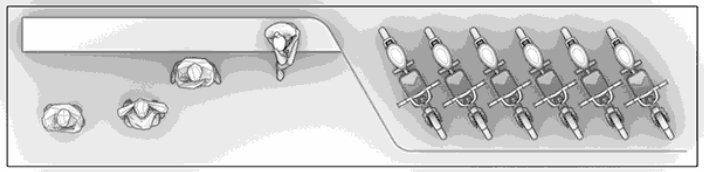


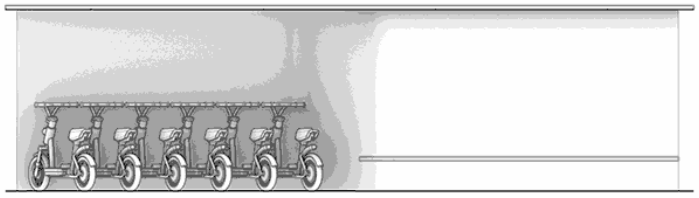


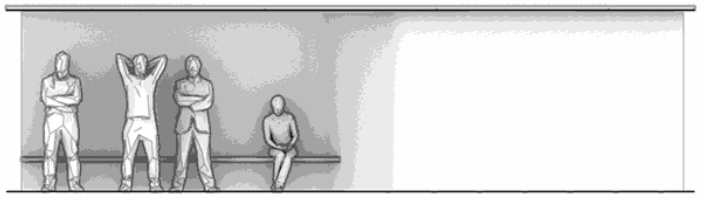
Bus stop Concept



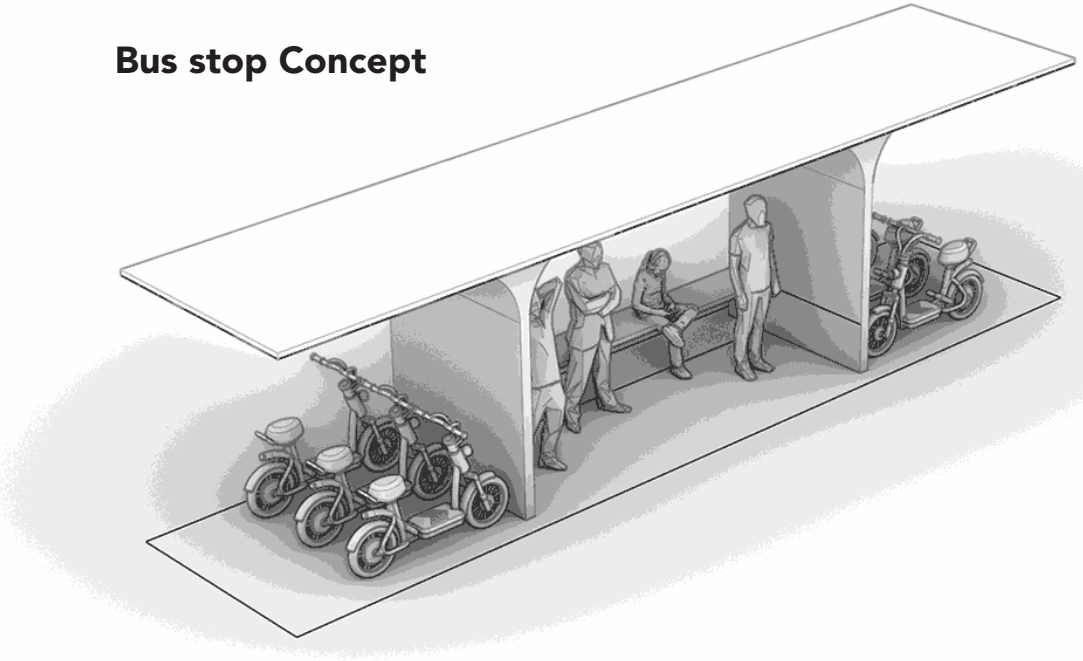


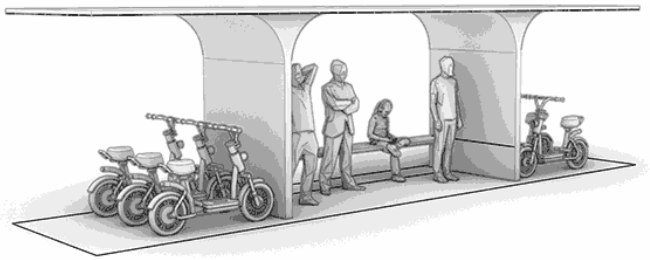


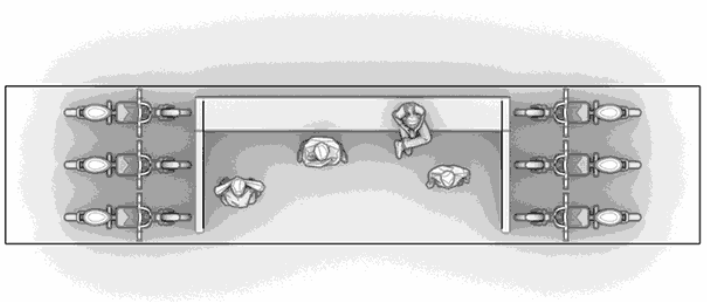


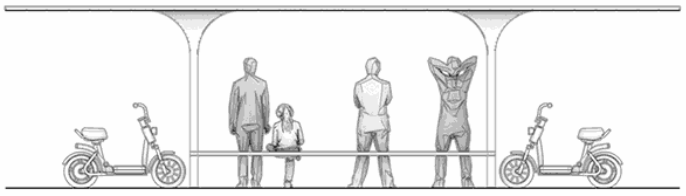


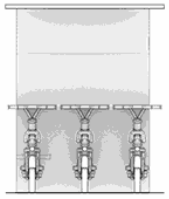
Bus stop Concept

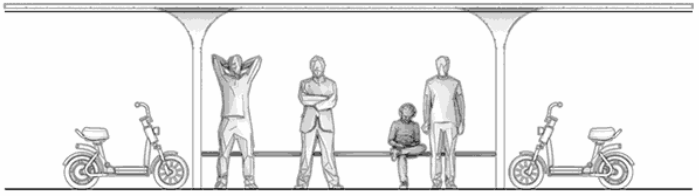




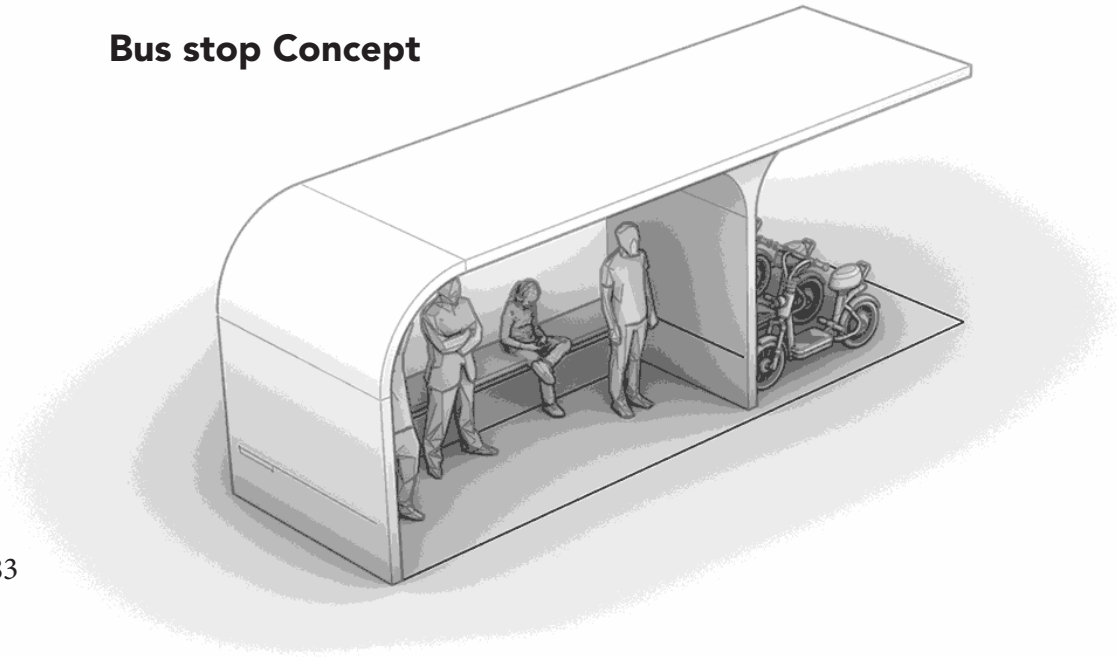


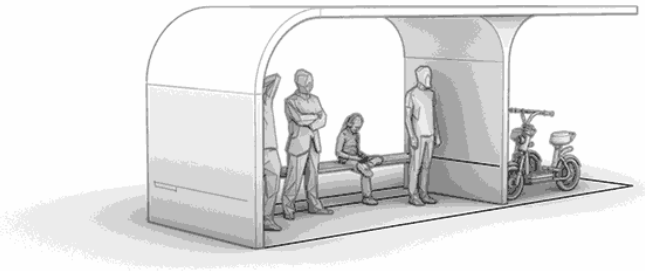


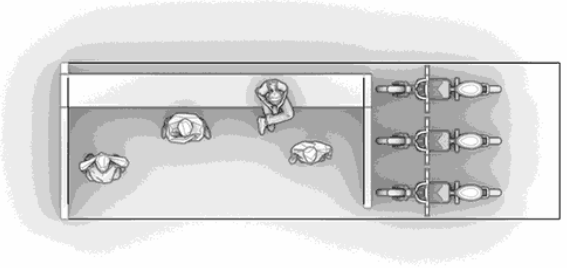


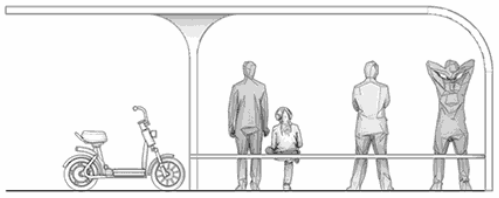


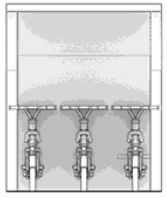
Bus stop Concept

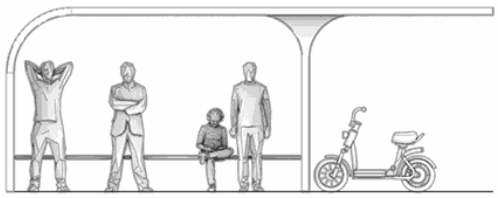




