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Styling of a lifestyle three-wheeled motorcycle for avid elderly users
(post/near retirement)

Design Project III

By Abhishek Gogoi (156390004)
Guided by Dr. Sugandh Malhotra

DECLARATION

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

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APPROVAL SHEET

This Mobility and Vehicle Design project report entitled “Styling of a lifestyle three-wheeled motorcycle for avid elderly users”, by Abhishek Gogoi is approved in partial fulfilment of the requirement for Master of Degree in Mobility and Vehicle Design.

Project Guide:

Chair Person:

Internal Examiner:

External Examiner:

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And last but not the least, I would like to give a huge heads up to my classmates, all the elderly people who gave me their opinions and enriched my knowledge, my parents for their unconditional support and my friends outside of my academic area for their crazy support throughout this journey.

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ABSTRACT

Motorcycling is one of the last freedoms available to those who want the total view, the total sound and, very importantly, the total smell of our planet. Once an avid-rider, remains an avid rider. Also, with time, owning a motorcycle becomes more of a life-style statement. However, motorcycling and age doesn't go hand in hand. As one ages, nearer to retirement, motorcycling becomes challenging.

The main intention of this project, was to design a motorcycle for such riders who can continue riding their passion experiencing the same motorcycle feel minus the risks and certain difficulties that come with it.

Another intention of this project was to style a trike, i.e., a three-wheeled motorcycle as it provides a broader spectrum of safety and comfort. Secondly, the product was designed throughout as to make it viable for the very near future. And thirdly, it must connect to the emotions of the prospective users.

A brief study of the motorcycles of the classic era in India was researched, along with global trends happening in the three-wheeled motorcycle segment. A thorough user research helped in finding out what do the prospective users really wish for while going for motorcycling.

As per the research, the design brief was set to 'Styling of a three-wheeled motorcycle for avid elderly users', with certain parameters to work around – ease of access, luggage bags, a new riding experience. The challenge was

to design it in such a way so it doesn't look as if it is a differently abled motorbike. As the keywords that came out of the survey; grand, classic, larger-than-life and road presence, the final design helped in portraying these characters.

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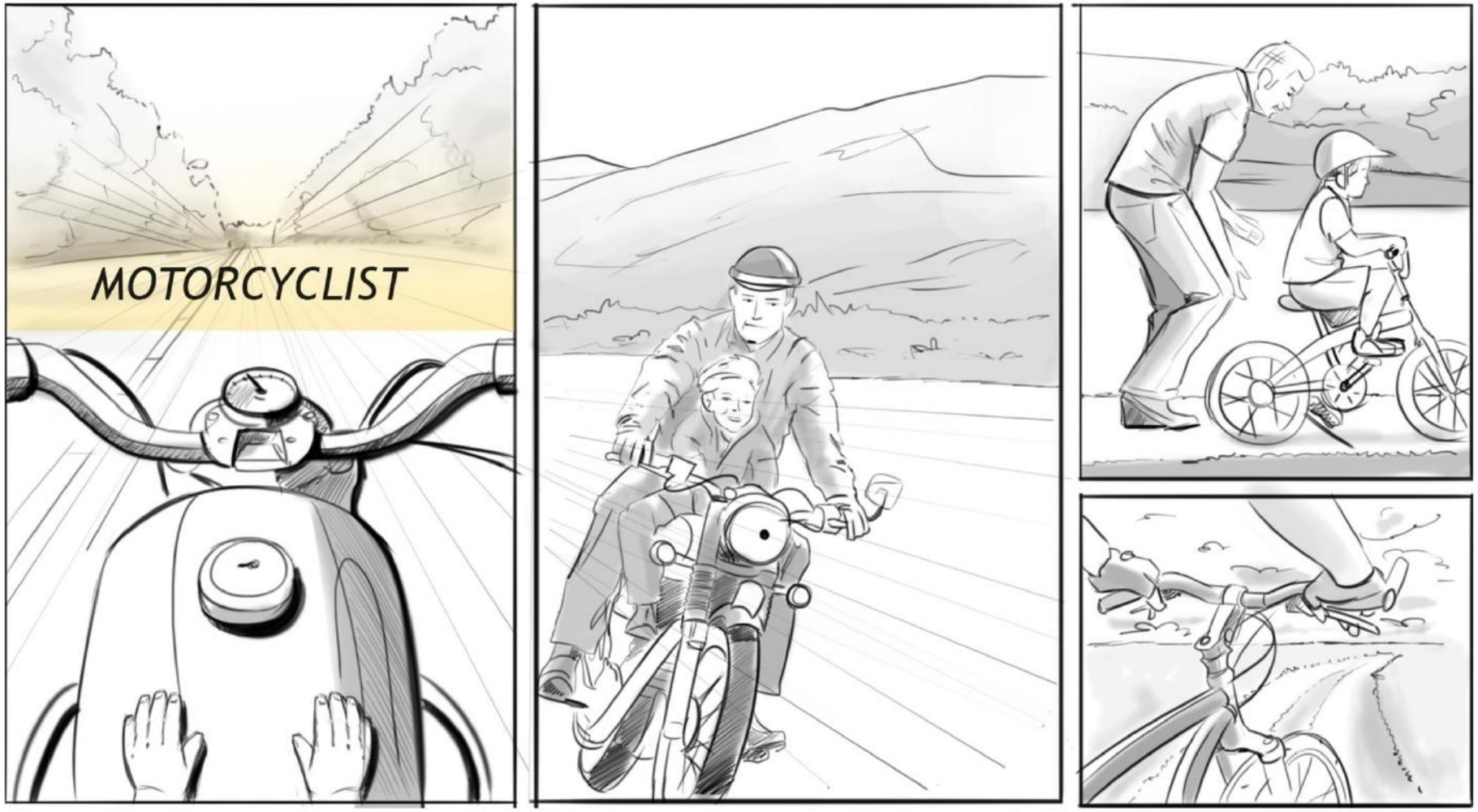
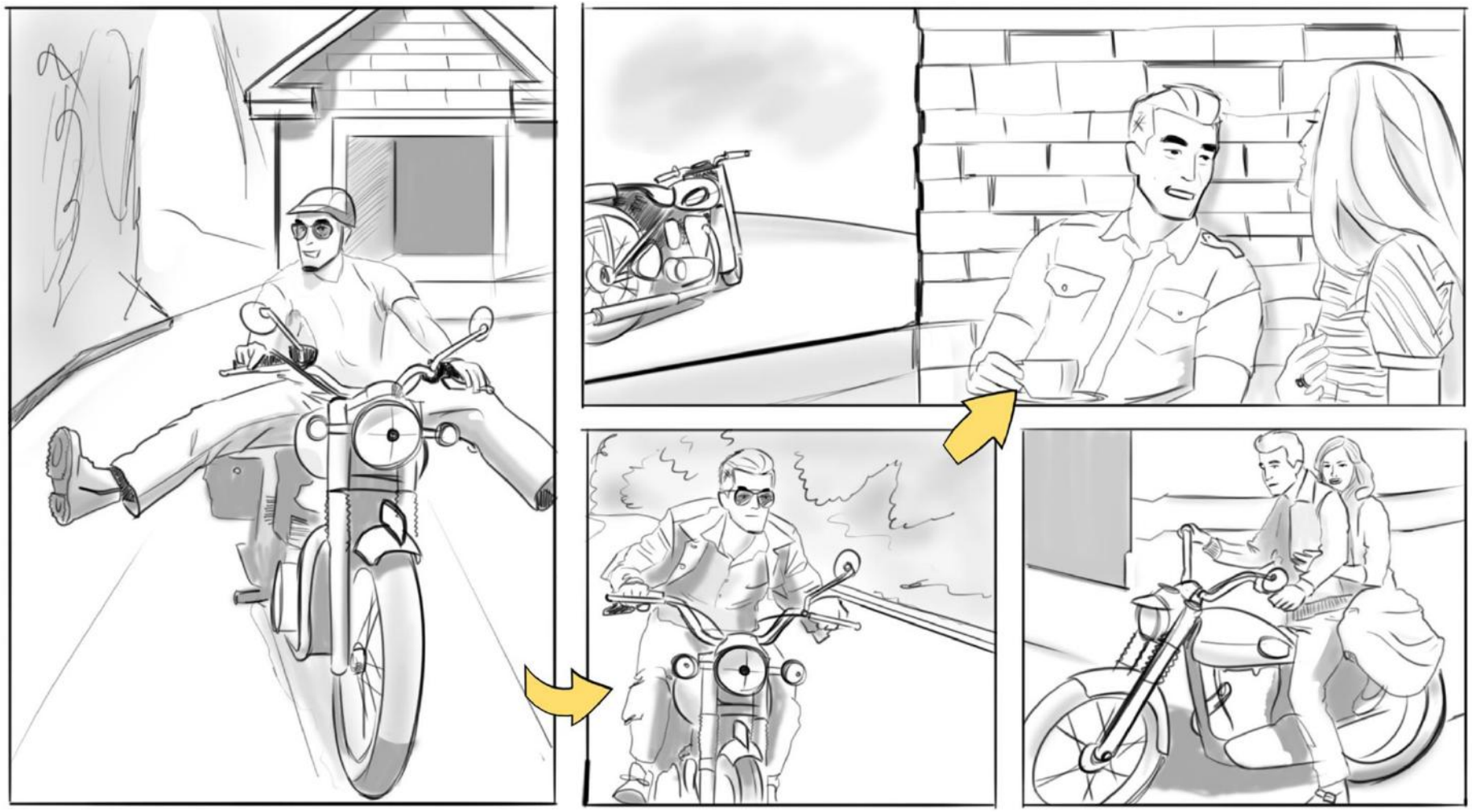
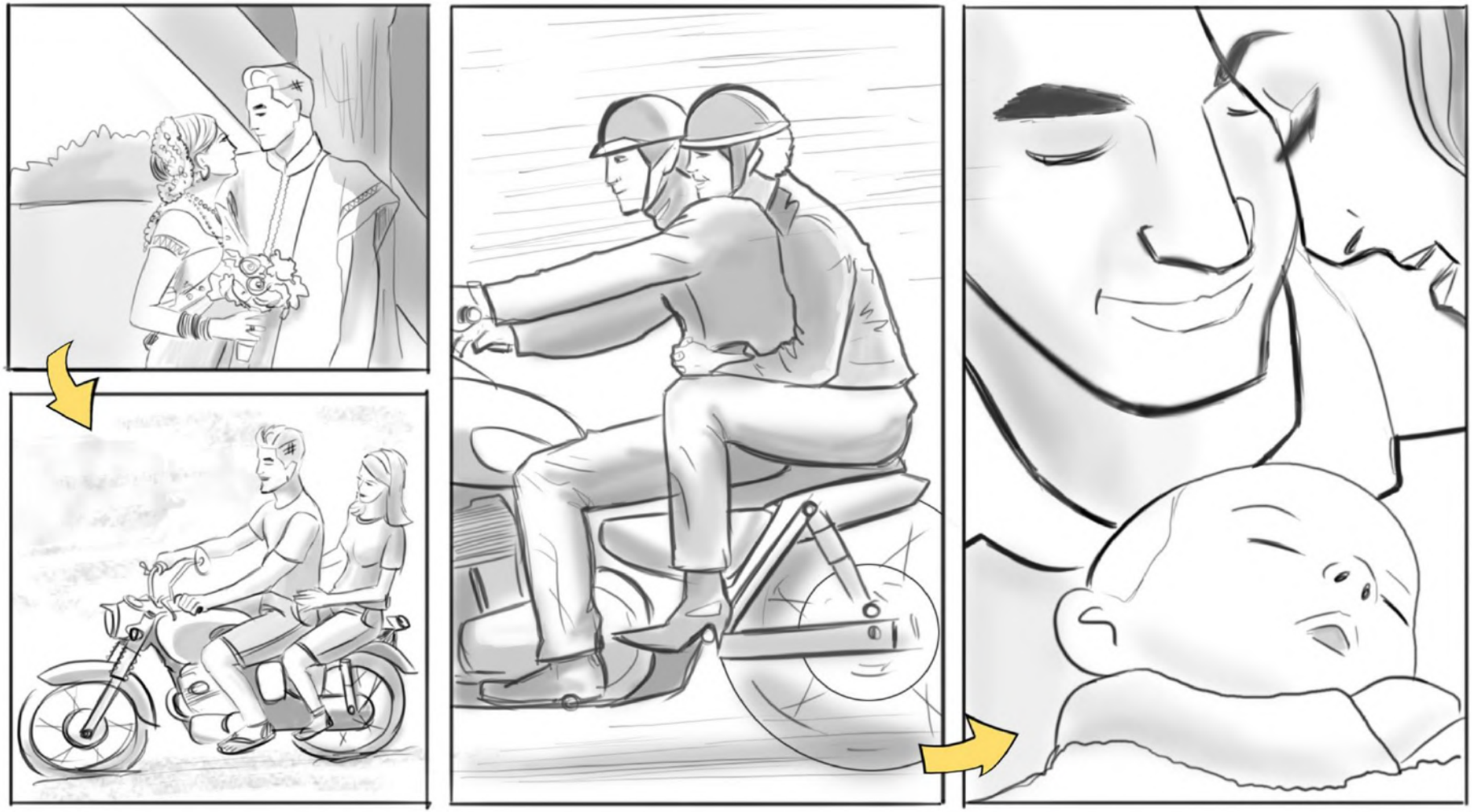
LIST OF IMAGES

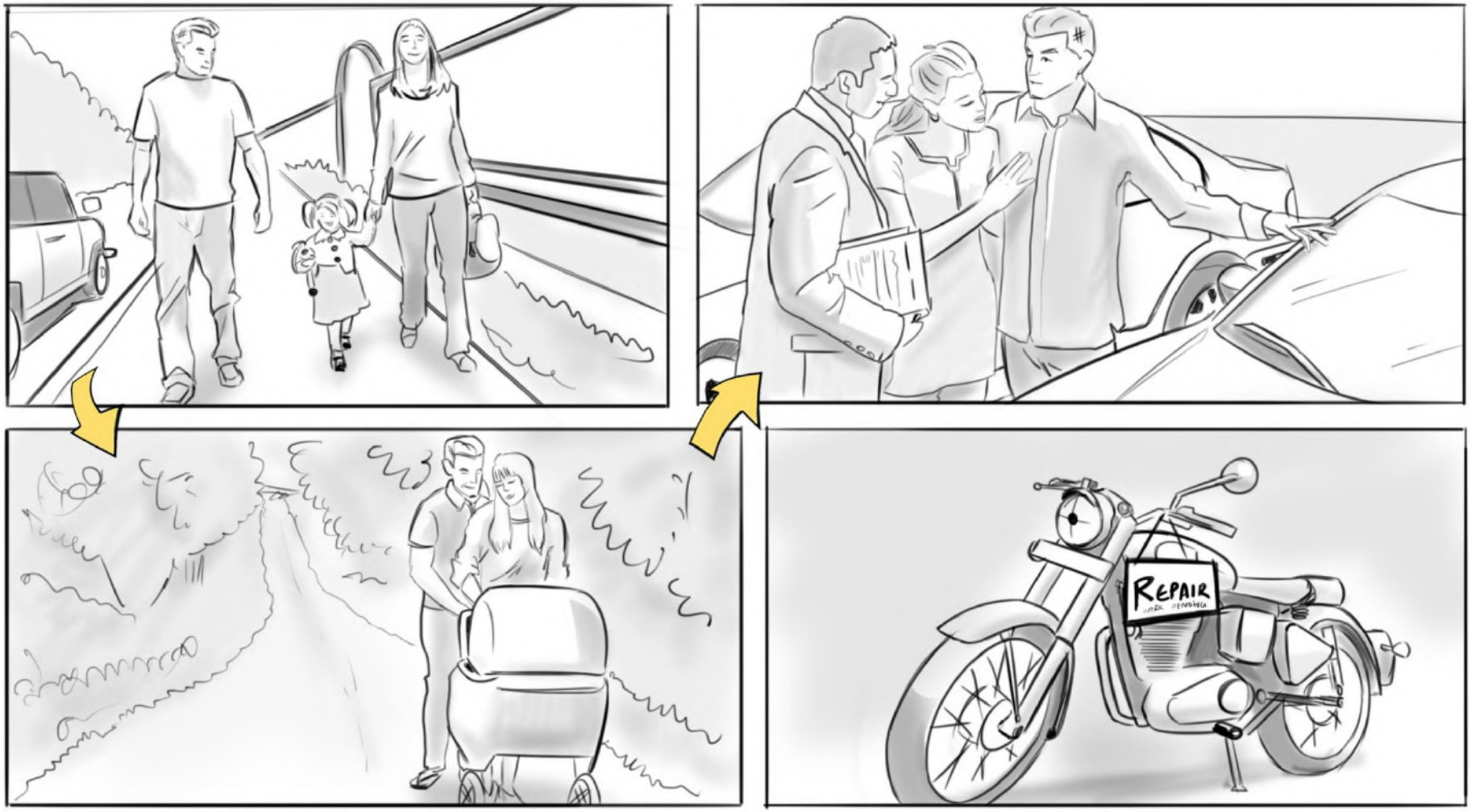
1. INTRODUCTION

The project started with a storyboard, imagining how a motorcyclist is born. The child gets these emotions from the parents; riding on as a toddler. Then a day comes when he first puts his step on a baby tricycle with the help of his parents. As time passes, tricycle evolves to bicycle, and bicycle evolves to a his dad's motorcycle. Growing up with how the family motorcycle is being taken care of right by the hands of his dad, there is a connection that develops between him and the machine. Life takes him to a newer route; going on trips with his friends, finding love, getting married and eventually starting a family. All in this while, with the fast paced growing up, the motorcycle connection somewhere, sometimes dies or weakens. Years and decades pass by, him and his wife's children are settled. One fine event on a random day rekindles their early memories and that triggers in their hearts to start riding again.


MOTORCYCLIST



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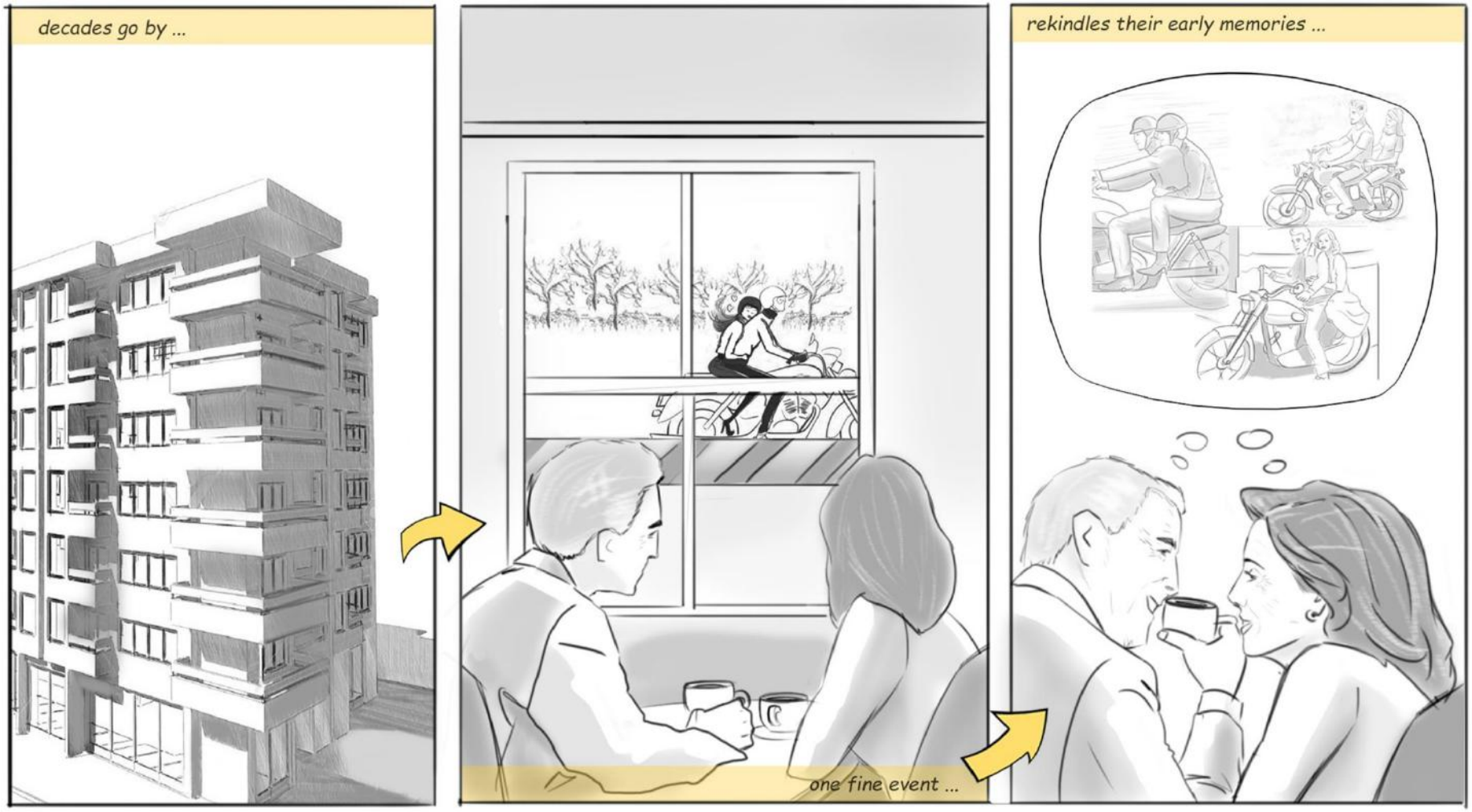

decades go by ...
one fine event ...
rekindles their early memories ...

The storyboard was the inspiration, to do something for them. When we look at the current motorcycles in the market, we have motorcycles ranging from commuters to sportbikes, cruisers to adventure bikes. Looking deeper, we can find, that motorcycles for the younger crowd exist as well as mature crowds exist. But there is nothing that really exist for people who ae around their retirement time, or post retirement age. Although this storyboard was a way to establish the case, it wasn't enough to define the cause and need for this.

The following stages involve finding the real cause, the needs, and is there really an area where a new product could be developed keeping in mind the orginal purpose of designing a motorcycle for the elderly avid riders.

