IDC School of Design
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DESIGN OF A PUBLIC COMMUTER VEHICLE FOR GUWAHATI

Design project II

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Guided by Dr. Sugandh Malhotra

DECLARATION

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

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APPROVAL SHEET

This Mobility and Vehicle Design project report entitled “Design of a Public Commuter Vehicle for Guwahati”, by Abhishek Gogoi is approved in partial fulfilment of the requirement for Master of Degree in Mobility and Vehicle Design.

Project Guide:

Chair Person:

Internal Examiner:

External Examiner:

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I would also like to thank Professor Nishant Sharma, for helping with the project assessment from the very beginning.

And last but not the least, I would like to give a huge heads up to my classmates, my friends back in Guwahati, my parents for their unconditional support and crazy ideas throughout this journey. Also, the RTO department of Guwahati, the public and the trekker association of Guwahati, for taking out their time to help me with my project.

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ABSTRACT

The Advent of road transport in modern Guwahati as elsewhere in India, has developed during the British period. The first form of a vehicle used in Assam, was in the year **1942**, at the WWII time; a military bus used to run through the heart of the city for their own use. Post-independence, new roads were constructed and major repair happened. **1947**, the first city bus was placed on the roads of the city. It was a Ford-L Land Bus, named 'Shuttle Service', later renamed as 'Navayuga'. By the year **1975**, there were 8 city bus routes spawning over the entire region.

A decade ago, the popular means of transportation within the city were cycle-rickshaw, Auto-Rickshaw and City buses, city buses being the most widely used mode. It was however found that, even though the bus routes were widespread, it did not connect the localities thoroughly. There was still a large section which remained unconnected; narrow lanes were primarily the reason prohibiting the entry for buses. To tackle this issue, in **2003,** Assam government came up with a new transport system – by use of a stripped-down Tata Sumo, naming it the *'Trekker'* system. It received an overwhelming response from the crowd.

Over the course of development, the transport system in the city has developed a giant leap, with the government recently launching a fleet of

400 AC Volvo buses. Trekker service, has seen considerable changes since its establishment. But this hasn't been addressed in depth, one of major concerns is overcrowding of the vehicle.

This project deals with the acute problems faced in the trekker segment and redefining it from grounds-up to make it stay updated to the current aesthetic and safety norms that ply on the road globally keeping the routes of Assam preserved.

As per the research, brief was set to design a new four-wheeler vehicle with ease and quick ingress/egress capability, weather protection and safety and humbleness in the design to suit to the Guwahati city context. Safety, modern, humbleness and welcoming were the keywords in shaping up the final design.

STAGE 1

This stage includes the initial contents of the project giving it a concrete base and structure, for this will make the project an efficient and fruitful learning enitity and experience for the student as well as the audience and people involved and associated with it.

This stage basically comprises of the Research, Observations and analysis carried out in order to build up a case for the project, articulating the problems associated with the present system and helping foresee the scope and room for solutions. This is followed by studying other vehicles tha are used for purpose similar to the subject of research. Further, beyond this is the benchmarking, which is to form a basic level of requirements needed to look upto or take inspirations from. All this is articulated properly to come up with a concrete design brief. Following are the contents of this stage:

Overview of Guwahati Public Transport (Personal + Internet)

Observation

Inferences (from observation)

Quantitative Passenger Analysis

Qualitative Passenger Analysis

Inferences (from quantitative passenger analysis)

Qualitative Driver Analysis

Inferences (from qualitative driver analysis)

Brainstorming Tata Sumo and Trekker

Brainstorming similar purpose vehicles used locally

Brainstorming similar purpose vehicles used globally

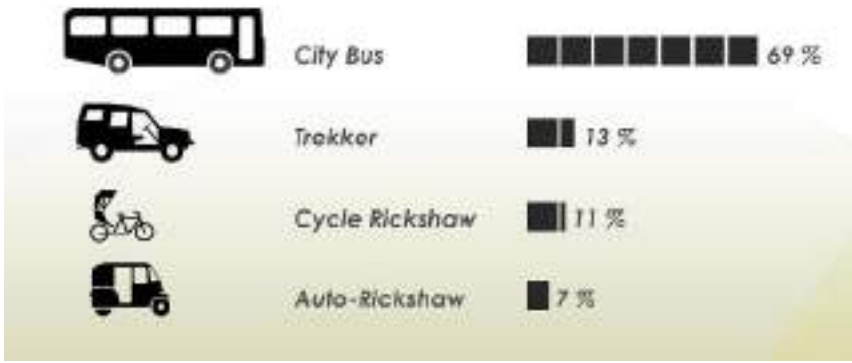
Benchmarking

Design Brief

OVERVIEW OF GUWAHATI PUBLIC TRANSPORT

Major commuting modes in Guwahati

This research was to understand the transport system that functions in the city premises, the various means of transportation, the advantages and disadavantages of each of the different modes. Also to understand why the trekker system was introduced in addition to the city buses, auto-rickshaws and cycle-rickshaws.



Based on the data obtained from RTO Guwahati, the city bus takes the most number of passenger transportation, racking up to 69% and a total of 1294 buses plying on the streets. Second comes the Trekker, racking up 13%, and 1100 vehicles on the roads, about 2 lakhs passenger use this daily. And although, Auto-rickshaw, 4530 count, provide much better transportation than cycle-rickshaw, but not adhering to the meter fare rules, auto rickshaw loses out to reach out to people. Cycle-Rickshaw controls approximately 11% of the total market. The bottom slot taken by the Auto-Rickshaw at 7% of the total count.

The next stage after this primary data and analysis, was to briefly examine these modes of transportation. Every mode has its pros and cons. Part of it was searched online, part of it was conducted personally. The cycle rickshaw segment is quite popular; DoD - IIT Guwahati (under Dr. A. K. Das, HOD, DoD – IIT Guwahati) has developed a new design for rickshaw users and it is sold by the name ‘Dip-Baahan’. Auto-rickshaws suffer as mentioned before, due to lack of following the regular fare, public in general try to stay away from it.

Coming to this stage, delving deeper into the research, it was found that, cycle-rickshaw and auto-rickshaws are privately owned. While the former is restricted in some lanes, auto-rickshaws can work anywhere within the city permits. Advantages and disadvantages of each of these modes are thoroughly mentioned in the coming section.

Cycle-Rickshaw

Advantages

Can navigate easily in narrow lanes

Passenger-friendly during flooding of streets

Ideal for short distance commute

Comfortable to get a ride on

Better viewing for both the rider and the passenger

Disadvantages

Do not cover long distance

Slowest mode of commuting

Cannot carry more than 2 people

Not the cheapest mode for commuting

Have restrictions for plying on public roads

No proper registration at RTO/DTO

AUTO-RICKSHAW

Advantages

Can carry people most comfortably

More personal space for the passenger on-board

Quickest mode of transport

Adequate rain protection

Point to point dropping

Disadvantages

Biggest flaw: does not follow meter rules for fare

3-wheeled, not the safest mode

Do not travel longer distance compared to buses

Passenger has to reach auto stands, rather than having multiple nearby auto stands

Small coverage in availability

CITY BUS

Shared mode of commuting within the City premises.

The advent of road transport in modern Guwahati as elsewhere in India, has developed during the British period.

Post Independence, the first bus was introduced in **1947**; a Ford L-Land Bus.
Also known as 'Navayuga' in the city.

By **1975**, there were 8 city bus routes.

Currently, there are **1294** counts of buses plying on the road and 15 routes across the city.

CITY BUS

15 routes across the city | 1294 buses | Fare ranges from Rs. 5 to Rs. 23

City Bus route mapping across Guwahati

Advantages

Can carry large number of passengers.

Comfortable when not in peak hours.

Cheapest mode of traveling.

Covers a large traveling distance.

Safe especially during heavy downpour.

Disdvantages

During peak hours, gets beyond over-crowded state.

Not the fastest mode of transport.

Follows a certain route, difficult in navigating through narrow lanes.

Passenger fear of getting pick-pocketed.

A large area still remains inaccessible.

With the three modes of transportation inside the city, the city buses were the most sought after one. But it can be seen, the coverage of the city bus routes in the region is not wide, it does not connect the city outskirts to the main city. Also within the city premises, the coverage of the bus routes is not enough for the public to connect well. There is a large region, especially in the west of the city as can be seen in the map shown previously, that is uncovered by the bus routes. Also, North Guwahati as well as 'Lokpriya Gopinath Guwahati International Airport' also remains unconnected by it. Apart from this, even within the central region, a lot of these paces are connected by by-lanes and narrow streets which cannot be tread by city bus because of their larger size.

There was a need to address these shortcomings in connecting the local areas within the city.

To counter this, a new transport system was introduced in the year 2003, named Trekker service. There were primarily two major objectives of this introduction; one – to provide better connectivity within the city; two – to provide employment to the youth of the city.

VEHICLES CONSIDERED AS TREKKER IN 2003

Prospective vehicles

	PRICE	POWER	LENGTH	WHEELBASE
 Force Motors Trax	5.4 – 8.6 lacs	60 ps	4832 mm	3050 mm
 Tata Sumo Spacio	4.2 – 4.9 lacs	60 ps	4552 mm	2425 mm
 Hindustan Motors Trekker	Discontinued	37.5 ps	3833 mm	2311 mm
 Mahindra Jeep	- 5-6 lacs	50 ps	4305 mm	2400 mm
 Mahindra Maxx	4.55 – 4.91 lacs	62 ps	4985 mm	2430 mm

**Early 2000s*

From the above speculation, the right choice for the new trekker service was Tata Sumo. It is more affordable than almost all its competition, it is also the most modern in terms of architecture used, it also is the second most powerful vehicle, producing only 2ps less than the class leading (Mahindra Maxx). And above all, it is backed by TATA Motors' wide service and repair network.

Tata Sumo was further modified to make it more accessible to the owners and be more user friendly when public transport comes to scene. The trekker service garnered a huge success from the public. There are nearly 2 lakh passengers who depend on this mode of transport and 1100 trekkers currently ply on the city as of till date 17th August 2016.

Tata Sumo

Trekker

Further, from the RTO Guwahati (Kamrup Metro), a data explaining all the various trekker hubs was obtained. A detailed map showing the trekker routes was made by the help of Google Maps. In the coming section, we can see there are 23 hubs and its subsequent routes across the city. The reach of trekker system is far more wider and deeper than all the other modes. It connects the outskirts of the city and important locations such as North Guwahati and the airport. Also, it can be noticed, how dense the routes are in the main city area, thereby well connecting the inter-city localities.

s

LIST OF THE PRESCRIBED ROUTES IN RESPECT OF TEN SEATER SHARE TAXIES
(TREKKERS) INTRODUCED BY THE RTA, KAMRUP FOR PLYING WITHIN CITY AREA UNDER THE SCHEME "CITY CAB 2007" SHOWING NUMBERS OF PERMITS ISSUED AGAINST EACH ROUTE.

Route No.	Route description	Numbers of permit issued		
		Periodic	Temporary	Total
1	2	3	4	5
R/No. 1(A)	**Nepalimandir to Balaji Mandir** via Rehabari, Serabbhati, Kalapahar Cycle Factory, Bhaskar Nagar, Lalganesh, Jyotikuchi, Lokhara Chariali	160	10	175
R/No. 2(A)	**Lalganesh to Nathorva(Housing Complex)** via Odalbakra, DPL Kahilipara, Ganeshguri, Little Flower School, Hatigaon Chariali, Sixmile Masat (Station Road)	33	2	35
R/No. 3(A)	**Public School (Jurnighat) 1 to A.G.Residential Colony** via Sankardev Kalakhetra, Sixmile Jatianagar Bylane Tiniali, Beltola Chariali, Ghoramara Chariali	18	0	18
R/No. 4(A)	**Rajgarh(chenni Rijyarr) to Adabari** via GMC Rupnagar, Birubari, A.V College, Chatipool Santarpara, Bharalumukh with extension up to T.V. Tower	62	4	66
R/No. 5(A)	**Sunchali to Chandrapur** via CISF Camp, Noonmati, Narengi Tiniali, Bhikalia, Bonda, Panikhaiti	6	0	6
R/No. 6(A)	**Jaipur(Lohing Academy) to Langa** via Satagaon, Geetpur or Amingaon, Dakshinpath Mandir, Bangmahal, Pholong	19	2	21
R/No. 7(A)	**Panda Colony to Balaji Mandir** via Panda Bazar, Maligaon Chariali, Gosala(Gotanagar or Nepali School), Boragaon	20	1	21
R/No. 8(A)	**Bharalumukh to Rani** via Maligaon, Jalukbari, Lakhipur, Garigaon, Satsang, Dharapur Chariali	1	0	1
R/No. 9(A)	**Bharalumukh to Balaji Mandir** via Fatasil Ambari, Dhirenpara, Garchuk	65	3	69
R/No. 10(A)	**Khanapara Veterinary College(Research Gate) to Kalitakuchi** via Sixmile, Express Highway, Barbari, Pathargaon, Narengi	31	0	31
R/No. 11(A)	**Khanapara(Veterinary College) to LGBI Airport** via Sixmile, Tripura Road, Jawahar Nagar, Basistha Chariali, Basistha mandir, N.H-37, Jalukbari	101	1	102
R/No. 12(A)	**Gita Mandir to Amingaon Jurchar** via Narengi Tiniali	75	2	77

TABLE 1: DATA OBTAINED FROM RTO GUWAHATI (KAMRUP METRO), PAGE 1

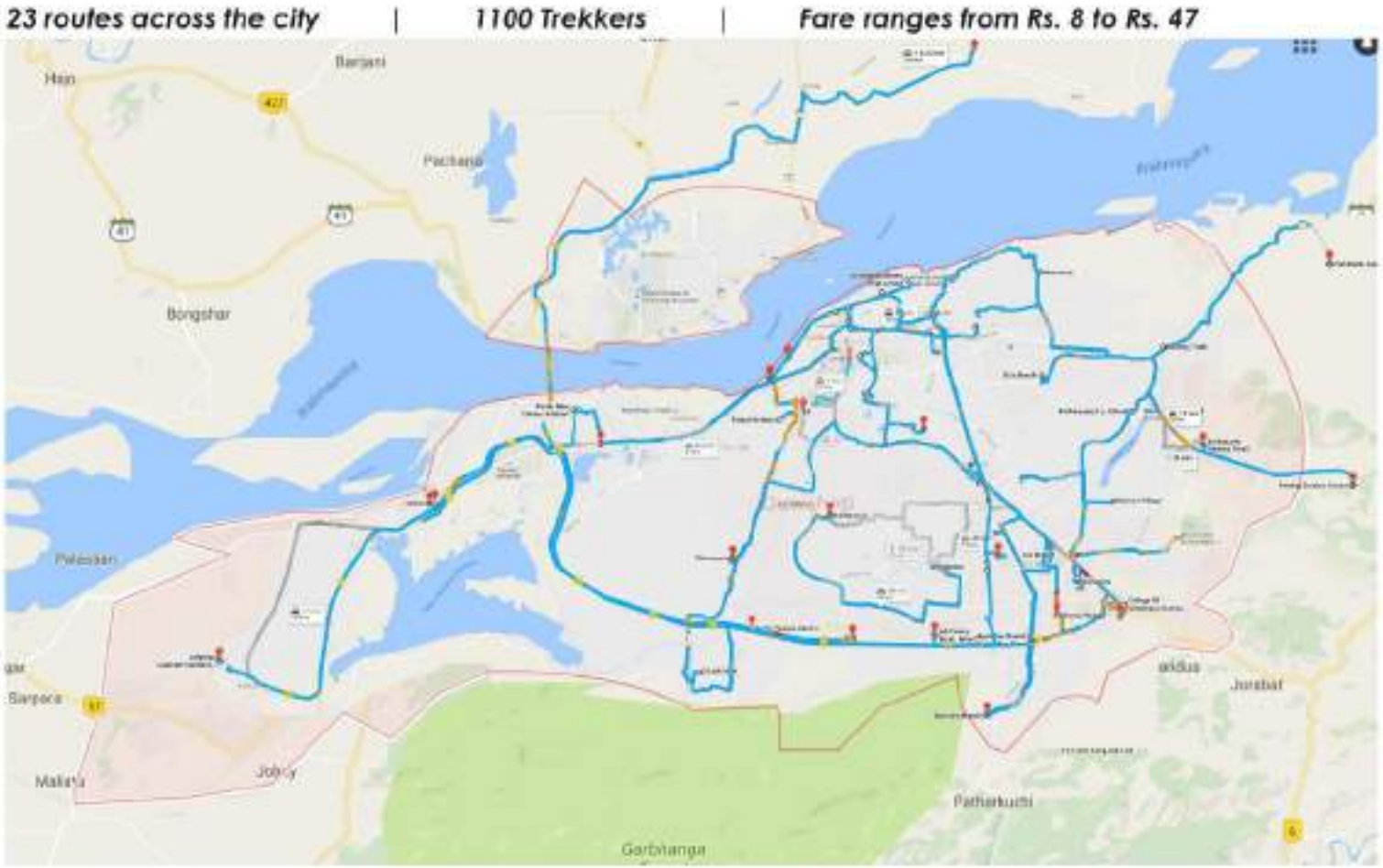
Route No.	Route description	Numbers of perr	
		Periodic	Tempo
1	2	3	4
R/No. 13(A)	**Khanapara to Panikhaiti** via- Research Gate, Science Museum, Agile Hospital, Joyanagar, Sixmile, VIP Road,Patharquary, Narangi, Panikhaiti	23	1
R/No. 14(A) R/No. A-14(B)	**Route No.A-14(A) : Basisthamandir to Adabari-** via Basistha Chariali, Hatigaon Rotary, Ganeshguri Fruit Market, Dispur College, Kachari Basti, GMCH, Auditorium Rotary, Right turn up-to Srimantapur Path point and turned back again to Rotary, Rupnagar, Birubari, Serabhhati, D.G.P.Office, Ulubari, T.C.Point, District library, High Court Point, M.G.Road, Bharalumukh, Adabari. At the time of return from G.M.C.H. Auditorium Rotary directly to Kacharibasti, Hanu Boro Police Point(Wall Ford) to Ganeshguri(under the over Bridge) Chariali, Hatigaon Rotatary, Brahamaputra Board, Basistha Mandir.	97	1
R/No. 15(A)	**Basistha Chariali to Garpandu Bus Stand-** via Survey, Lastgate, Ganeshmandir AIDC, Chandmari, Uzanbazar, Kachari, Machkhowa	7	3
R/No. 16(A)	**Patharquary to Adabari** – via Noonmati, Bamunimaidam, Chandmari, Guwahati Club, Ambari, Handique Girls' College, Kachari, Bharalumukh.	79	4
R/No. 17(A)	**Public Health to ISBT** via-Borbari, Sixmile, Joyanagar, Museum Point, Koinadhora Point, N.H.-37,Basistha Charjali, Dispur Lastgate, Rajdhani Masjid, Ganeshmandir, Kahilipara, Dakhingaon, Survey Settlement School, Sawkuchi Lokhara ISBT.	22	3
		18	0

TABLE 3: DATA OBTAINED FROM RTO GUWAHATI (KAMRUP METRO), PAGE 2

Route No.	Route description	Numbers Periodic
1	2	3
R/No. 2(B)	**Basisthamandir to Engineering College** Via- Basistha Chariali, *Khanapara, Sixmile, Ganeshguri,* R.G Barua Road, Chandmari,Guwahati Club, Uzanbazar, Kachari, Bharalumukh, Adabari, Jalukbari.. *(N.B. Proposed to abolish this route with a provision to the permit holder for changing of route to any one of another prescribed routes.)*	0
R/No. 3(B)	**Patharquary to GMCH** Via-Noonmati, Chandmari, Guwahati Club,B.Baruah College, *Ulubari, Bhangagarh. (N.B. Proposed to abolish this route with a provision to the permit holder for changing of route to any one of another prescribed routes.)*	2
R/No. 4(B)	**Hengrabari Housing Colony to Chandrapur**-via Barbari, Patharquary, Narengi, Panikhaiti.	13
R/No. 5 (B)	**Bharalumukh to Rani** via- Maligaon, Jalukbari	1
R/No. 6(B)	**Khanapara to Ganeshpara- via Basistha Chariali,** Lalmati, Bhetapara Chariali, Hatigaon Chariali, Lilie Flower School,Ganesh Mandir, Dispur College, Kacharibasti, Khristianbasti, GMCH, Rupnagar, Birubari, Kalopahar Cycle Factory, Ambari Timiri, Dhirenpara.	0
GRAND TOTAL		966

TABLE 2: DATA OBTAINED FROM RTO GUWAHATI (KAMRUP METRO), PAGE 3

TREKKER ROUTE MAP



Advantages

- It covers a wide range of localities within the city.
- It also connects the city with the outskirt locations.
- It is, in most of the cases, the second quickest mode of transportation.
- The average fare-to-time ratio is the lowest here.
- It is the only mode of public shared transportation which goes all the way to the Airport.
- Above all, it has created a huge number of emplyoment to the youth since its establishment.