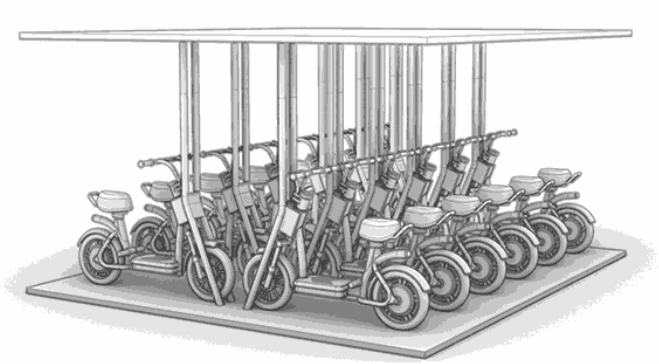


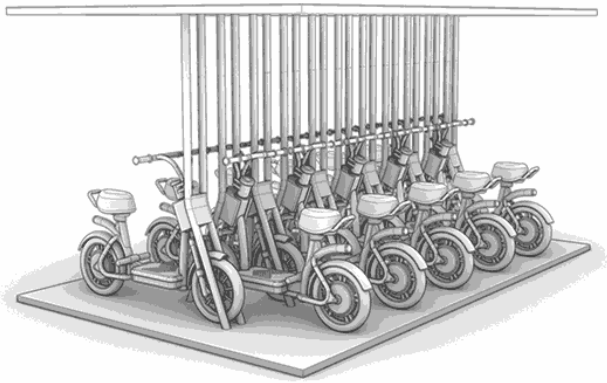


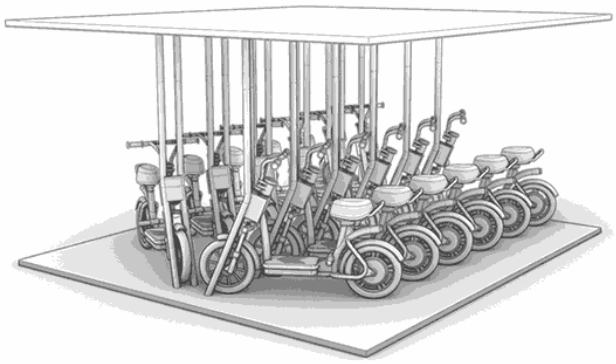


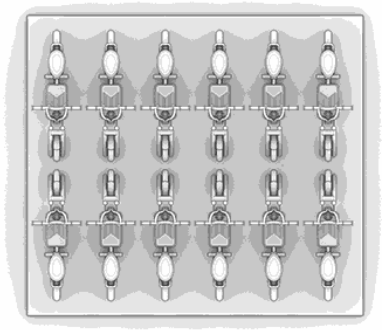


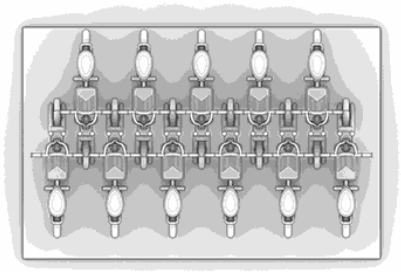
Parking Hub Concept

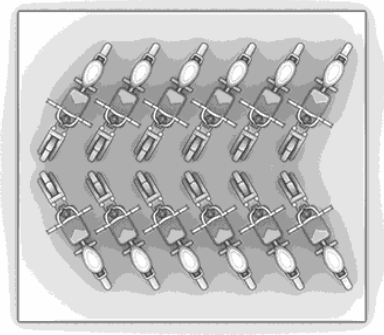




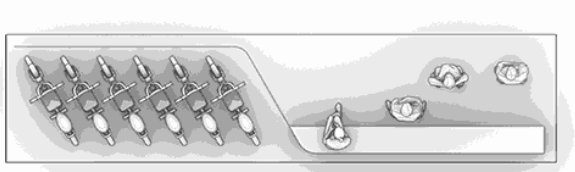


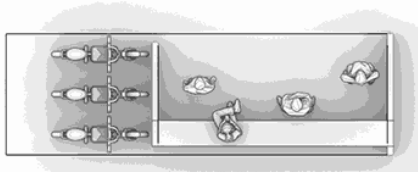


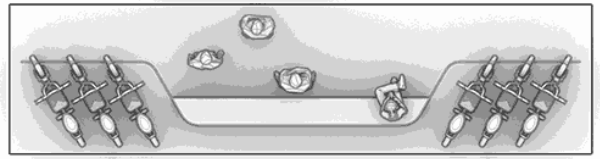


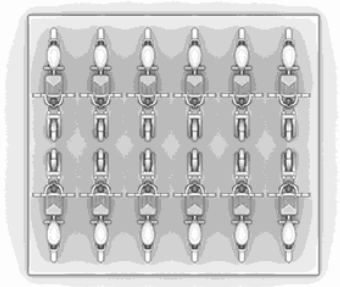


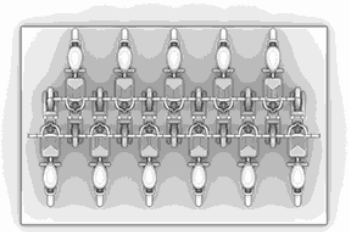
Ideation

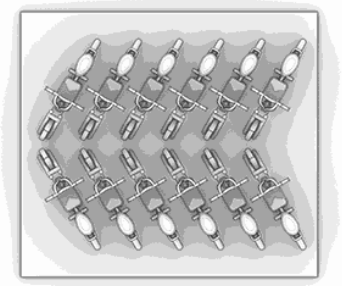


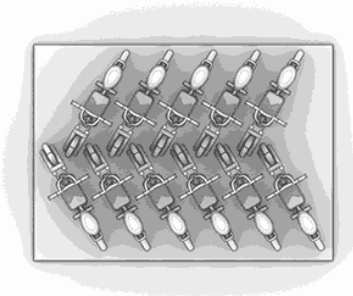




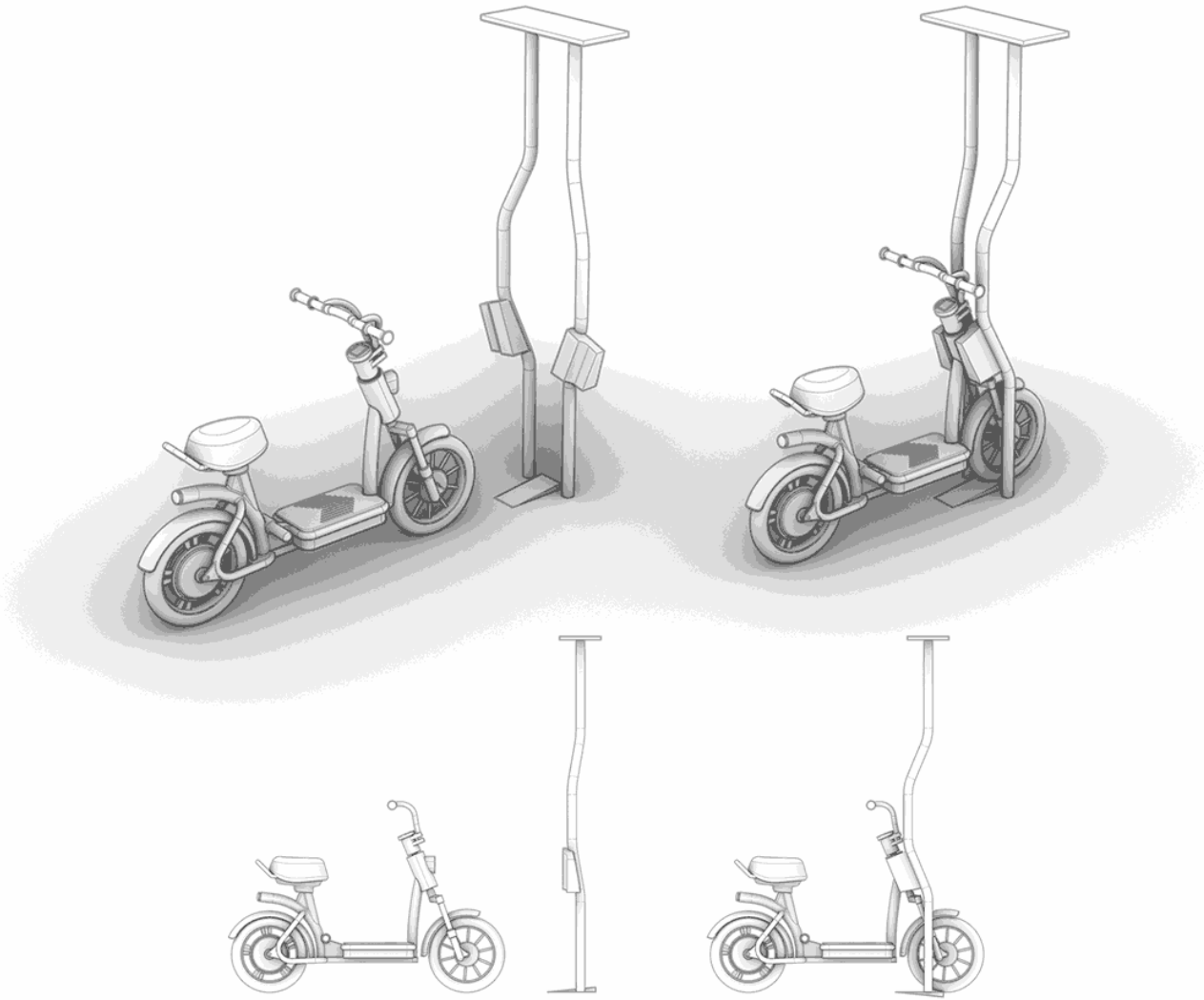


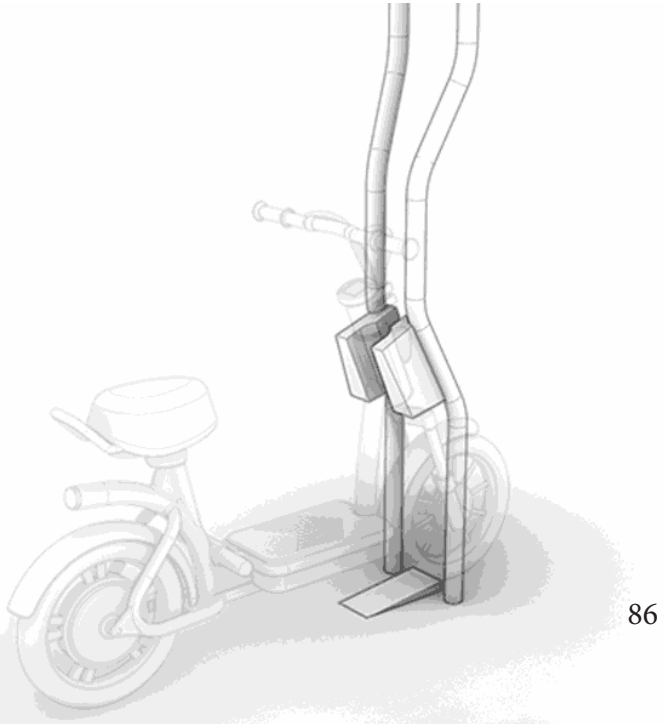