2. STAGE 1

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

This stage basically comprises of the Pre-Research involving motorcycles of the classic era, preliminary user research and analysis carried out in order to build up a case for the project. This is followed by studying what defines a trike (three-wheeled) motorcycle, along with trends in trikes in the global scene as well as Indian. Followed by carrying out a major User Survey by talking to prospective users categorised on the basis of age, sex, occupation. This helped in creating a user profile, which led to product study. This helped in understanding what factor segments a motorcycle into various categories. Further, beyond this is the benchmarking, which is to form a basic level of requirements needed to look upto, or even better it. All this is articulated properly to come up with a concrete design brief.

Following are the contents of this stage:

2.1.1. MOTORCYCLES OF THE CLASSIC ERA

As the prospective users age band is already known, this section involves in studing motorcycles that were there in the Indian market during the years startgin from 1960s to the late 1980s. This study further helped in understanding the design language of the classic era, which came in handy while connecting to the users during the forthcoming research explained in the next section.

FIGURE 1. ROYAL ENFIELD 350

1955

The Enfield Cycle Company, originally responsible for designing and producing the Royal Enfield Bullet, partnered with Madras Company to form Royal Enfield India. The first lot of motorcycle brought purely for the use of Army and the Police, was the Royal Enfield Bullet 350. A fleet of 800 were ordered by the government.

FIGURE 2. JAWA 250

FIGURE 3. YEZDI ROADKING

1960s

Jawa and Yezdi bikes, especially the ones with fuel tank paddings and ignition systems on the fuel tank are now collectors' items. The catchphrase for the bikes sold by the firm was "***Forever bike, Forever value***".

1970s

Introduced in the late 1970s, Yezdi Roadking had a prominent tank and came in Jawa maroon color and black color with gold stripes. It was also followed by another model known as Oil King, launched during the late 1970s, which featured an oil pump for the 2T mix with petrol but later production was ceased.

FIGURE 4. RAJDOOT BOBBY

1973

Rajdoot (Escorts Group) introduced a mini-motorcycle which was a first for the Indian market, GTS Bobby. It used a 175cc 2-stroke engine mated to a 3-speed gearbox.

FIGURE 5. ROYAL ENFIELD CRUSADER

1980s

Introduced in the market targetting th youth, it was powered by a 173cc single cylinder engine. It was quite wirthy to note that a Royal Enfield motorcycle was there in those days with a much amaller displacement engine, unlike what we see today, the smallest of them is a 350cc engine.

FIGURE 6. ROYAL ENFIELD MINI BULLET

1980s

Launched earlier in 1973, named as Enfield 200, but later in the 80s was changed to Mini Bullet 200 as a marketing strategy. Mini Bullet was developed as an advanced version of 173cc Villiers powered crusader and was a first choice among the racing enthusiasts.

FIGURE 7. YAMAHA RD 350

1980s

Escorts Group, manufactured the Rajdoot 350, under license from Yamaha Japan, modified to suit Indian conditions. It was launched in the year 1983. It was primarily targeted at the Royal Enfield Bullet 350, the Yezdi twin was another competitor.

However, the Rajdoot 350 was not a commercial success due to its relatively high consumption in a cost-conscious Indian market.

FIGURE 8. HERO HONDA CD 100

1984

Hero Honda, started its operation in the year 1984, as a joint venture between Hero Cycles (Hero Groups) and Honda Japan, modified to suit Indian conditions. This venture went on becoming the most successful in the Indian history of two-wheeler industry.

The first motorcycle launched under Hero Honda was the CD 100ss. It was powered by a single cylinder 98cc 4-stroke SOHC engine powering 7bhp.

FIGURE 9. SUZUKI AX-100

1984

It was this year that Japanese Auto giant Suzuki came to India as Ind-Suzuki Ltd. One of the first bikes launched was the AX-100.

It was powered by a single cylinder 98.2cc 2-stroke producing 8bhp.

FIGURE 10. YEZDI 175

1985

Ideal Jawa in response to the onslaught of Japanese 100cc invasion, launched a smaller capacity motorcycle named Yezdi 175.

FIGURE 11. YAMAHA RX100

1985

The Yamaha RX100 was launched and produced until 1996. With the failure of the RD350 and the success of Ind-Suzuki's AX100 in the market and masses, Yamaha realized the potential of smaller displacement bikes in India.

The RX100 was one of the most reliable and peppiest smaller displacement bike of the time. Powering the motorcycle was a 98cc 2-stroke single cylinder producing 11bhp, it was also amongst the powerful bikes of yesteryears.

As we can see, from the late 50s to late 90s, there was a shift in the design language of motorcycles. Surface treatment started getting tighter and edgy with more simpler details. The overall volume shifted towards being lighter and nimbler. There was a visible pattern in use of more squarer shape and this basically led to the modern bikes of the previous era. Classic motorcycles as we can see (in India) were mainly Royal Enfield Bullet, Ideal Jawa and Yezdi Twins, Rajdoot Bobby and Rajdoot RD 350. They can be categorized with use of more rounder elements, with more voluminous proportion to it. Also, intricate details can be seen in the way headlights merge with the front forks as can be seen in Royal Enfield Bullet, Jawa 250, Royal Enfield Crusader and Rajdoot Bobby.

2.1.2. **PRELIMINARY USER STUDY (QUANTITATIVE ANALYSIS/QUALITATIVE ANALYSIS)**

After carrying out the previous research, a preliminary user study was carried out. This user research was done to understand what motorcycling means to the prospective users. A quantitative analysis also leads in getting more information on what the product should fulfil based on the user needs. Users were categorized based on age, sex, profession, opinions, interests etc.

The method used for data collection is by a survey. A questionnaire for the survey is prepared, which includes questions regarding users riding status, whether they still ride or they used to ride, questions expressing any of their fond motorcycling memories and, if any, are there challenges that they face and that they feel should be reworked upon.

A few prospective users were approached and the collected information was analyzed to find out what are their needs that must be taken in consideration to proceed further with the designing of the motorcycle.

The following page shows the questions asked and the results obtained in this preliminary user study.

A short survey

Dear ones, answering this google form will help me establish my case! :D It is for my final semester Design Project. Thank you! :D

*Required

1. **Please enter your name here! :)**

2. **Your age:**

3. **And your profession:**

4. **Do you ride motorcycles? Or do you used to ride motorcycles?** *
   Mark only one oval.
   - ◯ I used to — *Skip to question 5.*
   - ◯ I still do — *Skip to question 6.*

Untitled section

5. **Why have you stopped riding?** *

Untitled section

When you look at these bikes; Picture 1

Jawa 250 'A' Type

Royal Enfield Bullet

Picture 2

Yezdi Roadking

Picture 3

Rajdoot Yamaha RD 350

Picture 4

Rajdoot Bobby

6. **Which one reminds you of your best memories?** *
   Mark only one oval.
   - ◯ Jawa 250/Royal Enfield Bullet
   - ◯ Yezdi Roadking 250
   - ◯ Rajdoot Yamaha RD 350
   - ◯ Rajdoot Bobby
   - ◯ None of them.

7. **Any specific reason on why the chosen picture? Feel free to express your heart! :)** *

8. **No restrictions, would you own a new motorcycle now?** *
   Mark only one oval.
   - ◯ Yes
   - ◯ No
   - ◯ Maybe

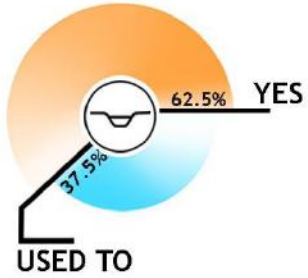
9. **How do you explain your perfect motorcycle ride?** *

10. **If there is a motorcycle that addresses most of your concerns, how would you use it?** *
    Mark only one oval.
    - ◯ Long distance/Adventure trips with spouse
    - ◯ Solo riding
    - ◯ Both

QUANTITATIVE USER ANALYSIS

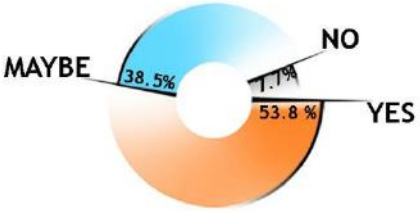
- **Age:** 55-63 years
- **Occupation:**
  - Navy Officer (1)
  - Pawan Hans Pilot (2)
  - Indian Armed Force (2)
  - Indian Armed Force Retd. (2)
  - IOCL (1)
  - OIL Retd. (1)
  - Service (1)
  - Service in PSU (1)
  - Tea Taster and Auction buyer (2)
  - Teaching (1)
  - Creative/Art/Director (1)

DO YOU **RIDE** MOTORCYCLES ?



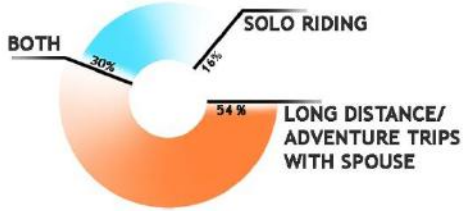
WHICH REMINDS OF YOUR **BEST** MEMORIES ?

WOULD YOU **BUY** A MOTORCYCLE **NOW** ?



IF ALL THE CONCERNS ARE ADDRESSED
WOULD YOU BUY A NEW MOTORCYCLE ?

HOW WOULD YOU LIKE TO USE IT ?



QUALITATIVE USER ANALYSIS

Ravi Malhotra, 59Y

Pilot, PAWAN HANS Co. Guwahati

" I use the regiment's Classic 500. Couple of times during weekends, me and my wife, have gone on trips to Shillong, Tezpur and Nagaon from Guwahati. It was one of the few things we look forward to."

Debajit Phookan, 60Y

Teaching, Guwahati

" Jawa was the bike on which I learned to ride back when I was in class 6 and Enfield was my first bike. I still ride motorcycle. It is a style statement. Currently I own an Enfield Classic 350."

Col. R. K. Talukdar, 62Y

Retd. Army Officer, Delhi

" Being mediocre in height and prevailing style among middle class bachelor I chose Yezdì .It was very reliable, easy handling and affordable then. Style and usefulness are factors generally considered after forty plus."

Nitin Poddar, 63Y

Retd. IOCL Officer, Mumbai

" I learned riding motorcycle on my father's bullet. it will always remain a special one for me. I stopped riding after me and my wife had our first child as we decided to upgrade to a car. "

Rupjyoti Baruah, 59Y

Oil India Limited Officer, Duliajan

" RD 350 was the rocket of our time. Even though I have just recently bought myself an Avenger, I only wish I was young enough to get a RD 350. Of course, given the fact that it would be comfier, I would definitely go for a new one."

Dr. A V K Mohan, 60Y

Management at Hospital Administration, Hyderabad

" I enjoy riding both motorcycle as well cycling. I am highly passionate for running as well. I have recently done a trek from Kanyakumari to Kashmir. Regarding motorcycling, I owned a TVS Fiero in which I had done my North-East expedition in 2014. "

KJ Singh, 59Y

Indian Armed Service.

" I love Royal Enfield. I have the Thunderbird 500 with me currently. I am quite passionate about riding. I have been to Leh, Ladakh and also riding in Siachen is beyond words to express. "

Satyajeet Chaudhury, 56Y

Tea Taster and Auction buyer, Guwahati

" More sturdy and heavier. Therefore good to balance. I used to ride motorcycle, but that was long ago. Now, thinking of buying a motorcycle won't occur to my mind, because i am more comfortable with four wheelers now. "

QUALITATIVE USER ANALYSIS

Surajit Phukan, 56Y

Tea Auction Centre, Guwahati

" I learned riding on my father's Jawa. My first motorcycle was an Enfield Bullet. It has been more than 20 years now, and my wife quite recently gifted me a Thunderbird on my birthday. "

Parth Bora, 56Y

Service in PSU, Mumbai

" My brother used to have a Yezdi, which according to me was making good sound and it appeared to be a sturdy bike in those days. Although I have been more of a scooter guy, I might be interested in a motorcycle."

D'Com Bhuyan, 57Y

Film & Theatre Director

Enfield 350 was the first motorbike I drove. Back in the days, there were very few bullets in our locality. And i was so passion-ate, that i could make out who is coming on his enfield just by the sound of it.

2.1.3. **INFERENCES** FROM PRELIMINARY USER STUDY

After gathering all the data and information, quantitative as well as qualitative analysis; it was found that majority of the users still seemed passionate about riding a motorcycle. Although very few of the users still owned a motorcycle at their current age, but a couple of other users had done rented rides with their spouses on weekend basis. Style and usefulness were two of the other major factors that comes in their need in buying a motorcycle.

A major reason of discontinuing riding a two-wheeler is the phase of starting a family, where they would upgrade to a much more spacious vehicle, case in point, a four-wheeler.

One common thing was there in these users; all of them had fond memories of riding motorcycle. One user in fact described his perfect ride in quite a detailed manner stating,

"I like wide bars, I have in fact changed my standard handlebars into a custom wide bar. As I like going on long rides with my biker buddies, and tried the Harley 883 and the Glide, I found 883 to be friendlier than Glide. I prefer a little shorter bike. I really don't like motorcycles like the ones which we see today. My perfect ride should be something with classic looks, manly presence comfortable seating and handlebars. And yes, more importantly, I need luggage bags, as can be seen in my standard 350, I have put racks around it."

Therefore, we can see an interest in these users willing to go for a motorcycle, if it deals with their concerns.

However, this research was still a preliminary one, i.e., was done online by sending questionnaire to the prospective users. A more detailed personal interview with the users was still pending, which would give a deeper and a better insight into what a customer really wants in their product.

2.1.4. **USER RESEARCH (QUALITATIVE ANALYSIS)**

Once the trike study was done following the preliminary user study, a more in-depth research of the prospective users was much needed. In this section users were met in person, they were casually asked to speak about their motorcycling experiences, instances like any stories they have that they'd like to share regarding motorcycling. They were then made to get accustomed about what the project was dealing with. This helped them open-up about a lot of issues and wishes that they want to be looked at if a new motorcycle is to be designed keeping their choices in place. This entire process was recorded in video, to be able to get a look at it over loops to get a better understanding about what their passion is, what lifestyle do they live, what styling preferences they have, etc.

This also helped in creating a user persona based on their views, lifestyle and preferences, which further helped in categorizing what type of vehicle will suit them the best.

The following section has stills from the video being recorded as they spoke about their rides, memories and concerns. On average, a user spoke for about 7 minutes. The longest was a duration of 18 minutes. This interaction really helped in getting a direction towards setting up the design brief.

USER STUDY (QUALITATIVE ANALYSIS)

Parag Dutta, 57Y
Tea Estate Sector

" Essentially, I am quite a motorcycle freak, but I owned only one motorcycle ... ***unfortunately I had to sell it as I bought myself a car*** *..."*

" I really should have ridden more, ***I regret I didn't ride as much as I should have*** *..."*

" I am a fan of heavier motorcycles, I am biased towards it, it is more stable, for my style, ***I like some power ... essentially more like a cruiser ...*** *"*

" Interestingly my son has the Yamaha R15, ***I find it really hard to climb on it, let alone ask my wife to sit on the rearseat*** *..."*

USER STUDY (QUALITATIVE ANALYSIS)

D'Com Bhuyan, 57Y
Film & Theatre Director

*" The new style that we see, having mo-no-shocks and stuff, it doesn't fascinate me. For me, i**t has to be the classical look, that's where I've grown up** ... ofcourse I know the new thing is the trend but **I like the iron** ... "*

*" It should be heavy, I like the feel that an enfield gives. It is stable, on straight roads, you don't feel phased out ... **again for me the design has to be classic** ..."*

*" ... three of my friends just came from South Dakota, international riders hub, many of the families came on harley trikes ... **it's a different feel, riding with family** ... "*

USER STUDY (QUALITATIVE ANALYSIS)

Col. S P Aggarwala, 63Y
Army Officer (Retd.)

*" I would prefer my bike to have a low seating, because **I like to have my feet placed firmly on the ground** ..."*

*" The handlebar should not be too wide, **it should just be around my reach**, so i know what I am controlling ..."*

*" As we just discussed, one with two wheels at the back, then one with two wheels at the front, **I would want one that is better balanced and safer**, as I cannot afford to take a fall at this age now... "*

*" I'd like to add that **sound is something that I really fancy**, i still remember the sound of enfield 350 ... "*

USER STUDY (QUALITATIVE ANALYSIS)




Debajit Phookan, 60Y
Teaching/Businessman

*" I like the idea of a three wheeler, i**t is like the perfect get-away kind of thing** ..."*

***" I would want my handlebars to be in such a way, that my back is always straight** ... at this age, I really do not need to bend on the tank and ride ..."*

*" the current bikes that we see, they are impressive, nibby, good pick up ... **but my interest still lies in bullets, jawa, the classic looks and the stance** ..."*

*" the getting on the bike and out should be easier, **I don't want it (seat) to be in a position that I have to jump on and off** ..."*

USER STUDY (QUALITATIVE ANALYSIS)

Madhumita Dutta & Raj Dutta, 57Y, 58Y
Service in Government

*" I have always **preferred a scooter more than a motorcycle, as it is easier for me to climb on the seat** ..."*

*" One very annoying thing that keeps happening is when someone is sitting at the back, for instance; when I am in a traffic situation and **I have to put down my feet to ride slow, my daughter's foot keeps hitting my leg** ..."*

*" Also, the rear footrest are not good, **I really have to stretch and twist my legs to have a grip on it** ..."*

*" considering my back issue, **an upright seating position is a must**, so my back and hands don't feel stressed ..."*

2.1.5. **INFERENCES** FROM THE USER STUDY (Product Need)

Conducting out this user study was fruitful as it helped give a better understanding on what do users want.

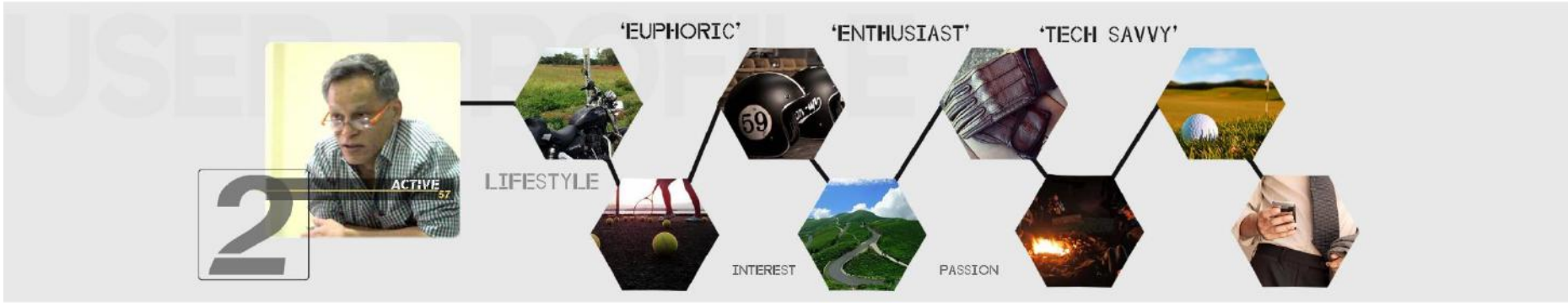
When we look at the analysis from the point of motorcycle aesthetics, we can see a major trend in users wanting the classic motorcycle looks. Reason – because it was the type of motorcycle they all grew up with, learnt their first ride on and eventually went on buying themselves one. Users prefer motorcycle that are heavier than the ones that we see today. They also do not prefer lighter bikes having 100-150cc. 'Grand', 'right from the heart', 'emotional connect' are some of the key expressions these users spoke about. Many of the users pointed out the interest in showing more machine stuff; as can be seen in one user saying, "I like the iron". We can conclude that aesthetics of the motorcycle must speak of the classic era. The ride that helps them connect to their times.

Now analyzing at it from the point of usage, here we can find a strong urge in wishing to use it more as cruising than short city distance trips. They prefer power, not the outright acceleration of the modern motorcycles that we have, but more of a stable road presence connect. They do not look for twisting turning ability but rather stability. Users look for a motorcycle as a perfect family get-away kind of trip. Some of the riders even prefer going on trips with their so called 'brothers from another mother'. The passion for riding is still young and alive.

Although only two users talked about luggage carrying ability, but it is evident that if the mode is of cruising nature not within the short city distances; a way to store luggage must be there.

And now, coming to the point of addressing users riding concerns, the ingress-egress must be easier, it should not give the user an intimidating feel when they look at the motorcycle. Issues like footrest placement should not hamper pillion and rider comfort. Pillion comfort is a must; hence the seat design should not be compromised or should not seem as if it is an additional fit onto the rider's seat. Lastly, the riding position must be upright so it does not hurt their back and put stress on their wrist and neck area.

2.2. **USER PERSONA**



2.3. **PRODUCT STUDY** (What makes a Cruiser?)

After analyzing what the users' needs and concerns are and thereby creating a generic 'User Persona' to obtain a target to design the vehicle around, it was fixed that the motorcycle trike must be designed as a cruiser bike. This section shows the study involved in understanding what kind of proportions, seating, ergonomics, stance defines a motorcycle. For this, various categories of long ride motorcycles were searched and their design were studied. In short, this study is to find out what makes a motorcycle a comfortable cruiser.

To proceed with this study, motorcycles ranging from classics, to cruisers to power cruisers were individually studied, for a motorcycle to be ergonomically comfortable, the first factor is to find the three points forming a triangle, i.e., H-point on the seat, handlebars and footrest. Once you join these points, a triangle is formed and the angle which the lines make with the perpendicular from the ground is what defines the ergonomics of the motorcycle.

Another aspect that matters in the design of these motorcycles is the rake angle and trial. Rake angle can be defined as the '*angle between a line; drawn through the handlebar pivot point; intersecting at the ground, and a line drawn perpendicular through that intersecting point*'. And trial can be defined as the horizontal distance between the point of contact of the wheel with the ground and the point at which the rake angle line contacts the ground.

The following section shows the study conducted.

