Design of Taxi Interior And Seating Layout For The Commuters Of Mumbai

MOBILITY AND VEHICLE DESIGN PROJECT II

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under the guidance of
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Approval sheet

This Mobility & vehicle design project report entitled **Design of Taxi interior and seating layout for the commuters of Mumbai** by Anand A is approved in partial fulfillment of the requirements for Master of Design degree in Mobility and vehicle design.

Project Guide:

Chair Person:

Internal Examiner:

External Examiner:

Date:

Place:

Declaration

I declare that this written submission represents my idea in my own words, and where other's ideas or words have been included, I have adequately cited and referenced the original source. I also declare that i have adhered to all the principles of academic honesty and integrity and have not falsified, misinterpreted or fabricated any idea/data/facts/sources in my submission. I understand that any violation od the above will be cause for disciplinary action by the institute and can also invoke penal action from the sources from which proper permission has not been taken, or improperly cited.

signature

Name : Anand A

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Date :

Acknowledgement

I would firstly like to thank my guide Prof. Nishant Sharma for the support and valuable inputs that he has provided during the course of this project. I would also like to thank Prof. Ramachandrn, Prof. Munshi and Prof. Bhaumik for their valuable feedbacks.

Anand A

Date :

Abstract

In India, Taxis are the most used mode of Personalised public transport. Due to overcrowding in Mumbai trains, less frequency of buses and requirement for heavy luggage transportation, people prefer using taxis to travel within the city. With growing population and narrow roads, these taxis have to cater to different needs of the commuters. The scope of this project is to identify the issues that are specific to Mumbai taxi interiors. Further Interior design solutions are explored in order to address the issues of the passengers.

The main focus of this project is on the seating layout arrangement within a given space taking the vehicle architecture into consideration. The needs of various Mumbai taxi commuters are also studied and different possible usage scenarios are created. The scenarios include luggage carrying commuters from/to railway stations and airports, and wheel chair-driven passengers. Based on these user scenarios, a suitable vehicle architecture is proposed. An interior space arrangement is explored based on the proposed vehicle architecture and an interior layout is finalized. After finalising the layout, the final design solution is derived by concept explorations and scaled mock-ups. A reconfigurable taxi interior space based on different usage requirements is also explored through various seat folding concepts.

Contents

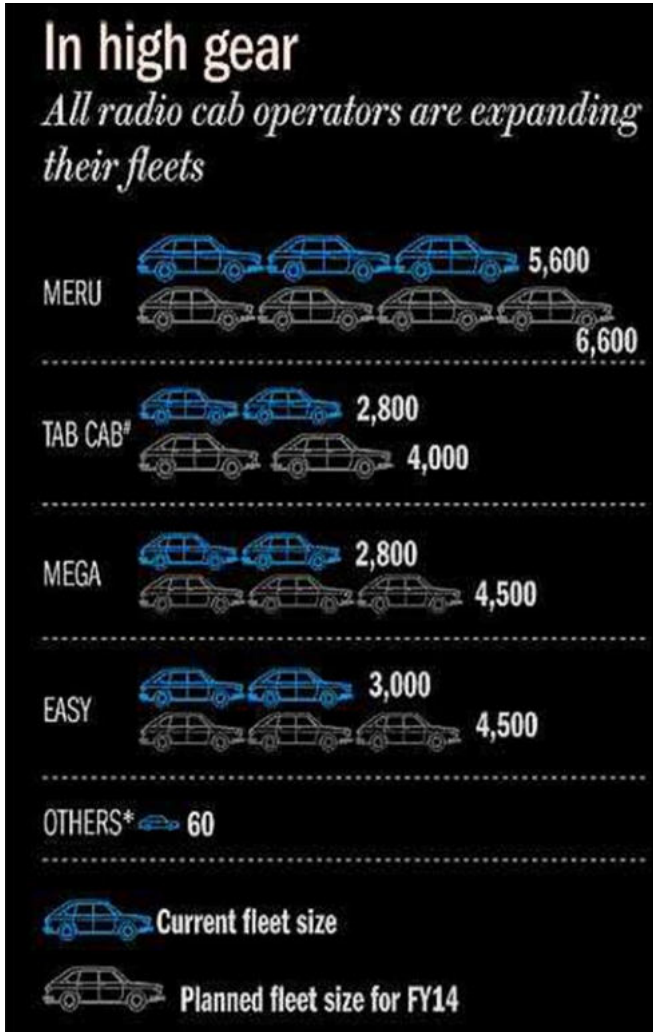
Pre-Research

Taxi as a public Transport in India

In India taxi travel is considered more of a personal mobility and convenience. It is more prominently used in the cities of Mumbai and Kolkata. In other cities taxis are mostly employed in airports and railway stations where the passengers carry lot of luggage. Otherwise, taxis in India face a stiff competition from the auto rickshaws.

Total number of registered Taxis in India is around 4,80,000 and it is growing at the rate of 20% (particularly in the Radio Cab segment). Current organized players like Radio cabs occupy only 5% of the Taxi industry in India (source - Business Outlok India Magazine - April, 2013 edition). But the taxi segment as such expanding with more and more organized players coming in. Automotive OEMs have started launching taxi variants of their models aiming at the growing taxi segment.Even with these growing statistics, it is found that there is no taxi specific model which caters specific to the multiple needs of the users.

Since 2009 the Radio Cab industry is expanding rapidly with a compounded annual growth rate (CAGR) of 41.90% in terms of market revenues. Google backed online car rental service has finally launched its operations recently in Bangalore through which passengers can call taxis through their smart phone.



Source :
http://business.outlookindia.com/article_v3.aspx?artid=284955

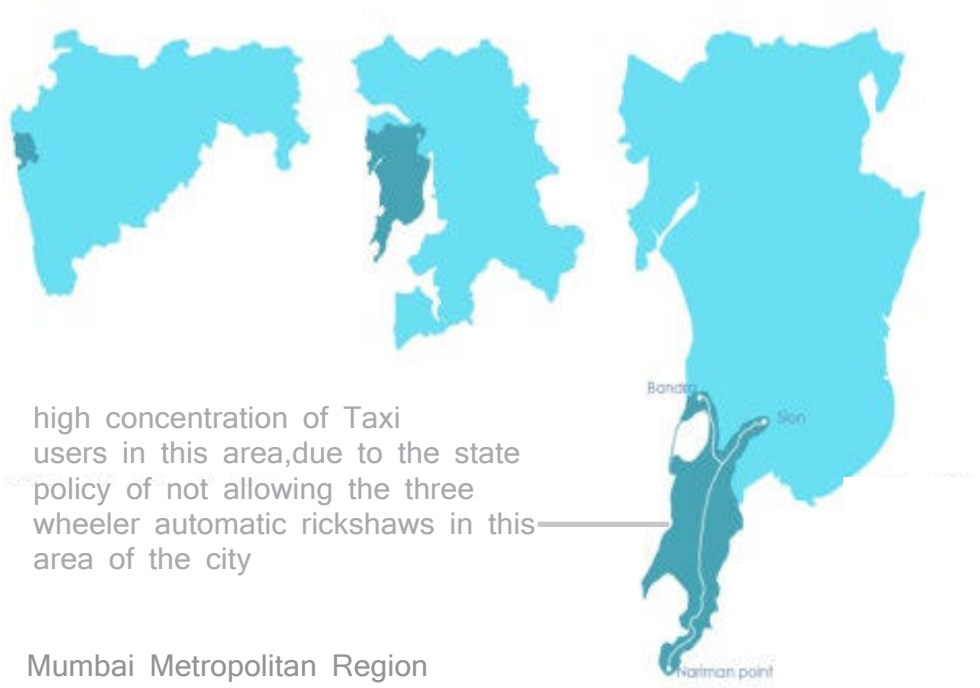
Taxi in Mumbai

Also known as Bombay, is the capital city of the Indian state of Maharashtra. It is the most populous city in India, and the fourth most populous city in the world, with a total metropolitan area population of approximately 20.5 million. Along with the neighbouring urban areas, including the cities of Navi Mumbai and Thane, it is one of the most populous urban regions in the world. Mumbai lies on the west coast of India and has a deep natural harbour. In 2009, Mumbai was named an alpha world city. It is also the wealthiest city in India, and has the highest GDP of any city in South, West or Central Asia.

Mumbai has a very high demand for public transportation out of all the Indian cities. With multiple modes of public transports like local train, Best bus services, auto rickshaws and Taxis, the demand for more transportation services is still high. This can be attributed to very high population density. Further, metro rail and mono rail services are also going to functional in the near future.

In this scenario, the need for taxi services is also high as it offers a comfort close to personalised transport for the commuting public. Taxi travel is preferred particulaly when the commuter does not want to go through the strain of travelling in the heavily crowded Mumbai trains. Further incase the passenger is carrying more luggage, a taxi travel is more preferred as it offers better luggage space than the other public transportation facilites available.

Taxis arrived in Mumbai at 1911 to complement horse wagons. Black and yellow Fiat taxis are an integral part of the city's heritage and have been depicted in numerous Bollywood movies.



Mumbai Metropolitan Region
Population 20,748,395 (2011 Census)
Population Density 16,692/Sq.km

Metered taxis ply throughout Mumbai and have a monopoly from Bandra to Churchgate on the Western line and Sion to Chatrapati Shivaji Terminus on the Central line. Beyond Sion and Bandra auto rickshaws are not allowed and one has to hire a taxi. However, between Sion to Thane and Bandra to Bhayandar, both Taxis and autorickshaws are available to transport passengers. Currently, there are around 51,000 registered Taxis running in Mumbai.

Taxi cabs of Mumbai


IR1

Fiat Taxis

Fiat padminis are as synonymous with Mumbai taxi world as the Ambassador is to Kolkata or the Hackney cab to London. Known for its vintage feel, bumpy rides, rattling doors, customized interiors, sofa seats and rear boot.It is now the end of age old Fiat Taxis as the Mumbai government passed a law in April 2013 that said only under 20-years-old taxis could run as taxis from August 2013.


IR2

Hyundai Santro

Compact and tall boy design, better mileage, comfortable seats, less engine noise makes Hyundai Santro the new preferred taxi of Mumbai.The end of Fiat taxis has made more taxi drivers shift to Santro.Uncomfortable for the passenger when it comes to boot space and rear seating (in case of 4 passenger)

Maruti Omni

Mainly used by passengers with more luggage because of its interior space. Due to this, it is more used by the taxi drivers in railway stations and airport where luggage space requirement is high. Also if the passengers are more than four in number, they prefer Omni as it can accommodate more passengers.
Noisy and uncomfortable as the engine is packaged inside the cabin.

User Study

Few of the interview questions where asked to both passengers and taxi drivers and they were video recorded for later interpretation.

Which mode of transport do you prefer in Mumbai ?

How often do you ride a taxi in Mumbai ?

Do you ride a taxi alone mostly or in a group
Share the issues you face when you are commuting in a taxi.

What would you like to change in the current Taxi riding experience ?

Do you carry any luggage during your ride ? If yes, how much ?

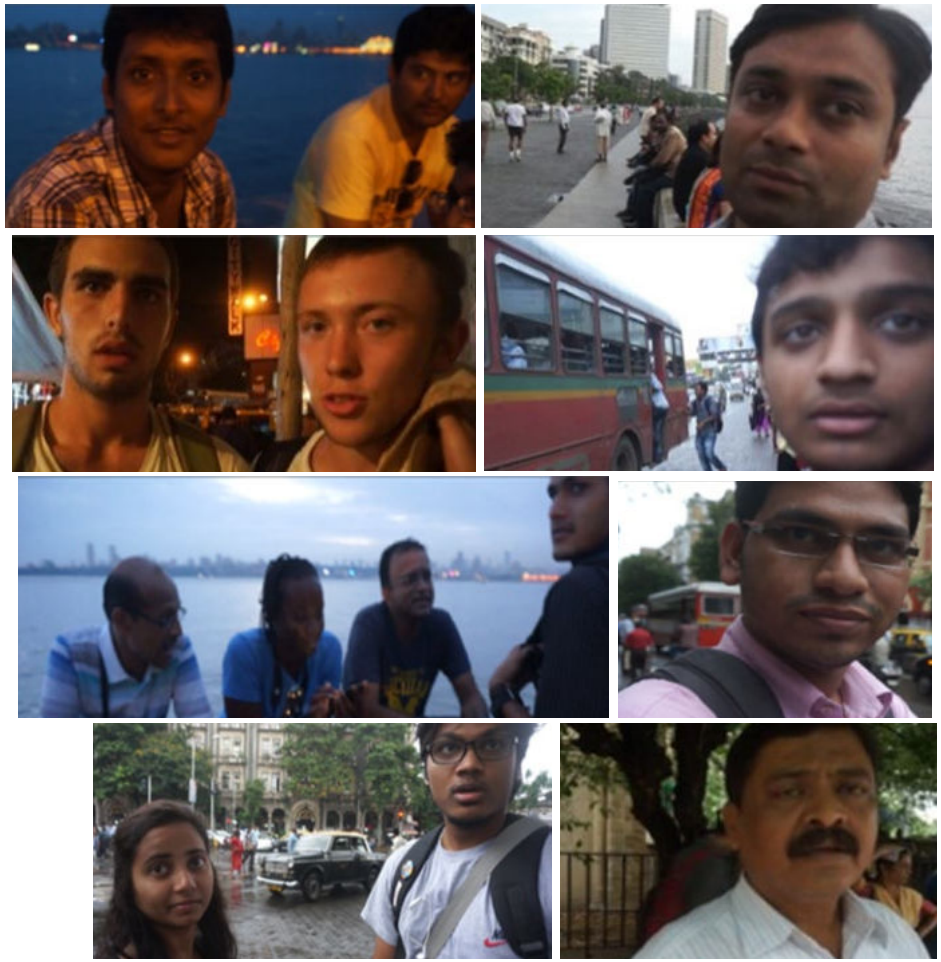
What kind of Luggages you carry when you take a taxi?

What is the route you journey most in a taxi ?

Which taxi do you prefer the most ? Why ?

What is your experience of a taxi ride in Mumbai?

How do you find the interior space in the Mumbai Taxi?



User groups interviewed - 10
Area - Andheri, Bandra, CST
Age Group - 19 to 55 years

Some of the user responses

"The seating space is small and cramped when 3 people sit in the rear"
"Install entertainment system in taxi to make the travel time better"
"The seating space is small and cramped when 3 people sit in the rear"
"The ambience and the smell inside the taxi is not good"
Need for better seating space and arrangement
"Fiat taxis bring a sense of nostalgia to Mumbai"

The Insights

- Passengers prefer a taxi ride when they are going for a long distance or going in a group of 3 or more

- Most of them use taxis for travelling in South Mumbai because of the non availability of auto rickshaws

- Time spent on traffic is high. Increase in traffic and rush increases the travel time thus making the ride uncomfortable and uninteresting.

- Taxi also preferred for short distance ride from the railway station.

- Issue of improper taxi fares incase of tourists.

- Cramped up interior space and not enough space for luggage.

- A lot of users preferred SANTRO as a taxi due to its comfortable seating and compactness

- Cleaner interior space

- Requirement of a proper fare meter

- Front row seating in Fiat taxi is much more comfortable becuase of the absence of central console

- Passengers find th einterior ambience unclean









Drivers interviewed - 10
Taxi Area - Andheri, Bandra, CST
Work Experience - 4 to 16 years

Insights from Taxi Driver Interview

- The drivers were from different states and stay in the suburbs of Mumbai.

- Most of the taxi drivers drive a rented taxi.

- “Difficult to get passengers during return trip”

- Prefer Santro for driving because it is small and compact which makes it an ideal car for narrow Mumbai roads.
Spend most of their time with the taxi (even sleep in the taxi).
Mileage centric and worried about increasing fuel prices hich reduces the profit

- Less traffic in the night but more taxi requests during day time.
space, investment and operation cost.

- Aspire to buy their own taxi. While buying they look for better mileage/performance, compact, comfortable space, tall boy design, luggage

- Less luggage space in most of the taxis. Eeco is preferred when it comes to carrying more luggage.

- The roof carriage is often used for luggage

- The pasengers are mostly from railway stations and long distance journey.

- Sometimes passengers carry unorganised luggages like shifting household items (used as a mini cargo carrier)

User Study Observations

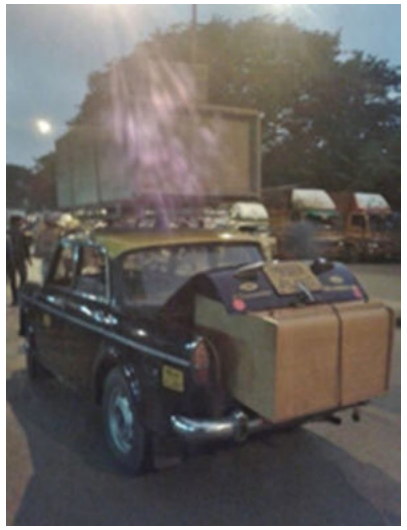
The Luggage space

The Luggage space inside most of the Taxis used in Mumbai are very less. The boot space that is provided in the car is further occupied by the CNG cylinder tank. So, the use of roof carrier is very common.

Other than the organised luggages that passengers from Railway stations/airport carry, taxis in Mumbai are also used to carry unorganised luggages. Typical examples found are transportation of household items like washing machine, fridge etc. People transport a lot of unorganized luggage in the taxi as the cost of transporting is cheaper and well suited in city operations.

Incase of Santro, the boot space is ocupied completely by the CNG tank. This results in moving any normal luggage to the roof carrier. The roof carrier is unsafe to carry as the luggage is open to the external environment. In case of rainy environment, the luggage has to covered to prevent it from getting wet.


IR5




IR6

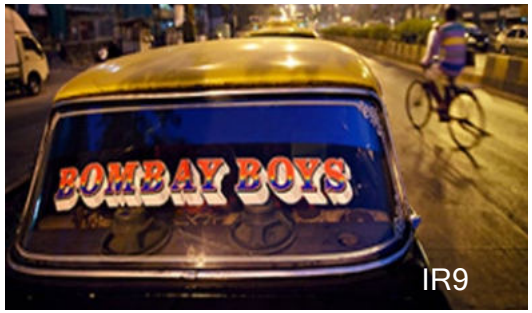

IR4


IR8


IR7

Exterior Accessories

Many of the Mumbai Taxis are richly decorated with a litany of the driver's favourite things. The graphic text and imagery used in the decals announce the driver's home neighborhood/titles of Bollywood songs/different patterns.The patterns may vary from visual references to gods mingled with film titles, western brand logos and complex geometric patterns.



IR9


IR10

Ticking Fare

The fare meter has recently been standardized and made electronic in many of the systems. But still there are situtations in which passengers are unaware of the proper fare and the night charges. This is more the case with foreigner tourists who travel in Mumbai taxis.

Some of the passengers share their taxi ride with other commuters to reduce the Taxi fare. This is more common among office goers who prefer a Taxi from the railway station to the office over a bus but does not want to spend much on the taxi.

The Interior Space

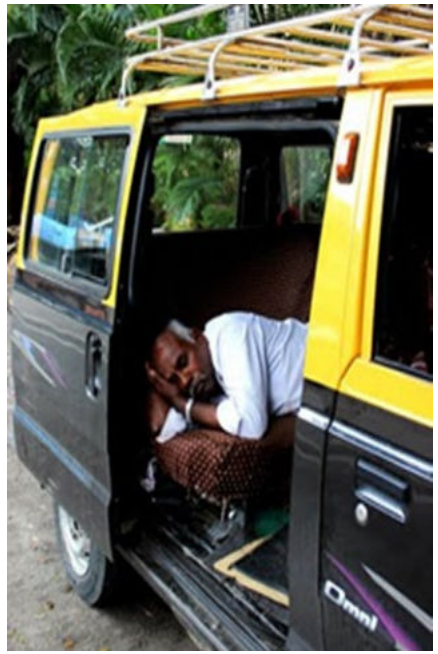
Since most of the taxis are used in South Mumbai which has lot of tourist spots, shopping areas and sea sides, the taxi can provide a peek of the Victorian Mumbai to the passengers. It is found that Fiat taxis have high day light opening and front seat with no head rests which provides a better view of the outside for the rear seat passengers. Also the absence of head rest in seats and integrated front seat has makes the interior space visually less cluttered.

In case of long duration journey, or increased travel time due to traffic, the passengers get bored and sleep inside the car.

When not in operation, the taxis occupy a lot of parking space in the already congested roads of Mumbai. Also the drivers sleep in the taxi and use it like their second home. Most of the taxi drivers stay in far off suburban area of mumbai but drive the taxi in the city. So, the taxi also serves as a living space.

The passengers feel cramped in the rear when there are three persons journey in the rear seat.The current seating layout does not allow the passengers to interact with each other and gives a cramped feel.

The taxi drivers even customized the interiors of their Fiat taxis with lighting elements and seat covers to give a different ambience.



Trend Study

Hackney cabs of London

The hackney cabs are an identity of London taxi. It has a spacious interiors and is disabled friendly. The taxis are based on Austin FX4 platform and it is the only cab designed completely to be used as a taxi. The design is exclusively built for London taxis thus creating a unique identity.

The passenger compartment in the LT1 is spacious and designed to accommodate wheelchair users easily. Once in place, the wheel-chair and passenger are secured using special harnesses and extendable seat belts.The wide swing doors also help those with limited mobility, as does the intermediate step and swivel seat.

The passenger compartment also has controls for intercom with driver.

Source -
http://www.carbodydesign.com/archive/2006/10/19-lti-tx4-london-taxi/

Volkswagen Milano concept

The two passenger Volkswagen Milano Taxi is an electric cab designed to make major cities pollution-free. The lithium-ion battery-powered cab can produce 45 kw hours, giving the Milano Taxi a top speed of 74 miles per hour and range of 186 miles..
It has a single swivel-sliding door that opens far forward on the passenger's side to offer a broad entrance.

The front passenger seat was quite intentionally left out on this taxi. In its place, there is a cargo space for luggage; the design of the instrument panel in this area was modified accordingly, creating additional space.

Source -
http://www.netcarshow.com/volkswagen/2010-milano_taxi_concept/02.htm

New York - Nissan NV 200

New york wanted to change their Taxis and hence they conducted a design pitch competition among OEMs which was won by Nissan.

The Nissan NV200 is suppose to become the city's sole taxi cab design for the next ten years. It is an electric hybrid. IT is a MUV with ample of seating space for four passengers. Also it has a luggage space which addresses the needs of the comuters of New york.

The Taxi has a GPS touch screen which shows the route for the passengers and fare details. It has been made wheelchair accessible taxi with the addition of a folding ramp and a latching hook to secure the whelchair to the floor.

Sources :
http://www.nissanusa.com/innovations/taxi-of-tomorrow.article.html
http://www.greencarreports.com/news/1087562_nyc-taxi-of-tomorrow-rule-deemed-unlawful-fatal-blow
http://globalaccessibilitynews.com/2013/03/29/wheelchair-accessible-taxi-of-tomorrow-headed-to-streets-of-new-york/

Three wheel Taxi concept

Designers Michael Scherger, Nina Thaming and Henrik Mucha have come up with a green and clean taxi concept for the city of Mumbai with their sustainable ‘Taxi Green Mumbai’ idea.

The three-wheel taxi’s design is taken from that of conventional rickshaws, making it a simple mode of transportation. Taking into consideration the extreme weather conditions of Mumbai, the solar-charged ‘Taxi Green Mumbai’ will meet the power needs saving energy.

Source - http://indianautosblog.com/2011/01/taxi-green-mumbai

Beetle Taxis of Mexico

Taxicabs of Mexico is a form of public transport in Mexico, notably at Mexico City, with very low fares compared to that in more economically developed countries (about 90% lower). Is estimated to be a fleet of more than 100,000 taxis, making it the biggest taxicabs fleet in the world. Just as cities like New York and San Francisco want their taxi fleets converted to hybrids over the next few years, Mexican officials also want to retire the classic Beetles and upgrade to newer taxis ehich might see the end of these small beetle taxis in Mexico soon.

Source - http://green.autoblog.com/2008/09/06/mexican-beetle-taxis-may-soon-be-a-thing-of-the-past/

Possible Design Directions

Based on the user study and observations, the following possible design directions are arrived at.