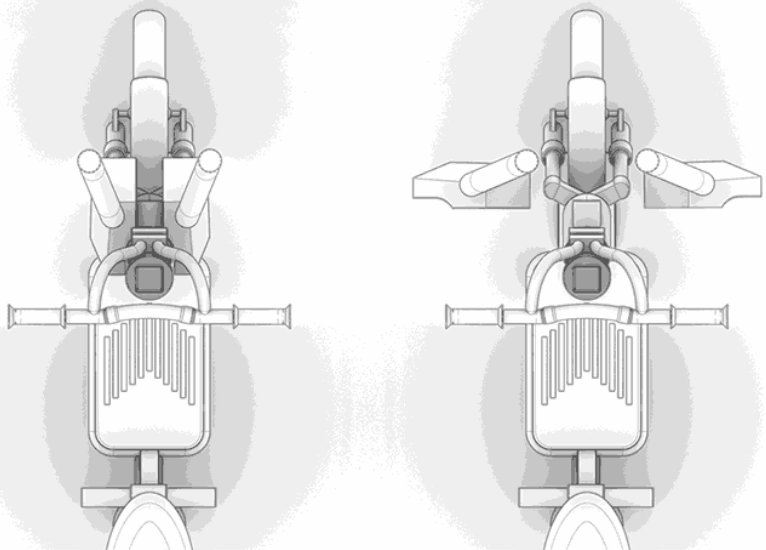




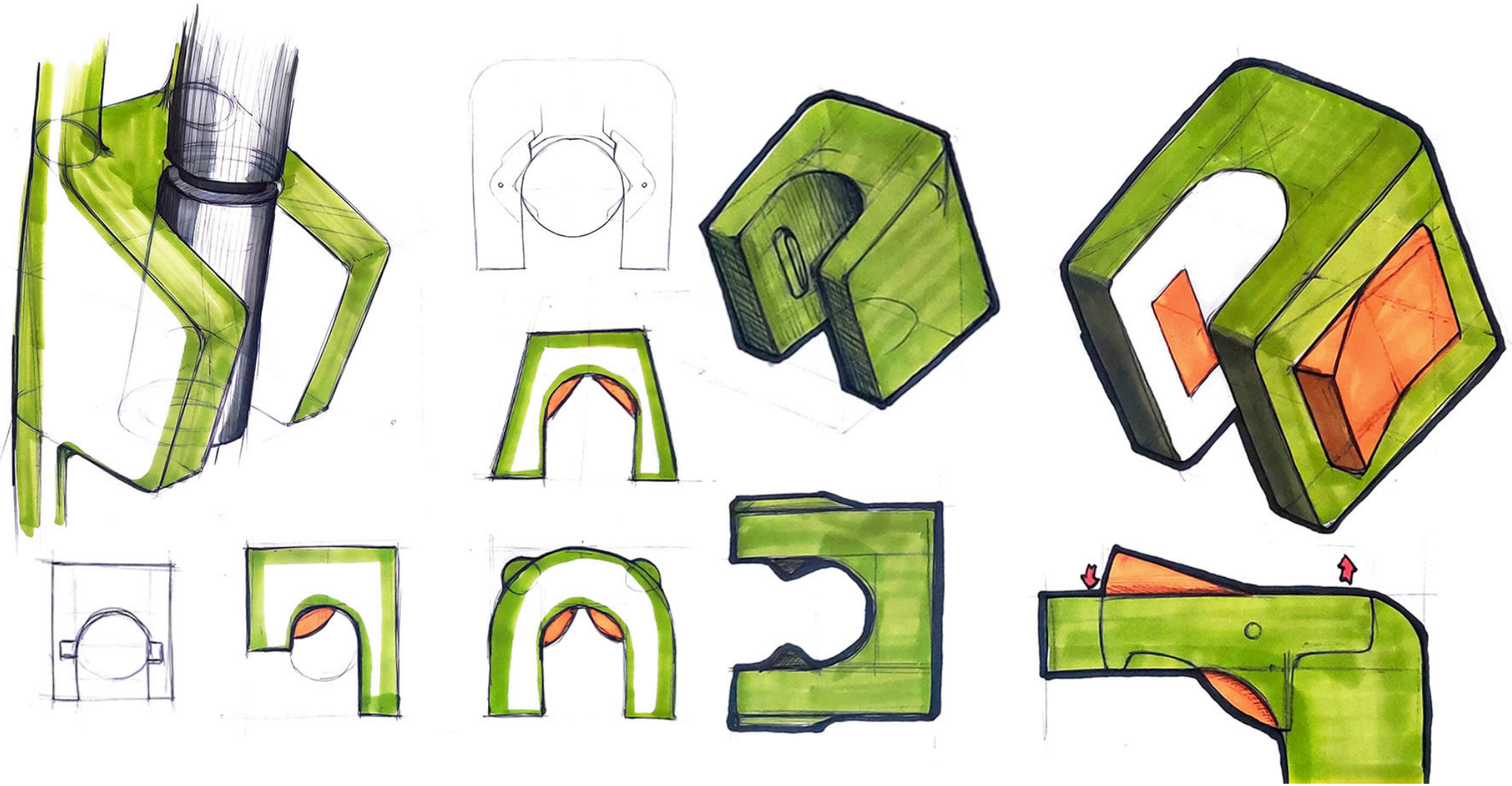
Locking Concept



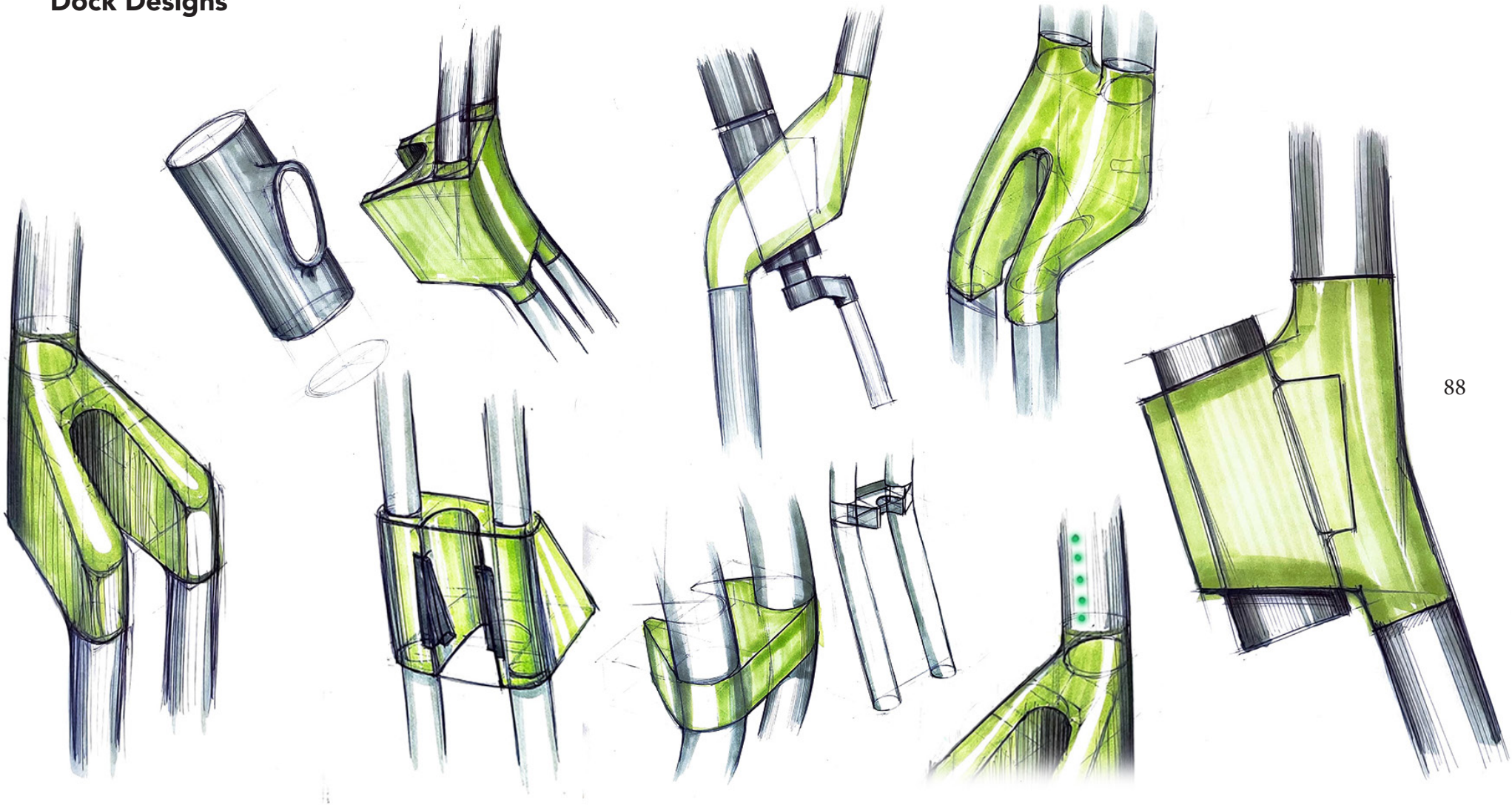


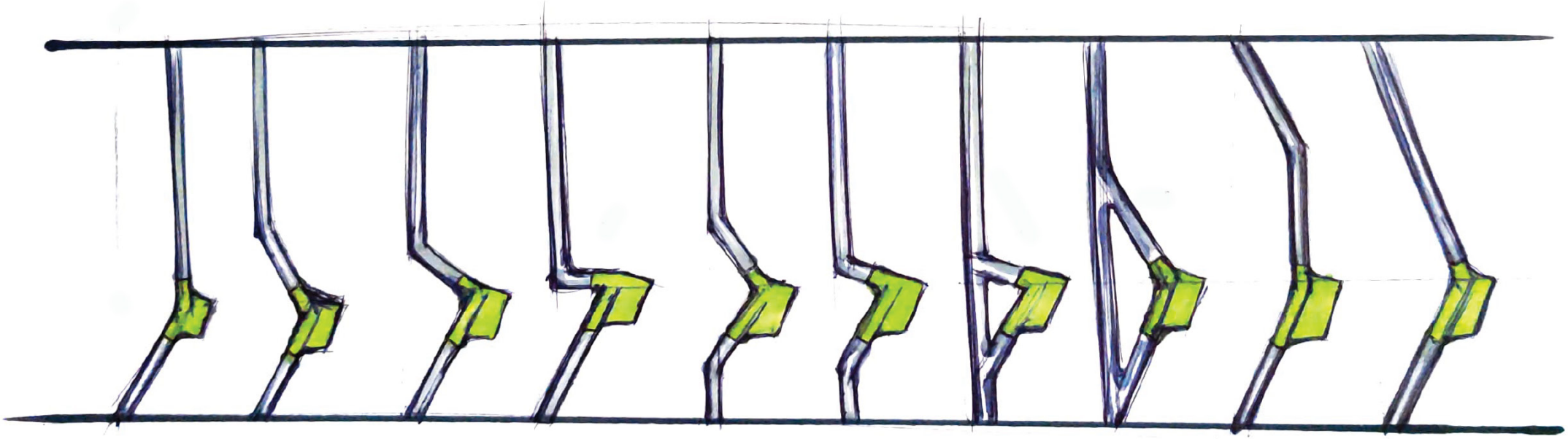


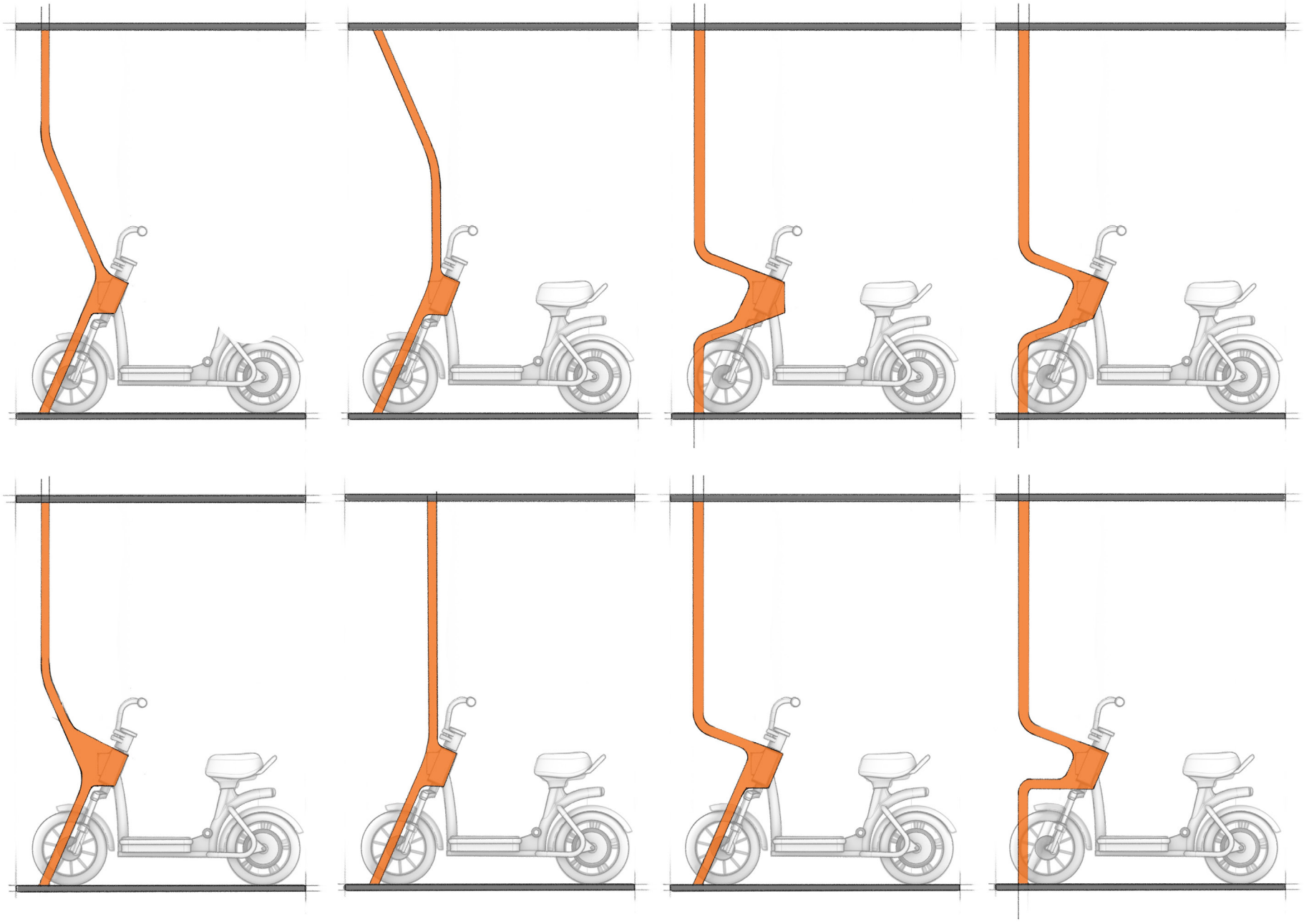
Ideation

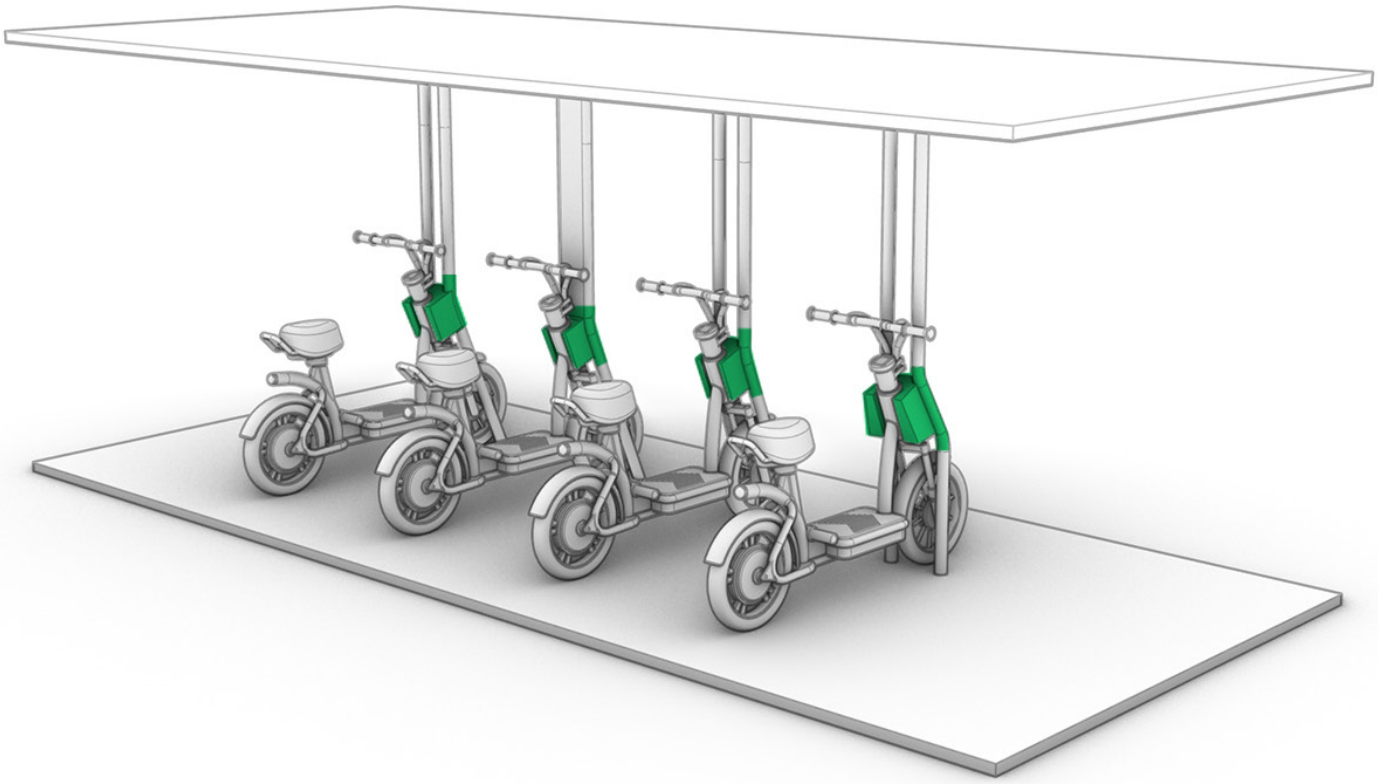


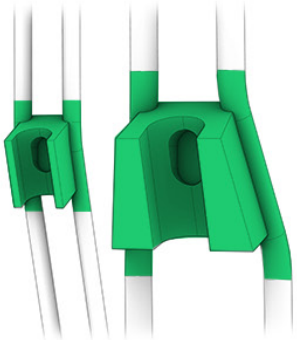
Dock Designs

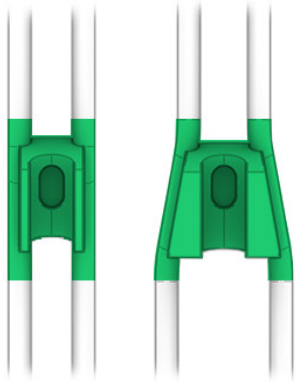


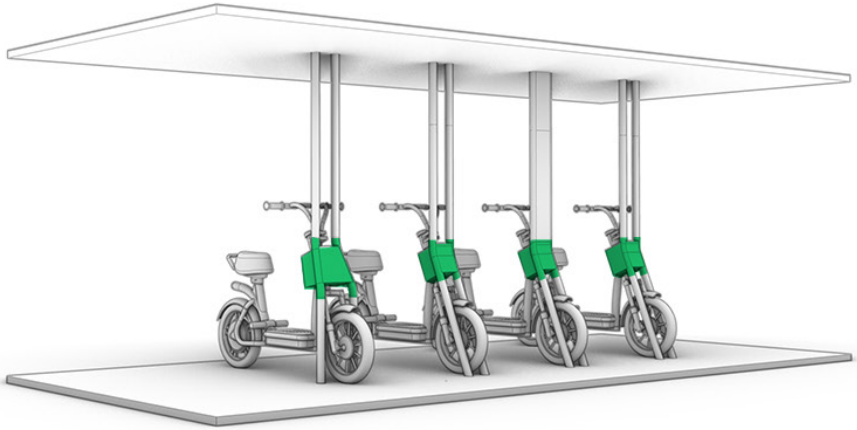


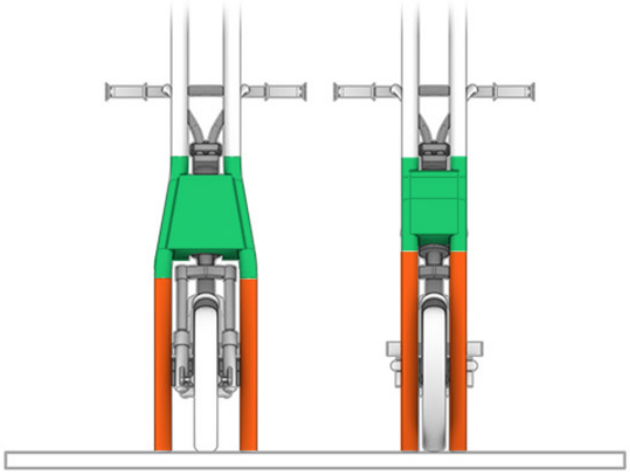


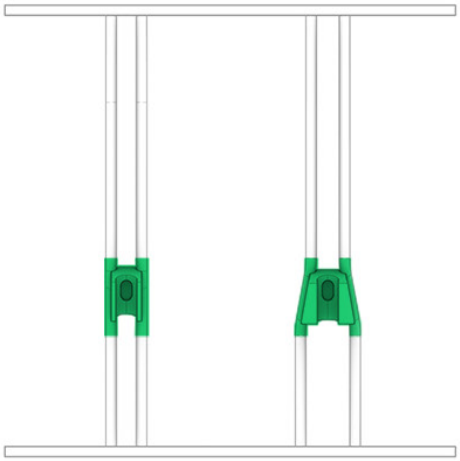


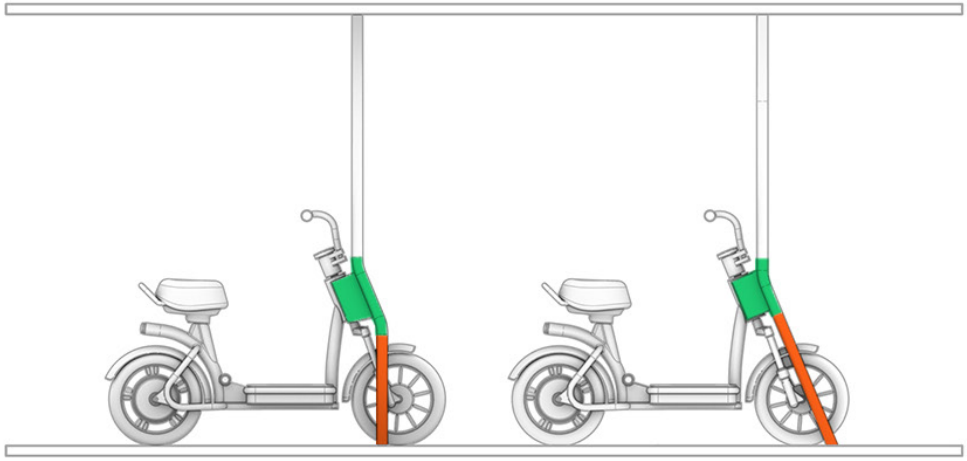


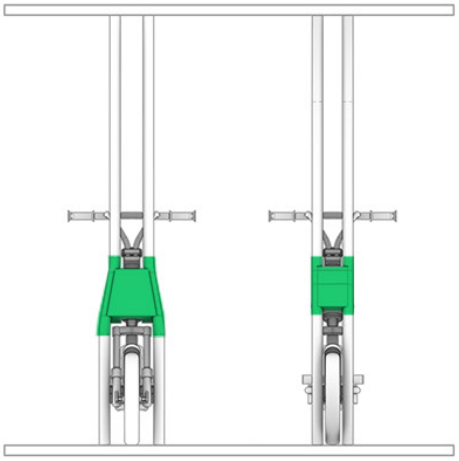




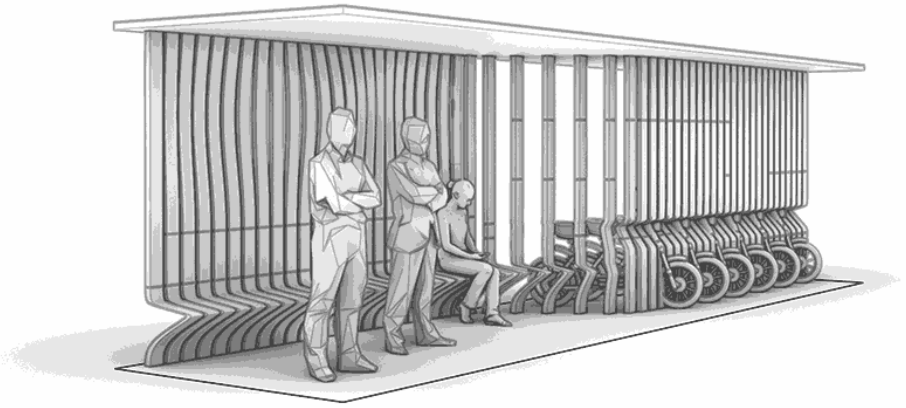


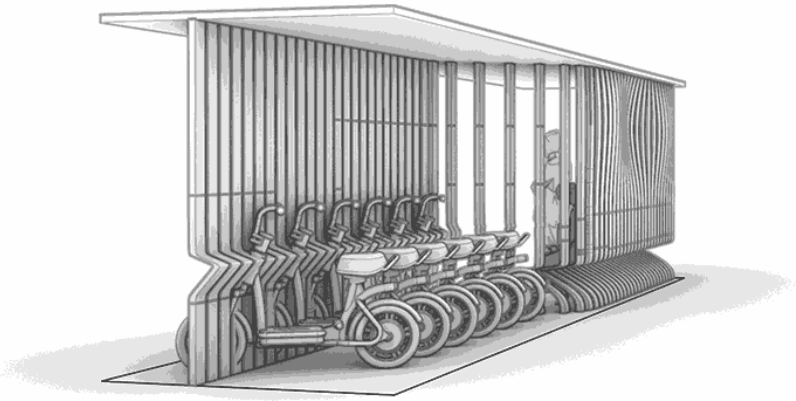