2.3.1. **CLASSIC CITY MOTORCYCLES**

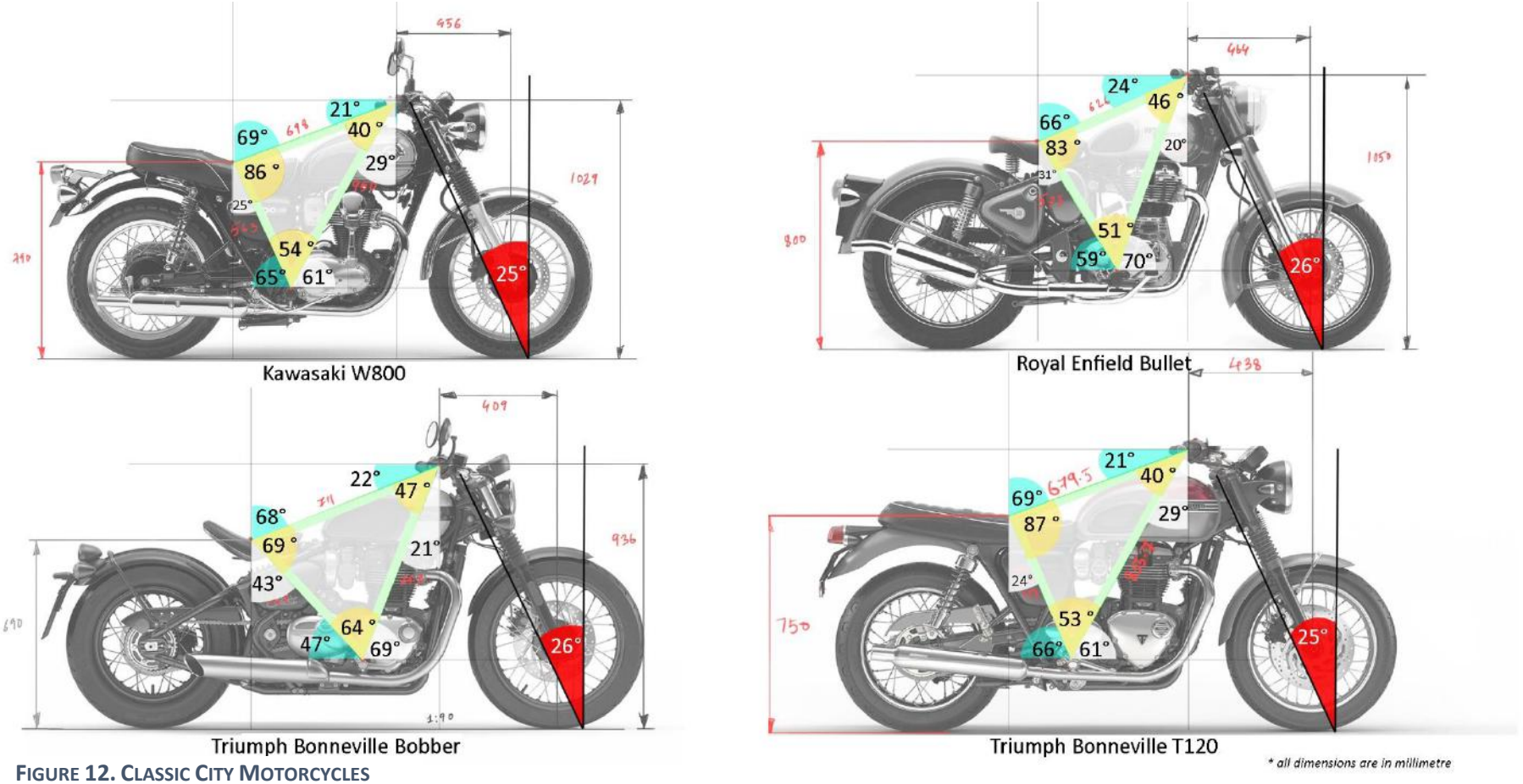


FIGURE 12. CLASSIC CITY MOTORCYCLES

2.3.2. **POWER CRUISER**

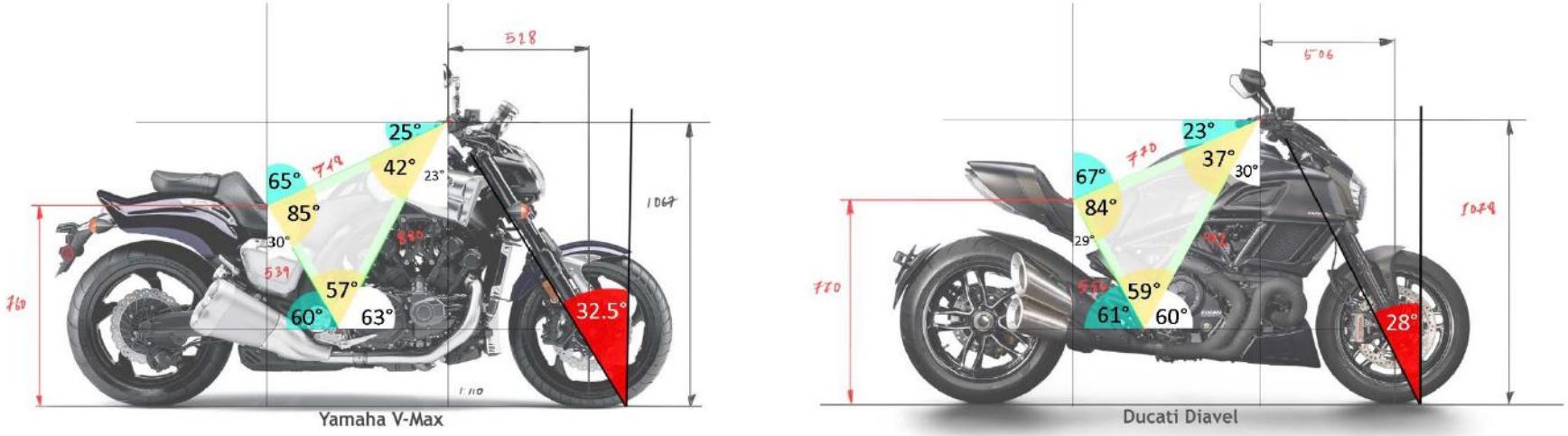


FIGURE 13. POWER CRUISERS

2.3.3. **CRUISER MOTORCYCLES**

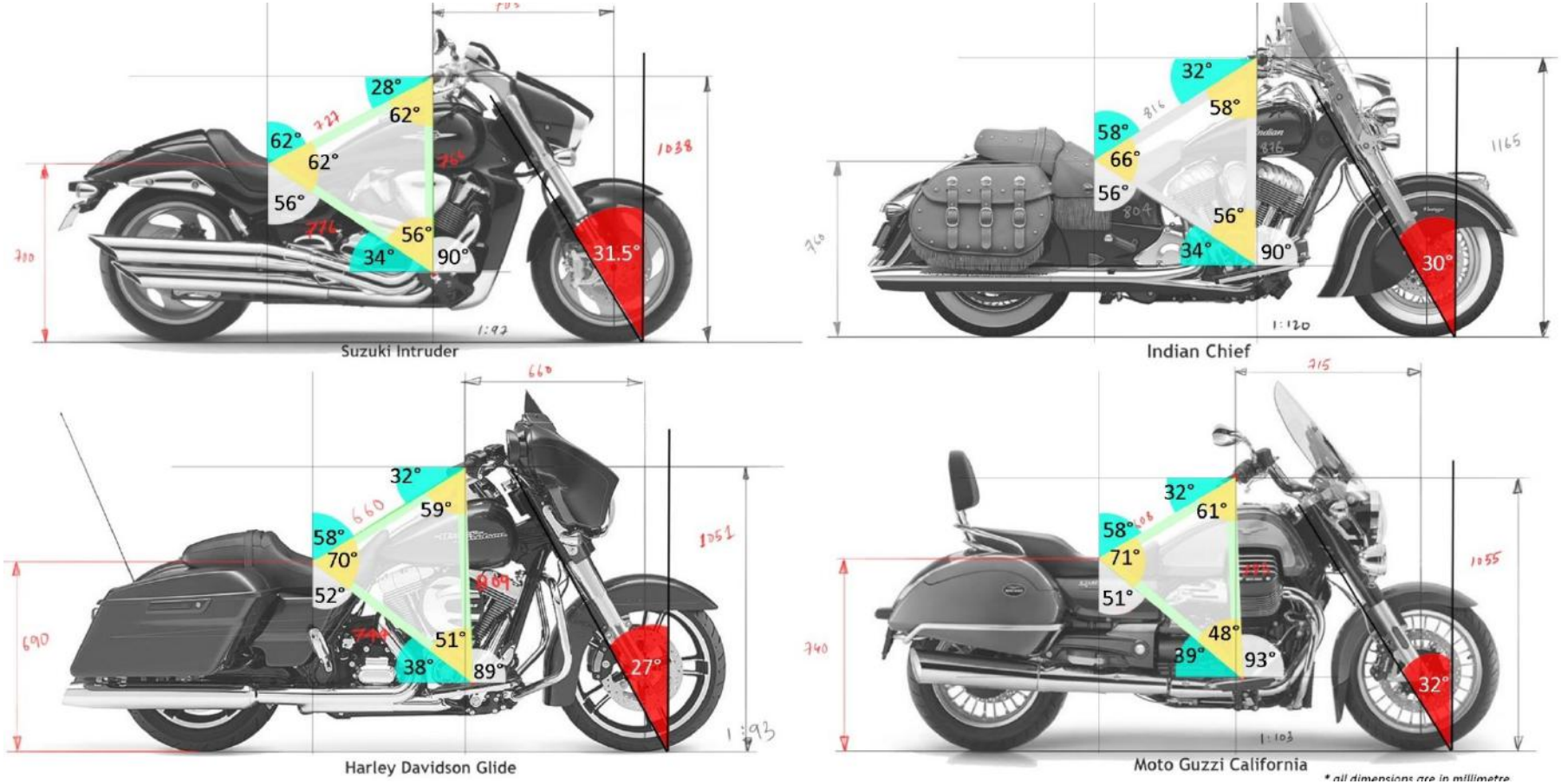


FIGURE 14. CRUISER MOTORCYCLES

2.3.4. **INFERENCES**

We can notice from the above diagrammatic study that, classic city motorcycles have the least rake angle, ranging between 25° and 26°. Any rake angle beyond 27° shifts the stance towards power cruisers and cruisers.

Now, regarding the triangle formation, there is a similarity between classic city motorcycles and power cruisers. All the angles that the line from foot-peg to handle bars make, ranges from 60° to 69°. This results in a more bent knee ergonomics. Cruisers on the other hand have upright angle, in most cases 90°. This results in a more relaxed posture for the rider's knee angle.

Looking at the angles that the line from seat H-point and handle-bars make. We find that, the classic city motorcycles make angles ranging between 21° to 24°. Power cruisers also form similar angles, between 23° and 25°. Cruisers again, have a different stance, their angles are much larger ranging between 28° and 32°. This results in cruisers having a raised handlebar, thereby providing a much upright sitting posture.

Therefore, the design consideration for this project must stick within the dimensions found in the cruiser segment. This would help in setting up the next stage, i.e., benchmarking. Another consideration that needs to be looked is, since streets in India aren't as big and wide as the motorcycles where these have been designed for (i.e., mostly American continent), the motorcycle's wheelbase for this project should fall in between a city motorcycle and a cruiser.

To conclude we can say the following points:

- Rake angle should be between the largest of city motorcycles and the lowest of the cruisers.
- Knee angle must be maintained like cruisers, i.e., 90°.
- Top line of the triangle angle must range between 28° and 32°.

2.4. **BENCHMARKING** (Dimensional benchmarking)

Once the parameters for vehicle ergonomics were set, there was further need to study cruiser motorcycle in India, as the design is intended to be used by Indians. The two most popular cruisers in India are Royal Enfield Thunderbird and Bajaj Avenger. Also, keeping in mind, the project deals with styling of a 'trike' and none of the current vehicles are trikes, hence some 'pre-brief' brainstorming and ideation on how the approximate chassis layout could develop must be done. This would help finalizing the design brief giving it a concrete foundation and justification.

This section consists of the followings:

2.4.1. Ergonomic Study of Indian Population

2.4.2. Inferences from Ergonomic consideration

2.4.3. Benchmarking based on current/outgoing products

2.4.1. **ERGONOMIC CONSIDERATIONS**

Based on Indian Anthropometric Data

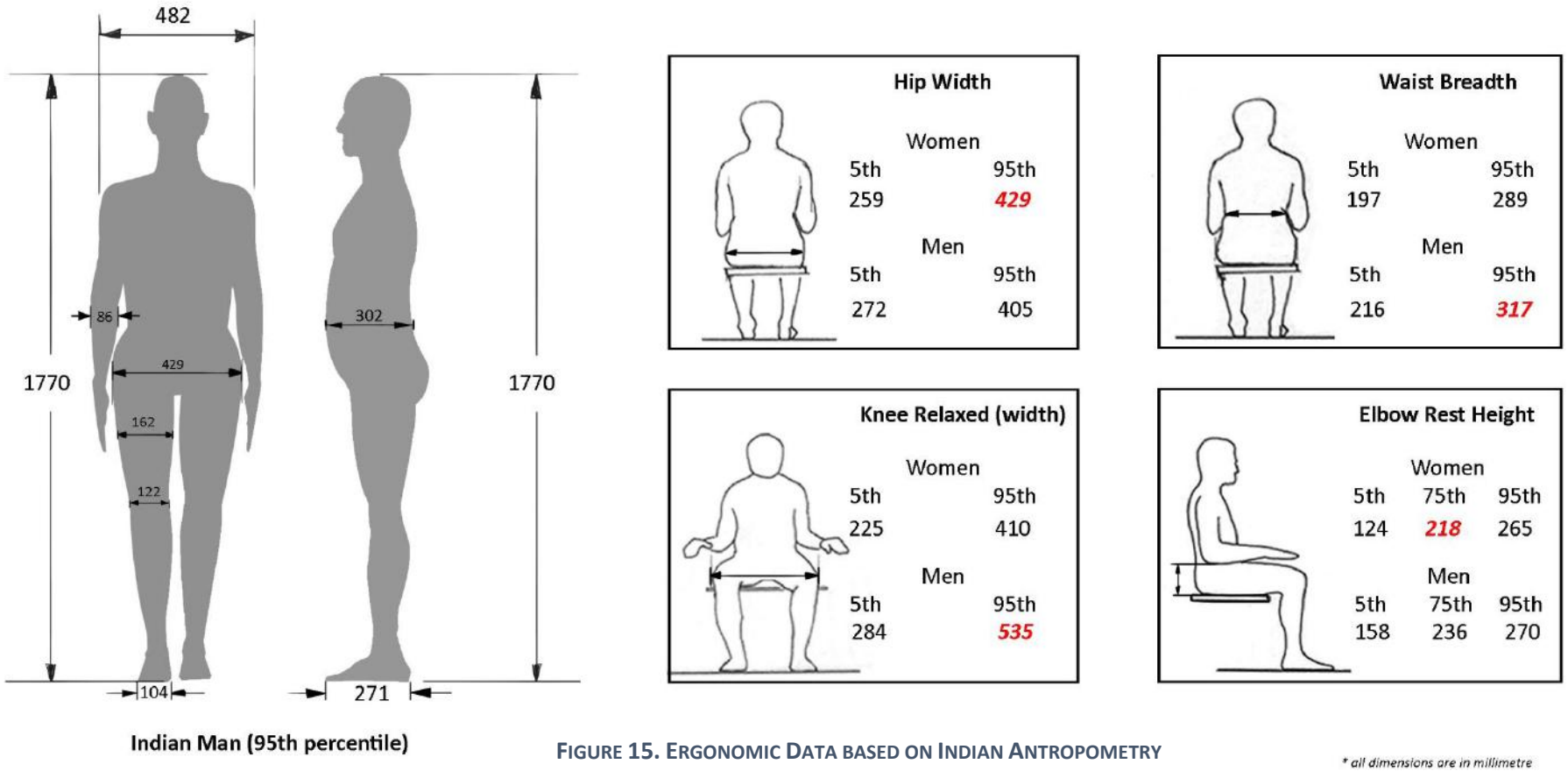


FIGURE 15. ERGONOMIC DATA BASED ON INDIAN ANTROPOMETRY

2.4.2. **INFERENCES**

Apart from the regular anthropometric date of Indian men based on 95th percentile (according to *'Indian Anthropometric Dimensions for Ergonomic Design Practice by Dr. Debkumar Chakraborty*'), some other data as shown inside the boxes are must to be considered while designing the seat especially for the rear passenger. The traditional motorcycles that we see, do not really have seats designed for optimum comfort for pillion riders. They are designed more as an additional fit. But here, that approach cannot be done.

- The dimension of the seat butt width must be adhered around the anthropometric data of Hip width, i.e., 429 mm. Also, maximum seat width should not exceed the relaxed knee width of women, as it will cause discomfort. Hence the maximum seat width should be approximately 400-410mm.
- Considering back-rest design, the width of the it should be designed keeping waist breadth dimension as its limits. 317mm is the 95th percentile of Indian men data, while women have 289mm. The back-rest width should range between these two ranges.
- For a comfortable ride, the pillion should be able to rest their forearms. An arm rest design is must. For this, 'Elbow Rest height' should be considered, and we find that in this case, 75th percentile of women is the ideal value, i.e., 218mm from the seat height. This is the ideal height at which the arm rest must come. And width of the armrest should be approximately 100mm to accommodate forearm width of 89mm as per the anthropometric data figures.
- Lastly, for foot-peg design, the dimensions should fit the foot in full comfort. As per the data, its approximate dimensions be ~271mm x ~104mm.