- A compact car for narrow lanes of Mumbai with interiors that provide a better view of Mumbai for the tourists

- Reconfigurable interior space for passenger seating, luggage transport and driver activities when not in operation

- Modular seating arrangement to give a spacious feel for the passengers

- Address the needs of the driver such as sleeping dock when not in use

- Re-designing the Fiat taxis as per the current needs and giving a facelift

- interior with cleaner ambience creating a spacious feel

- Provide additional functions inside the taxi to improve the travel experience of the passengers like mood lighting, entertainment systems, magazine space , route/fare information

- A fusion of Taxi and auto rickshaw which reduces the ride cost but offers the comfort of a taxi with the feel of a rickshaw

- Adding additional functions to taxi for space utilization when it is not in operation

- A taxi interiors which also addresses wheelchair accessibility

the highlighted design directions are considered to form a design

The Design Brief

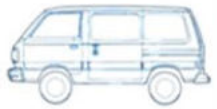
To design a taxi interior for Mumbai which addresses the organized / unorganized luggage requirements and the seating requirements of the passenger. The interior design should also focus on wheelchair accessiblity for diferently abled commuters and give a clean spacious feel for the passengers.

Packaging and Specification

To propose a possible layout for optimized luggage space and passenger seating and can be reconfigurable as per requirements. The taxi has the current system of CNG powered engines as it proves more efficient in the present scenario

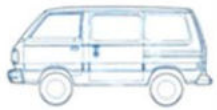
Technical Study

Comparison study of the Mumbai taxis

	Overall length (mm)	Overall width (mm)	Overall height (mm)	Wheelbase (mm)	Ground clearance (mm)	Boot space (mm)	Kerb weight (kg)	No. of rear seating rows
	3930	1460	1468	2340	128	308	895	1
	3565	1525	1590	2380	164	218	854	1
	3600	940	1640	1840	165	-	785	2
	3675	1475	1800	2350	160	540 (5 seater)	928	2

CNG fitment comes in the boot which reduces the luggage space. Santro is least preferred for high volume luggages. External Carrier is used in all the vehicles

Comparison study of the Mumbai taxis

	Seating layout	Headroom (mm)	Rear legroom (mm)	No. of doors	Door opening	Engine	Tyre size
	4+1 seater, front facing seats	863	280	4	conventional	4 cylinder 1089cc gasoline 39.5 bhp	65/60 R14
	4+1 seater, front facing seats	1060(front) 990 (Rear)	240(min) 330 (max)	5	conventional	4 cylinder 1086cc gasoline 62 bhp	155/70 R13
	5/8 seater versions (opposite facing rear seats)	890	670	5	sliding doors	3 cylinder 796cc gasoline 35 bhp	145R 12 LT
	7 seater, front facing	1050	760	5	sliding doors	4 cylinder 1196cc gasoline 73 bhp	155 / 80R13

Omni and Eeco has both 5 & 8 seater versions.

Fiat has low head-room space

The leg room varies based on the ad-justable front seat position

sliding door in Omni and Eeco helps door opening easier even in cramped narrow lanes

Drivers opt for CNG fitment for better fuel mileage and low cost of fuel

User Scenario

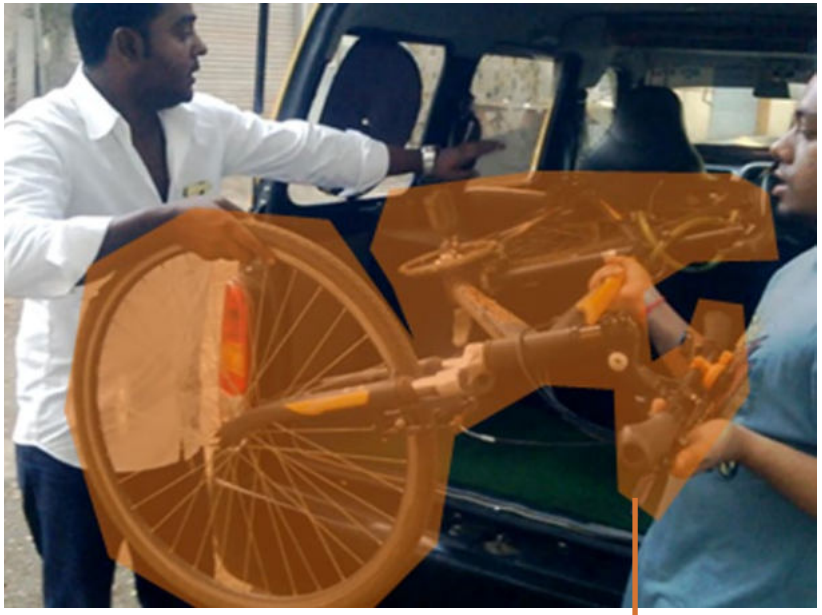
Passengers from Airport/Railway station

Various user scenarios of the Taxi users in Mumbai were studied and the following few usage cases were arrived upon to address the design brief. The first scenario is a A family travelling by taxi to airport with lot of luggage. There are more than one passenger and the quantity of luggage they carry is also very high.
This requires enough space for luggage as well as passenger seating.

In case of the current taxis, Eeco and fiat has more interior luggage space. Since Fiat is a 3 box design, it has a separate boot area. In case of Santro, the boot space cannot be used de to CNG tank fitment. Most of the cases, the roof carrier is used in which the luggage is tied and left open.

From the technical study of different taxis of Mumbai,it is observed Eeco has efficient space utlilsation with a tall boy design offering more headroom and luggage space. The length and width of Eeco is not much diferent from other vehicles. As the engine is placed under the driver seat incase of Eeco, it reduced the frontal area thus offering more interior space. Based on the space requirement, Eeco is taken as the reference platform for the interior design.

Transporting a Bicycle in Taxi



Approx. Luggage size - 165 x 20 x 115 mm

In this scenario, a student goes to Andheri from Powai to buy a bicycle. While coming back, since it's a long ride the cycle has to be transported in a taxi. The only way to transport is to fold up the rear seat of the taxi and stuff the cycle as placing it transversely will prevent side door closing.

This scenario is tested by loading a typical cycle (firefox roadrunner) in Eeco taxi. It is found that the cycle cannot be fully loaded inside as it introdes into the front cabin. The approximate area occupied by the cyle loading is found out. It is not possible to load any cycle in the taxi from the rear tail gate because of the presence of CNG cylinder. Further the width of the taxi is low enough not to accomodate the cycle transversely and hence it has to loaded longitudinally along the length of the vehicle.

Transporting a washing machine for repairing in a taxi

In this scenario, the passenger transports a washing machine to repair shop. Even people use taxis to transfer their big house hold appliances in case of repair/ buying / shifting house. This is a typical scenario in Mumbai where taxi is used as a mini load carrier as the cost of transportation involved in case of using a taxi is lower as compared to using a load carrier for the passenger.

A trial was done to simulate the scenario with a luggage box of defined size (in this case washing machine).The trial was done in Eeco because it is the most used preferred taxi for such scenarios as other Taxis have low boot space with the addition of CNG tank.

Approximate Luggage size - 610 x 610 x 915 mm
Boot space required - around 207 liters

Disabled friendly Taxi

IR14

The taxis in Mumbai are not disabled friendly. A person in a wheel chair will find it tough to get in/out of the taxi as he has to leave is wheelchair. It usually requires one more person aiding him and making him sit on the taxi seat while the wheelchair is folded and kept on the top carriage.

Study for disabled friendly taxis present in other cities outside India is done . There are two systems currently being used, one which uses a ramp and other an automated hydrualic system for the wheelcahir entry. In the current taxis, the space required to accomodate a wheelchair is not available. Also ingress/egress of the wheelchair driven person has to be considered with constraints of the rear seating and CNG tank.

Approximate size with the passenger space required - around 1380 liters - 750 x 1280 x 1440 mm

IR13

IR12

Transporting Cargo in a taxi

In this scenario, wooden blocks are transported through Taxi. This kind of cargo requires a Mini commercial vehicle. This is a more atypical case. Also to be noted, since it is raining, a tarpaulin covering is done as the cargo is exposed to the monsoon. The tarpaulin cover tied to the top carrier prevents water seepage. Further the cargo unloading is very difficult as it is kept at the vehicle top.

There are many such cases of carrying unorganised luggages in Mumbai taxis. The design of the interior can provide ample space for such unrganised luggages.

Technical Study

Boot Space Requirement

The minimum boot space requirement is arrived at by studying the luggage space options in various 4 wheeler segments. It is found among the taxis used in Mumbai, Eeco has the highest lugage space with 540 liters whereas Santro has the lowest of arounf 218 liters. This space is further reduced by the positioning of CNG tank in the lugage area. As per the user scenarios described previously, the minimum luggage space requirement is around 250 liters.

Since the taxis in mumbai are also sed as a mini cargo carrier in some cases, the cargo space avaiability in LCV is also considered. After comparing all these luggage space data, It is decided to go with a boot space requirement of around 600 liters (more than Eeco but far less than a typical LCV) which will address the regular luggages requirements as explained by the scenarios.

Based on all these requirements of Luggage space and other technical specifications, Maruti Eeco is taken as the reference platform for the interior design.Though Eeco has a boot space of 540 liters the placement of CNTG tank inside the cabin reduces the space. Further it looks shabby and not so safe for the passenger. Hence the CNG tank ccan be relocated for more luggage space.

CNG cylinder occupying the rear boot space

Luggage space in existing Taxis

Santro
218 liters

Fiat
308 liters

Eeco
540 liters

Tentative Boot space in a LCV and Sedan

Tata Ace
2700 liters

Honda City
506 liters

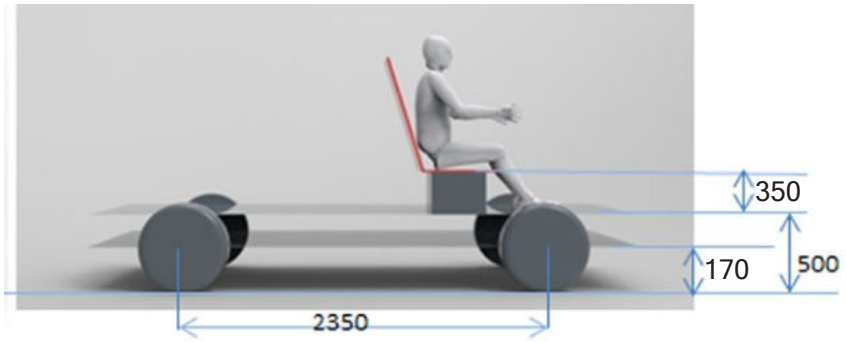
SX4
430 liters

Swift Dzire
316 liters

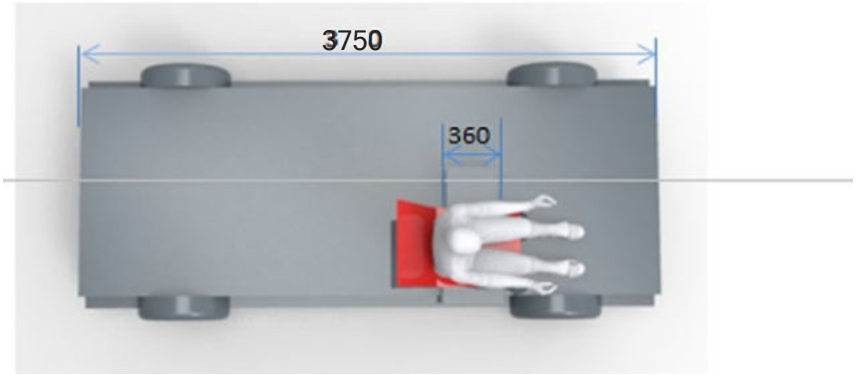
Basic Vehicle Dimensions

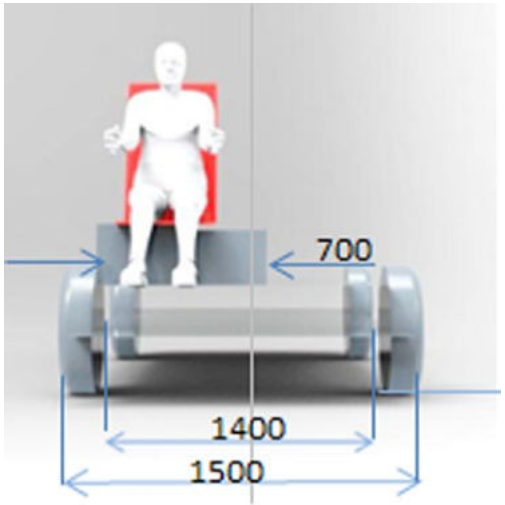
The dimensions for basic layout is got from benchmarking Eeco as it has a mid engine configuration which gives more interior space with less frontal box. Further the engine of Eeco is measured taken as a reference.

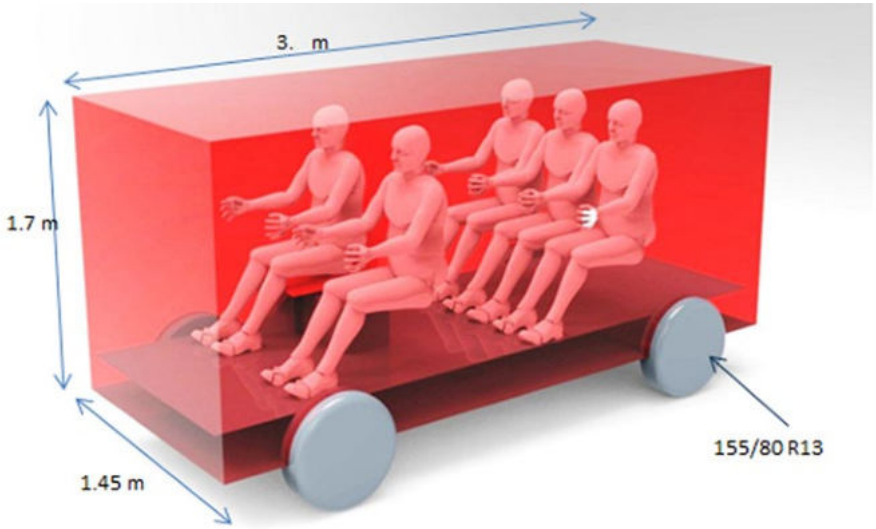
Eeco has a front mid-engined configuration in which the engine and tansmission is placed under the under the driver seating area. This is typically used in Multi-utility vans (MUVs). This reduces the front end thus providing more interior space. The driver seat height and the engine box dimensions were measured. Also the ground clearance and the floor heigt from the ground is found out. These dimensions are used to define the basic vehicle diemsnions as shown.



All dimensions are in mm







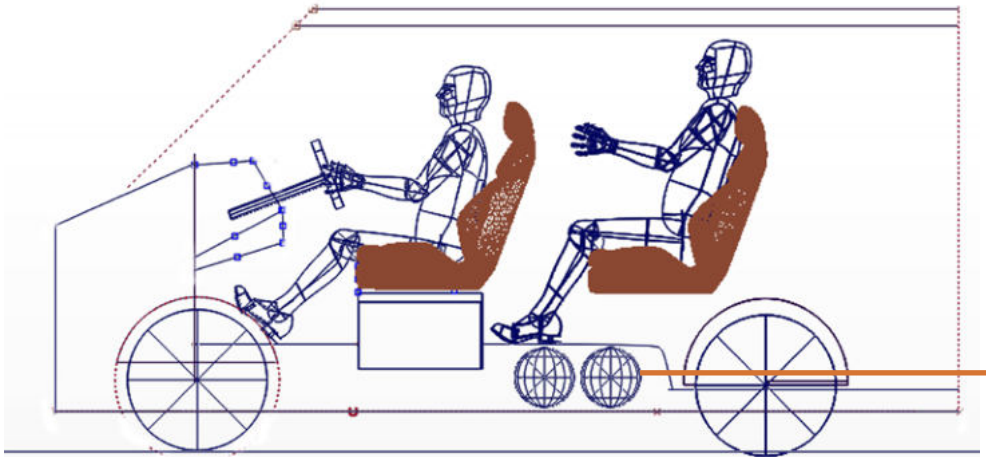
CNG Tank Placement

Repositioning the CNG tank can pave way for the ingress/ egress of wheelchair and ofer more luggage space. The presence of CNG tank inside the passenger cabin gives a feel of unsafe to the commuter. The CNG tank can be moved below the underbody as done in Fiat Punto and Ducato CNG models. For this, the current rear wheel drive system of Eeco should be converted to front wheel drive to avoid fouling of the drive shaft with the CNG tank. In most of the CNG vehicle, there will be an auxiliary gas tank of around 15 to 20 liters.

With the basic vehicle dimensions, the vehicle interior layout is constructed in Alias, and the floor height is slightly increased to accomodate the CNG tank in the underbody. The increase in floor height will also affect the roof height. Based on the tank size available, a tank of 50 liters is chosen for the package.It is of optimal size and fuel volume to accomodate under the body maintaining the ground clearance of the vehicle.

Fiat Ducato using underbody CNG IR15

Source -
http://www.cngofokc.com/services/tanks
http://www.autoedizione.com/most-eco-friendly-gas-fueled-car-soon-made-in-italy/



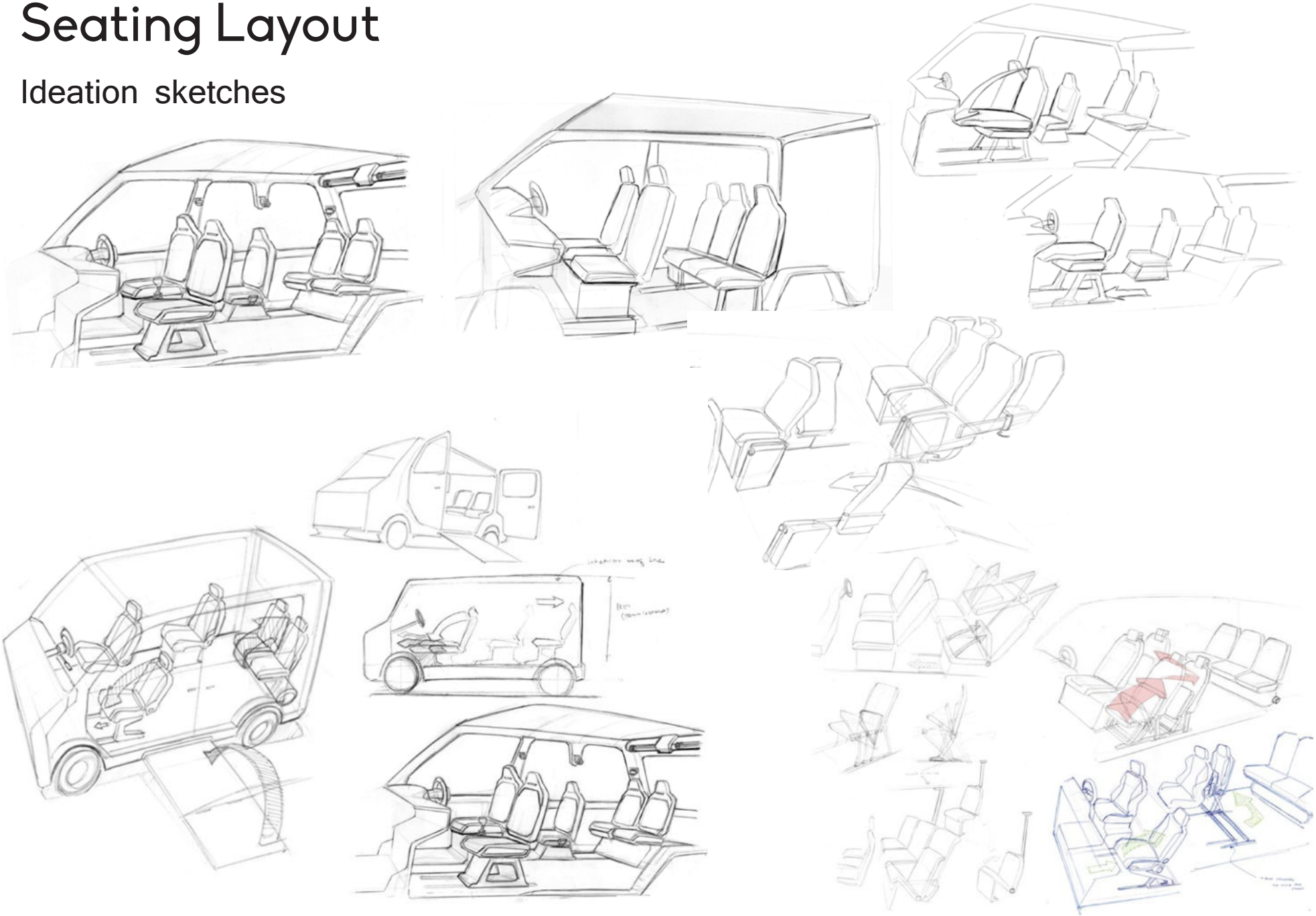
CNG Tank Specification

Cylinder diameter - 245 mm
Cylinder length - 970 mm
Capacity - 66 litres (33 X 2)

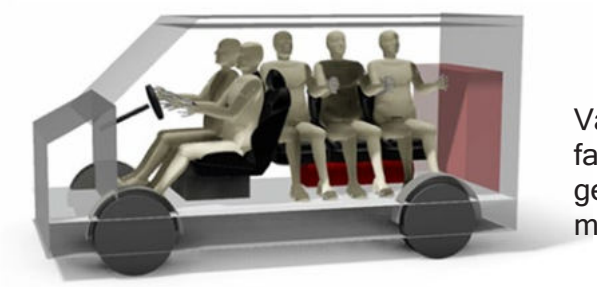
2 CNG tanks below the under body

Seating Layout

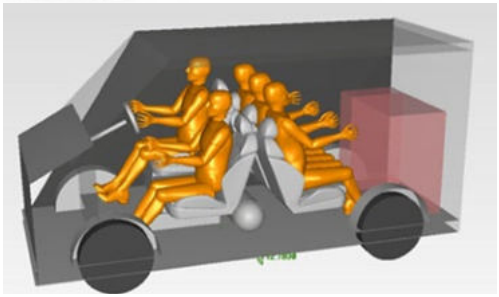
Ideation sketches



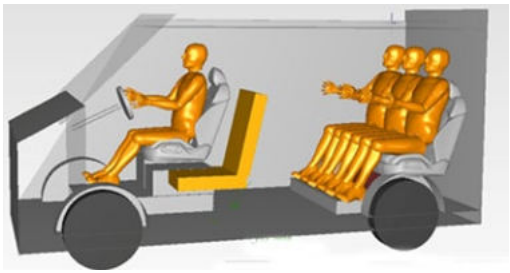
Seating Layout



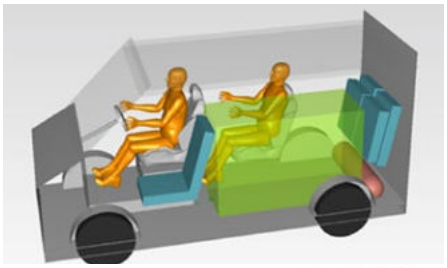
Various configuration of seating was explored. The possiblity of rear facing passenger seats, side facing seats, folding of seats to create luggage space were explored. Incase of the rear passengers sitting sideways, providing clear space for luggage. But when loaded with lot of luggages, it might feel cramped for the passenger. Also the ingress/egress is also very limited for the user.

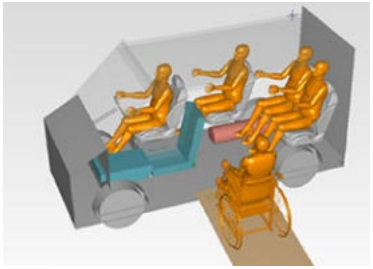


In the rear passenger seating layout, the passenger is facing opposite to the direction of vehicle motion. More space is lost inbetween the front and rear passenger seats.



In this layout, the rear seat has been pushed to the extreme rear possible with out changing the CNG cylinder placement. Also there is no tailgate and ingress/egress is from the side. The rear seating is lifted to avoid fouling with the wheel well which might result in change of seating posture. In this layout, the possibility of luggage obstructing the rear passenger's view and feeling cramped is high.





In this layout configuration, a three row seating approach is followed. Asymmetry in the layout is present to make access way for the wheelchair in the left. There is no tailgate and the ingress/egress is from the sides.

This is the conventional seating layout with front facing rear passenger seats and bot space in the rear most position. This conventional layout is more suitable as it provides better ingress/egress points and avoids the luggage obstructing the passengers view.

Seating Space

Minivan dimensions are chosen as the refernce vehicle platform is that of Eeco and minivans have an efficient packaging within the space and has good ingress and egress.