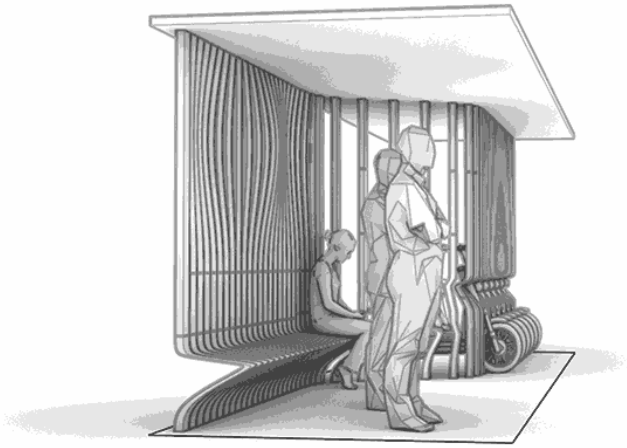


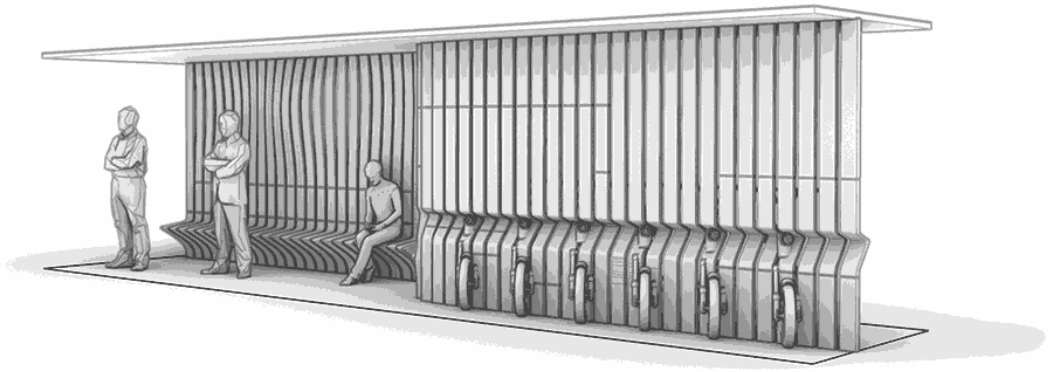


Final Concept #1

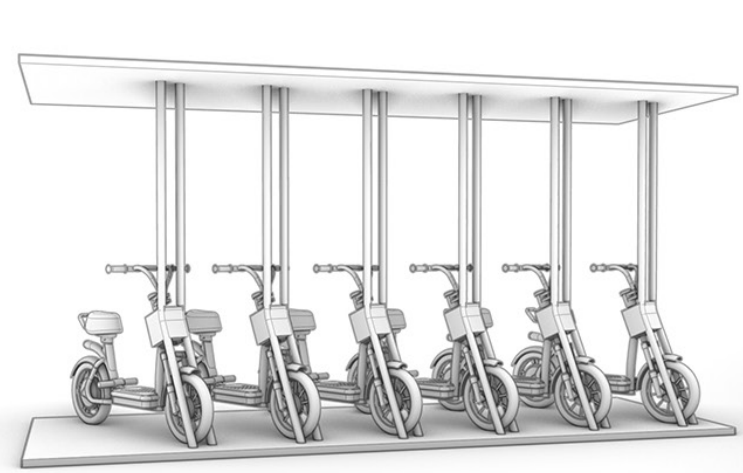


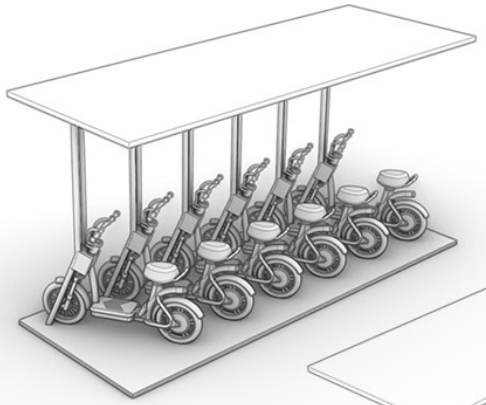


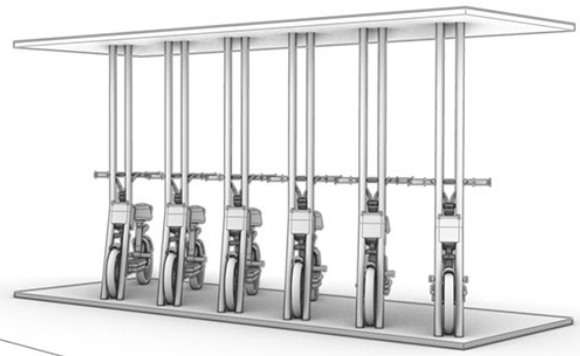


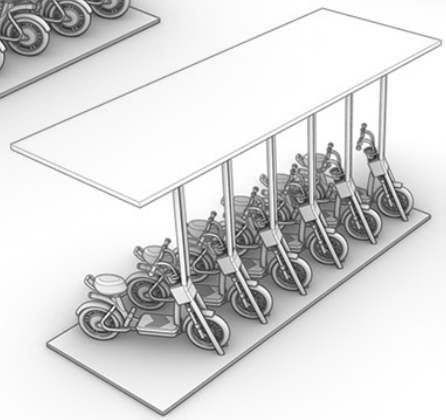


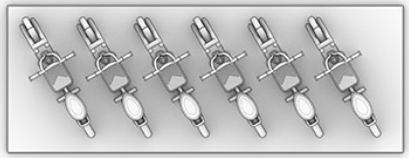
Final Concept #2

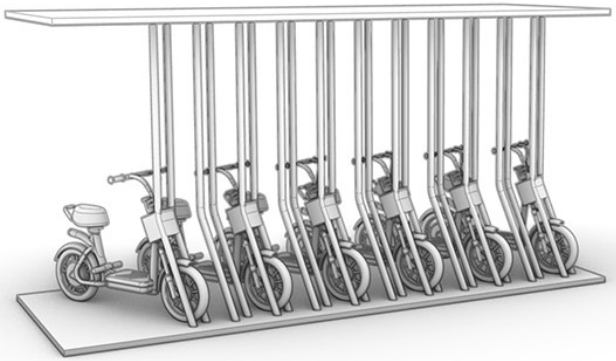


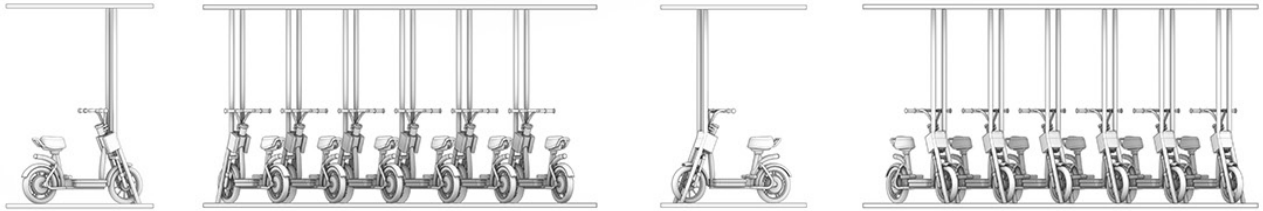






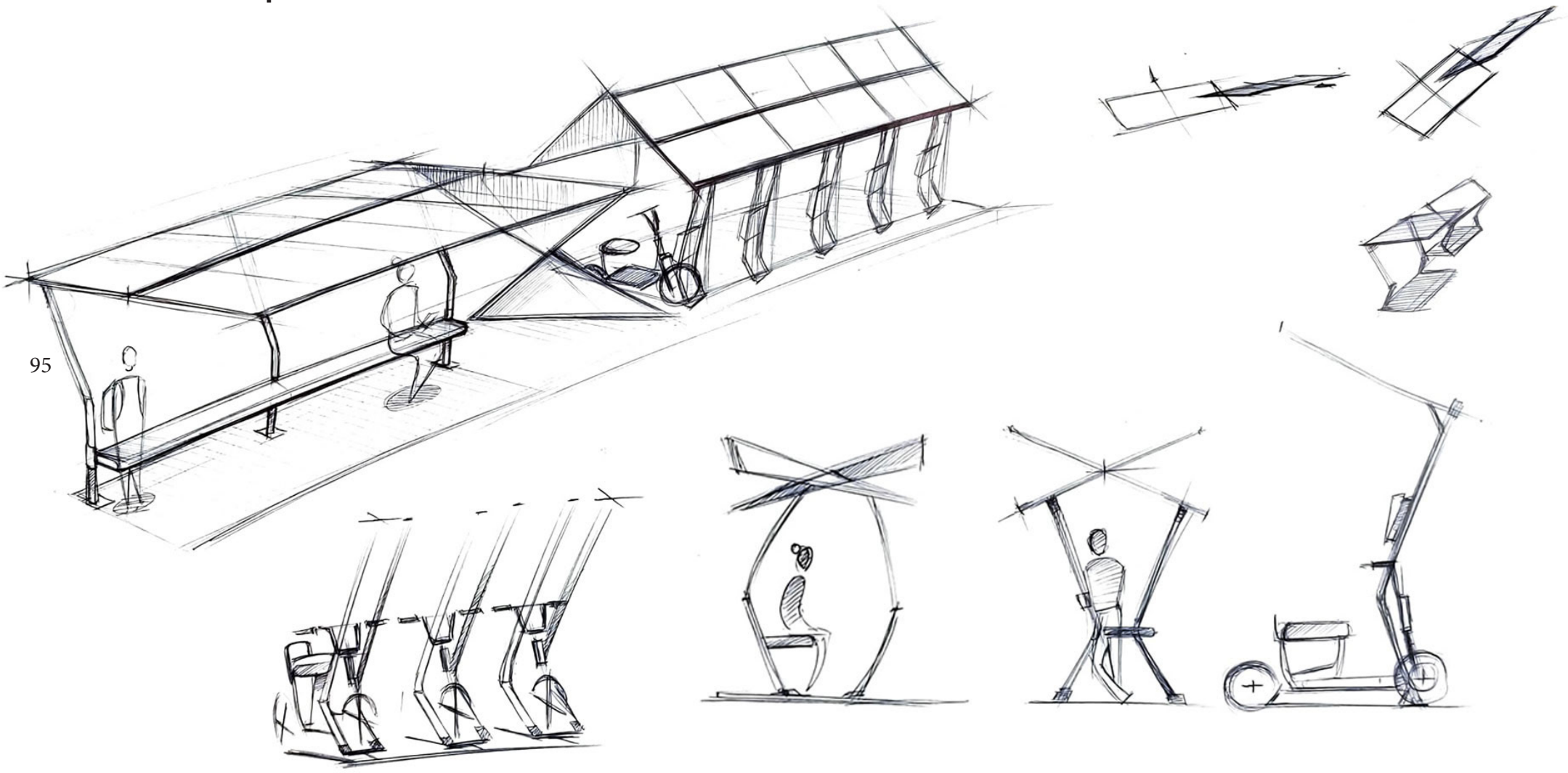


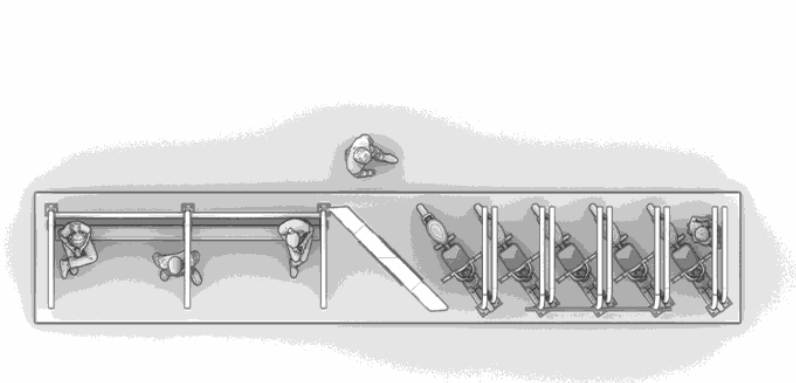


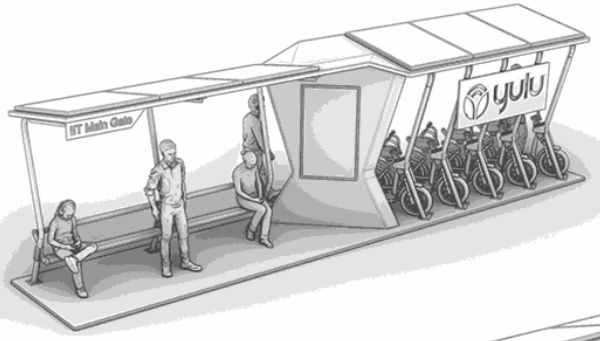


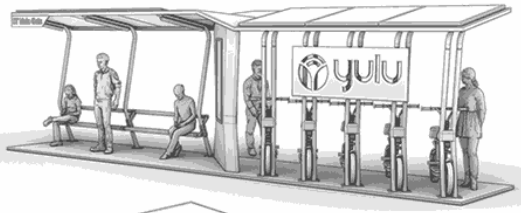
Final Design

Final Concept






IIT Main Gate
yulu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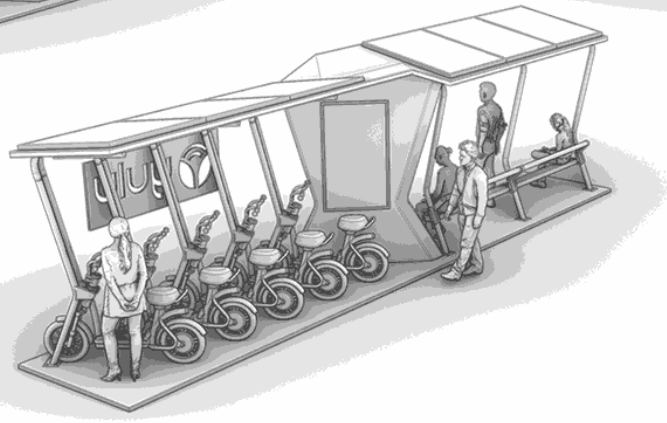
