

Project II

Design Of A Three-Wheeler

By

Vaibhav Gadade
02613005

Is approved for the partial fulfillment of the requirements for the
postgraduate degree of

Master of Design in Industrial Design

At

Industrial Design Centre,

Indian institute of technology, Bombay

Guide.....

Chairperson.....

Internal examiner.....

External examiner.....

Acknowledgement

I express my deepest gratitude towards my guide Professor V. P. Bapat for his valuable guidance in this project.

I would also like to thank Professor M. Bhandari for his moral support and guidance

I am also thankful to all the faculty members of IDC who evaluated and gave guidance to me at every stage.

I am also grateful to the IDC staff for their help and assistance in the workshop.

And at last but not the least I am thankful to all my classmates for making project II a wonderful journey.

Abstract

I got interested in this project after I saw a three-wheeled motorcycle concept, which tilted while cornering. A Spanish engineer called Carlos Calleja had designed it. The tilting mechanism was very simple and very viable. He had made a prototype and had tested it successfully.

I immediately imagined an extension of the mechanism to be applied to a small vehicle that can function as an extended two-wheeler and be made more safe and reliable.

There is no automotive product of such kind in India, which can be better and secure with the comfort of a car and the ride and handling of a two-wheeler.

This project is a humble effort to design a new type of a vehicle, which attempts to solve many of the problems associated with the two-wheeler while maintaining the benefits of the same.

Project objectives

To study user behavior
To identify the product need
To design a product according to the user need.
To solve various problems related to a two-wheeler by means of an extended design

Personal objectives

To understand the design process in depth.
To know automobile design basics and design approach.
To improve car sketching and rendering.
To improve perspective skills.

Contents

- 1 Introduction**
 - 1.1 Need for a different vehicle
- 2 Data collection**
 - 2.1 Transportation in Indian cities
 - 2.2 Direction the manufacturers are adopting
 - 2.3 Three wheeler types in general
 - 2.4 Engineering of this vehicle
 - 2.5 Three wheelers of the world
 - 2.6 Three wheelers in India
- 3 User survey**
 - 3.1 Target segment
 - 3.2 Talking to the users
 - 3.3 General studies
- 4 Brief**
- 5 Design process**
 - 5.1 Seating layout
 - 5.2 Seat adjustability ideas
 - 5.3 Ergonomics
 - 5.4 Technical specifications
- 6 Concept generation**
 - 6.1 Type I, Handsomely Aggressive
 - 6.2 Type II, Techno
 - 6.3 Type III, Safe
- 7 Concept Evaluation**
- 8 Final Concept**
- 9 Work on Final Concept**

Bibliography

1. Introduction

1.1 Need for a different vehicle.

Worldwide, the benefits and liabilities of private automobiles are being more closely scrutinized. Cars have been targeted because of three offensive traits: their appetite for fuel, the traffic congestion they cause, and the pollution they produce ... After nearly 20 years of intensive efforts to economize or find new solutions, viable alternatives to gasoline-fueled private cars remain elusive ... the machine itself may need a holistic renewal, a wholesale overhaul, in order to remain the central component of our modern society's transportation system.

A fresh direction will be needed to move vehicle designers, manufacturers, and consumers away from the idea of multi-purpose, high-performance cars for routine local trips, and toward the concept of specialized vehicle types for urban and commuting travel.

Are downsized urban cars and commuter cars marketable? Is a three-wheel vehicle safe? Will prestige, styling, and comfort need to be compromised for energy-efficiency? Is it possible to capture the imagination of consumers with small, mission-specific automobiles? These are some of the questions to be dealt with.



2. Data Collection

2.1 Transportation in Indian cities

Of late the economic growth of India has been substantial. The buying power of the consumer has increased and so has the population in the cities due to unparalleled migration. Simultaneously the small car segment in India is booming, with all major players having a vehicle in that class.

Also the two-wheeler market has seen a tremendous growth in the past few years, especially the motorcycle segment. Slowly the two-wheeler is becoming a regular household commodity, and the idea of owning a car as a luxury item is disappearing. And it is not because people don't use public transport system. Nor is the public transport system inefficient, but it has its fallouts. In a city like Bombay there are a lot of people who still greatly depend on the local trains and BEST buses for their daily travel. But then they are only point-to-point services and to get to the railway station from the house a lot of people use two wheelers. The same two-wheeler is then used as an extended family vehicle for everyday shopping and running household tasks and even to transport the entire family, especially by the lower middle class. Clearly, a two-wheeler is over utilized.

The fallout of this situation is the increasing no of two wheeler accidents in the country. The fact is that a two wheeler as a machine was designed for pleasure riding, to get the high speed, wind in the face experience. A vehicle that responds to the body movements and gives the adrenaline rush. But as the concept became more successful over the world, India adopted a downsized version of the same not for pleasure purposes but for daily use. The engine capacity was reduced, the fuel economy was increased and the vehicle was made more affordable. But at the same time the risks associated with riding the wheels was not greatly reduced. The speed came down but then again the issues of skidding, slipping and balancing the vehicle in critical situations remained. Sales grew, so did the no of accidents.

The upper middle class has a car, which is mostly underutilized. Just a single person or at the most two at a time use it to get around town. With the oil prices soaring, to use the car for daily office commuting is again a costly affair. It should not be encouraged either, as the road infrastructure is not that equipped to handle such heavy traffic.

All said and done, the public transport system will stay for long and should, for better. The need of the hour is to sell a concept that is intermediate to a two-wheeler and a car. A concept that is more safe and less polluting and efficient in terms of utilization.



2.2. Direction the manufacturers are adopting.

The white flag is out in the bike market. Squeezing margins and increasing costs are forcing bike makers to bury the hatchet. So, no more cut-throat price wars.

The new mantra higher priced models that also mean better profits. Manufacturers are now trying to steal a few tricks from the marketing books of high profile car makers and launch newer and snazzy variants of their ageing bikes to step up the excitement.

This, market watchers say, is a clear departure from the strategy employed by most bike makers at the beginning of last year when stripped down models were in vogue. "You cannot go below a certain price point. The base price for a motorcycle has already come to a low of Rs 25,000. I don't see it going down any further," says HeroHonda senior V.P. (marketing) Atul Sobti.

He adds that margins are tight and manufacturers are now looking at how best to maximize returns while pushing demand. "A consensus now seems to be emerging on looking at executive models as the next growth segment"

The shift in consumer preference and buying habits is just aiding this change in strategy. "Buyers are now looking for more in their bikes too. As in the car market, they also want an individual stamp on their vehicles. And, they don't mind spending a little more for that little extra," adds Paresh Vais, a consultant with McKinsey.

The result: LML recently unveiled 15 different variants of its fast-seller Freedom. Hero Honda is experimenting with newer variants on its Splendor and Dawn.



Bajaj Auto is rolling out spruced up models of its C "This is the only way forward. We have to look at how to continue to broaden the market while keeping margins intact. The price points have bottomed out and now manufacturers are increasingly looking at other options," says LML senior veep Rakesh Jayal. The options include offering zero per cent finances as in the car market and launching models at slightly higher price points.

The rush for deluxe models also stems from the fact that sale of the basic 100cc commuter bike has plateaued after almost three years of unstoppable growth.

Clearly it indicates that the big players are ready to take the chance. This is I believe the right time for them to come out and experiment with a radically new concept and pave the way for a new breed of vehicles.



2.3 Three wheeler types in general

The idea of smaller, energy-efficient vehicles for personal transportation seems to naturally introduce the three wheel platform. Opinions normally run either strongly against or strongly in favor of the three wheel layout. Advocates point to a mechanically simplified chassis, lower manufacturing costs, and superior handling characteristics. Opponents decry the three-wheeler's propensity to overturn. Both opinions have merit. Three-wheelers are lighter and less costly to manufacture. But when poorly designed or in the wrong application, a three wheel platform is the less forgiving layout. When correctly designed, however, a three wheel car can light new fires of enthusiasm under tired and routine driving experiences. And today's tilting three-wheelers, vehicles that lean into turns like motorcycles, point the way to a new category of personal transportation products of much lower mass, far greater fuel economy, and superior cornering power.

Inherently Responsive Design

Designing to the three-wheeler's inherent characteristics can produce a high-performance machine that will out corner many four-wheelers. A well designed three-wheeler is likely to be one of the most responsive machines one will ever experience over a winding road.

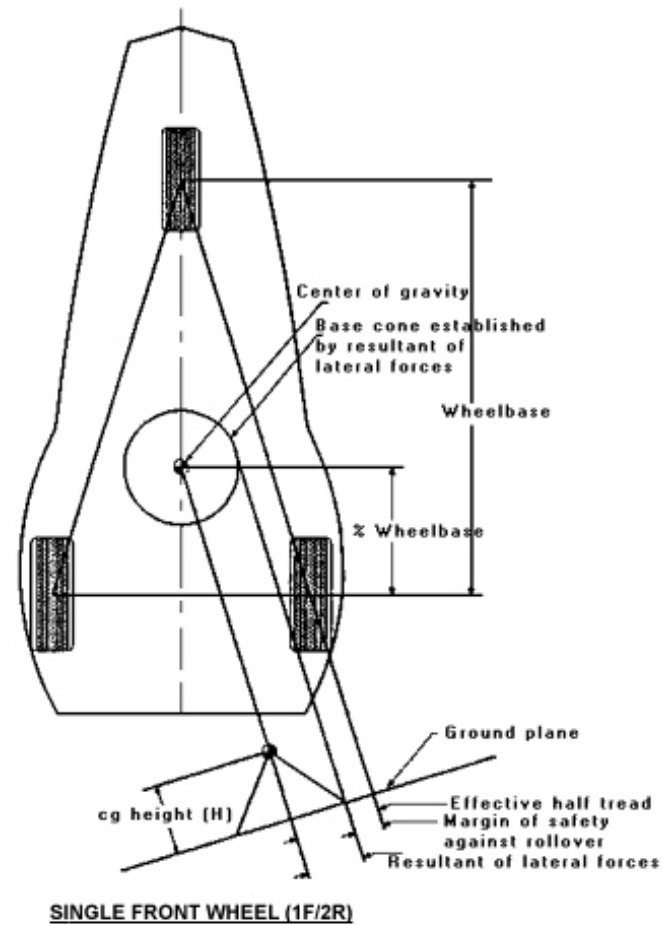
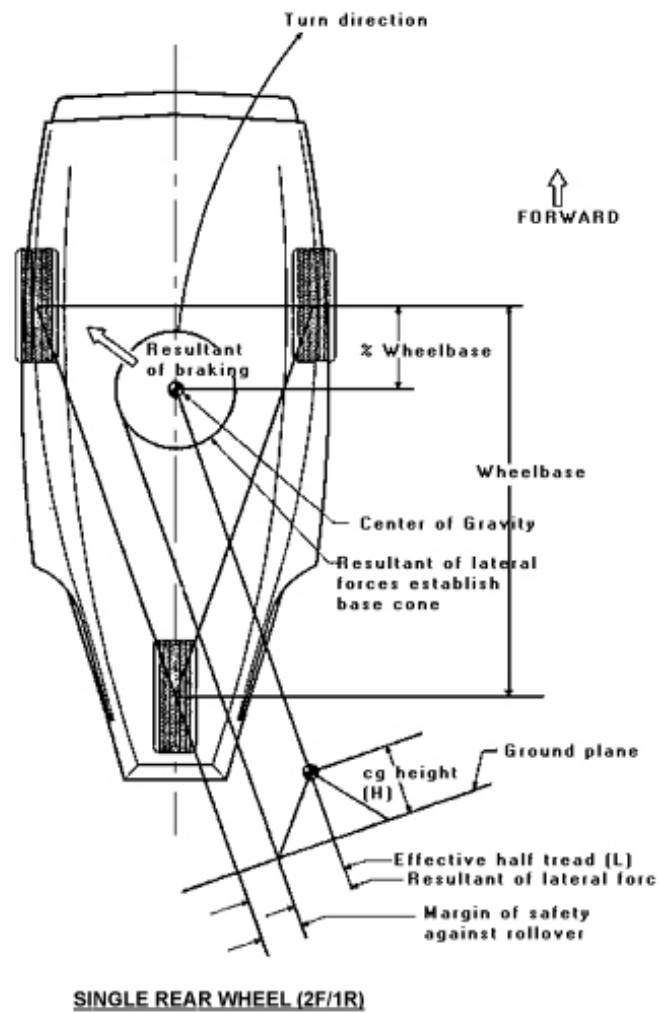
Quick steering response has nothing to do with the number of wheels or how they are configured. It is a byproduct of reduced mass and low polar moment of inertia. A typical three-wheeler is lighter and has approximately 30 percent less polar moment than a comparable four wheel design.

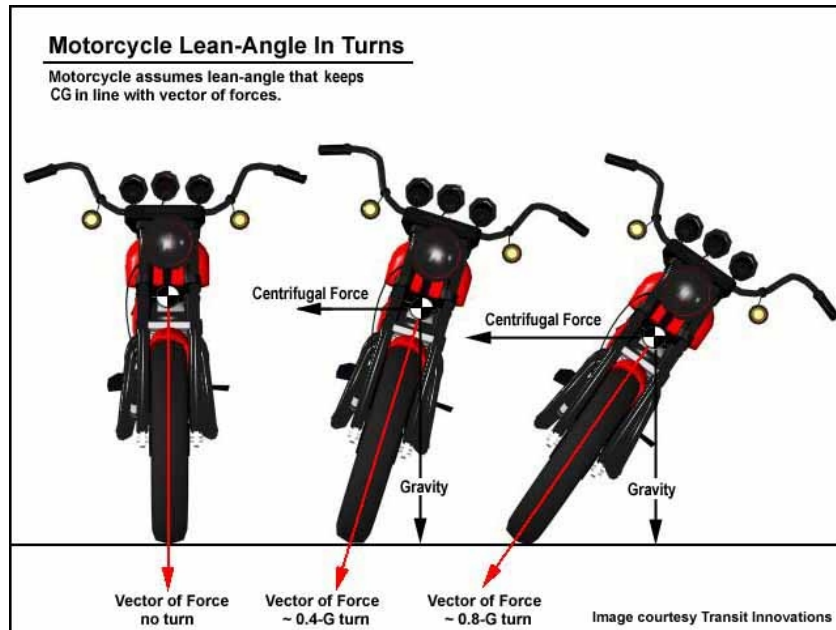
Rollover Stability of Conventional Non-Tilting Three-Wheeler

A conventional, non-tilting three wheel car can equal the rollover resistance of a four wheel car, provided the location of the center-of-gravity (cg) is low and near the side-by-side wheels. Like a four wheel vehicle, a three-wheeler's margin of safety against rollover is determined by its L/H ratio, or the half-tread (L) in relation to the cg height (H). Unlike a four-wheeler, however, a three-wheeler's half-tread is determined by the relationship between the actual tread (distance between the side-by-side wheels) and the longitudinal location of the cg, which translates into an "effective" half-tread. The effective half-tread can be increased by placing the side-by-side wheels farther apart, by locating the cg closer to the side-by-side wheels, and to a lesser degree by increasing the wheelbase. Rollover resistance increases when the effective half-tread is increased and when the cg lowered, both of which increase the L/H ratio.

A simple way to model a three-wheeler's margin of safety against rollover is to construct a base cone using the cg height, its location along the wheelbase, and the effective half-tread of the vehicle. Maximum lateral g-loads are determined by the tire's friction coefficient. Projecting the maximum turn-force resultant toward the ground forms the base of the cone. A one-g load acting across the vehicle's cg, for example, would result in a 45 degree projection toward the ground plane. If the base of the cone falls outside the effective half-tread, the vehicle will overturn before it skids. If it falls inside the effective half-tread, the vehicle will skid before it overturns.

COMPARISON OF 2F/1R AND 1F/2R LAYOUTS





The single front wheel layout naturally oversteers and the single rear wheel layout naturally understeers. Because some degree of understeer is preferred in consumer vehicles, the single rear wheel layout has the advantage in this department. Another consideration is the effect of braking and accelerating turns. A braking turn tends to destabilize a single front wheel vehicle, whereas an accelerating turn tends to destabilize a single rear wheel vehicle. Because braking forces can reach greater magnitudes than acceleration forces (maximum braking force is determined by the adhesion limit of all three wheels, rather than two or one wheel in the case of acceleration), the single rear wheel design has the advantage on this count as well. Consequently, the single rear wheel layout is usually considered the superior platform for a high-performance consumer automobile. But much depends on the details of the design.

Tilting Three-Wheelers (TTWs)

Tilting three-wheelers, vehicles that lean into turns like motorcycles, offer increased resistance to rollover and much greater cornering power - often exceeding that of a four wheel vehicle. And designers are no longer limited to a wide, low layout in order to obtain high rollover stability. Allowing the vehicle to lean into turns provides a much greater latitude in the selection of a cg location and the separation between opposing wheels.