Disadvantages

- A major issue which this segment has faced since its time of implementation; overloading of passengers can be seen occasionally, resulting in poor safety.
- Over tie, the vehicles have become outdated. No major change in this system for more than a decade.

OBSERVATION RESEARCH

The next stage was the Observation research. This research is on-sight based. The objective is to personally do the entire research of the concerned area. This is further divided into 3 sections, namely:

- Observation Study
- User Study Analysis
- Driver Study Analysis

It primarily started off with getting an appointment with the RTO Office, Guwahati, Assam, to get a better judgement of the number of trekker vehicles plying on the roads, the total number of trekker hubs and stops/depots/ Also, to get a direct personal coverage from the RTO authority to better understand why the service was introduced and since the time of its establishment, what are the types of changes and development that has been done to keep up with the current situation. Three different trekker depots were examined. Careful attention was paid in physically examining the vehicles and the users.

Observation

Irregular grab handles. Aftermarket application

Roller covers for rain protection on all sides

Driver directly collects the fare from the fellow passengers

Service responsibility under the owners, not the drivers.

Most of them do not carry spare wheel. Rare to find them.

A single bulb inside the cabin for illumination

Bench style seat for all including driver

Irregular design in side door. Most of them have the right side closed due to traffic regulation

Observation

Passenger grab on to roller covers for support while getting in

No standard dashboard

Grab rail for passenger for support

After market rear door. 2 welded halves with a narrow entry
Spare wheel mounted rear door

Aftermarket rear door latch (varies)

Rear Footboard is standard. Irregular pattern on the Side foot-board

Some have bull-bar front protection

Observation

Aftermarket storage box . Drivers make their own arrangment for storage

No standard soft top. No 3rd row windows

USER STUDY (Quantitative Analysis)

After the observational research, User study was carried out. This further consists of four stages:

- Quantitative Analysis (Passengers)
- Qualitative Analysis (Passengers)
- Quantitative Analysis (Drivers)
- Qualitative Anaysis (Drivers)

In quantitative analysis, passengers were surveyed with the help of questionnaires relevant to Trekker transport system. The count of the passengers is considerably less than that of the city bus commuters, but to reach the users was not a very hard task, as a lot of people have had experience regarding the trekker ride. There were some people who were questioned in their shops, in case of businessmen; some were questioned from their house; while the majority of tese passengers were questioned at the trekker depots. And interesingly, the trekker system is used by a wide range of people showing great diversity.

There were 24 no. of users from the age group of 19-54 years, (which includes mostly students, parents, women, men, teachers, Techie. businessmen) participated in the survey

The following page shows the questions asked and the results obtained in this stage.

Questionnaire for the passengers

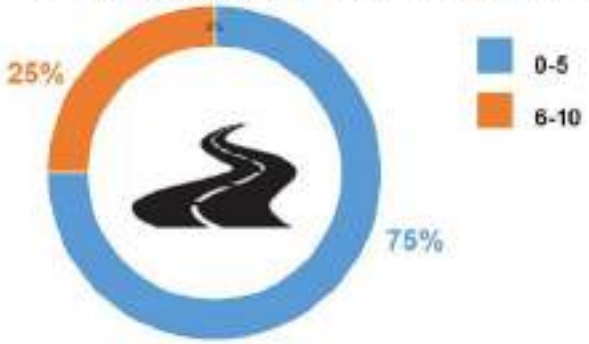
1. How many times do they travel in trekker in a week?
2. How many kilometers do they travel in a trekker per day?
3. Rank the following in terms of very important and not so important
    - Comfortable
    - Safety
4. Would they travel on a trekker that is already legally full? For example, hang around it?
5. How much are they willing to pay more for comfort?
    - Rs.5
    - Rs.10
    - Rs.15
6. What type of luggage do they carry on a daily basis?
7. Any issues with ingress & egress of the trekker? Specially for the ladies.
8. Social issues, such as do the passengers get worried of theft from fellow passengers?
9. When boarding it, do they wish to have some preference in choosing seat? If yes, why?

QUANTITATIVE USER ANALYSIS

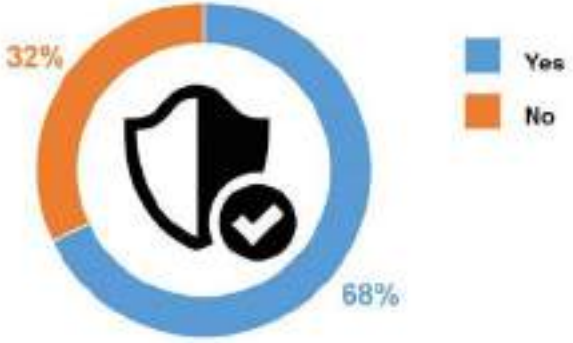
- **Age:** 19-54 years
- **Occupation:**
  - Student (15)
  - Business (2)
  - Housewives (2)
  - Techie (2)
  - Academic (3)

- How many times do you travel in a trekker, in a day?

- How many kilometers do you travel in a trekker per trip?



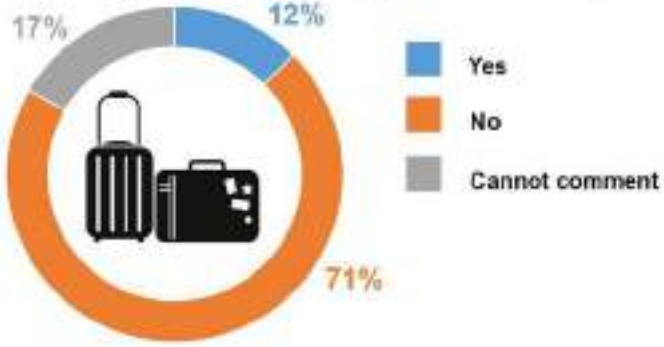
- Do you feel safe inside?



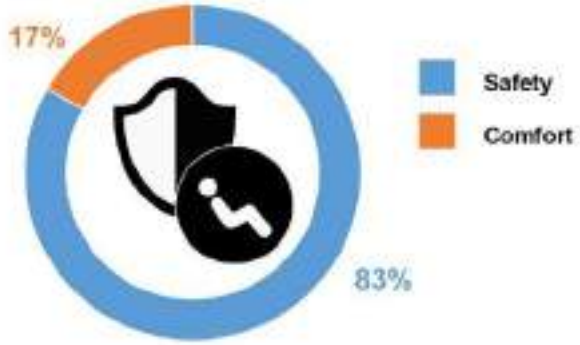
QUANTITATIVE USER ANALYSIS

• Do you feel comfortable with the leg space inside?

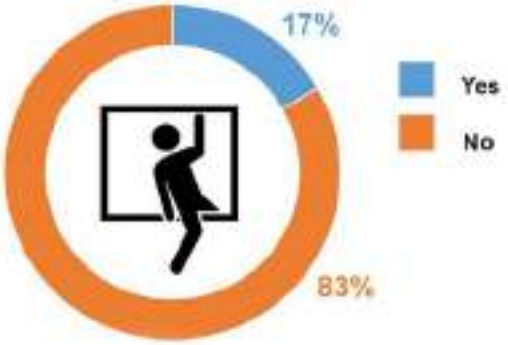
• Is there any problem carrying luggage while travelling?



• Pick the more important among the two factors

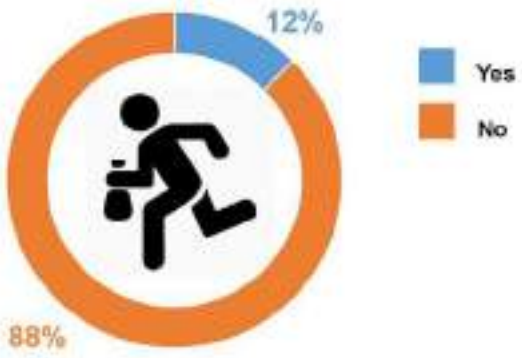


• Do you find entry/exit okay?

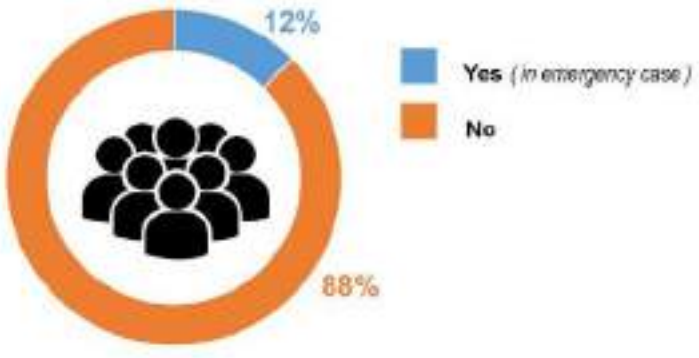


QUANTITATIVE USER ANALYSIS

- Do you get worried of theft from fellow pasengers?



- Will you travel in a trekker that is already full?



USER STUDY (Qualitative Analysis)

In the second stage of the User study, several commuters from different age groups were interviewed about the problems they face in trekker and also the good things that they prefer in trekker compared to other modes of transportation in the city. This study helped in understanding the needs of passengers. The following page epicts some of the excerpts gathered from this study.

QUALITATIVE USER ANALYSIS

- Sometimes I feel, it's **too high to get in**, that I may fall down

  - Sugandhmita Deb (Student), 21

- It is **too congested**, I always **wait for the front seat**, because it is easy for me to get out and **it has better view** too

  - Sashwati Das (Student), 21

- I prefer the middle row, because it **becomes easy for me to get out from both the sides**

  - Anindita Chaudhury (Student), 20

- I usually travel light – there are **no side bars** you see; you can hardly hold on

  - Pratyush (Student), 24

- I prefer thet first row seat, I guess because of childhood habit, **we always want the first bite**

  - Pranjal (Student), 19

QUALITATIVE USER ANALYSIS

- There are times when the drivers drive rashly, it gets scary that I **might fall off the sides**

  - Arundhati (Housewife), 54

- Sometimes they **don't go to stops where they should**. There should be **a way of letting the passengers know the route** in case of such changes

  - Bhagyashree Devi (Student), 20

- They **could increase the fare** a little more, **if I can get to sit comfortably**

  - Ripon Das (Businessman), 41

- I like the fact that the door area is open, **it doesn't feel "bandh-bandh"**

  - Alka Handique (Housewife), 36

- I hate when I have to sit **in the rear row, you cannot see anything**. it is very small and so difficult to get out

  - Alpana (Teacher), 24

QUALITATIVE USER ANALYSIS

- During rains, the **covers don't protect** that much from it

  - Garima Gohain (Receptionist), 25

- The **latch on the back of the door** in many trekkers are **faulty** and also they vary, **it creates confusion**

  - Sandeep Gupta (Engineer), 26

- **The back seats**, they are **not that strong** nor are they big enough to be comfortably sitting inside. **You feel like holding onto something while you're seated there**

  - Raghav (Student) 23

- **No proper horns**, almost all trekkers have a wire they connect to a bolt like thing and you hear the horn

  - Manisha (Analyst), 24

USER STUDY (Quantitative Driver Analysis)

In the third stage of the User study, by personally visiting three different trekker depots, several drivers were questioned using a questionnaire. This study helped in figuring out their daily routine as they go by driving the trekker .

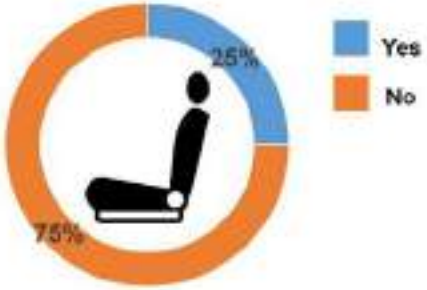
The following questions were asked asked and the percentile results obtained is shown as follows:

1. How many people do they carry in a vehicle per trip?
2. How many trips in a day do they make?
3. How much money do they spend on maintenance?
4. Where do they keep their belongings? What kind of belongings? Photos? Emblems? Etc.
6. What are the problems faced by them when the vehicle gets overcrowded?
7. Rank the following factors for their vehicle in terms of very important to not so important to least important?
    - Looks
    - Maintenance
    - Safety
    - Comfort
8. How many times do they take the vehicle for service in a month/a year?

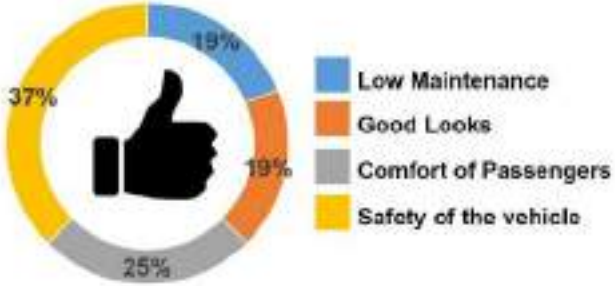
QUANTITATIVE DRIVER ANALYSIS

• How many trips do they make in a day?

• Is the seating sufficient?

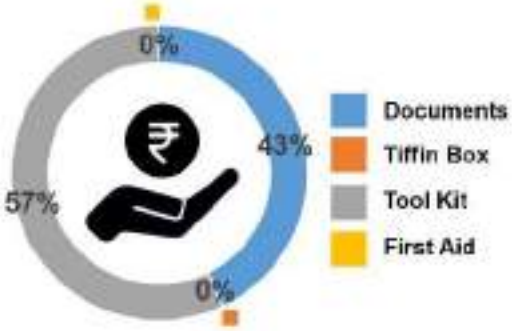


•Rate the following in terms of importance?



• Any shortcomings with the storage provided?

• What type of belongings do you keep in your vehicle?



USER STUDY (Qualitative Driver Analysis)

In the final stage of the User study, drivers were personally interviewed about any shortcomings that they face. Also, if there are any good bits about the trekker, that was noted. This study helped in understanding the problems and needs that has to be addressed while developing the conceptual vehicle.

The following page shows some of the insights into drivers' perspective views:

QUALITATIVE DRIVER ANALYSIS

Ganesh Majhi, 24 (Area: Amsing Jorabat - Khanapara)

- **Servicing isn't our responsibility,** It's the owners
- If the vehicle looks nice, it is a good thing, passengers approach more!
- We **usually have our meals when we head back to our depot** during the mid day break

Babu, 22 (Area: Rajgarh - Adabari)

- Making 4 passenger sit at the rear row, isn't feasibe for us in terms of money
- **We have changed seats**, have put broader seating
- Generally, **vehicles come with a storage box** under the seat

Ringtush Bongshi, 30 (Area: Not specific)

- **Some of us, like me, do not have a fixed depot,** we take driving duty whichever route suits us
- I just want to earn money

Chandan Barman, 31 (Area: Rajgarh - Adabari)

- **Carrying the legal limit (10 passengers**) turns out **difficult for our daily earning**
- If there is a special space for storage and decoration, it would be nice

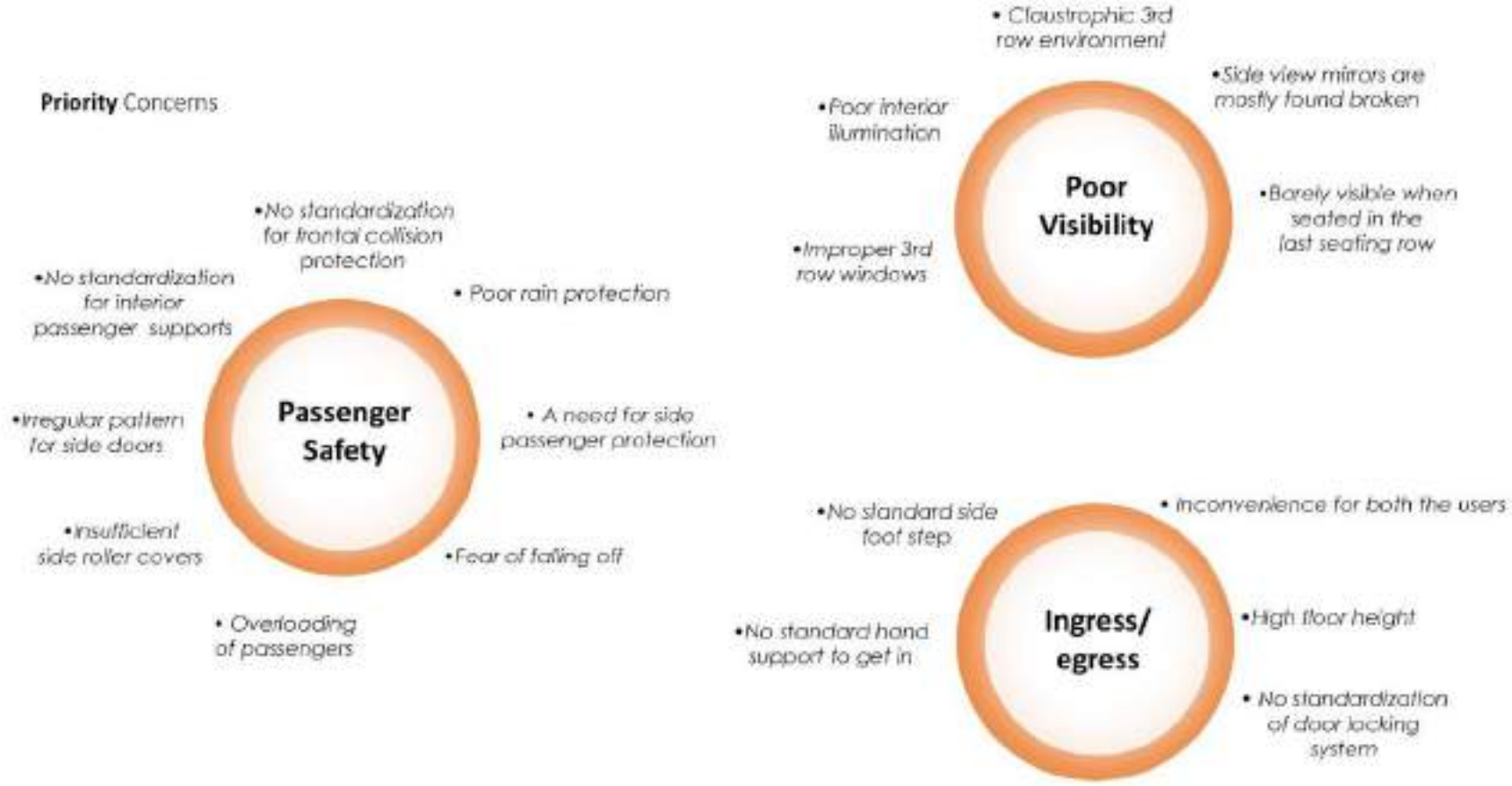
INFERENCES FROM THE USER STUDY

After gathering all the data and information, and several inferences from each of the four stags of the user study, the data were grouped under based on their similarities. This further study helped in narrowing down the needs that must be addressed.

