Designing an electric auto rickshaw

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Abstract

The project deals with designing an auto rickshaw considering the existing ergonomic issues, running costs and styling of it. The design approach consists of understanding the available rickshaws, user study for the identifying the problem areas, ergonomic study for enhanced comfort, power train and source analysis for efficient power train, a design proposal and finally coming up with a styling of the rickshaw

Objective

Designing a battery operated 3 seater Auto rickshaw

Introduction

- An auto rickshaw is a motor powered rickshaw
- The word rickshaw basically comes from the Japanese word ‘Jin-riki -sha’ meaning human strength vehicle
- Majorly used in developing nations and specially in places where traffic congestion is a major problem
- First auto rickshaw ‘Hanseat’ was introduced in 1957 in India under B Achchraj Trading Corp which was based on German three wheeler.

Usage

The usage of auto rickshaw is prominent among the following people:

- People moving around with family members
- Office going population, due to the ease of availability
- School going children (Chartered service)
- Senior citizens
- Vegetable and fruit vendors

Also an autorickshaw is used as a leisure vehicle at various places and for few a recreational vehicle

Definition of problem

- Taxis and rickshaws being prominent modes of transportation leading to high amount of air pollution in densely populated cities
- Depleting fossil fuel reserve raising concerns for the future validity of gas powered vehicles
- Need for introduction of a innovative contemporary form for the next generation of auto rickshaws
- Need for introduction of an alternative material for steel and other metals due to its increasing rates

Need of the project

- Modernize the existing auto rickshaw design for future applications
- Considering an alternative power source for propelling the vehicle to take into account the depleting fuel resource and also keeping pollution in check
- Considering an alternative material for the existing metal body and frames to keep in check with rising metal costs

Existing products

Bajaj

Lovson

Goel tempo

Jimkim

Scooters India Ltd.

Atul Motors

Bench Marked product

Bajaj Re series

2 stroke, 145.45cc, 7bhp@5000 rpm,
12.1 Nm@3500rpm
LWH 2610 1300 1710 GVW 277kg
Fuel tank capacity 8L (main+reserve)
Cost: Rs.90,039.00

4 stroke, 173cc, 8.01bhp@5000rpm,
11.5Nm @ 4000 rpm
LWH 2610 1300 1710 GVW 305kg
Fuel tank capacity 8L (main+reserve)
Cost: Rs.1,15,000

Diesel 416cc, 7.12 BHP @ 3000 rpm,
20 Nm @ 2200 rpm
LWH 2610 1300 1710 GVW 350 Kg

User study

- Understanding the usage of auto rickshaw (Observation)
- Understanding the problems generally related to auto rickshaw by data collection techniques (Observation and interviewing)
- Analyzing the data collected during the user study
- Generating insights

Targeted users:

- Rickshaw drivers
- Passengers
- Service personnel
- Students

Essential Parameters

- Range of traverse generally covered:
- Maximum distance covered in one trip: 35km
- Average distance covered in a single trip: 1.5km
- Overall distance in one day: 75km (avg)

  100 km (Max)

- Running cost:
  - Average running cost for Bajaj RE petrol:
    - Average cost for the fuel consumed: Rs. 175/day
    - Average cost for maintenance: Rs 1500/month
  - Average running cost for Bajaj RE 4S CNG:
    - Average cost of fuel consumed: Rs 90/day
    - Average cost for maintenance: Rs 1500/month

Conclusion

Points generated from interviewing 20 passengers and 15 drivers:

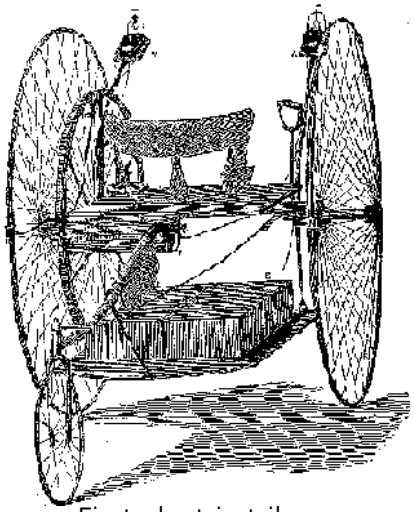
- Clutch and other small parts get wear off easily and generally result in high Engine failure or problem, a common problem faced almost two to three times a year causing high repair or replacing costs (5)
- No boot space while carrying lots of baggage (5)
- Noisy compartment, irritating engine vibrations (4)
- Rexin gets torn off or starts sagging after a period of time (4)
- Low roof height (3)
- Low illumination at night makes reading of meter very difficult (3)

- Colour of the vehicle causes problem in identification in the night if light does not work properly (3)
- Brakes generally wear out easily (3)
- Handle bar position too low (2)
- Low pulling power (2)
- Ingres and egress a problem (2)
- Polluted air gets in directly, no barrier provided (1)

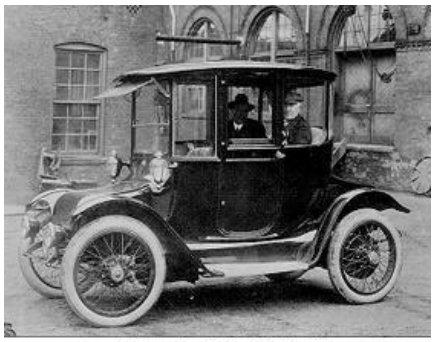
Design insights

- Design of vehicle looks clumsy and aged
- Better utilization of space necessary for comfortable seating
- Luggage space repositioned from back to front for a secured feeling
- Rexin soft top should be replaced for a strong material to enhance overall rigidity and enhancing the look
- Front portion should be modified for better horizontal as well as vertical visibility range and for provision of ventilation for driver
- To keep the driver comfort as most important consideration as almost whole of the day is spent in the rickshaw

Electric vehicles



First electric trike



An early Detroit Electric

- The initial works had started in 1835 by Thomas Davenport with introduction of small railway operated by miniature electric motor
- In 1838, Scotsman Robert Davidson built an electric locomotive attaining speeds of four miles per hour
- Gaston Plante invented rechargeable lead-acid batteries in 1859
- In 1870, Sir David Solomon propelled an electric carriage
- In 1888, F.M. Kimballs and P.W. Pratt from U.S. developed an electric car
- Later in 1889, Thomas Edison built an EV using Nickel alkaline batteries
- Anderson Electric Car Company started the production of the electric automobile 'Detroit Electric', powered by a rechargeable lead acid battery, began in 1907

GM ETV 1

GEM EV 4

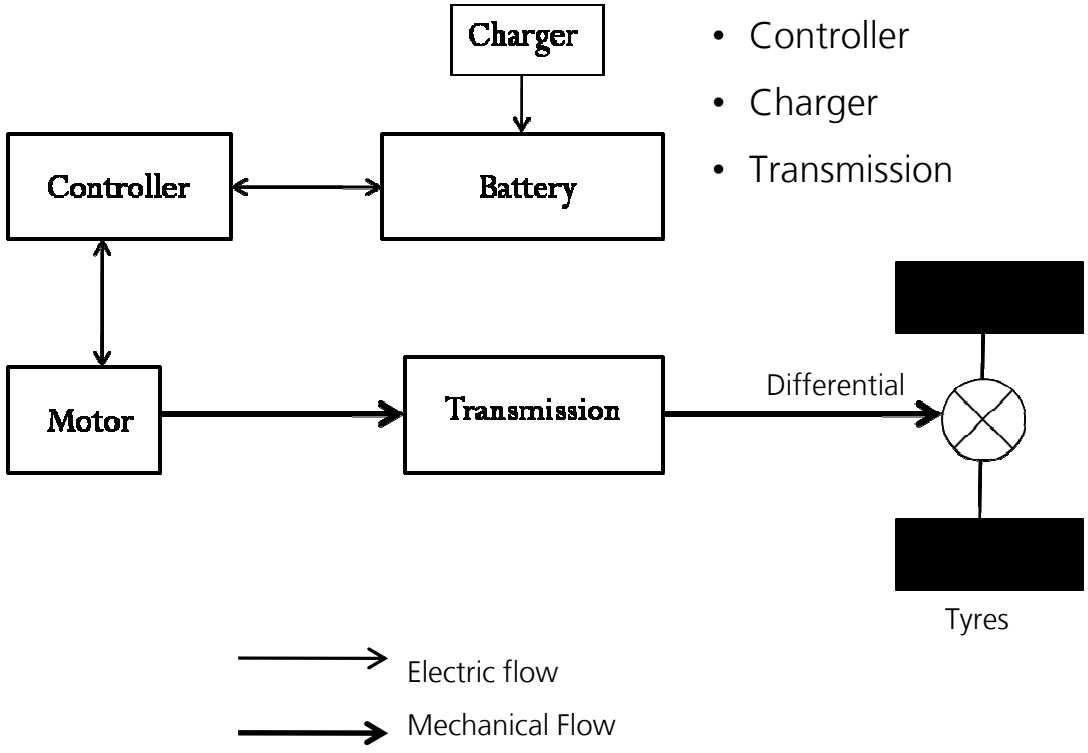
Maini Reva

- In 1960, the interest towards EV increased due to the increased concern for pollution
- In 1970, Energy crisis also became an overriding concern
- 1970's saw the development of sodium sulphur batteries by Ford while Chrysler teamed up with GE to work on ETV-1
- But in 1980's the EV activity slowed down due to plentiful oil supplies
- Again 1990's saw the rise of EV's with California and other major states establishing ZEV(Zero Emission Vehicle) Mandate
- Many companies introduced Evs but on lease
- But also there were few companies as Maini, the Maini REVA, GEM EV4 which started as small volume production but later on commercialized the production of vehicles for the international markets

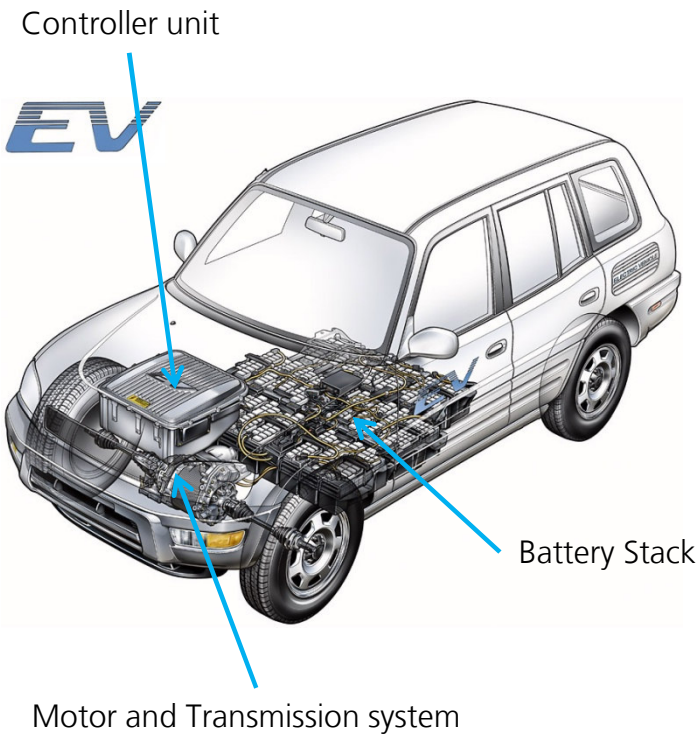
The working

The basic components:

- Battery
- Motor
- Controller
- Charger
- Transmission



General layout



Battery:

Basically the main source of an EV
The energy stored in form of chemical energy is utilized for providing power

Motor:

The main element converting electric power to mechanical torque and providing motion to the vehicle

Controller:

The brain of the EV.
Regulating flow of electricity form battery to motor

Charger:

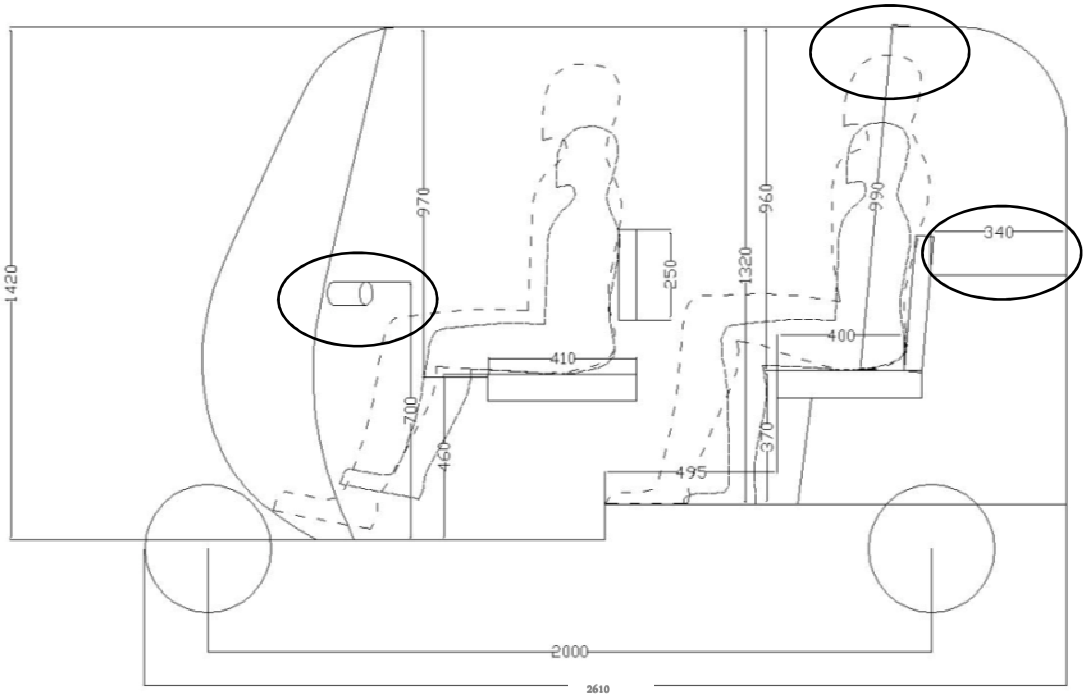
The medium through which electric energy is stored in chemical form in the batteries

Usage

- Initially in the mid 90's and early 00's electric vehicles were basically used as experimental vehicles but never sold to customers instead leased out for a limited period
- Electric locomotives and trams existed right from the early twentieth century
- Used for mass transportation for long or short distance travel and transportation with the source easily made available in form of electric line running through the route

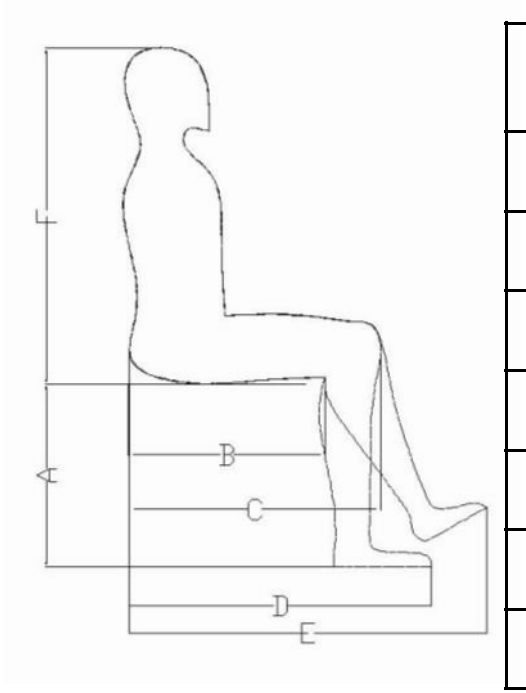
- An attempt to make personal electric vehicles were made common basically in the initial phase of 21st century with the first experiment being the Maini Reva and other small companies which later transformed into a global seller
- GEM also started off with NEV's around 1998 which were basically very light weight open vehicles powered by batteries basically for household use and limited range travel
- Other applications as fleet of bus for city travel, trucks for short distance frequent start stop applications were also successfully implemented
- Due to limited range further implementation has been limited