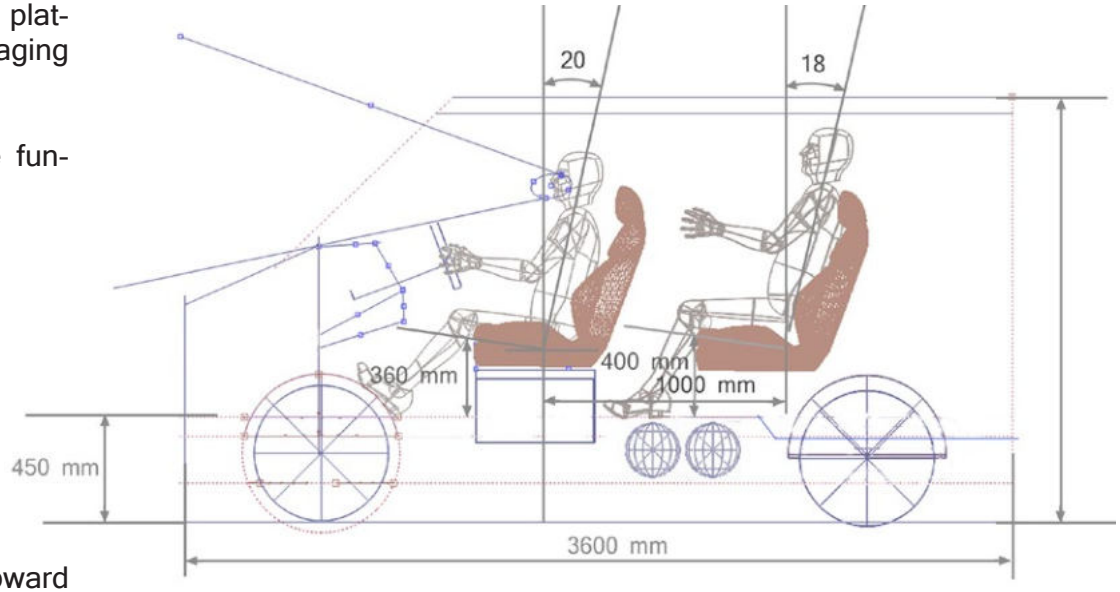
The basic dimensions are used from the book ‘H Point - The fundamentals of Car Design and Packaging’ by Stuart Macey.

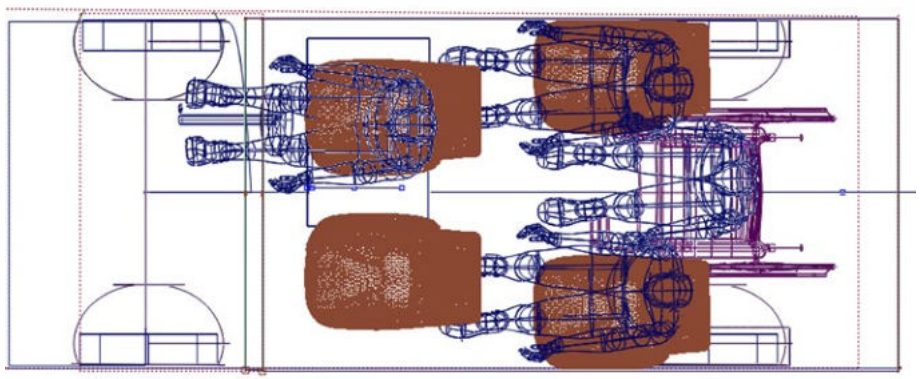
Driver/Front occupant seating
Seat height (H30) - around 425 mm
H point to ground (H5) - around 775 mm
Back angle (A40) - 20 deg

Rear occupant seating
Seat height (H30-2) - around 425 mm
Back angle (A40-2) - 22 deg

It is ensured that the dashboard should not obstruct the upward vision angle of 19 deg and downward vision angle of 11 deg (for a minivan as per H- pont) of the driver. The eye elipse is constructed to detemine the vision angle as per SAE J941.

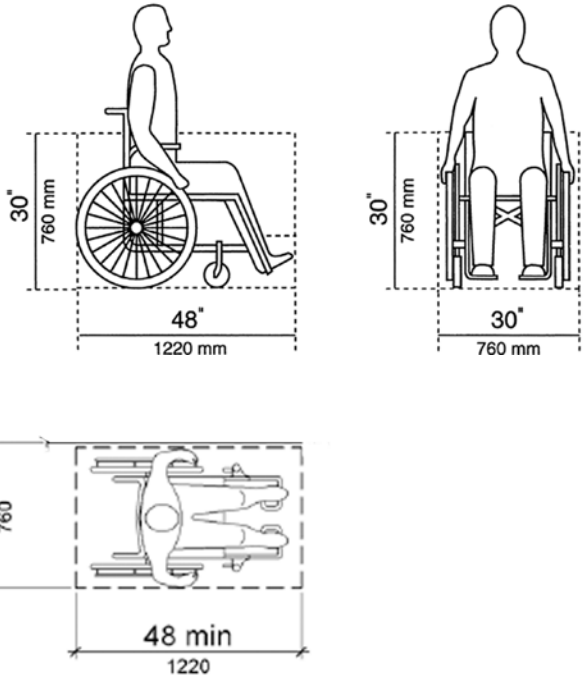
Wheel wells are constructed taking into account the steered position of wheels at 45 degrees. This wheels intrude into the interior space adding constraint for seating and wheelchair entry.

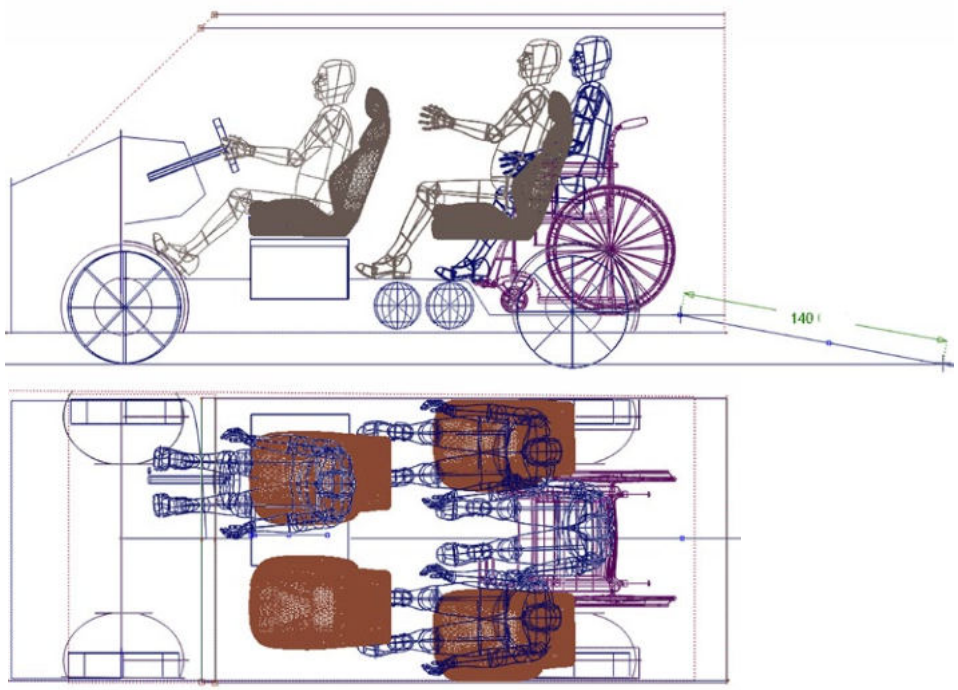




Wheelchair Accessiblity

The wheelchair dimensions are taken as below as per standard dimensions defined by ISO 7193 Wheelchairs - Maximum Overall dimensions. The wheelchair is fitted inside the package to verify the space requirements as shown. The rampover angle for wheelchair entry is taken as 10.5 degrees (the maximum ramp angle for wheelcahirs is 12 degrees)



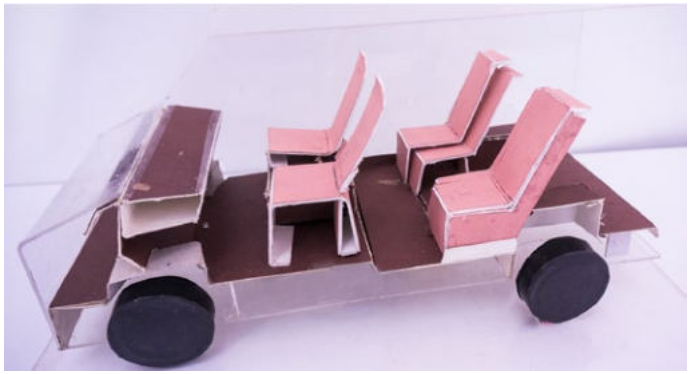


Reference -
http://accessibility.gtri.gatech.edu/assistant/acc_info/ada_guidelines.php

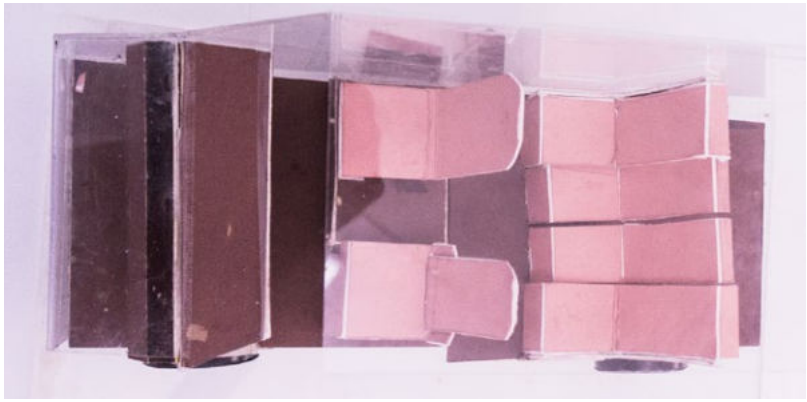
Seat Folding Concepts

As per the final package dimensions, mockup models of different seat folding concepts were tried out using mount board. The model is of scale 1:10.

In this concept, the middle rear seats slide into the side seats making way for the wheelcahir entry. The side seats can also be folded to create more luggage space as per requirement.



Concept 1

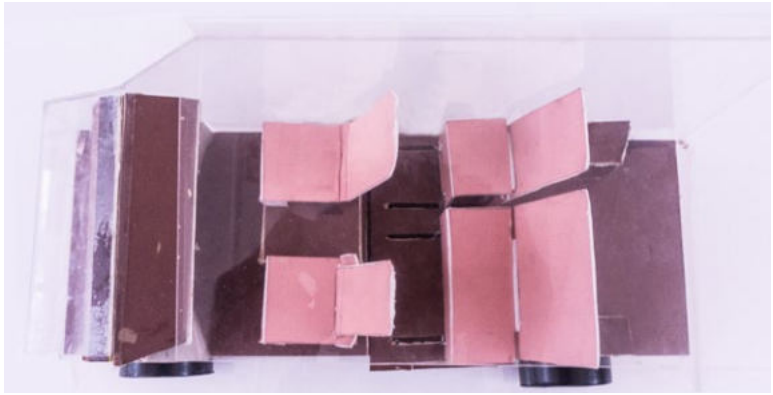


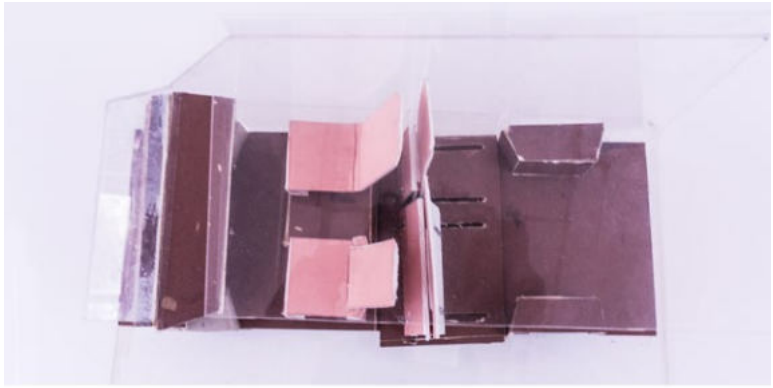
Concept 2

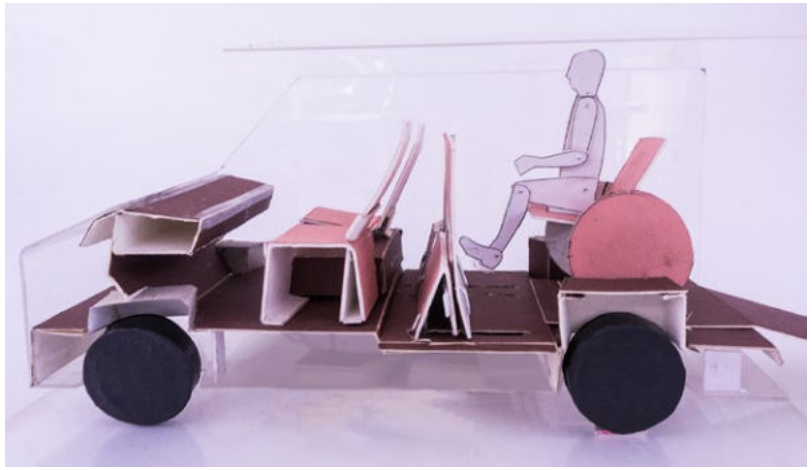
In this concept, the rear seats fold like a folding chair to make the required space. Each rear seats can be individually folded to create the required space. The seats fold up similar to folding chairs with the use of linkages. The wheelchair ingress/ egress is through the rear tail gate once the rear seats are folded and moved to the front.

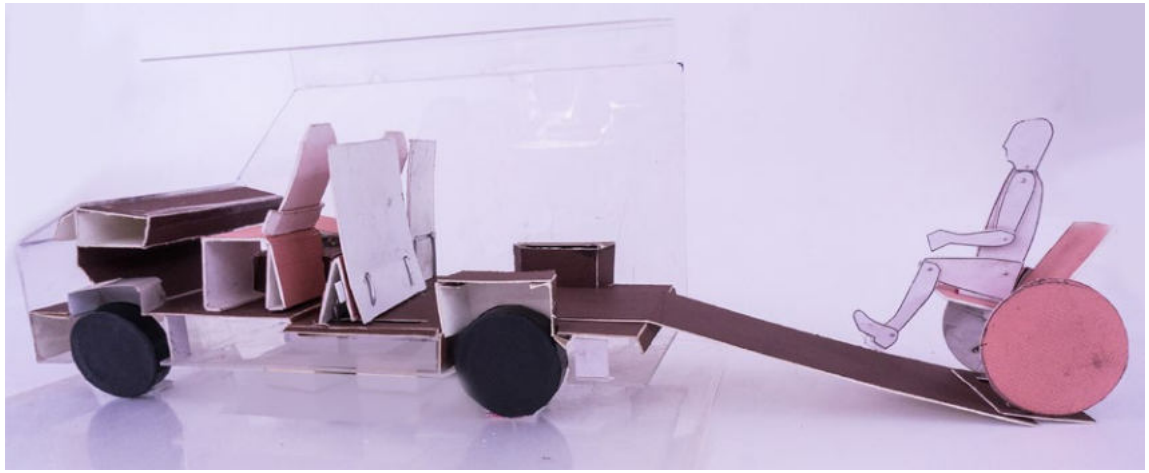
IR16

typical folding chair with seat









Concept 3

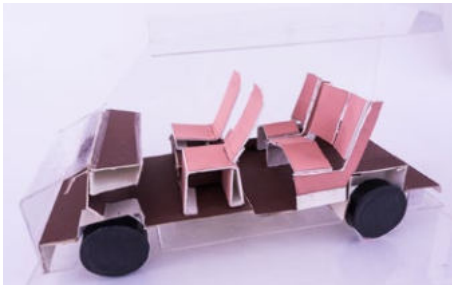
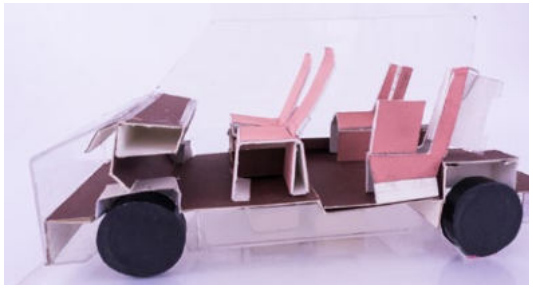
In concept 3, the rear middle seat fold and slide to the front creating space as shown. Further, the other two rear seats can also be folded.



Concept 4

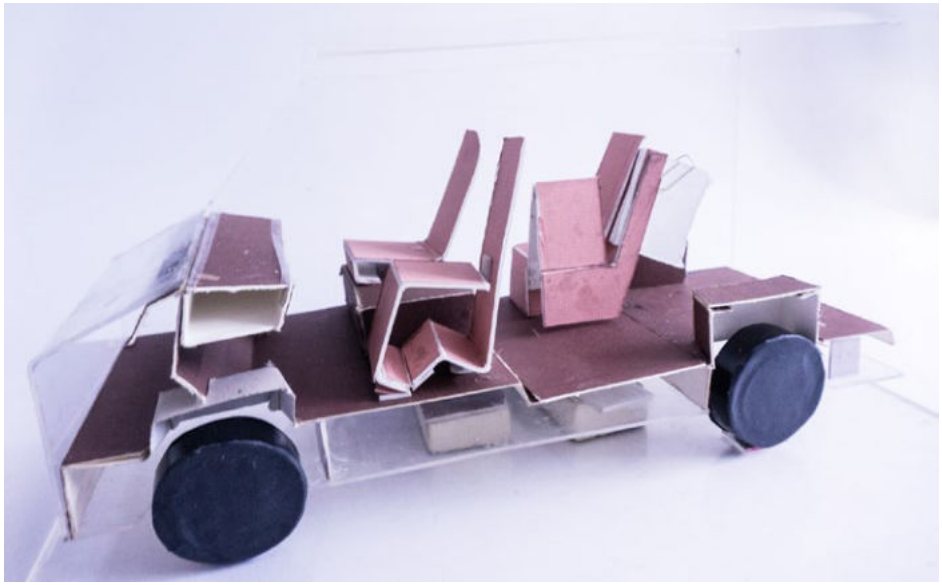
In concept 4, the rear seats fold laterally creating a variable free space as shown. The seats fold like an origami pattern and the mechanism will have lot of linkages.

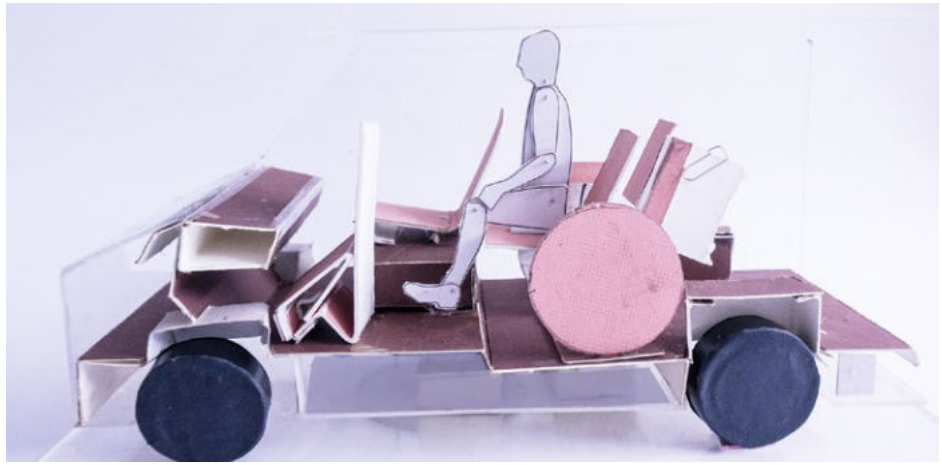
concept 4 inspiration
source -
http://mrsimon.es/works/com-oda/

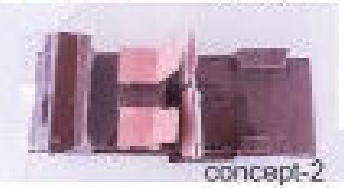
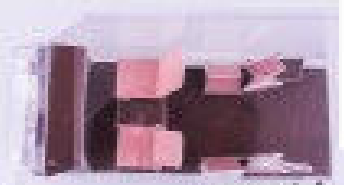



Concept 5

In concept 5, the rear seat in the left hand side of the car folds inwards to create entry spacce for wheelchair from the side.
There is absence of center pillar (B - Pillar) in this concept to provide entry/exit space for wheelchair. The front co-passenger seat folds and moves towards the front thus creating enough space for the wheelchair driven passenger. The ramp is taken from the side and since the wheelchair entry is from the side doors, it requires a larger entry space which results in absence of center pillar (B- pillar). Further, side entry of wheelchair is not feasible as it involves turning the wheelchair from the side door entry.

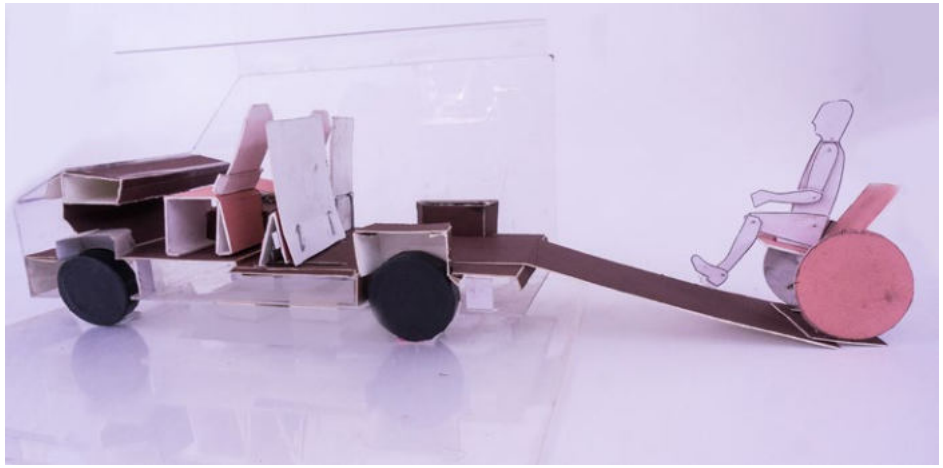


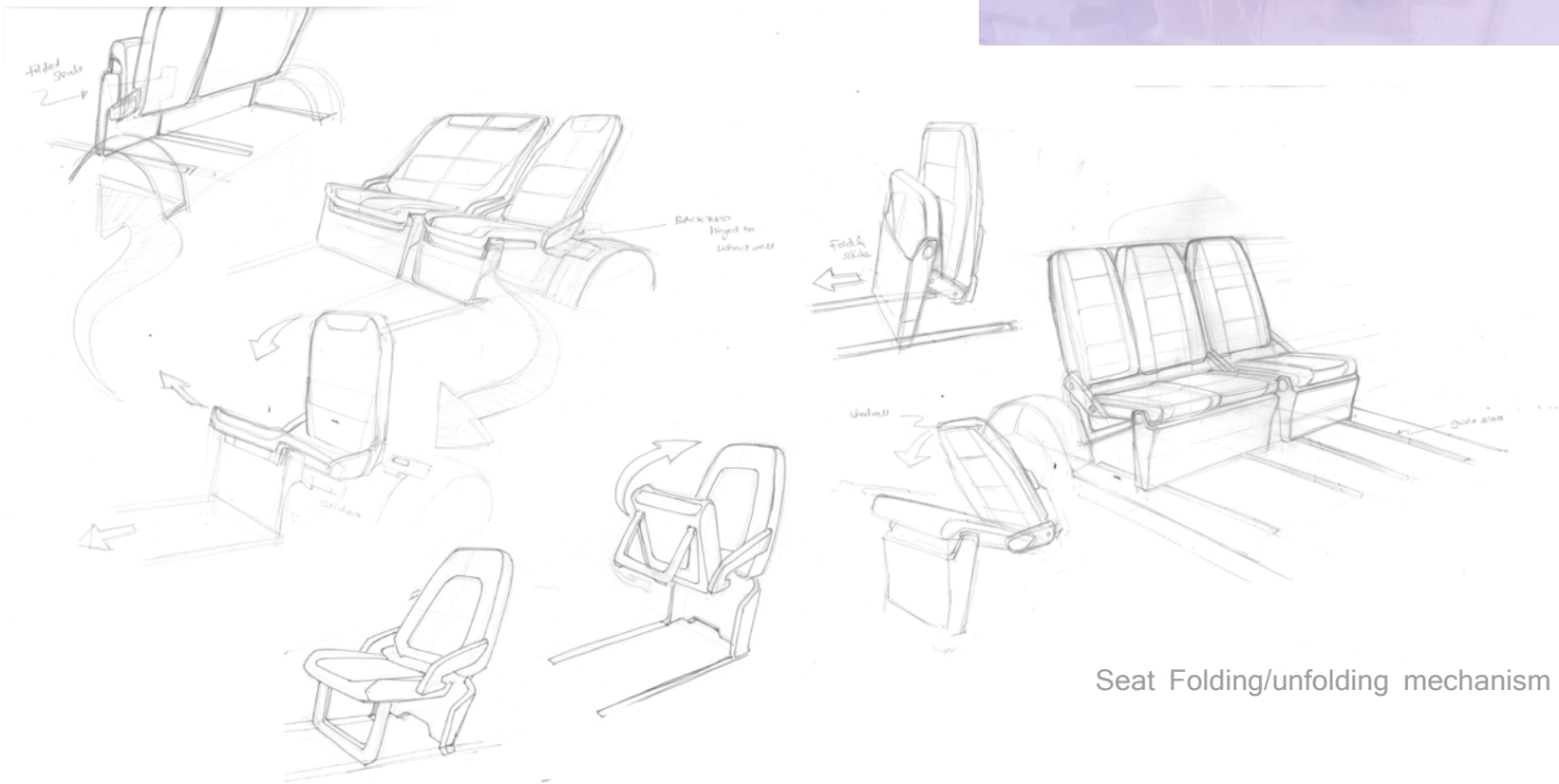


	Ease of operation	Free space after folding	Ingress/egress of wheelchair	complexity in operating mechanism	pros/cons
 concept-1	easier as it involves only sliding operation	enough for wheelchair entry	from rear tail gate	the seat heights will differ as it involves one seat stacking inside the other	does not have high modularity interms of free space created after folding
 concept-2	involves more operation than concept-1	space availed after folding is very high	from rear tail gate	involves multiple hinges and sliders	high modularity and mechanism is similar to folding chair
 concept-3	less operation than concept-2	enough for wheelchair entry	from rear tail gate	involves multiple hinges	less modular and complex folding mechanism
 concept-4	easier as it involves only sliding operation	more space than concepts 1 & 3	from rear tail gate	involves a lot of moving parts	folding mechanism has lot of moving parts and complex
 concept-5	involves folding the rear seat and folding/moving the front seat	enough for wheelchair entry	from side door	less complexity	absence of B-pillar as entry is from the side doors. Also wheelchair turning is difficult

Seat Folding concept

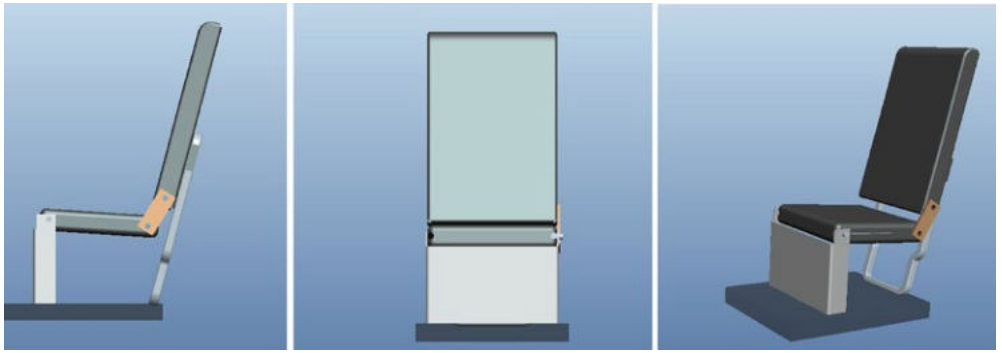
Concept 2 is chosen as the final seating concept as it is very modular and the rear space can be configured as per requirements by folding the rear seats individually. It also offers high free space for luggage and wheelchair accesiblity.