Based on this study, two concerns were obtained; '**Priority** concerns' and '**Other** concerns'

The following page shows the final output obtained.

ANALYSIS FROM THE OBSERVATION STUDY



Other Concerns

BRAINSTORMING TATA SUMO AND TREKKER

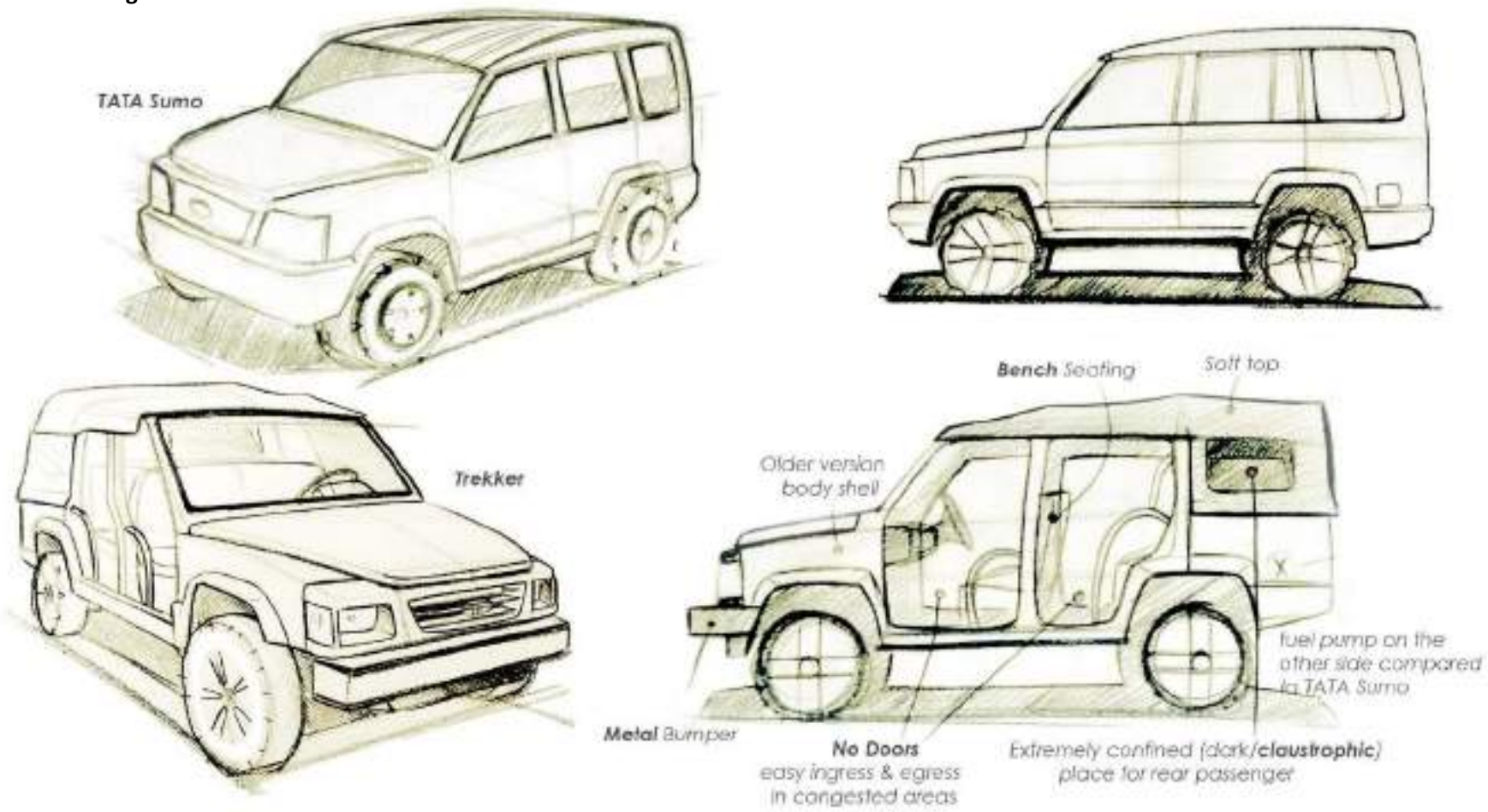
To further understand the vehicle for its desired purpose, TATA Sumo and Trekker were compared and analyzed briefly. Shortcomings were noted and it was found that although the vehicle is stripped down version of Sumo, it enhances the public commuter feel in certain areas, for instance, there are no doors, this makes the vehicle vulnerable for passenger side safety and during sharp turns, passengers seated in the middle don't have any side support to hold themselves into the vehicle. But this modification makes it more comfortable to sit 4 people adequately inside the vehicle. The rest of the findings are mentioned in the coming sections

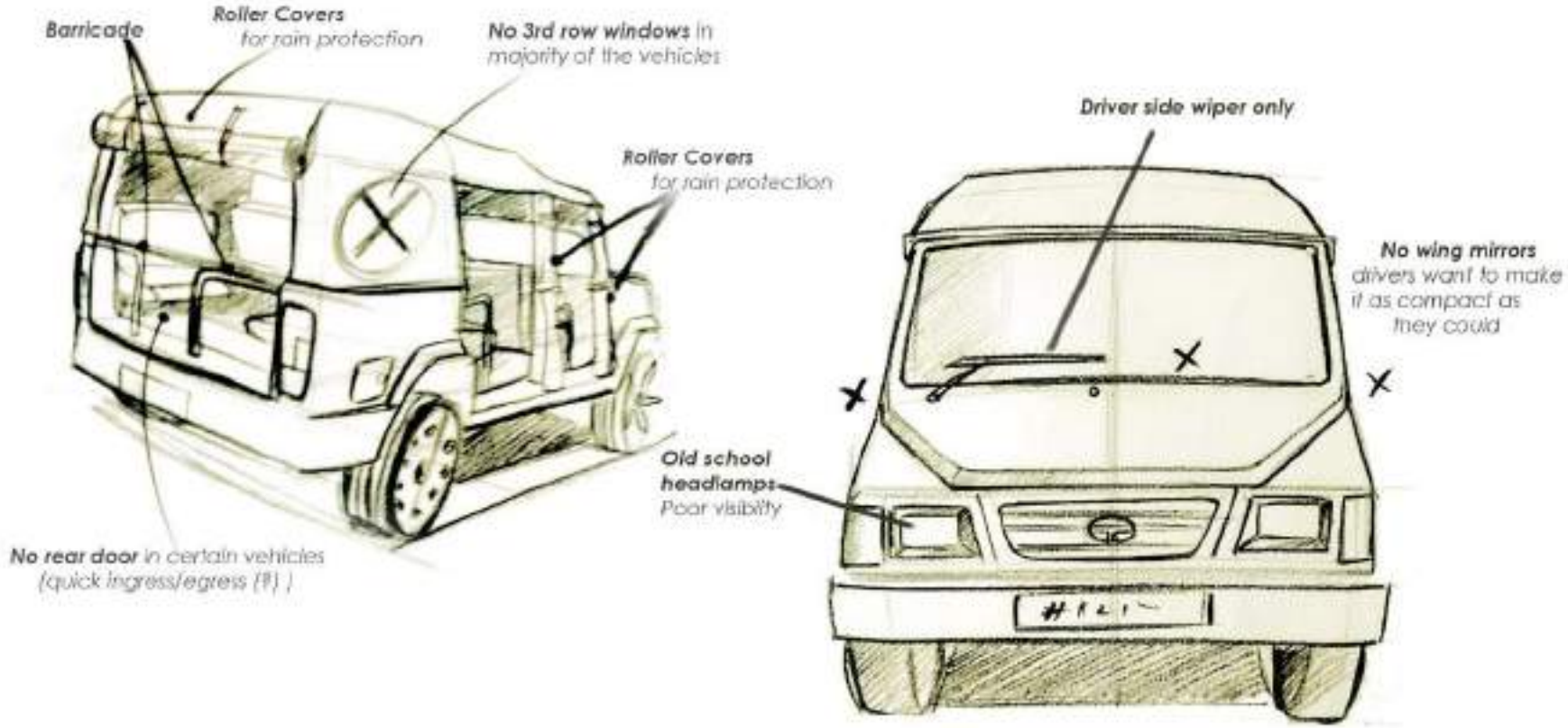
.

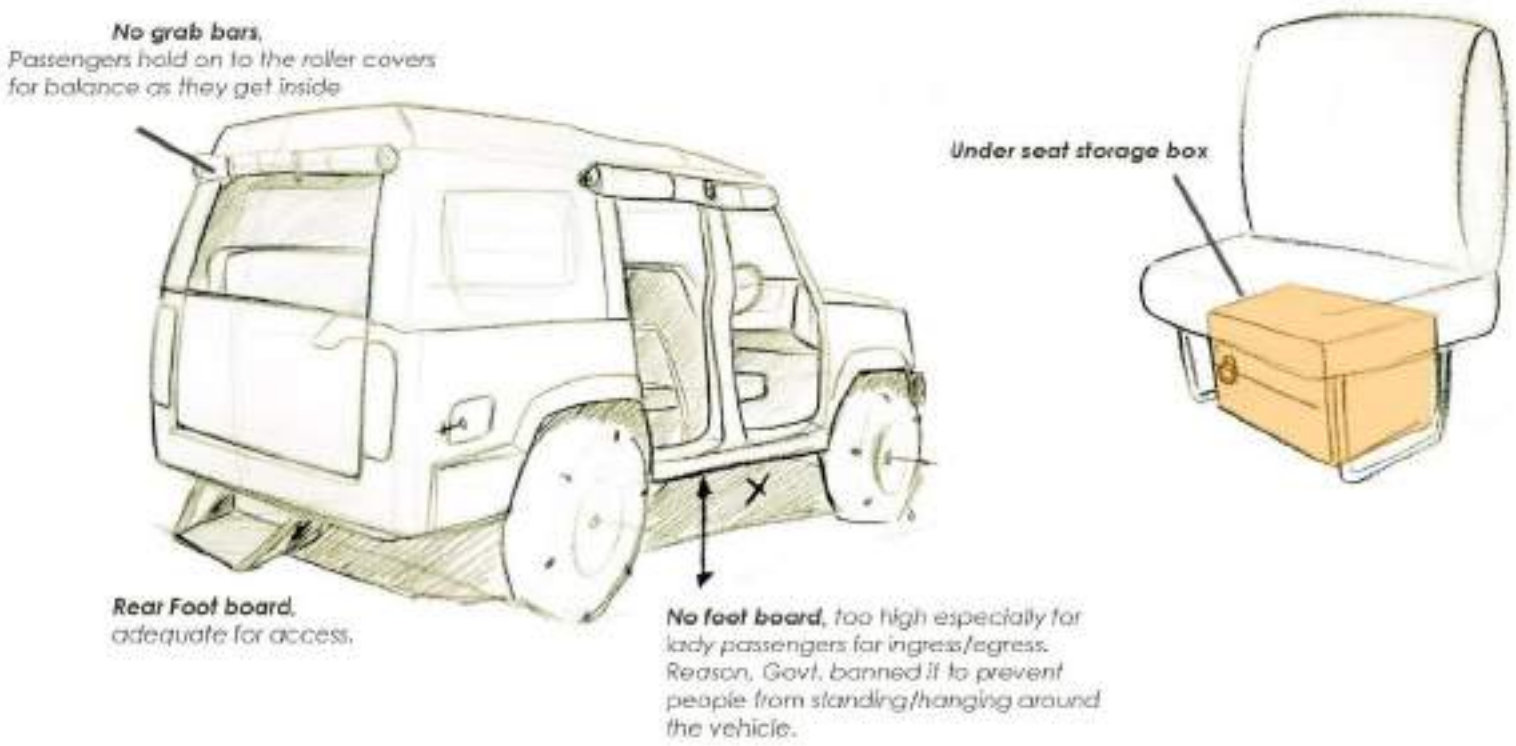
Tata Sumo

Trekker

Brainstorming TATA SUMO and TREKKER



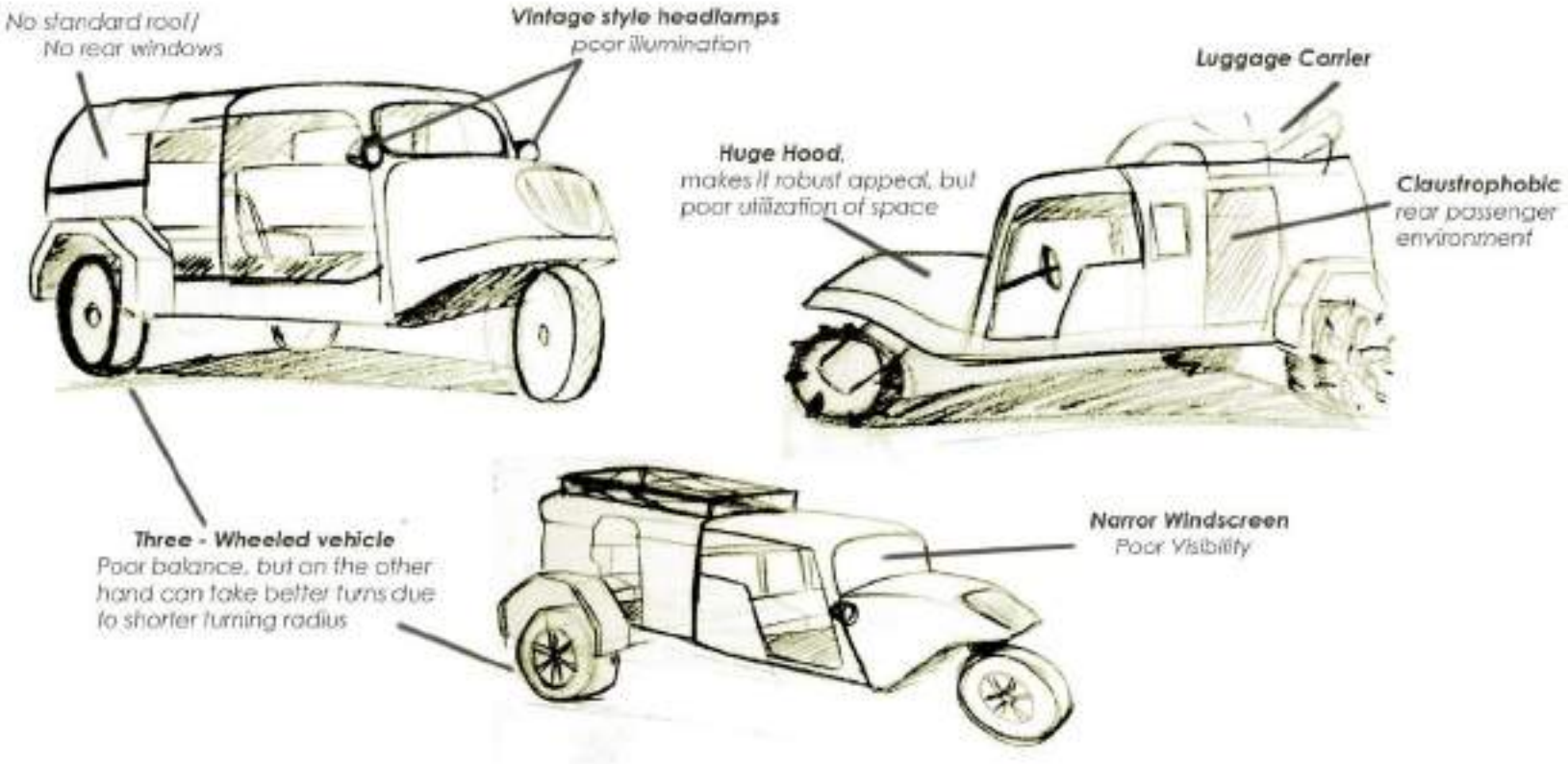

Barricade
Roller Covers
for rain protection
No 3rd row windows in
majority of the vehicles
Roller Covers
for rain protection
No rear door in certain vehicles
(quick ingress/egress (?))
Driver side wiper only
No wing mirrors
drivers want to make
it as compact as
they could
Old school
headlamps
Poor visibility