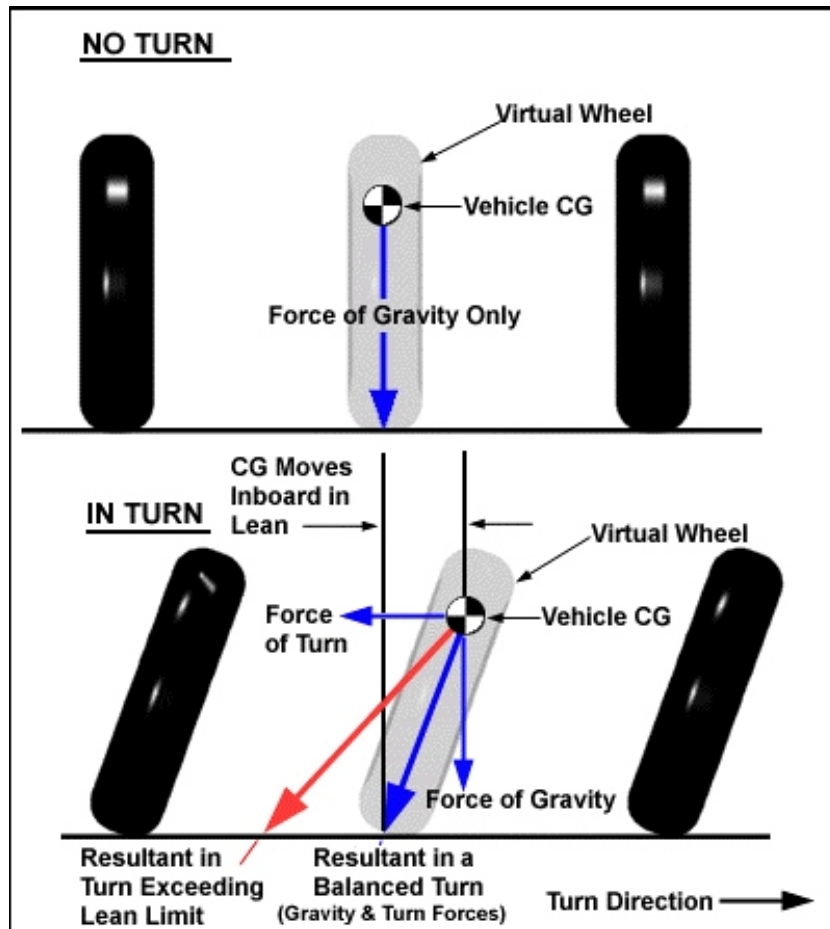
Consider that a motorcycle has no side-by-side wheels, yet it does not overturn when going around corners. A motorcycle negotiates turns by assuming a lean angle that balances the vector of forces



Three and four wheel vehicles can also be made to lean into turns. But with tilting vehicles equipped with side-by-side wheels, other physical and geometric realities come into play. For example, a vehicle having a wide body may contact the ground even at moderate lean angles, which will make it impossible to stay in balance with turn forces at the upper extremes. In addition, the greater the separation between the side-by-side wheels, the greater the wheel movement at equivalent lean angles. The movement of the side-by-side wheels can become excessive even at relatively small angles of lean in vehicles having a track approaching that of conventional automobiles. And the mechanical challenges of accommodating steering, bounce, and tilting, along with the angular limitations of CV joints on powered axles, places additional limitations on the lean angle of tilting multi-track vehicles. As a result, much of the recent work on tilting suspension systems has concentrated the three wheel platform. The [Project 32 Slalom](#) (1F2R) and the [Mercedes F300 Life-Jet](#) (2F1R) are excellent examples of modern tilting three wheel designs.

Free-Leaning versus Active Lean Control

Tilting three-wheelers can be free-leaning and controlled by the rider, just like ordinary motorcycles. However, if the mechanical limit of lean is less than is necessary to balance turn forces under all possible conditions, then some form of active (forced) lean control must be used to account for turns that exceed the lean limit. This is usually accomplished by hydraulic or electro-mechanical actuators operating on signals from an electronic control unit (ECU). Normally, the ECU processes signals from sensors that monitor lateral acceleration, vehicle yaw and lean angle, steering angle, and other relevant factors, then provides control output to the lean



Rollover Threshold of TTWs

The rollover threshold of a TTW is determined by the same dynamic forces and geometric relationships that determine the rollover threshold of conventional vehicles, except that the effects of leaning become a part of the equation.

As long as the lean angle matches the vector of forces in a turn, then, just like a motorcycle, the vehicle has no meaningful rollover threshold. In other words, there will be no outboard projection of the resultant in turns, as is the case with non-tilting vehicles. In a steadily increasing turn, the vehicle will lean at greater and greater angles, as needed to remain in balance with turn forces. Consequently, the width of the track is largely irrelevant to rollover stability under free-leaning conditions. With vehicles having a lean limit, however, the resultant will begin to migrate outboard when the turn rate increases above the rate that can be balanced by the maximum lean angle. Above lean limit, loads are transferred to the outboard wheel, as in a conventional vehicle.

The behavior of an all-leaning-wheels TTW can be explained in terms of a virtual motorcycle wheel located between the two opposing real wheels.

In a balanced turn, the resultant remains in line with the virtual motorcycle wheel. But in turns taken above the limit of lean, the resultant projects to the outside of the virtual wheel (vehicle centerline), according to the magnitude of turn forces in excess of those at lean limit. It's also important to note that the vehicle cg moves inboard as the vehicle leans into a turn.

When calculating the rollover threshold of a TTW having a lean limit, one must consider the inboard migration of the cg due to the angle



of lean, the outboard projection of forces at the friction limit of the tires, and the traditional relationships between the cg height, the effective half-tread (at lean limit), and the wheelbase.

TWs With Only One Leaning Wheel

Another interesting category of TWs includes vehicles having only a single leaning wheel, such as the Lean Machine developed at General Motors in the late '70s and early '80s. GM's Lean Machine is a 1F2R design wherein the single front wheel and passenger compartment lean into turns, while the rear section, which carries the two side-by-side wheels and the powertrain, does not lean. The two sections are connected by a mechanical pivot.

The rollover threshold of this type of vehicle depends on the rollover threshold of each of the two sections taken independently. The non-leaning section behaves according to the traditional base cone analysis. Its length-to-height ratio determines its rollover threshold. Assuming there is no lean limit on the leaning section, it would behave as a motorcycle and lean to the angle necessary for balanced turns. The height of the center of gravity of the leaning section is unimportant, as long as there is no effective lean limit.

The rollover threshold of a vehicle without an effective lean limit will be largely determined by the rollover threshold of the non-leaning section. But the leaning section can have a positive or negative effect, depending on the elevation of the pivot axis at the point of intersection with the centerline of the side-by-side wheels. If the pivot axis (the roll axis of the leaning section) projects to the axle centerline at a point higher than the center of the wheels, then it will reduce the rollover threshold established by the non-leaning

section. If it projects to a point that is lower than the center of the side-by-side wheels, then the rollover threshold will actually increase as the turn rate increases. In other words, the vehicle will become more resistant to overturn in sharper turns. If the pivot axis projects to the centerline of the axle, then the leaning section has no effect on the rollover threshold established by the non-leaning section.

In vehicles of this type that have a limit on the degree of lean, rollover threshold would be calculated as with an all-tilting-wheels vehicle operating at or above its limit of lean. In this case, the cg height of the leaning section would have an important effect on the behavior of the vehicle as a whole. Once a tilting vehicle reaches its limit of lean and locks against its limit stops, it can be analyzed as a non-tilting vehicle having the geometric configuration of the tilting vehicle at lean limit.

The front-to-rear incline of the roll axis of the leaning section is an important consideration with this type of vehicle. With free-leaning designs, the roll axis should project to the ground at the front (leaning) wheel. This is done to avoid a roll/lean couple, which could result in roll inputs during acceleration and braking. This is not as important in vehicles equipped with active lean control.



2.4 Engineering of this vehicle

The inspiration for this project was a wonderful mechanism designed by a Spanish guy Carlos Calleja, an engineering student at the Granada University.

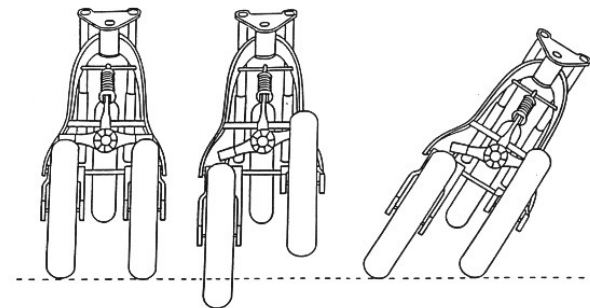
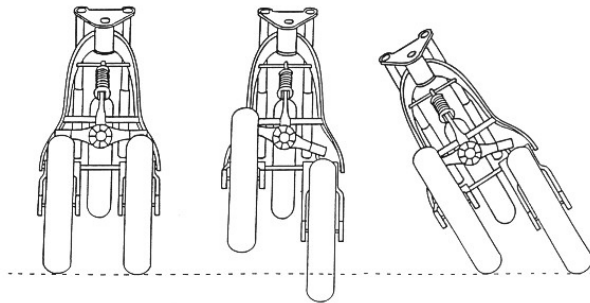
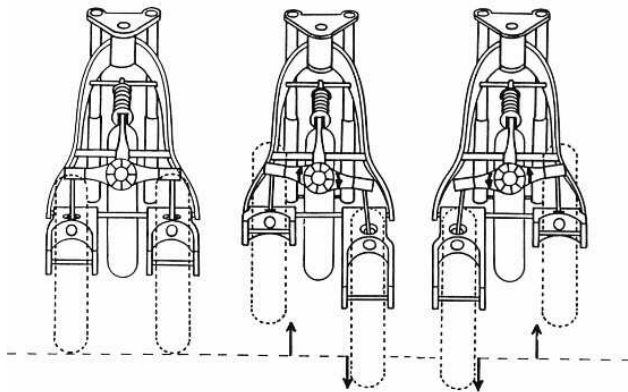
What Carlos has done is to design an elegantly simple solution for the task of allowing two side-by-side rear wheels to lean like a motorcycle and react to bumps independently.

There are many possible solutions to this problem, several of which could be made to work satisfactorily, but it is the simplicity and low component count of the Calleja solution that particularly appealing.

To prove his ideas and demonstrate the principle to prospective investors or manufacturers, Carlos joined forces with his father, also called Carlos, to construct a three-wheeled motorcycle prototype.

The resulting machine is very impressive and the standard of construction is superb.





Carlos was not trying to make a better motorcycle as such, this machine was built to test and demonstrate an idea that could be applied to fuel and space efficient city vehicles. To that extent it succeeds brilliantly, applied to a machine like the BMW C1 it would go a long way to remove the objections aimed at two wheeled alternatives to cars. The lean lock combined with it's uncanny slow speed stability would endear it to those worried about their own perceived lack of balance skills. Who knows, this might just be the way to attract more converts to "mainstream" motorcycling.

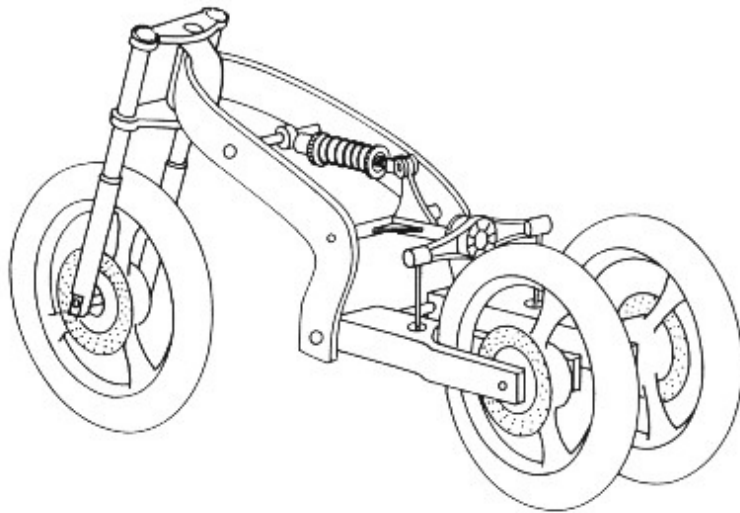
Details of the mechanism:

Narrow Vehicle Technology

Operation principle. The stability in curves is obtained by enhancing the lateral tilting of the vehicle. For This, each rear wheel must allow an up or down motion; each of these motions is opposite to the other but to the same extent.

Technical solutions. By means of "ball-and-socket" joints, two connecting rods connect the balancer with the rear swinging forks (arms), converting the balancer's rotation to an up-and-down motion. The balancer's axle allows an oscillation motion controlled by a shock absorber, that provides the rear suspension of the vehicle. The static balance and certain characteristics of the dynamic behavior are obtained by locking the rotation of the balancer.

Advantages. With this arrangement, the suspension and inclination mechanisms are independent of each other, thereby improving the



stability of the vehicle by eliminating interference between both mechanisms. Moreover, it provides an efficient static equilibrium for very narrow vehicles.

This vehicle, which maintains the " motorcycle feeling", offers diverse advantages with respect to a conventional motorcycle:

It considerably reduces the possibility of the rear tyre sliding (the most frequent cause of motorcycle accidents).

It offers more traction in any situation on any type of terrain, in particular when they are slippery.

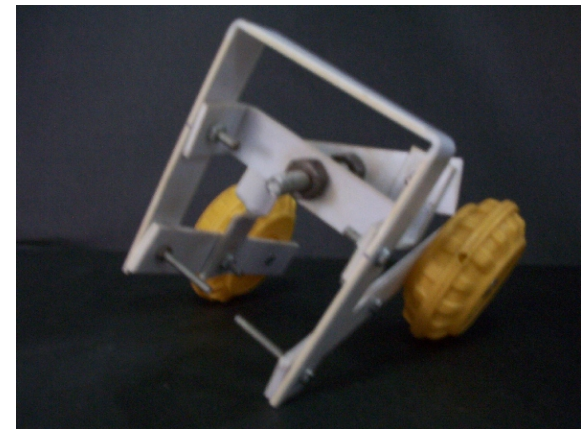
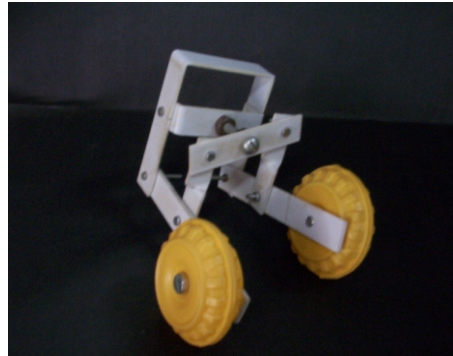
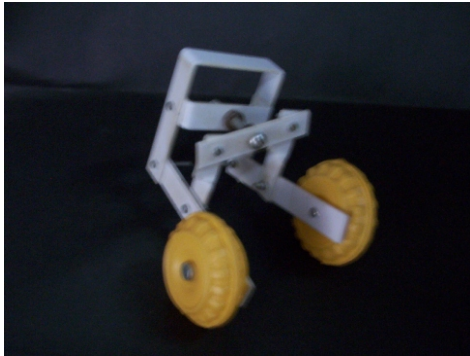
The third wheel offers better braking as well as increased stability whilst braking

No effort is needed to park the vehicle, even on inclined road surfaces, since has no stands.

The driver need not hold the vehicle when stationary, because it maintains its upright position when the balancer is locked.

This allows the vehicle to be enclosed, protecting the driver against cold weather and rain.

A model was made to study the mechanism and understand its working.





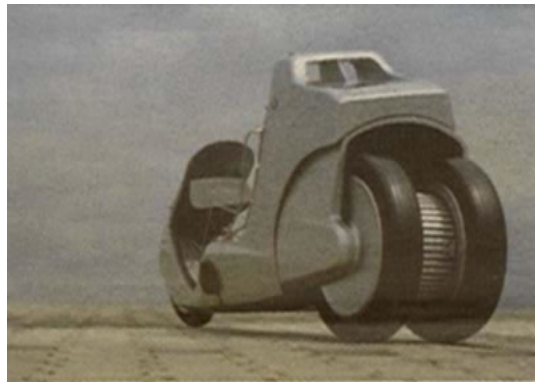
2.5 Three wheelers of the world



As a study to see the trend that is prevalent in the world, some of the images of three wheelers, both custom made and mass manufactured were collected. These are some of the car looking forms which tend to look more toy like.



Some more car like three wheelers.



These are narrow track three wheelers. Some are modified two wheelers. Barring these, they can be called as a completely new breed of vehicles as they are not a scaled down version of any car.



Some more narrow wheel track three wheelers.



2.6 Three wheelers in India

The mention of three wheelers in India bring forth such similar images, the rickshaw look that has been greatly embedded on our minds.

The very mention of the project as a three wheeler design made people think that I am doing something on the auto rickshaw platform.

Very soon I realized that I will have to have a form that will have to destroy such image.





But then there were two wheelers with side cars that were an accepted means of transport, in fact as an extended family vehicle. The clue is to keep the two wheeler identity.



Why middle class??

This is the class of people that mostly use a two wheeler.

They have a monthly salary of about 10,000 Rs.

They Can't afford a car.

They are educated, marrying later and have fewer children.

They are the people who want something more in life.

They Look for convenience in fast paced urban life.

They have a changing standard of living.

More no of women have started working, and need a vehicle to travel.

3. User survey

3.1 Target segment

The target user was decided early on and very specifically in order to clearly define the scope of the design.

The user would be.....

Middle/upper middle class urban individual

Aged 20 to 35 years

Someone having a small nuclear family

Or single

Young couple

Other possible user

A rich person buying a second or third vehicle as a substitute to a car

Sales person/ delivery person

Elder citizen.

3.2 Talking to the user

The method adopted was the one that was taught to us in the first semester. I went and had a casual talk with varied users, without giving them any hint that I am actually doing a survey. There was no set questionnaire. I had just some key questions in my mind which I asked appropriately during the conversation.

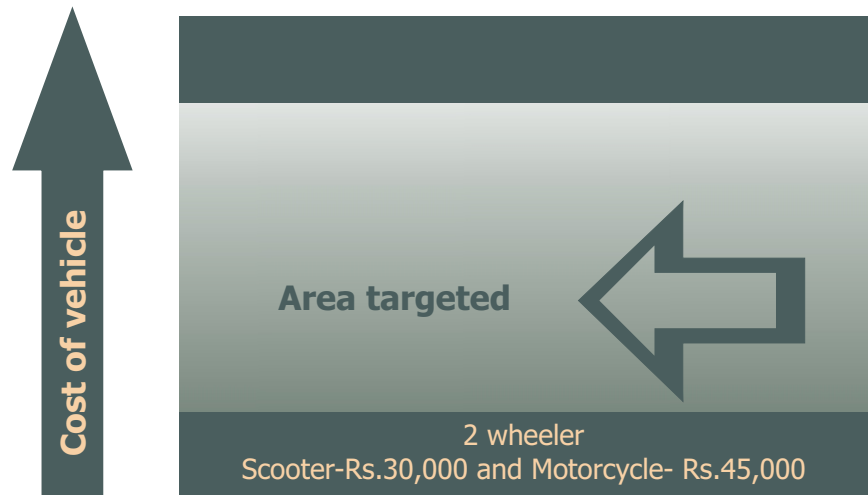
After every session I wrote the key insight down in a single phrase and then expanded it for better understanding of the problem. Immediately I gave possible solutions, no matter how radical, for the same.