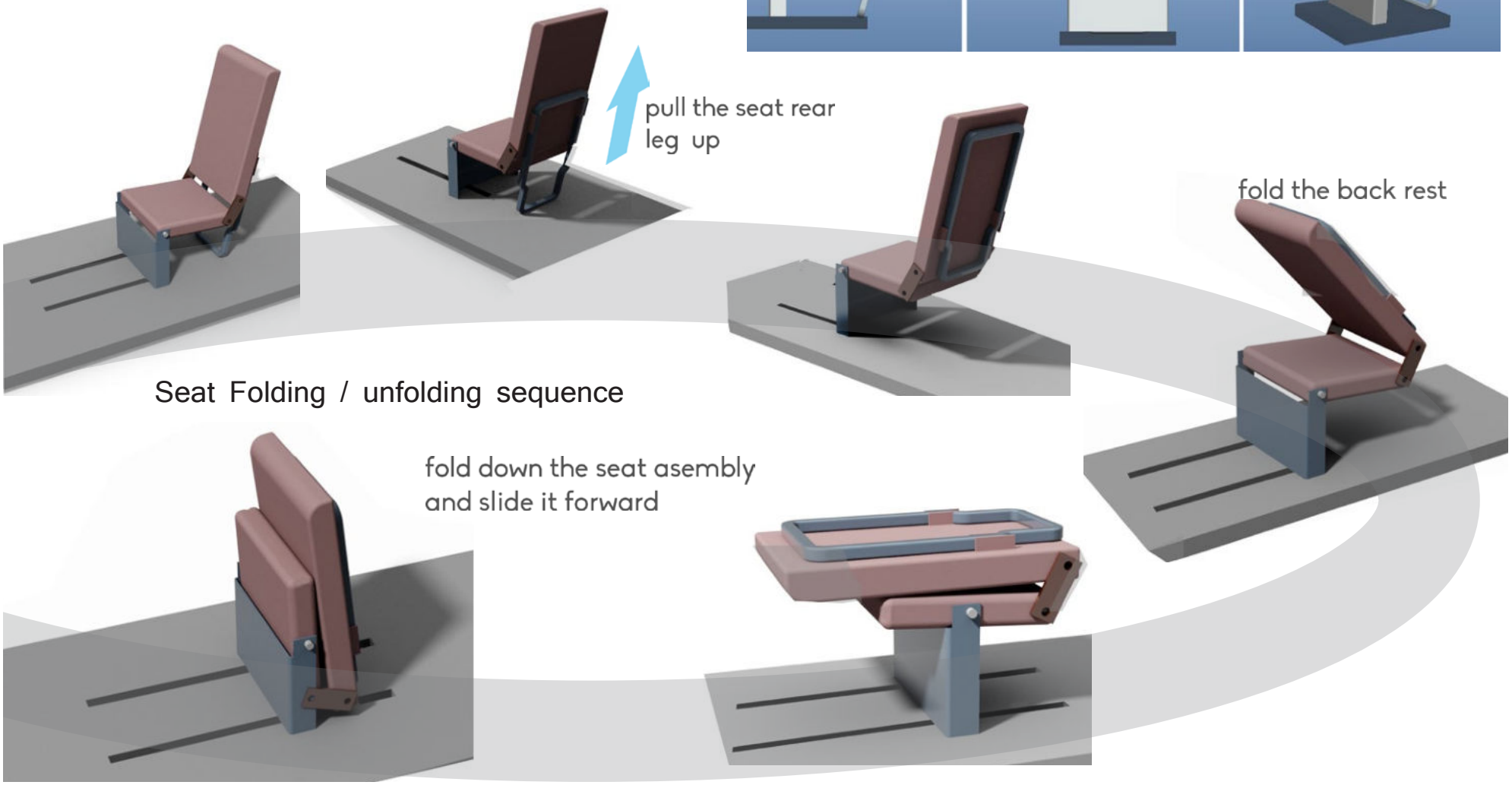




Seat Folding/unfolding mechanism

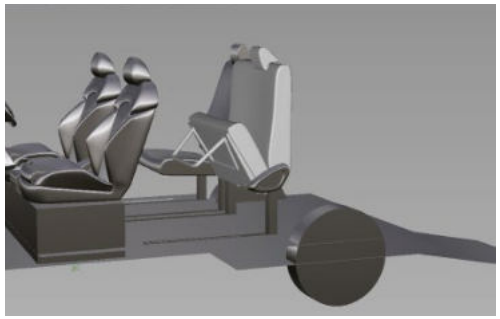
Concept 2 is further developed by creating a parametric basic model of the rear seats in PRO-E and verying the feasiblity of the folding mechanism. The folding sequence of the rear seats is shown below.

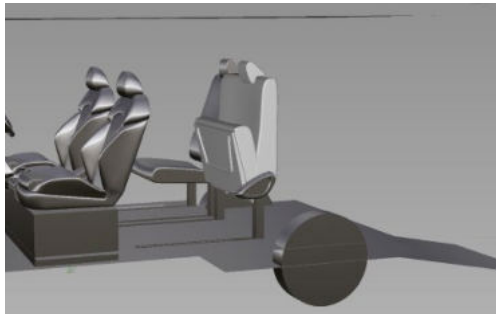


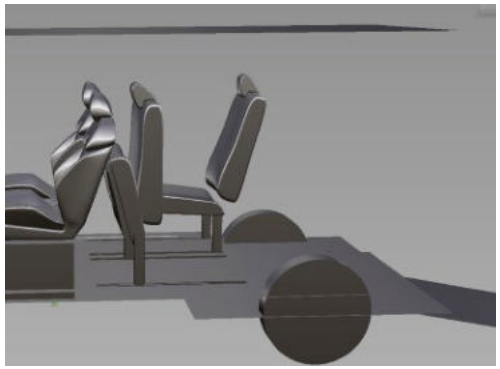


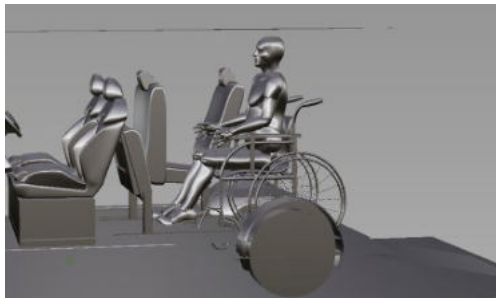
Seat Folding / unfolding sequence

The chosen concept of seat folding is simulated by making a 1:1 mechanism prototype. After checking it is found that the mechanism is not easy for the user to operate as it involves the user to get insie the vehicle and fold the seat. Hence further concept exploration was done.







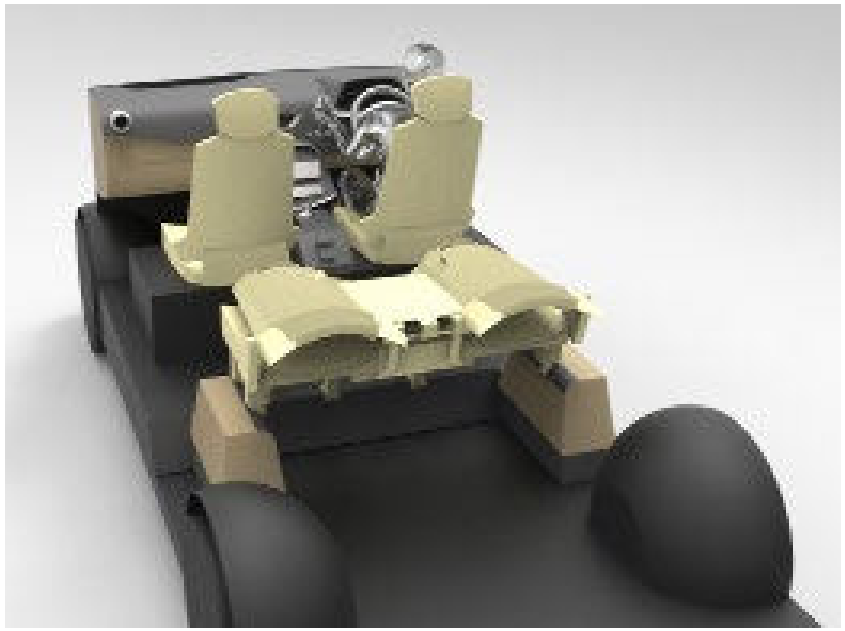


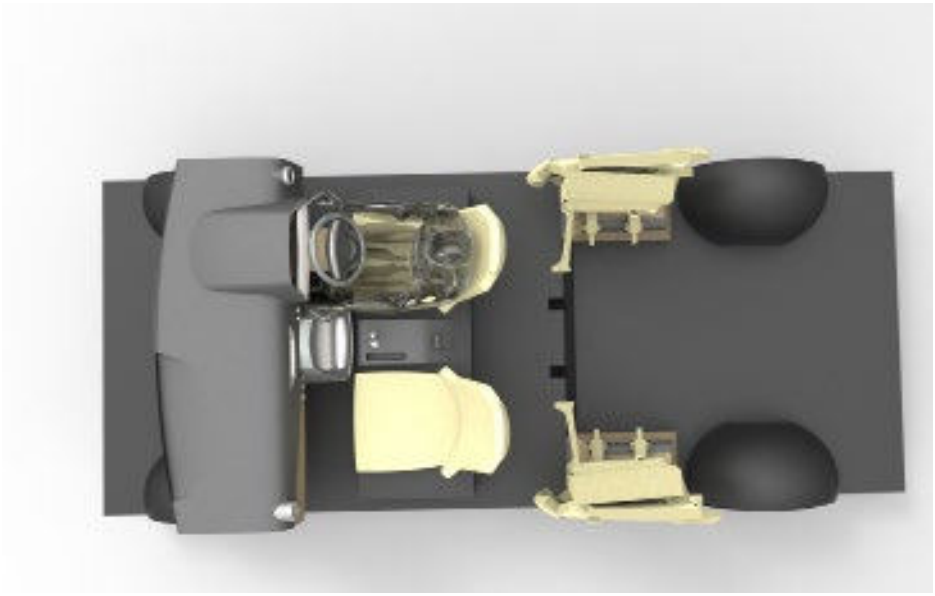
Concept is further modified to accomodate the folding from the side. This is simulated in CAD and further checked as shown.

This folding method employs a slider on the floor which may not be suitable for a taxi as there is a possiblity of dust getting inside the sliding slot.

Further concept excplorations and mockups were done to simulate for the seat folding concept.

in this concept the seat is folded from the side and the folding activity involves 3 steps. This creates more space than the previous concept.





Seat Folding concept

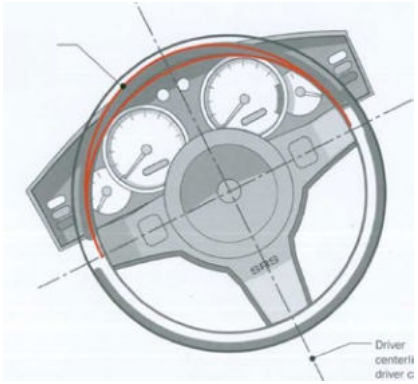
After above explorations and mock-ups, the seating folding as shown is chosen as it clears out the maximum space and occupies a more compact setup. Also it provides less effort in folding/ unfolding.

Interior Concept

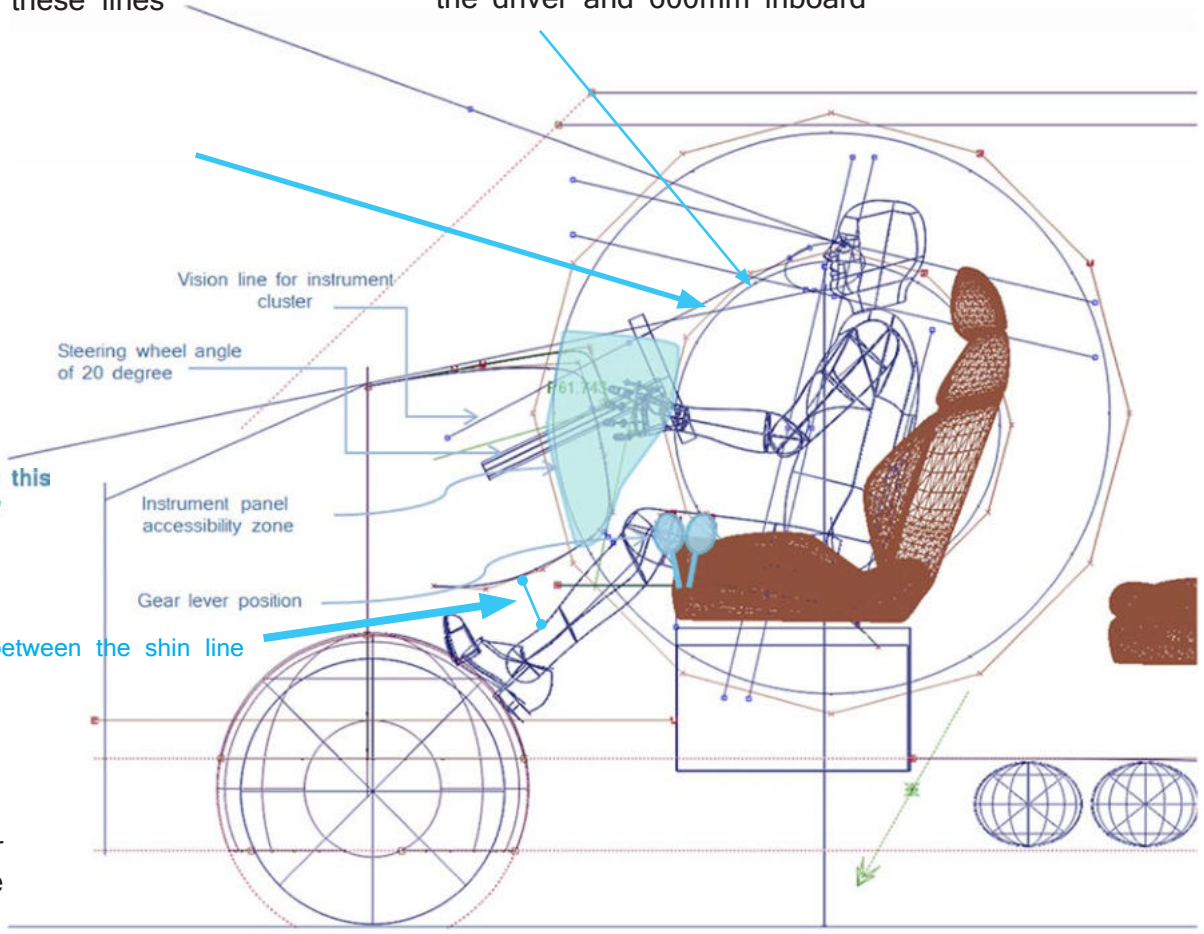
Technical Study

The instrument panesl constraints of steering angle, visiblity, gear lever position and clearance between the driver and the panel were studied. These technical constraints are then mapped onto the existing package in Alias and the dash-board position is fixed.

the instrument cluster visiblity through the steering wheel is set by projecting the vision lines of the 95th percentile man-nequin onto the cluster plane resulting in a moustache shaped area. The instruments should be designed below these lines (marked in red)



SAE J287 reach envelope sections created between 400mm outboard of the driver and 600mm inboard



instrument panel should start below this vision line to ensure proper visiblity

approx. 20- 150 mm minimum gap between the shin line and the dashboard

Reference - 'H Point - The fundamentals of Car Design and Packaging' by Stuart Macey for the above images and details

The basic elements of Dashboard panel are identified. Shown here is a typical instrument panel (of that of Eeco) with basic functional elements like AC vents and controls, Audio system, instrument cluster, Control witches, glove box, steering wheel and the transmission gear console.

Further incase of a Taxi, there will be a Fare meter and bill printer as show below.

These basic functional elements are taken and the form for the dashboard and interior space is explored. The theme of the interior space is to bring an uncluttered and simple feel as many passengers have talked about the cramped seating and ambience in the current taxis. Based on these a mood board is created.