Dimensional study of benchmarked rickshaw



Problem areas

Ergonomic study



No	Nomenclature	5th %	50th %	95th %
1	A- popliteal	365	425	471
2	B- buttock to popliteal length	340	455	512
3	C- buttock to knee length	459	558	615
4	D- buttock to leg length	540	719	779
5	E- Buttock to leg length (extended)	719	923	1086
6	F- Erect seating height	713	837	905
7	G- Bi-deltoid	319	426	482

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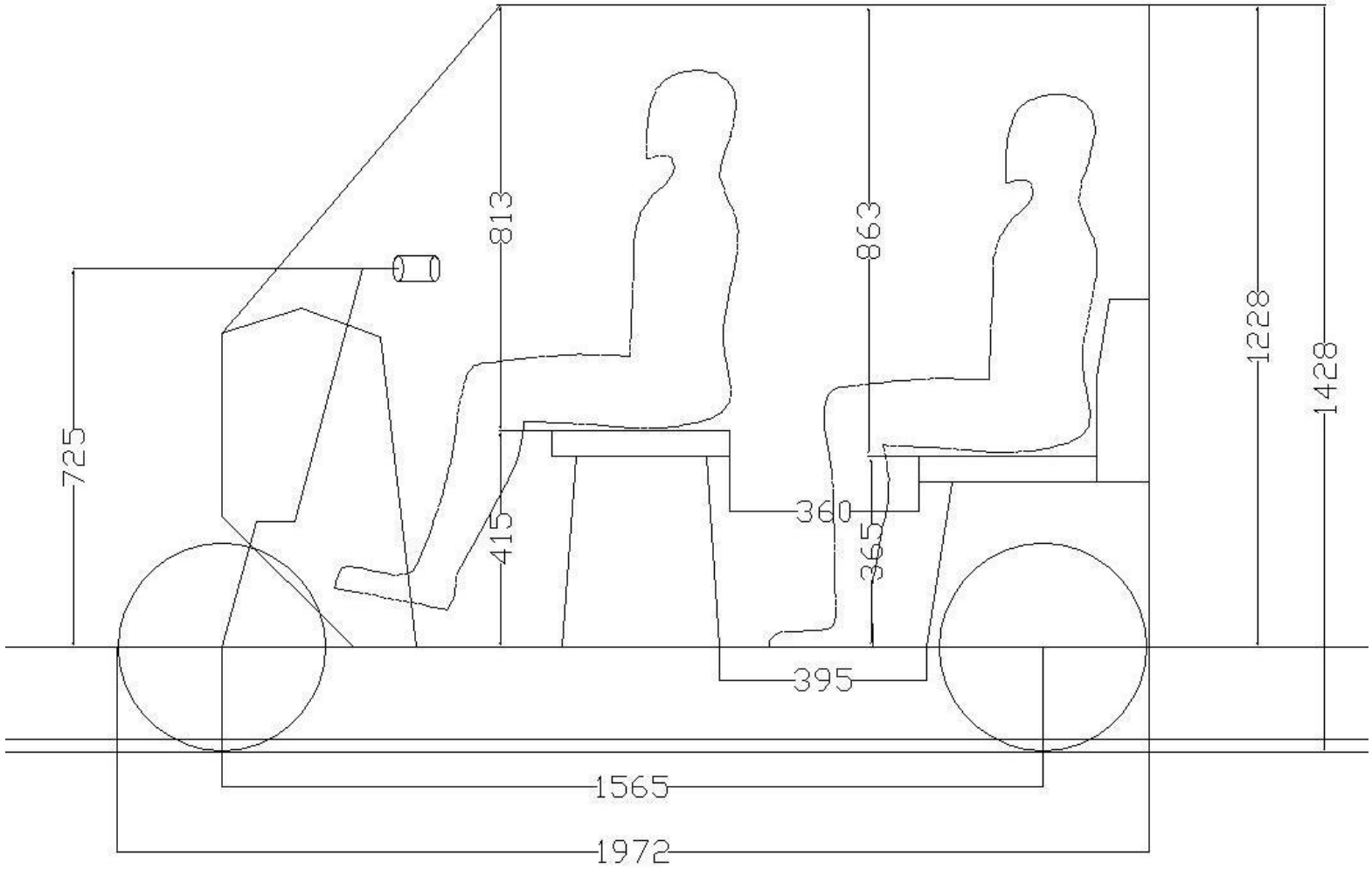
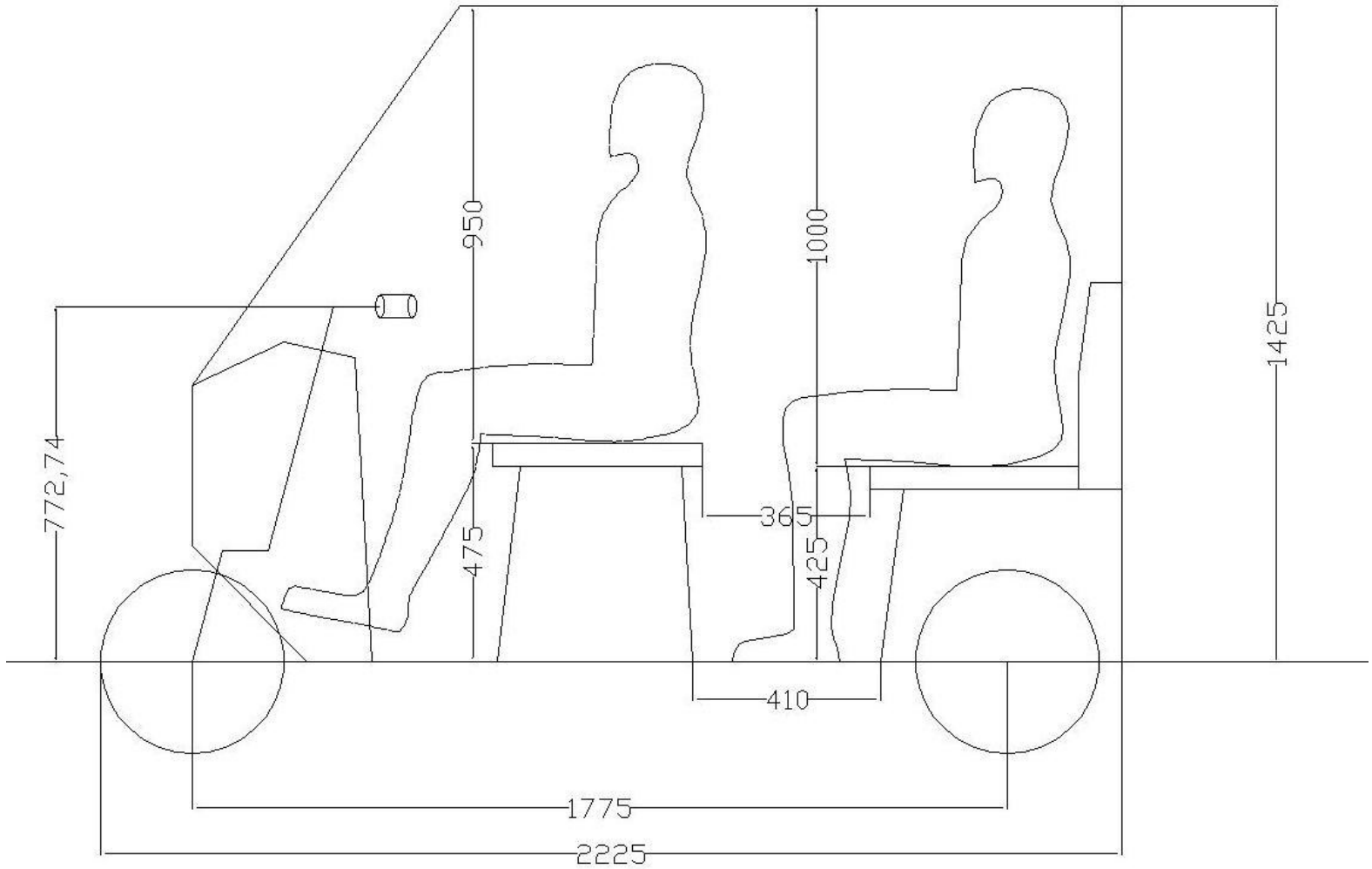
Indian Anthropometric Dimensions