People who were interviewed included, young college students, office going people both male and female, house wives with children, and some doctors from a municipal hospital.



Some of the insights that were noted were as follows:

- ✍ Many females don't ride a two wheeler because they can't balance
- ✍ Sitting with legs on either side feels more safe
- ✍ Can't sit comfortably with a sari
- ✍ Scooters are more comfortable for girls than m/cycles
- ✍ There is no protection from rain
- ✍ During rainy season rain drops enter the eyes while driving
- ✍ Mud flaps are inefficient in motorcycles in rains, hence a temporary polypropylene sheet covering is put on the leg guard
- ✍ Putting the leg down in a puddle in slow moving traffic is a nuisance
- ✍ Car feels more safe because of the bonnet ahead
- ✍ Car has a protective body
- ✍ Car is more desirable
- ✍ Motorcycle is more fun to drive
- ✍ Two wheeler has most no. of accidents.
- ✍ Head injuries most common and fatal.
- ✍ Youngsters are more prone to accidents.
- ✍ Family riding on a scooter is at high risk.
- ✍ Ground clearance is too low, in some two-wheelers
- ✍ Luggage space is less
- ✍ Enhanced rickshaw as a family vehicle is not acceptable
- ✍ Three wheels on a two-wheeler may look funny



3.3 General study

To understand the purchasing capacity of the middle-class people and to know their preference in buying a particular vehicle some people were interviewed.

What is their salary, the no of years they have been working, number of members in the family etc. were studied.

The inference was that most of the young professionals buy a two wheeler first and as the family grows, they invest in a car. Usually they go for a Maruti 800 or some go for a Santro, or Indica.

Also some study was done to see as to how people use the vehicle they own. The occupancy of the vehicle, the ease in navigating through traffic, the parking problem etc. The area was a nearby supermarket and IIT campus.

What was observed was that mostly the car was underutilized. Of the 50 cars observed, 36 had only two or less no of occupants.

Of the 78 two-wheelers observed only 23 were riding single.

Parking of a two-wheeler took approximately 10 seconds

Finding a place to park for a car itself took around 2.5 minutes.

In the area in which a car was parked around 4 two-wheelers could be parked.

4 product Brief

Technical:

Will carry two adults, a child of up to 12 years and small luggage

Will have a hardtop transparent hood, tinted in the roof section

Will be a light weight construction

Will be compact and narrow, i.e. the wheel track will be small.

Should be priced under one lakh

Should be mass-produced.

Form:

Form should have an individual identity, but not looking like a car.

It will be without doors

Will have an open feel

Form should be based on the users attitude and mind

Should be able to animate the inanimate

Safety:

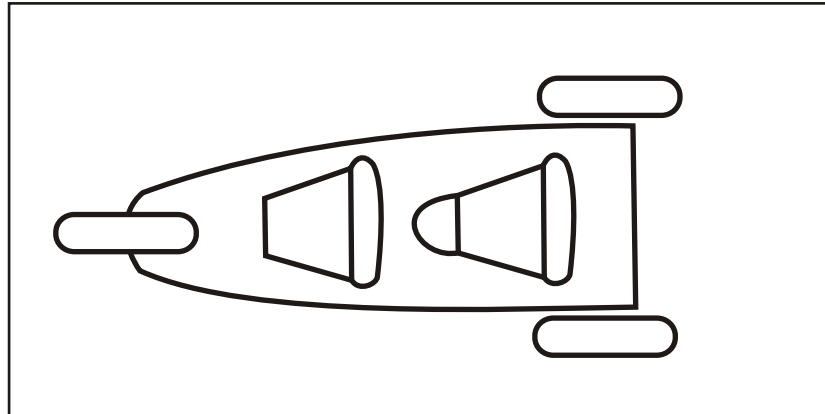
Should have a stabilizing mechanism to take the cornering forces

Should be self balancing

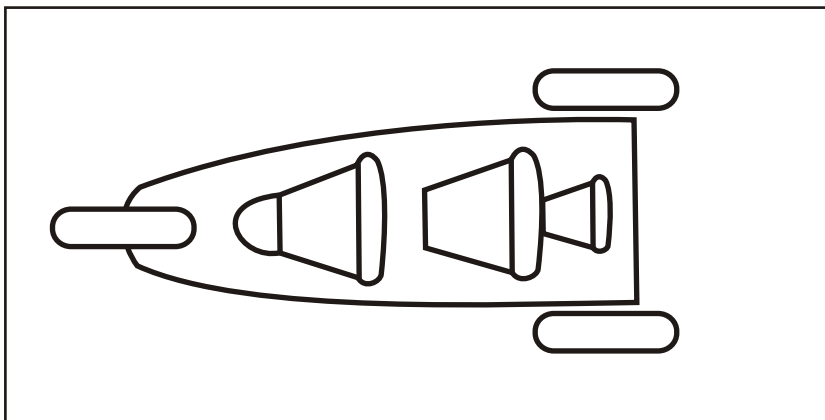
Should have adequate head room

Have comfortable seating with backrest

Should have excellent front and side visibility.



Layout 1



Layout 2

5 Design process

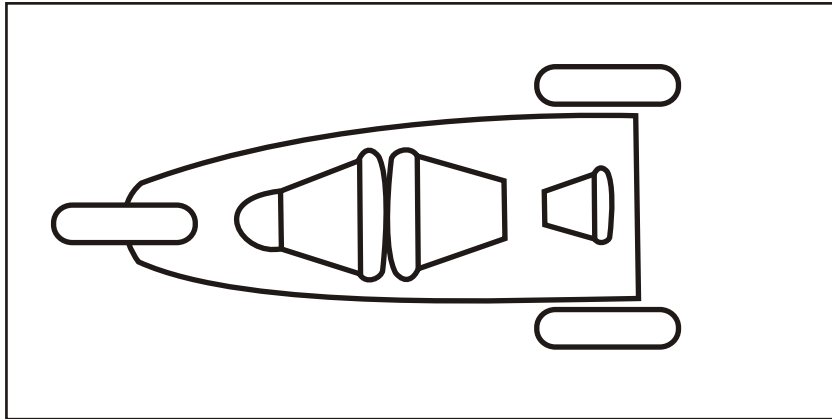
5.1 Seating layout

To select a layout, the considerations were :

- ✎ Narrow wheel track.
- ✎ One wheel in the front and two wheels in the rear configuration.
- ✎ Child safety and closeness to either rider or pillion rider.
- ✎ Intimacy between the rider and pillion rider.
- ✎ Position of steering handle with reference to the rider.

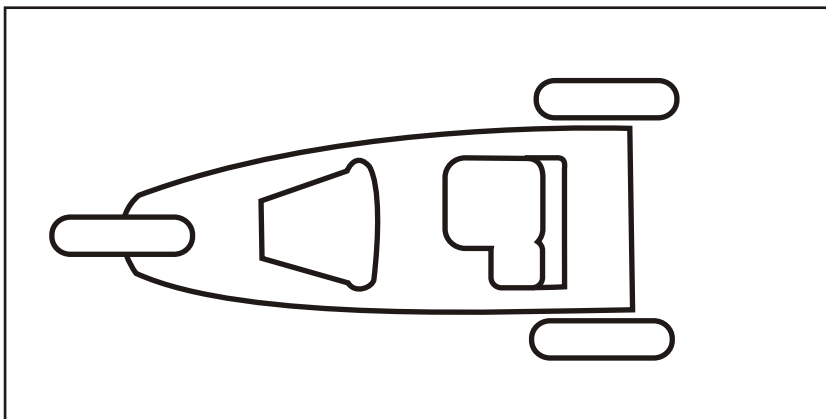
This layout has the child seat in between the rider and pillion seat. Disadvantage is that in absence of pillion rider, the child remains out of sight and a bit unattended.

In this layout the main child seat is behind the pillion, but this is at the cost of luggage space. Thought there is an extra seat for a smaller child in front of the rider.



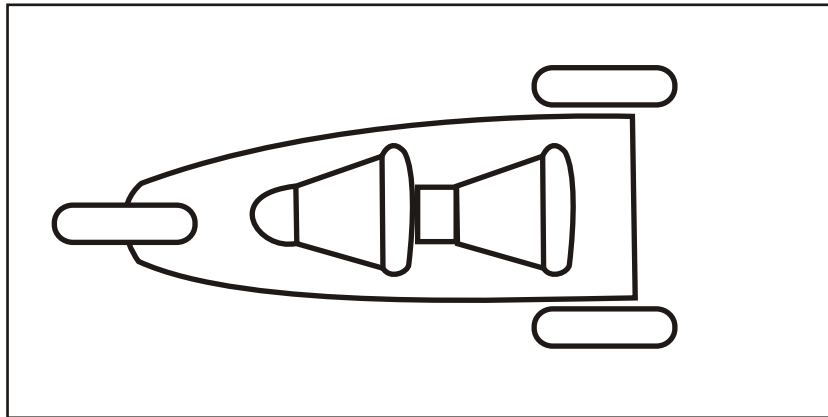
Layout 3

The rider and pillion seat with their back to each other, but the child would be distant in case the pillion is not there. Again riding backward is irritating to the pillion.



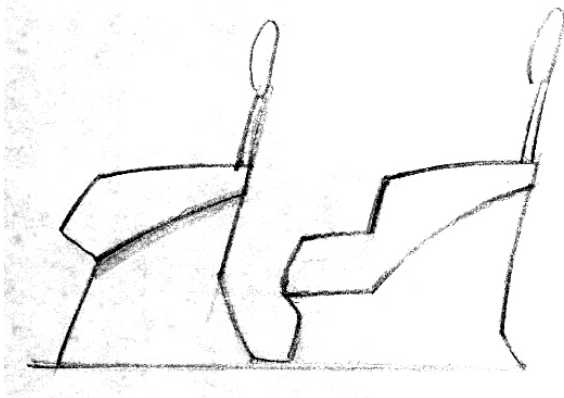
Layout 4

The child seat is on the left side of the pillion. Disadvantage is that the child is too near the edge of the vehicle, and the wheel track may increase.



Layout 5

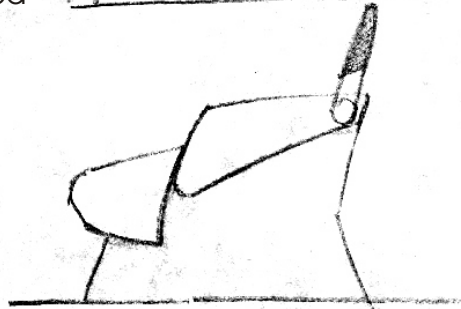
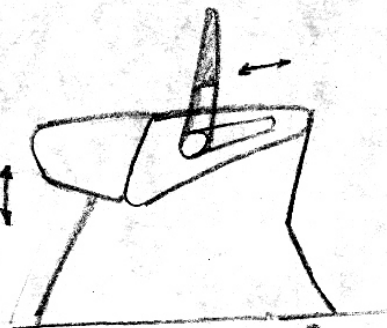
In this layout, there is a small child seat in front of the rider so that the child remains in view at all times. There is a folding seat for one more child in between the rider and pillion. In presence of the pillion the child in front can be made to seat in between so that the rider might feel bit free while riding. This layout was ultimately selected for its versatility .



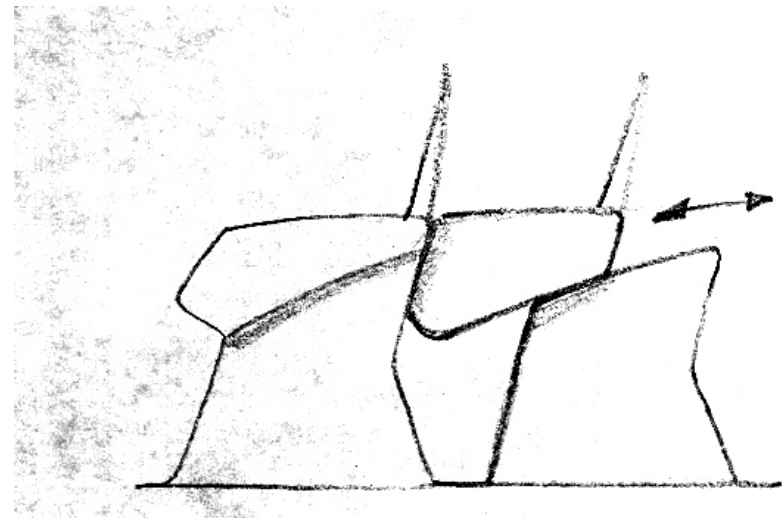
5.2 Seat adjustability ideas

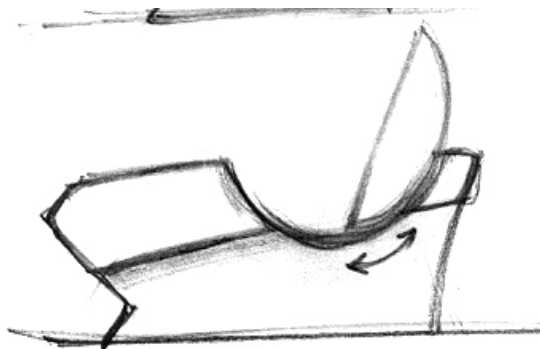
Low height child seat in between the rider and pillion.

Adjustable child seat that can be pushed down and the back rest pushed behind for pillion rider when a child is to be seated

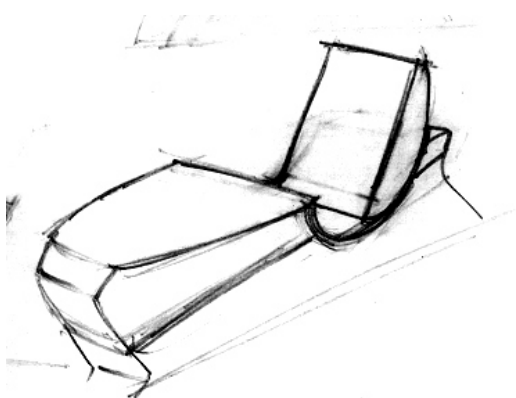


Rear seat that can be slid forward to increase intimacy after egress.

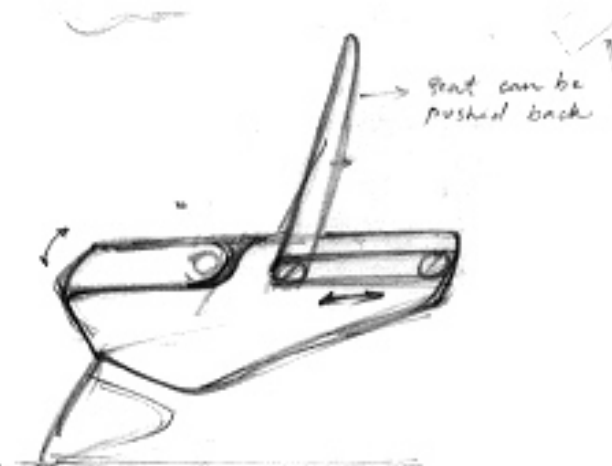


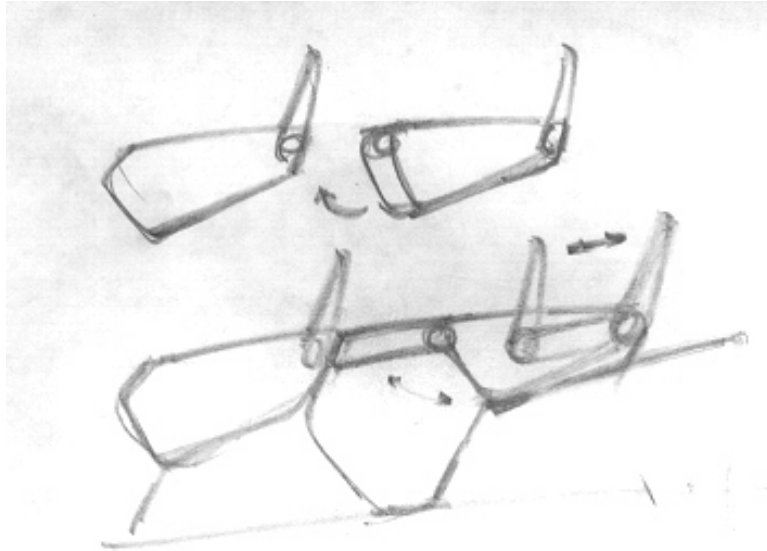


The pillion seat rolls over the base for reducing the height at the time of egress.