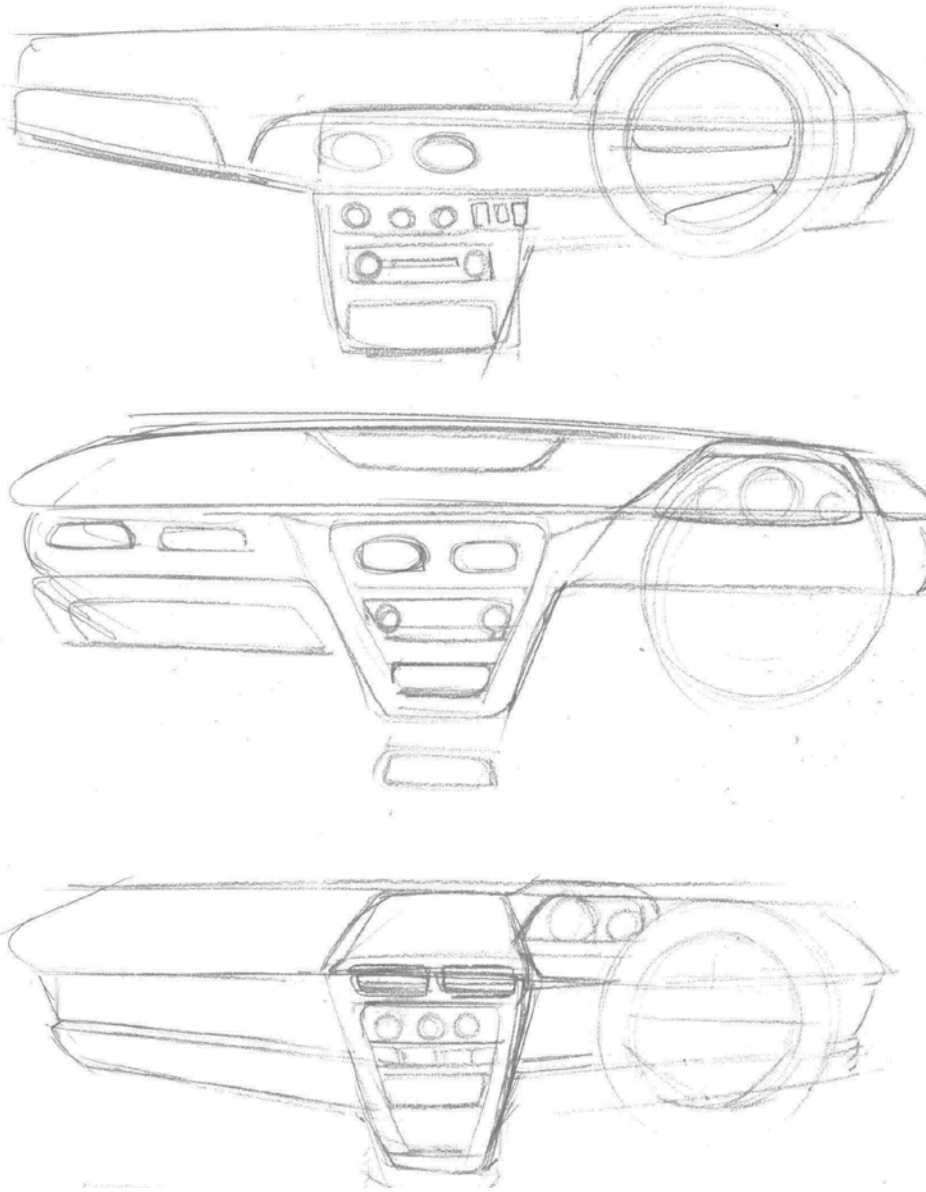
Moodboard for interior space

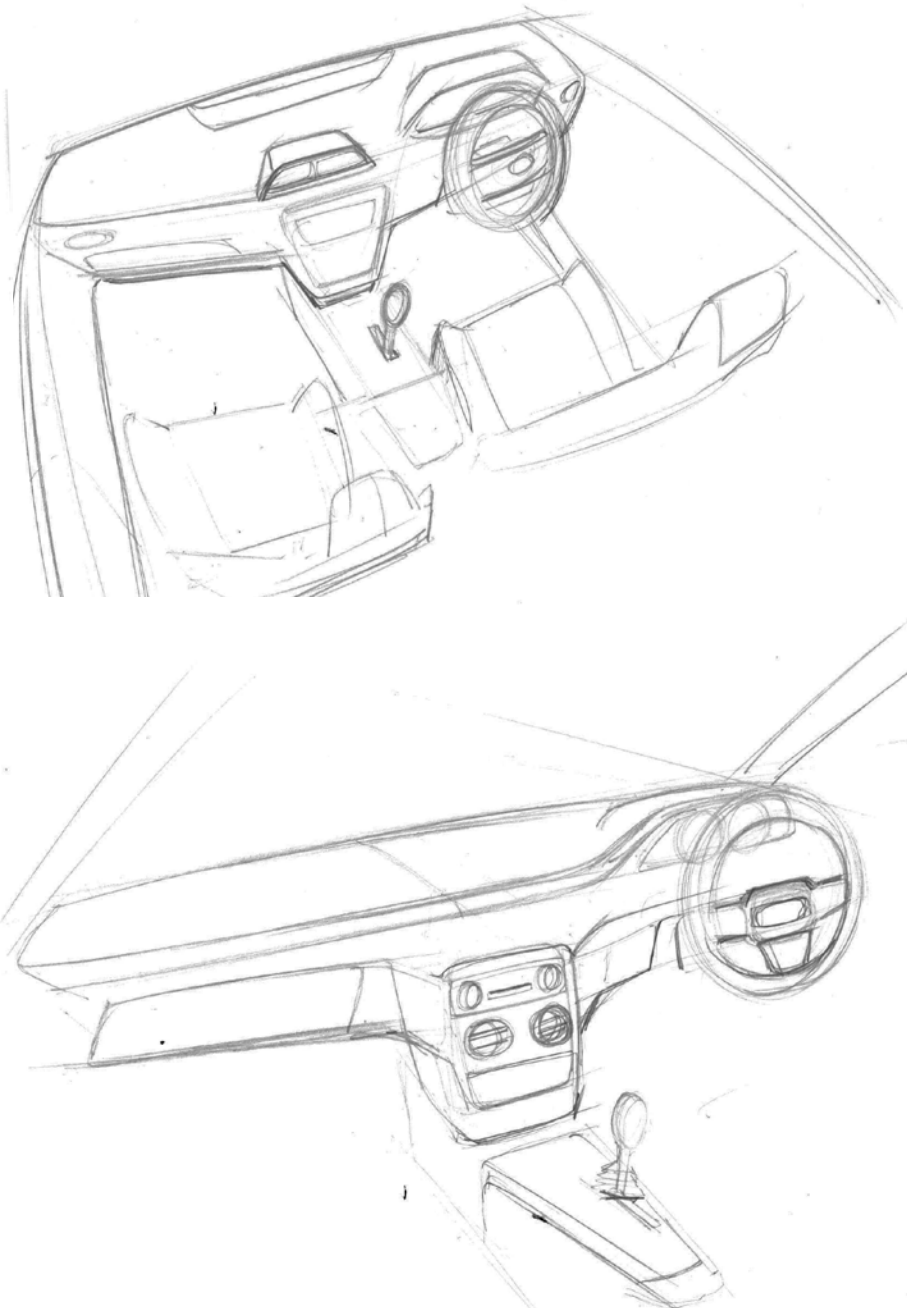
Simple

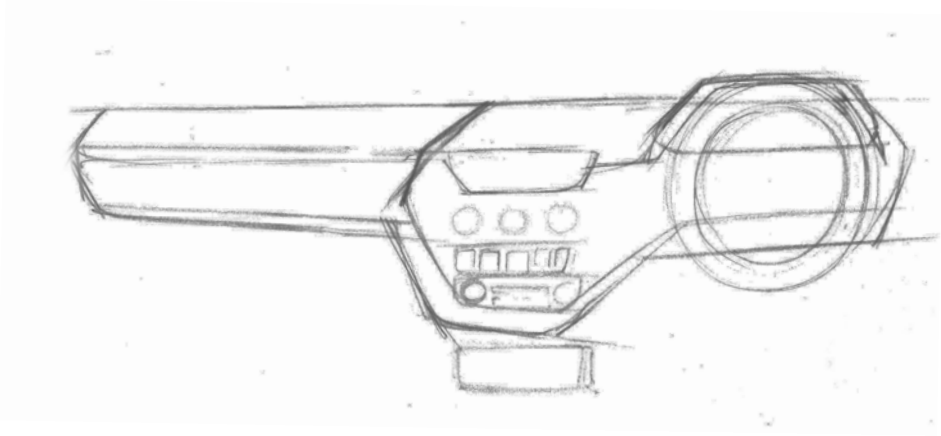
Modular

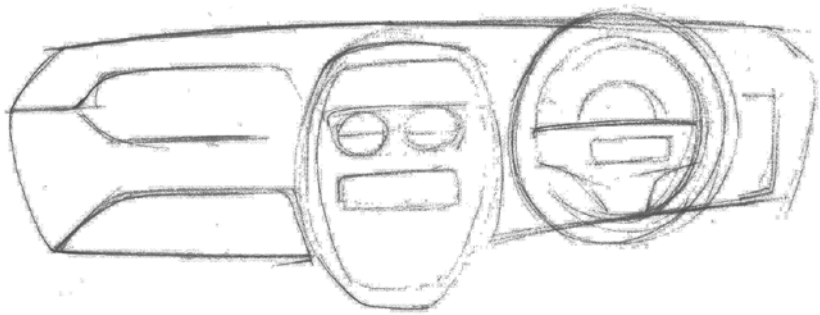
Clean

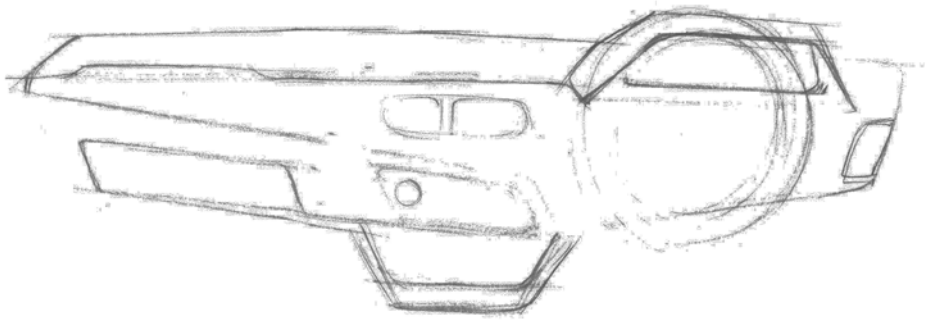
the basic volume and form of dashboard is explored . The form should represent the mood board attributes of simplicity and clean

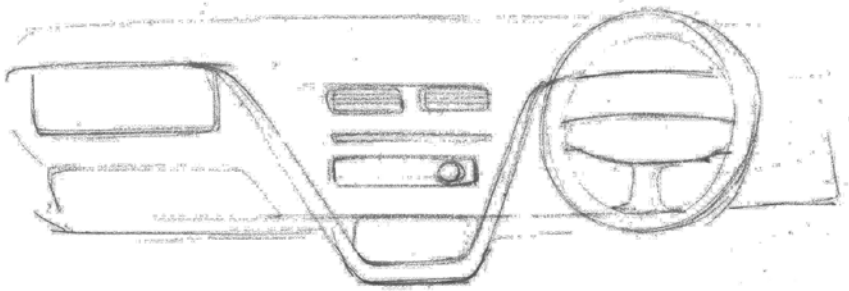


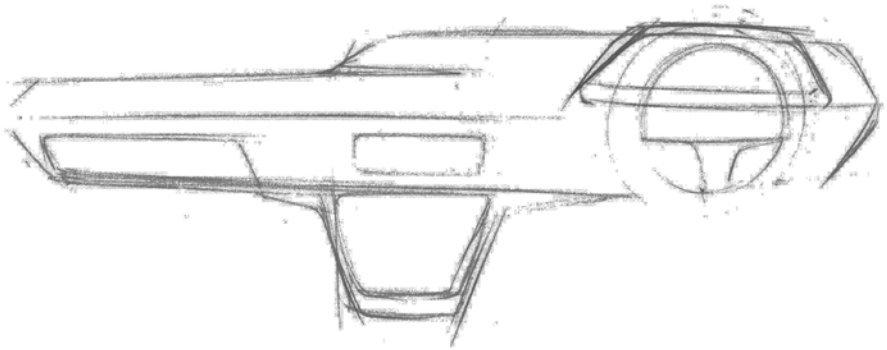


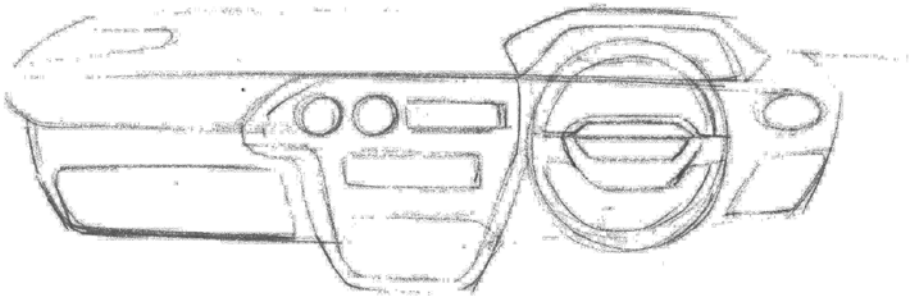


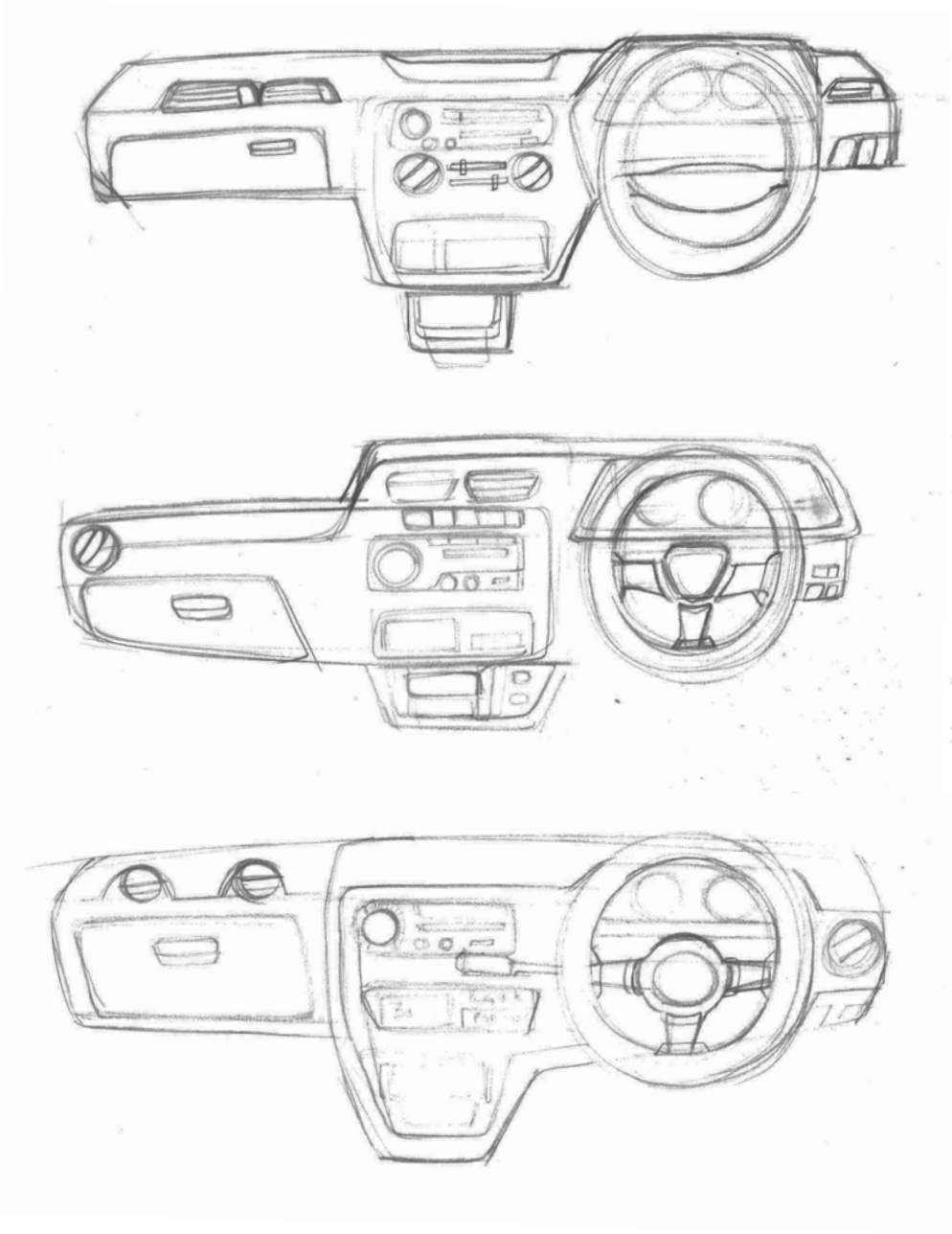


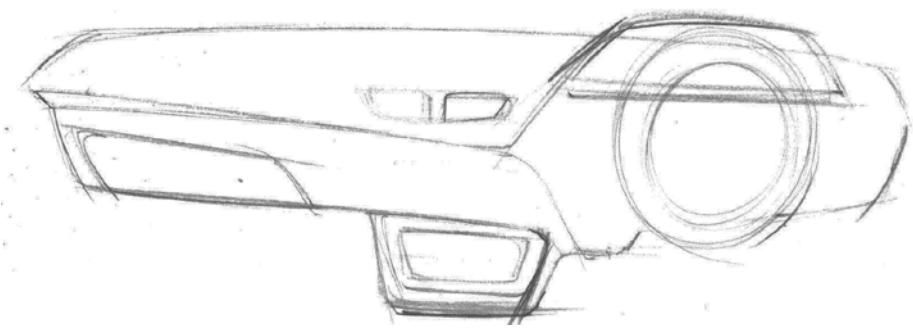


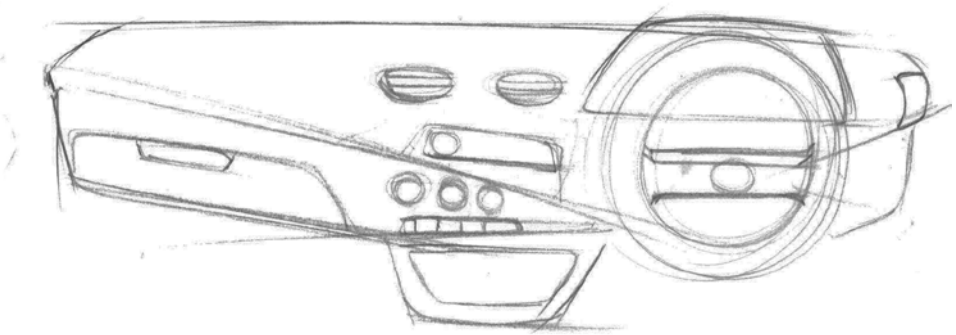












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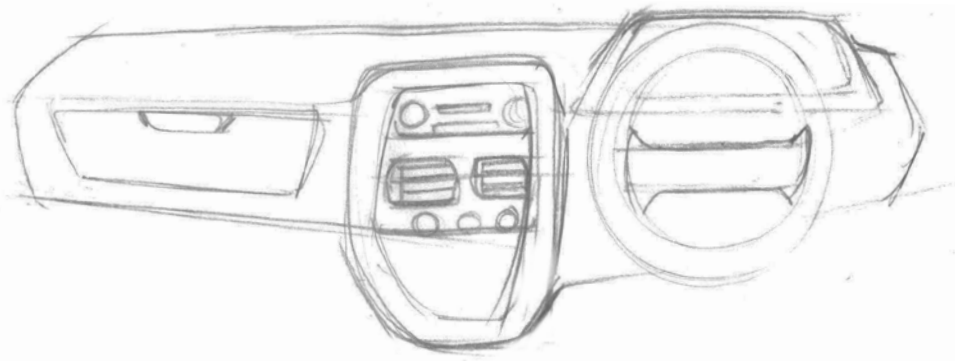
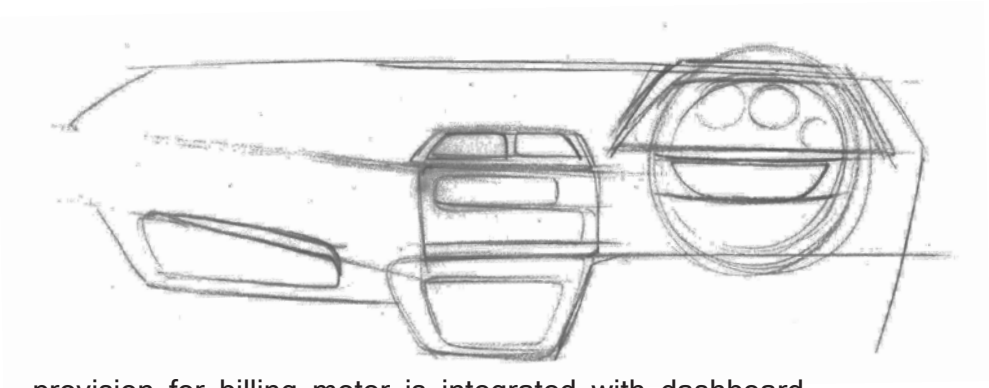
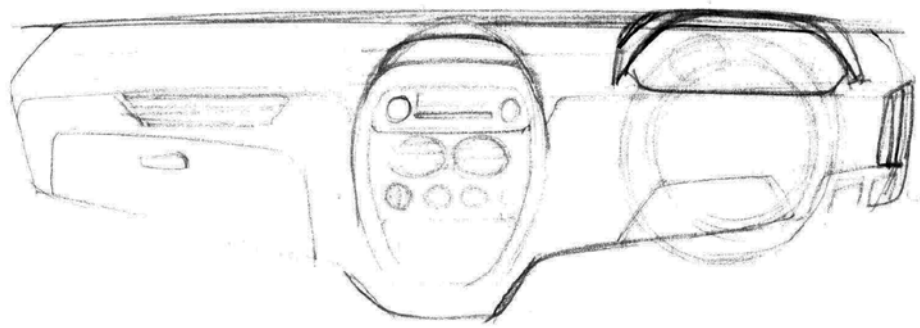
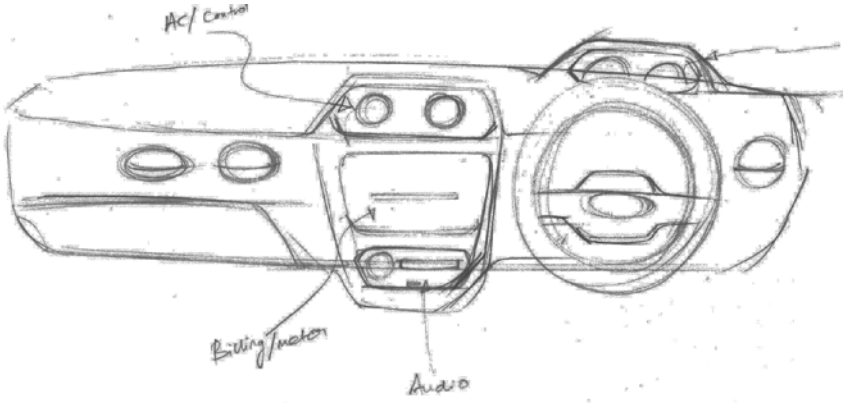
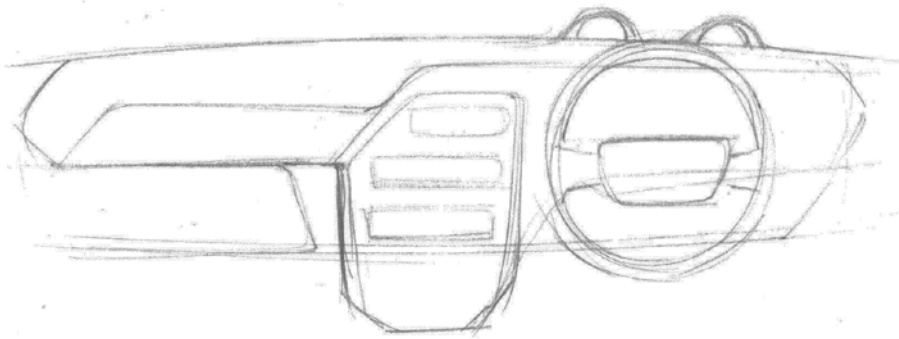


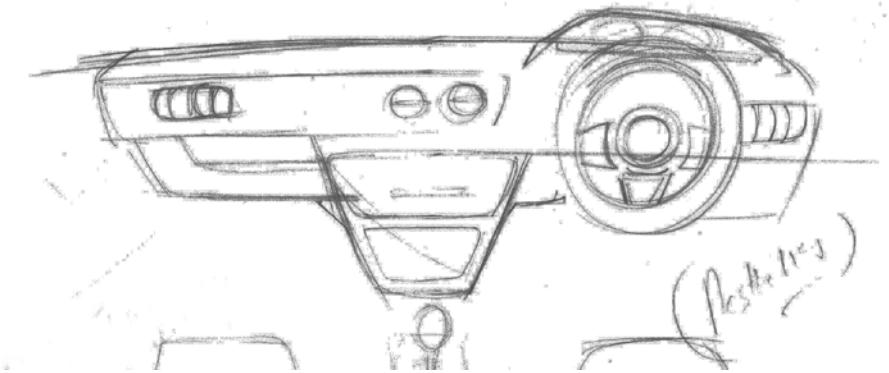


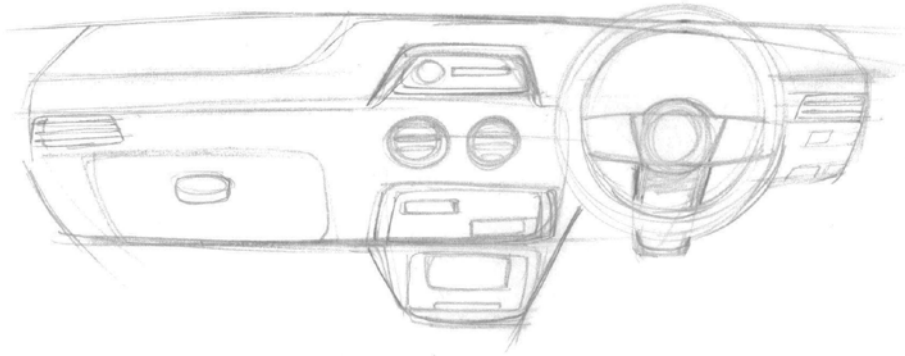


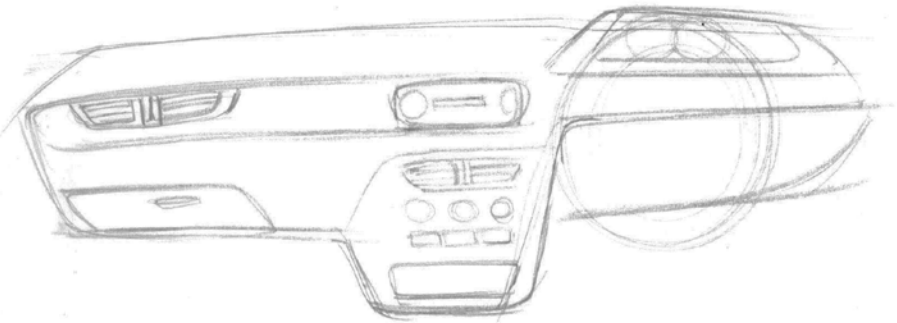
provision for billing meter is integrated with dashboard