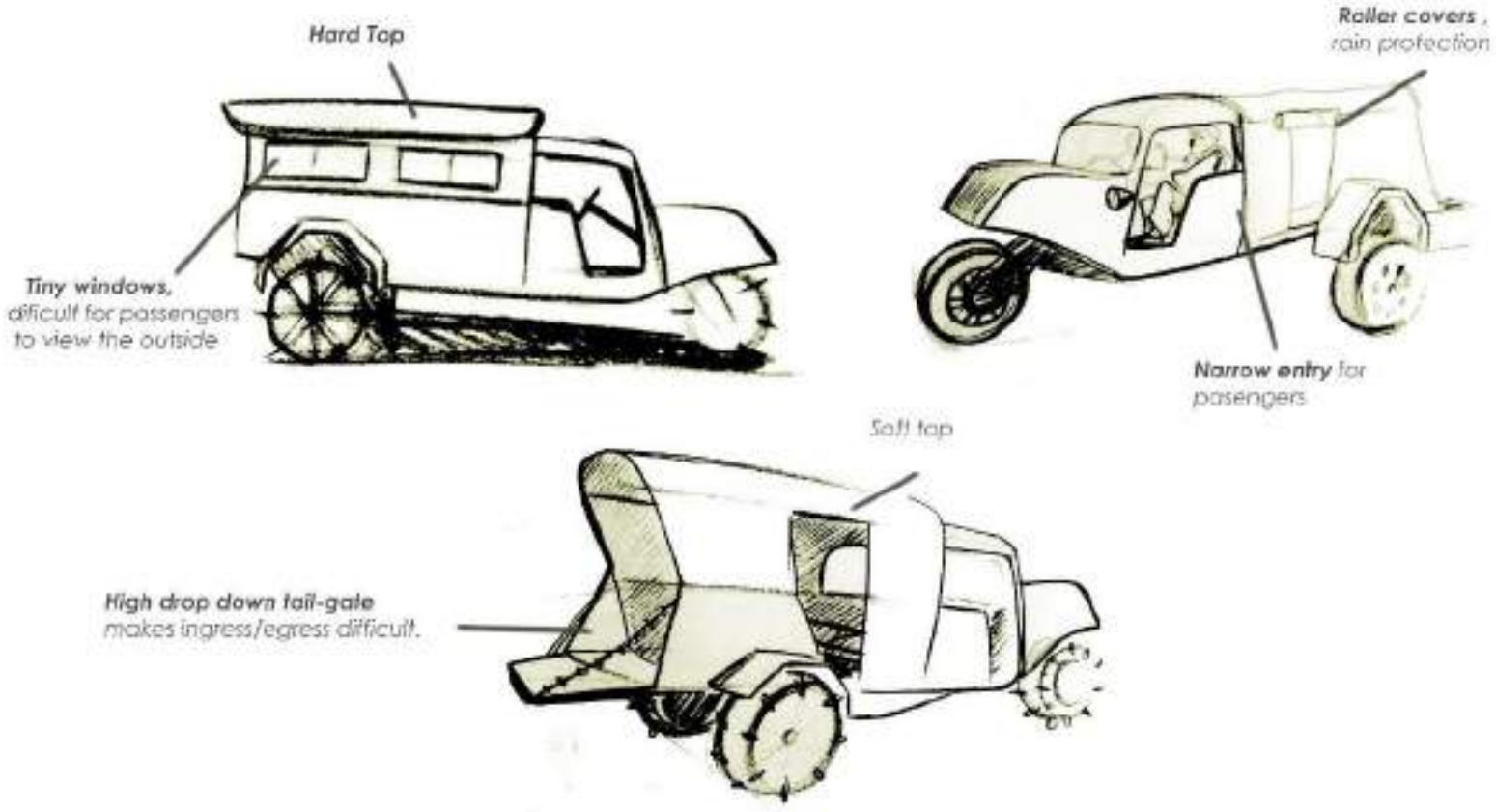

No grab bars.
Passengers hold on to the roller covers for balance as they get inside
Under seat storage box
Rear Foot board.
adequate for access.
No foot board, *too high especially for lady passengers for ingress/egress. Reason, Govt. banned it to prevent people from standing/hanging around the vehicle.*

BRAINSTORMING SIMILAR PURPOSE VEHICLE USED LOCALLY

After carefully analyzing the TATA Sumo and Trekker, vehicles used across India for similar transport purpose were analyzed. Some of the commonly used vehicles are Bajaj Tempo found in plenty in Punjab, Rajasthan and Haryana region. Then we have Hindustan Motors Trekker found in Kerala, Mahindra MAXX painted much to the tone of Kaali Peeli (Mumbai taxi; black and yellow) in Uttar Pradesh region. The analysis is shown in the following context:

BAJAJ TEMPO

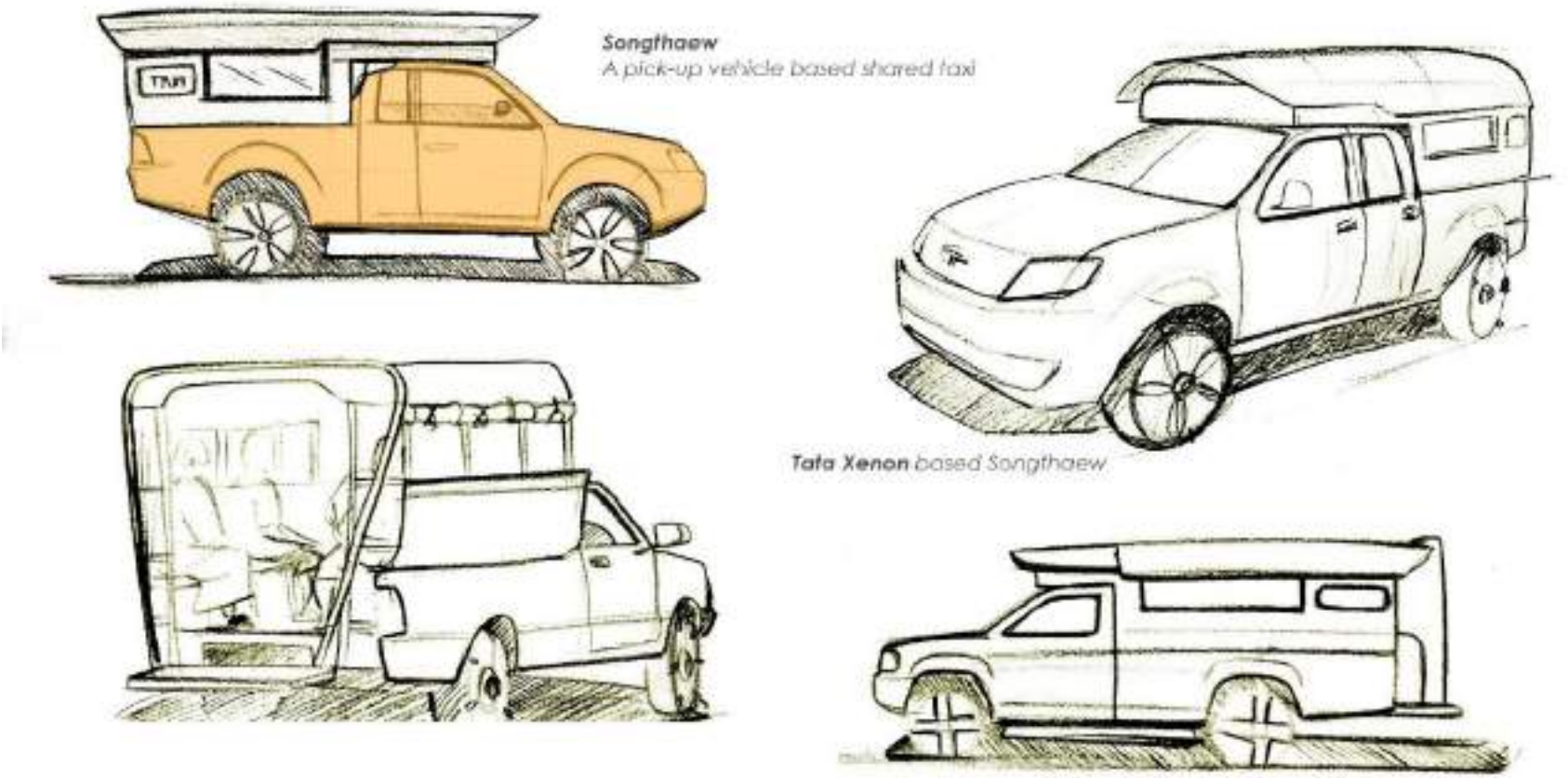

No standard roof/
No rear windows
Vintage style headlamps
poor illumination
Luggage Carrier
Huge Hood,
makes it robust appeal, but
poor utilization of space
Claustrophobic
rear passenger
environment
Three - Wheeled vehicle
Poor balance, but on the other
hand can take better turns due
to shorter turning radius
Narrow Windscreen
Poor Visibility


Hard Top
Tiny windows,
difficult for passengers
to view the outside
Roller covers ,
rain protection
Narrow entry for
pasengers
Soft top
High drop down tail-gate
makes ingress/egress difficult.

BRAINSTORMING SIMILAR PURPOSE VEHICLE USED GLOBALLY

After analyzing the local trend, the next step was to analyze on a global front. Shared taxi used in such purpose globally aren't found anywhere in countries such as The United States of America, Canada, nor anywhere in European countries. But these are prominently used in Peru, South America, Mexico; vehicles like the discontinued version of Toyota HiAce; Suzuki Harga in Indonesia and modified pick-up vehicles later termed as Songthaew are used widely in Malaysia. These vehicles were thoroughly analyzed over the internet to come to a definite conclusion about how this market functions and could there be anything of use that we could look up to for inspiration.

Songthaew used widely in **Malaysia**



Songthaew used widely in **Malaysia**

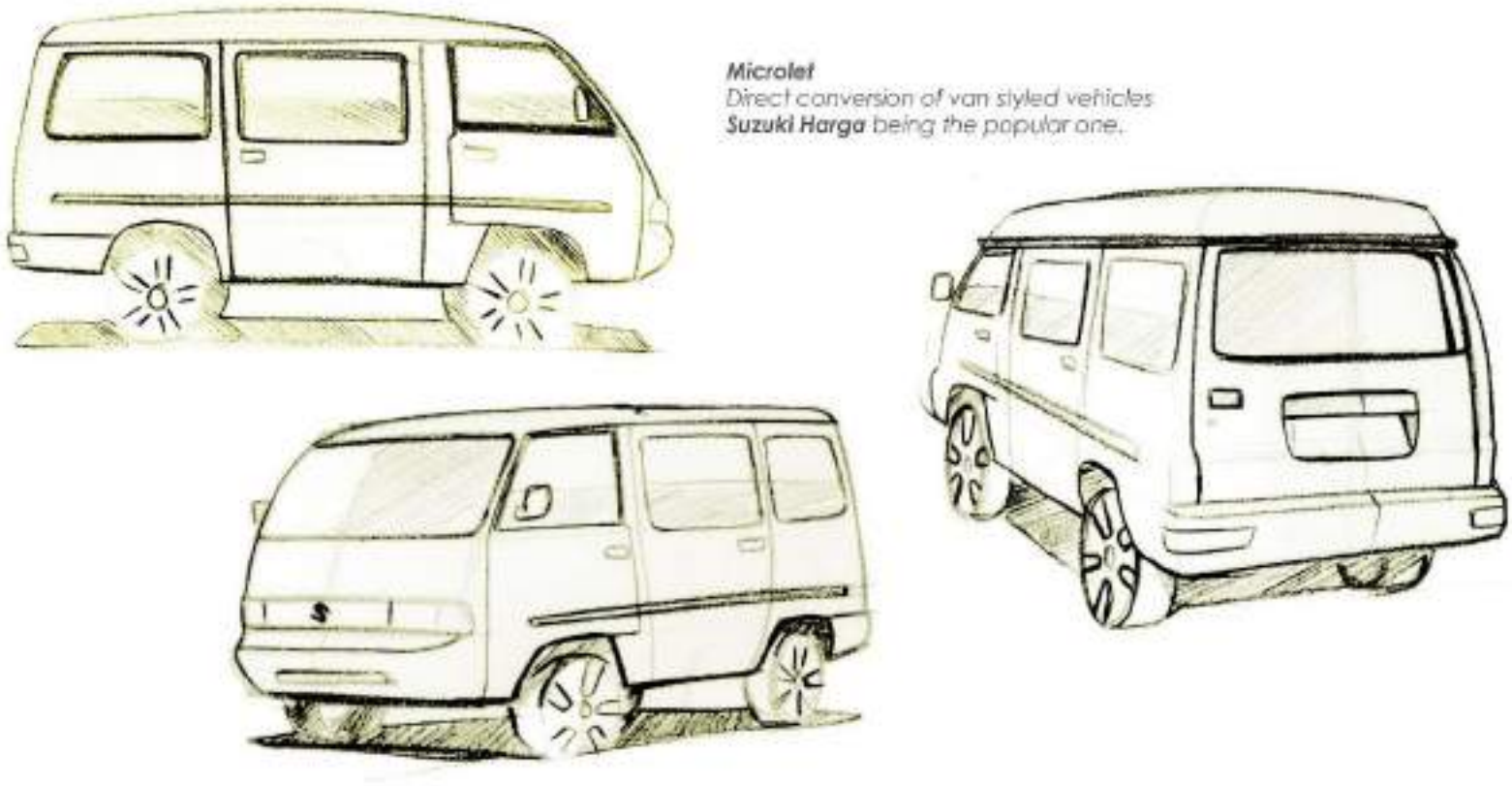
Large Foot Board *for passengers to stand comfortably*

Tall Cabin + extended roof, *aids passenger's commute*

Two Parallel Seating, *more people, ingress/egress easier, but may not be comfortable for all.*

Back support, bars to grab *for passengers to rest against, comfortably.*

Microlet used widely in **Indonesia**



Microlet used widely in **Indonesia**

Two Parallel Seating, *more passenger capacity, but ingress/egress is a pain, due to the narrow door.*

Over-crowded, *one of the common sights seen in a microlet taxi.*

No grab handles - No Separate foot board *- Passengers hang around the door of the vehicle.*

Note - *How passengers climb on the roof of the vehicle.*

DIMENSIONAL COMPARISON

From this study, it was found that none of these vehicles solve the issue of transporting passengers comfortably. The ingress and egress issue remains. Given the size of the vehicle and how they were originally designed, say for instance, TATA Sumo itself was designed to carry 7 people, but the vehicle is used as trekker to accommodate 10-12 people inside it. Suzuki Harga, which is essentially mini cargo van, were designed to accommodate 8 passengers including driver, are used as Microlet and carry in more than a dozen people. None of the vehicles have doors, which makes it susceptible to people getting in and ending up hanging around the door, risking their lives. These vehicles create a claustrophobic environment for all the passengers inside of it. Seeing the outside from the inside becomes a hard task as passengers really must bend and move to look out. Passengers once seated inside, have nothing to hold on to for support. TATA Sumo, even though it seems to be the most suited vehicle when compared to its counterparts, still has a lot of space at the front which is poorly utilized; it produces 60 bhp and 27kgm torque from a 3.0 L engine; current generation powertrains are smaller in capacity and can produce much higher output. The space that TATA Sumo occupies, clever packaging can create a lot more interior space resulting in a much better passenger commuting experience. Also, the new vehicle in context is specially being designed for Guwahati, it must relate to the people of the city and their lifestyles. Coming to the lifestyle of Assamese population, people are outgoing, men and women both work in fields, equality spreads in every section. There is a tradition of gifting any guests who visit, with an Assamese handloom called '*Gamosa*' and *'Japi'*. Hence the keywords to define the character of this vehicle were 'humble', 'welcoming', 'equality'; i.e., it should not be too masculine, nor too feminine, the vehicle must neutral harmony in its surfaces and the last, 'Modern'.

Following this, benchmarking was done to get inspiration and set up a minimum level that needs to be achieved in designing the new vehicle.

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BENCHMARKING

In terms of interior utilization

- Has enormous number of seating within 5 meters of length
- Sliding doors; better ingress/egress
- Roomy interior

Nissan Urvan nv350

DESIGN BRIEF

To conceptualize a public passenger vehicle that can carry minimum 10 inboard, a driver and a conductor (12 seater)

The vehicle should fulfil the following requirements:

Packaging:

- Carrying capacity of minimum 10 passengers plus a driver and the conductor.
- It should have easy ingress and egress.
- It should have an option of passenger standing for short range commuting.
- It should sustain the weather and road condition.
- It should have passenger protection, yet feel open enough to not create a claustrophobic environment inside the vehicle.
- It should have a wide glasshouse area for easy visibility on the outside.
- Low floor structure with a raised floor interior, for a planar interior layout.
- Features based on the driver's and the passengers' need should be provided such as –
    - Control of the passenger entry/exit door to the driver/conductor.
    - Properly placed safety bars for the passengers to hold on to.
    - User-friendly mechanism for passenger ingress / egress.
    - Provision for destination signboard inside the vehicle.
    - It should have a signboard indicating the count of seat available.
    - Conductor should be able to keep a clear view of both the route and passengers inside.

Specification:

- It should not have larger foot print especially considering Guwahati transport conditions.
- Under floor/seat longitudinal engine.
- It should have sliding doors to counter the tight parking and spaces in the city premises.
- Entry/Exit should be from the left side/left cum rear of the vehicle.

Aesthetics:

- It should be welcoming to look at.
- It should look well planted to the ground for portraying a safer message.
- It should look secured.

Technical Consideration for the vehicle:

- Approximate exterior dimensions (L × W × H): 5000mm × 2000mm × 2500mm
- Approximate wheelbase: 3500mm
- Approximate ground clearance: 180mm
- Approximate wheel dimension: 205/65 × 15

STAGE 2

This stage is about giving shape to the design brief including packaging explorations with respect to the ergonomics, exterior ideations with keeping the keywords '*Humble', 'Welcoming', 'Modern'* and *'Equality'*. And finally shortlisting the package and exterior form which are rendered and finally evaluated and the most suited one is chosen among them.