Generating Schematic sections for different percentile people

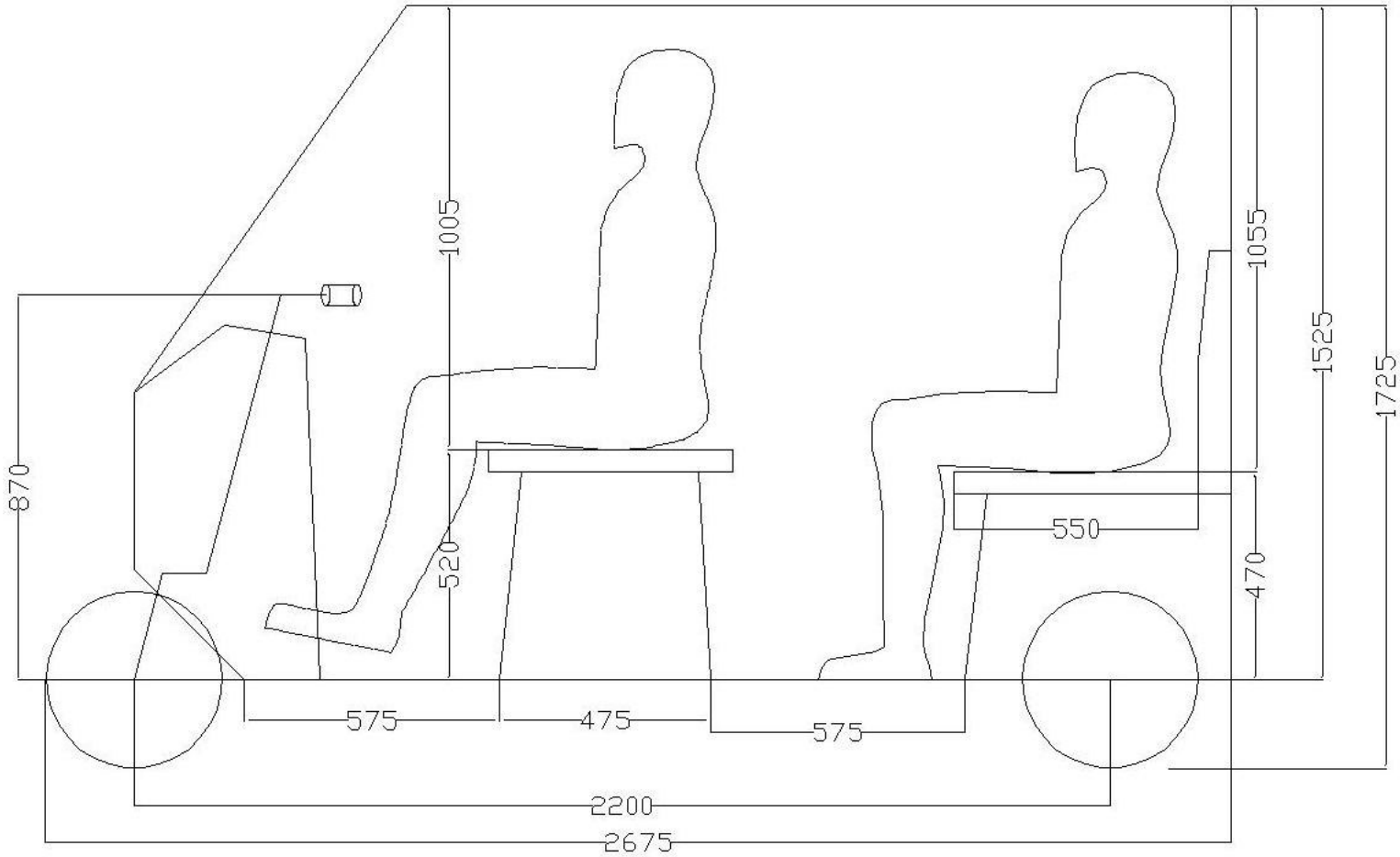
For 5th percentile



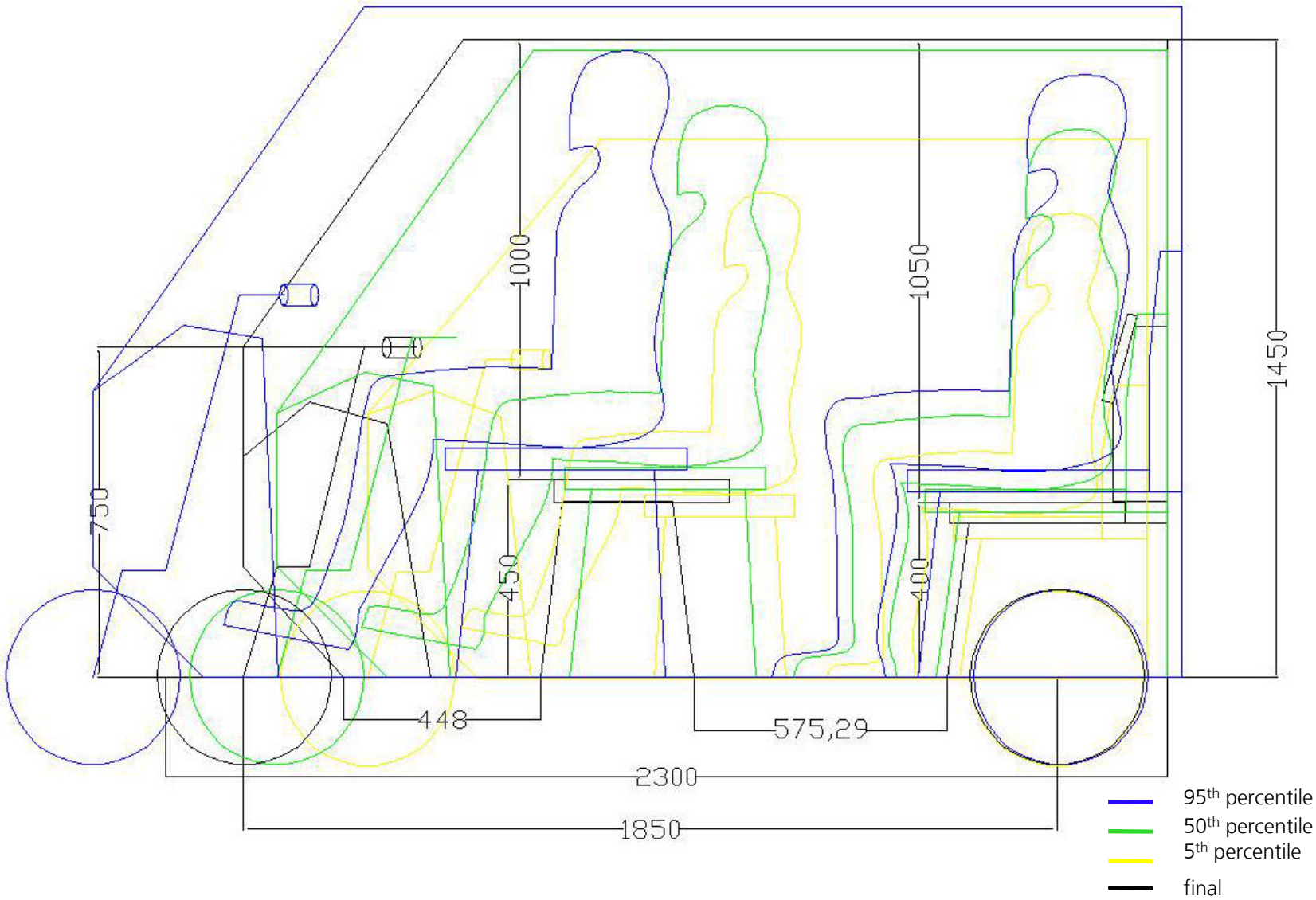
50th percentile



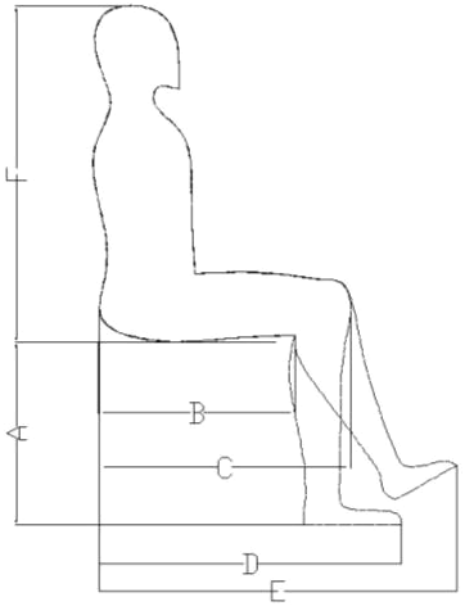
95th percentile



Combined layout



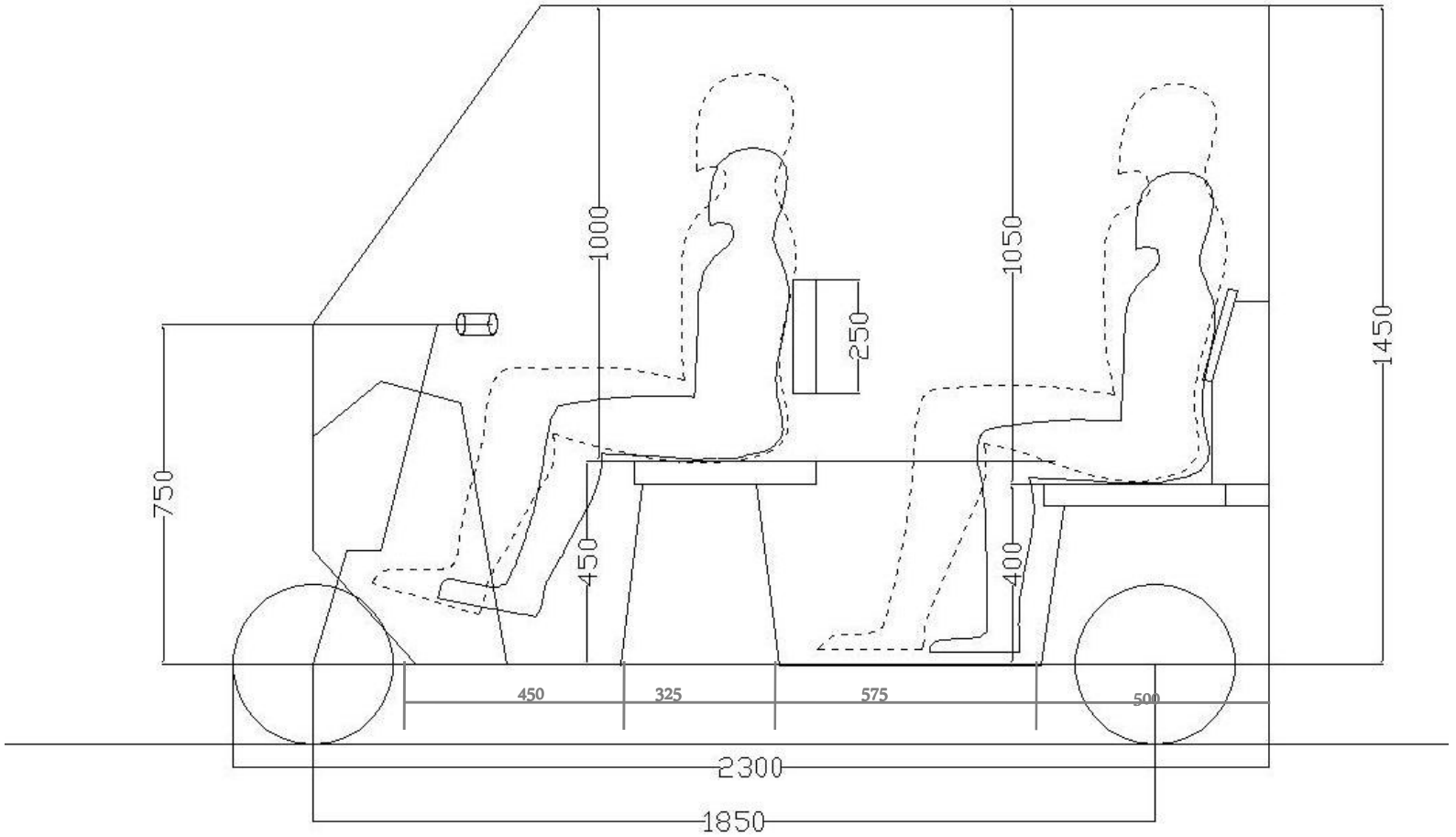
Ergonomic study



No	Nomenclature	5th %	50th %	95th %	Final
1	A- popliteal	365	425	471	400
2	B- buttock to popliteal length	340	455	512	400
3	C- buttock to knee length	459	558	615	615
4	D- buttock to leg length	540	719	779	779
5	E- Buttock to leg length (extended)	719	923	1086	950
6	F- Erect seating height	713	837	905	905
7	G- Bi-deltoid	319	426	482	482

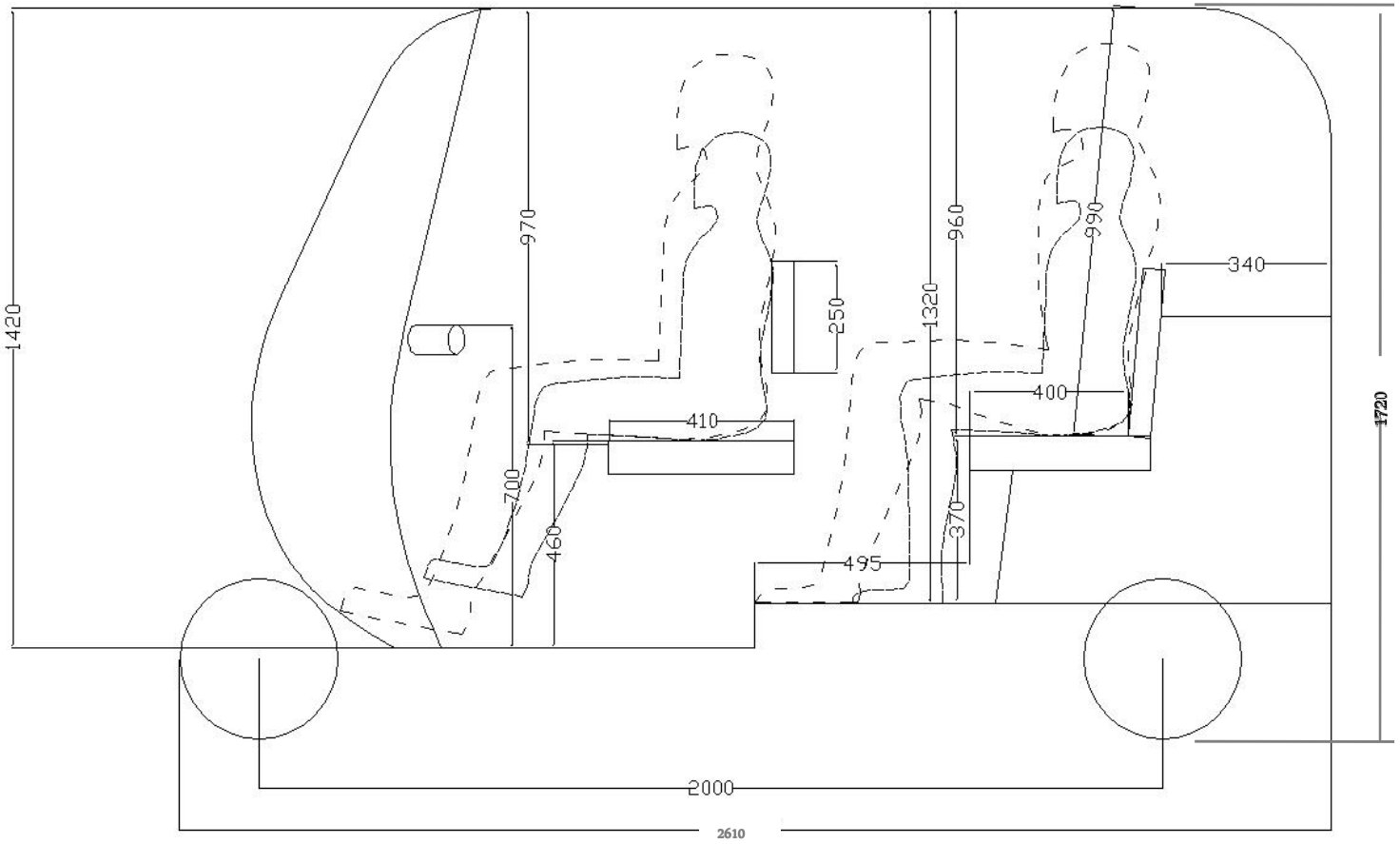
Deb Kumar Chakrabarti:
Indian Anthropometric Dimensions

Proposed Schematic section

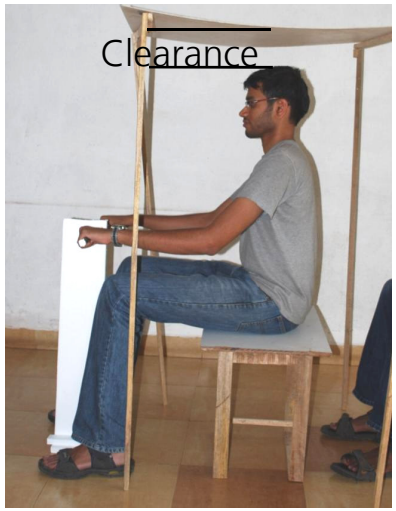


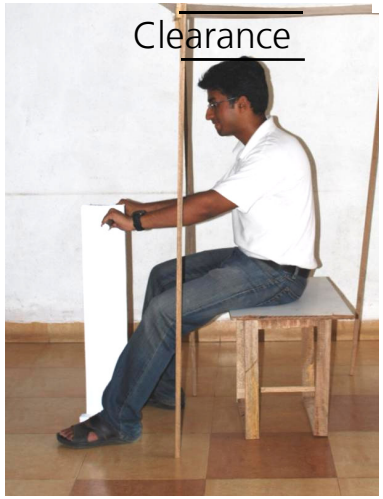
Existing Auto rickshaw

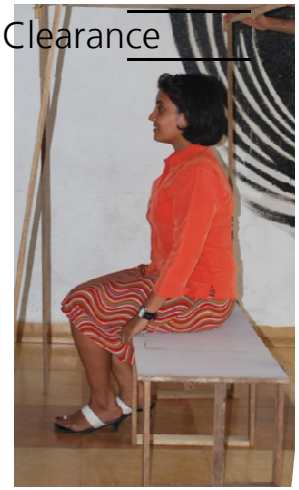
Bajaj RE 4S



Space exploration

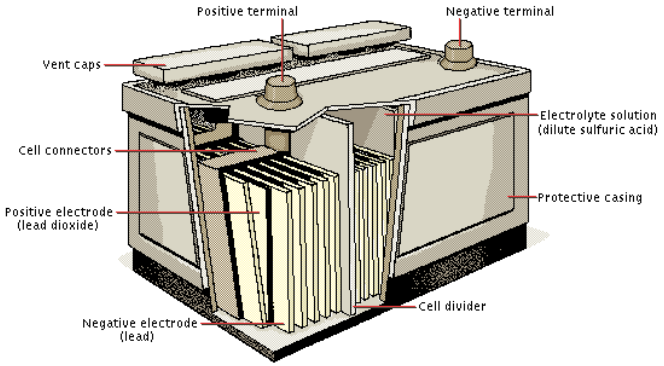






1:1 Setup

Motor and battery details



Types of batteries used in EV's

- Lead Acid:
  - The most commonly used recharagble batteries for EVs.
  - Cheapest form of medium - high capacity
  - Ability to supply high surge currents
  - Low energy-to-weight ratio
  - Very bulky
- Lithium ion
  - Best portable batteries due to high energy-to-weight ratio
  - Compact dimensions and less weight lead to its extensive usage in mobiles, laptops, etc and is venturing into EVs
  - Can sustain high charge and discharge cycles
  - Life cycle of the battery limited to 3- 4years irrespective of usage
  - Should not be fully discharged
- NiMH (nickel metal hydrate)
  - Commonly used batteries for Hybrid vehicle
  - Cheap and easily maintainable but have low energy-to-weight ratio

Motor specifications

20kW hub mounted BLDC motor

- Brushless DC motor:
  - Higher efficiency, reliability, reduced noise, etc
  - Requires no airflow due to natural conduction
  - Casing of motor can be completely enclosed resulting in protection from dirt and other foreign matter
- Hub mounted BLDC motor:
  - Directly fitted onto the wheel of vehicle resulting in space saving
  - Compact dimensions and clean feel to the vehicle
- Inverted SR Motor:
  - The inverted Switched Reluctance motors are very rugged
  - It does not have magnets which makes it more reliable and also lighter in weight compared to others
  - It provides high torques with excellent dynamic capability at very low end of the speed and also is with high speeds
  - For a given input voltage range, the domain of speed, torque and efficiency of an SR drive system is the largest

Battery options

Battery	Configuration	Weight (Kg)		Dimension (mm)	Cost (Rs)		Remarks
		Single	Total	Single	Single	Total	
Lead Acid							
12v 35Ah	4 in series, 2 set in parallel (8 no.s in total)	13.15	105	195*130*183	4178	33424	Too heavy
12v 65Ah	4 in series	19.6	78.4	275*175*190	5810	23240	Suitable and comes under the considerations
48v 35Ah	2 in parallel	25.85	51.7	178*202*406	-	-	Too big to be placed
Li-Ion							
3.8v 70Ah	13 in series	2.2	28.6	24*260*210	-	-	Higher no. of batteries required but best suited due to less weight

Practical solution for current scenario

Optimal solution for the best performance

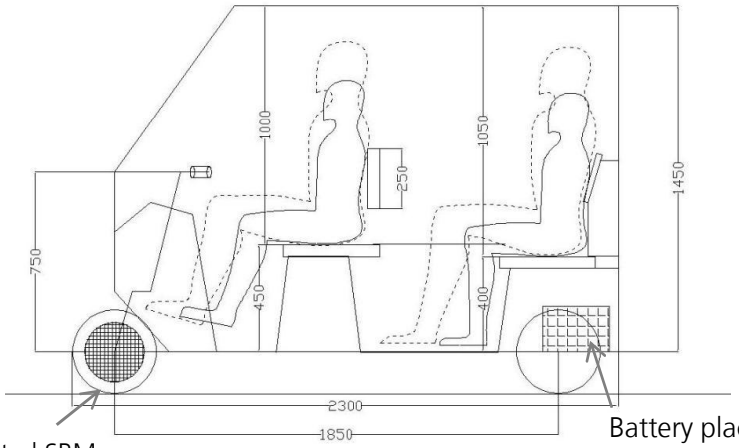
- Data generated from the calculations and corresponding options available in the market

Motor specifications

Weight (kg)	Power(Kw)	RPM		Torque(Nm)	
		Min(20Kmph)	Max (50 Kmph)	Hi Speed(50Kmph)	Low speed(20Kmph)
500	3	265	665	43	90
600	3.5	265	665	50.41	115

Considering a 3kW motor providing a maximum torque of 90Nm

Basic rickshaw configuration



- Configuration — Front motor, front wheel driven
- Motor specification — 3kw, 10” hub mounted Inverted SR motor fitted in front wheel
- Battery specification — 13no.s., 3.8v, 70Ah Li-ion batteries in series placed in a chamber below the passenger seat

Front wheel drive vehicle

Bajaj Hanseat

Fiat 500

The motor of the rickshaw is positioned on the front to provide better distribution of load of vehicle since the batteries and passenger weight get concentrated at the rear portion of the rickshaw.