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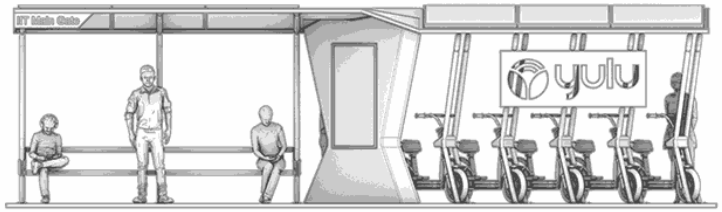
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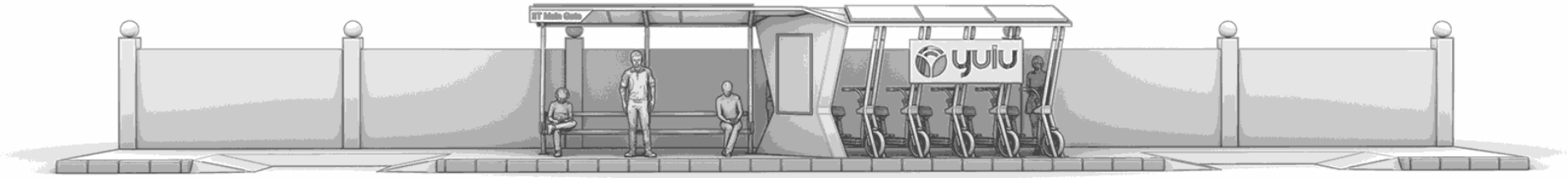
IIT Main Gate
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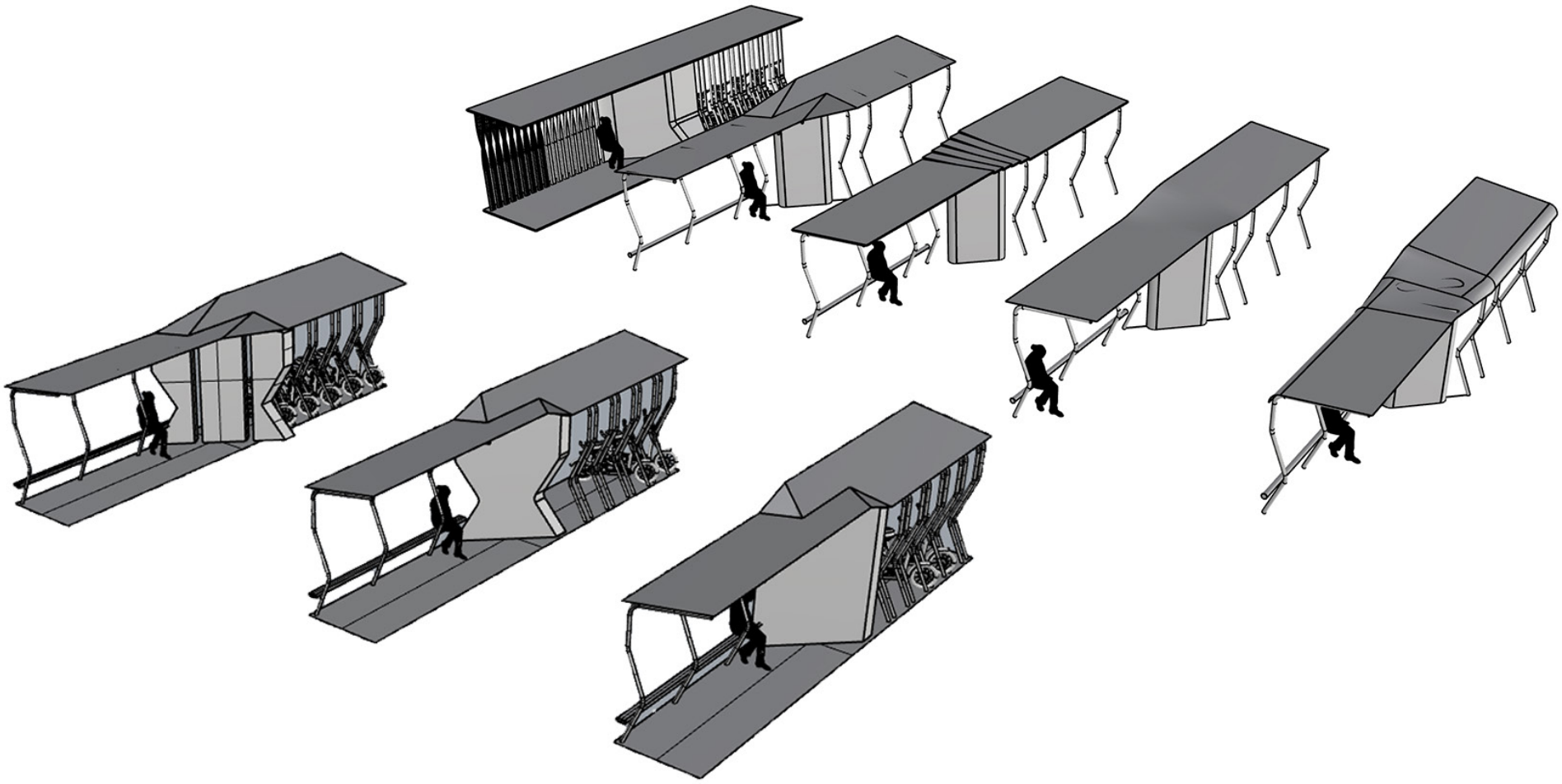
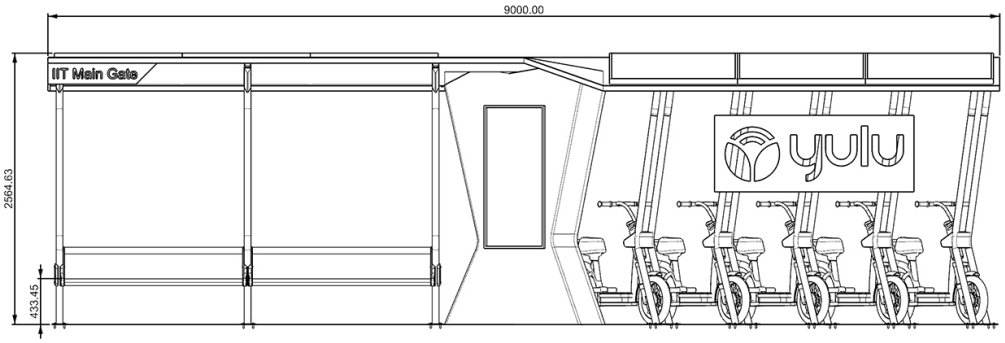
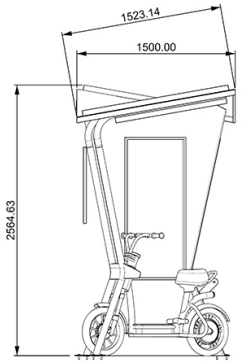
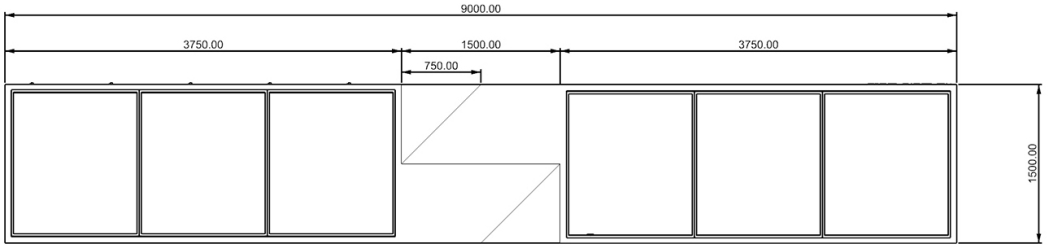
Final Design

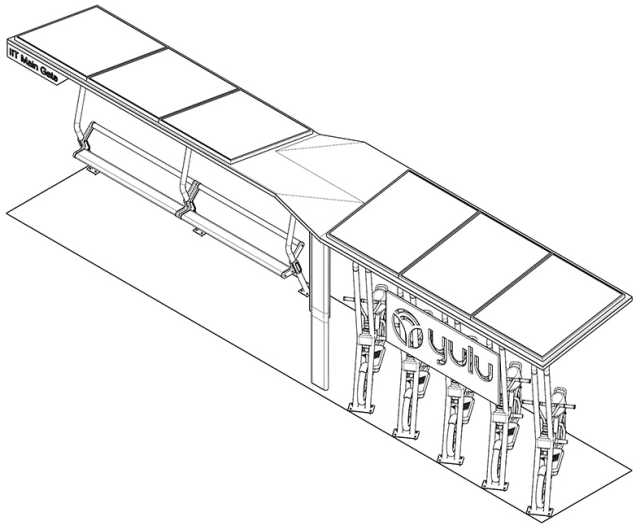


Dimension Drawing

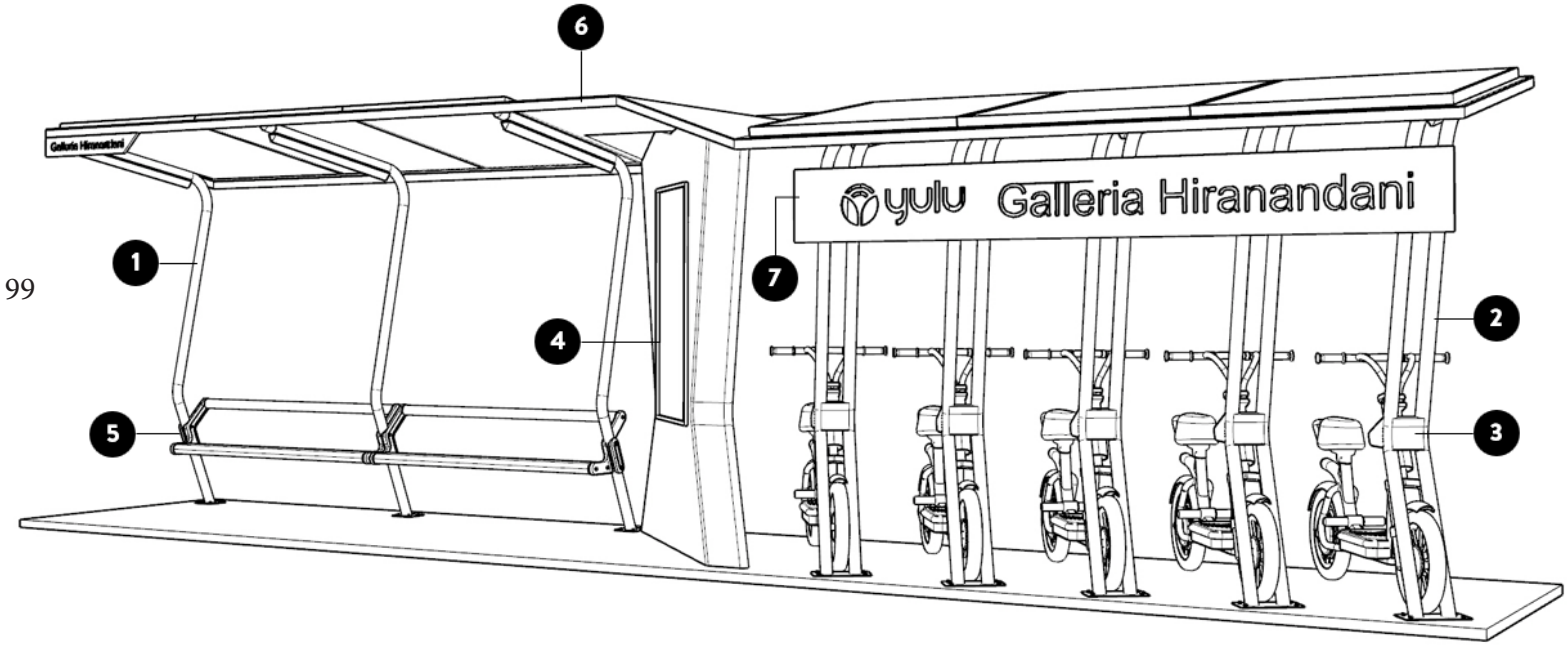








Parts to be Manufactured



Parts

1. Bent Pipe Type 1
2. Bent Pipe Type 2
3. Dock port
4. Battery housing