Following are the contents of this stage:

Ergonomics Study

Drivetrain Layout

Vehicle Packaging Exploration

Final Interior Layout

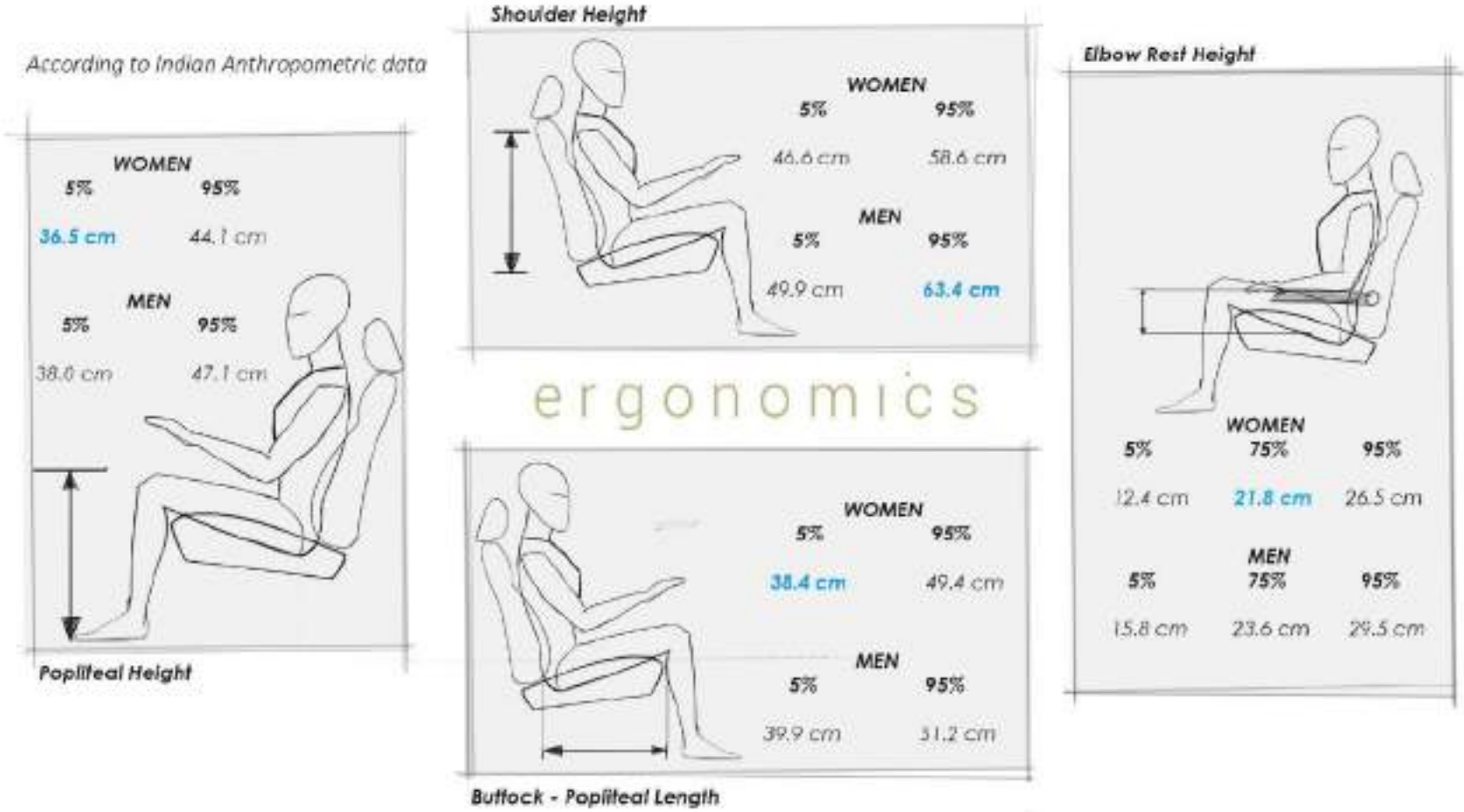
Interior Concept

Aesthetic Explorations

Ideations

Final Concept

ERGONOMICS STUDY



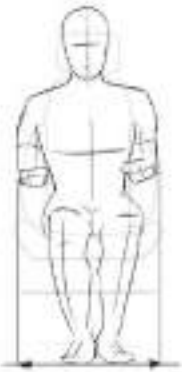
Indian Anthropometric Data

Bi-Deltoid Breadth

WOMEN	
5%	95%
31.9 cm	44.9 cm
MEN	
5%	95%
37.9 cm	48.2 cm

Hip Breadth

WOMEN	
5%	95%
25.9 cm	42.9 cm
MEN	
5%	95%
27.2 cm	40.5 cm

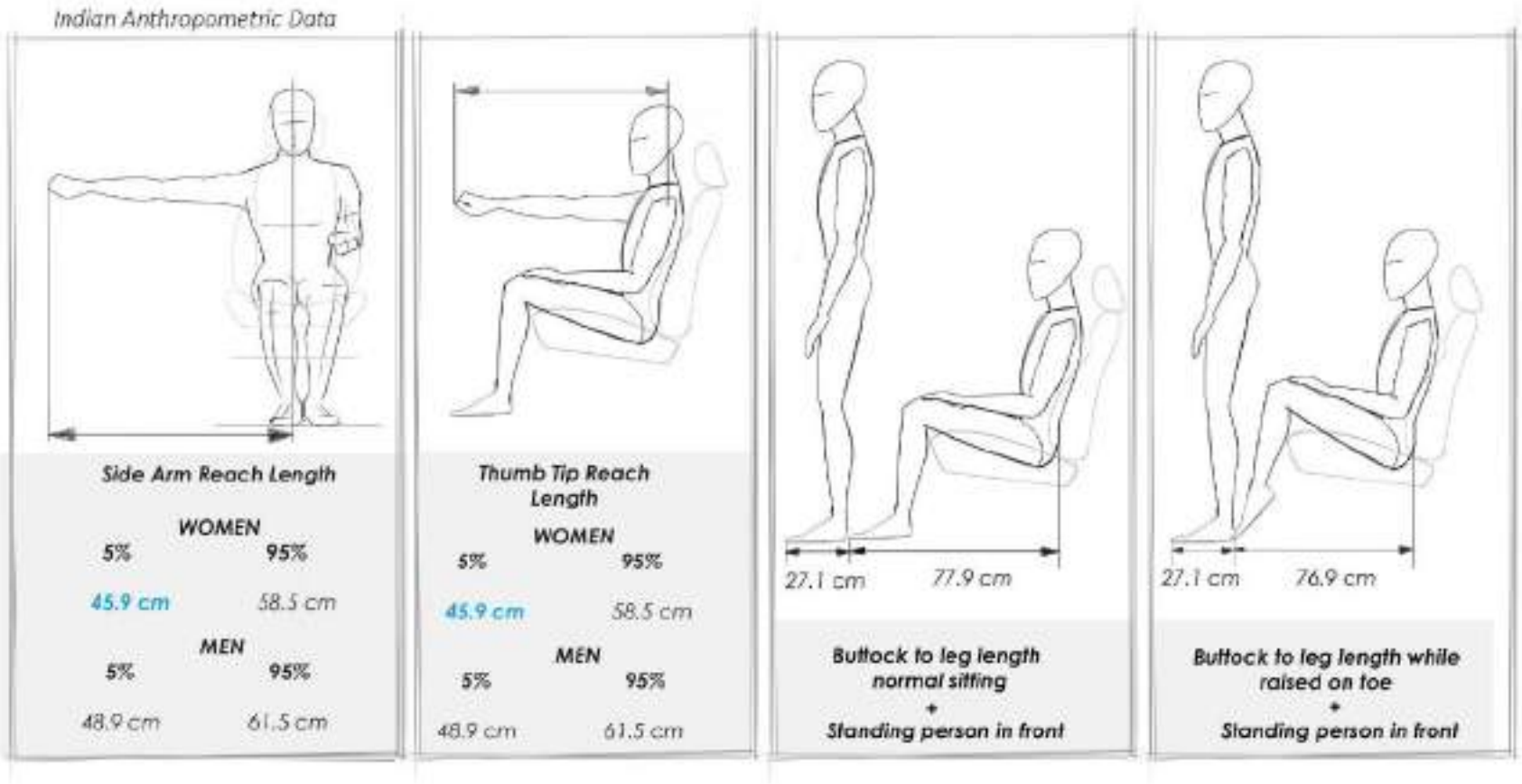


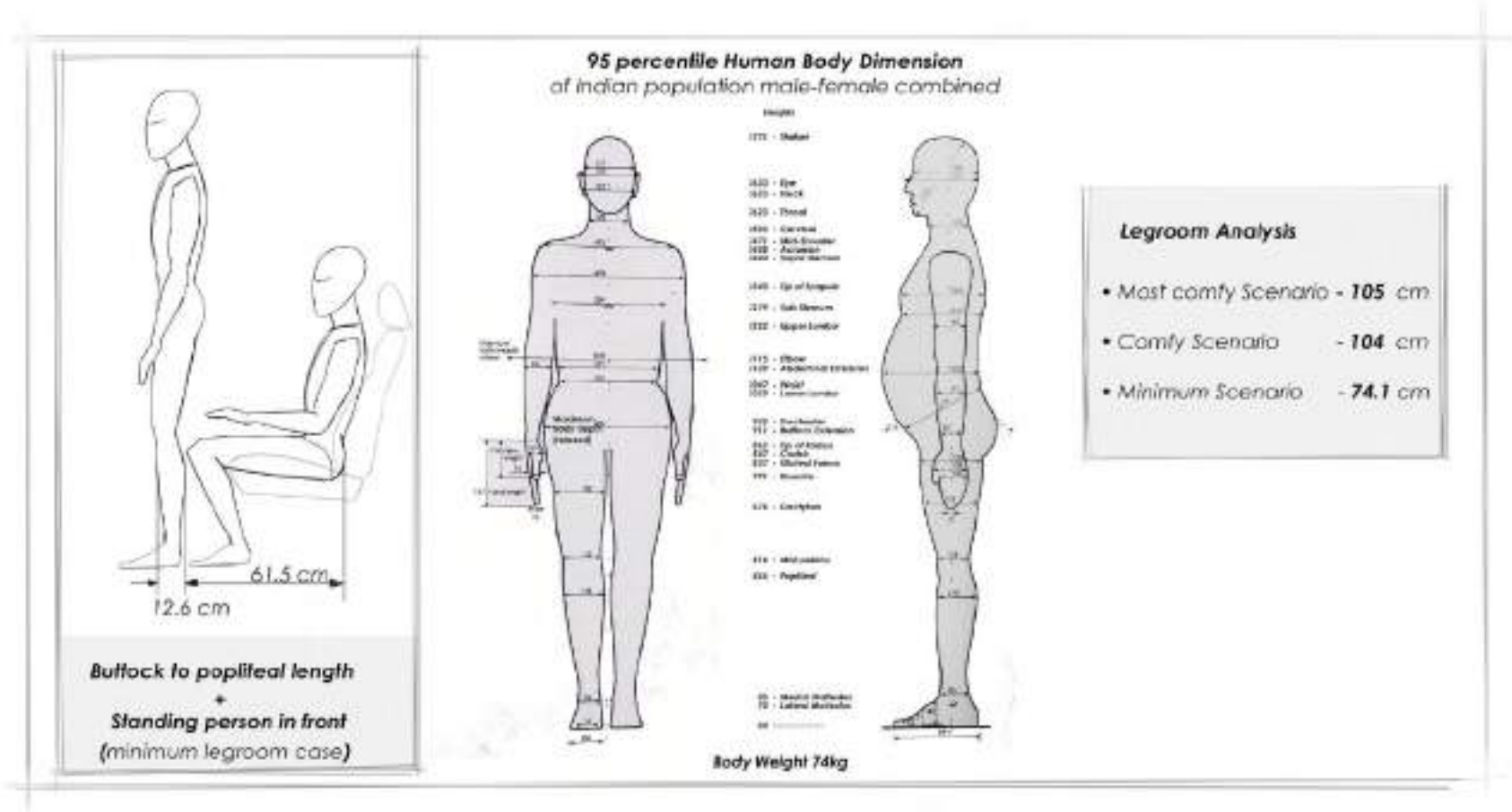
Elbow-to-Elbow (Closed) Length

WOMEN	
5%	95%
32.5 cm	43.5 cm
MEN	
5%	95%
37.5 cm	48.9 cm

Buttock to Knee Length

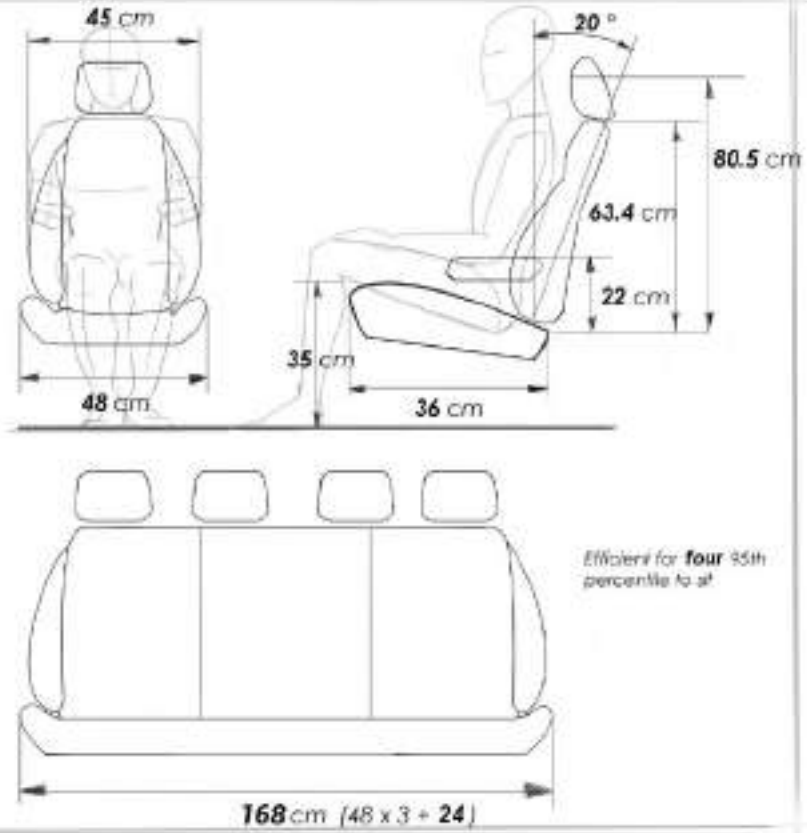
WOMEN	
5%	95%
45.9 cm	58.5 cm
MEN	
5%	95%
48.9 cm	61.5 cm


Indian Anthropometric Data
Side Arm Reach Length
WOMEN
5%
95%
45.9 cm
58.5 cm
MEN
5%
95%
48.9 cm
61.5 cm
Thumb Tip Reach Length
WOMEN
5%
95%
45.9 cm
58.5 cm
MEN
5%
95%
48.9 cm
61.5 cm
27.1 cm
77.9 cm
Buttock to leg length normal sitting
+
Standing person in front
27.1 cm
76.9 cm
Buttock to leg length while raised on toe
+
Standing person in front


61.5 cm
12.6 cm
Buttock to popliteal length
+
Standing person in front
(minimum legroom case)
95 percentile Human Body Dimension
of indian population male-female combined
Body Weight 74kg
Legroom Analysis
• Most comfy Scenario - 105 cm
• Comfy Scenario - 104 cm
• Minimum Scenario - 74.1 cm

Anthropometry Data for seating

Code	Anthropometry Data	Dimension (cm)
A	Popliteal Height	36.5
B	Buttock-to-Shoulder Height	63.4
C	Buttock-to-Popliteal Height	38.4
D	Elbow Height from buttock	21.8
E	Bi-deltoid Breadth	48.2
F	Hip Breadth	42.9
G	Elbow-to-elbow breadth	48.9
H	Buttock-to-Knee length	61.5
I	Buttock-to-back head tip	80.5
J	Leg Room	84.1
K	Shoulder Width	42.2

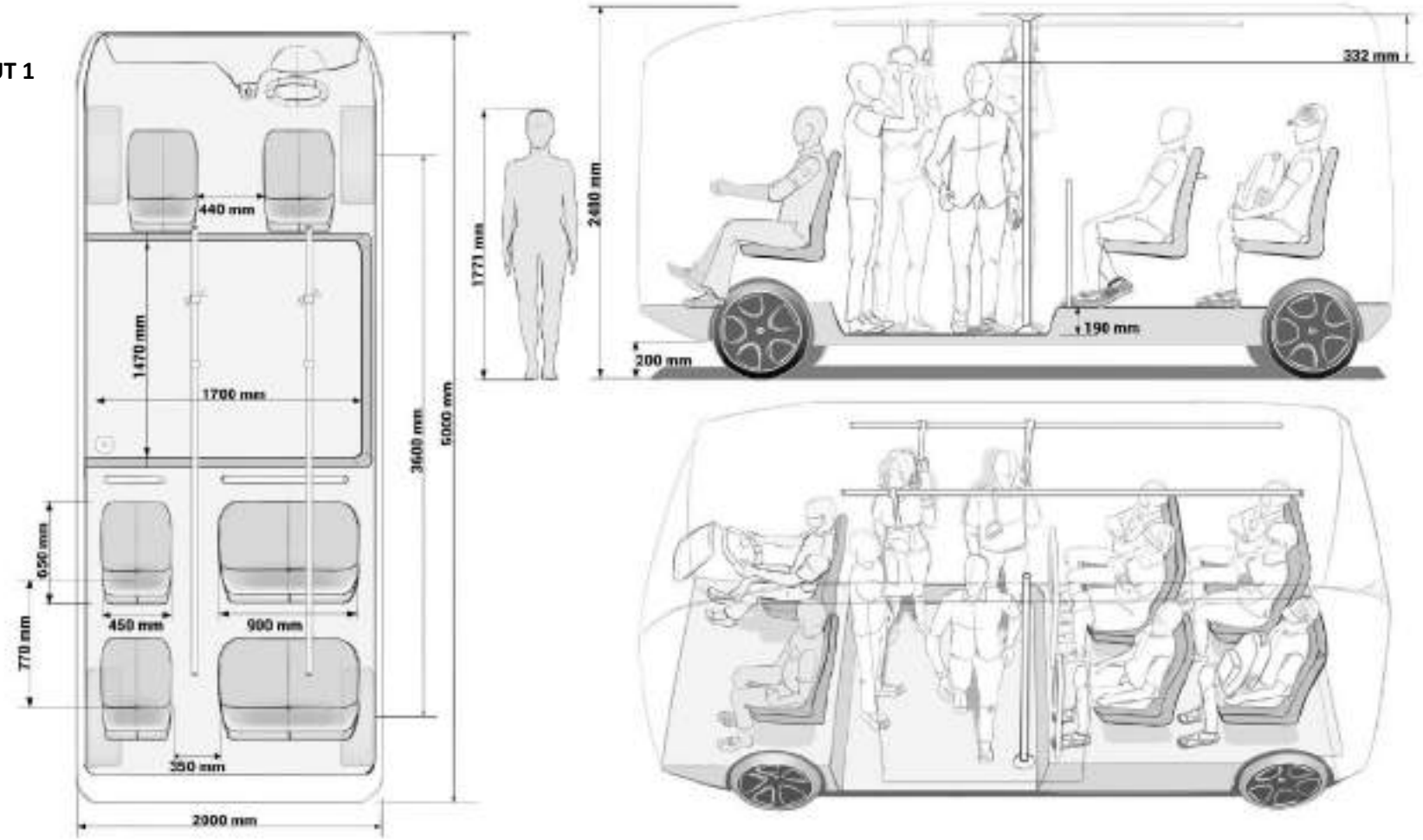


From the ergonomics study, it was found that the minimum seat width that is needed to accommodate 4 people should be approximately **168 cm**. The adequate seat height or, in anthropometrical terms, '*popliteal height*' should be **36.5 cm**. The seat width, (elbow to elbow width) should be **48 cm**. Width this width, there is ample of space for majority of the passengers. The seat depth (Buttock-to-popliteal length) should not exceed beyond **38.4 cm**. This ensures no pressure generating behind the knees in case of long distance traveling. The backrest should be in accordance with the 95th percentile value of buttock-shoulder height. By the Indian anthropometry, this value is 63.4 cm, hence he back rest must be approximately **64 cm.** This ensures all the passenger comfortable back support while seated. And lastly, the legroom for ease of opening the legs and getting out of the seat is **84.1 cm.** This ensures there is ample leg space in front of the seat.