'Bajaj Hanseat' is one of the famous examples of front engine, front wheel driven rickshaw

Advantages of front engine FWD:

- A front wheel drive vehicle has most of its weight on the front wheels, usually between 60% and 70%, so that it tends to go straight, just like an arrow where the weight is concentrated in the arrowhead.
- Placing the mass of the drive train over the driven wheels moves the centre of gravity farther forward than a comparable rear-wheel drive layout, improving traction and directional stability on wet, snowy, or icy surfaces.
- Causes under steering condition which can be easily controlled due to low power and speed

Product Brief

Layout:

Front wheel mounted motor, Front wheel driven

Power Train:

Electric, 3kW, 10" Inverted SR Motor

Power Source:

Electric, 13no.s, 3.8V 70Ah Li-ion batteries in series

Running cost:

Approximately Rs. .50/ Km

Overall Dimensions: (Subject to change according to styling)

L ~ 2300mm

B ~ 1300mm

H ~ 1650mm

WB ~ 1850mm

Styling Language:

The basic styling of the rickshaw should reflect the characteristics of electric vehicle and hence need to be more contemporary

Basic Styling considerations

- The new design should look contemporary and should be innovative as a form for a rickshaw
- The vehicle body has to be of least weight yet strong enough to sustain variable loads while traversing
- New design should not necessarily follow the basic characteristics of an auto rickshaw
- The design preferably should have monocoque structure

Characteristic features of an Auto Rickshaw

- Three prominent wheels
- Prominent wheel arch
- Minimal body panels
- Simple layout of seating
- Exposed frame structure
- Rexin cover
- Open cabin
- Small tyre size
- Shape of the hood
- Prominent curving in at the corners

Characteristic features of an electric vehicle

- Organic shapes
- Compact size
- Minimal body panels and roomy cabin
- Bright colours

Characteristics of term ‘electric’

- Dynamic
- Sharp
- Vibrant
- Uncontrolled
- Aggressive
- Bright

Defined attributes

Few attributes short listed from the characteristics, listed above, which acts as a base for the styling of the rickshaw

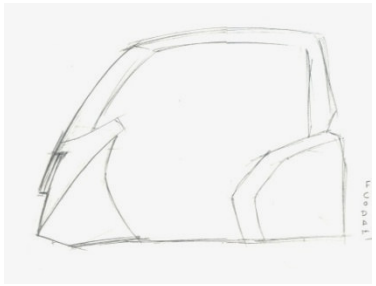
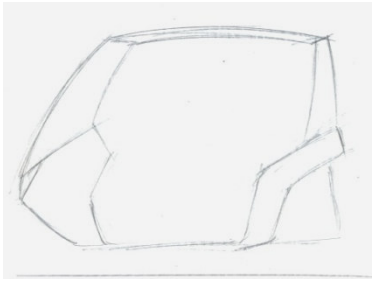
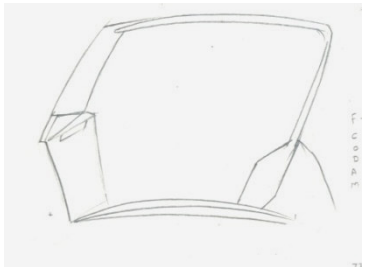
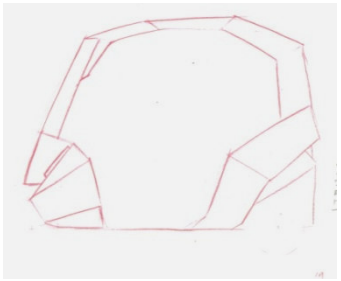
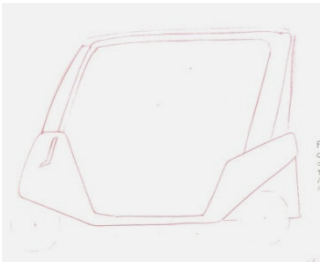
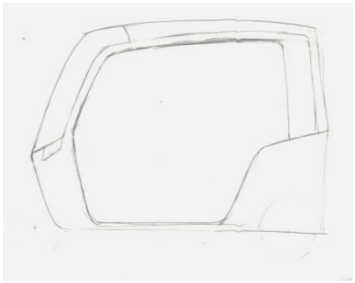
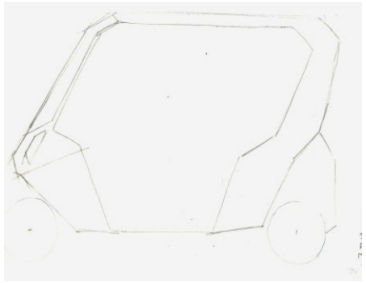
- Futuristic- the design had to look something from the next generation as most of the EVs have a touch of future and look totally different from the other designs
- Organic- The design had to look organic as it is one of the major characteristic of an EV.
- Dynamic- The design had to look more dynamic as it is the feature of the term 'electric'
- Minimalistic- Since the EVs generally are very light vehicles and does not carry any form of an extra component other than the basic required ones the design also had to reflect it.
- Compact- The design had to be very compact not only to keep the weight of the vehicle minimal but also to make it look smaller than the current rickshaw.
- Airy space- One of the major characteristic of a rickshaw and also most of the EVs

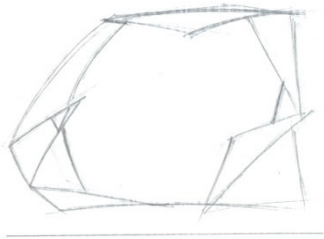
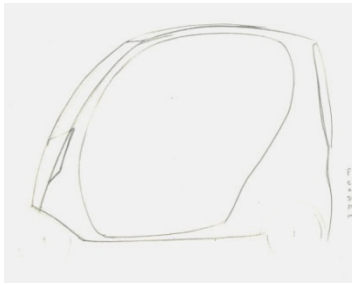
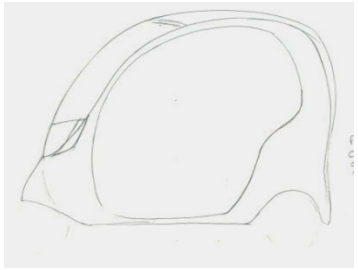
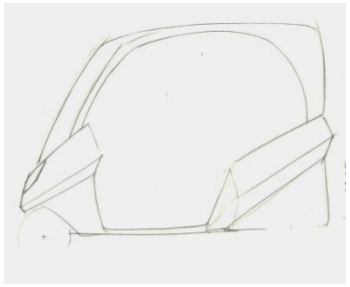
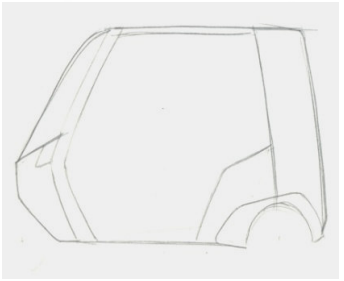
Image Board

Brainstorming

Series of sketches were generated and for validating the same the proposed schematic section was taken as the base

Few of the brainstormed sketches are shown aside and these were further clustered according to the most prominent feature.

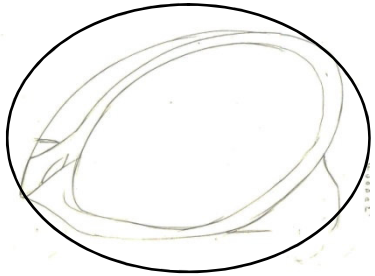








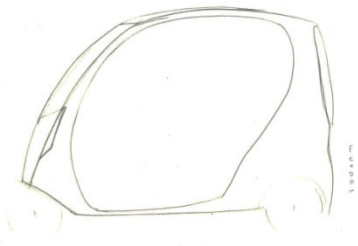






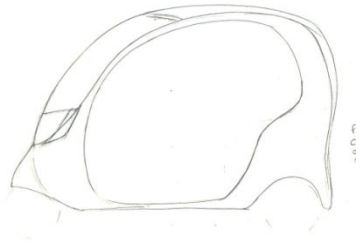
Clustering

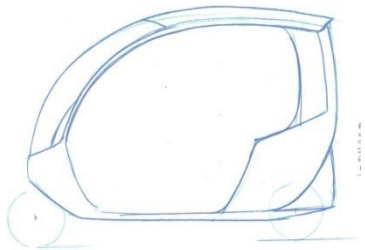
Cluster 1: Organic

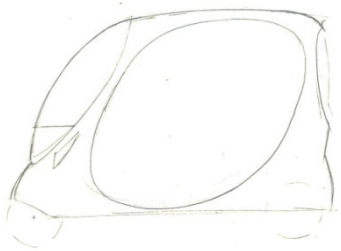
This cluster included designs which had a prominent essence of organicness. To understand the basic characteristics of 'organic' few examples were taken into considerations as shown besides

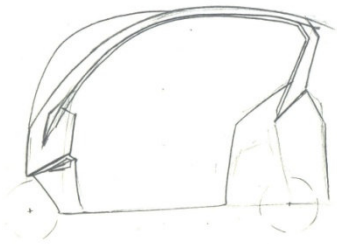


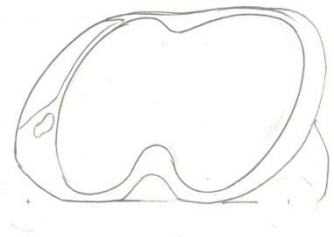








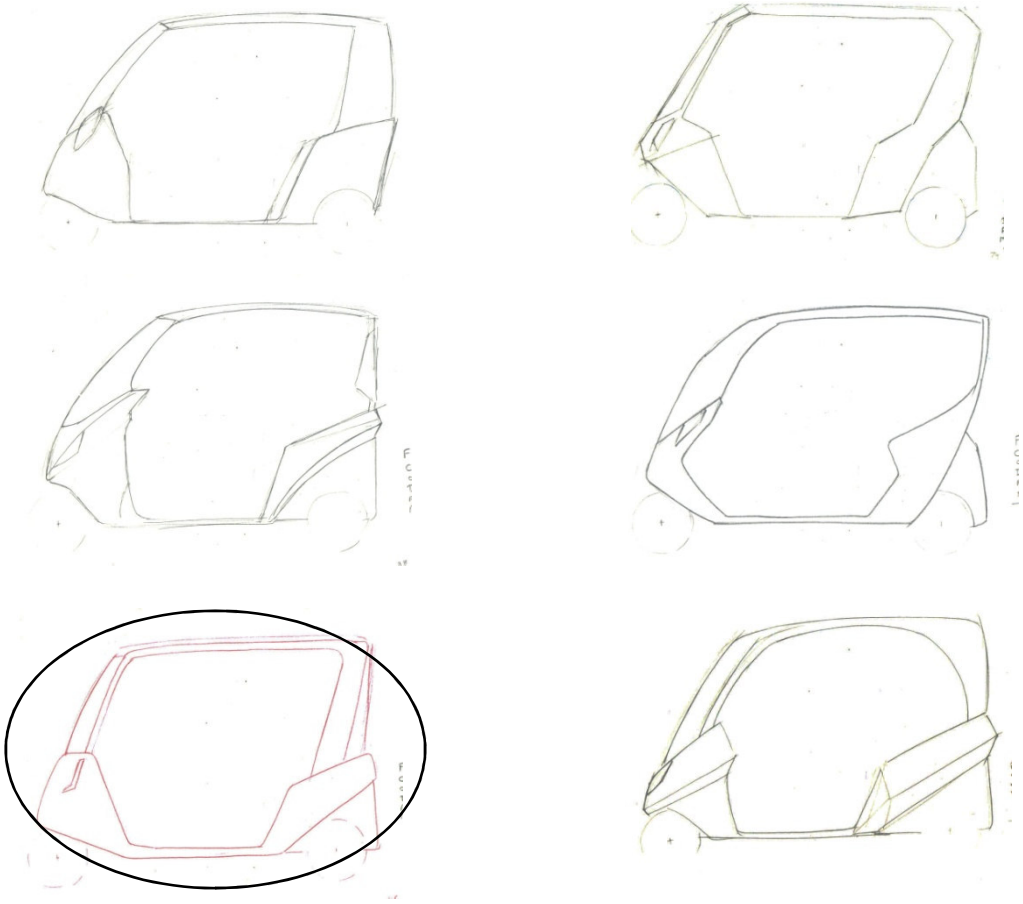




Cluster 2: Dynamic (Angular)

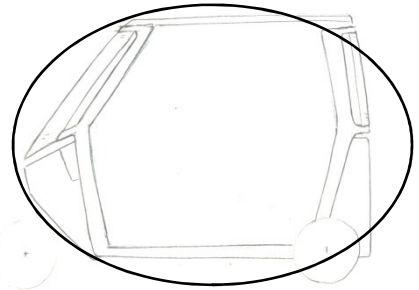
In this cluster the most dynamic designs were taken into consideration and ‘dynamic’ness was defined in the form of more angular design.

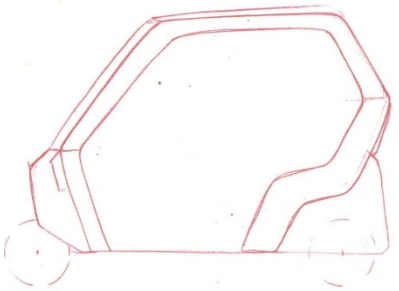
The encircled design was considered most dynamic design and this was considered as the representative of the cluster

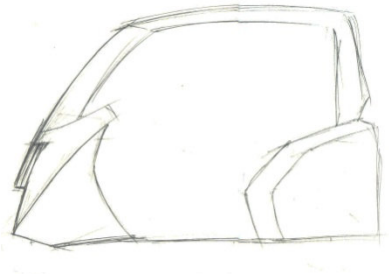


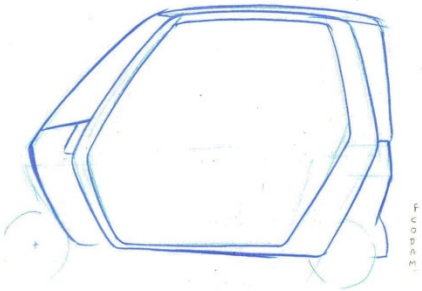
Cluster 3: Minimal

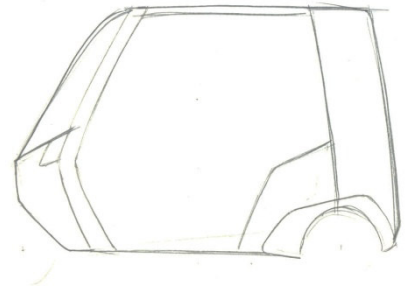
In this cluster, the body design is kept at minimal and most concepts had the frame structure as the major styling component

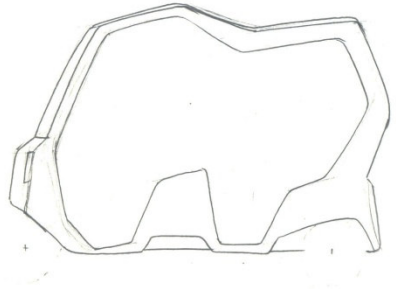






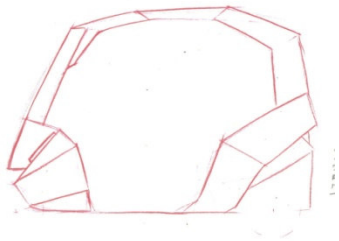


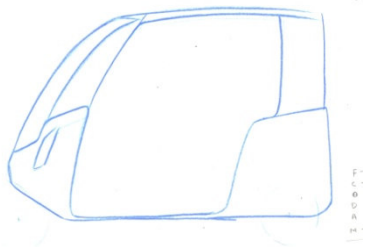


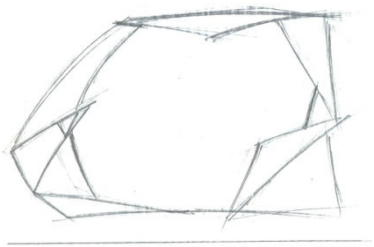


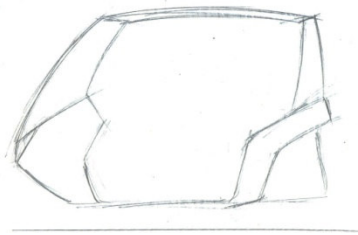
Cluster 4: Radical

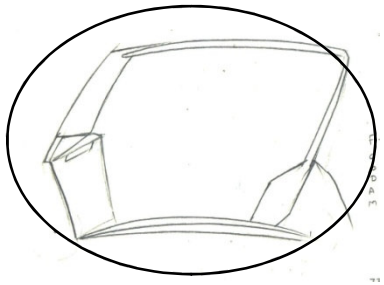
The designs in this cluster had more essence of radical'ness. The encircled design was selected as the representative of the group