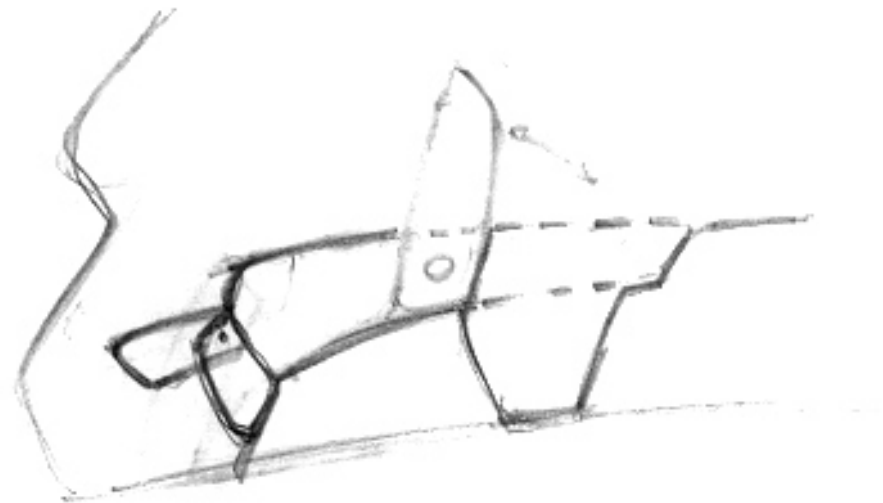
Part of the base becomes a backrest when lifted for the child seat and the backrest of the rider can be pushed behind. This way the child and the adult seating position can be made to interchange.

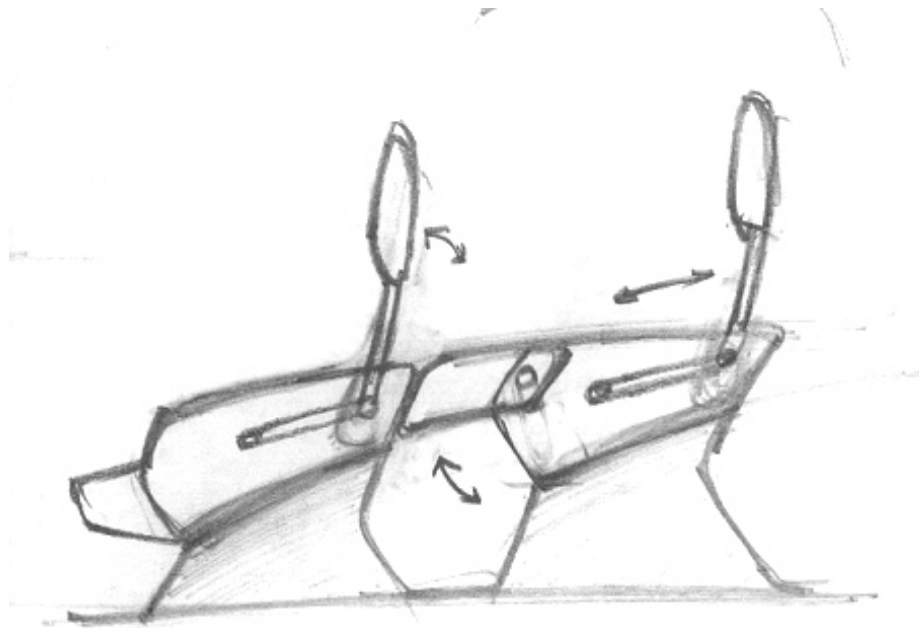




In this arrangement, the backrest of the rider unfolds down to bridge the gap. Female wearing a saree will have no problem in this case. There can be a small child seat that unfolds in the front.

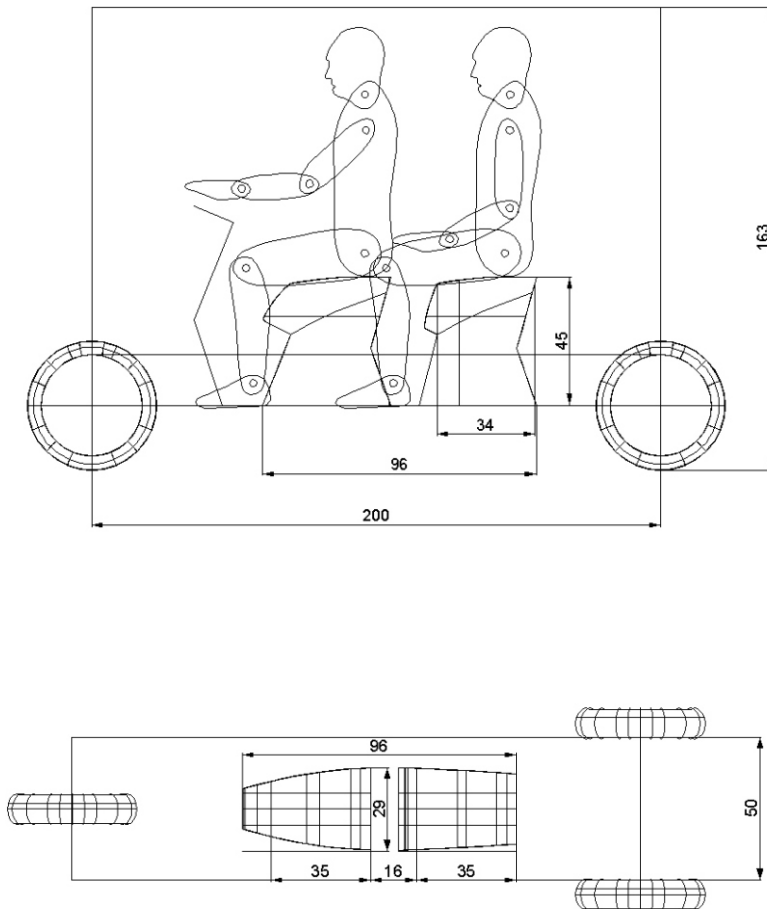
The rear seat unfolds up to bridge the gap between the two seats after the pillion rider enters. This allows intimacy between the two riders and this portion also can be used as a child seat too. The backrest is movable too. But if a female is wearing a saree then the child seat cannot be pulled up.





This is the most comprehensive solution. A small folding child seat in the front. Front backrest that folds down if there is a female seating behind wearing a saree and she wants to accommodate a child in between. rear seat that folds up if the pillion rider wants to come close and seat, and the rear backrest that moves back and forth.

Two children can be accommodated in this arrangement along with two adults.



5.3 Ergonomics

Ergonomic consideration for the design of a vehicle interior space is very important. Maximum comfort for the riders and issues like safety and visibility are of prime importance.

The seating position is of the alert type, i.e. vertical upright as in a motorcycle or a scooter with the pillion riders legs on the either side of the rider, with space in between for ingress so that females wearing a saree can seat with legs on either side.

Referring to the Indian anthropometric data, the dimensions for the seat base, the height of the seat, the space between the front and rear seat for easy ingress and egress were finalized.

5.4 Technical specifications

Engine: Bajaj Eleminator (petrol)

Displacement 174cc
BHP 15.2/8500
Torque 13.7/7000
Transmission 5 gears
Mileage 42 kmpl approx

Steering : direct steering

Brakes : front disc
Rear drums

Wheels : 14 inch alloys

Tyres : 3.00-14 Zapper M (MRF)

6 Concept generation.

For concept generation I followed a new approach. Generally I saw metaphors being used extensively in some of the old automobile projects done in IDC. It is a tried and tested and a very successful methodology. But nonetheless I decided to have a different direction. A study was done to see what the target user behaves like, what he likes and dislikes, what kind of goods he buys etc.

I discreetly followed some people around the market place and observed as to what kind of clothes they wore, what kind of products they brought from the supermarket, and what kind of music they listened to.

The observation was noted down, analyzed and then the user was broadly categorized in to three types

6.1 Type 1

This generally comprises of an age group that is from 20 to 27 year old. These are the people who have grown up listening to the new age rock music and seeing cable television in their college days. There is much influence of the western world. They have had a two-wheeler riding experience and are believers of I care a damn attitude. But then they suddenly find themselves grown up, when they take up a job. The black rock t-shirts disappear to give way to button down shirts and formal shoes. The boldness remains but then the classy handsomeness creeps in. responsibility is seen in the way they move in life. An effort to strike a balance between style and class is evident. The user is handsomely aggressive.

Handsomely aggressive

User is bold, ambitious and classy.

Wants to move ahead in life, wants to prove a point. Wants an image for himself

Is aggressive, and ready to take cutthroat competition.

He wants to be handsome

Wants a balance between style and class

For style, his dream vehicle is a Ferrari or Porsche and for class, a Mercedes or a BMW

He has a move ahead attitude.

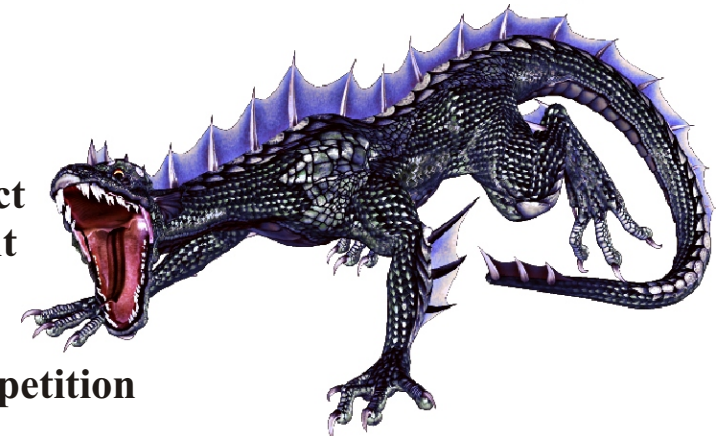
Diagonal lines, clean surfaces, good stance of the vehicle can bring out these qualities in the design



Diagonal lines, sharp edges, pointed triangles, all convey the feeling of dynamism, determination, aggression and boldness.

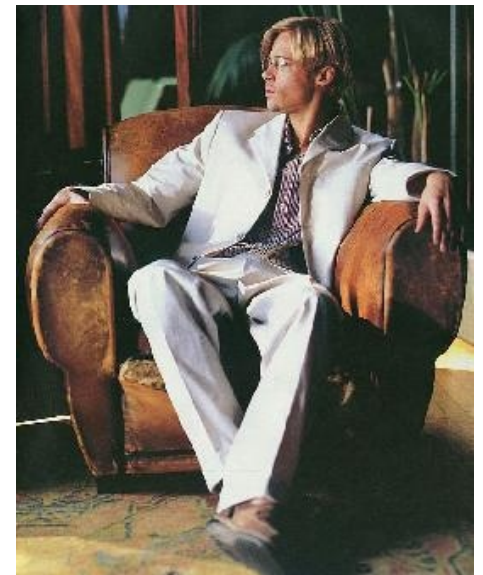


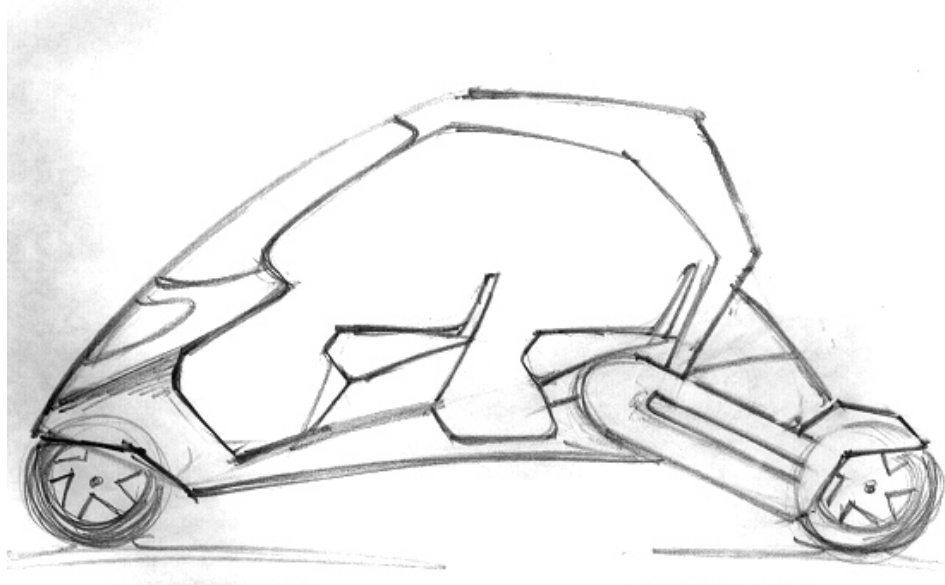
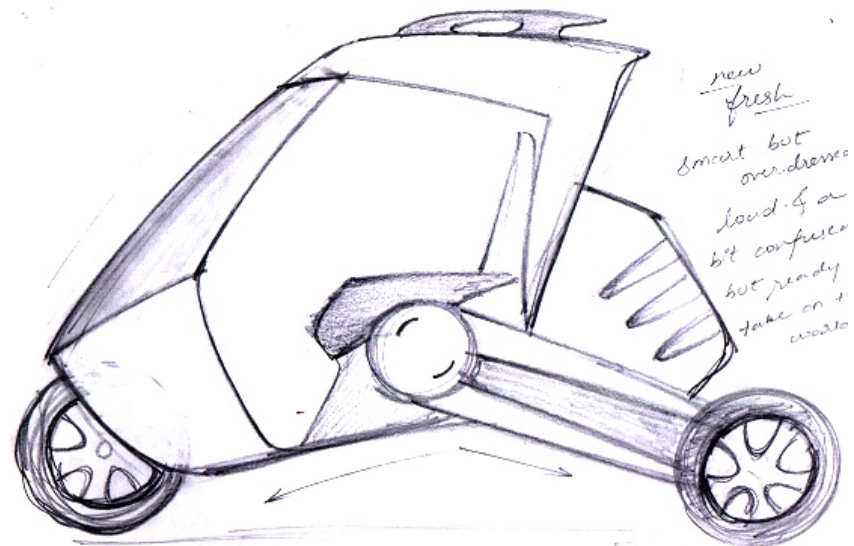
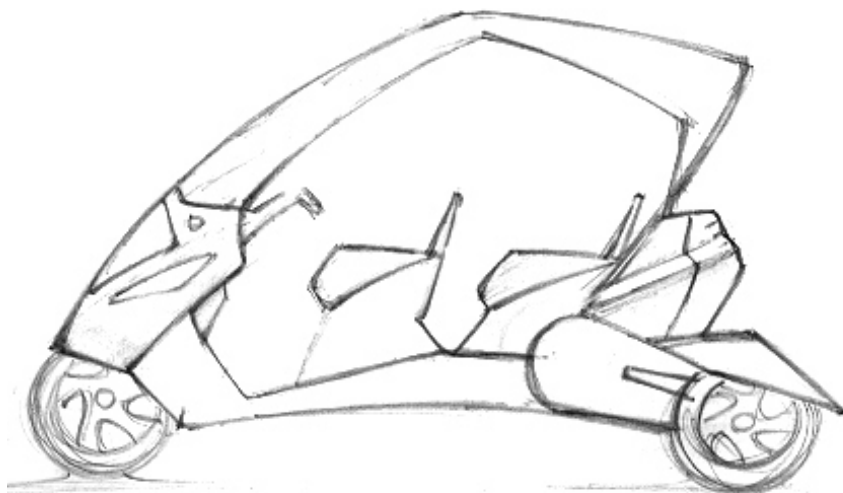
Aggressive
Bold
Killer instinct
Prove a point
Get ahead
Make way
Kill the competition



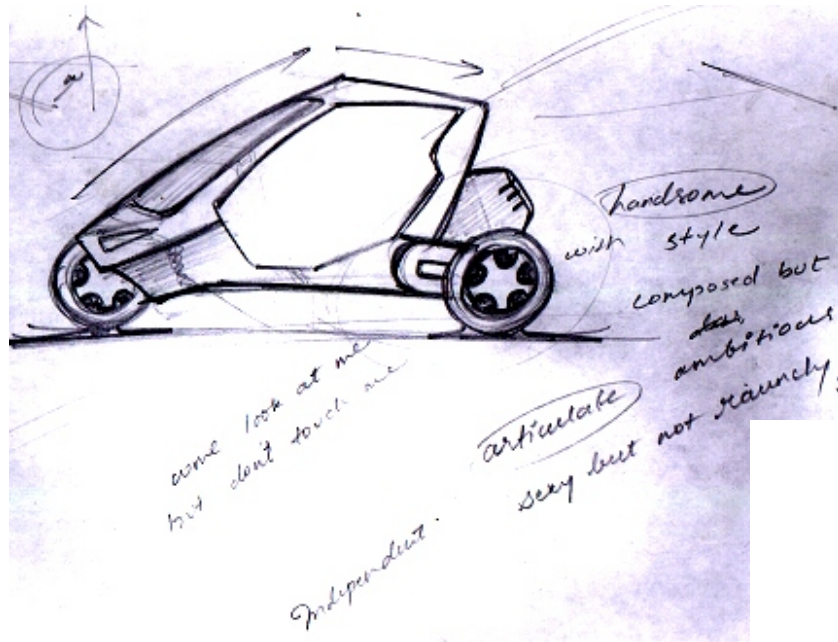


**Smart
Dynamic
Classy
Mannered
Polished**

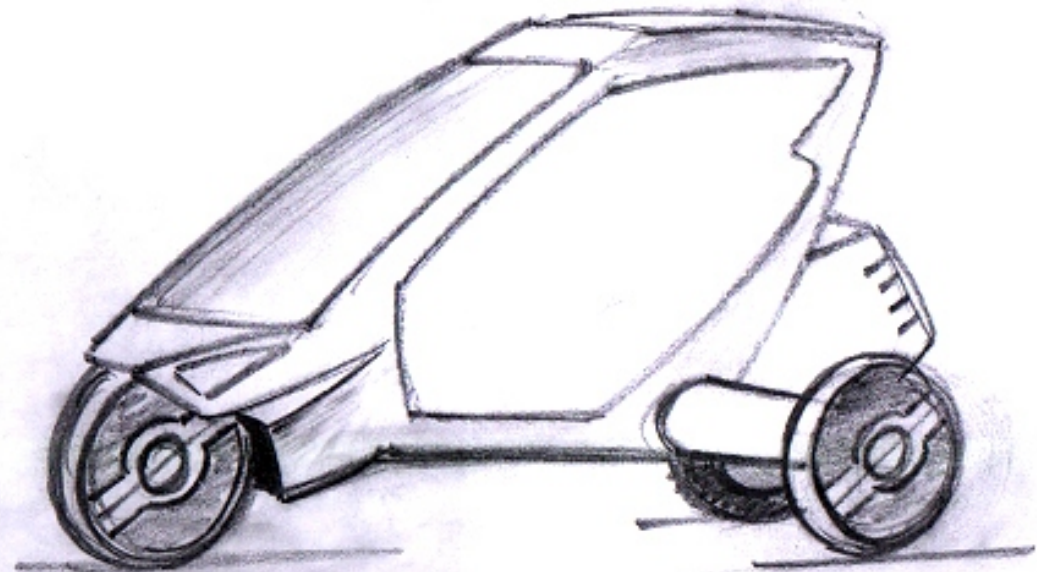




Preliminary sketches to understand the stance and poise of the vehicle. To bring about some attitude that is reflected in the emotion.