VEHICLE PACKAGING EXPLORATIONS

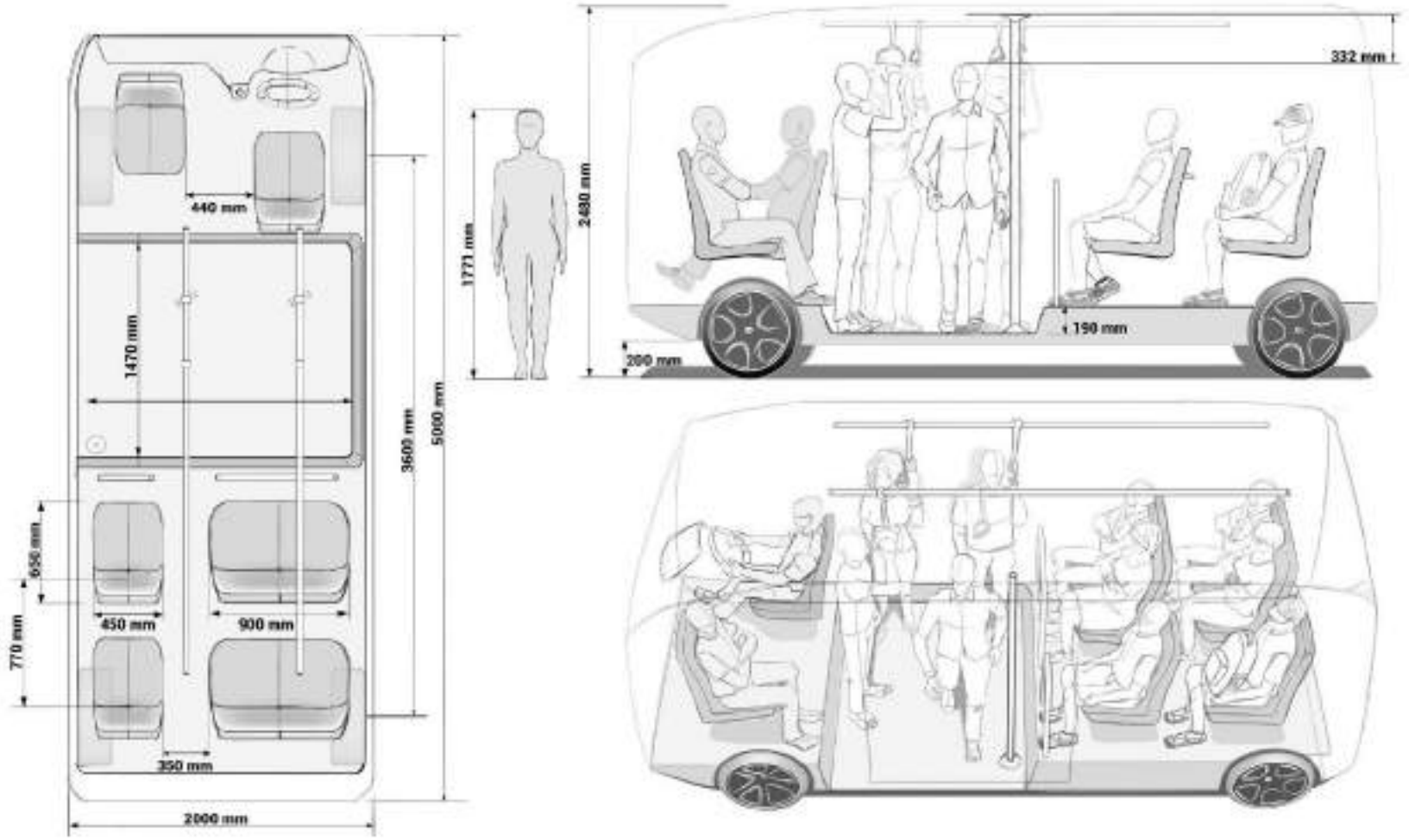
As the vehicle dimension was set at 5000mm x 2000mm x 2500mm (L x W x H), and the powertrain was decided to be under-seat the co-driver compartment, there was adequate space inside to be played with, while exploring various layouts for interior seating packaging. The following contents show the various possible explorations that was ideated to achieve the most suitable layout for this transportation mode.

LAYOUT 1


440 mm
1470 mm
1700 mm
650 mm
450 mm
900 mm
770 mm
350 mm
2000 mm
3600 mm
6000 mm
1771 mm
2480 mm
332 mm
190 mm
200 mm

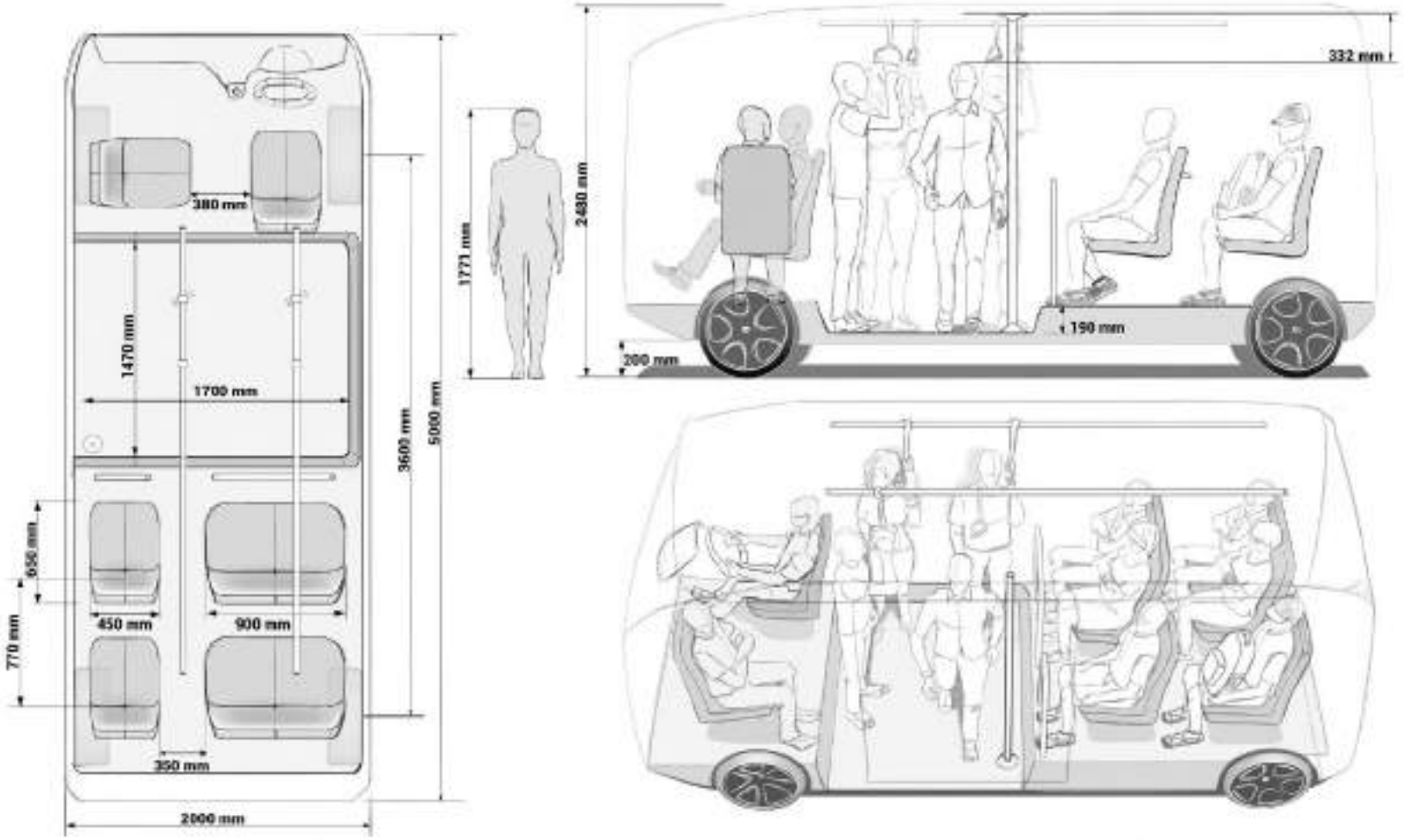
Here, there is sufficient space between the rear benches for passengers to walk in and out. For rear passenger support; back row, there is grab handle at the back of the seat ahead of them and for the front row passengers, there is a grab bar mounted on the floor to hold on. The conductor sits at besides the driver as in contemporary seating, but he faces the front. This helps the conductor in looking out for people waiting in the streets but doesn't give him a good view on the passengers seated inside. As a conductor, the main task is to lookout as well as interact with the passengers inside. This idea of conductor seat facing forward did not seem to be the right solution.

LAYOUT 2


440 mm
1470 mm
650 mm
770 mm
450 mm
900 mm
350 mm
2000 mm
3600 mm
5000 mm
1771 mm
2430 mm
200 mm
190 mm
332 mm

To counter the conductor seating issue, here the seat faces backwards, i.e., conductor has full view on the passengers. But even this has a shortcoming as, it can be seen, the conductor seat will obstruct the view of the driver's left side area. Even though this helps the conductor and passengers to interact in the best way providing the conductor ease of access in operating the entry door right close to him, but the drivers view obstruction was a serious concern that one can't overlook. The rest of the layout remains the same, with similar seating arrangement at the back and a platform of dimension 1700mm x 1470mm for passengers to stand in case of quick short distance traveling. There are bars over them where hand supports are provided as shown in the layout.

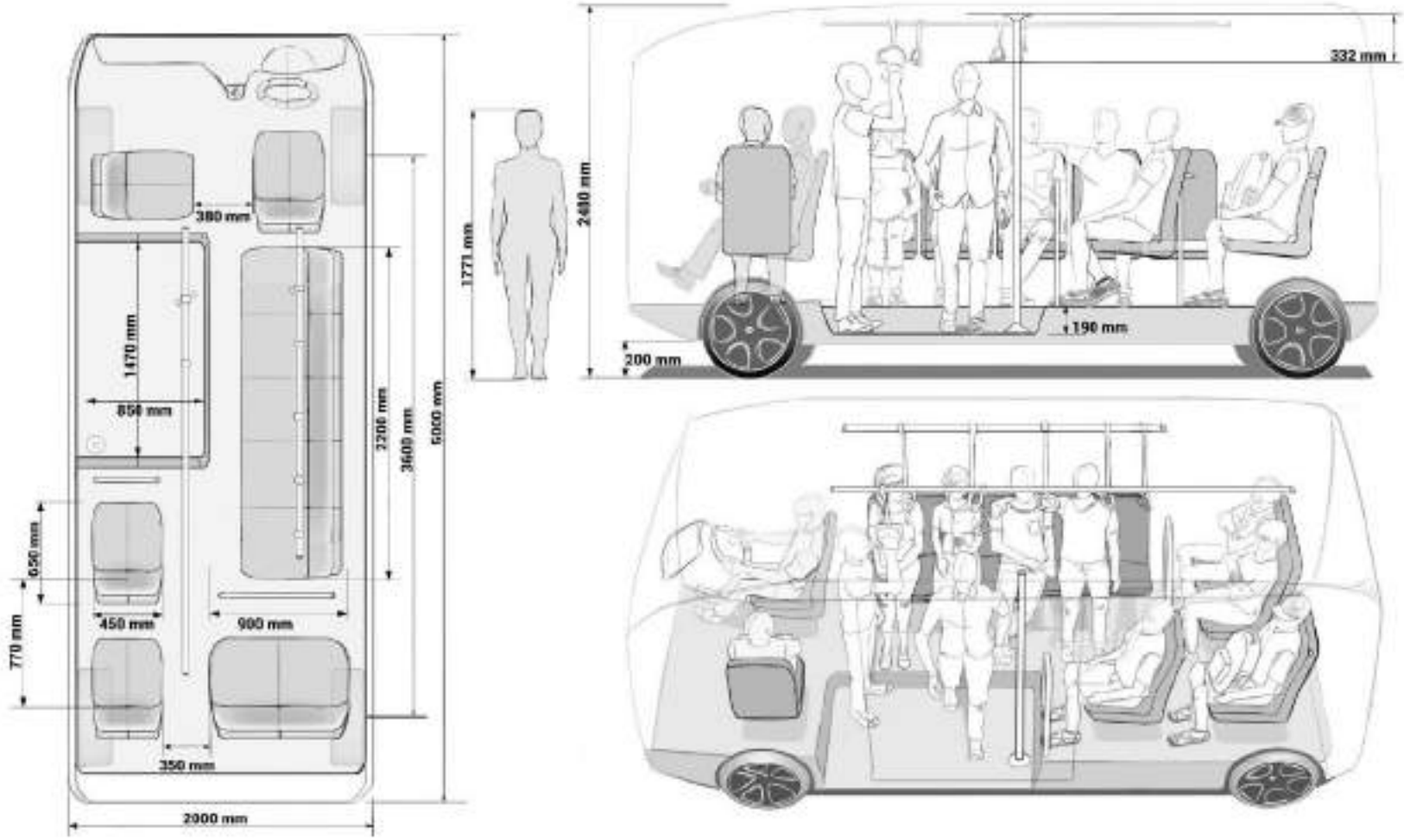
LAYOUT 3


380 mm
1470 mm
1700 mm
650 mm
770 mm
450 mm
900 mm
350 mm
2000 mm
3600 mm
5000 mm
1771 mm
2430 mm
332 mm
190 mm
200 mm

This layout showing the conductor seat facing sideways gives the best of both the previous layouts. The conductor has ease of reach over the entry door. He has a good view on the front of the vehicle, looking out for incoming passengers as well the forthcoming stops to inform the passengers inboard. Also, there is no obstruction in the view point of the driver. Rest of the layout is unchanged.

However, it was further found that, there is a lot of space at the back that is not getting used sufficiently. Hence, further layouts were explored for a better, more engaging and passenger efficient commute.

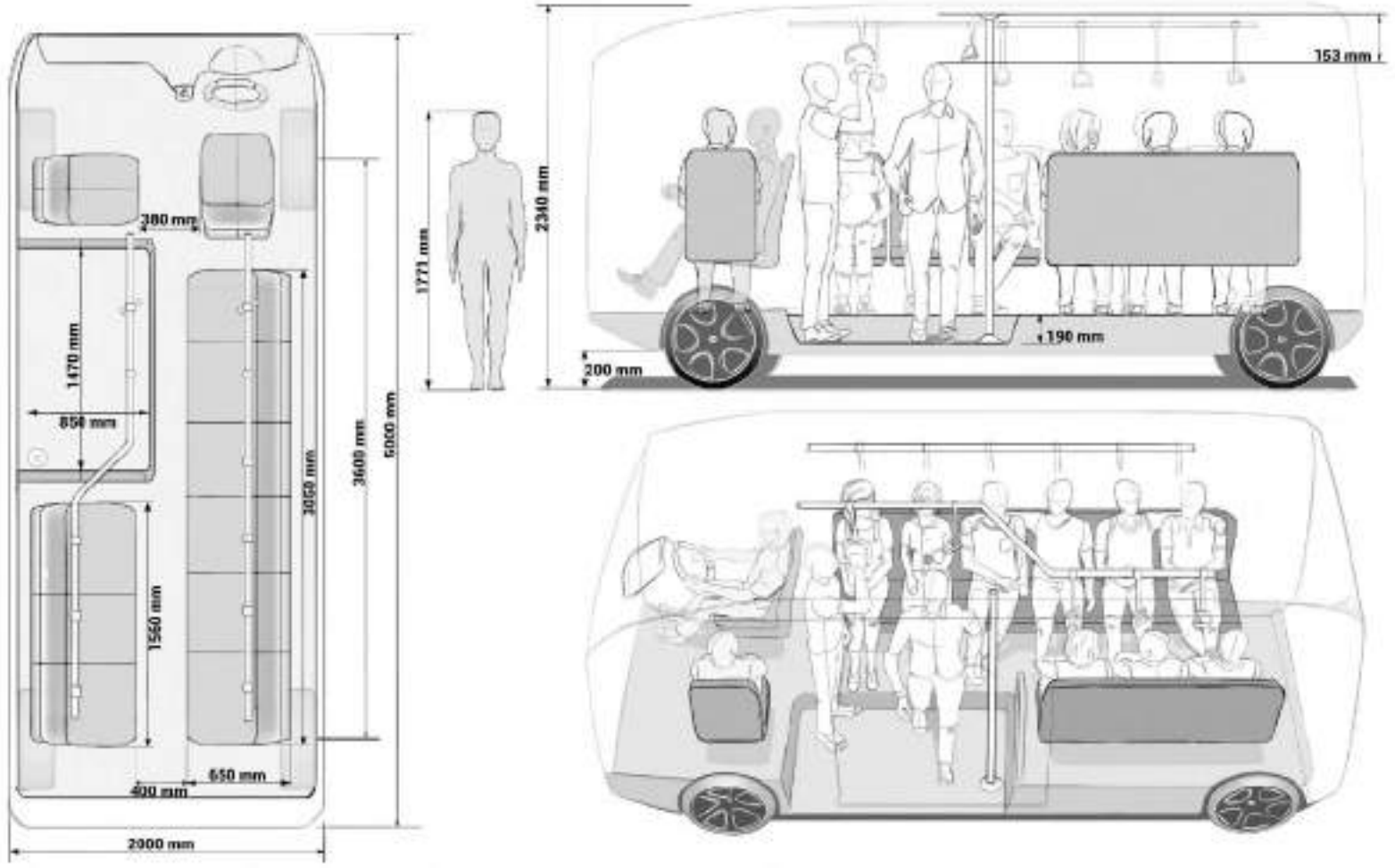
LAYOUT 4


380 mm
1470 mm
850 mm
650 mm
770 mm
450 mm
900 mm
350 mm
2000 mm
2200 mm
3600 mm
5000 mm
1771 mm
2480 mm
200 mm
190 mm
332 mm

In this case, the conductor seat is taken from the layout 3, but the passenger central area has been reduced to half of the initial width, this can accommodate easily 2 people to stand in case of quick traveling scene. There is side bench on the right side of the layout which can accommodate 5 people in comfort. In extreme cases, 6 people can be seated. There are two rows of back to back single seat at the end of the layout mimicking the prior layouts. And a double seated rear bench at the end. Sufficient grab bar is provided where needed. However, further explorations were done to come up with a better solution.

Next we move onto layout 5 as shown in the following page.