2.4.3. **BENCHMARKING BASED ON CURRENT/OUTGOING PRODUCTS**

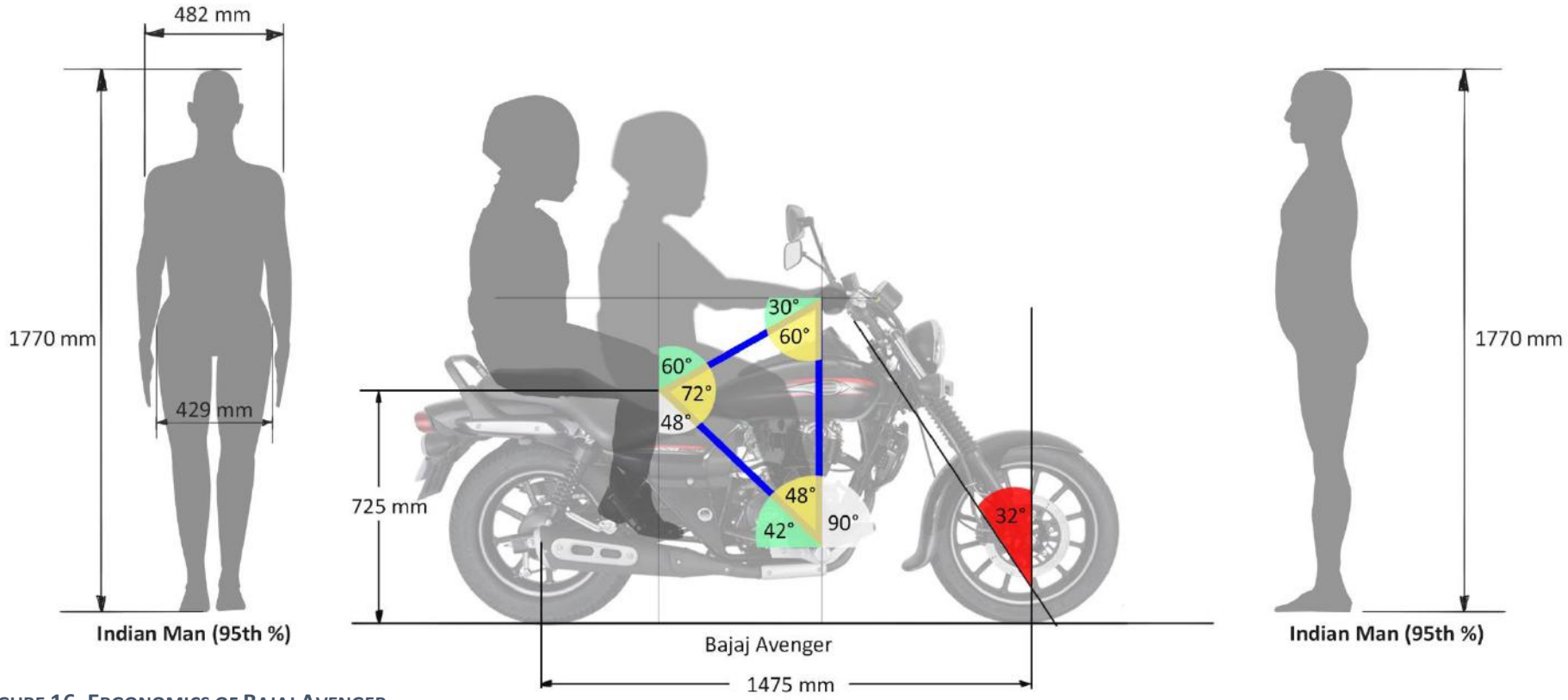


FIGURE 16. ERGONOMICS OF BAJAJ AVENGER

2.4.4. **BENCHMARKING**

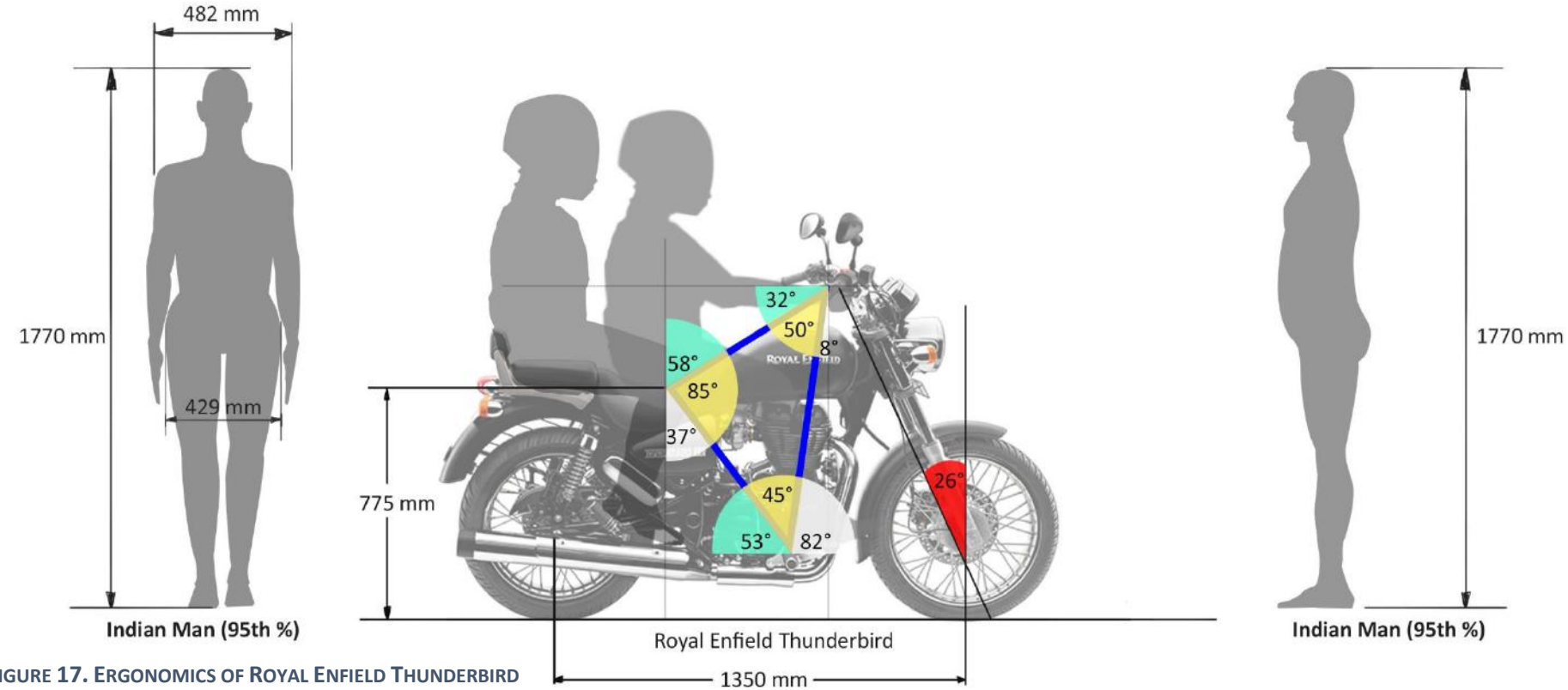


FIGURE 17. ERGONOMICS OF ROYAL ENFIELD THUNDERBIRD

2.4.5. **BENCHMARKING**

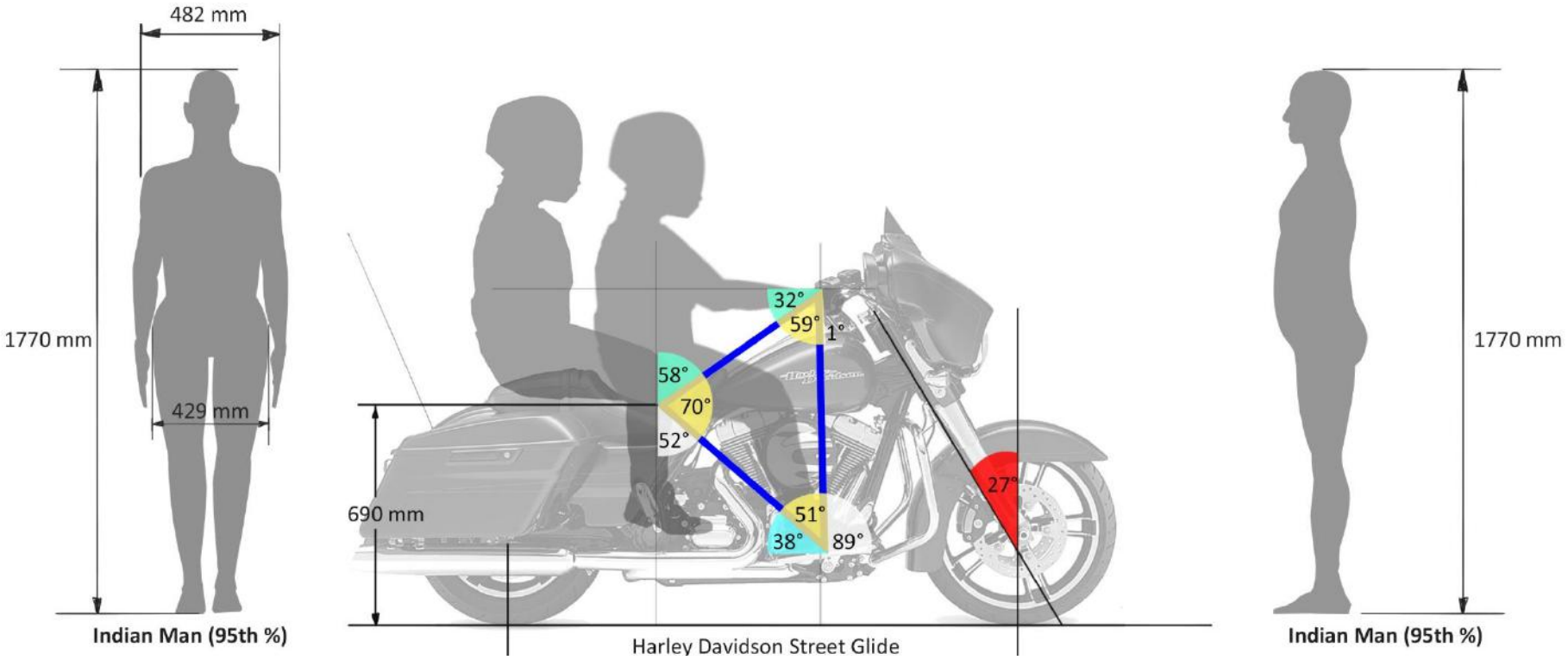


FIGURE 18. ERGONOMICS OF HARLEY DAVIDSON STREETGLIDE

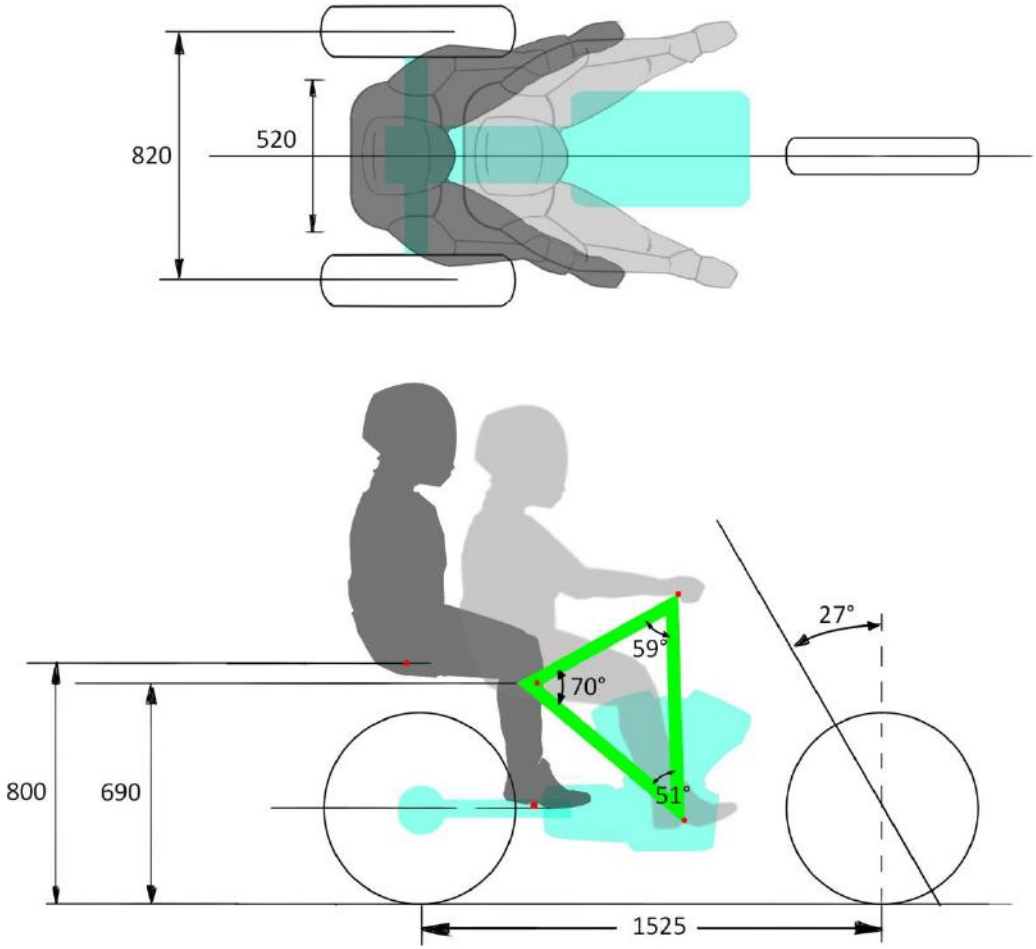
Benchmarking need not be a single vehicle. That is why here, three popular cruiser motorcycles are considered. It can be noted, Avenger has a proper cruiser stance with rake angle matching with those outright cruisers measuring at 32°. Wheelbase is also long enough, measuring at 1475mm, shorter by 150mm to the Harley Davidson Street Glide. While that of the Thunderbird, its wheelbase is quite short, measuring at 1350mm, almost 300mm shorter than the Street Glide. Although rake angle is closer to the Harley, but due to its shorter wheelbase, it is not a cruiser. And then short wheelbase also makes its rear seat short. It is quite visible; the rear passenger seems tightly spaced between the rider and the back-rest. But the riding posture sticks to the cruiser norm. Wheelbase should be placed between the Avenger and the Street Glide.

Seat height of both the Avenger and Thunderbird are low for average Indian riders, measuring at 725mm and 775mm respectively. However, as this project deals with elderly users, care should be taken so it doesn't look intimidating. Hence a seat height around the Harley Davidson seems a good proposal, i.e., 650-690mm.

Therefore, the motorcycle design should have the best of all these three combined.

2.5. **BRAINSTORMING CHASSIS LAYOUT**

LAYOUT.1



INSIGHTS

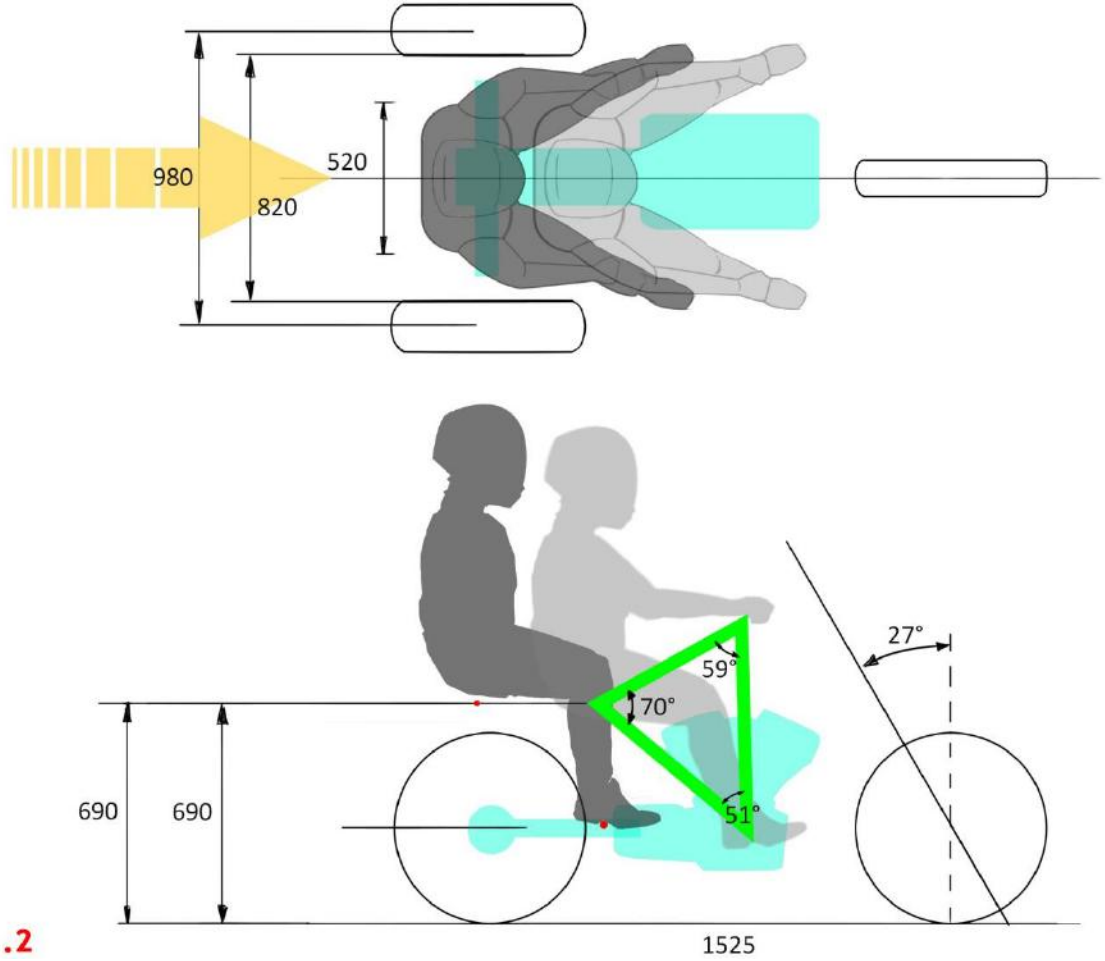
Taking a traditional trike chassis style as along with harley Davidson Street Glide's ergonomics.

It was found that, there is a lot of space getting wasted between the seat and the wheels, and not realy resulting anything special.

** all dimensions are in millimetre*

2.5. **BRAINSTORMING CHASSIS LAYOUT**

LAYOUT.2



INSIGHTS

Widening the rear track outside further.

This idea would fascilitate bringing the rear seat lower, thus ease of access.

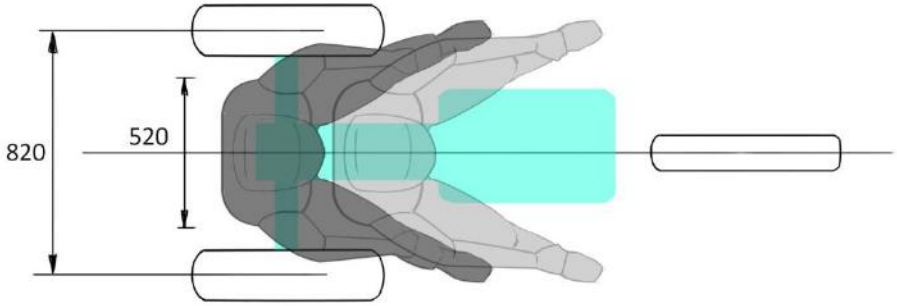
Also, possibility of rear pasenger entering from the back of the motorcycle.

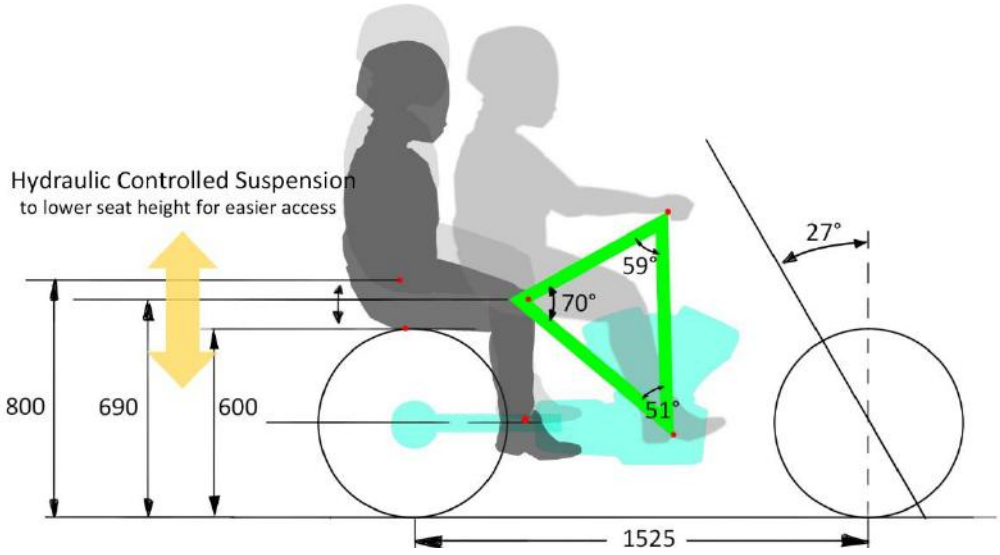
Although this seemed interesting, but it makes the motorcycle too wide, crossing a metre in width. Add to it, lugggae racks, for Indian road conditions, it does not seem to be a good proposal.

** all dimensions are in millimetre*

2.5. **BRAINSTORMING CHASSIS LAYOUT**

LAYOUT.3





INSIGHTS

This was an improvisation on the first idea.

By having a Hydraulically controlled rear suspension, during ingress, the seat height can be brought lower for easier access.

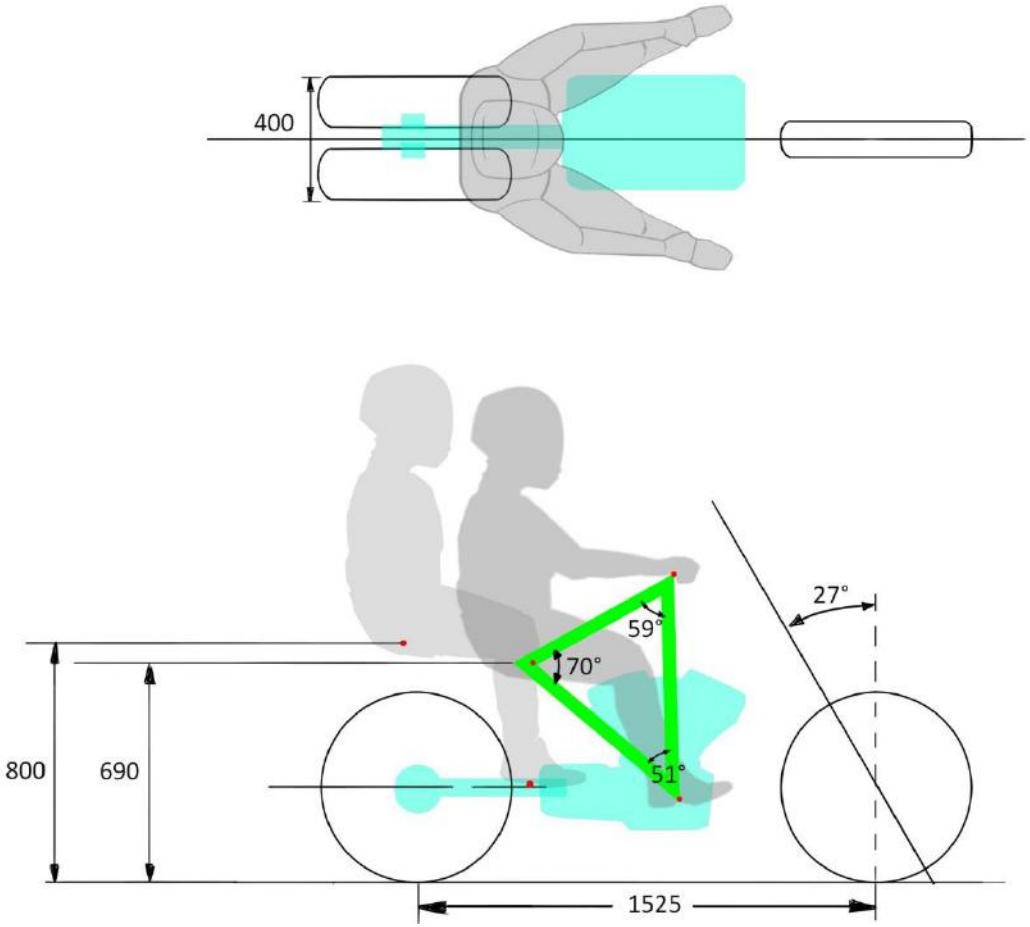
It seemed interesting as a conceptual ideation. However, users do not prefer technical gadgets, this proposal could get dicey.

Also, this still does not deal with the width issue.

** all dimensions are in millimetre*

2.5. **BRAINSTORMING CHASSIS LAYOUT**

LAYOUT.4



INSIGHTS

By bringing the rear wheels closer, it still provides trike stance and advantages. Also, gives it a different identity.

Addition of luggage also does not seem to hamper.

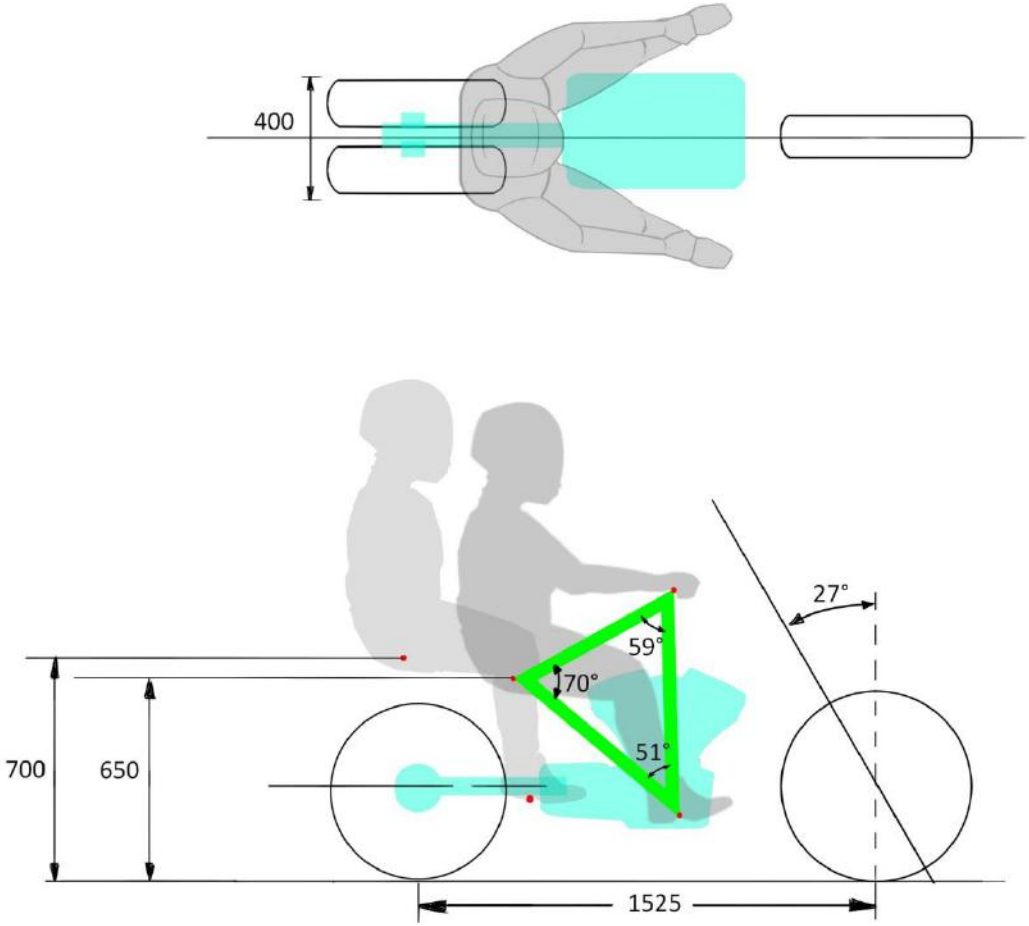
However, ingress-egress issue seems to be pretty much same to that of traditional cruisers. Does not give any advantages.