5. Bench
6. Roof
7. Branding

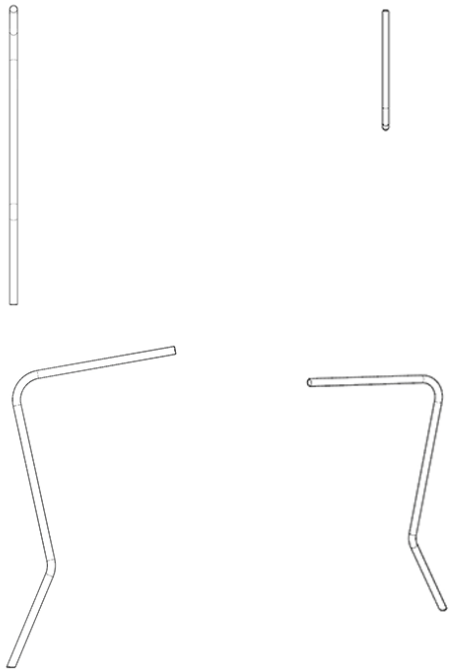
Parts

1. Bent Pipe Type 1x3
2. Bent Pipe Type 2x5

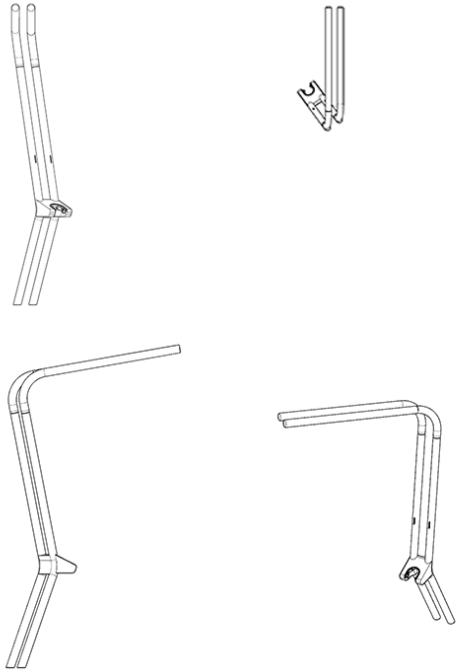
All pipes are bent in 40cm Dia using the same die to reduce production costs.

The thickness of the pipes used is 60mm with 14-16 Gauge to induce strength to bear the load of top and solar panels.

Bent Pipe Type 1



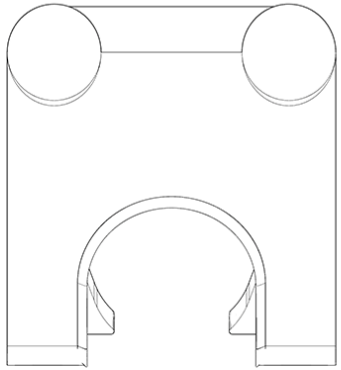
Bent Pipe Type 2

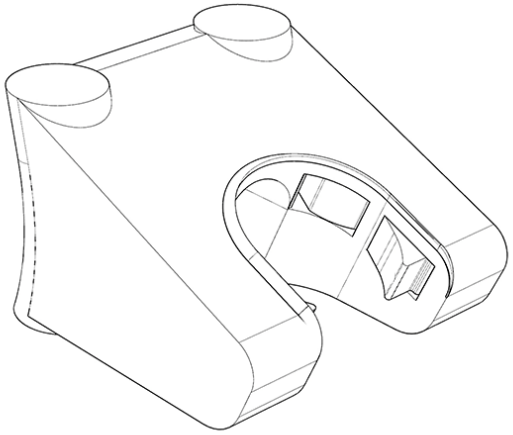


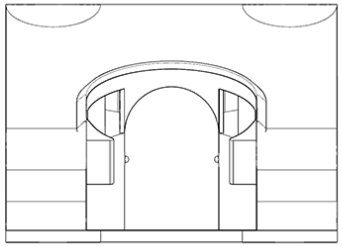
3. Dock port

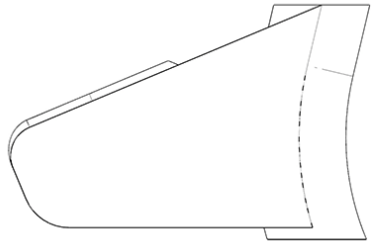
The Dock part is joined through internal bolting to the Bent pipe type 2 to make the dock more rigid.