Concept 1.1

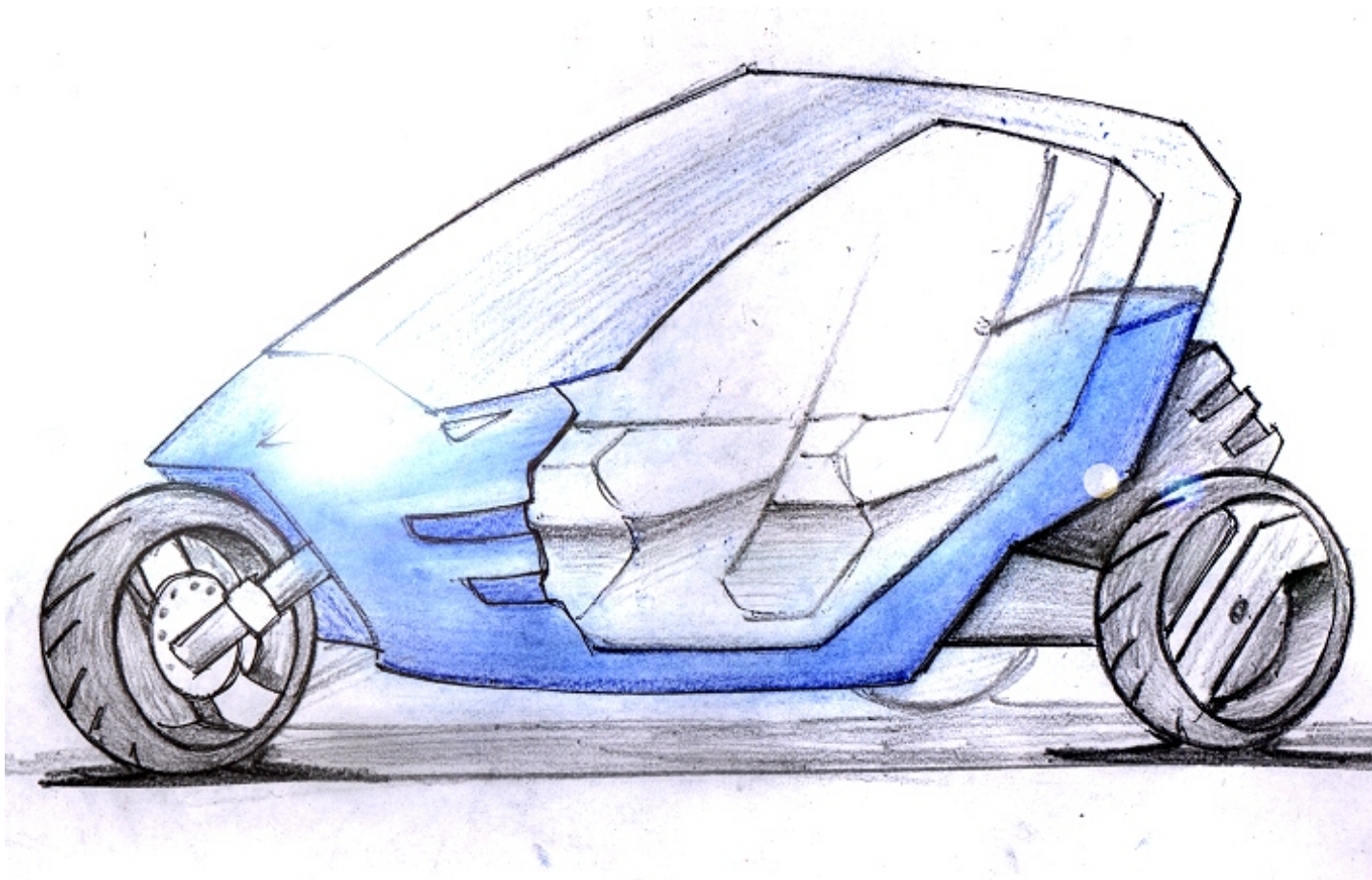




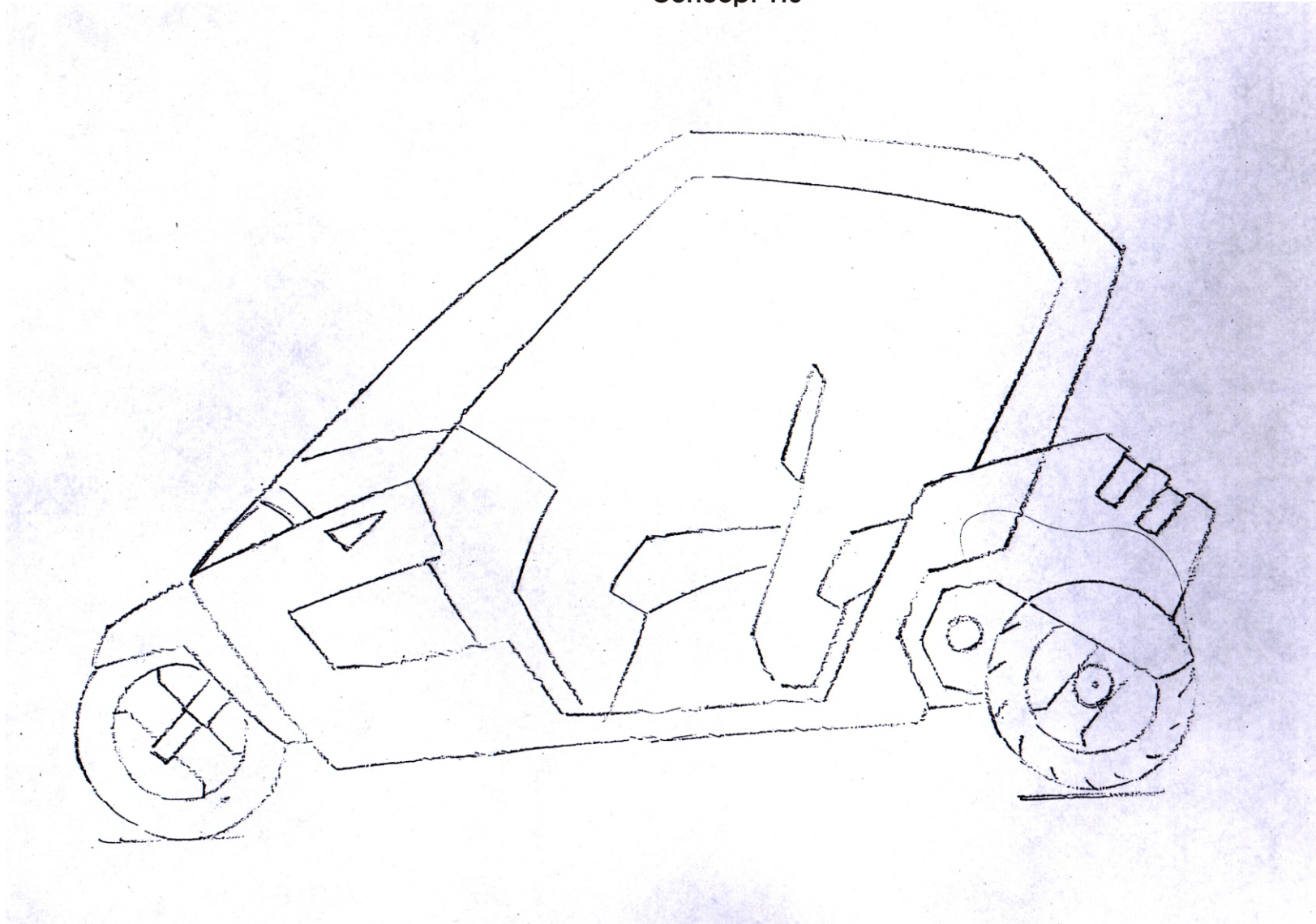
Thermocole models for better understanding of the surfaces were also tried out. These were refined later to arrive at the final form.



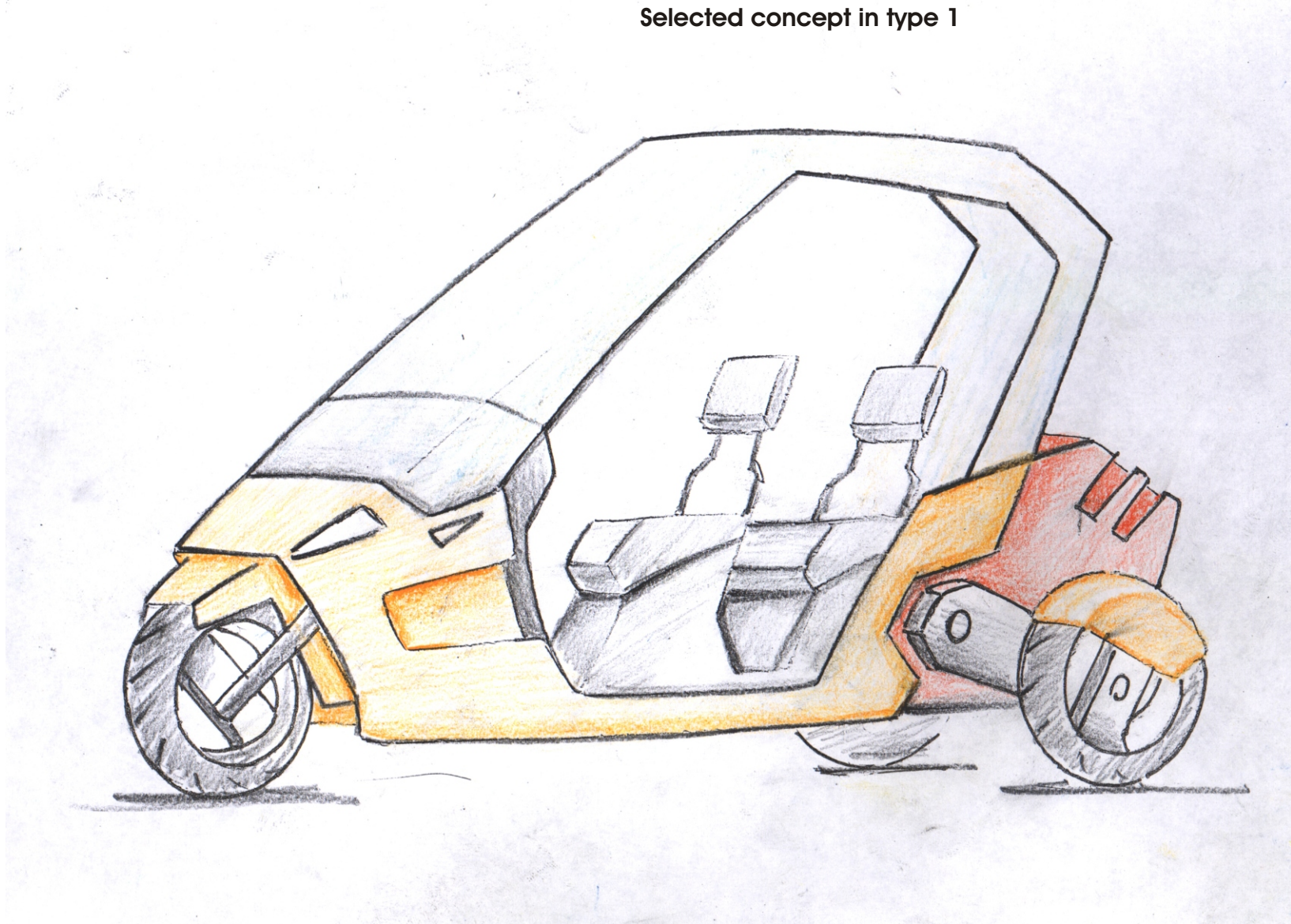
Concept 1.2



Concept 1.3



Selected concept in type 1



6.2 Type 2

This group comprises of a wider age group. People are always fascinated by technology, no matter at what age. Faster and better computers, laptops, Hi tech CD players, and hi-fi speaker systems are what they are running after. Smart gadgets, sleek lines, clean surfaces and shine. Techno remixed music and club culture is what rules. Space age shoes, sleek shirts, lycra top, are some of the dresses. This is the user that wants to say, I am smart, I am literate and educated, I am intelligent and I know what I am doing and what I am buying.

Techno

User is wise, technologically aware

Knows hi end products

Is a computer literate.

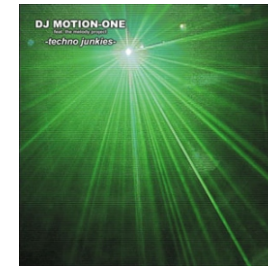
Digs laser lights and discotheques.

Listens to techno and trance and belongs to the remix culture

Buys hi end music players

Likes to have a lot of gizmos

Intelligent use of materials and smart components with visible hi tech parts will justify this category.



**Neon
Laser
Sophistication
Technology
Jazz
Razmataz**

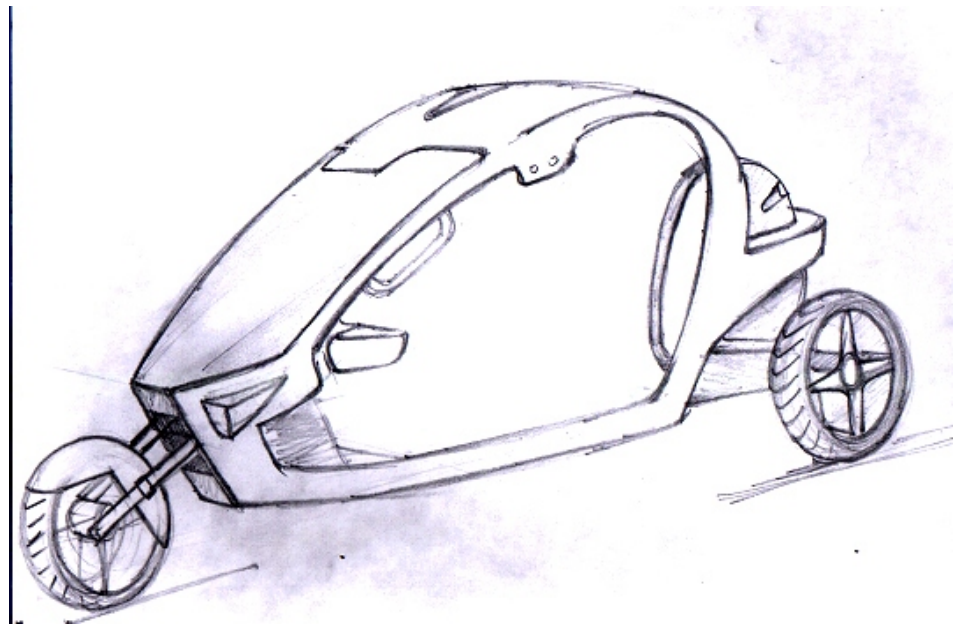
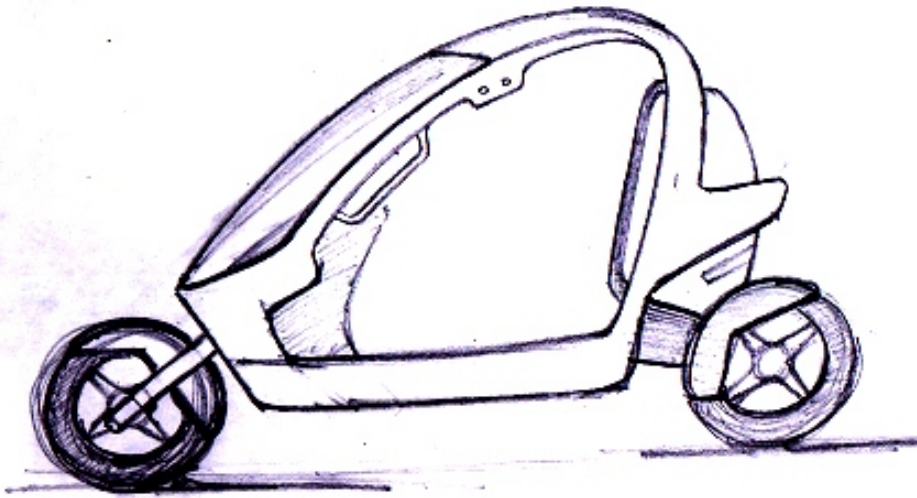
Sleek
Neat
Neutral
Elegant
Smart