Lastly, it nees to have independent rear swingarms, to aid better stability during cornerings.

** all dimensions are in millimetre*

2.5. **BRAINSTORMING CHASSIS LAYOUT**

LAYOUT .5



INSIGHTS

Improvising on the Layout 4, by making the rear wheels adequately smaller, seat height could be brough lower at 650 mm and pillion at 700mm.

Independent rear swingarms with hydraulic suspensions on each, to aid stability while turning and cornering.

Wheels have sufficient gap, for transmission to be powered to one of the wheels from the centre.

This layout was chosen as the best suited. It stands out, it doesn't lose on trike's advantages as well as not being overtly wide unlike traditional trikes.

** all dimensions are in millimetre*

2.6. DESIGN BRIEF

To design a three-wheeled lifestyle motorcycle targeted at elderly riders (near or post retirement age)

The motorcycle should fulfil the following requirements:

Packaging:

- It should have comfortable seating for both the rider and the pillion.
- It should have easy ingress and egress.
- It should have comfortable well-angled foot-rest.
- It should have compartments for carrying luggage for long distance riding mode.
- It must have back support and arm rest for comfortable journey.
- It should have wind protection screen for comfortable ride.

Specification:

- It should have a cruising riding stance, but should not have outright long wheelbase, considering Indian landscape.
- Approximate 500cc (Benchmark)

Aesthetics:

- It should have an emotional connect to the targeted consumers.
- It should emote classic, vintage aura.
- It should speak with ‘larger than life’ attitude, ‘grand’, ‘a sense of pride’, ‘right from heart’.

Technical consideration:

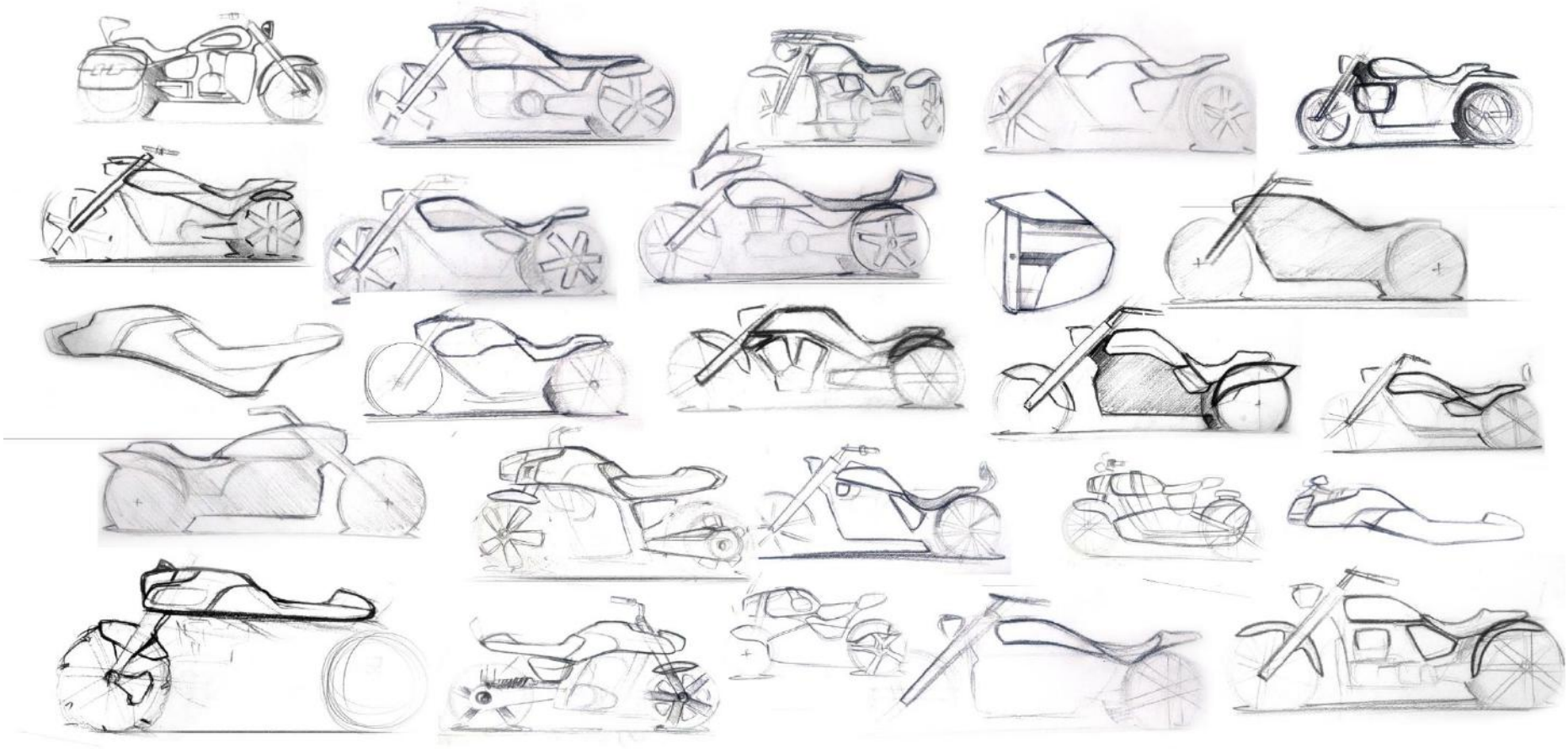
- Wheelbase: 1525 mm
- Angle: 27°
- Approximate Ground Clearance: 160mm
- Seat Height: 600-650mm
- Approximate Seat Width: 400mm
- Front Tyre Size: 130/60 x 18
- Rear Tyre Size: 130/85 x 13

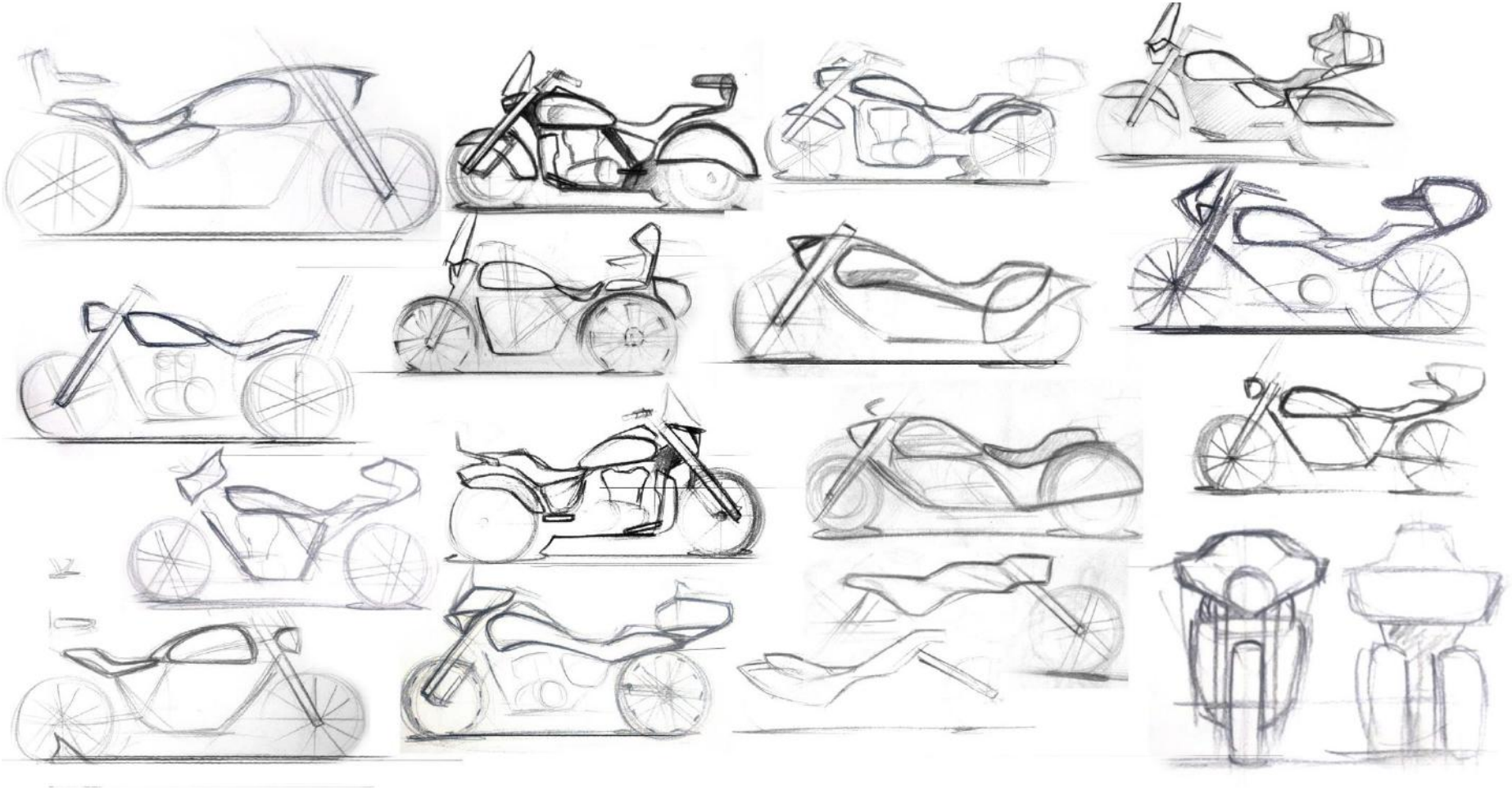
3. STAGE 2

This stage is about giving shape to the design brief which includes creating multiple moodboards based on the user persona, keeping the keywords, expressions stated by user analysis. Therefter initial form explorations based on each themes were done. Once multiple concepts were generated, the final one takes shape. Once the final concept was fixed, it was further explored and detailed both inside and out.

This stage consists of the following sections:

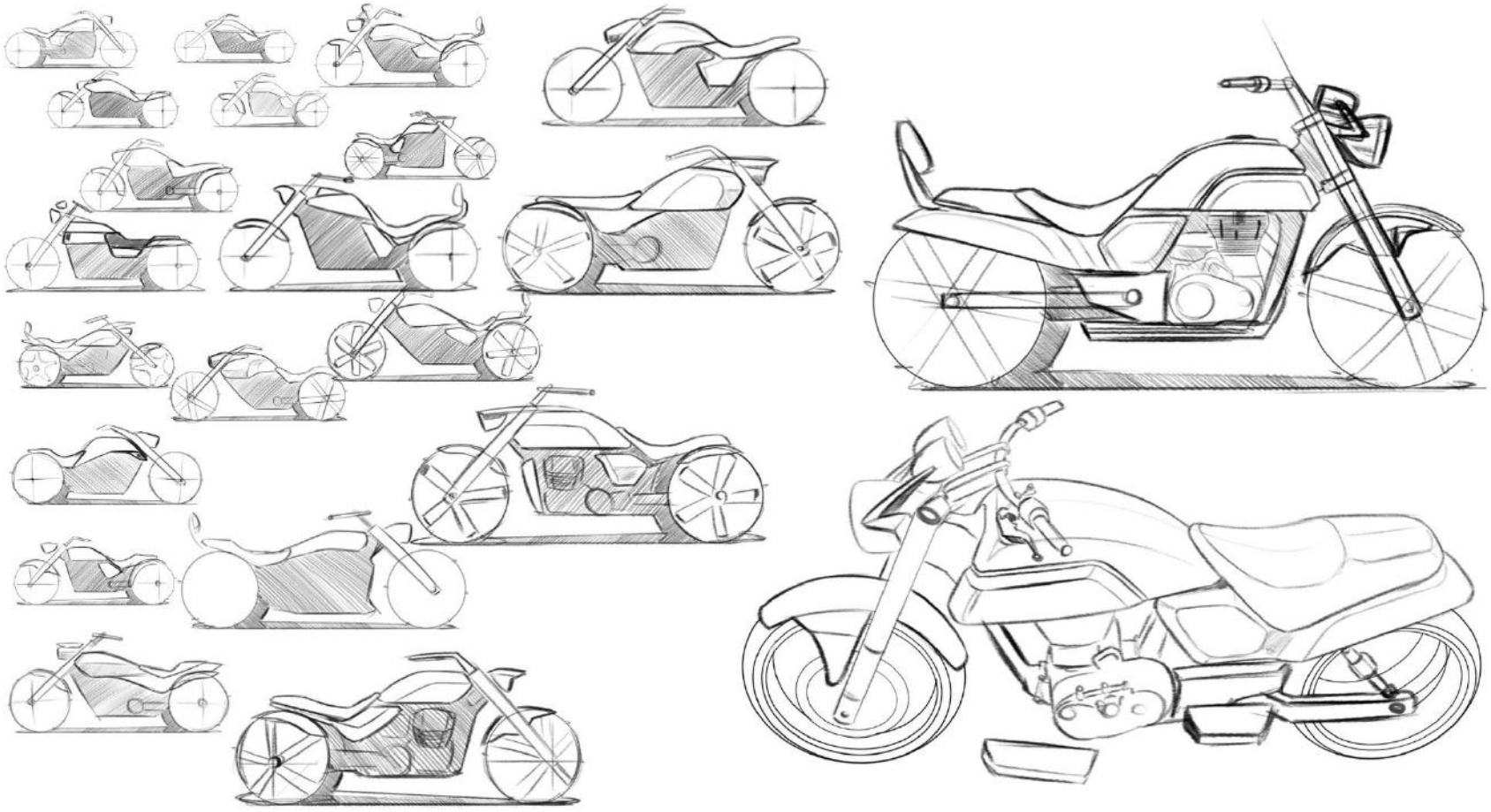
3.1. **CONCEPT GENERATION** – EXPLORATION SKETCHES