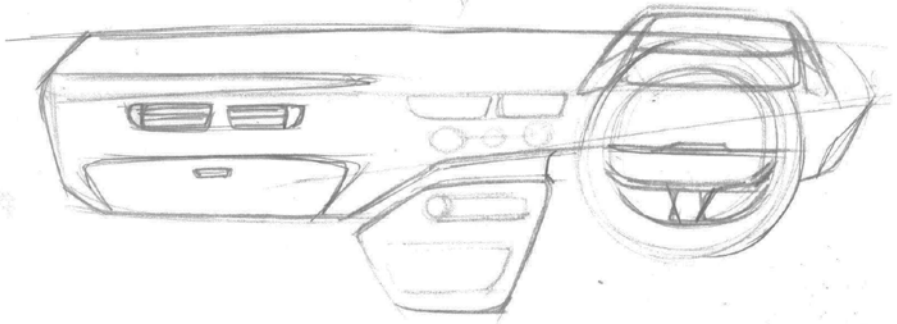


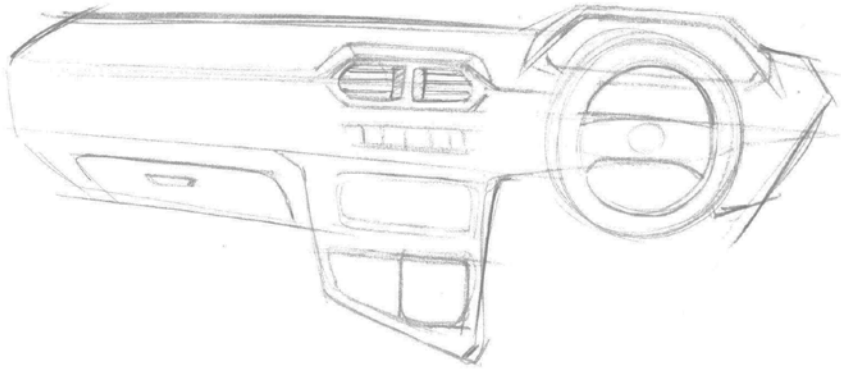


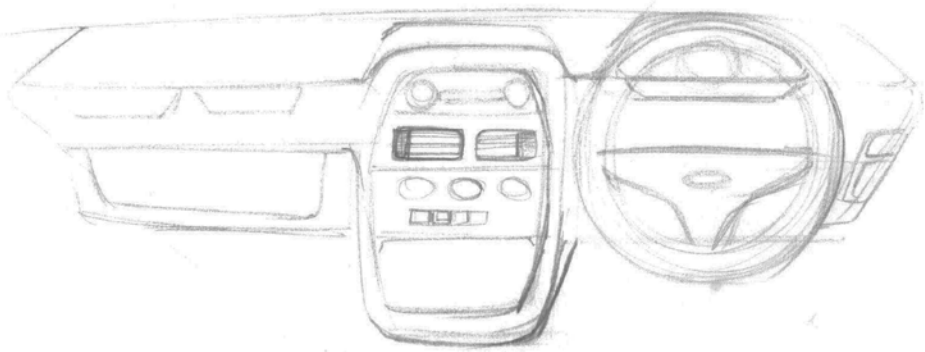


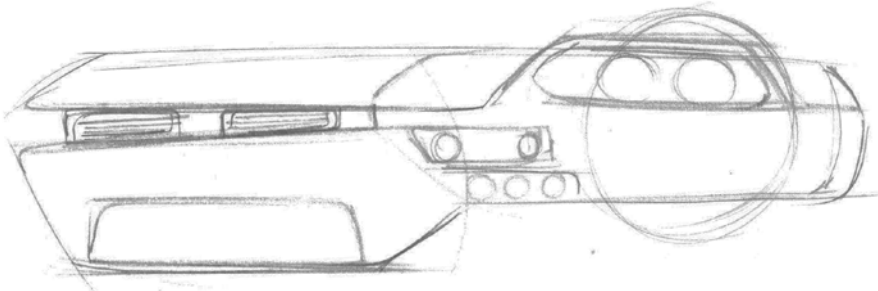












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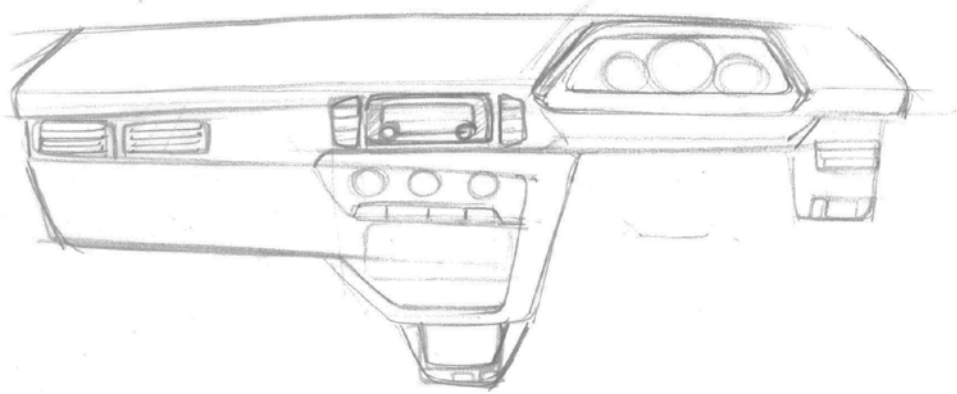
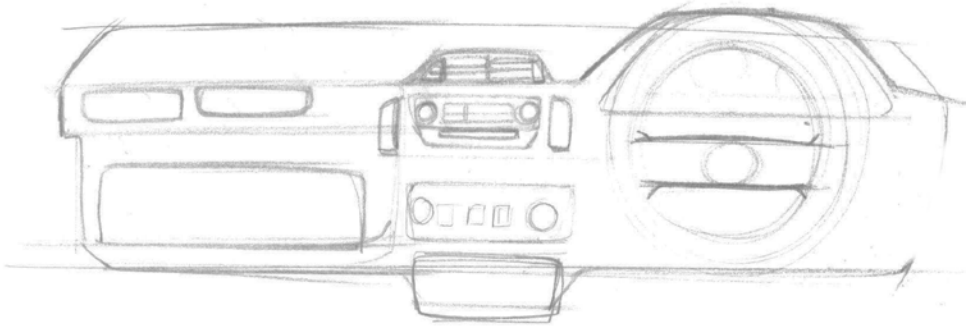
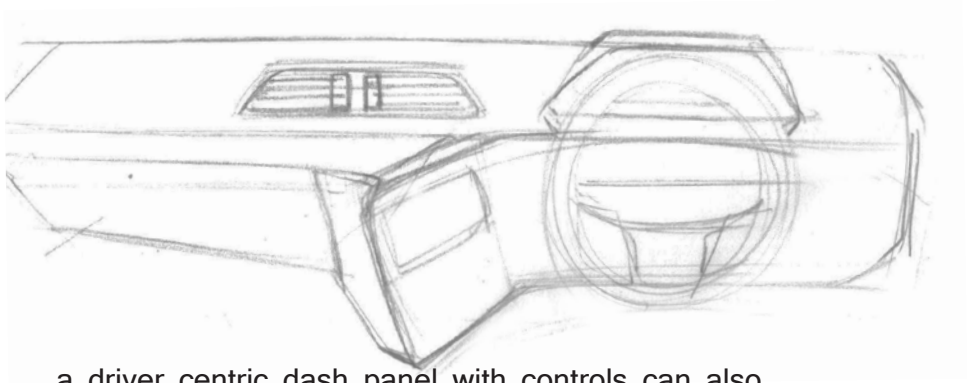
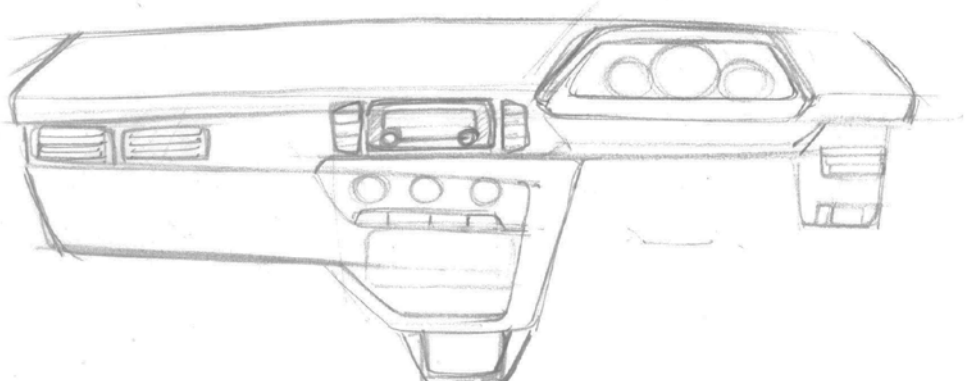
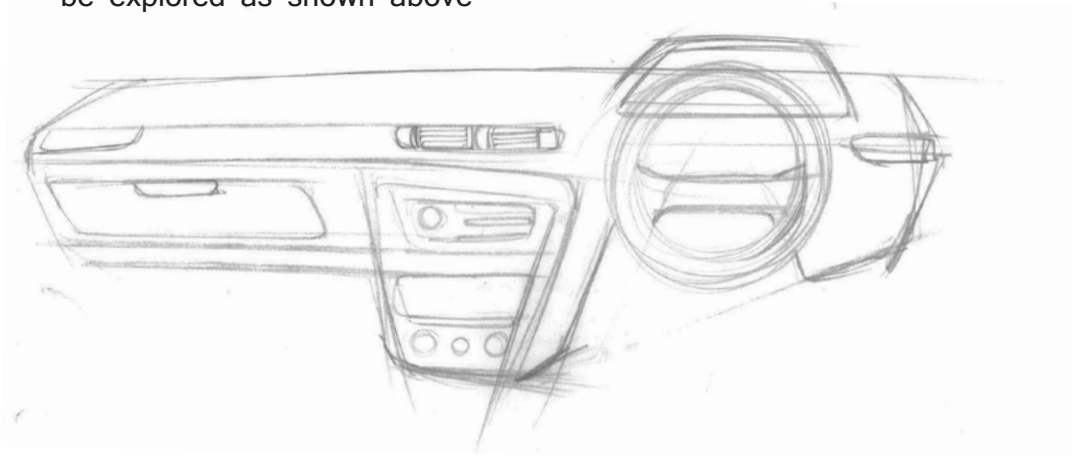


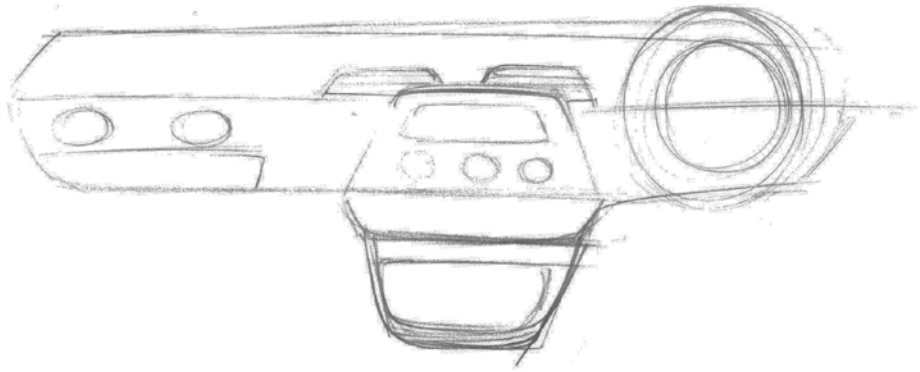


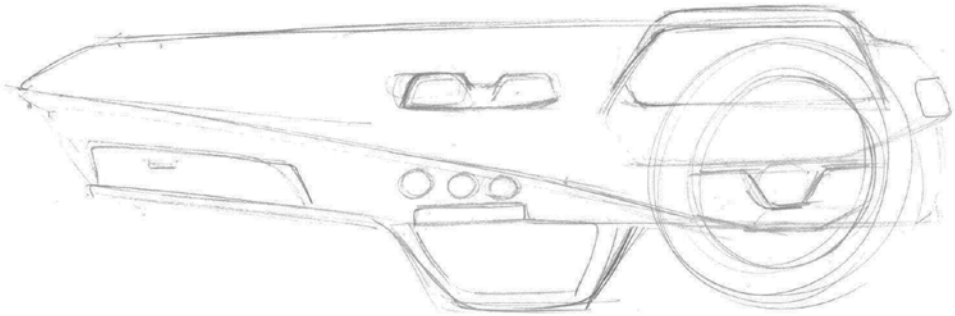


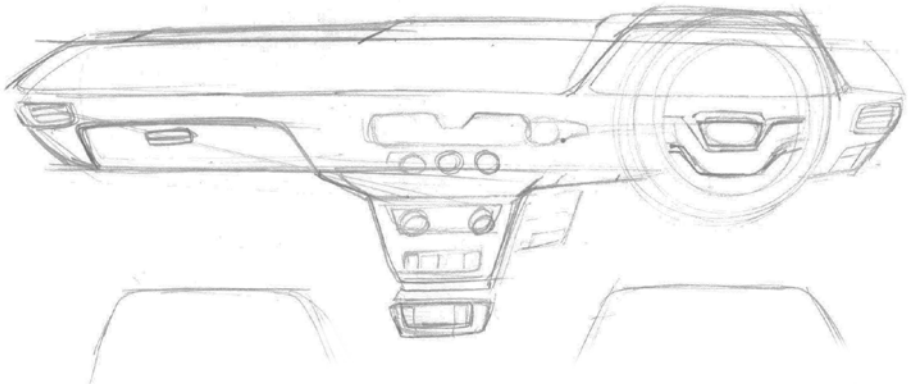
a driver centric dash panel with controls can also be explored as shown above

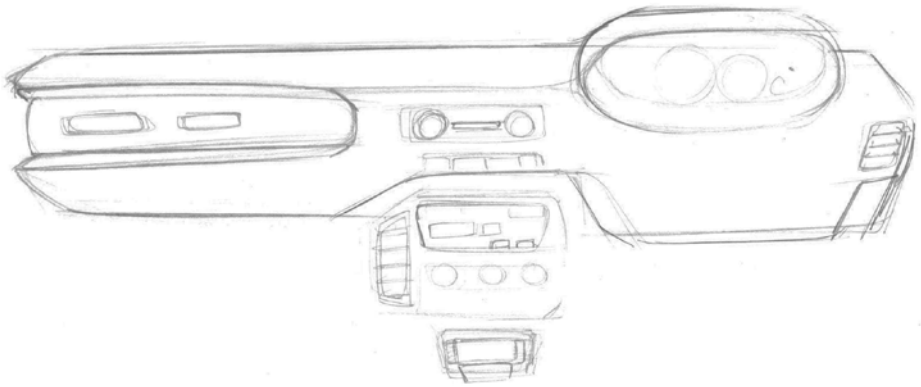


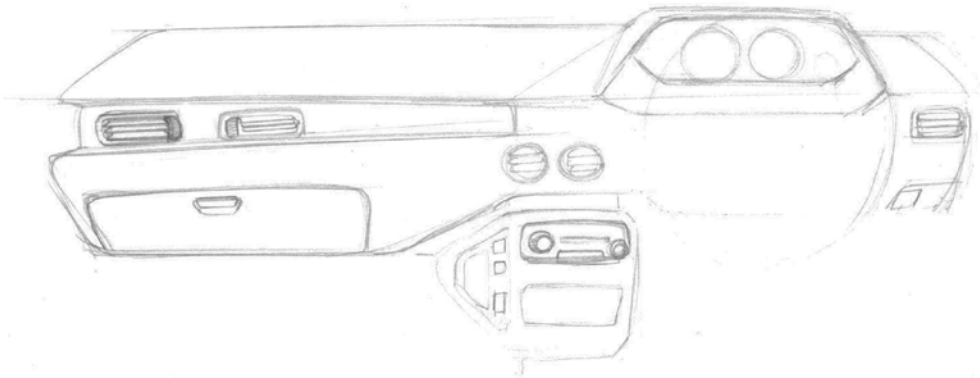


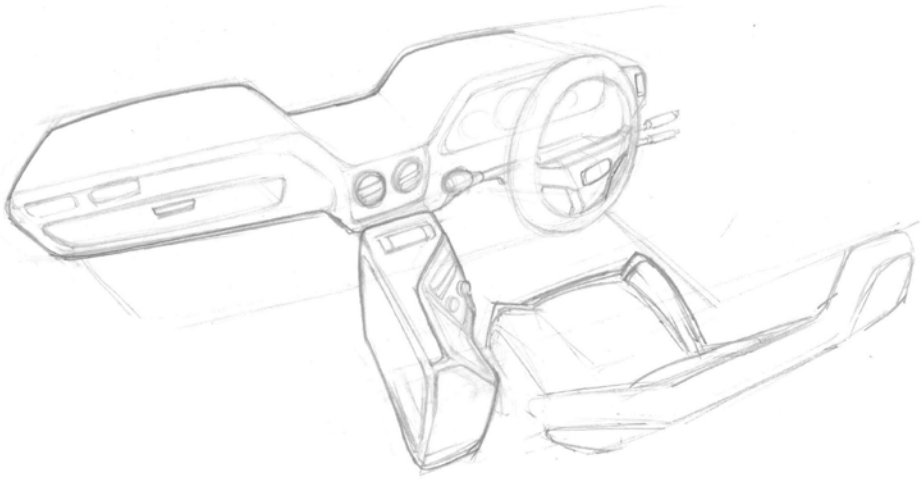




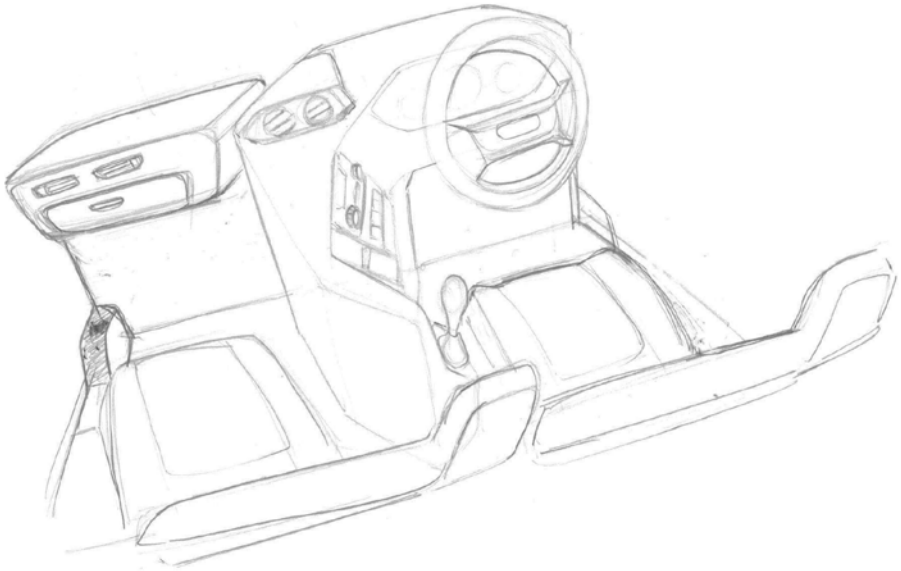




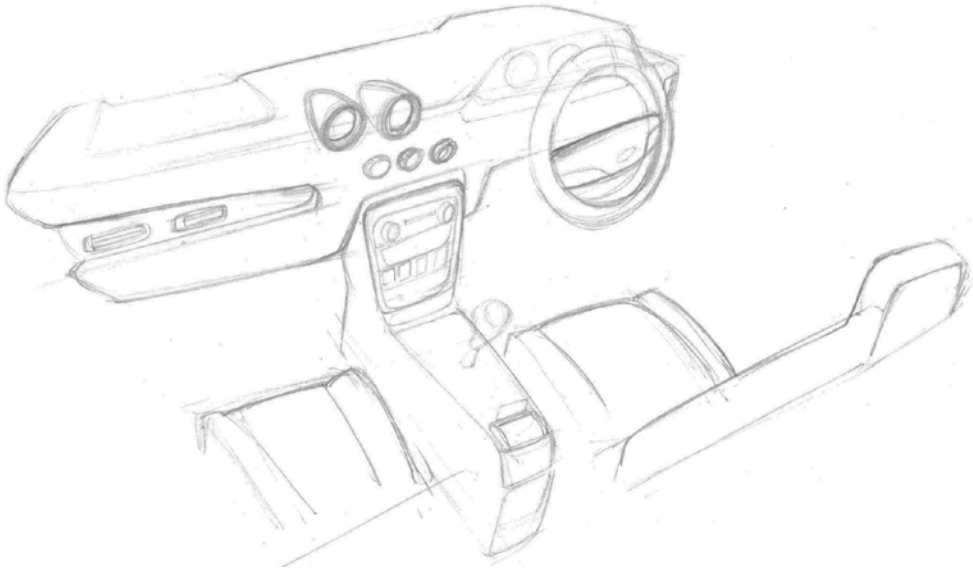


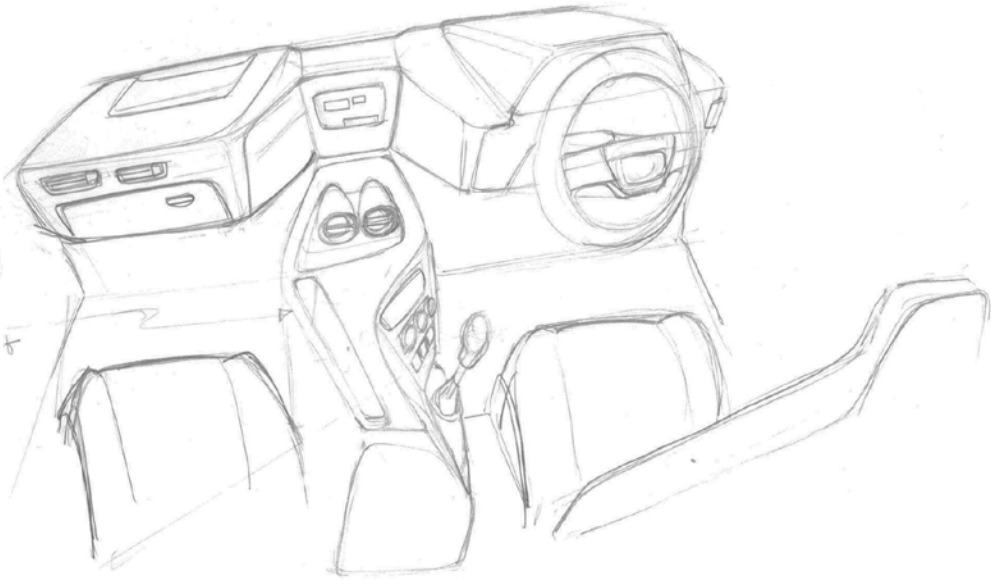


driver centric instrument panel with controls engulfing the driver space

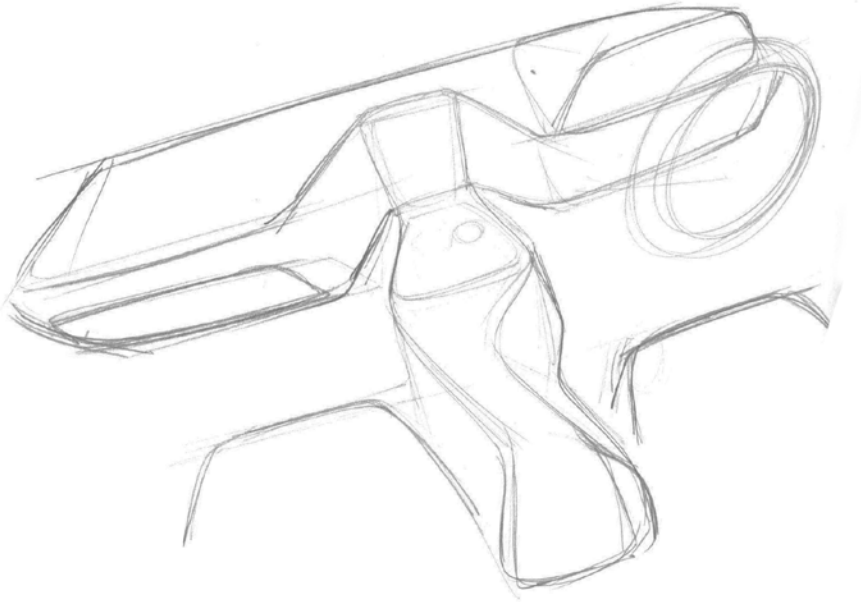


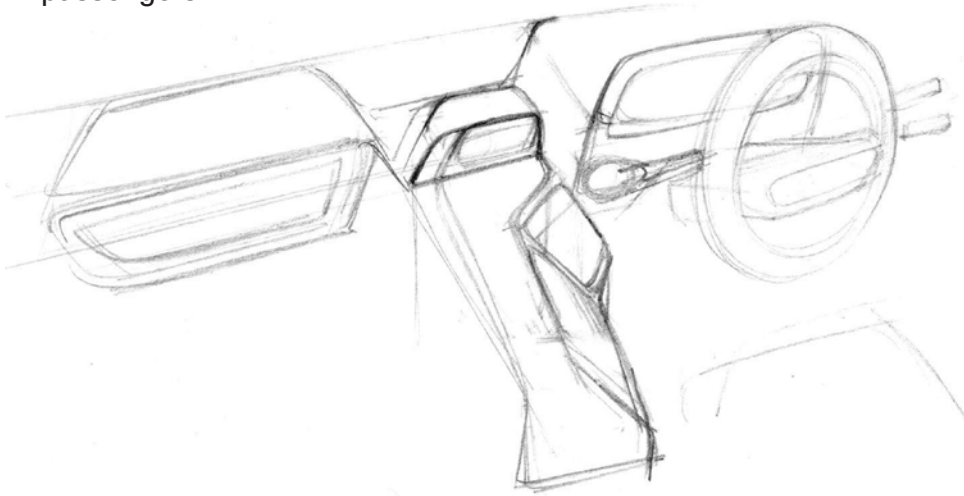
Also exploration for seat form is done as shown. The theme of minimalism and modularity is to be taken forward incase of seat.