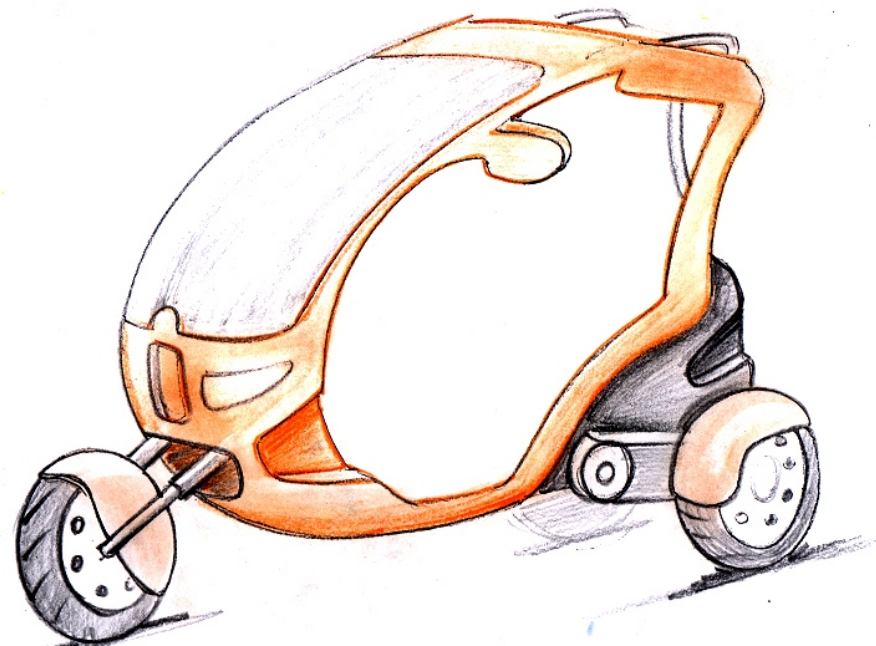
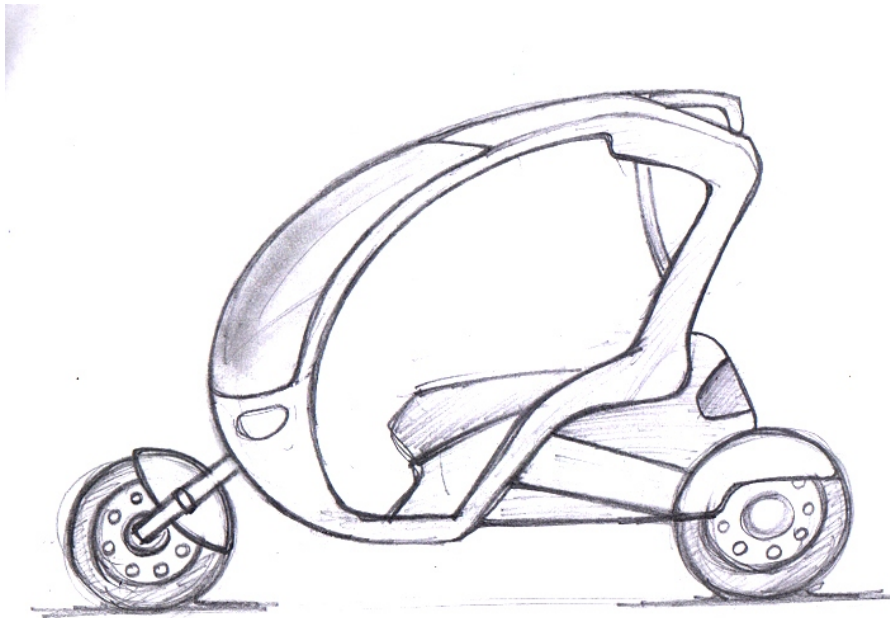
Clean
Hi fi
Intelligent
Aluminum
Chrome



Concept 2.1



Concept 2.2

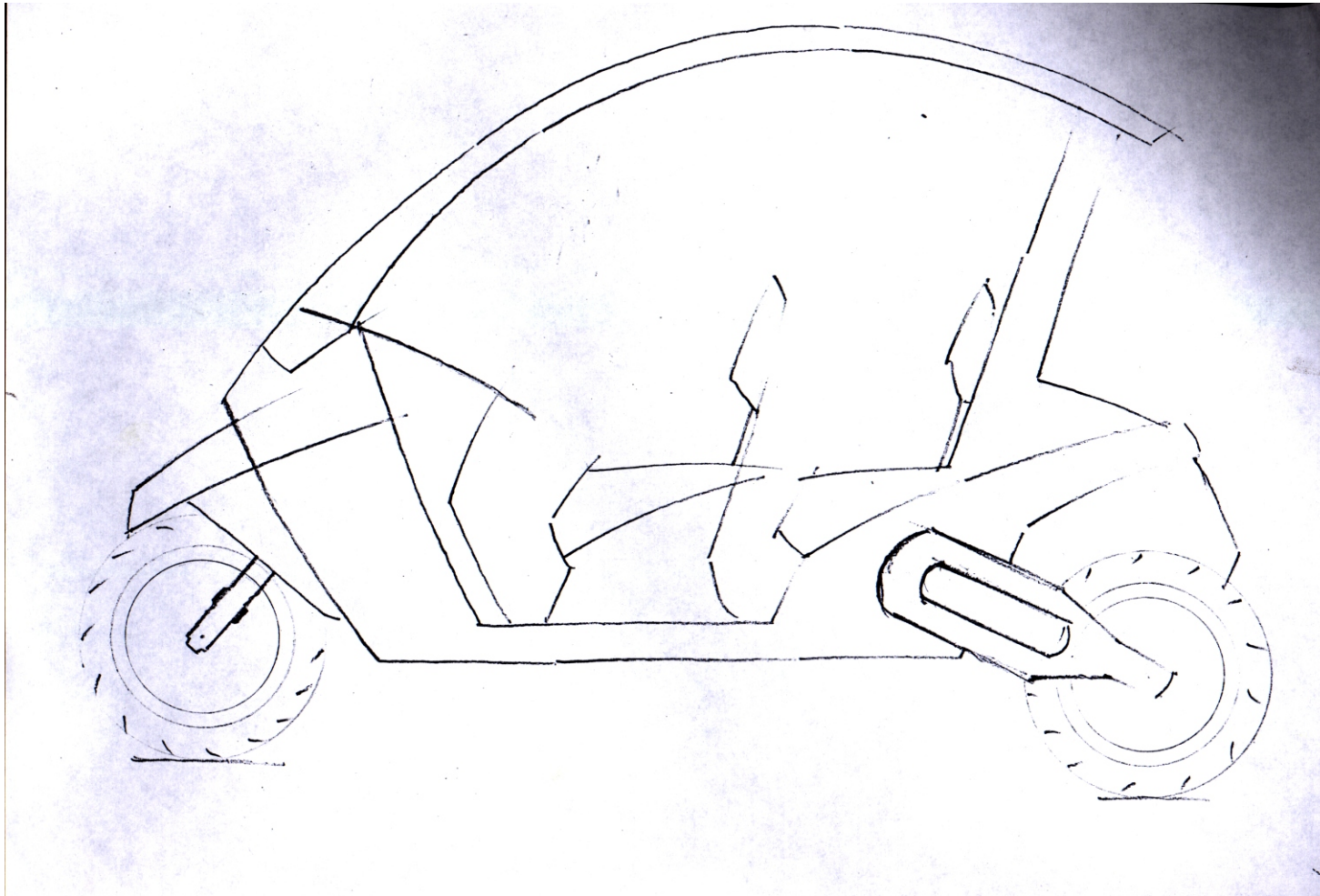




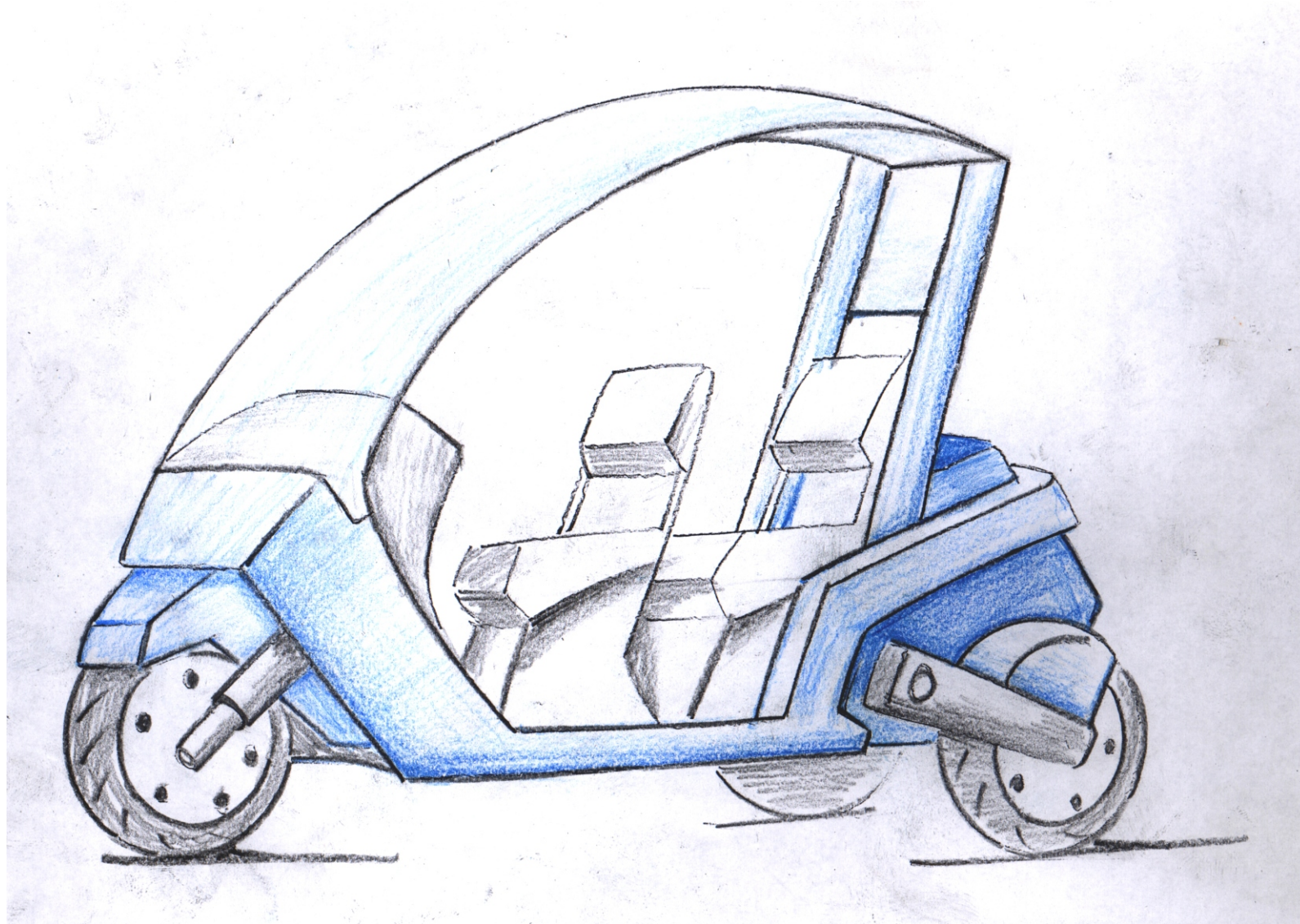
3d explorations



Concept 2.3



Selected concept in type 2



6.3 Type 3

As the age grows, and marriage happens, people tend to grow more responsible. The family man nature seeps in. the ability to provide takes precedence. They tend to become more caring and giving. More thoughtful and gentle. Safety for the family takes more importance. The loudness in his attire disappears, the speed in his driving reduces. Safety features become important. He starts looking for products that are useful for the entire family and not just to satisfy his personal needs and aspirations. The very idea of a small family car is a good example.

Safe

User is a family man.

Is a provider. Is caring and affectionate

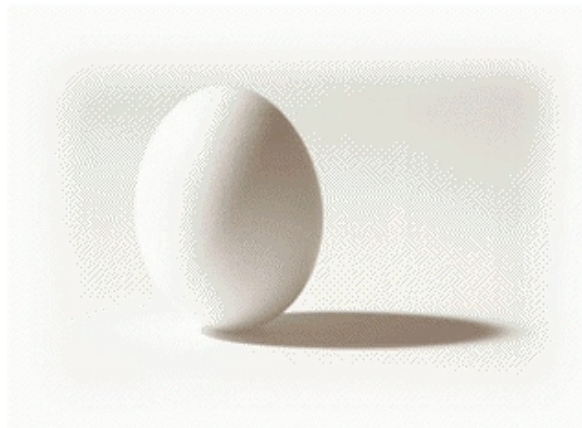
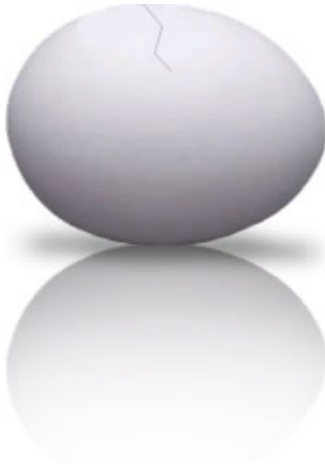
He feels he is responsible for his family

But at the same time he is playful with his kids and is wise.

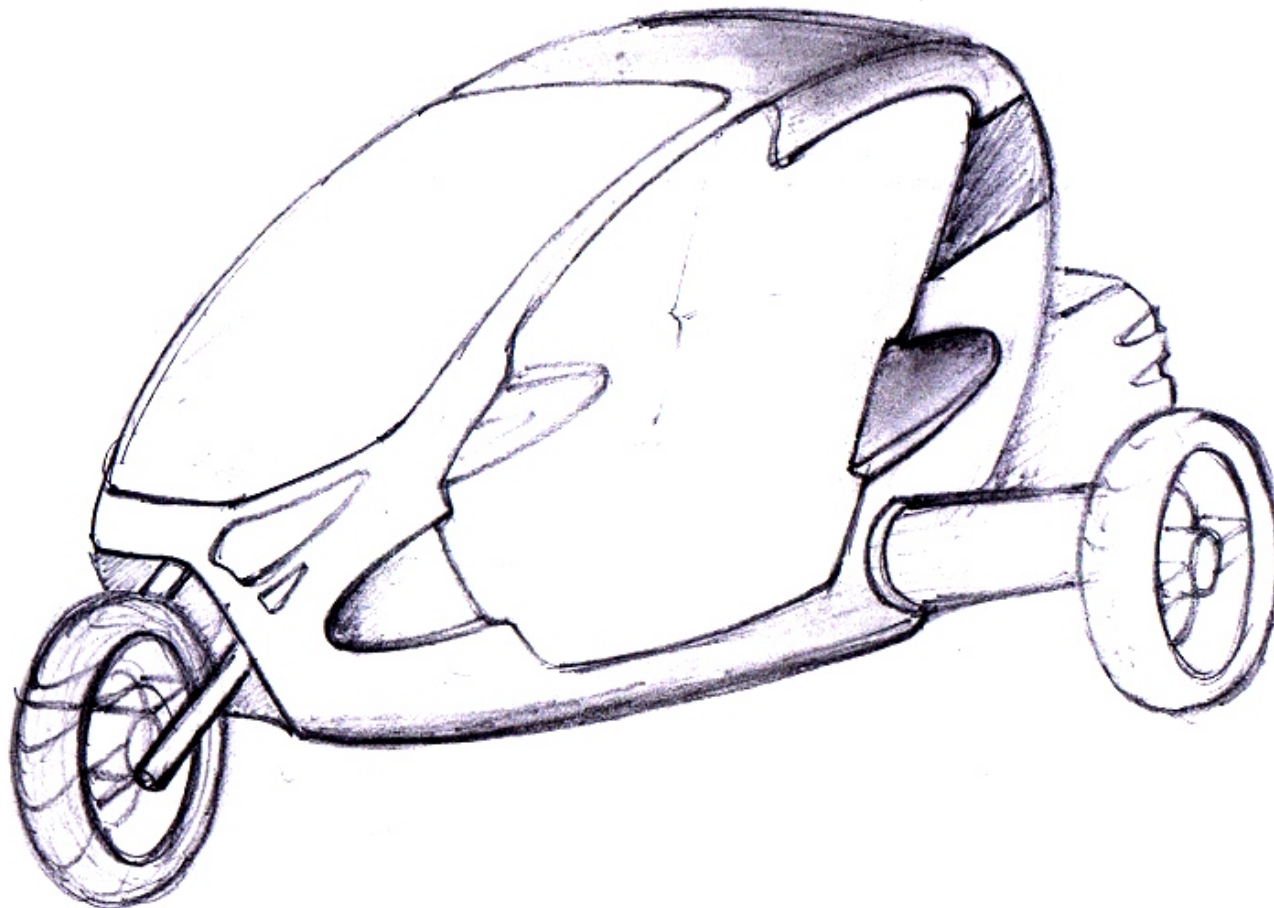
He is adorable to his children and funny and candid with his wife.

A cuddled up, cocoon like form that is practical and subtle, not loud but assuring is the key to design here.