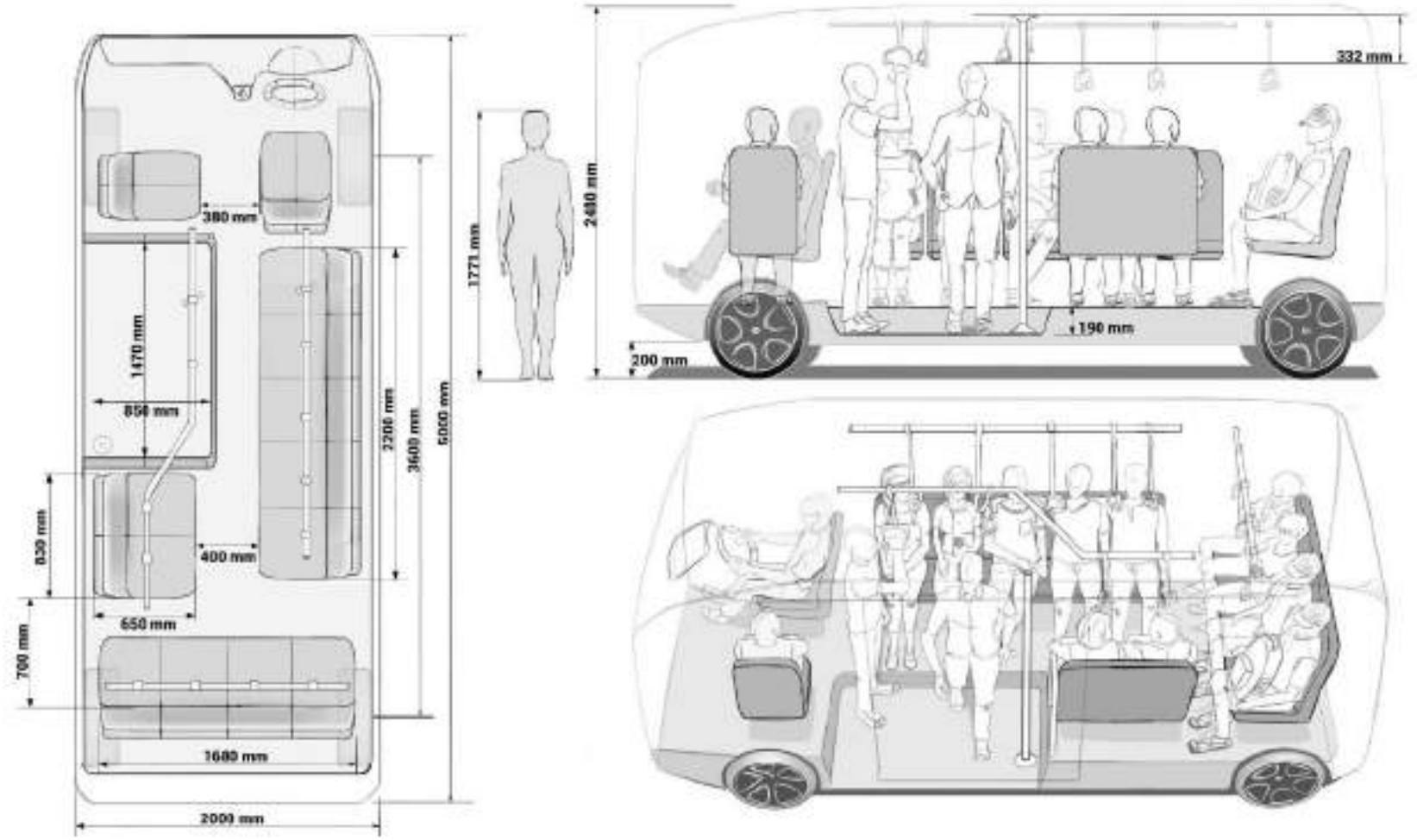
LAYOUT 5


380 mm
1470 mm
850 mm
1560 mm
3050 mm
3600 mm
6000 mm
650 mm
400 mm
2000 mm
1771 mm
2340 mm
153 mm
190 mm
200 mm

In layout 5, two rows of long bench are used. This can seat 6 people on the right end, with ample amount of space (3050mm), which is comfortable and in extreme cases can seat 7 passengers. The other end has a seating capacity of 3 people. There is a sufficient space for legroom in between them. 400mm. And the central area is taken by a lowered floor of dimension 1470mm by 850mm as in layout 4. This ensures comfortable commute for 2 passengers standing. Necessary grab bars are given on roof by use of bars and grip.

In an overview, to come up with the final layout, all the layouts were thoroughly analyzed and the good bits from each of them was incorporated to find the most suited solution for the final layout. This is shown in the following section.

FINAL INTERIOR LAYOUT

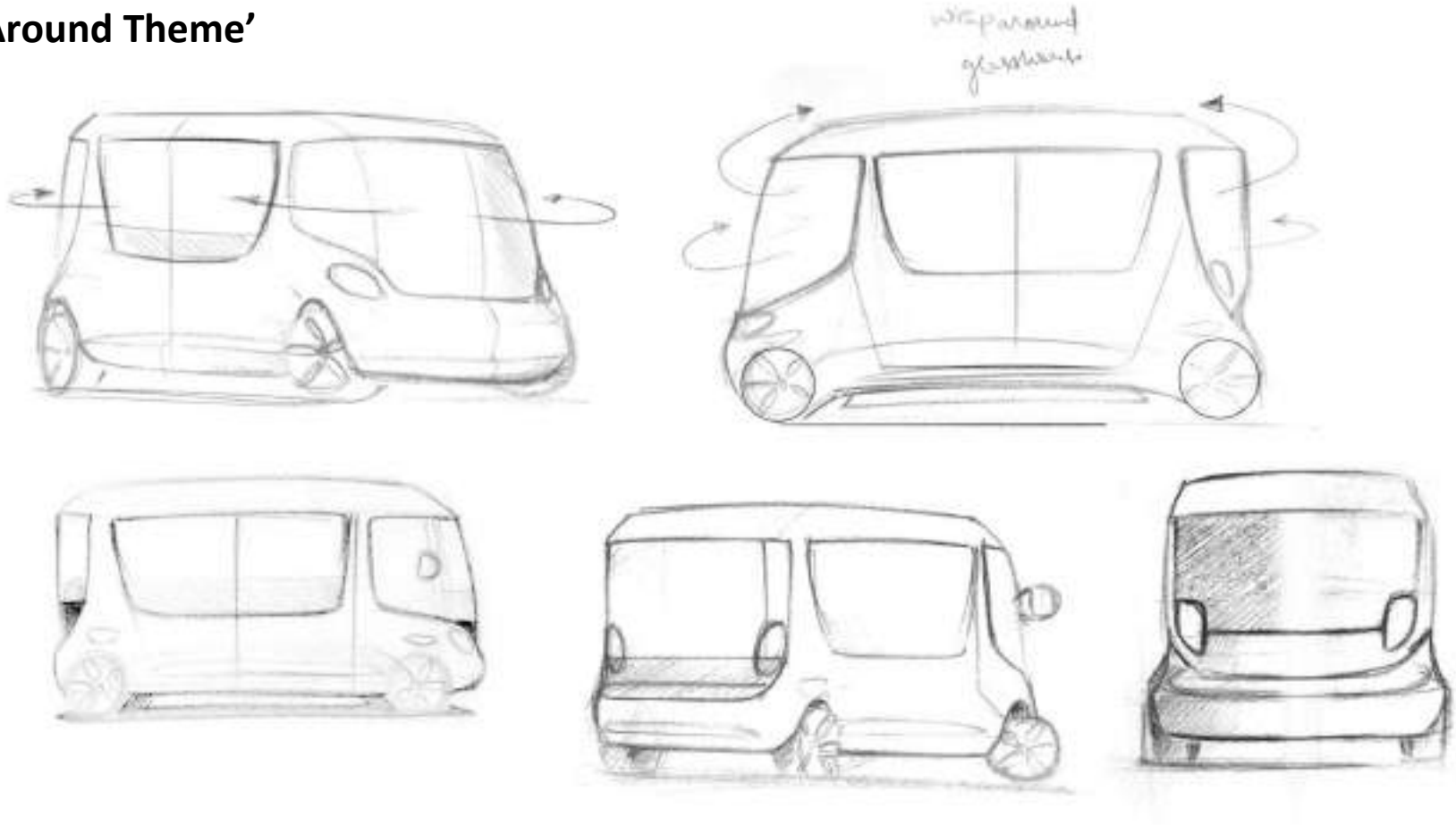


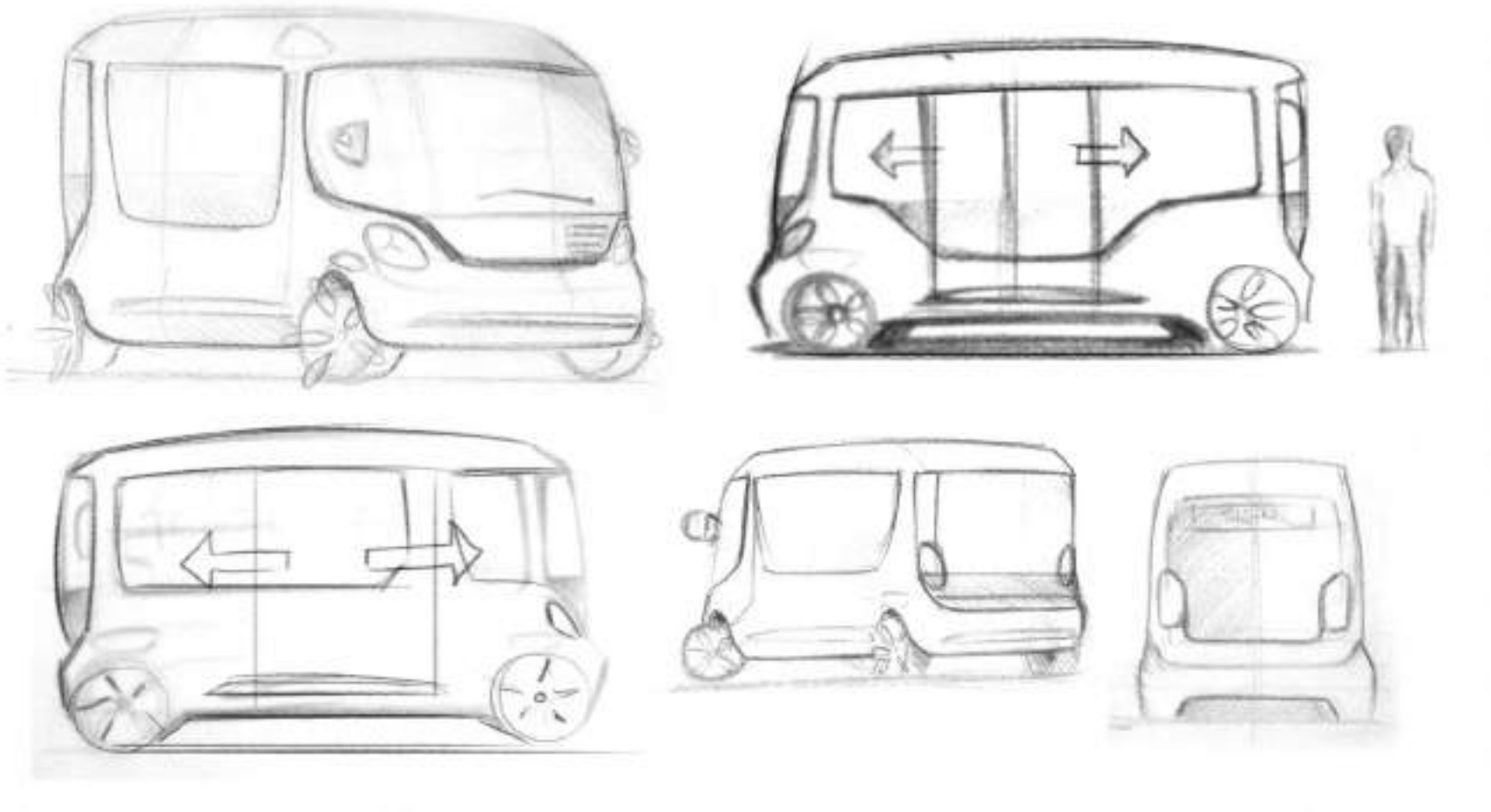
The final chosen layout has three seating benches. A long side bench width dimension 2200mm wide. It can accommodate 5 people in comfort, 6 people in extreme cases. A rear bench with a breadth of 1680mm, sufficient for 4 people to sit and legroom of 700mm, which is adequate for upright seating. And the last bench faces the left side of the layout. It can accommodate 2 people at full comfort. In total, there is a seating capacity of 11 people at full comfort and 13 people in extreme case. In addition to this, there is the low floor standing area for quick travel ingress/egress. This area measures at 1470mm by 850mm. This can comfortably accommodate 2 people standing. Necessary grab bar and handles are provided by the help of roof mounted bars. The conductor faces sideways. This gives him ease of access to the door, a good view on the road ahead, good view on incoming passengers along with the upcoming stops and lastly, passengers can interact with him facing no hassle.

EXTERIOR IDEATIONS

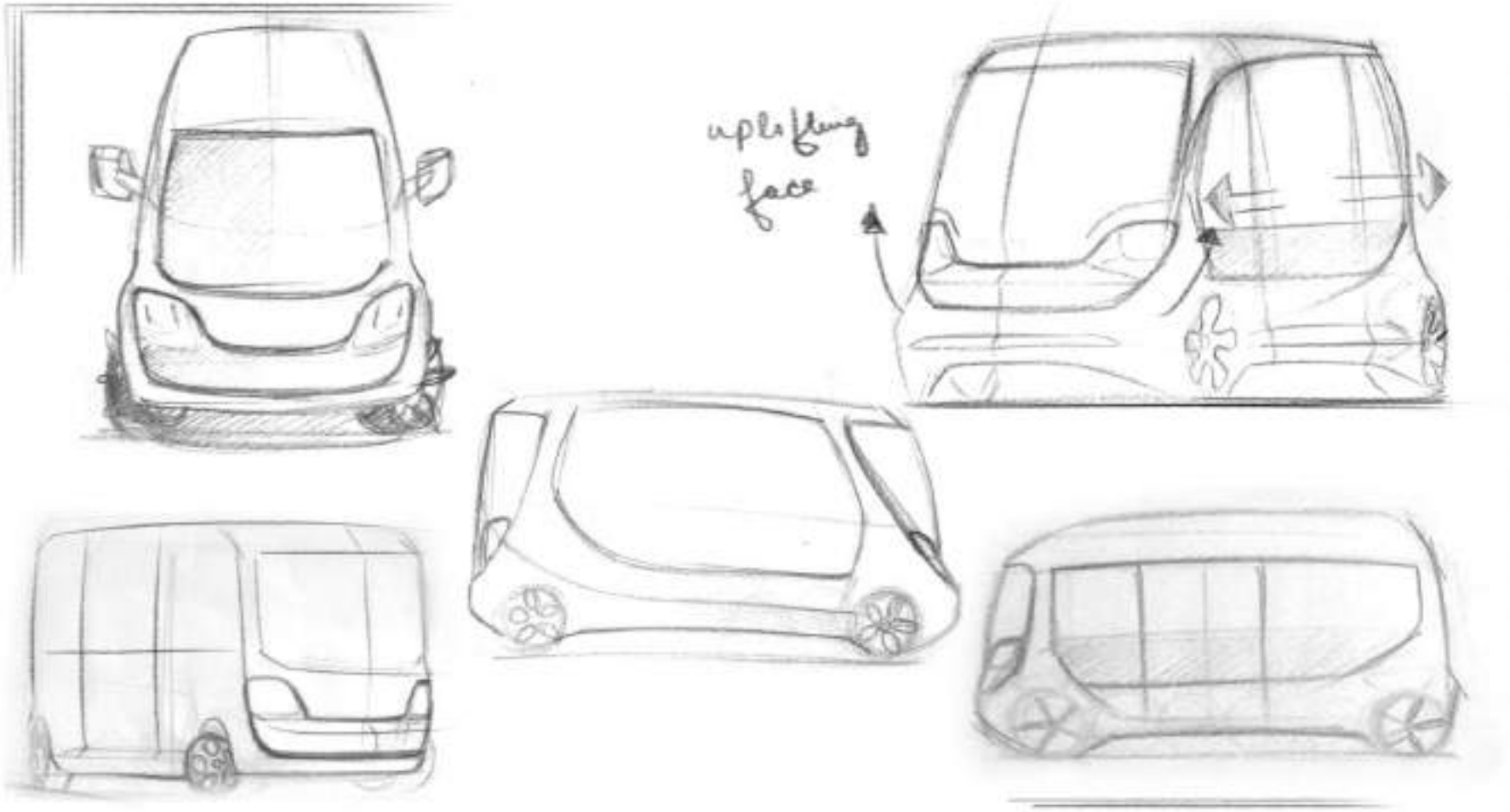
The next stage is the ideation exploration. The three keywords used during the ideations were ‘Welcoming’, ‘Humble’ and ‘Modern’. As mentioned in the research, these characters connect the to the Assamese people as well as the local context most aptly. Now when we think of these three expressions, all of these are expressions which come naturally. There is no sense of external force in it. It is pure, warm. To get to the ideation stage, these factors were the prime considerations. The surface treatment, the facia of the vehicle has to convey these emotions. Surfaces and lines and curves that don’t exert anger, rather peace, humbleness and welcoming aura.

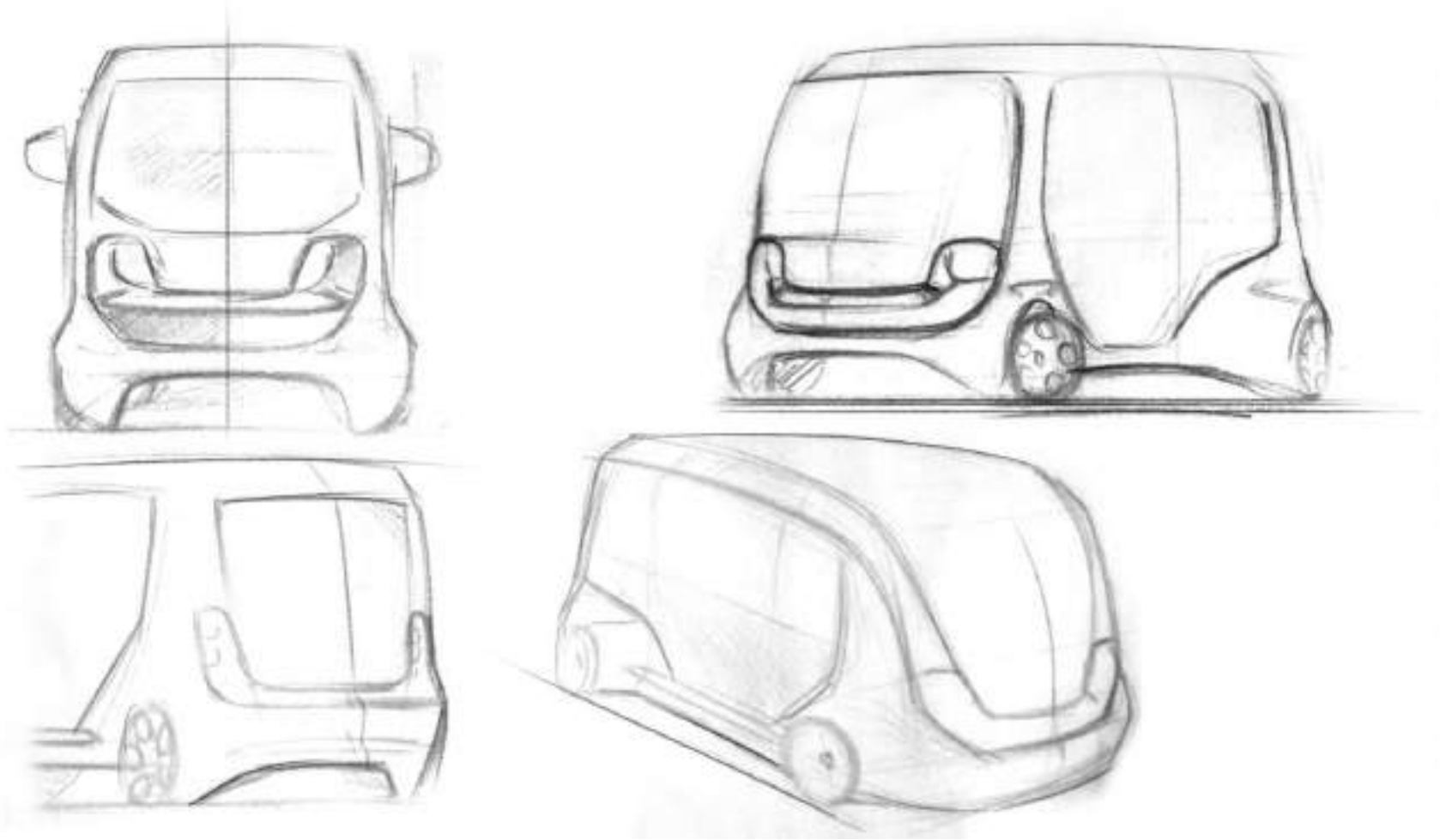
‘Wrap-Around Theme’