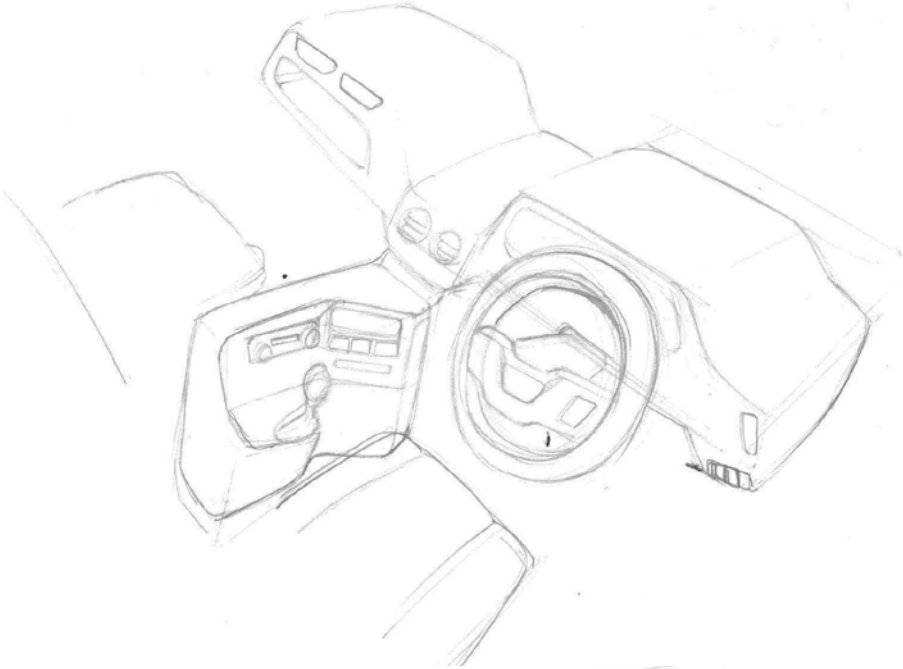


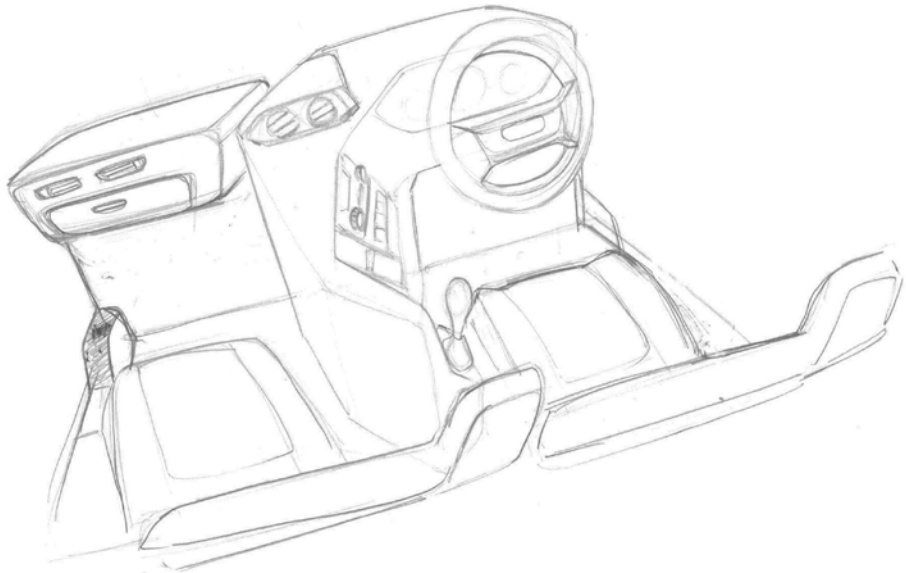


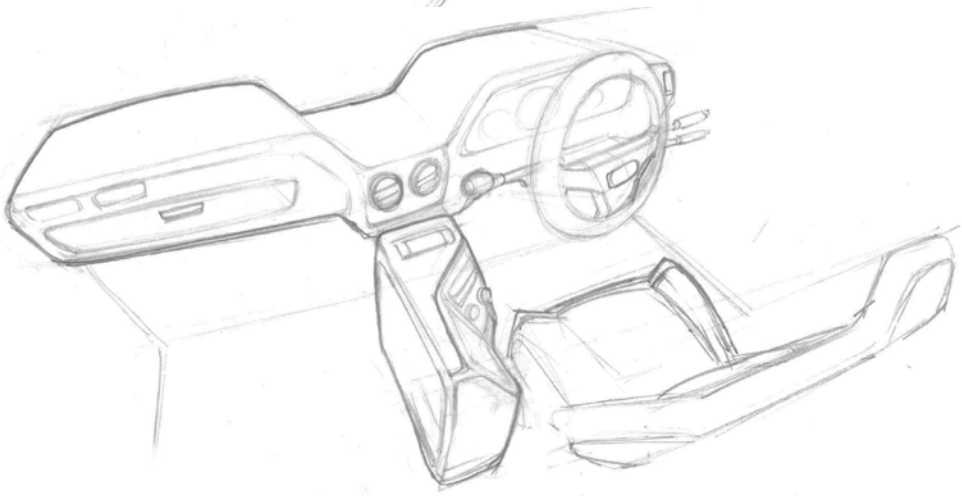
This sketch shows a driver centric dash panel concept. the console also has a magazine slot to keep magazines for passengers.