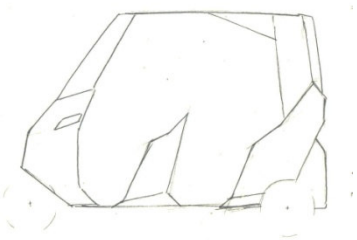






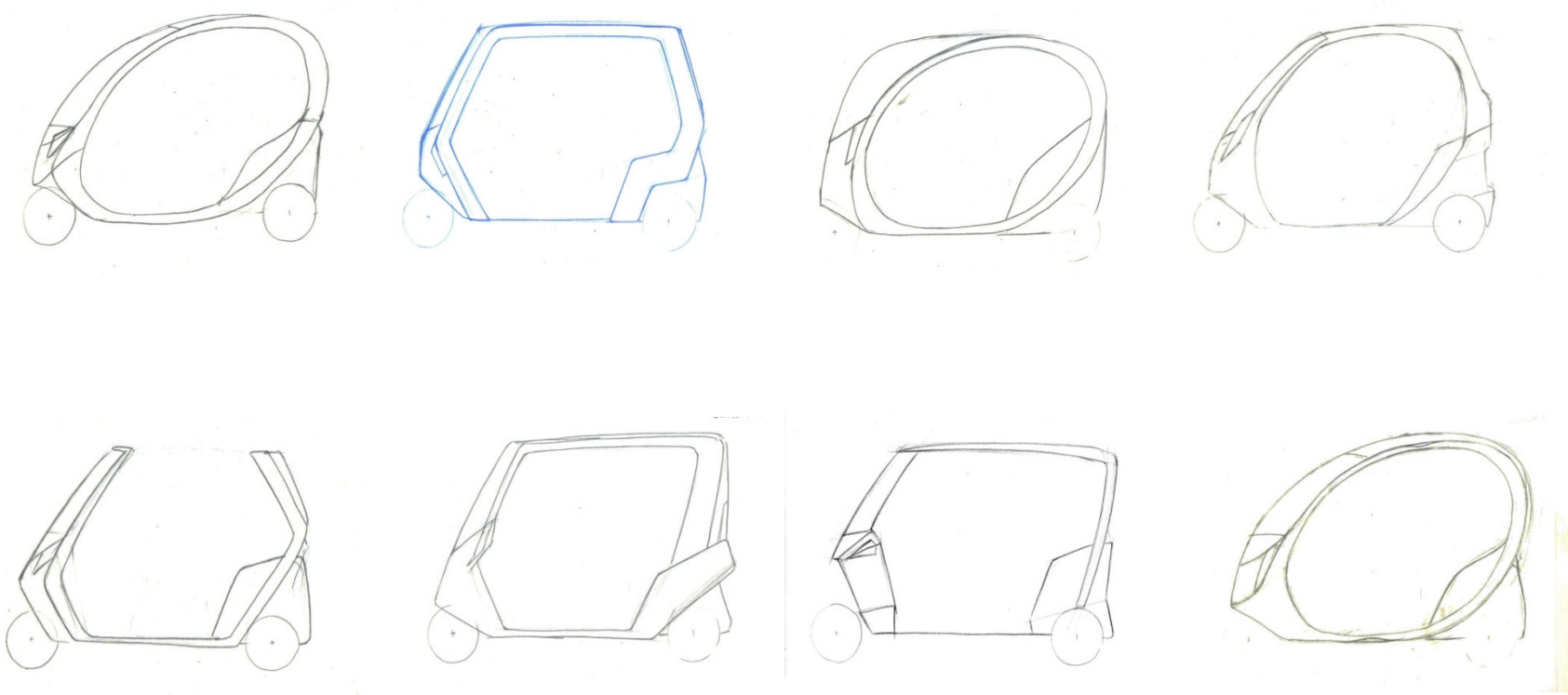






Concept Generation

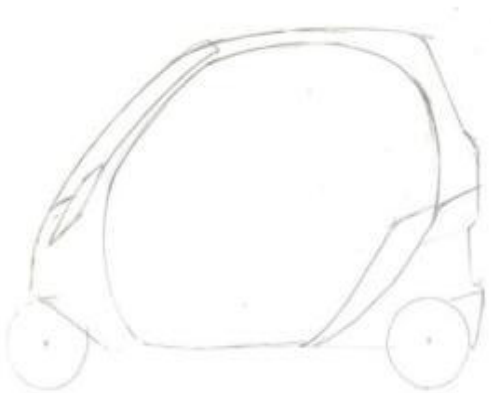
The following concepts are generated on the basis of the clustered groups and do carry the essence of each cluster



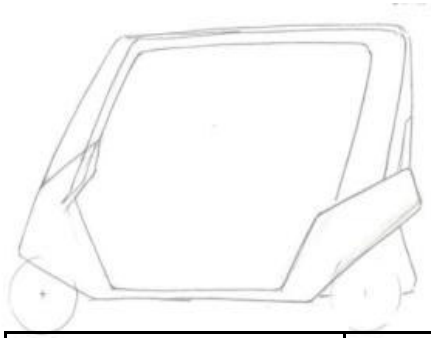
Concept Selection

The following three short listed concepts based on the ratings given on the basis of the attributes defined earlier

Self rating	22(30)
Rating by others (8)	21



Self rating	22
Rating by others (8)	21

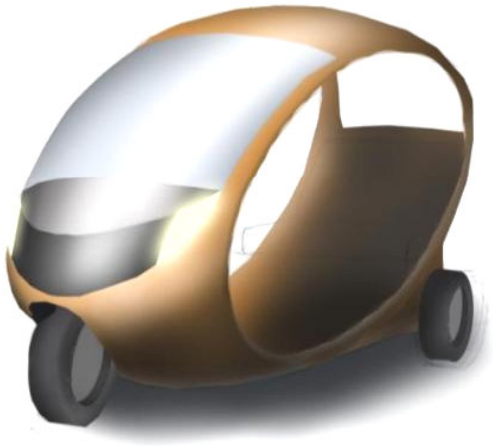


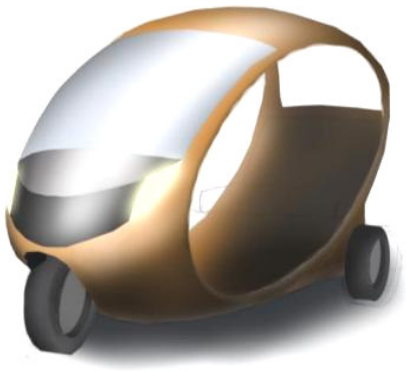
Self rating	22
Rating by others (8)	18

Concepts

The renderings of the three proposed concepts are as shown below

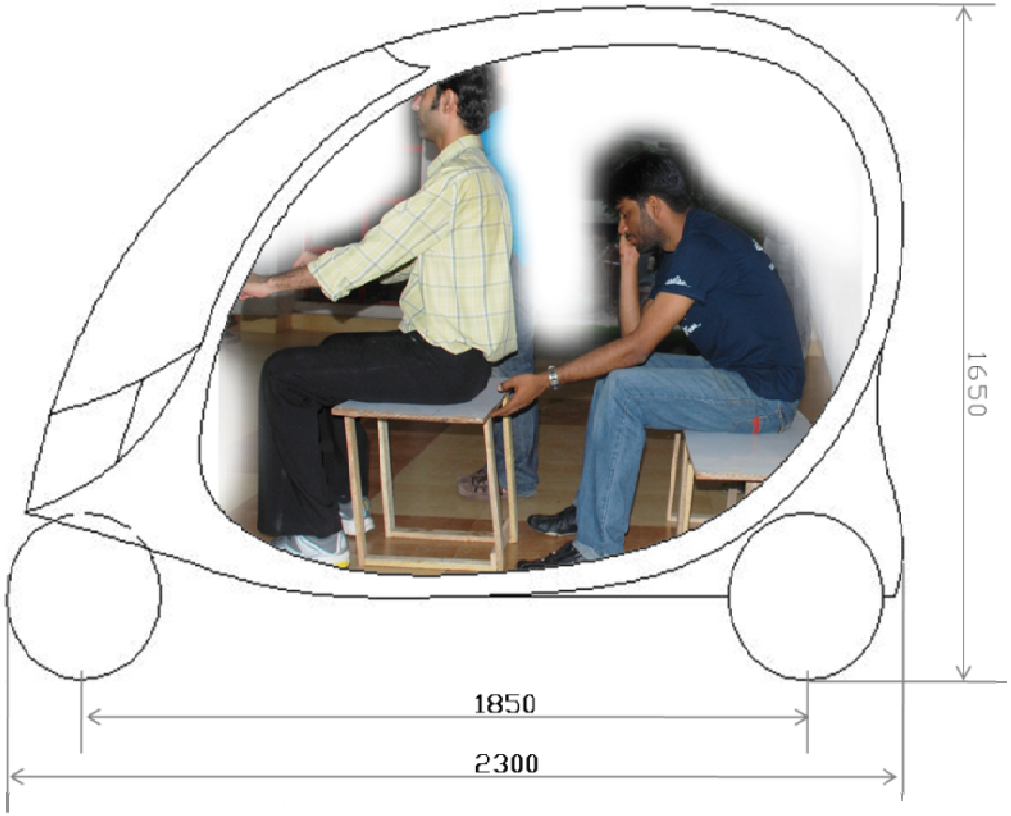
These carry most of the attributes as the second concept is more dynamic while the first one has more of organics due to the form

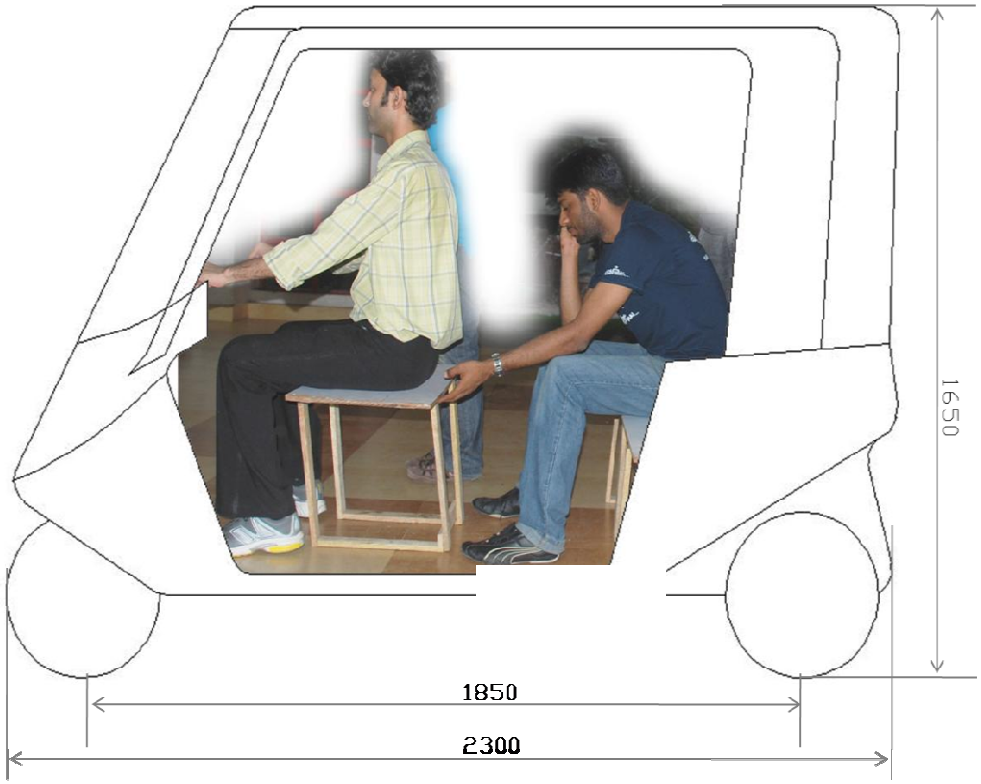


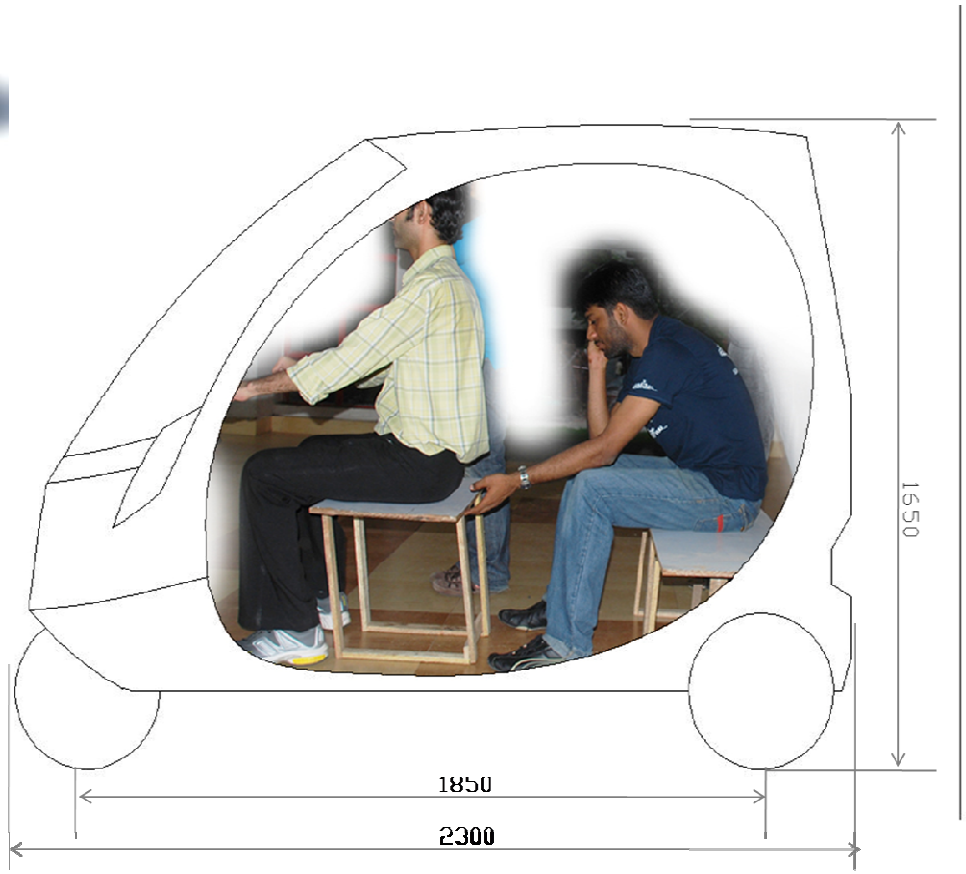


1:1 Realization

To understand the concept at life size scale the image was morphed with actual seating layout of the test rig