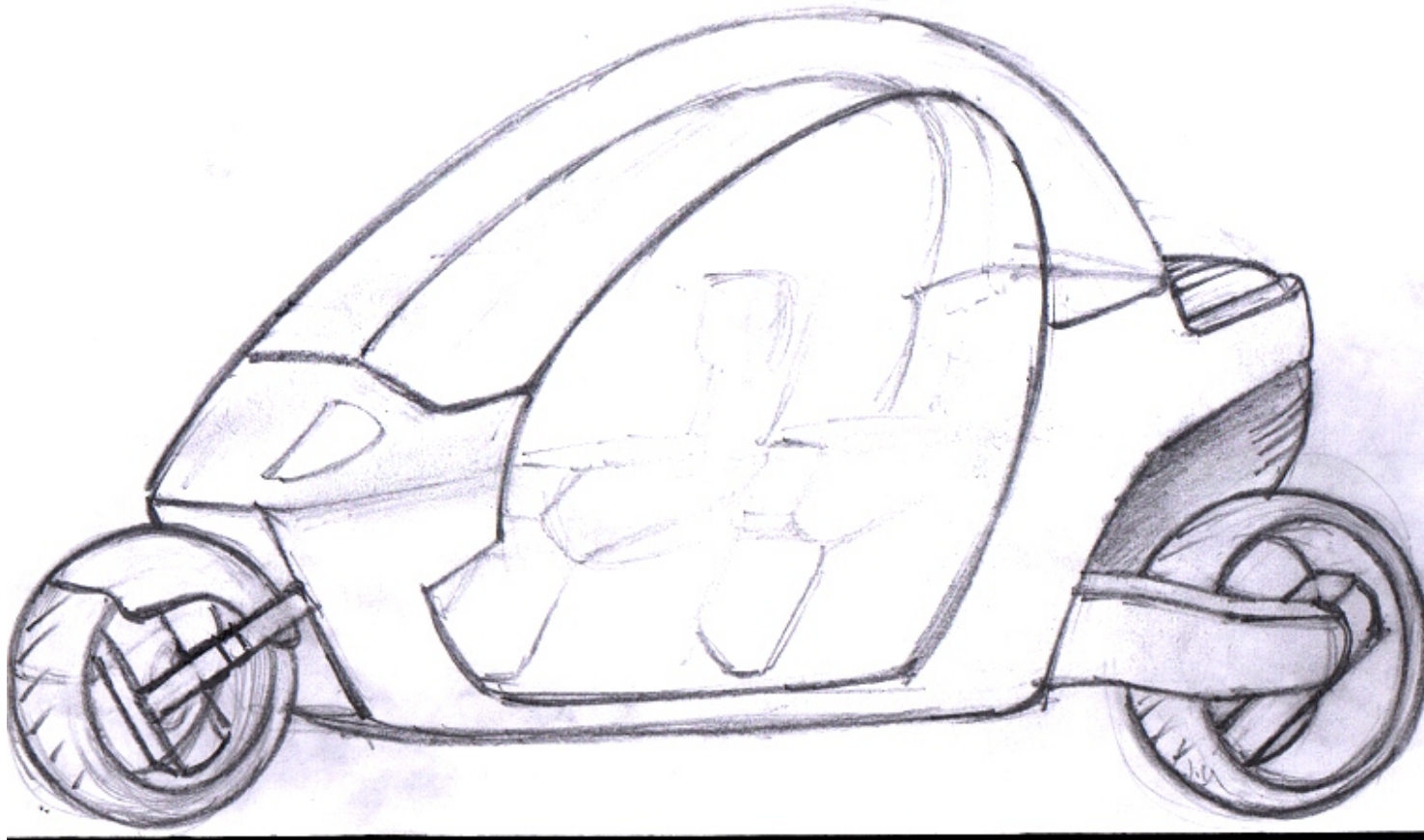
Soft
Caring
Protective
Nurturing
sharing



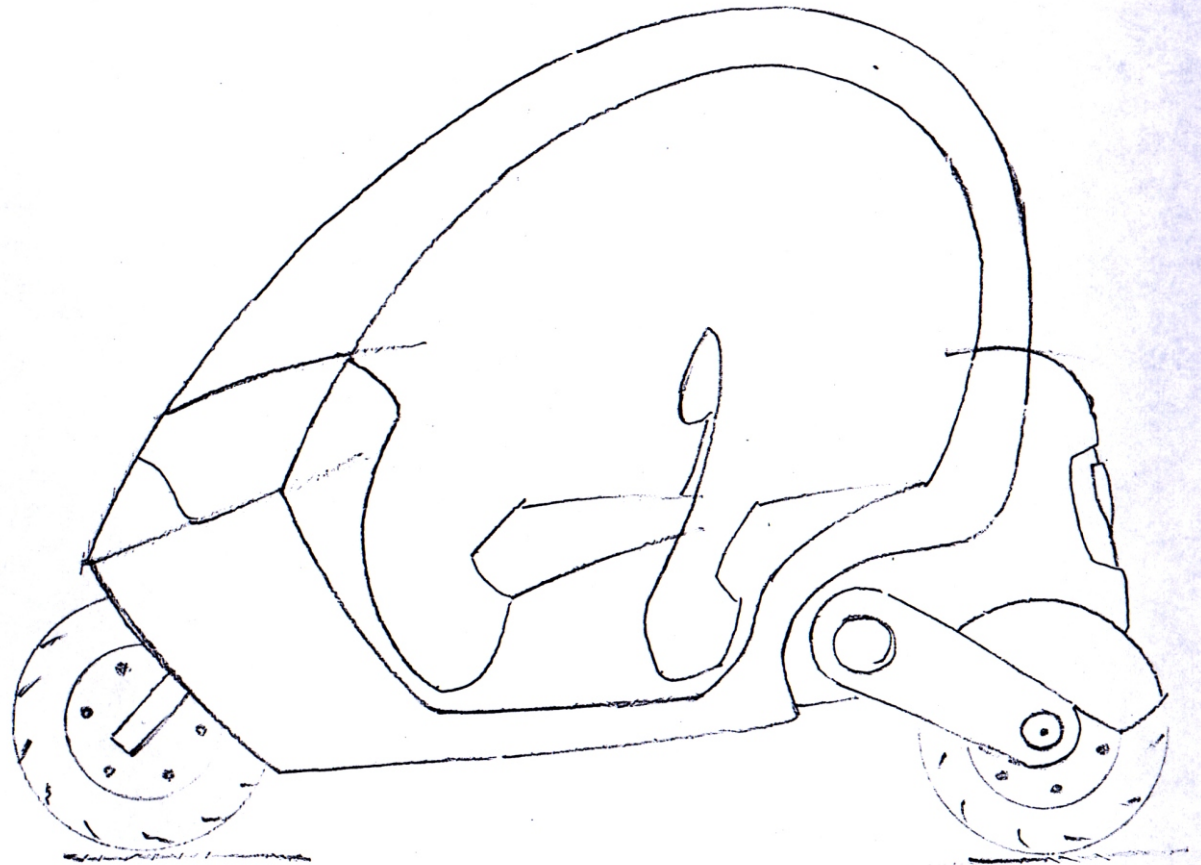
Concept 3.1



Concept 3.2



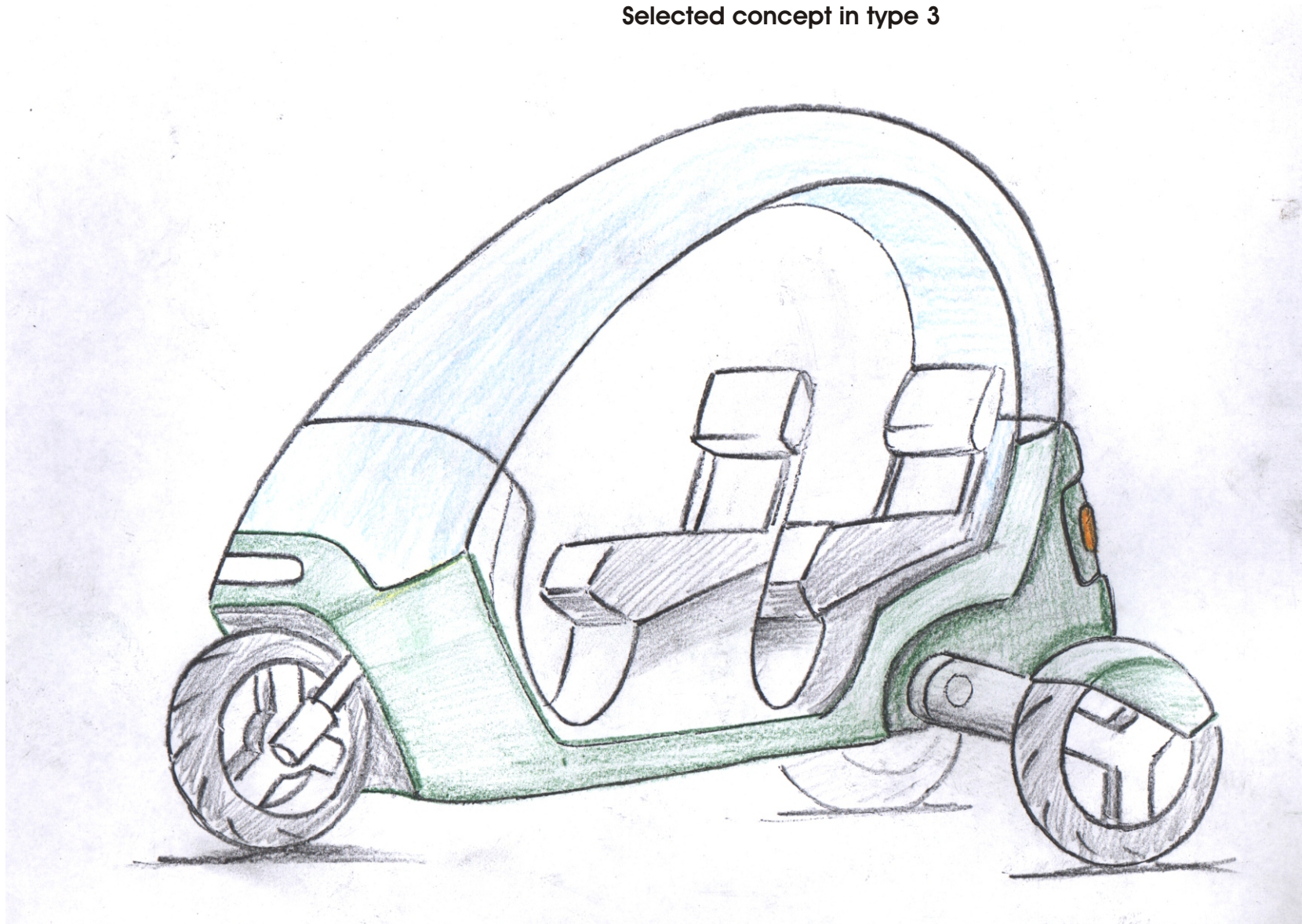
Concept 3.3



3d explorations



Selected concept in type 3



7: Concept evaluation

	Type I (1.3)	Type II (2.3)	Type III (3.3)
Form			
Resemblance with users temperament	3	4	4
Futuristic form	1	5	3
Unique Identity	2	5	4
Open feel	2	5	3
Comfort			
Ingress/egress	4	4	3
Head Room	3	4	3
Front Vision	3	4	3
Rear Visibility	3	5	2
Technical Specification			
Solution to the Traffic Problem	4	4	5
Compactness	3	4	5
Luggage space	5	3	4

Evaluation criteria

The comparison is done on different parameters, like form, comfort and technical parameters

Each evaluation parameter is given different weightage according to its importance and then each concept has been given rating out of 5 for each parameter.

Eg. Concept type II had got the rating 5 for futuristic form and the weightage for that parameter is 8, so $5 \times 8 = 40$ points. And similarly all the points of all the parameters were summed up. Then the total sum was divided by sum of all the weightage like concept 2.3 type II has a total of 342 and the weightage total is 80, so $342/80 = 4.275$. this was the rating given to concept type II concept 2.3

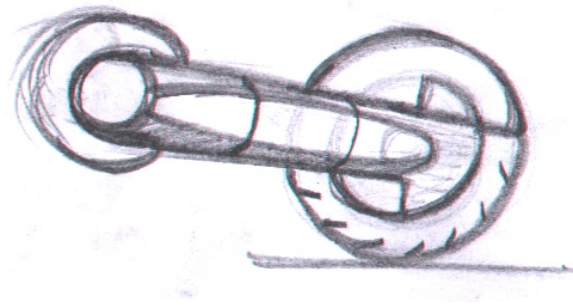
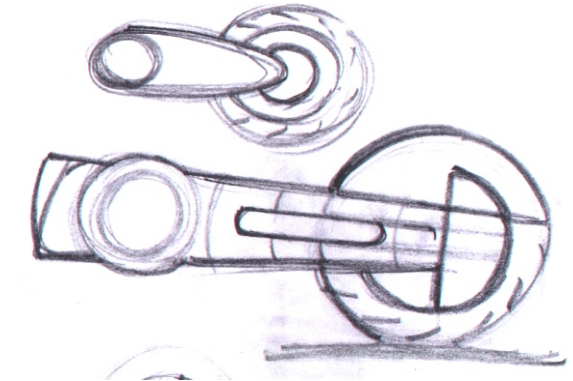
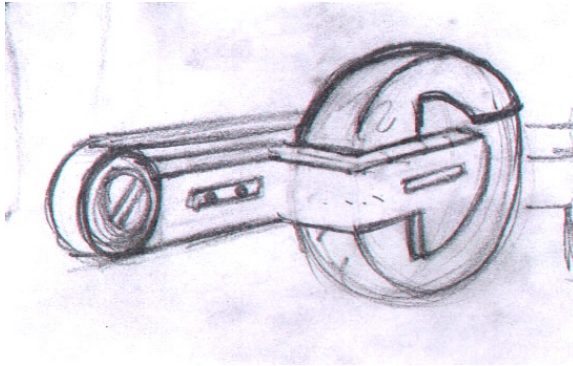
Similarly the rating for the other two were calculated.

Type I (1.3) = 3.0375

Type II (2.3) = 4.275

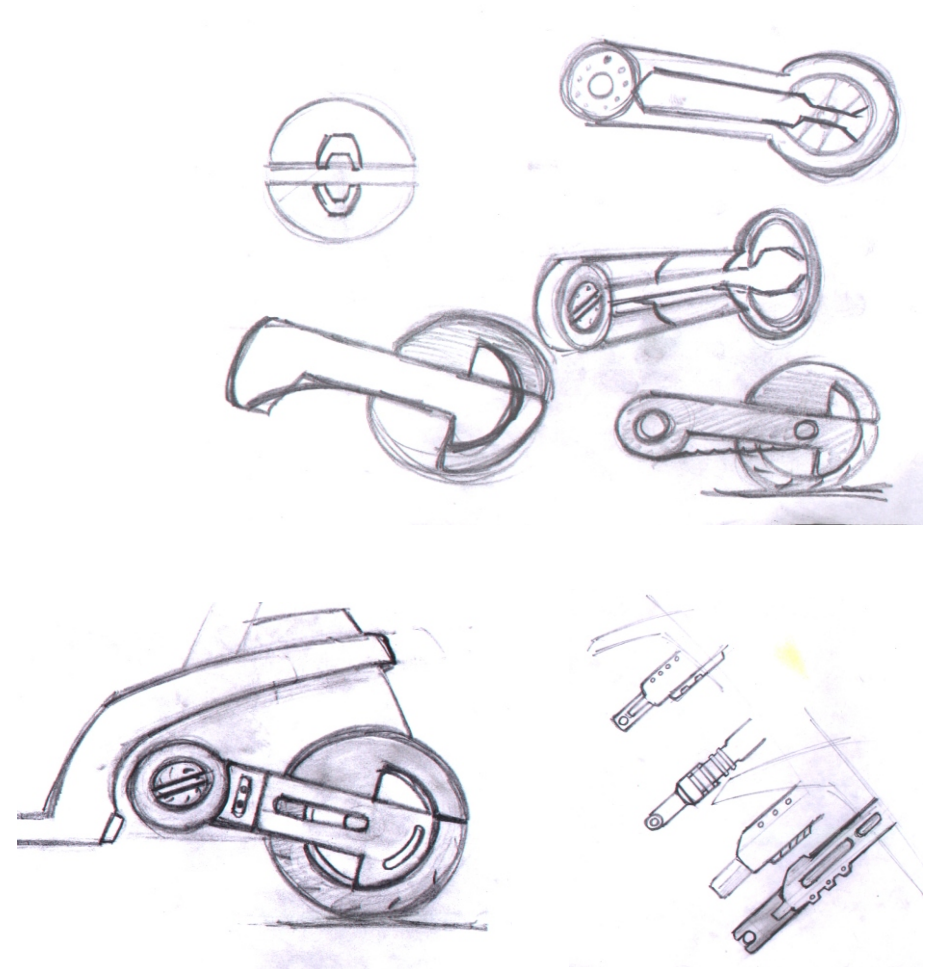
Type III (3.3) = 3.5875

After considering all parameters, points distribution and also user feedback, it was decided that concept Type II (2.3) has got maximum potential to be developed further.

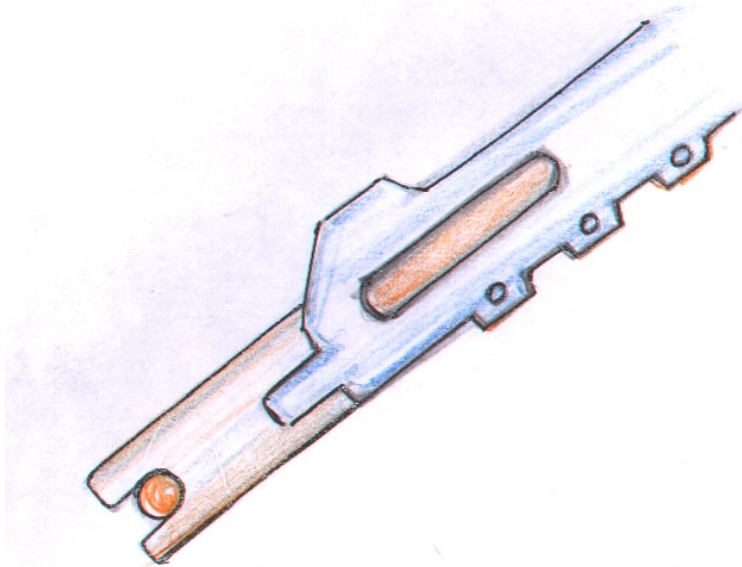


Refining the final form.