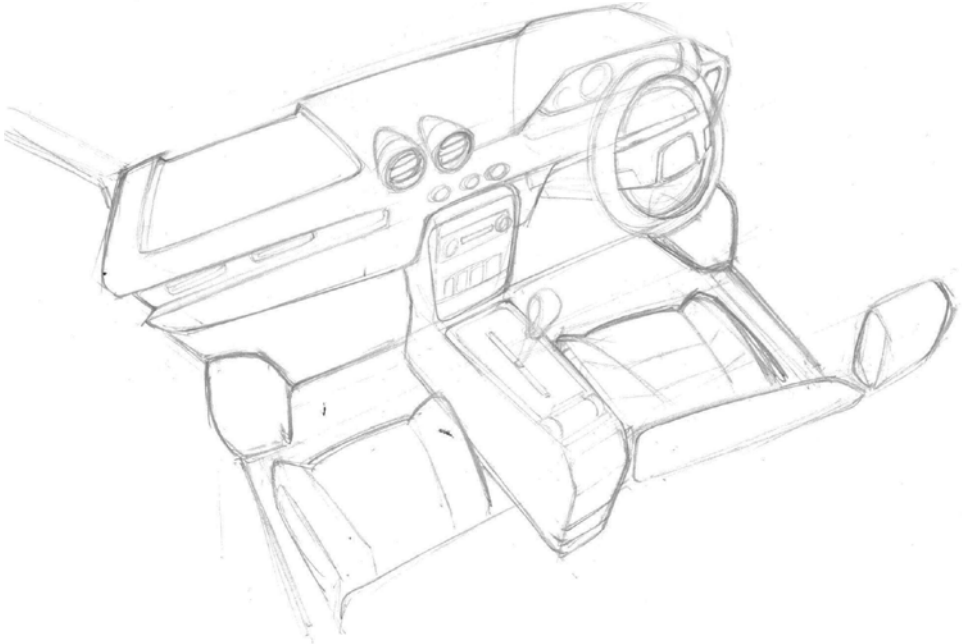


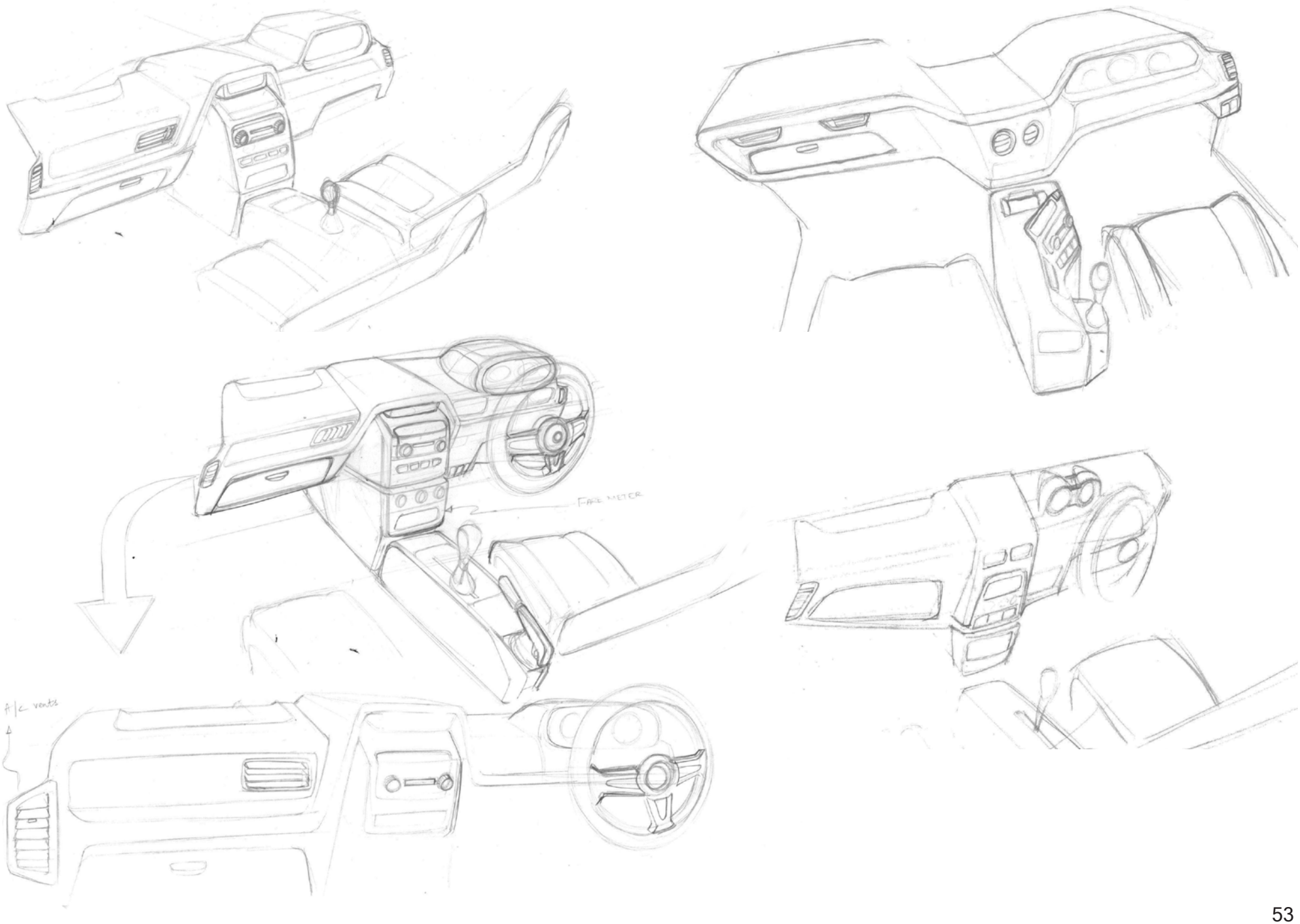


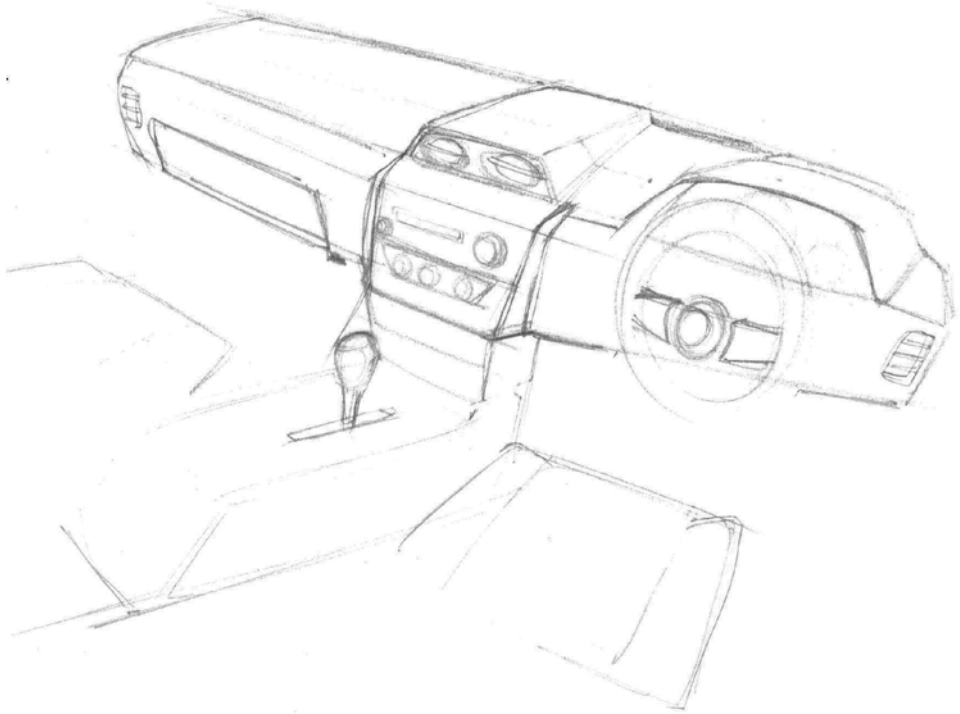


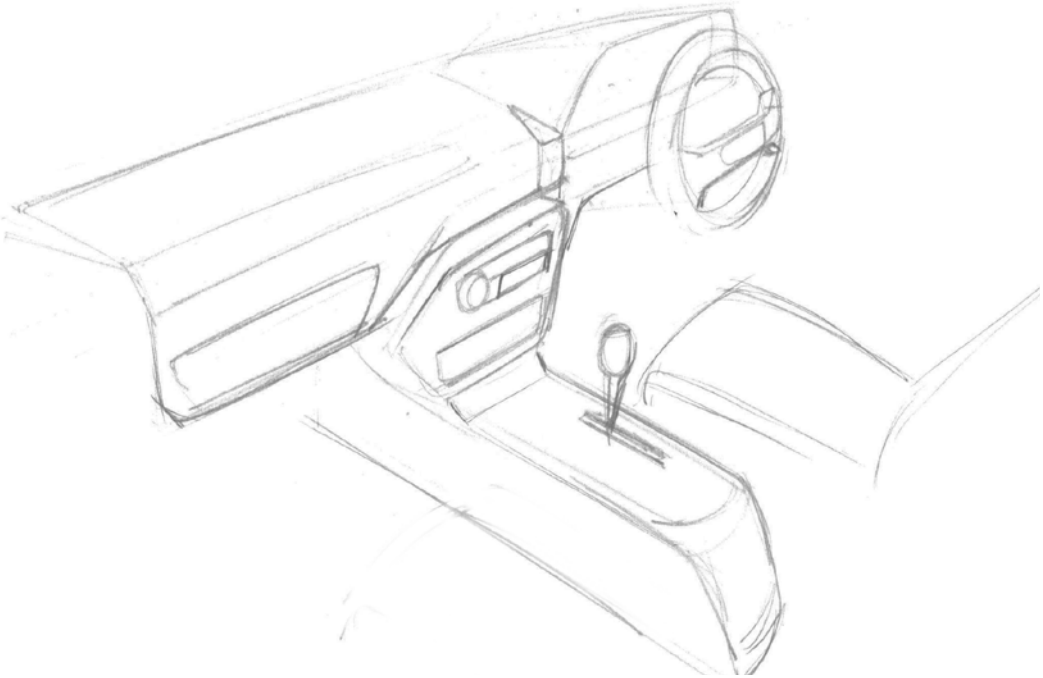


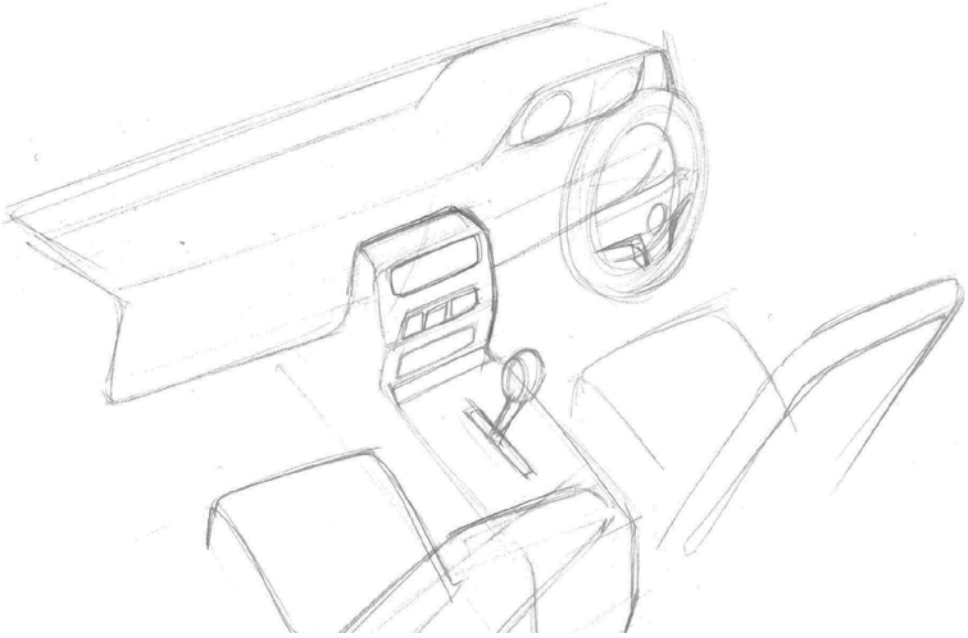


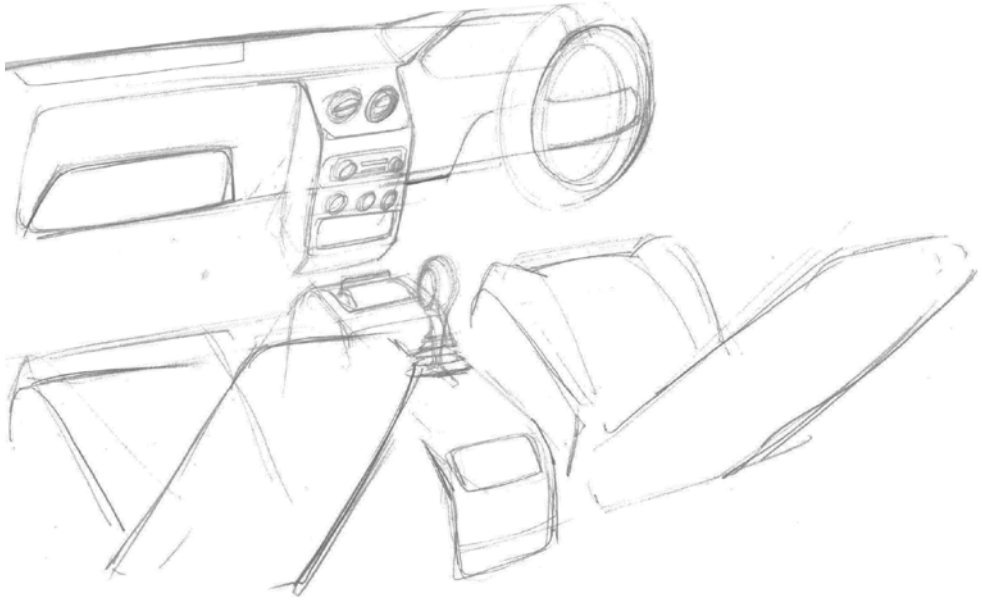


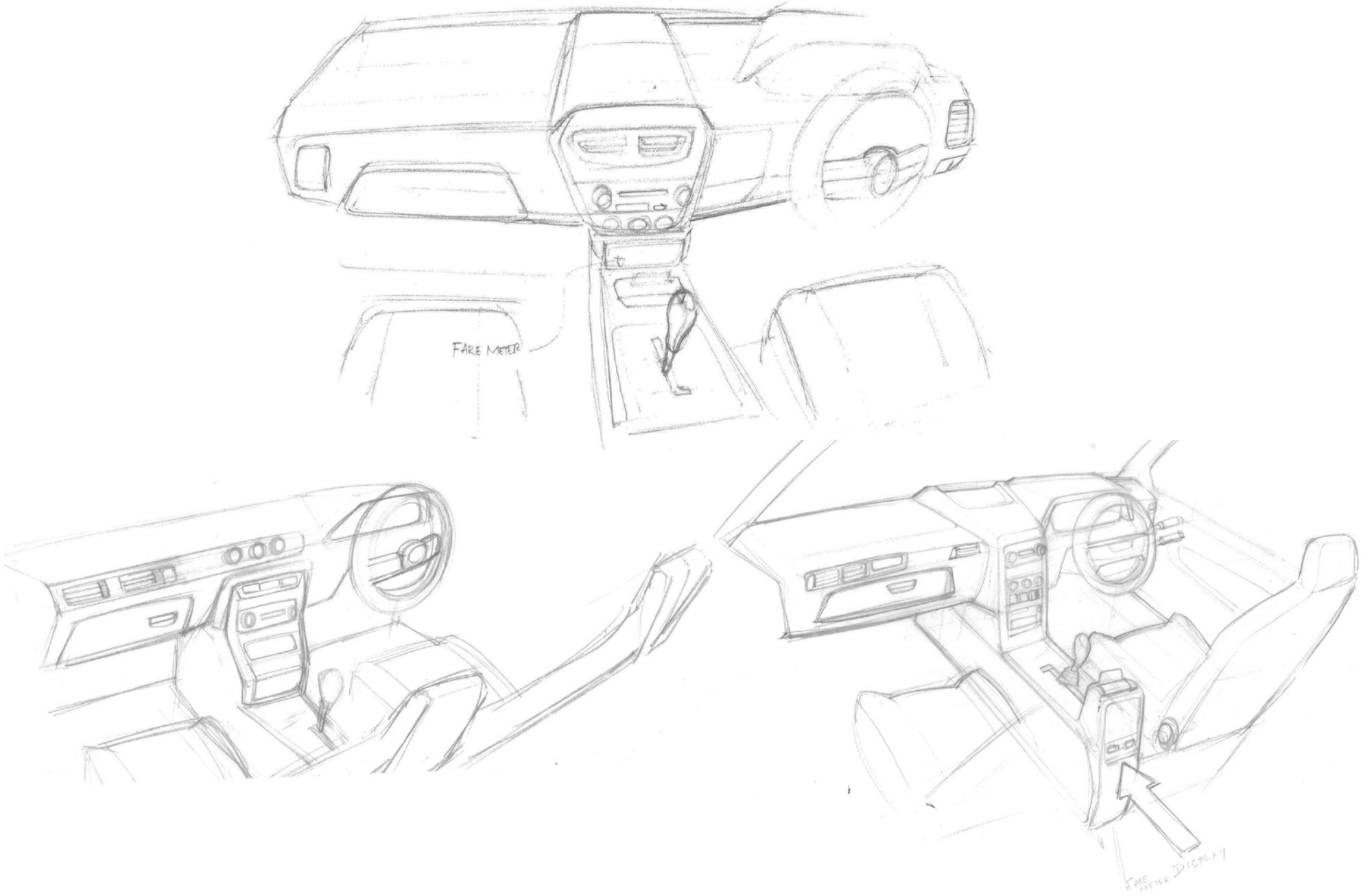

FUEL METER
A/C vents

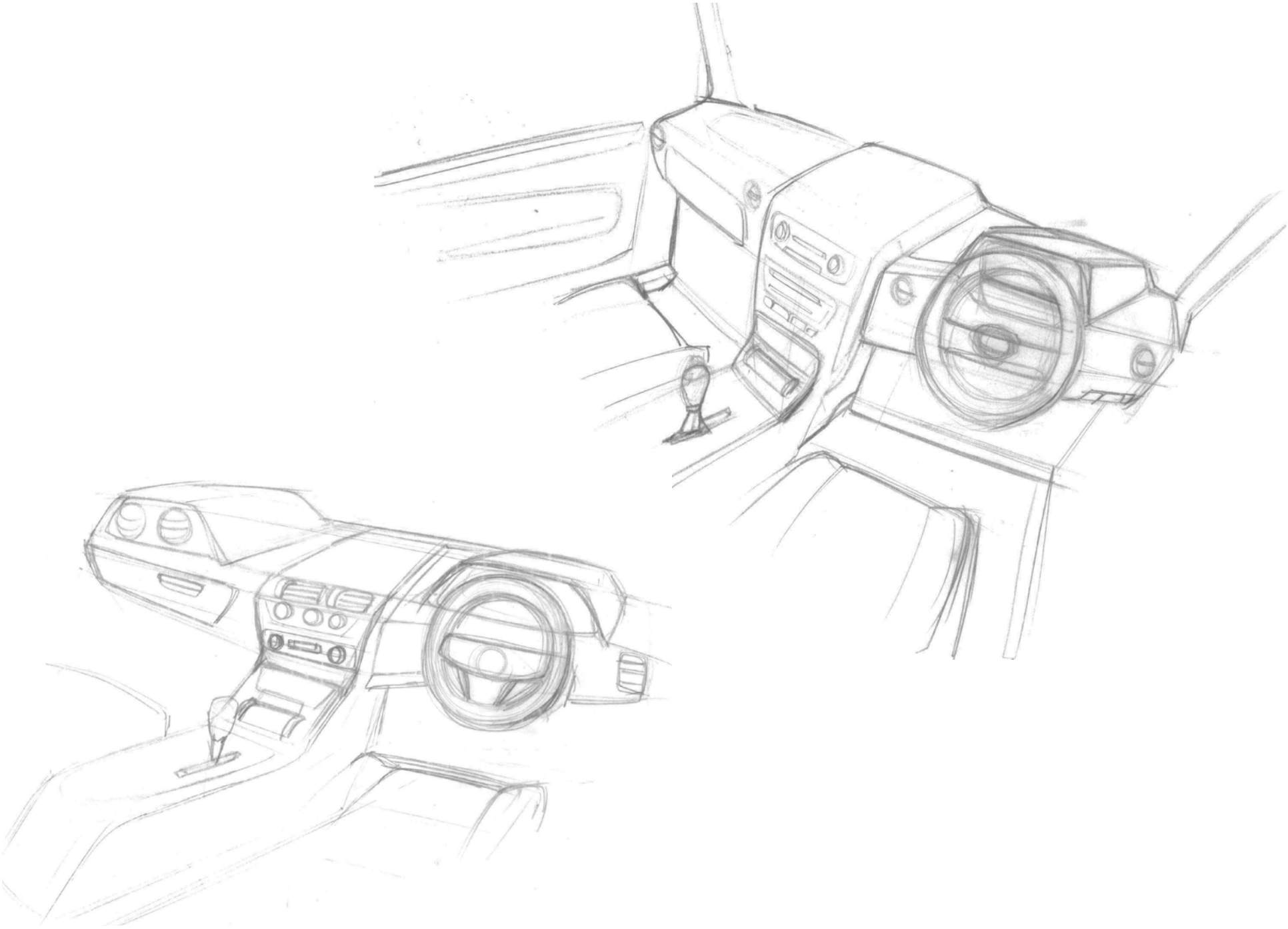








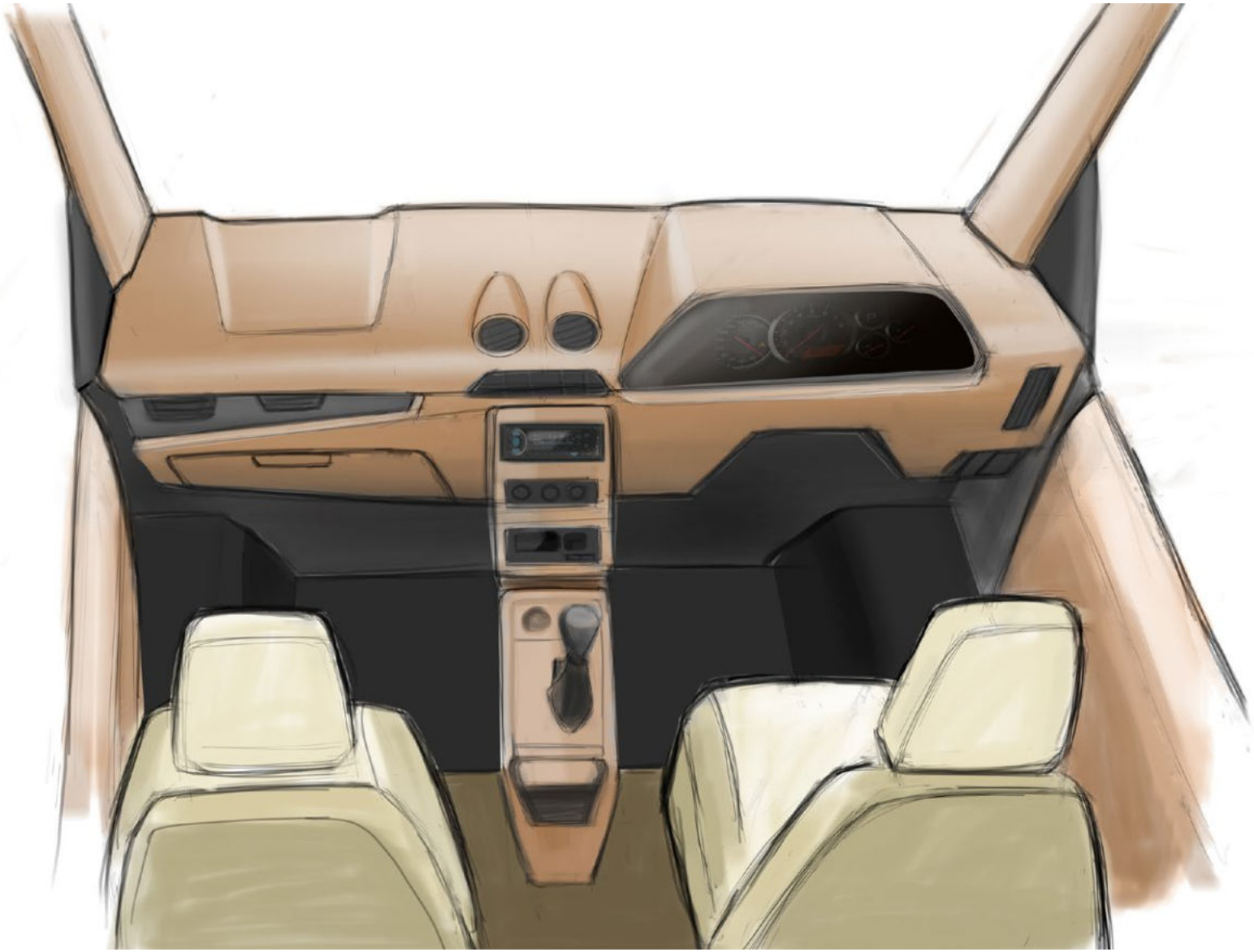

FARE METER
FARE METER DISPLAY

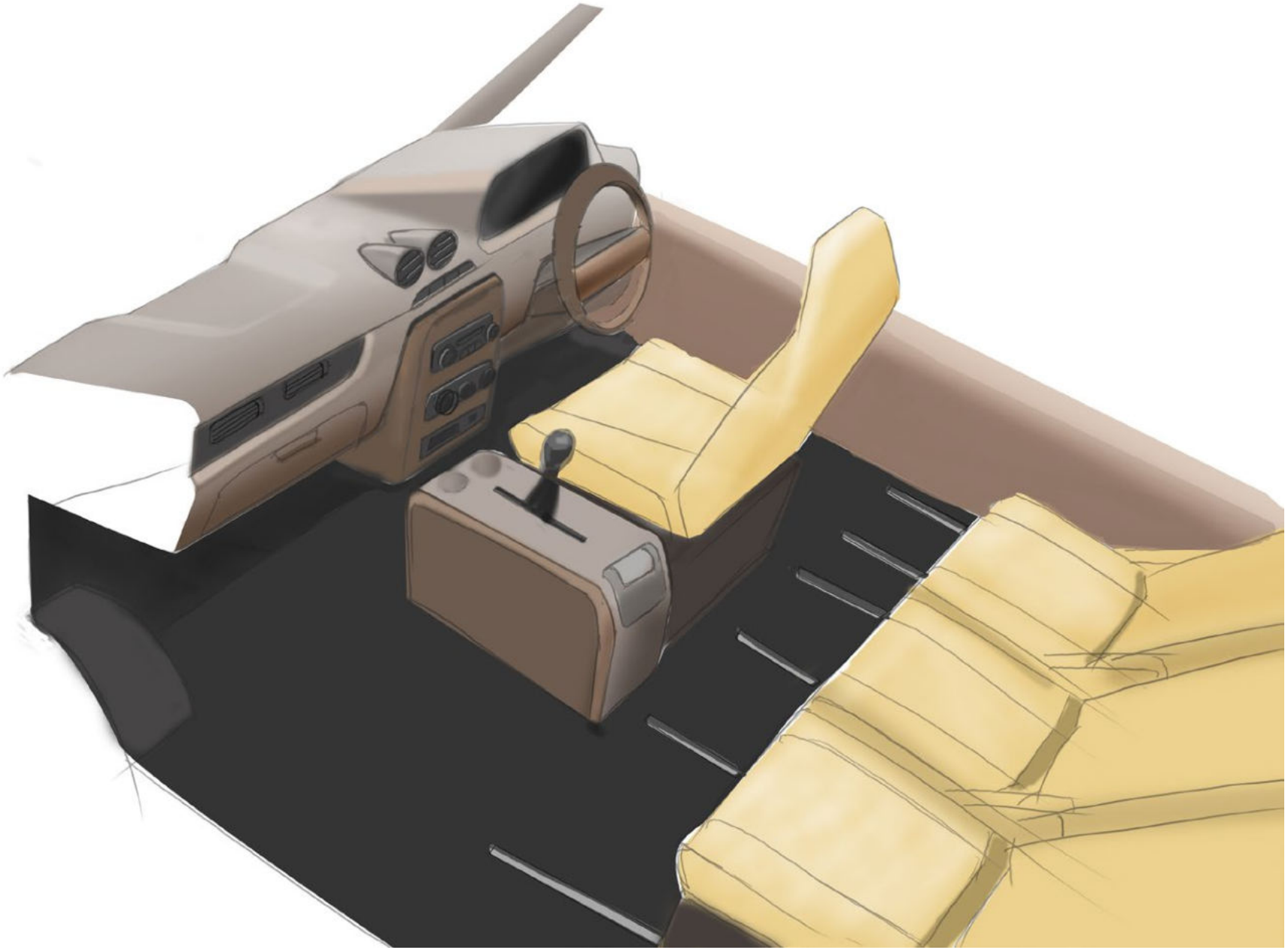


Final Concepts

From the exploration sketches, the following concepts are taken forward as final concepts

Concept 1





Concept 2

In concept 2, the console is removed to give a more clean look The gear lever is near the steering wheel similar to the Fiat taxis.

Concept 3

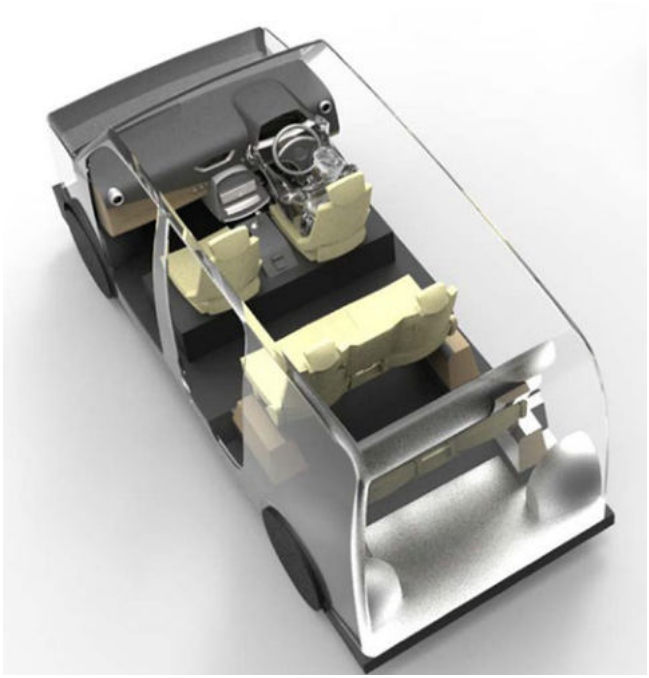
In concept 3, the console iseparates the driver compartment from the co-pasenger. The controls are placed in the console unit facing the driver.

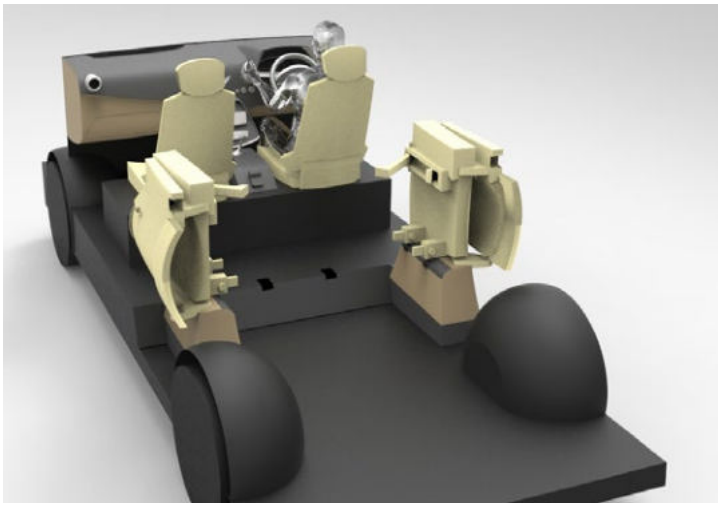
Final Interior concept

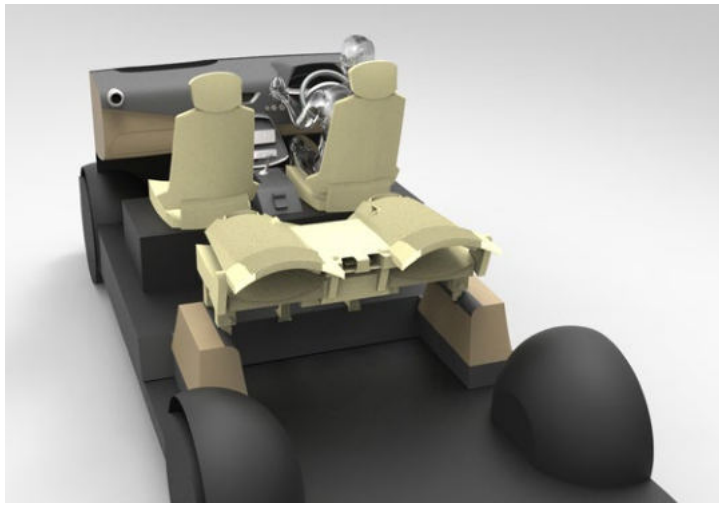
Out of the 3 concept exploations of the instrument panel, concept 3 is chosen for its minimal design and form. The absence of transmission console also makes this design clean and gives a spacious look for the front passengers. It also gives a feel of the current fiat taxis of Mumbai

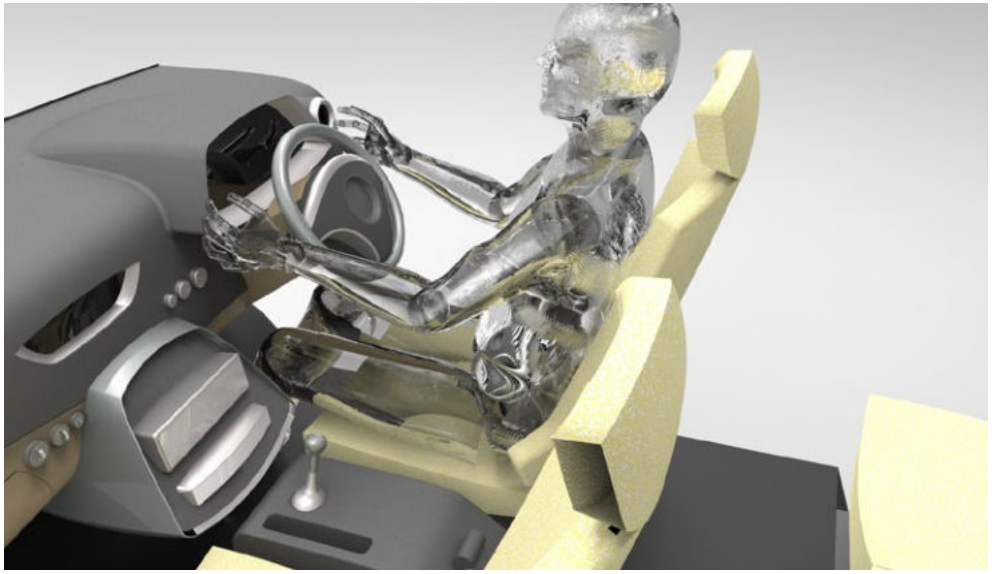
Final Seat folding concept

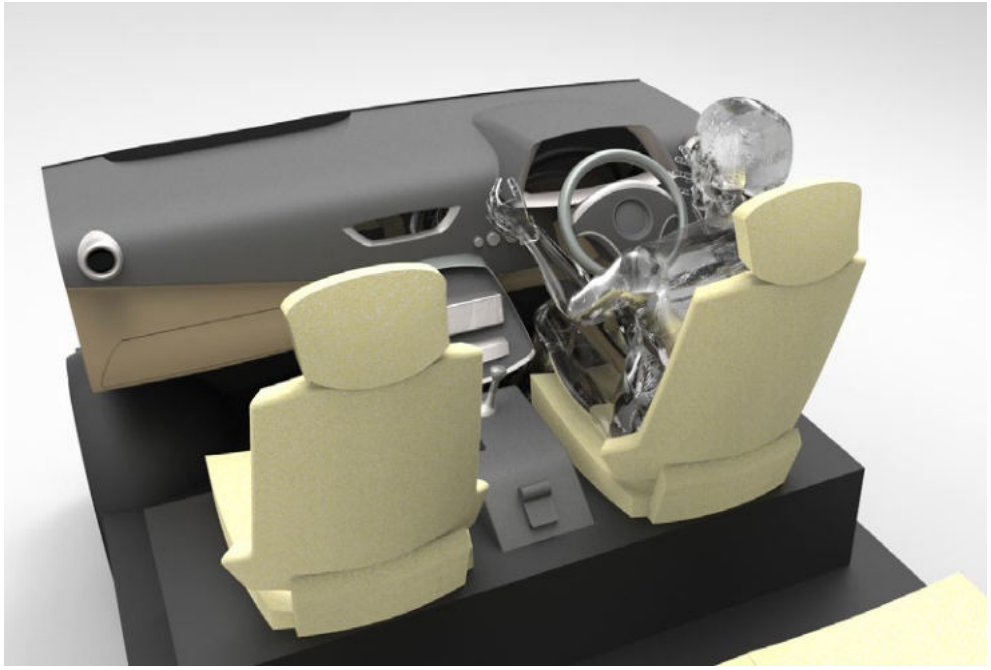
The final rear seat folding concept is shown. The sideways rear seat folding is easier for the user to fold from outside. It also occupies less space and more efficient compared to other explored concepts as shown in the renders.





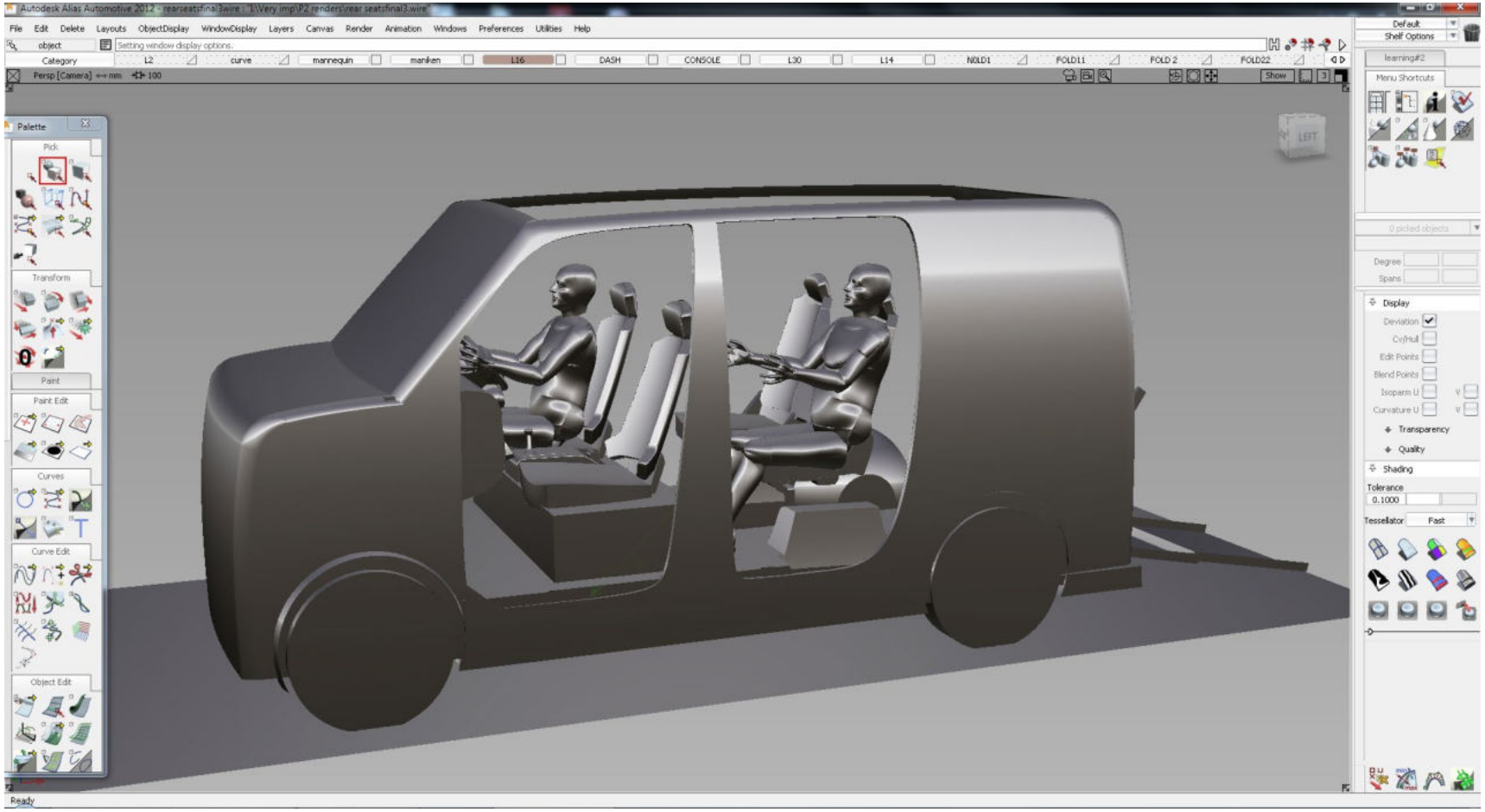






CAD Modeling

The CAD model is made in Alias Automotive with a 96th percentile mannequin as reference.



Physical Model

A physical model of scale 1:6 is made to showcase the interior space and seat folding.

References

IR1 - http://oldphotosbombay.blogspot.in/2013/05/fare-well-to-fiat-taxi-fleet-other.html
IR2 - http://mumbai-magic.blogspot.in/2011/07/advantage-omni.html
IR3 - http://www.motorbeam.com/cars/premier/history-fiat-premier-padmini/
IR4 - http://www.smh.com.au/world/end-of-the-road-for-mumbais-taxis-20130802-2r54e.html
IR5- http://www.firstpost.com/mumbai/why-mumbai-hindu-muslim-lash-in-bandra-over-relationship-102909.html
IR6 - http://numerousadventuresinindia.blogspot.in/2011/08/hows-this-for-air-conditioning-unit.html
IR7- http://janchipchase.com/2010/02/luggage/
IR8 - http://www.team-bhp.com/forum/technical-stuff/136254-questions-about-roof-racks-carriers-bicycle-carriers.html
IR9 - http://www.nytimes.com/slideshow/2012/12/30/automobiles/mumbai-slides-7.html
IR10 - http://mumbai.metblogs.com/2006/01/21/oye-taxi/
IR11- http://www.motorbeam.com/cars/premier/history-fiat-premier-padmini/
IR12 - http://www.disabilityindia.com/html/aprilvol1.html
IR13 - http://www.ctsblog.net/2010/04/mv-1-perfect-solution-for-paratransit.html
IR14 - http://www.theautochannel.com/news/2009/03/23/454275.html
IR15 - http://www.autoedizione.com/most-eco-friendly-gas-fueled-car-soon-made-in-italy/
IR16 - http://www.homefurnitureandpatio.com/TC19-sku/282/All-Things-Cedar-Folding-Chair-Cushion-(Set-of-2).html

The above given refernces are for images referred the web. Other references for sources materials are given in the contents itself.

Futher reference sources -

‘H point - The fundamentals of Car Design & Packaging’ by Stuart Macey & Geaof Wardle

‘Collapsibles - A design album of space saving objects’ by Per Mollerup

Toughest place to be a Taxi driver - a documentary program by BBC two - http://www.bbc.co.uk/programmes/b01r9yw6

http://meterdown.wordpress.com/ - a blog on Indian Taxi drivers