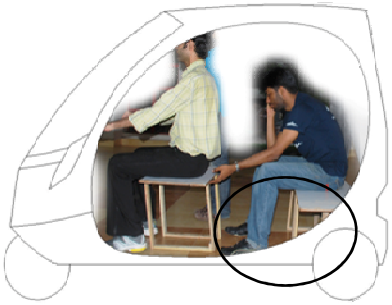

1650
1850
2300

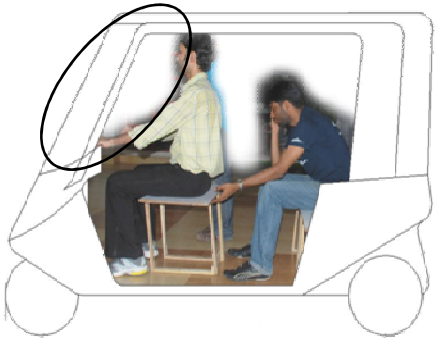

1650
1850
2300

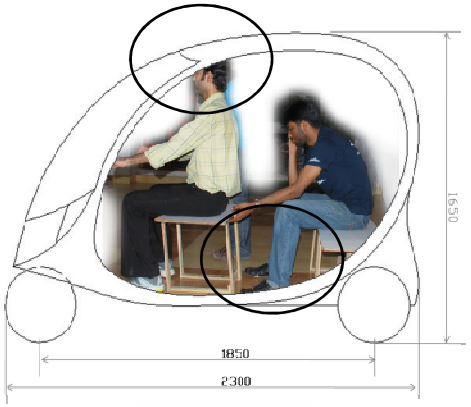
Problems

Few shortcomings got highlighted due to the 1:1 realization and these shortcomings are as listed below:

- The head clearance for driver was to be taken into consideration
- Obstructions especially during ingress and egress had to kept in check
- Styling of the concepts were almost similar
- Concepts reflected most of the existing rickshaw characteristics
- Concepts looked more bulky
- Driver facing the sun all the day

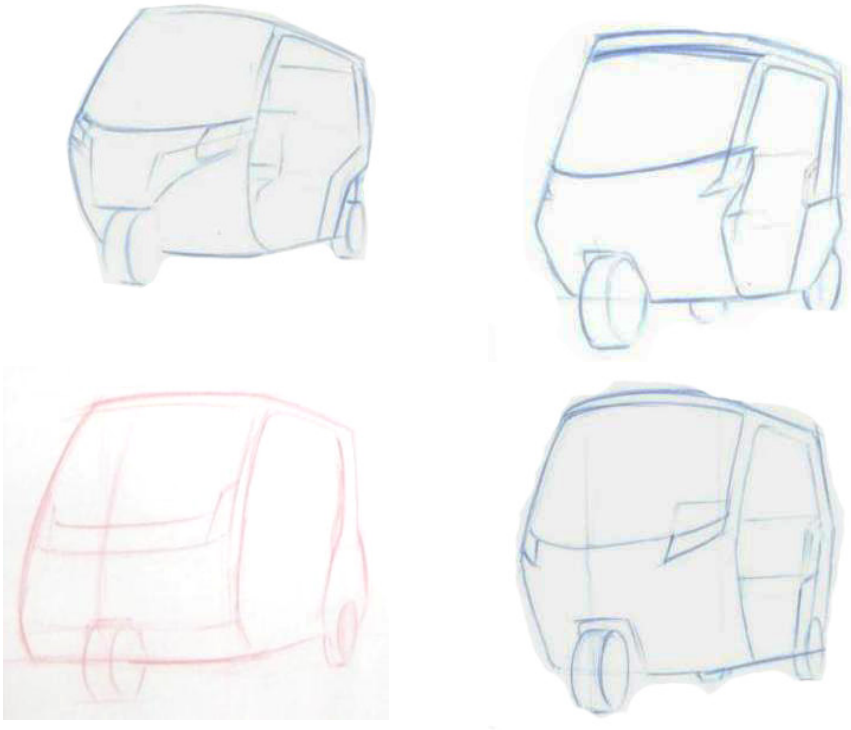






Reconsidering the styling

After the surfacing of the problems, the next step as usual was restyling the vehicle. Few concepts were developed with most of the earlier mentioned problems taken into account.



But still there were a few problems coming up as the basic components or rather the interior components of the vehicle were not yet defined

Designing the basic components

The basic components to be designed in the rickshaw are as listed below:
Components :

- Load floor: The base of the vehicle which forms the chassis for the vehicle

- Driver seat: The driver's seat is a stand alone component and had to be designed for better utility other than fulfilling the basic purpose of providing comfort to the driver

- Passenger seat: The passenger seat had to be designed is such a way to provide ample comfort to the passengers and also to, some extent, keep the overall weight of the vehicle minimal

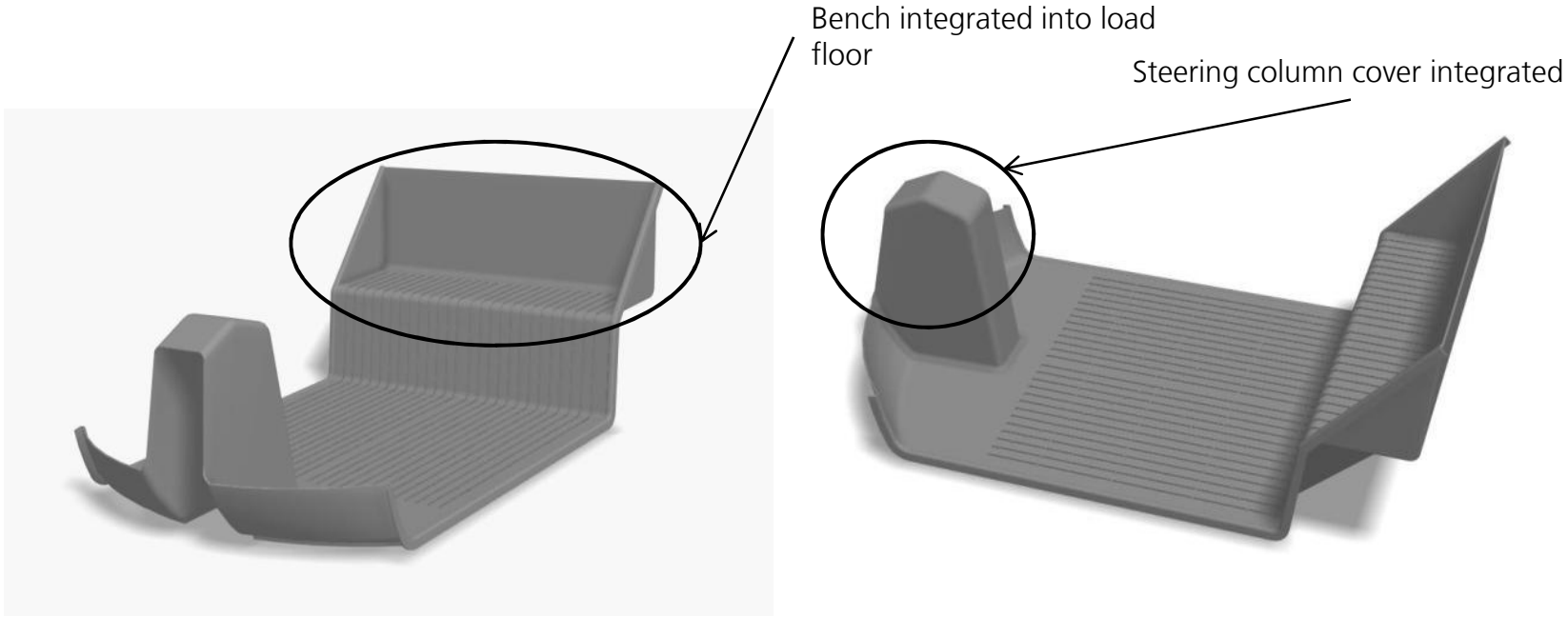
- Grab bar: The grab bar is one of the essential components as it acts as a support to climb into the rickshaw and also acts as a barrier between the driver cabin and passenger cabin

Load Floor

As mentioned earlier the load floor has to act as a chassis for the vehicle hence it had to be strong enough to sustain most of the dynamic loads.

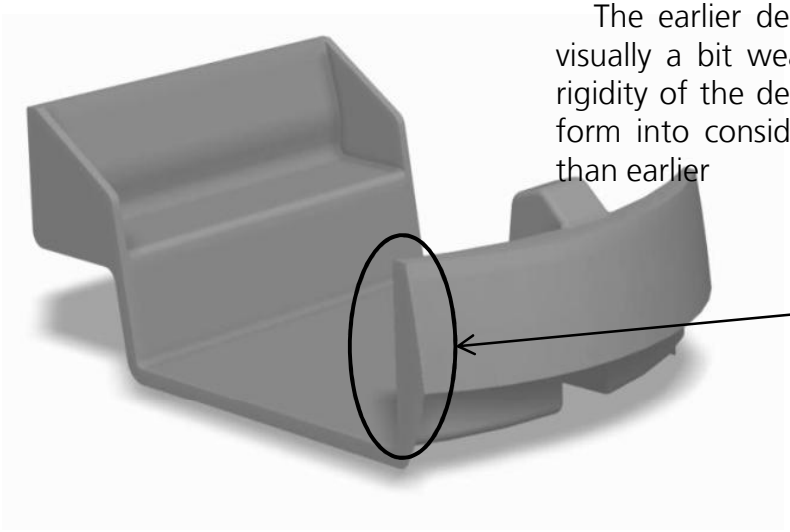
The main intention in designing the load floor was to integrate as much components as possible to make it strong and rigid.

In the design the steering column and the passenger seats are integrated together as shown below.

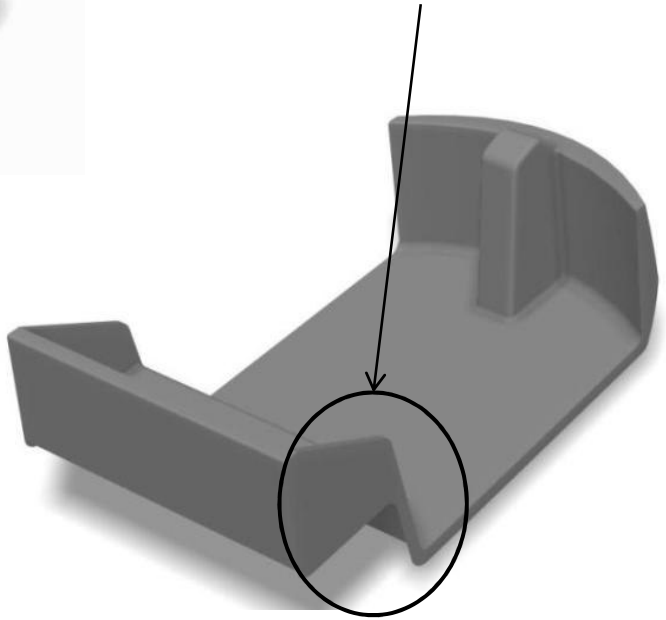


Load Floor

The earlier design of the load floor had a problem as it was visually a bit weak. To increase the visual as well as the actual rigidity of the design the load floor was redesigned with the box form into consideration. This led the load floor look more rigid than earlier

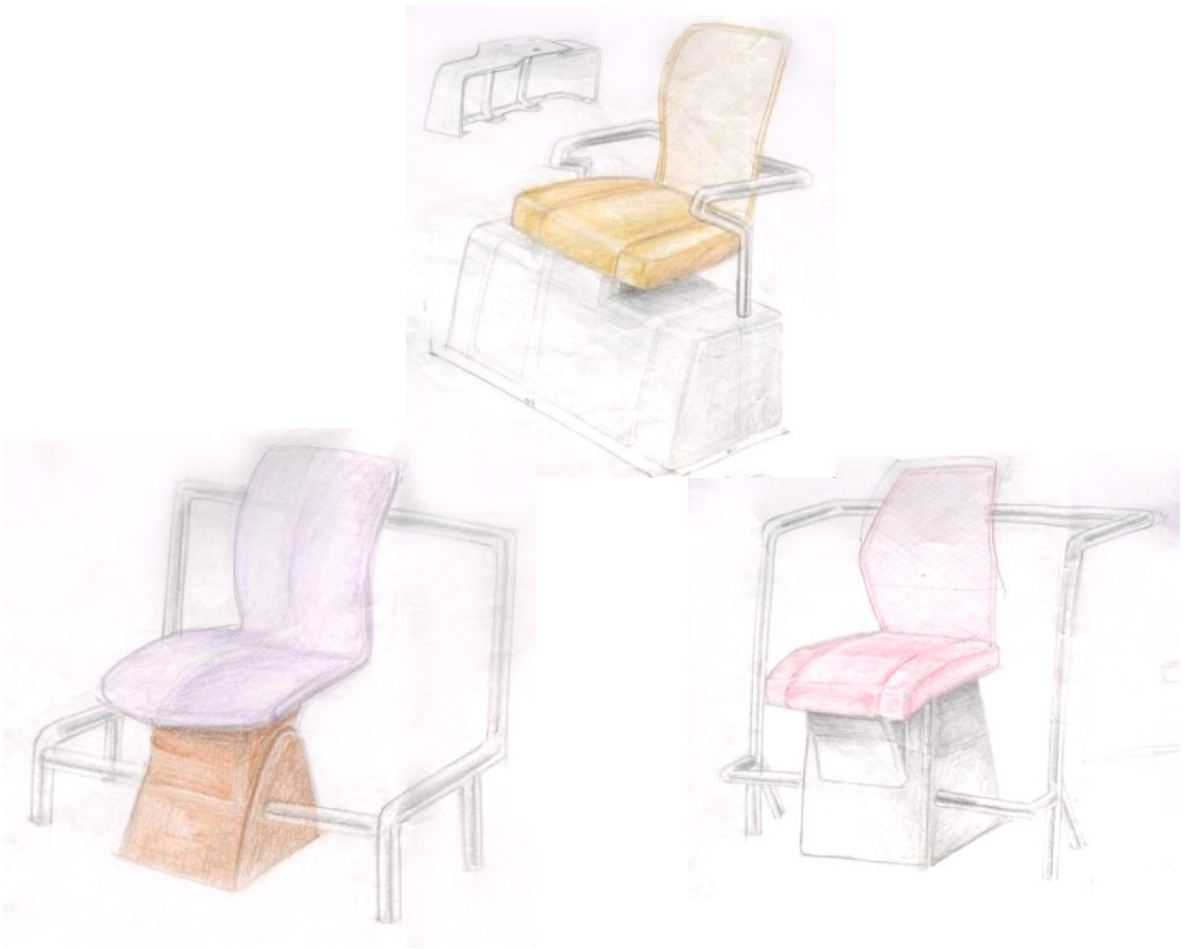


Basic structure converted to box form to enhance natural rigidity



Driver seat and Grab rail design

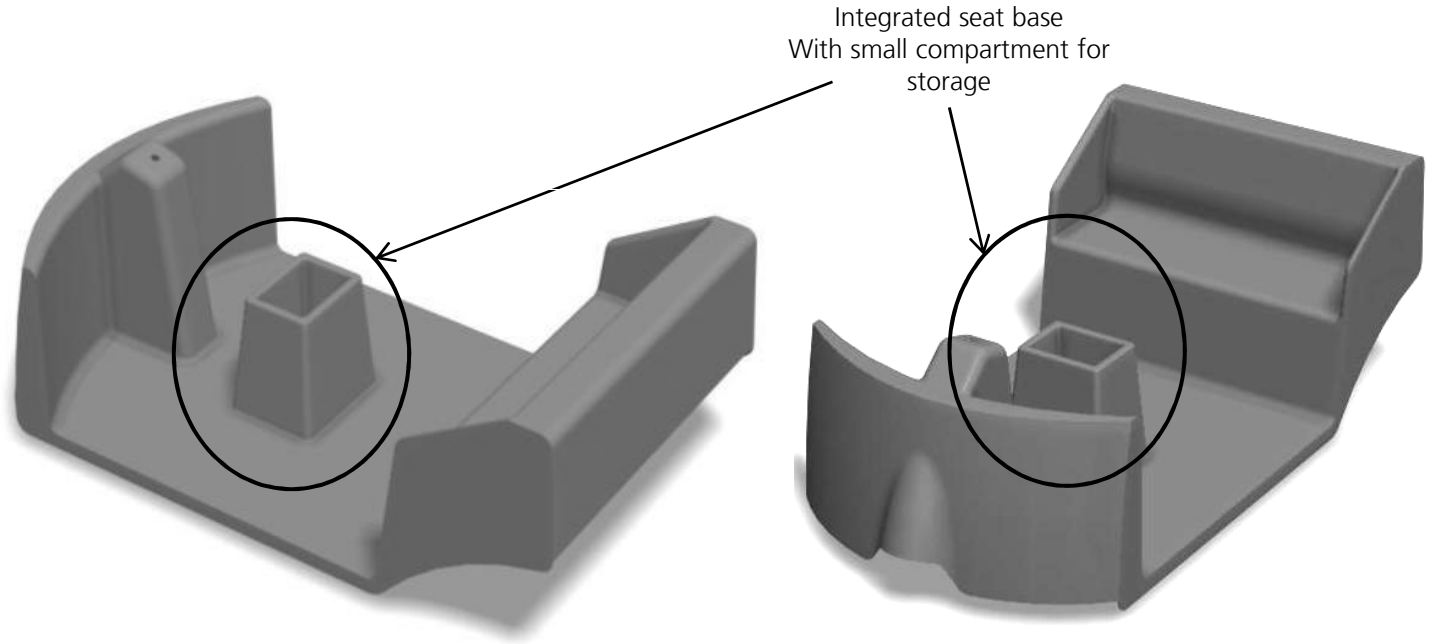
In the driver's seat design the basic seat structure, support and strength was taken into consideration. The integration of the grab bar with the design was also taken into consideration with the placement of the luggage also being the priority of design