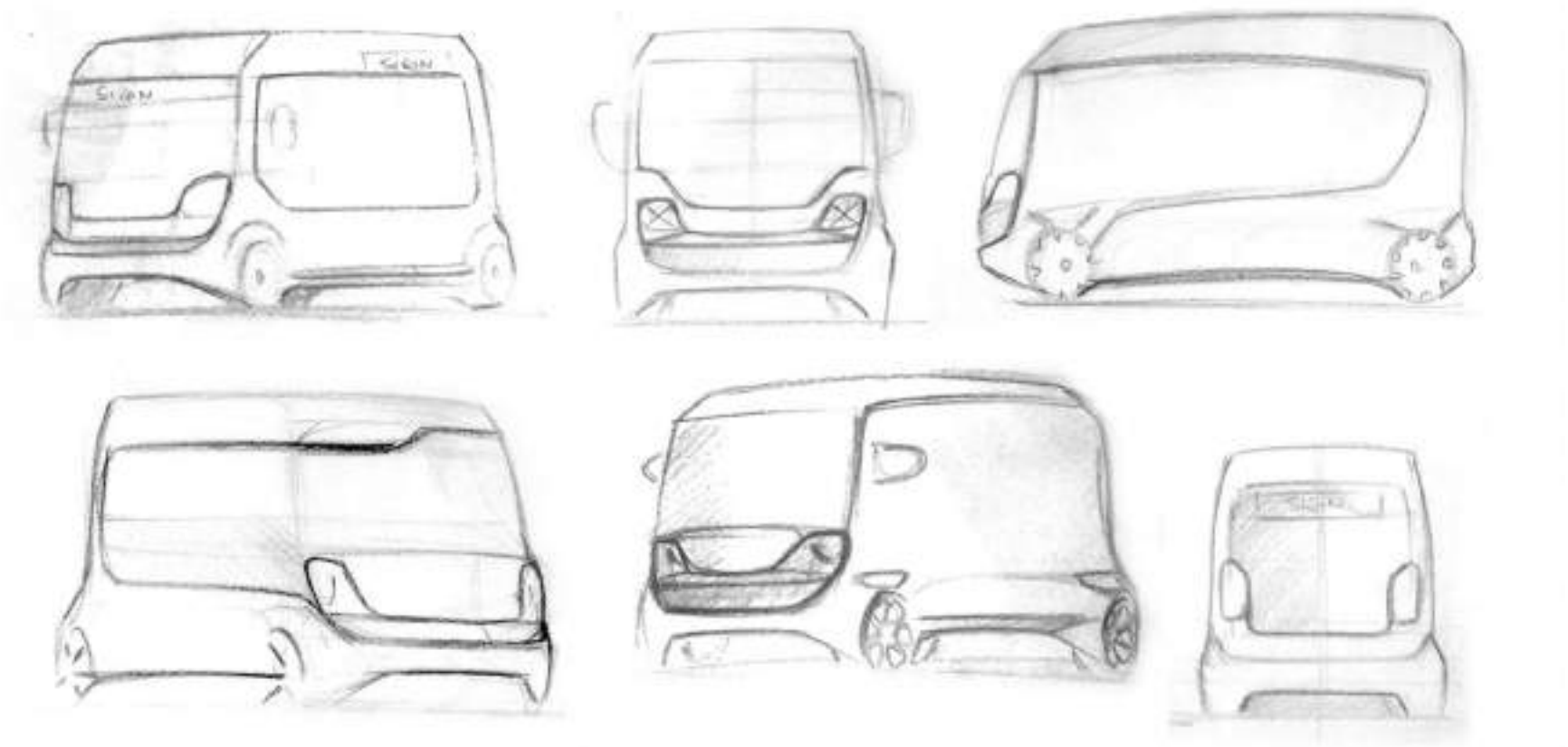




‘Uplifted facia’

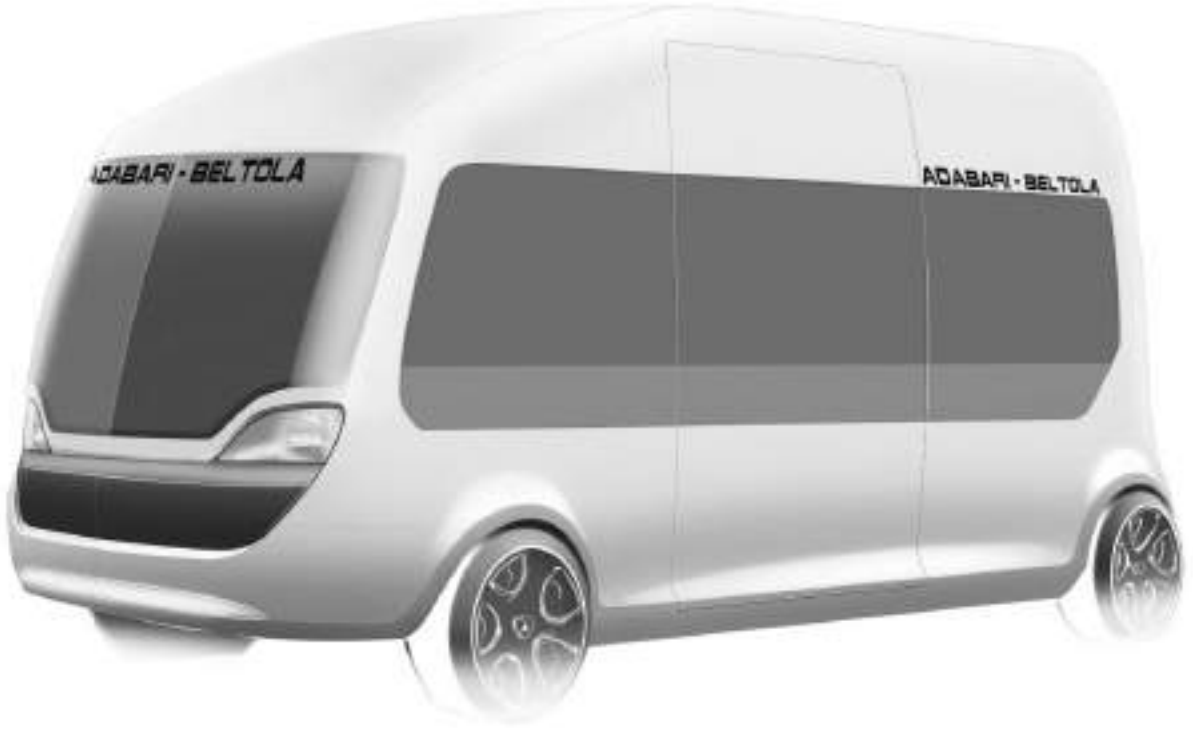




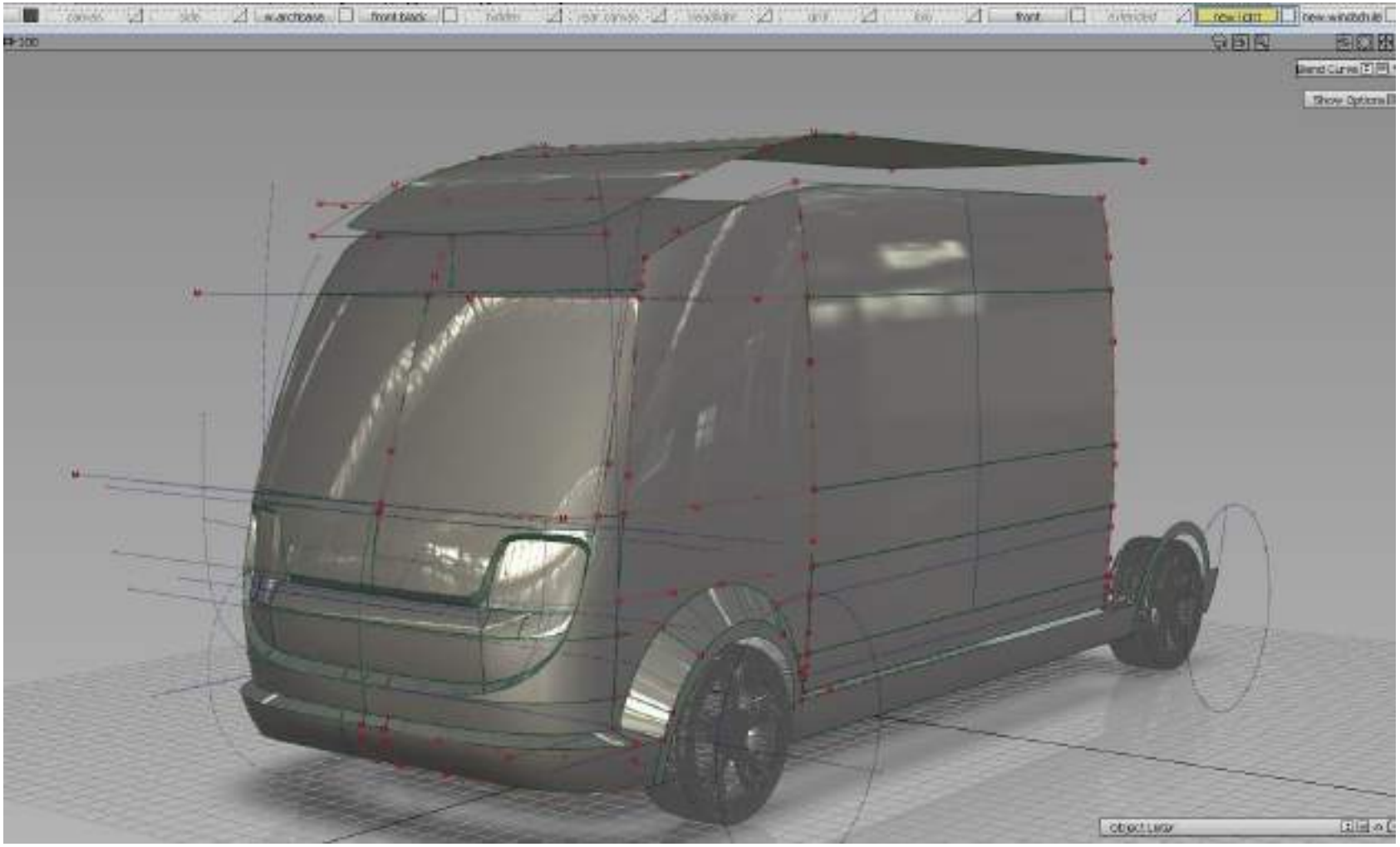


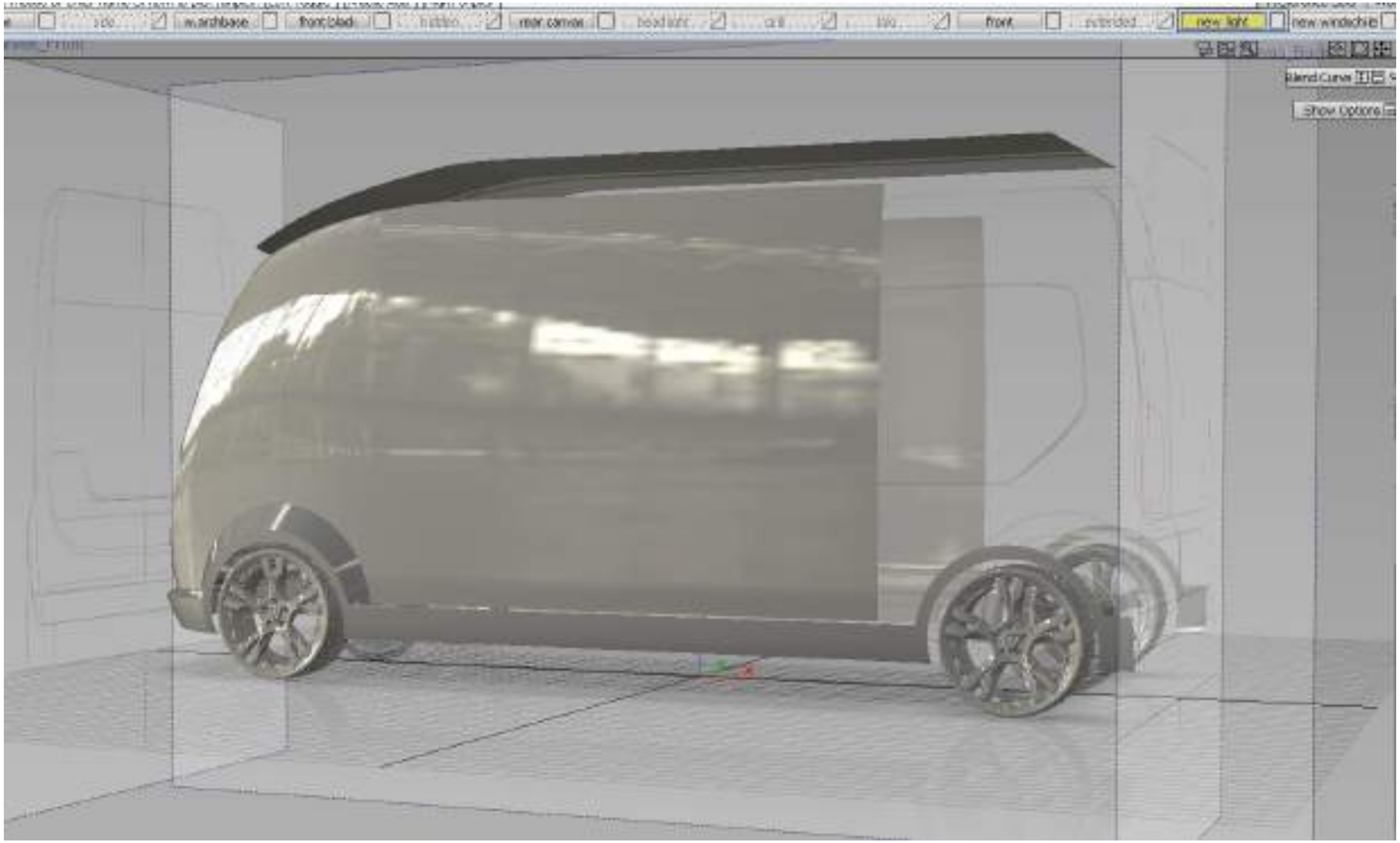
Final Render

From the above ideations, the uplifting facia was chosen as this expresses more of the welcoming, humbleness and modern character. v



CAD MODEL in progress

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new light
Blend Curve
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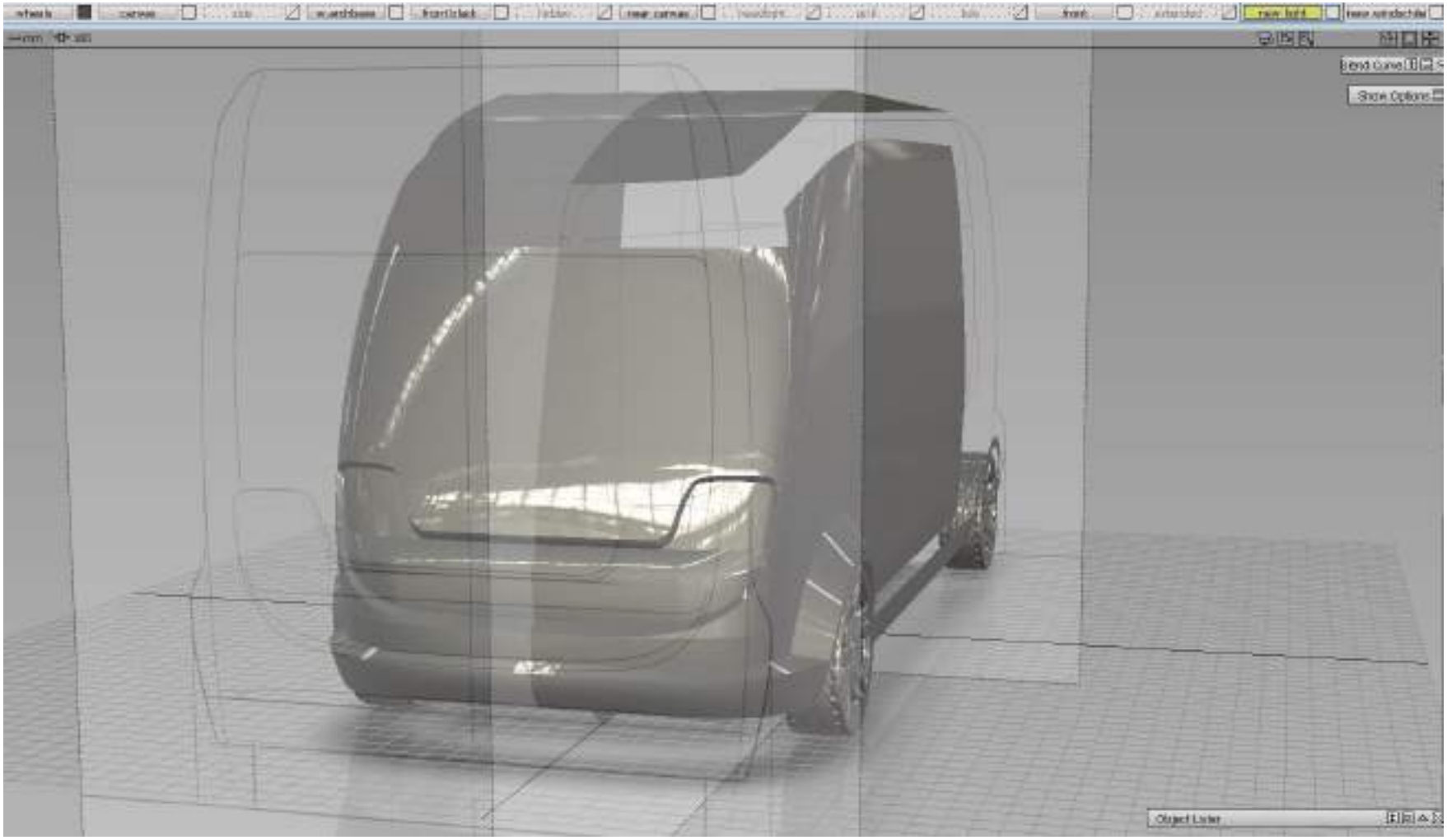

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