High Pressure Die Casting(HPDC Machining) process will be used to produce the Dock part with Aluminum to keep it light and higher strength.



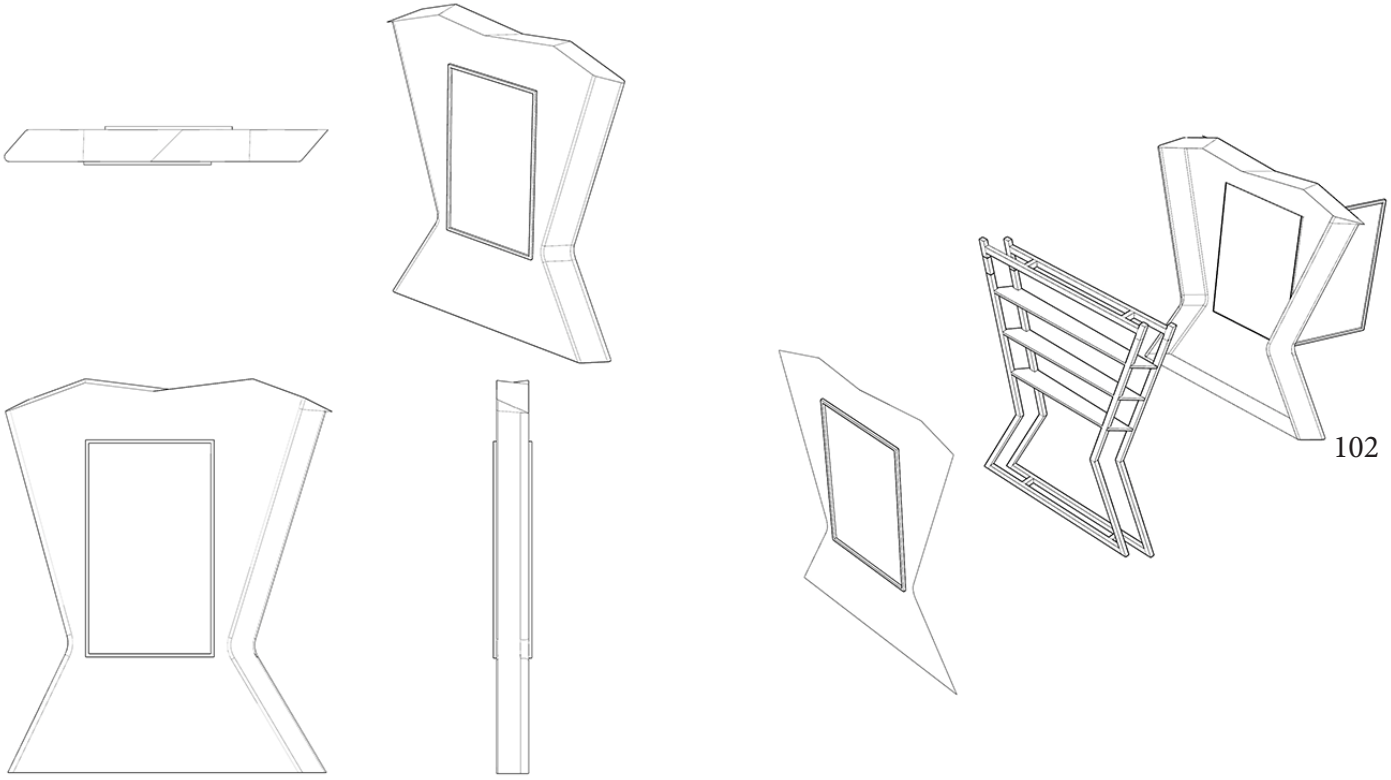






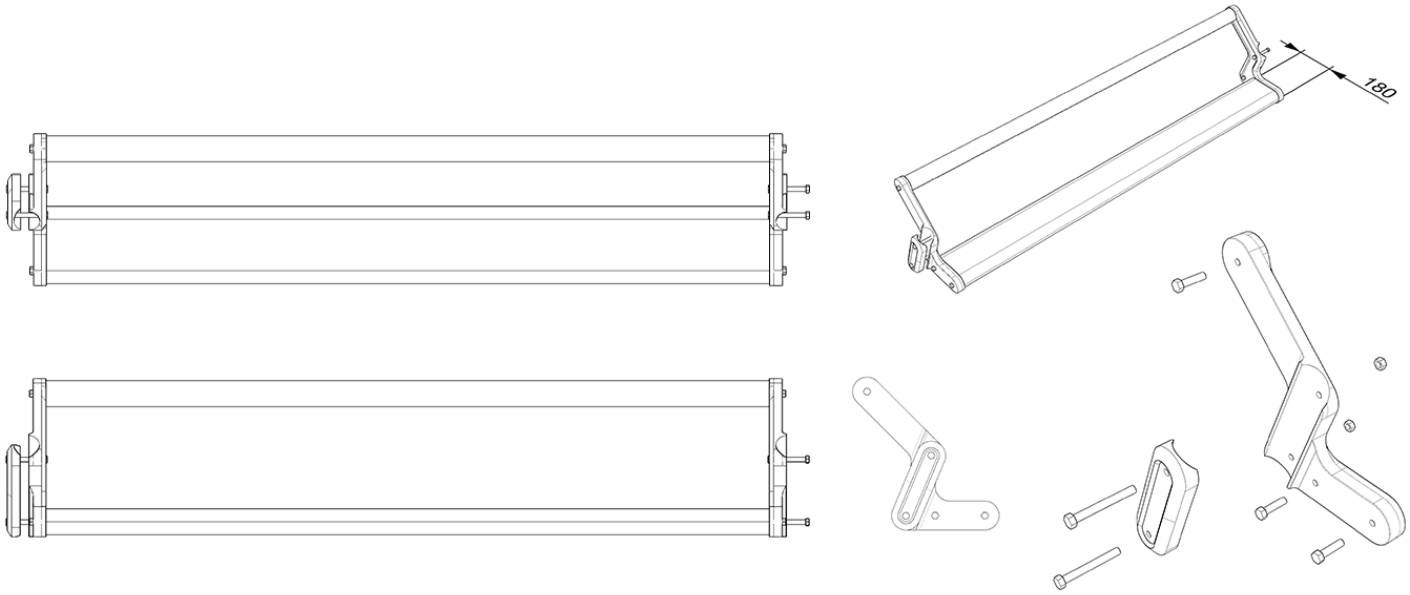
4. Battery Housing

The housing is made of 2 parts which are joined together via fasteners. The main structure is made of metal pipe frames where batteries can rest and other circuits like Charge Controller and distribution board can be kept.
The outer cover is made of sheet metal with one panel that can have quick access after opening the Yulu info panel and the opposite side which can be used to do occasional Major jobs.



5. Bench

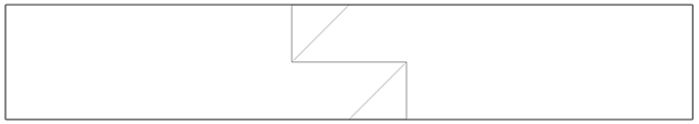
The bench has 3 parts and is directly bolted to the main pipes at a height of 45cm above the ground.
The bench is 18cm wide making it hard to sleep but comfortable enough to sit.
A single pipe back support is also provided so commuters don't fall back.
Both of these parts are connected via a side joinery which is cast

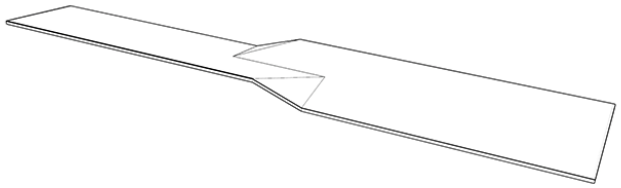


6. Roof

The roof follows a twisted design approach to reduce manufacturing panels. It can be manufactured into two or more subdivided parts, which complement each other around the center.
The Design is twisted to prevent the rainwater from coming in front of the passengers.

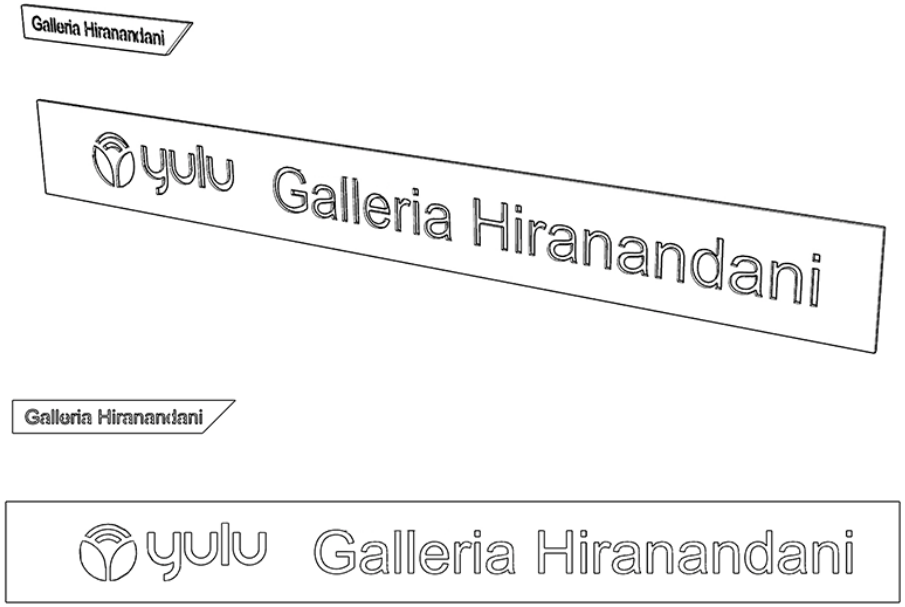
Further, the water can be channelled to drains via one or more of the pipes being used in support structures.



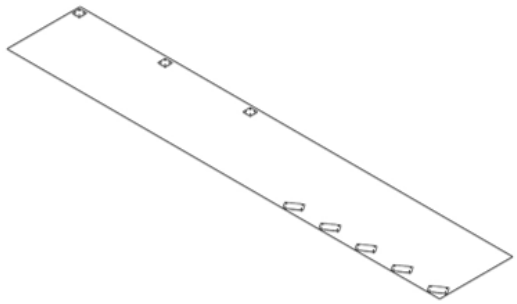


5. Branding/Signage

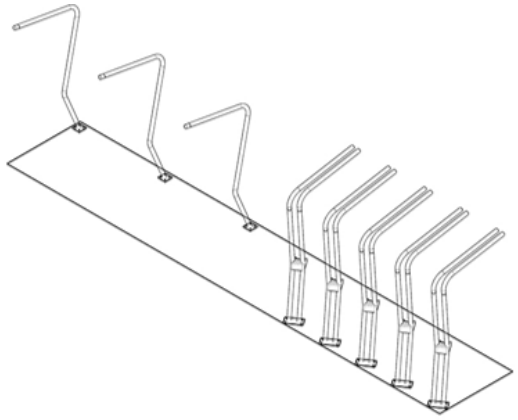
Branding and signage can be made with sheet metal welded to create a structure that can be internally lit.