Modified load floor

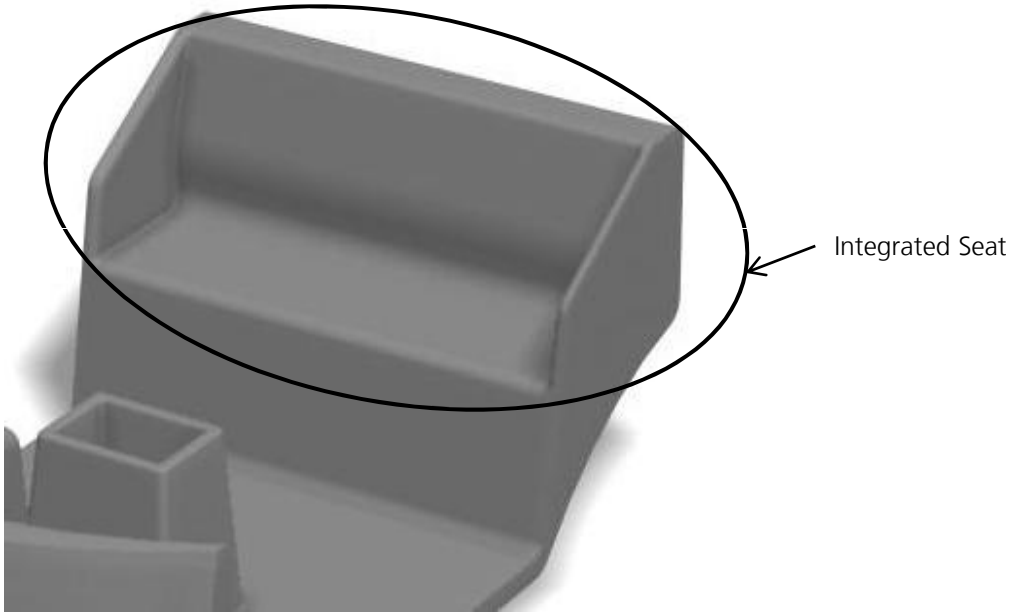
The driver seat design was reconsidered with integrating the base of seat with the load floor. This lead to increase in rigidity of the load floor and also reduction in parts to be assembled.

A parcel compartment provided below the seat which could accommodate any valuable or even the basic things like license and other papers.



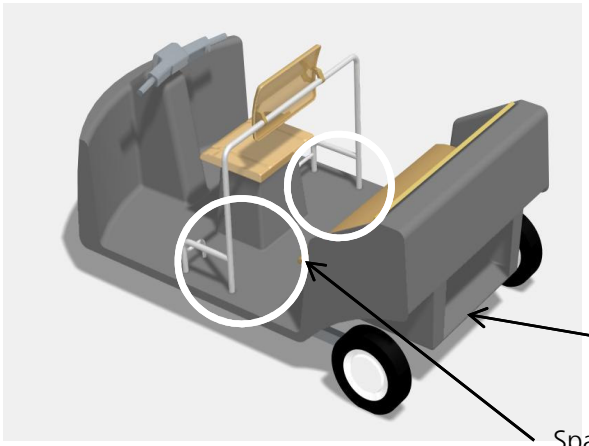
Passenger Seat

The Passenger seat is integrated with the load floor design as mentioned earlier. For back rest a profiled backrest area was provided in the load floor itself for comfortable seating and flexible cushion is directly placed on the profile.



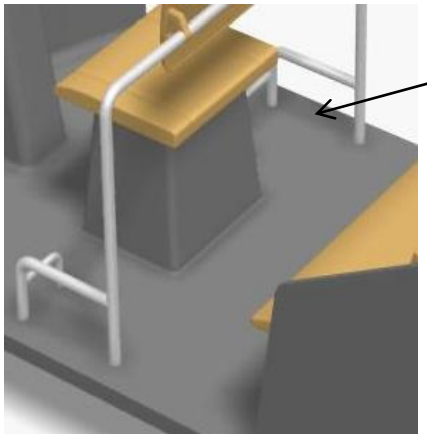
Final Layout

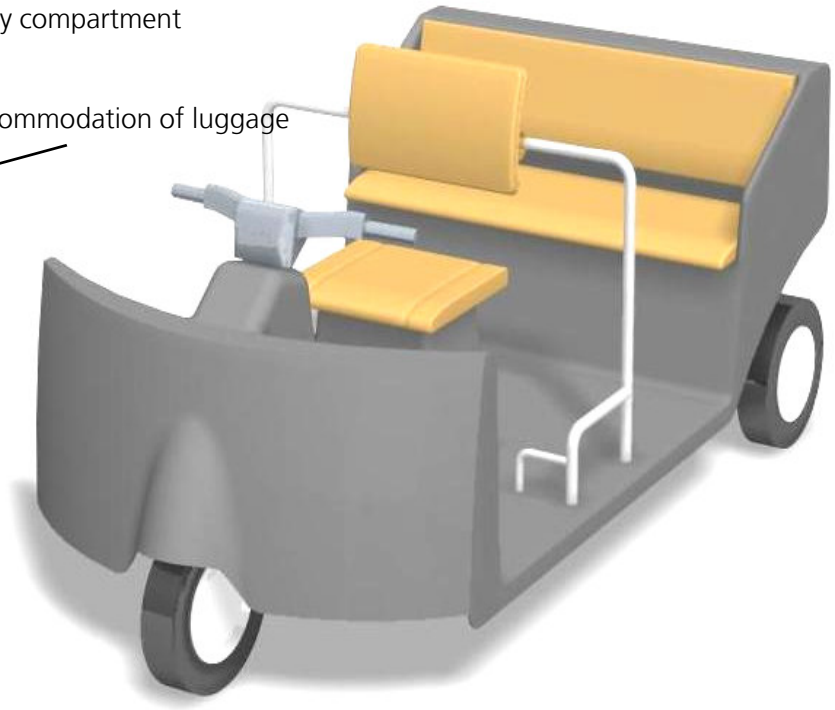
The proposed layout of the load floor, with all the base components placed at their positions, is as shown below. As you can see the grab bar not only acts as a support but also acts as a restrainer for the luggage to be kept besides the driver's seat. The battery compartment is placed below the passenger seat and the batteries, in stacked form, can be pulled out and kept for charging.



Battery compartment

Space for accommodation of luggage



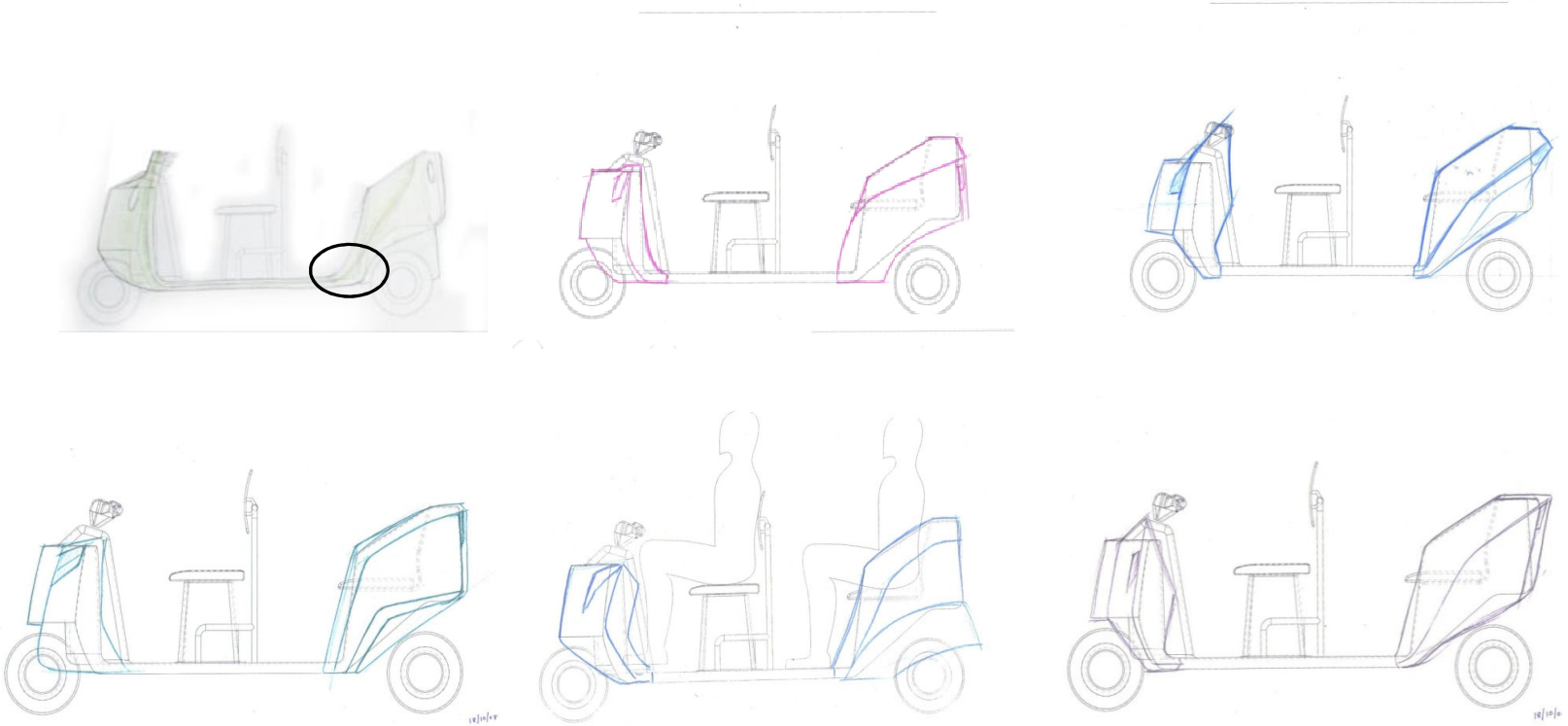


Exterior Re Styling

In this step, since all the basic dimensions were defined, the styling of the vehicle was reconsidered.

Other than the earlier image board a few more images were taken into consideration as the inspirations for the restyling of the vehicle. Few important features taken into considerations were the facets that are more prominent in any design of a vehicle had to be included in the new design.

For re styling the concepts only the lower portion of the design was taken into consideration for better concentrated work. Initially an important observation came into consideration i.e., the encircled portion led to be very narrow and caused a hindrance in the styling of the vehicle. Thus the length and wheelbase of the vehicle was increased by 150mm



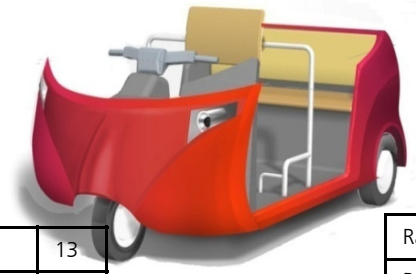
Concepts

Few of the earlier made sketched were converted into renderings, both Photoshop as well as hand renderings, basically to visualize the concept in s better manner.

These were later evaluated under the attributes. The self rating of the concept was done as well as by few of my colleagues for validating

From all the concepts the last concept was taken into consideration as it had the most important feature of most of the modern vehicle design, the facets around the body, which made it look interesting and also unique.

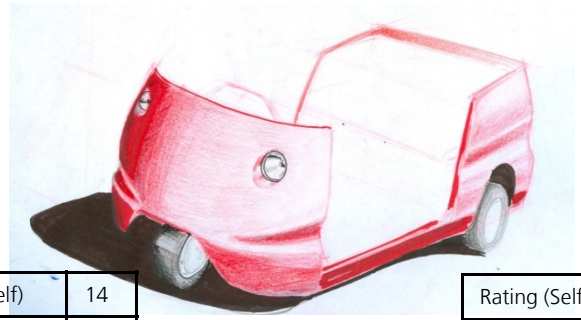
Rating (Self)	12
Rating (others)	11



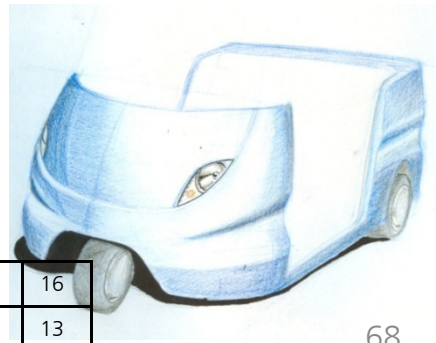
Rating (Self)	13
Rating (others)	11

Rating (Self)	12
Rating (others)	11

Rating (Self)	10
Rating (others)	11



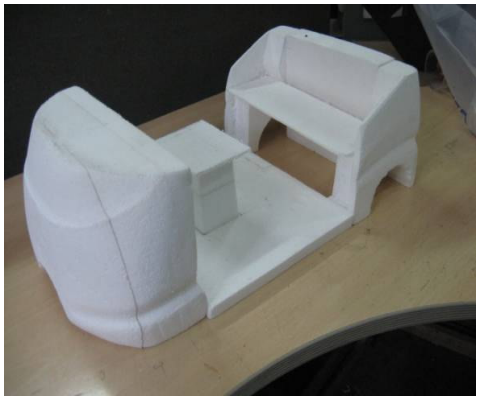
Rating (Self)	14
Rating (others)	12

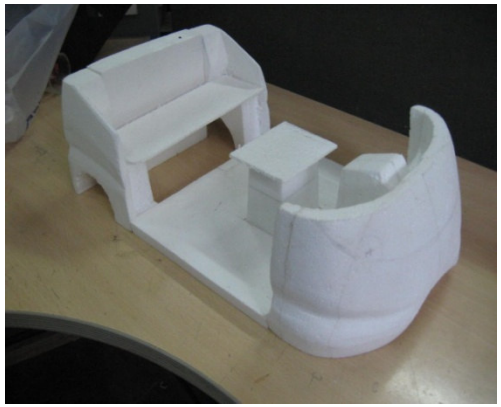


Rating (Self)	16
Rating (others)	13

Selected Concept

The earlier selected concept was later on worked upon in Photoshop and few exploratory models were made basically to understand the inclusion of few design features on the front surface



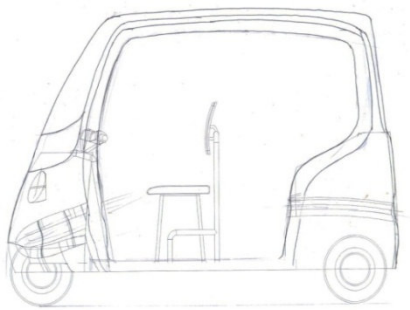


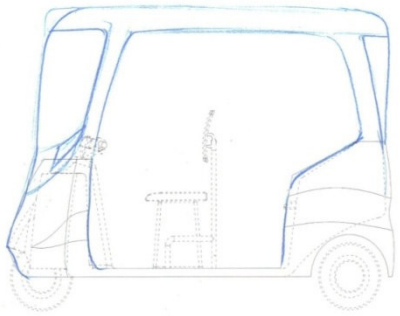
Later on these concepts had to be worked upon for the styling of the upper body. This basically consisted of making different options which could blend well with the lower portion

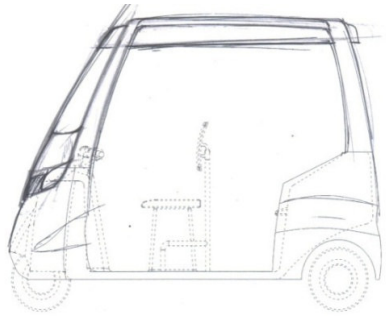
Complete styling of the vehicle

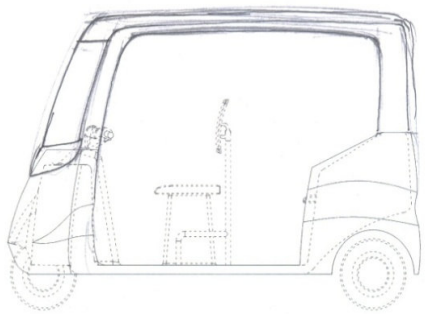
The following are the concepts developed on the basis of the earlier finalized lower body design. These concepts are made on the lines of the attributes as mentioned earlier and also carry a unique identity for an auto rickshaw.