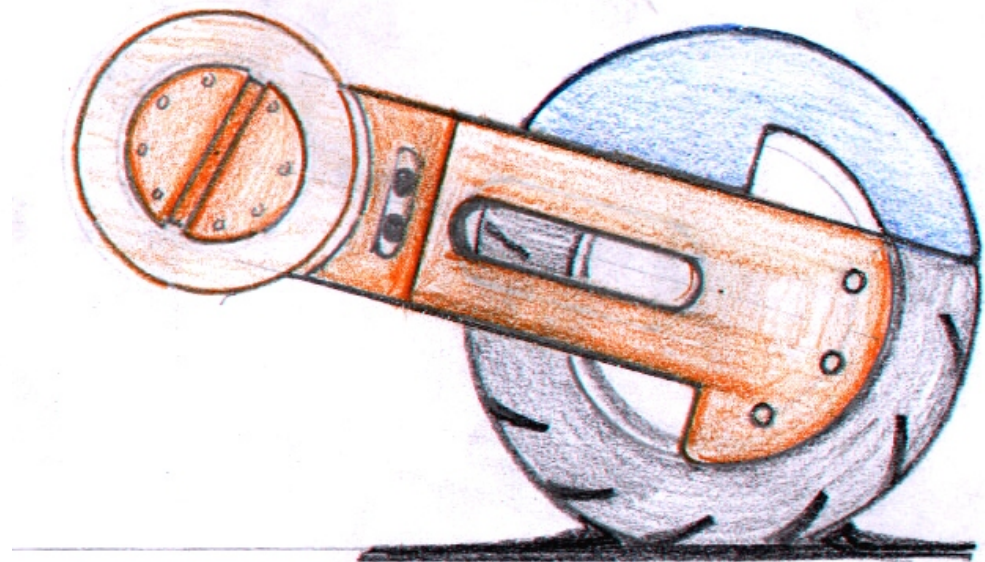
Rear swing arm and front suspension sketches.



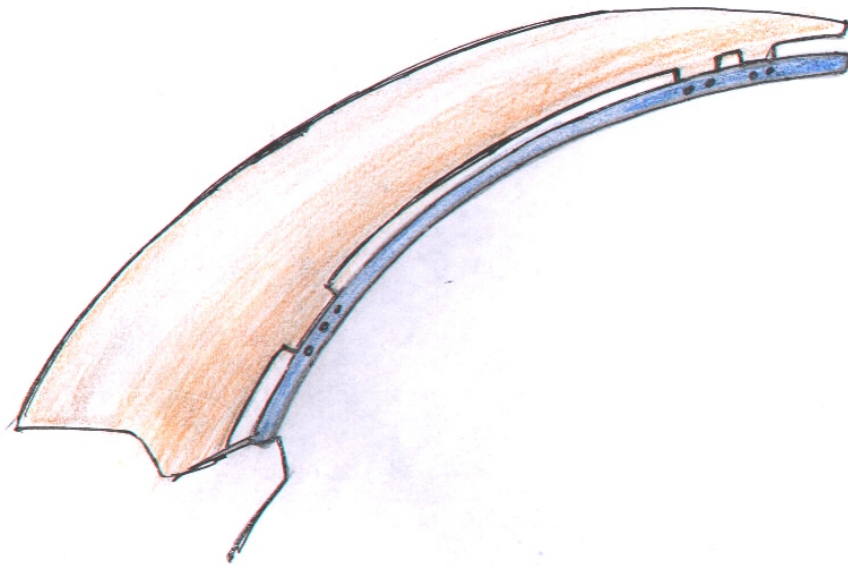
Tentatively final ideas



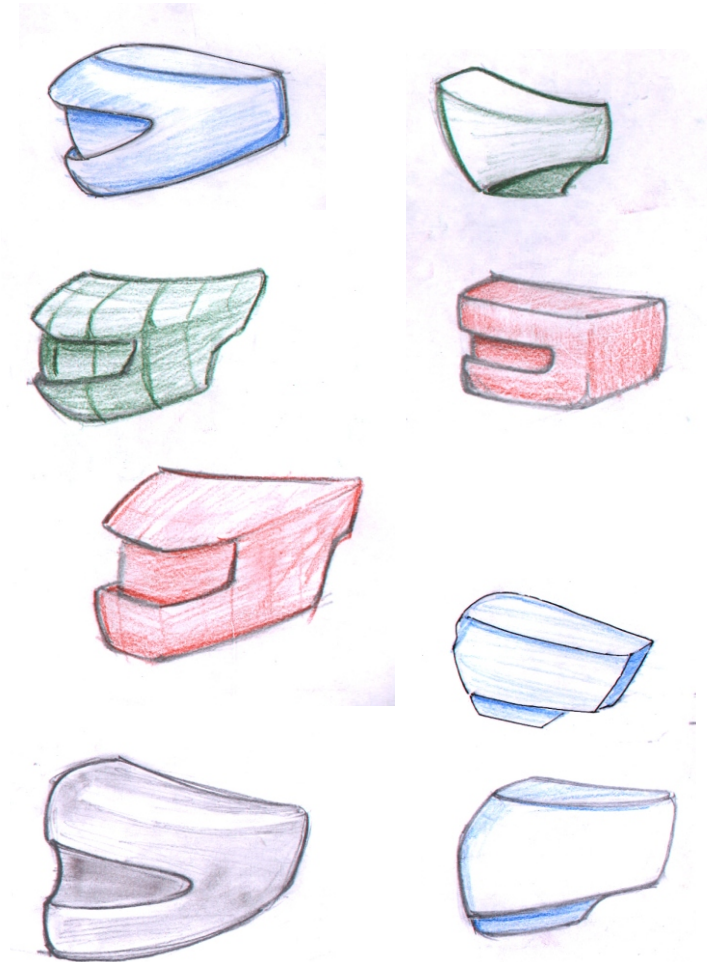
Front suspension



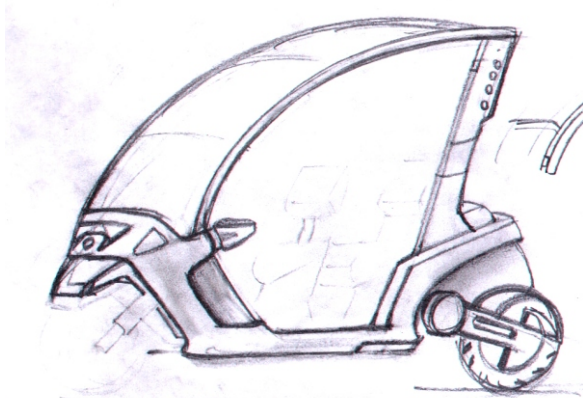
Rear swing arm



Windshield with the side members in steel or aluminum.

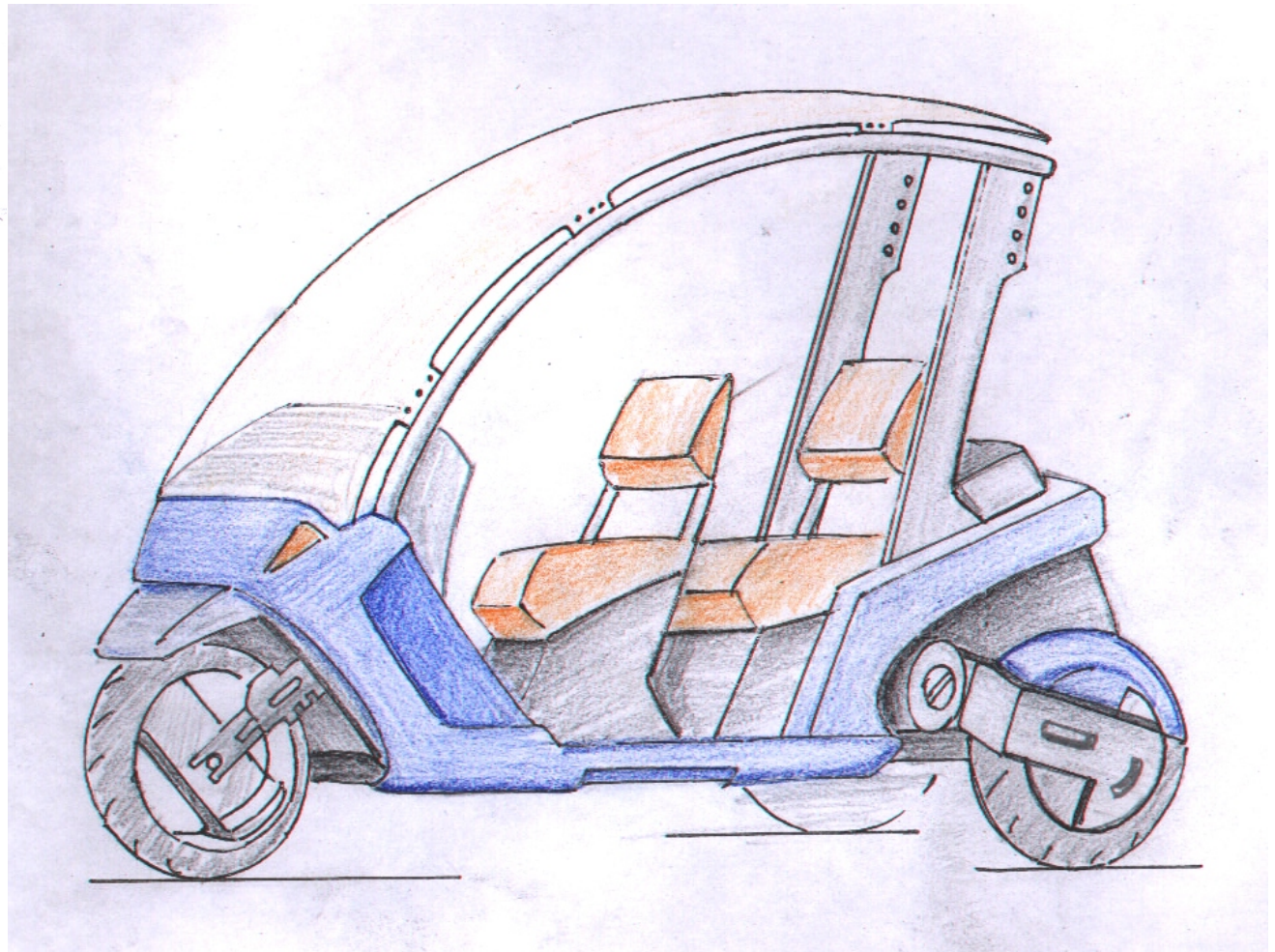


Rear view mirrors

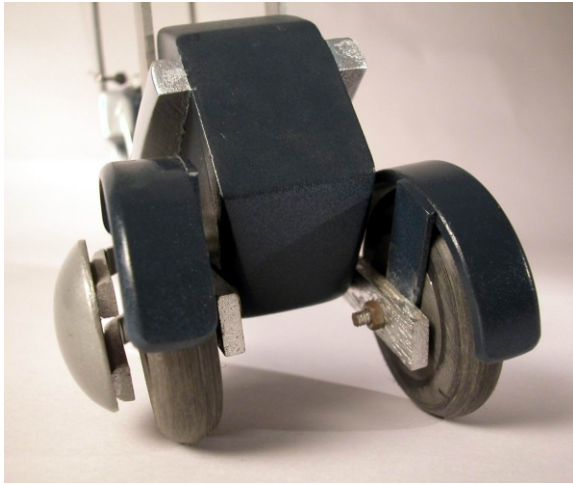


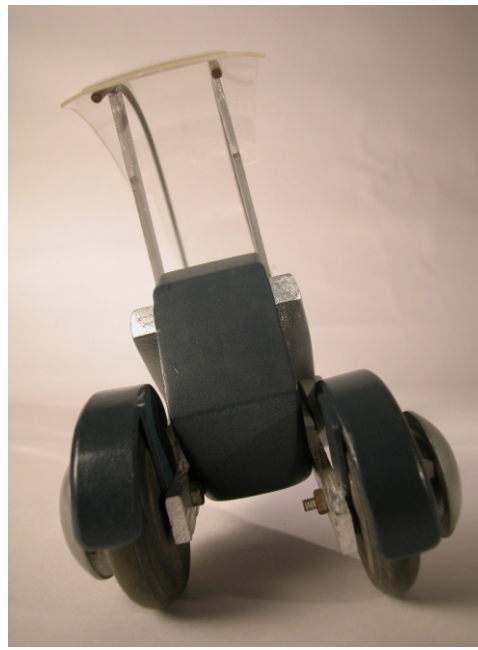
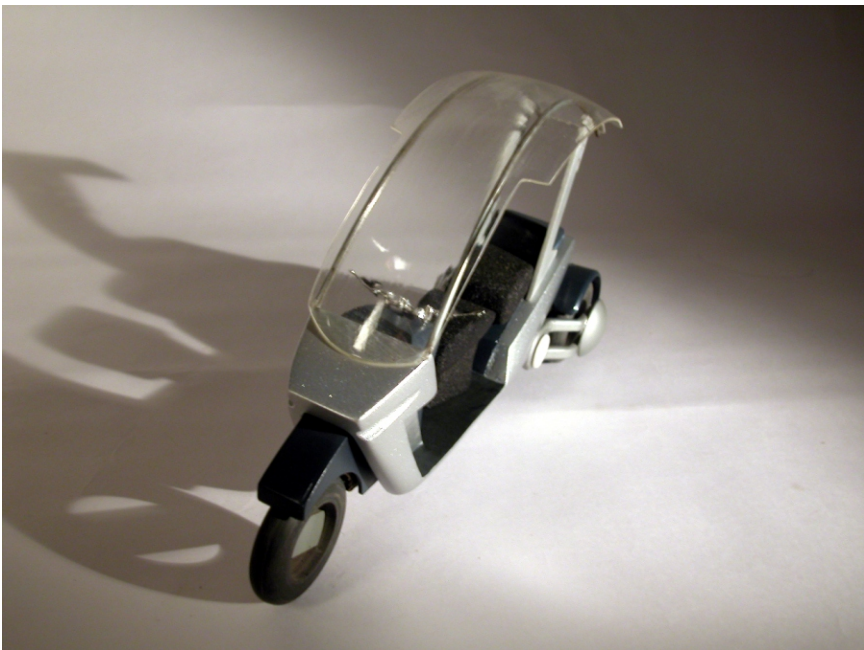
Final form.

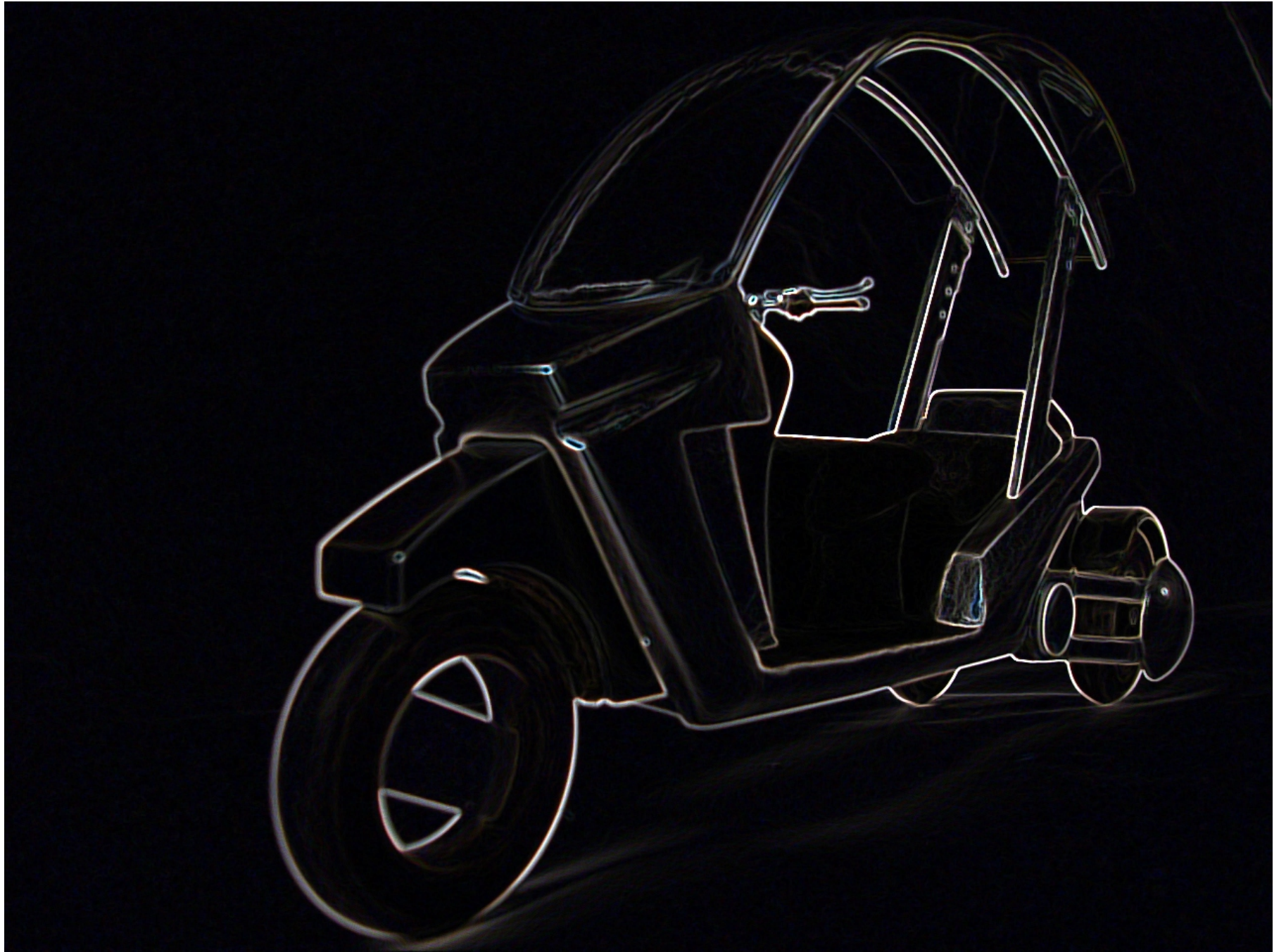
Though still unrefined, the final form will tentatively look like this. Tightening it further is still required.











Bibliography

Indian Anthropometric Dimensions For Ergonomic Design Practice
Debkumar Chakrabarti, NID

Measure Of A Man Human Factors In Design Whitney Library Of
Design 1960

www.motobykz.co.uk

www.ccardesignnews.com

www.economictimes.indiatimes.com

www.maxmatic.com

www.rqriley.com