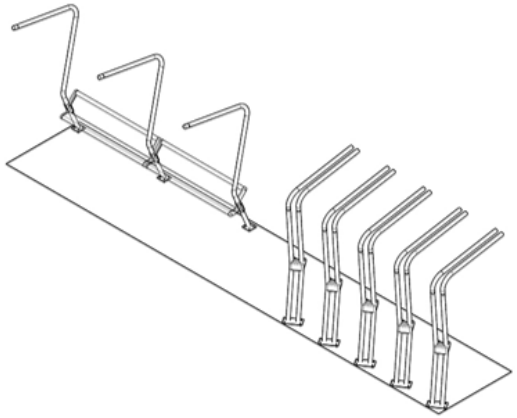
Installation



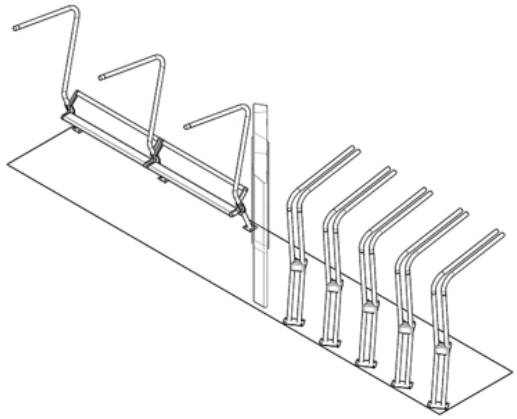
Concrete Foundation



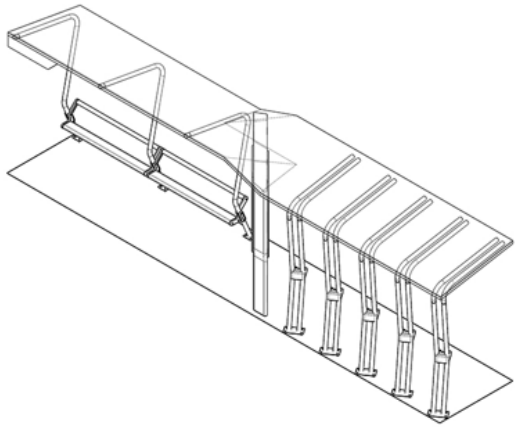
Pipe placement



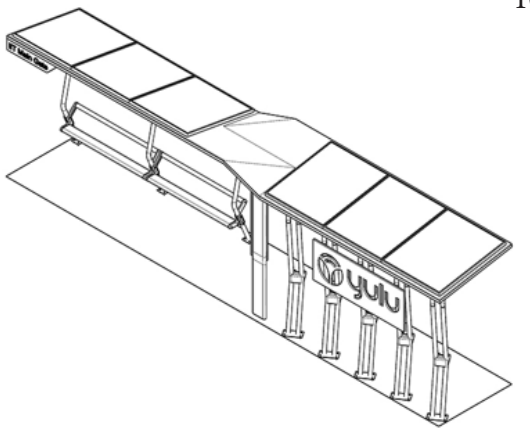
Seating placement



Battery housing Placement



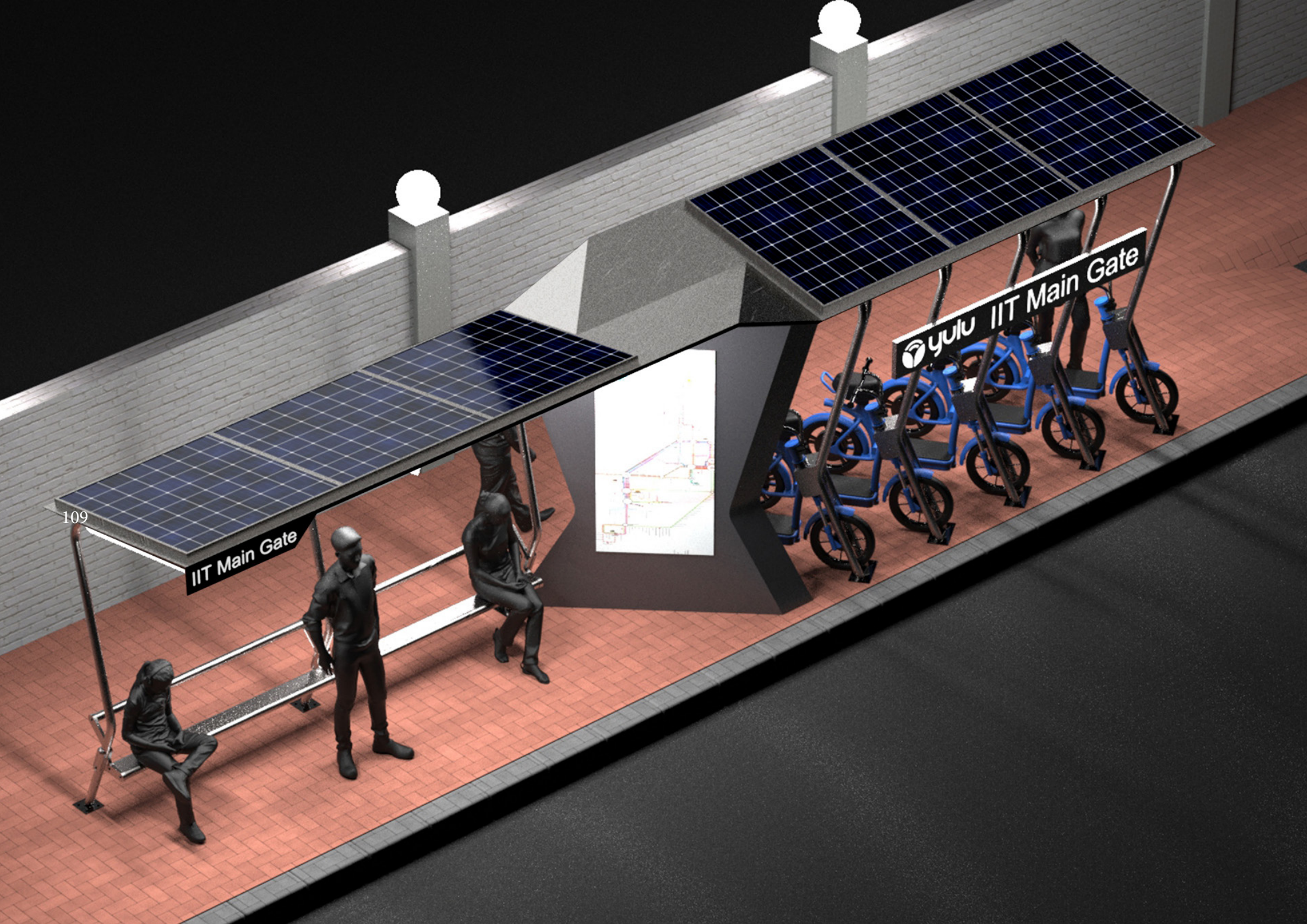
Roofing



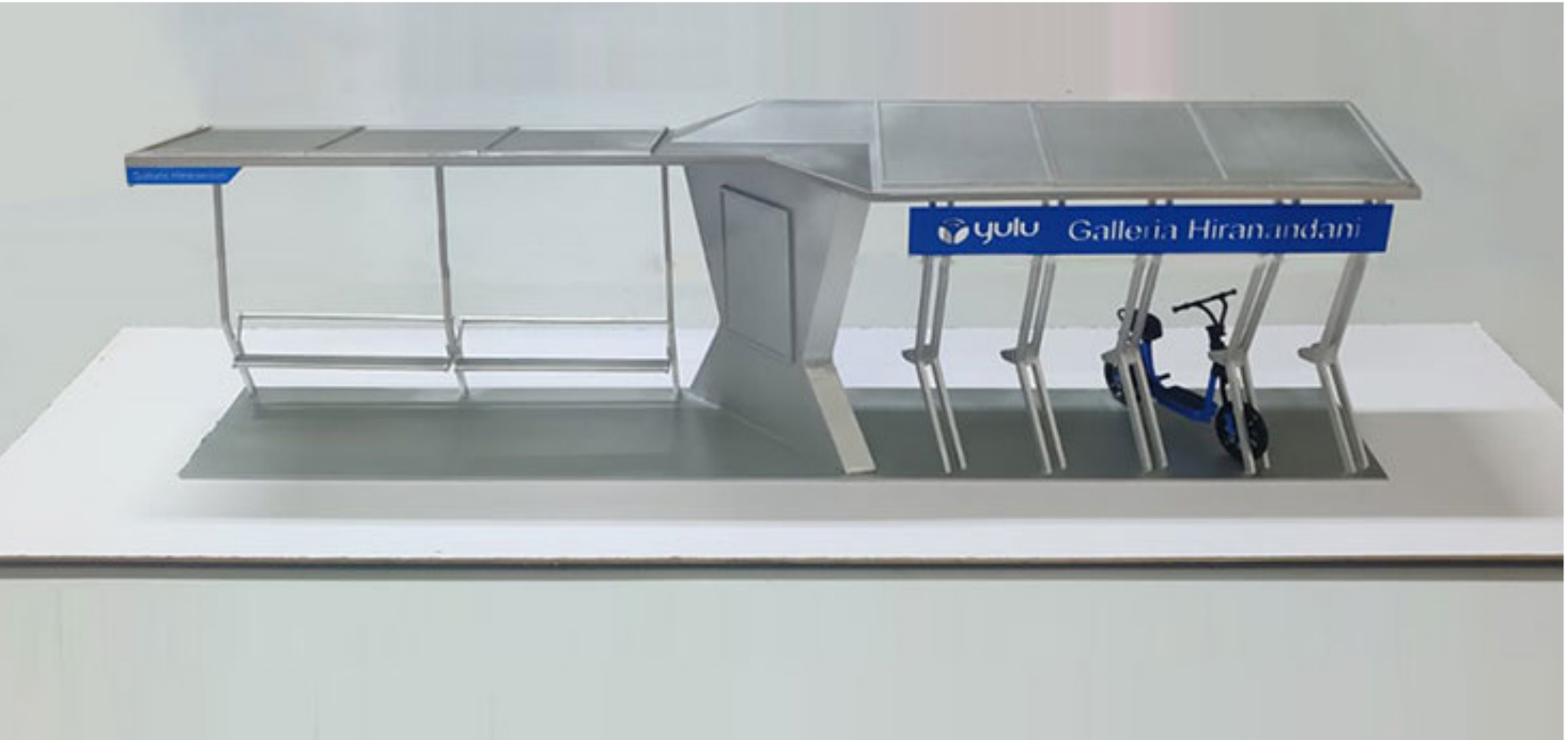
Solar panels and Signage installation

Renders

Docking, locking & Charge Of Shared Micro-Mobility


IIT Main Gate
yulu IIT Main Gate


Final Model


yulu Galleria Hiranandani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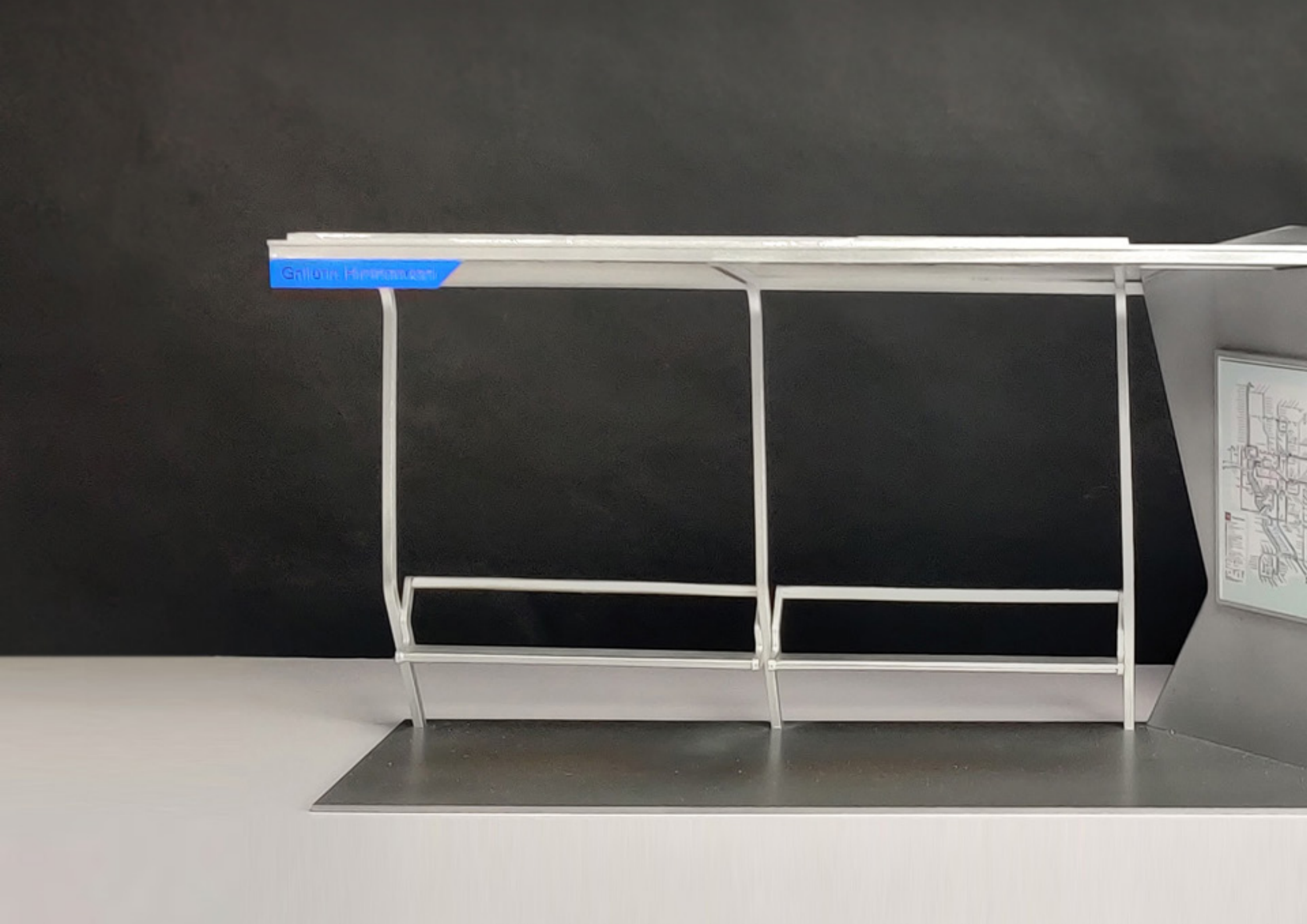


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List of Figures

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