3.2. **MOODBOARD 1** – POWER . AUTHORITY . STRONG

MOODBOARD 1 – DIRECTION SKETCHES

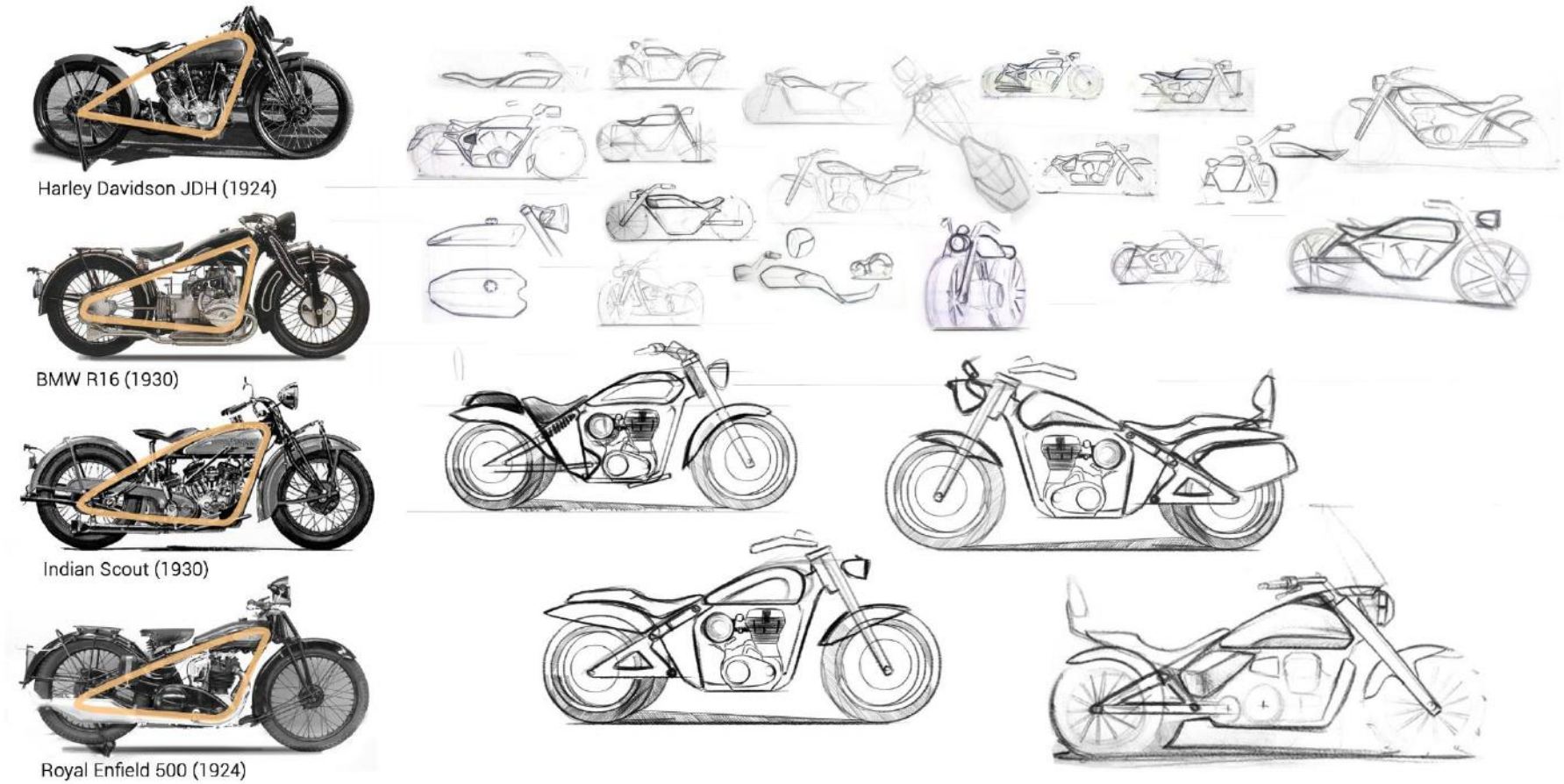



CONCEPT 1


CONCEPT 1

3.3. **MOODBOARD 2** – VINTAGE EXPRESSION

MOODBOARD 2 – DIRECTION SKETCHES

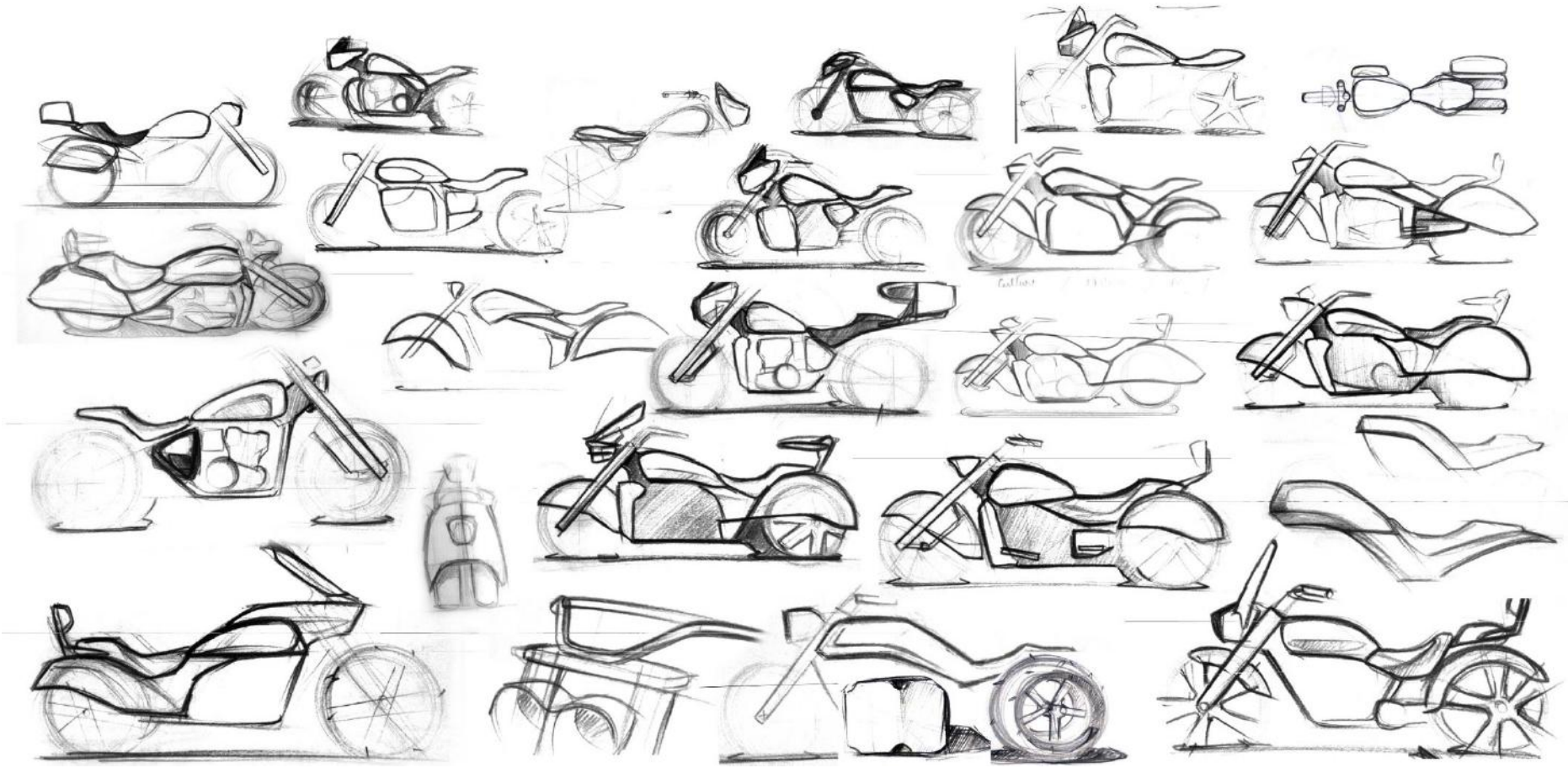



CONCEPT 2
Vintage Expression

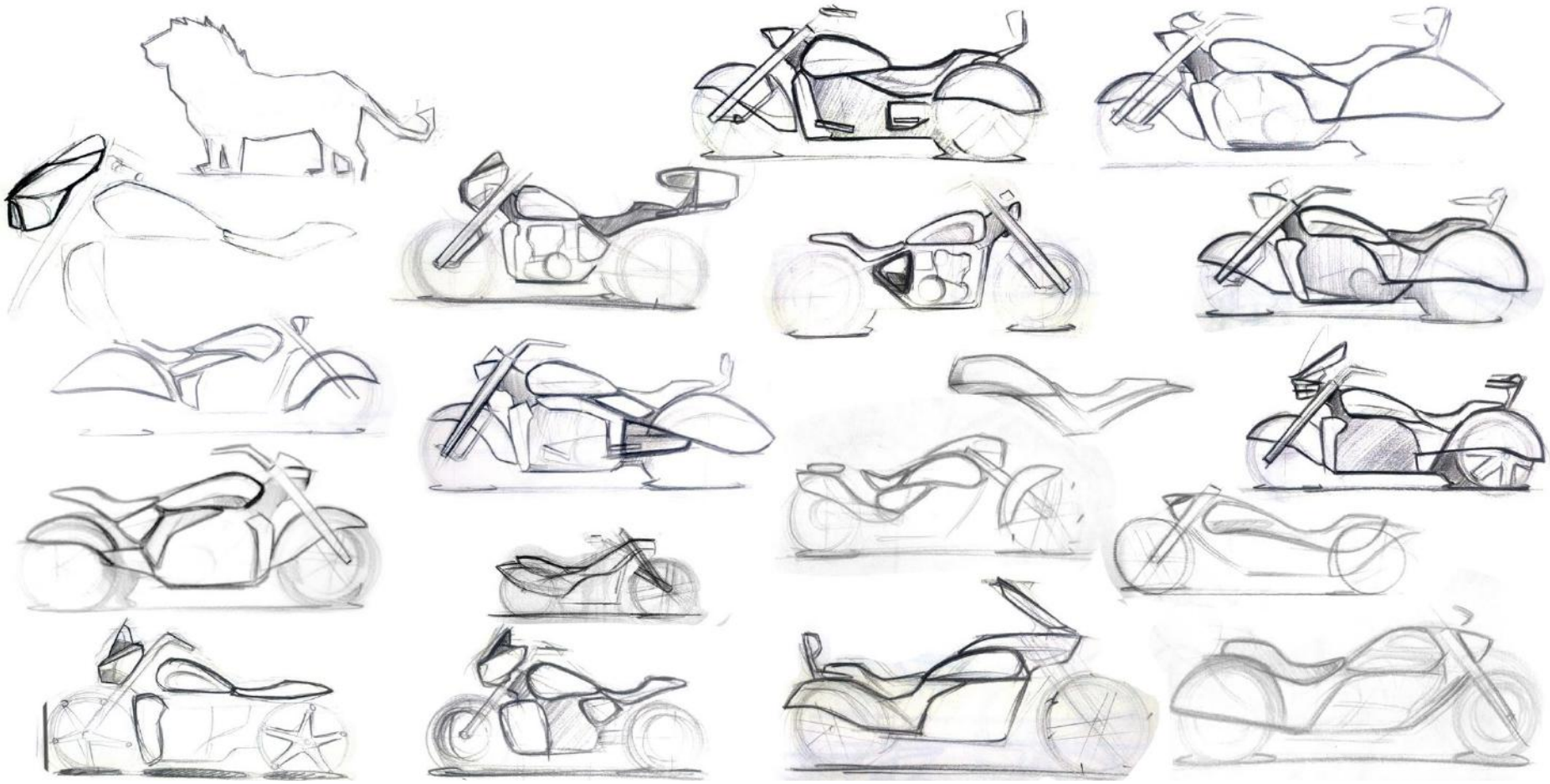

CONCEPT 2
Vintage Expression

3.4. **MOODBOARD 3** – GRANDEUR CLASSIC

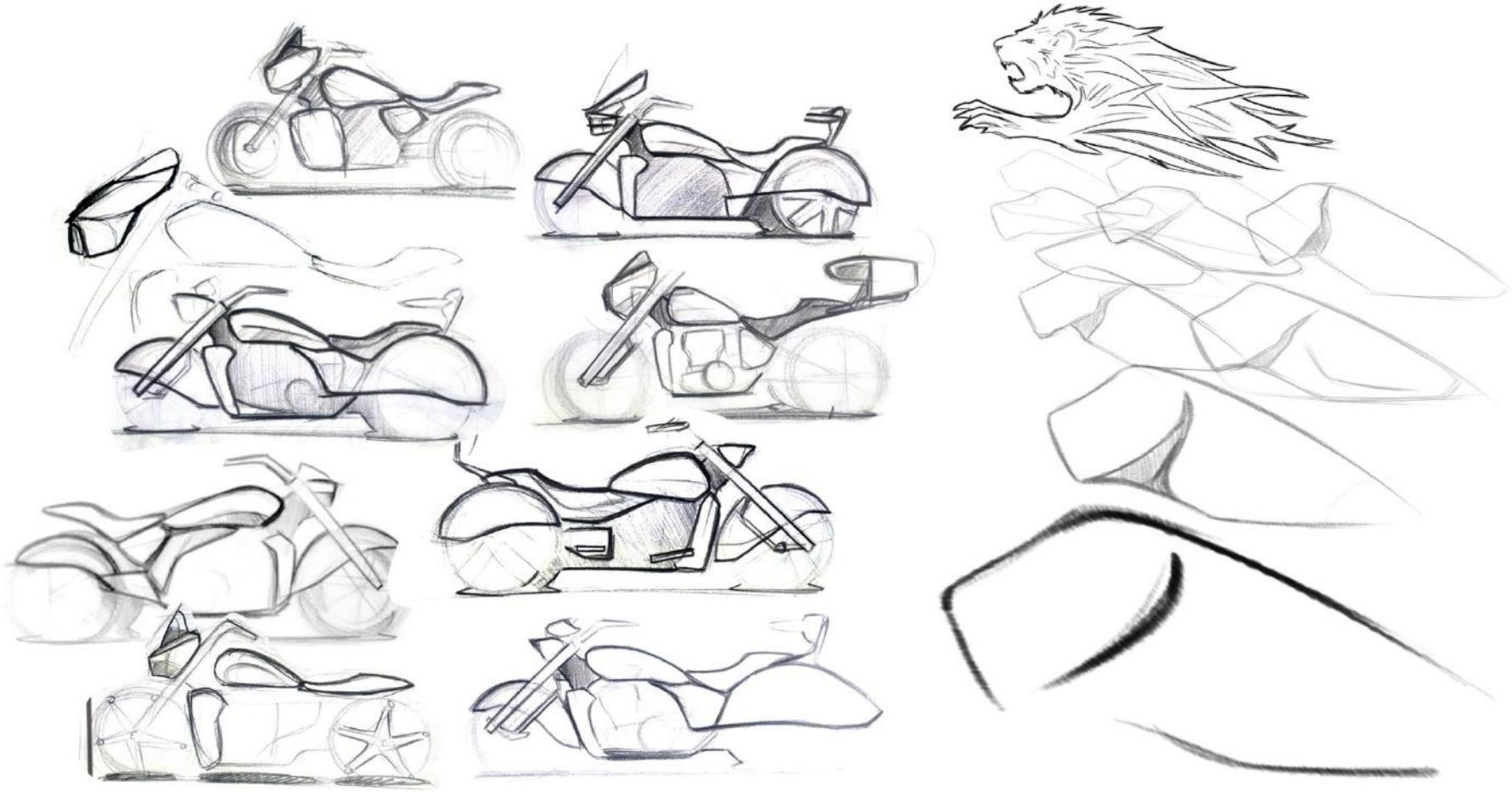
MOODBOARD 3 – DIRECTION SKETCHES



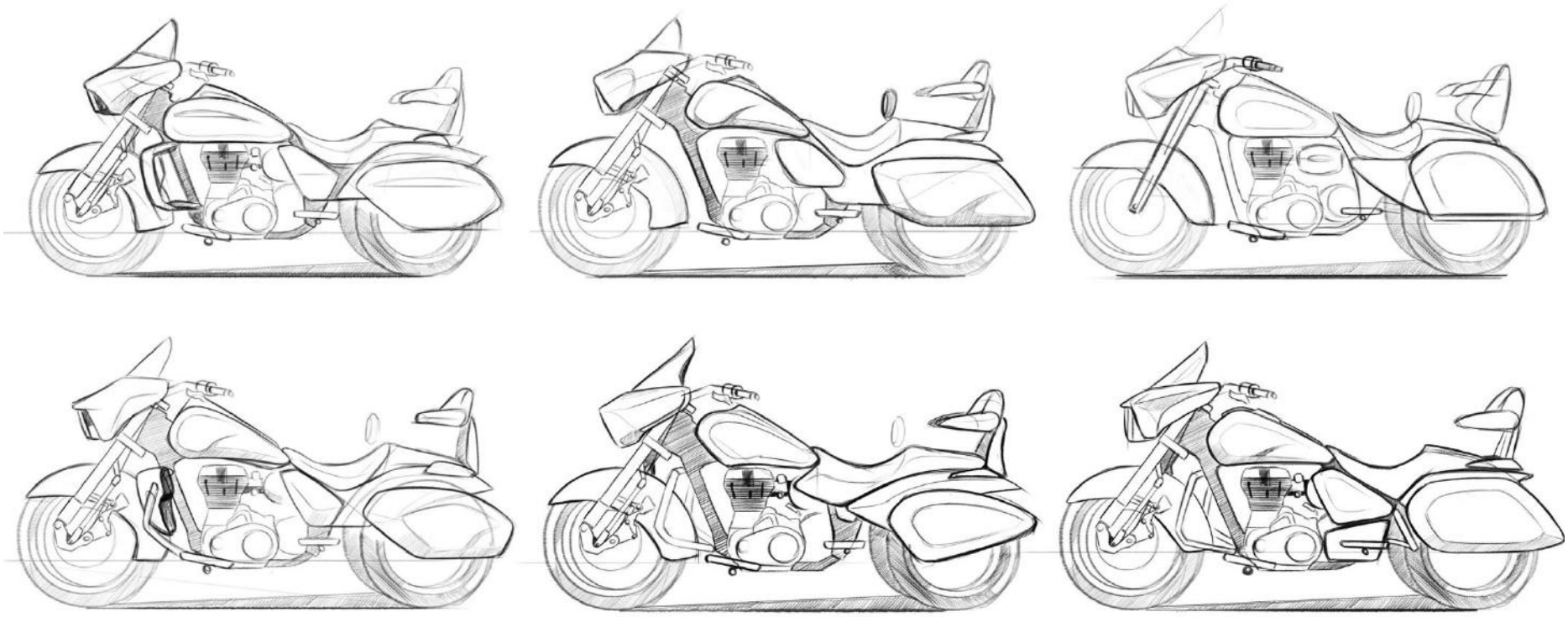
MOODBOARD 3 – DIRECTION SKETCHES



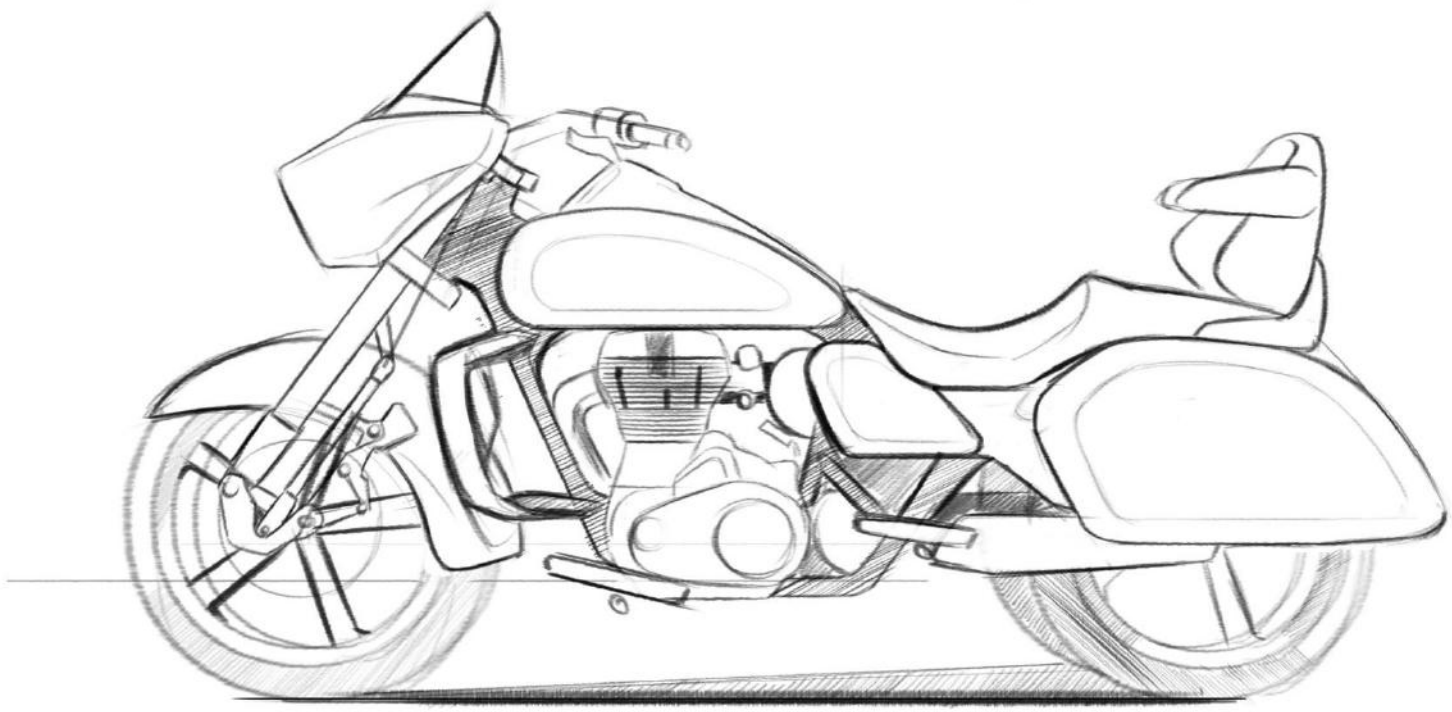
MOODBOARD 3 – DIRECTION SKETCHES



MOODBOARD 3 – DIRECTION SKETCHES



MOODBOARD 3 – DIRECTION SKETCHES




CONCEPT #3
Grandeur Classic

3.5. **CONCEPT FEEDBACK**

Concept #1

Even though, ergonomically this concept is sorted, it somehow looks as if the rider is a bit far stretched from the handlebars.

The muscular tank shrouds and similar themed luggage bags give it more raw appeal and certain unfinished character, which doesn't go well according to the target groups character.

Concept #2

This concept conveys the vintage aura, with the sweeping triangle form visible right from the suspension all the way to the rear side bags.

It emotes the feel of motorcycles such as classic motorcycles such as Rajdoot-Yezdi's chiselled lines and surface. But the downside is, to compare with current motorcycles, it doesnt really stand out especially in the Indian region.

Concept #3 ✓

The keywords; 'Grand', 'Classic', 'Pure' and 'Modern-Tradition', defines this concept. The side luggage is complimented by the front fairing. The suttle curves in the surface treatments give it a very classical-grand emotions.

Along with this, it stands out in the Indian market and suits the ideal solution for long-distance cruising for the target consumers' needs.

Hence, this concept was chosen to be the final, although with more refinement.

3.6. **CHASSIS DESIGN**

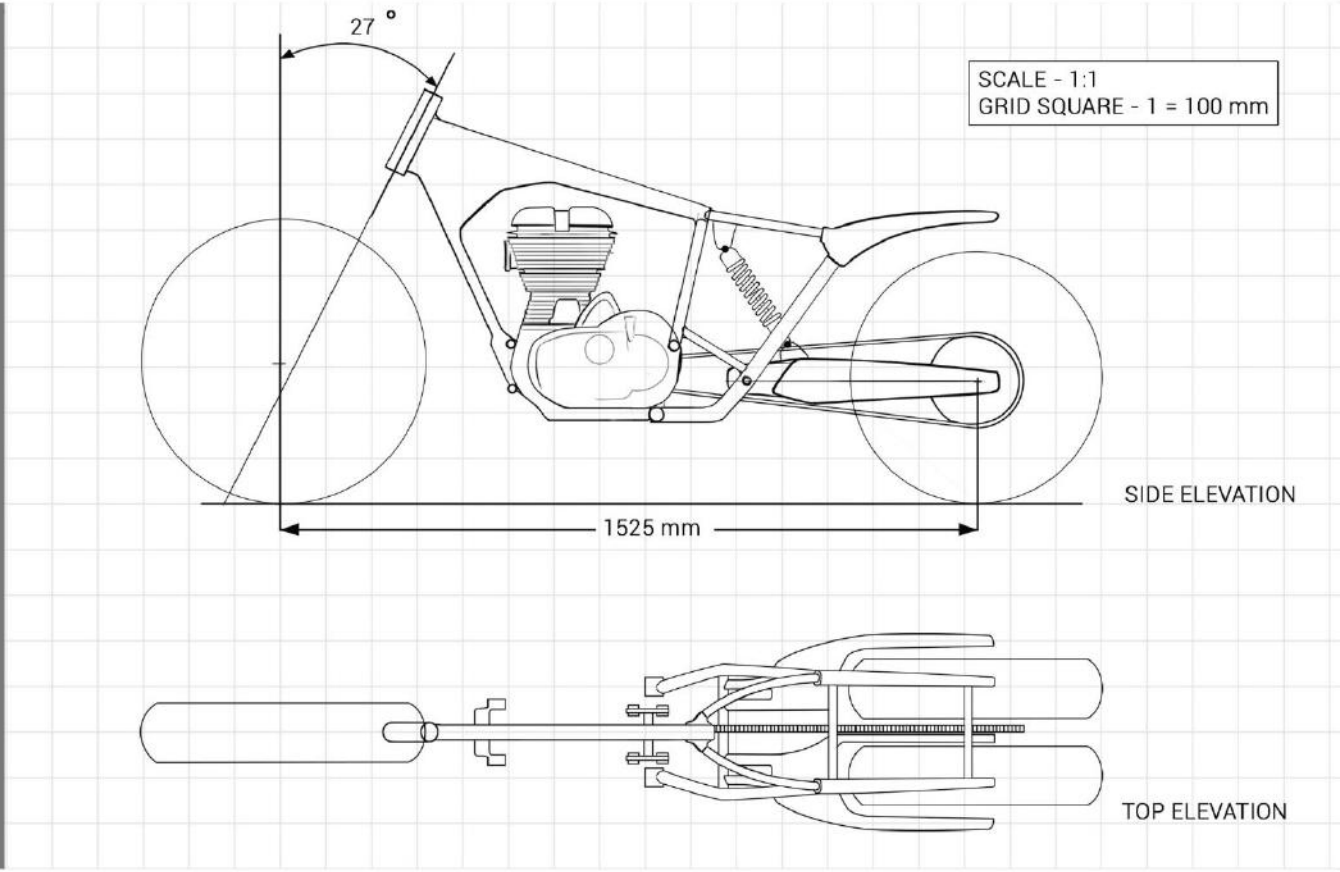
Royal Enfield 500 cc engine

CHASSIS DESIGN CONSIDERATION

Royal Enfield 500 cc Engine taken as the base. The chassis is designed considering the mounting points of the engine.

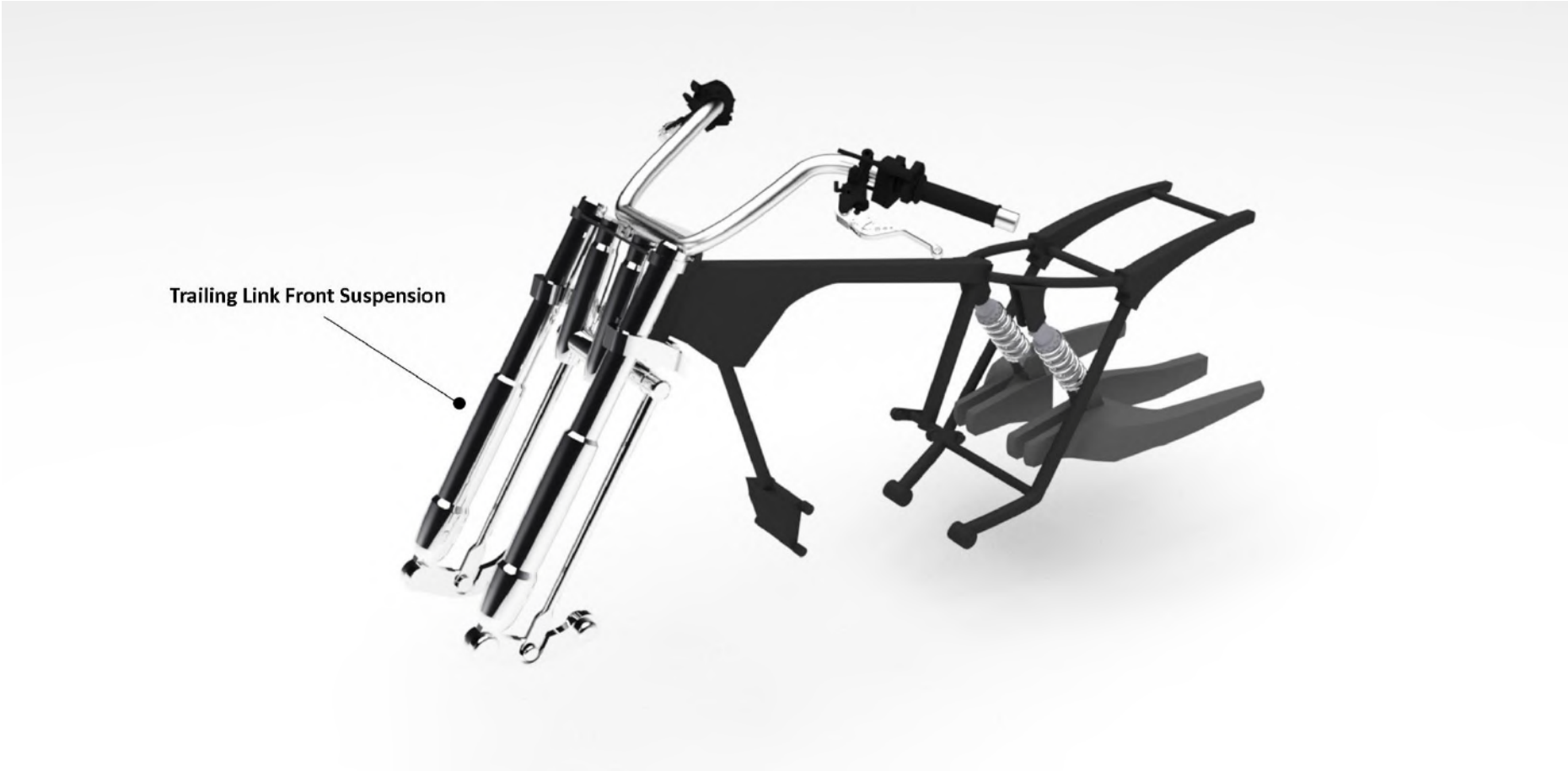
A key feature of this chassis design is the Dual single-sided independent rear swing-arms. In order to keep the track width narrower than the traditional trikes, rear wheels are closer.