Based on them a few rendering were made to understand the concept and basically to realize them in a better wav





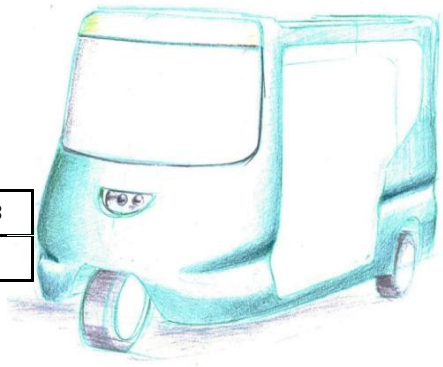




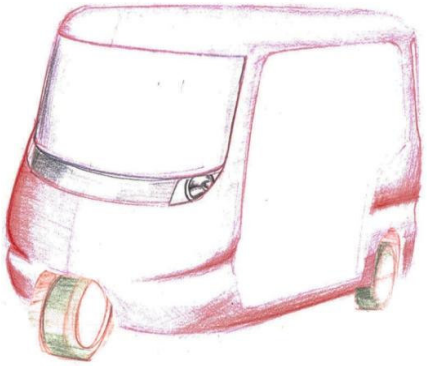
The following are the few selected renderings of the earlier defined concepts.

On the lines of these concepts, for better understanding, few exploratory models of the scale 1:5 were tried out in thermocol, while these concepts were rated according to the rendering.

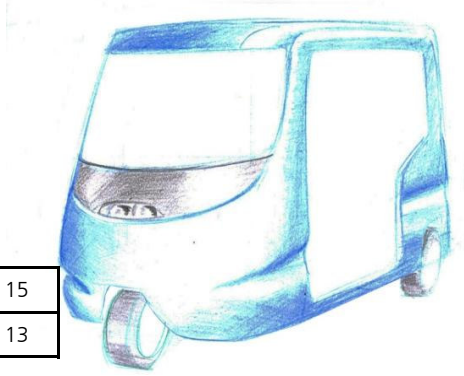
Rating (Self)	14
Rating (others)	10



Rating (Self)	13
Rating (others)	11



Rating (Self)	13
Rating (others)	9

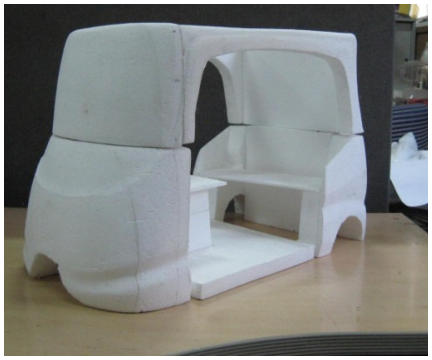


Rating (Self)	15
Rating (others)	13

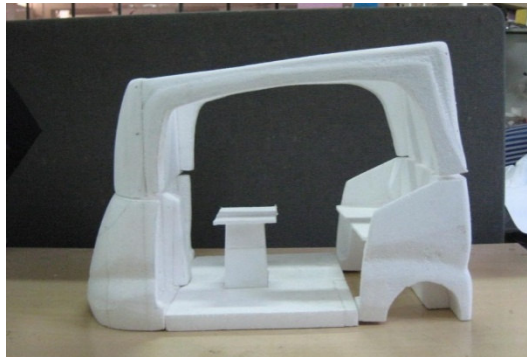
Exploratory models

Option 1

Option 2

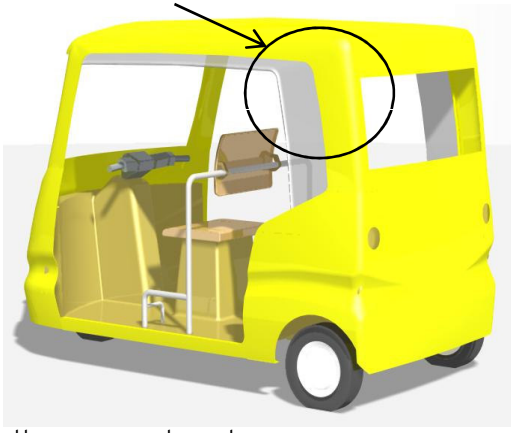


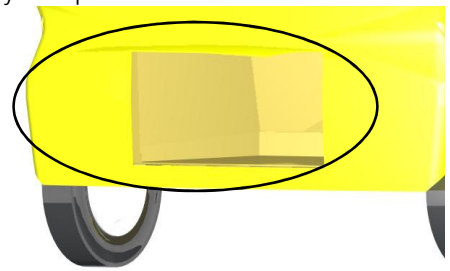
Option 3



The final concept

- The design has all the features of the attributes as organic, radical and futuristic.
- Narrower upper portion and broadening lower portion and merging of the body in to the front point making it fell dynamic.
- Features like the headlamps, are unique with twin individual members placed in a single housing making the design interesting
- Interesting facets, most prominent in the lower portion, making the design unique.
- The front of the rickshaw is more like the fairing of a motorbike hence making it look much more sleek.





The final proposed concept

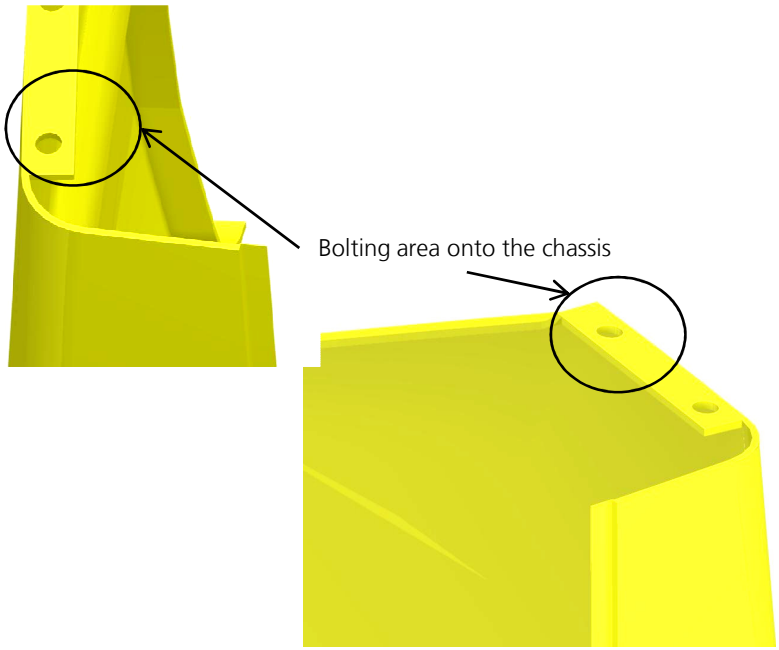
Design:

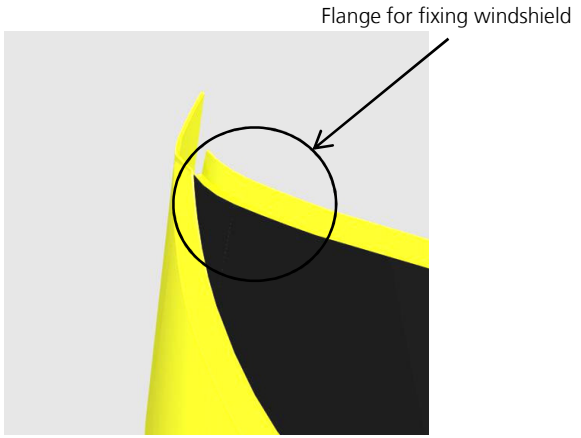
- The concept based on the design insights i.e., the luggage space has been relocated into the front besides the driver's seat.
- Leg room and the roof height have been increased for comfortable seating for all sized people.
- For better illumination, the rear has large vertical glass and the side covers are kept minimal for increased natural illumination in day time.
- A translucent cover is provided around for enhancing the natural illumination and also acting as a barrier from sun and rain.
- The soft rexin roof has been replaced by low weight composite material

Mock up model

Material and manufacturing:

- Material used SMC
- Whole shell broken down to basic components
- Components joined by bonding using industrial adhesives
- The essential components as the front and rear panel are bolted to chassis
- Usage of composite material leads to light weight body panel with high strength

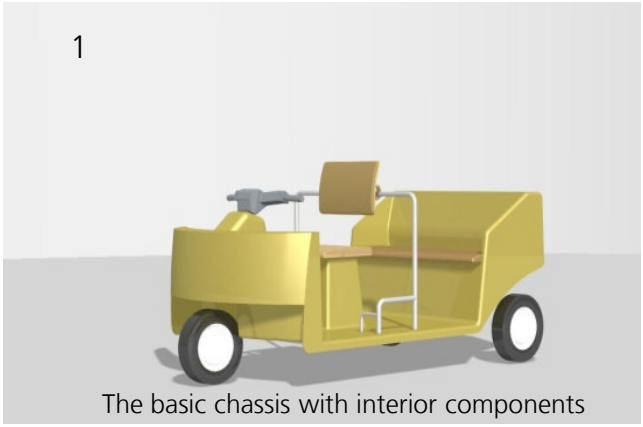




Stages of assembly

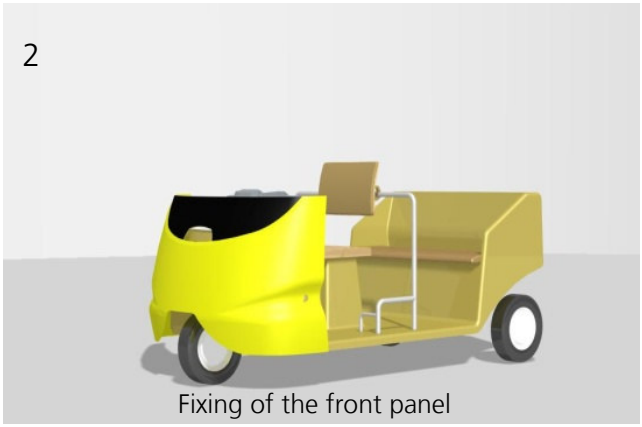
The different stages of assembly of the components of the rickshaw are as shown below

1



The basic chassis with interior components

2



Fixing of the front panel

3

Fixing of the rear side panels

4

Fixing of the rear panel

5

Bonding of the a pillars

6

Bonding of the rear pillars

7

Bonding of the roof

8

The final design with all panels fitted

Colour options

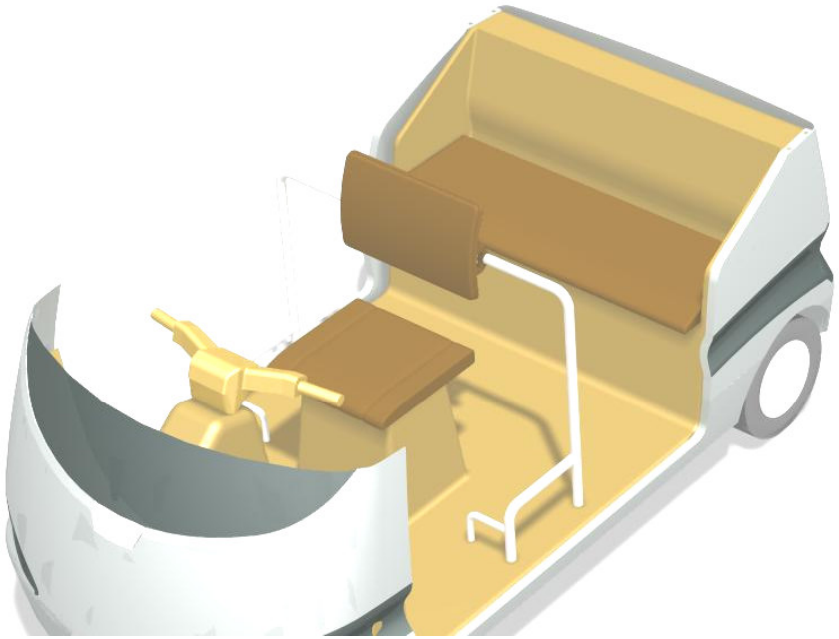
- Existing taxi and rickshaw colours

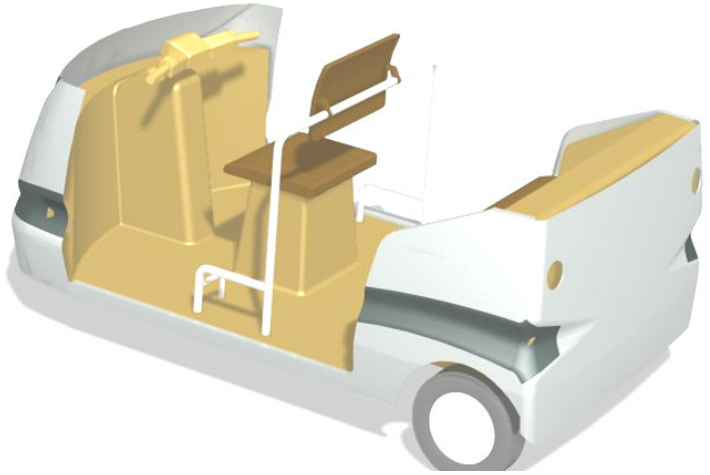
Colour palette

The final form

E-Lax

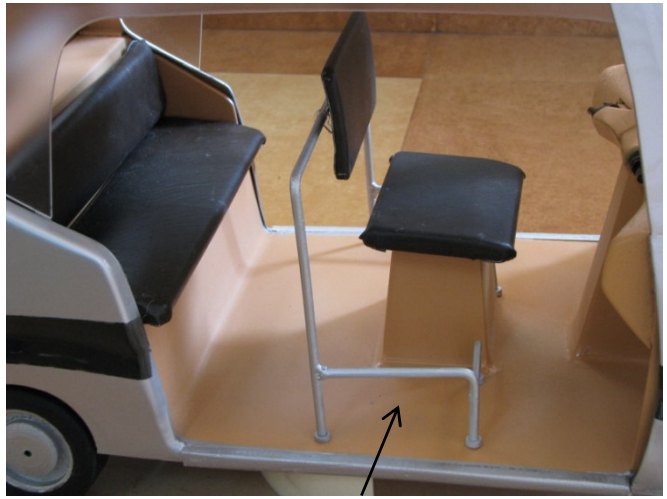
Interiors





Interiors

Dashboard



Luggage space

Features

- Comfortable seating and ample leg and headroom for passengers and driver
- Repositioned luggage space for comfort and secured feeling
- Higher open space for better illumination
- Car type dashboard to increase the value and standard of the rickshaw
- Ample amount of space in dashboard to keep any essential commodities
- Secured compartment provided below driver seat incase of keeping any valuables
- Provides ample comfort and rich feel to the driver due to the clean feel of the interiors
- Absence of clutch pedal leads to repositioning brakes onto handles, hence a flat floor and thus higher comfort
- Li-ion battery pack for light weight and faster charging time

Thank you