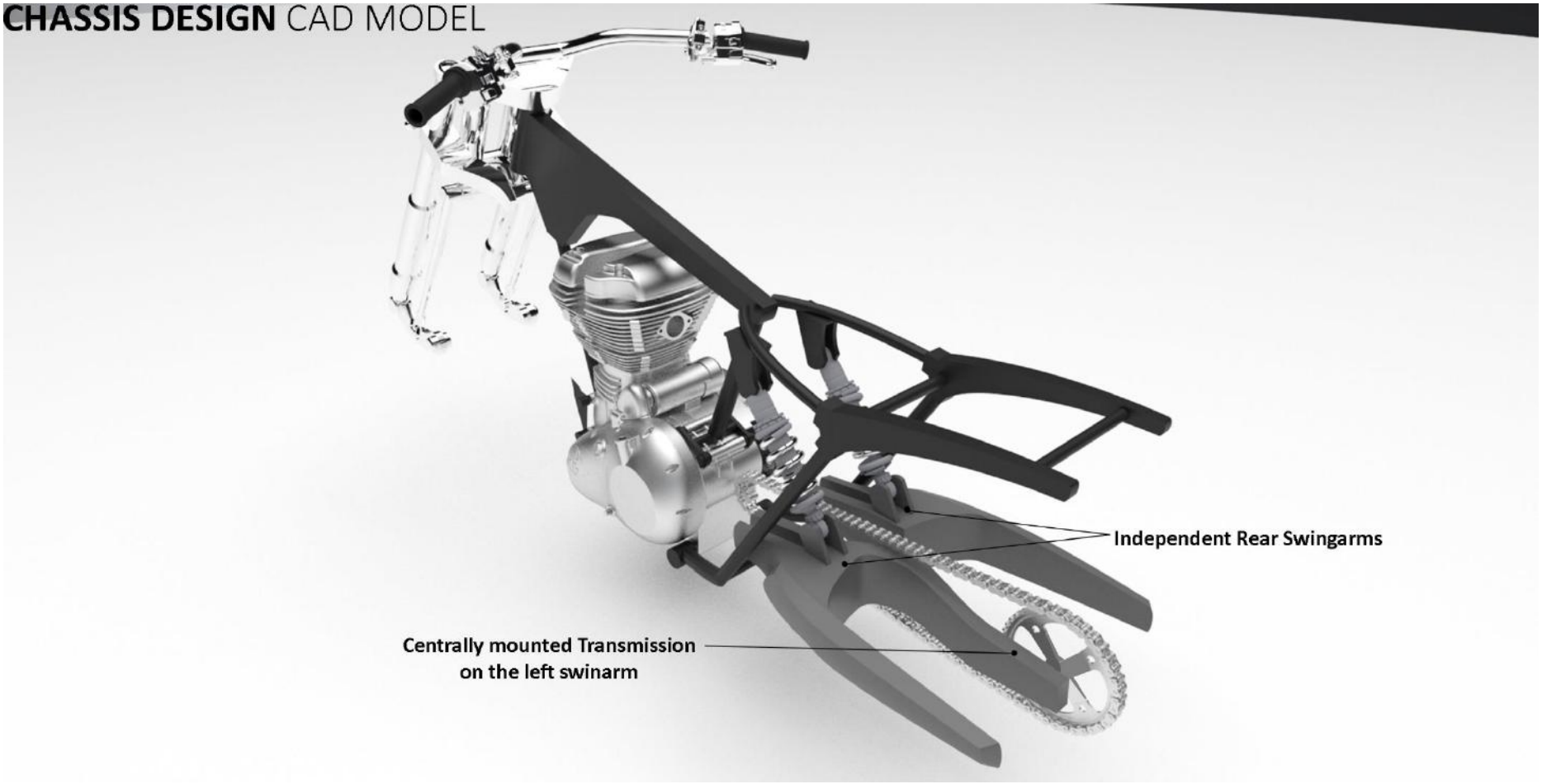
This design also aids a certain amount of leaning while turning, as each swingarm has its own independently mounted shock absorbers, both the wheels remain planted to the ground.

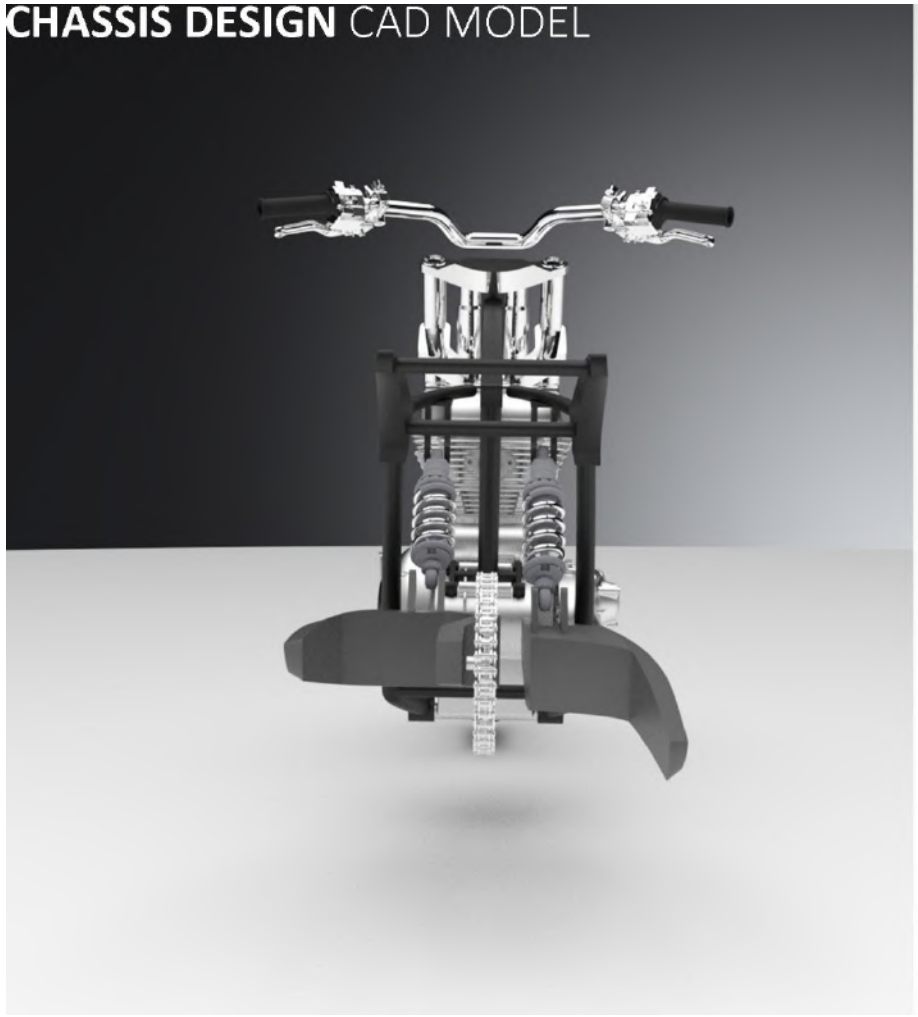


CHASSIS DESIGN CAD MODEL

CHASSIS DESIGN CAD MODEL

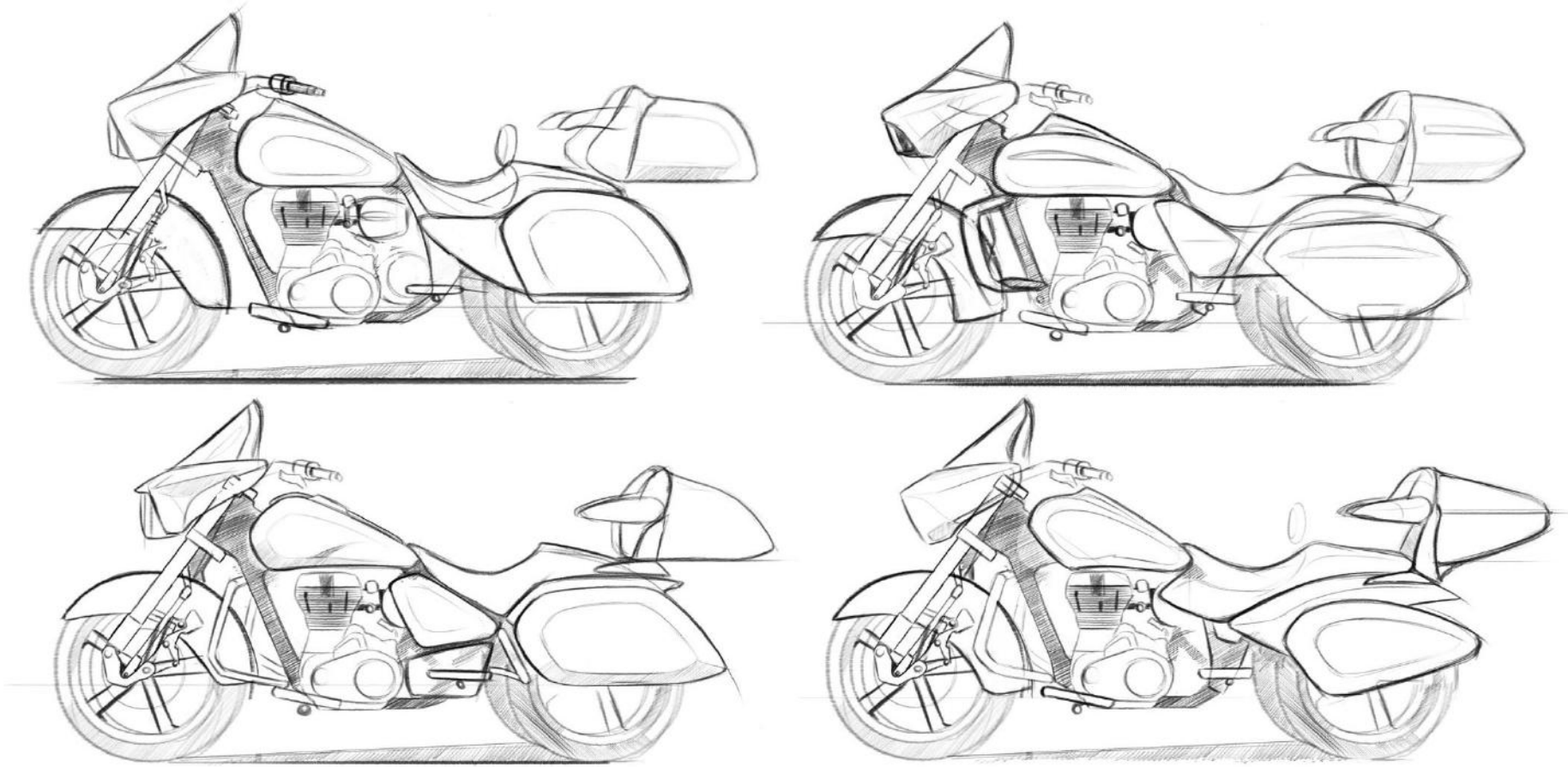



CHASSIS DESIGN CAD MODEL
Independent Rear Swingarms
Centrally mounted Transmission
on the left swinarm

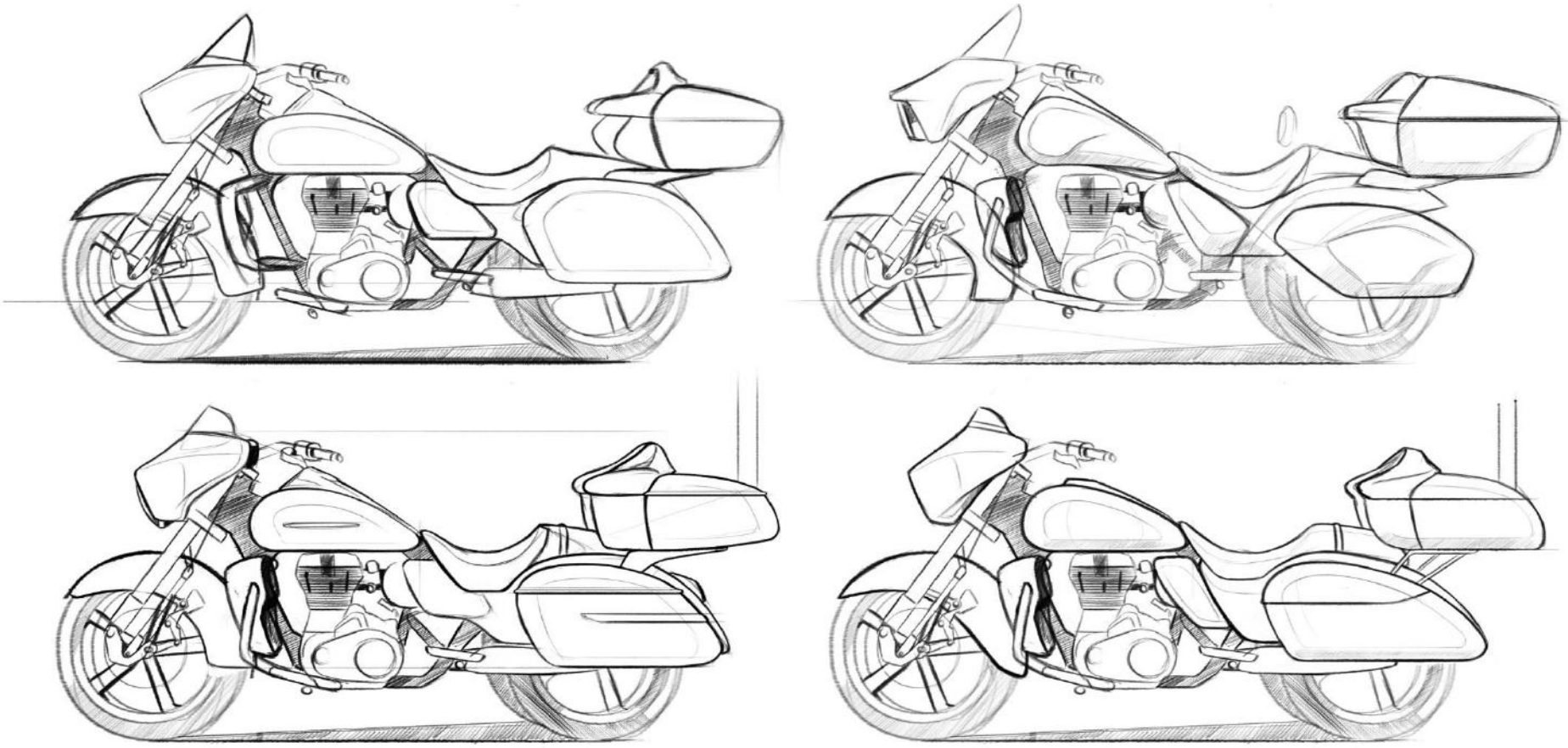

CHASSIS DESIGN CAD MODEL


CHASSIS DESIGN CAD MODEL

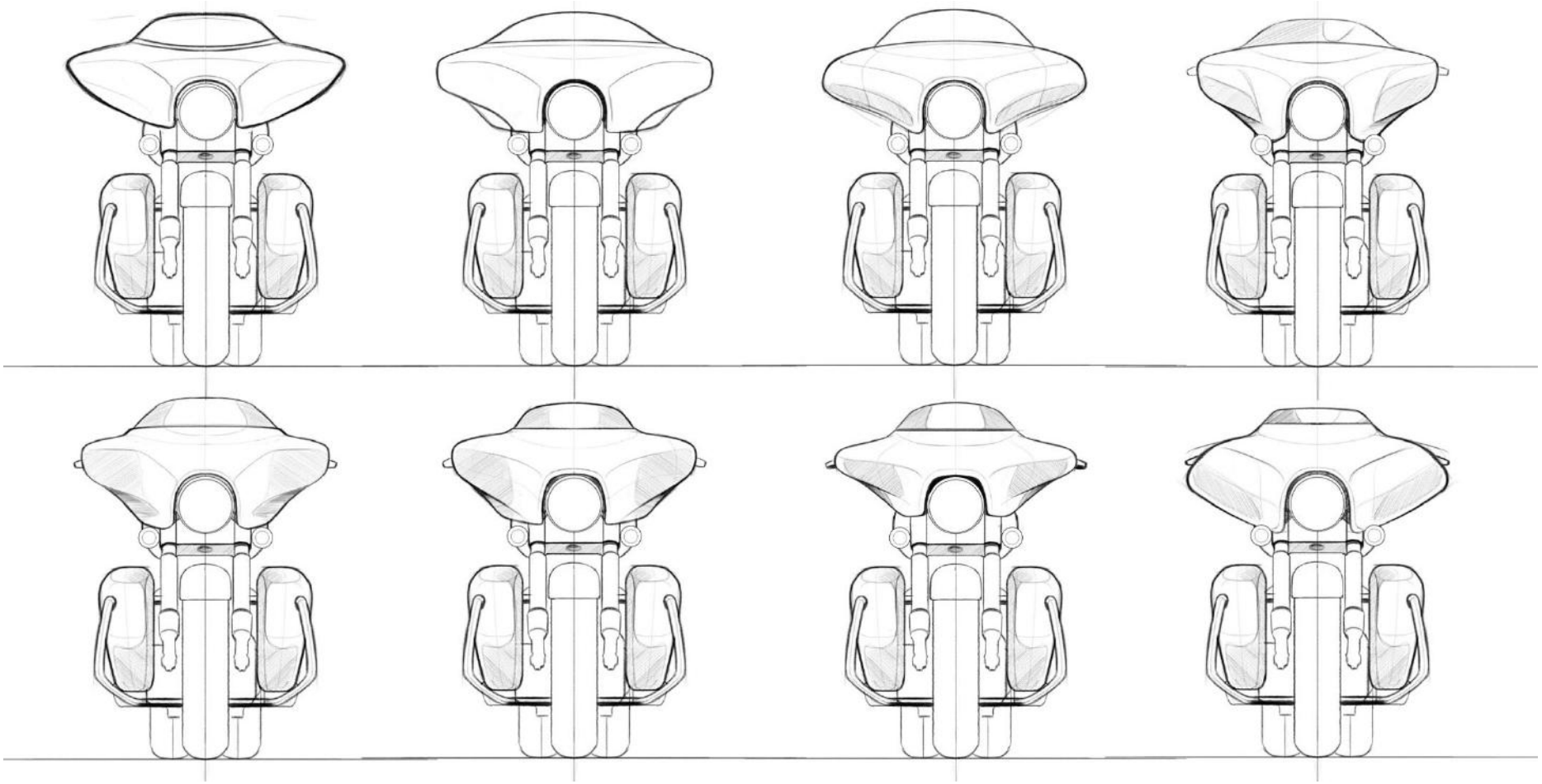
3.7. **FINAL DIRECTION SKETCHES**



FINAL DIRECTION SKETCHES



FINAL DIRECTION SKETCHES



4. STAGE 3 – Model Making

This stage involves the process of realizing the 2d and 2d sketches into real scaled physical model. After finalizing the final direction concept, it was still not convincing enough to choose the ideal sketch to go ahead with physical model making. Hence, out of the eight final direction sketches, five of them were picked based on the feedbacks and physical thermocol mock ups were made, This helped in getting a real feel to the design and in turn lead to freazing the final concept design. After this, 3D rendering takes place to get a realistic view, followed by a CAD model to get more precise regarding dimensions and surface finish. Lastly, a 1:3 scale model is made using multiple methods ranging from hand-modelling to CNC milling to 3D-Printing intricate parts.

The following sections are involved in this stage:

4.1. Mock-up Generation

4.2. Final Concept

4.3. CAD Model

4.4. CAD Drawing

4.5. Final 1:3 scale Model

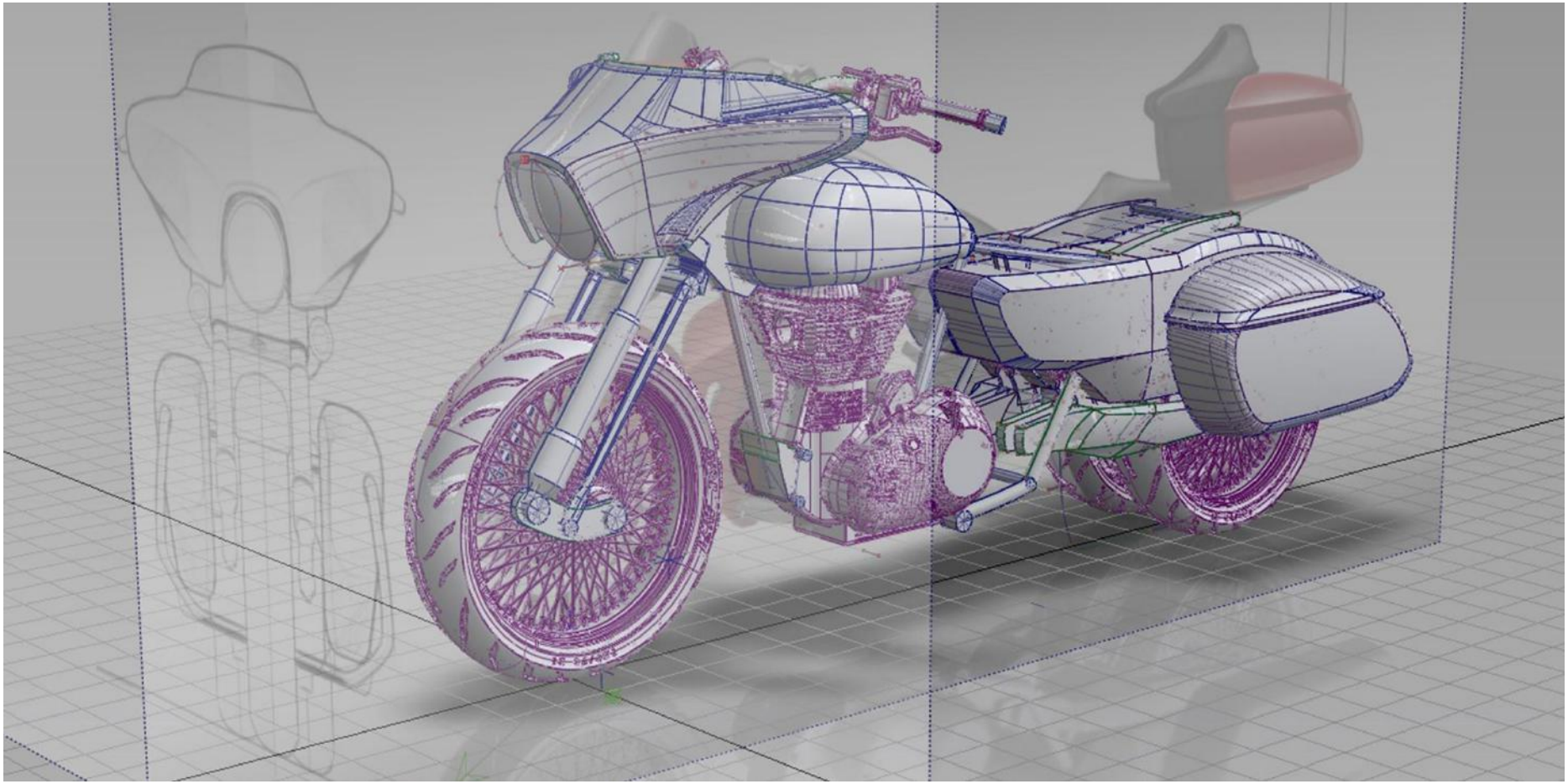
4.1. **MOCK GENERATION**

4.1. **MOCK GENERATION**

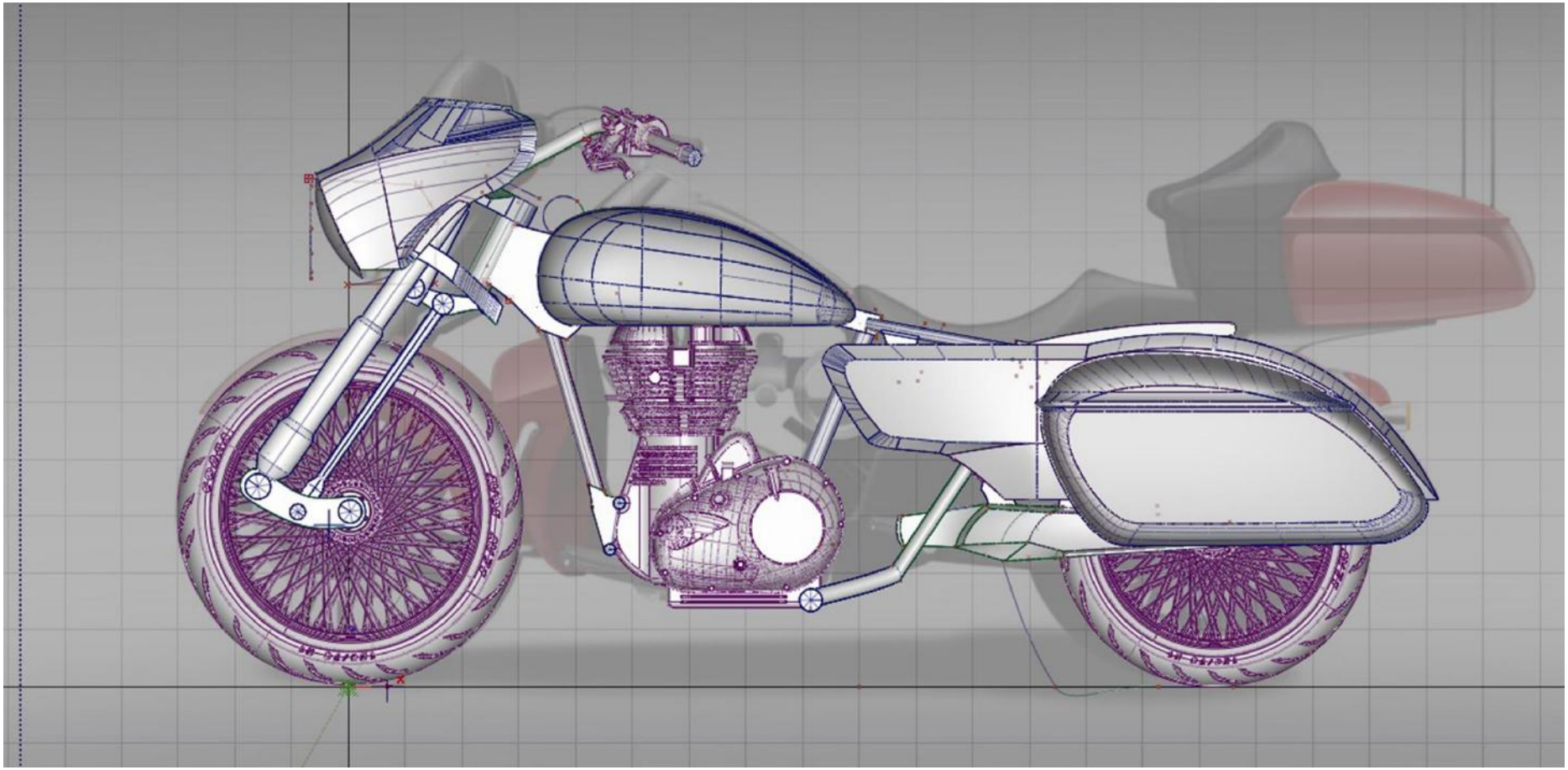
4.1. **MOCK GENERATION**


4.2 FINAL CONCEPT
Grandeur Classic

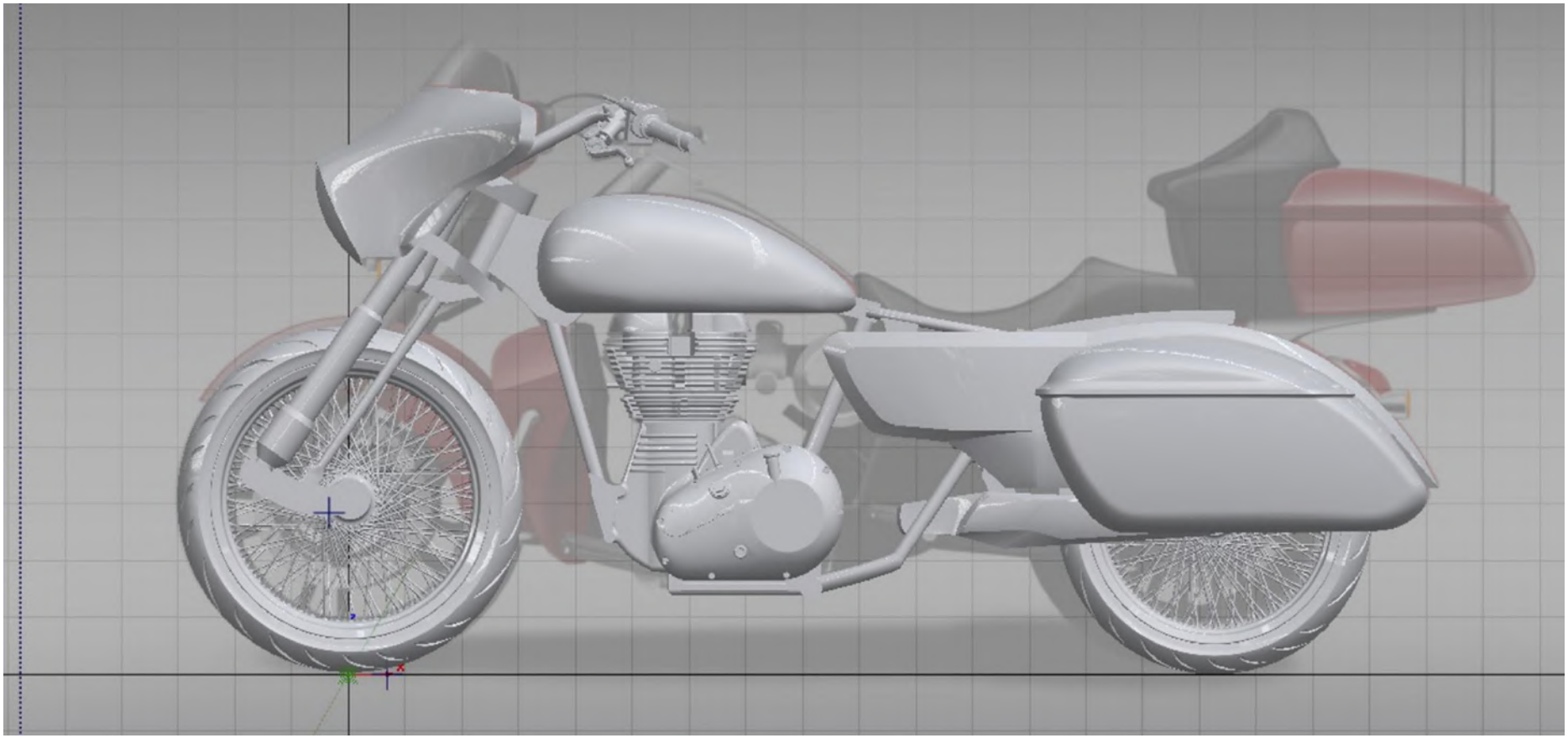
4.3. **CAD** MODELLING



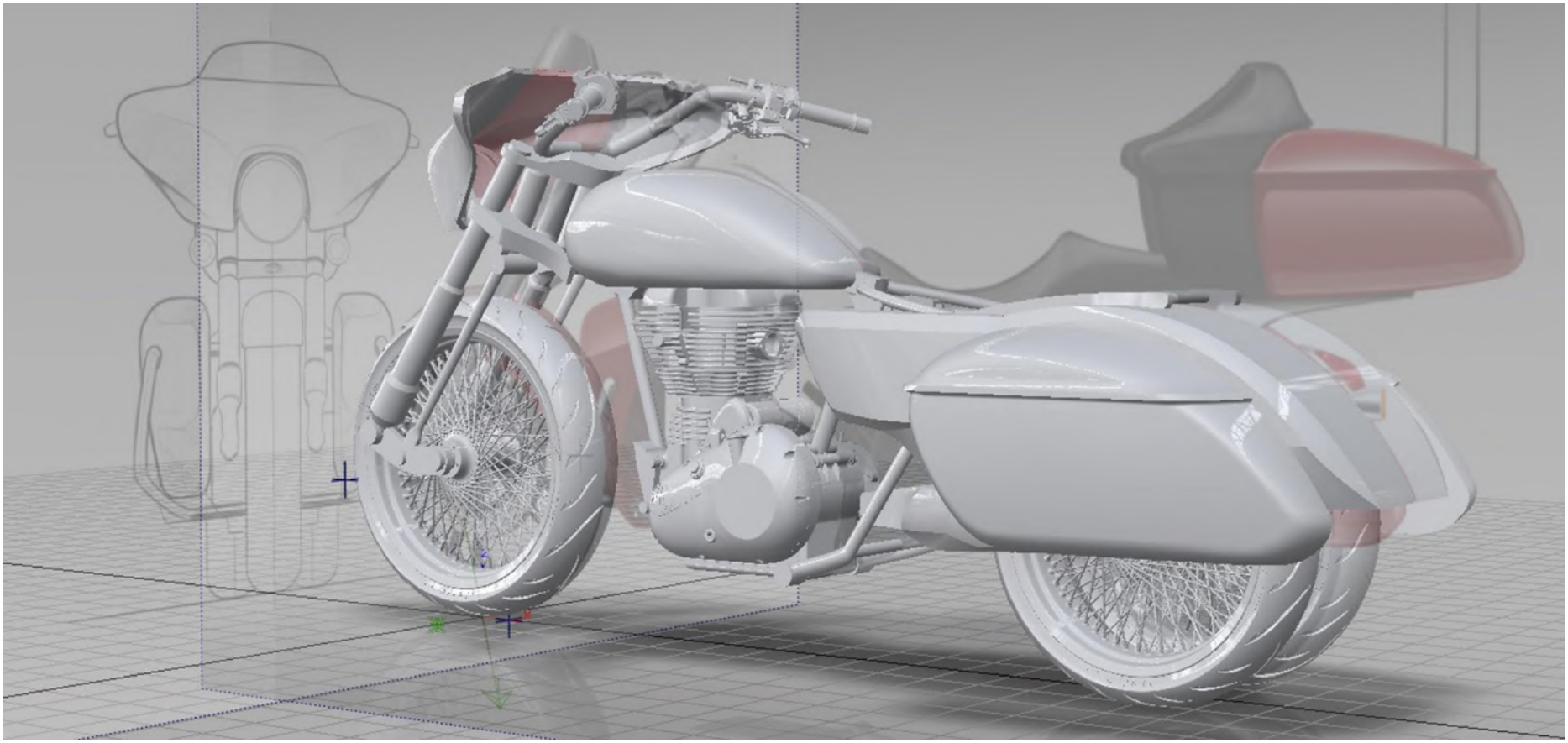
4.3. **CAD** MODELLING



4.3. **CAD** MODELLING



4.3. **CAD** MODELLING



Work in Progress …

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http://www.bajajauto.com/bajajavenger/

https://royalenfield.com/motorcycles/thunderbird-350

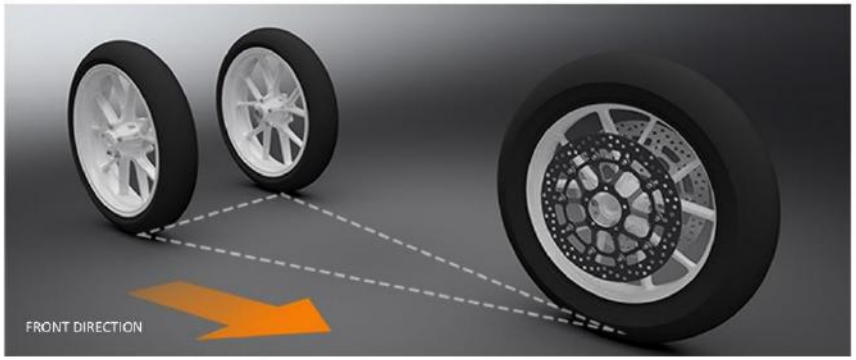
APPENDIX

WHAT MAKES A TRIKE ?

A vehicle with three wheels is called a Trike. It can be motorized and can be classified as automobiles or motorcycles or autorickshaws. While others are known as tricycles without motor, which are human powered vehicles.

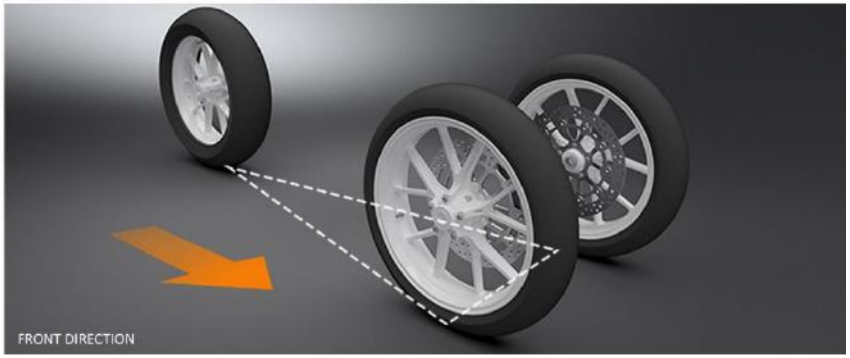
Exotic Trike | Trike Car | Trike Motorcycle | Trike Auto | Side Car | HPV Trike

CLASSIFICATION - DELTA & TADPOLE



DELTA TRIKE CONFIGURATION

Having a trike configuration of one wheel at front and two wheels at the back, forms a Delta Trike configuration. The name comes from the Delta 'Δ' like formation of its footprint.
Traditionally, leaning as in a motorcycle is not possible with this configuration, but with rear axle modification, it can be achieved.

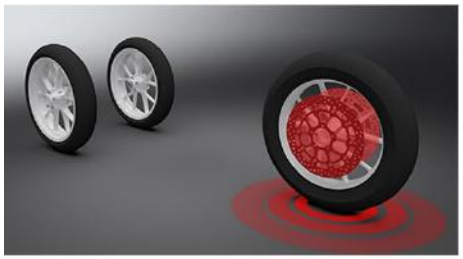


TADPOLE TRIKE CONFIGURATION

A configuration of having two wheels at the front and one wheel at the back, forms a Tadpole Trike configuration. the name comes from a Tadpole '⊲' like formation of its footprint.
Leaning characteristic, as in a two wheeled motorcycle is easily possible with this configuration.

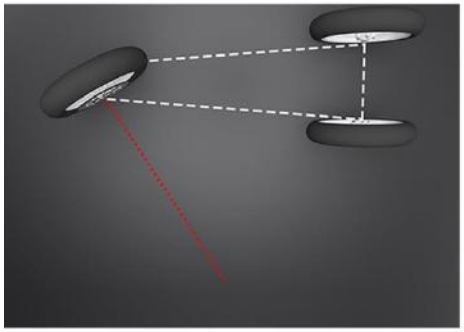
ADVANTAGES OF DELTA TRIKE

SAFER BRAKING



Although, diagramatically, Delta trike having one wheel at front, thereby, having a single point of frontal contact with the ground gives a uni-force of braking. But due to a heavier rear end, there is almost negligible chance of the vehicle getting 'stoppied', i.e., rear of the wheel getting lifted at hard braking.
Hence, Delta trikes are safer in braking.

SIMPLICITY OF DESIGN

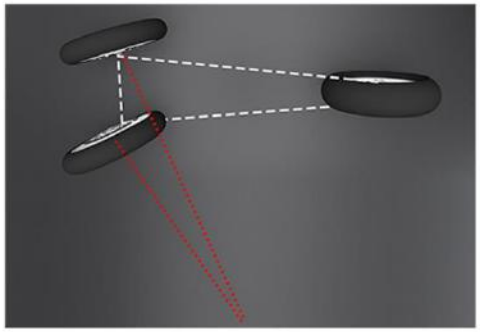


Delta trike having a conventional setup for front steering mechanism, provides a much more simpler design. Any regular upside-down or telescopic front suspension is sufficient for it to do its function.

TADPOLE BRAKING

Tadpole although offers twice as much brake-surface area and twice as much power to stop compared to Delta trike, but due to its relatively light weight distriution at the rear, the tendency for the vehicle to get lifted off from the back is higher and this can cause unsafe outcome.

COMPLEX FRONT SUSPENSION



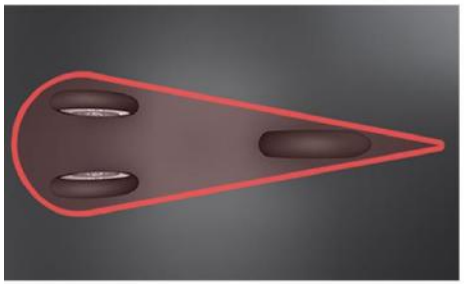
Tadpole trike needs special consideration to prevent wheel slippage. Additional incorporation of linkages to approximate Ackermann Steering geometry to avoid slip results in a very complex steering mechanism for the tadpole trike to do its function.

ADVANTAGES OF TADPOLE TRIKE

BETTER DYNAMICS

Tadpole trikes score high when it comes to turning dynamism. Having independent front suspension enables it to lean at angles comparable to a traditional two-wheelers. This results in a much better dynamics and feedback. Also it can travel on uneven tractions pretty much being unphased.

BETTER AERODYNAMICS

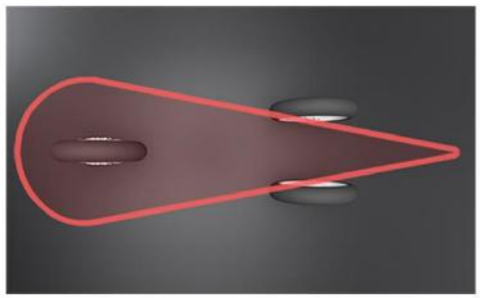


The ideal teardrop i.e., width/length ratio is 0.255. Tadpole design adhers to this ratio more easily and offers better aerodynamics.

NO LEANING DYNAMICS

A traditional delta setup offers no leaning ability. The rear axle being a single shaft connecting both the wheels, it needs differential even to require it to turn without wheel slippage. However, if provided with independent rear axles, it can result in better dynamics.

AERODYNAMICS GETS A HIT



Compared to tadpole, delta trikes have much wider rear track and this hampers it in the area of aerodynamics.

MOTORCYCLE TRIKE GLOBAL SCENE

HARLEY DAVIDSON TRI-GLIDE | CAN-AM SPYDER F3 | PIAGGIO MP3 SERIES | YAMAHA TRICITY

YAMAHA MTW-9 CONCEPT | YAMAHA 03-GEN F CONCEPT | YAMAHA 03-GEN X CONCEPT | HONDA NEOWING

INFERENCES FROM THE STUDY ON TRIKES

From the brief study done on trikes, it's classifications – Delta trike and Tadpole trikes. Both the layouts have certain advantages and disadvantages attributed to each other. While, the tadpole seems more dynamically balanced and aerodynamically superior to the delta trike layout, however when it comes to structure mechanism, the later i.e., delta is much simpler to design. Also, when we look at driving or riding aspect, we can say acceleration is optional, turning is a factor that is necessary, but braking is mandatory; just like for an airplane – taking off is optional, landing is mandatory. In this aspect, we can conclude that tadpole is better when it comes to performance oriented riding, as it offers better cornering stability and better aerodynamics. However, when the riding is more of a sedate condition, a delta trike makes for a better setup as braking is gentler and tendency to have a 'stoppie' is negligible. Also, turning ability of a delta is superior to that of a tadpole. Plus, one may think of Delta having the necessity of adding a differential at the rear axle, however, this can be eliminated by providing power to either of the rear wheels. This can relatively lower the complexity of the rear axle. Another major factor favoring the delta is the ability to carry more load, as it has two wheels at the back to support the additional weight over it.

Now talking about the trends happening in global scenario around motorcycle trikes, we can see the only production motorcycle trike favoring delta layout is the Harley Davidson Tri-Glide. An important point to note here is, it is basically a modified version of its traditional two-wheeled cousin Harley Davidson Street-Glide. Thus, it can be said that Tri-Glide was never originally intended to be designed as trike. Although there are other motorcycle 'feel' oriented trikes, but apart from the CAN AM Spyder F3, the rest are in their conceptual stage. Only the CAN AM Spyder is a production model and it follows tadpole layout. Moreover, the audience that these motorcycles target is towards the younger generation. The remaining trikes in the market such as Yamaha Tricity, Piaggio MP3 fall in the scooter category. We can conclude that there is really no motorcycle that is a trike and is intended at the elderly riders. And that it makes of a valid case to design a motorcycle for the target audience.