

Design of a performance brat cafe racer based on  
Royal Enfield Continental GT500 platform for  
Rajputana Custom Motorcycles

Design Project I



**IDC** IIT Bombay

Nipurn Solanki

176390004

Location  
Rajputana Custom Motorcycles, Jaipur



# 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.



Nipurn Solanki  
176390004  
Mobility & Vehicle Design

# Certificate



**RAJPUTANA CUSTOM MOTORCYCLES**

Dated: June 29<sup>st</sup> 2018

**To Whomsoever It May Concern**

This is to certify that **Mr. Nipurn Solanki**, has successfully completed the summer internship program with **Rajputana Custom Motorcycles** for a period of 1 month (5<sup>th</sup> May 2018 – 9<sup>th</sup> June 2018)

During this period, he was involved in the ideation, design and execution of projects which primarily include customization of motorcycles. He has excellent sketching skills and is detail oriented with his research. He is very well rounded in all aspects pertaining to design like material understanding, manufacturability and aesthetics. He takes directions well and effectively sees the project through.

His attitude and performance were found to be sincere, innovative and enthusiastic which reflected in the assignments he undertook during the training period. We feel that he will prove to be a valuable asset to any organization in the near future.

We wish him all the very best in his future endeavors.

**Vijay Singh**  
(Proprietor R.C.M)

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Cell : +91-99281 64795 | E-mail : rajputanacustoms@gmail.com

# Acknowledgment

I would like to sincerely thank Mr. Vijay Singh Ajairajpura, owner/designer at Rajputana Custom Motorcycles for his valuable guidance and creative input throughout the projects.

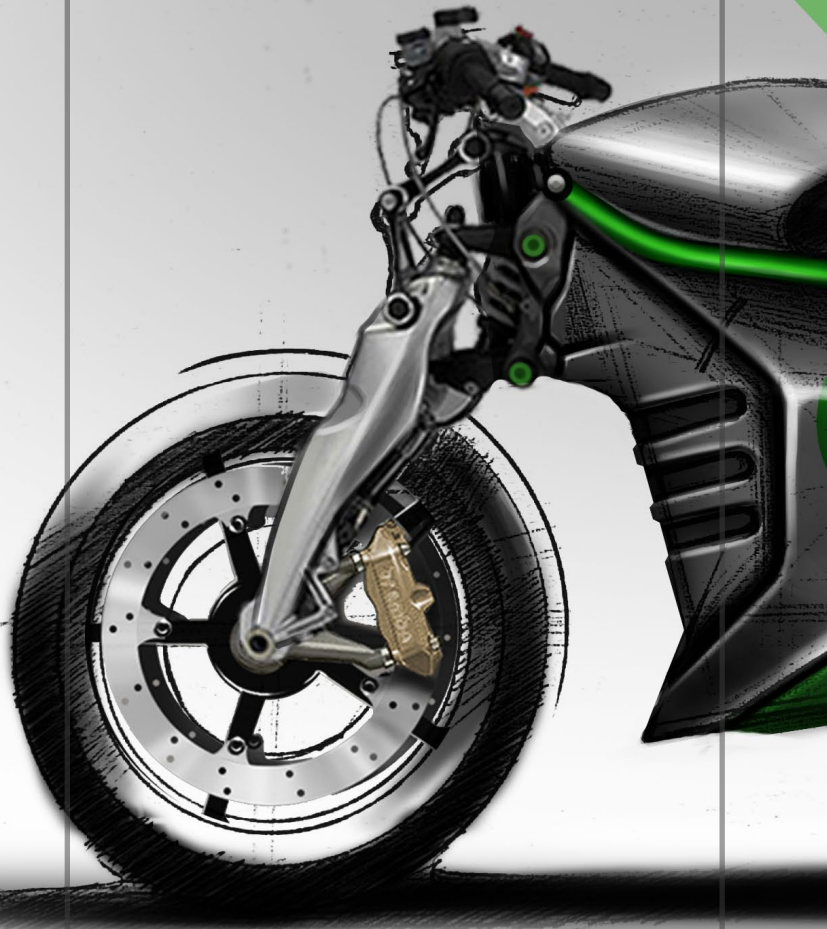
I would also like to thank him for giving me this opportunity to work for his firm and gain a better understanding about Motorcycles (both aesthetically and technically) Thanks to all the employees at Rajputana Custom Motorcycles for their endless support and hospitality during the two month I spent there.

A handwritten signature in blue ink, appearing to read "Bulanki", written in a cursive style.

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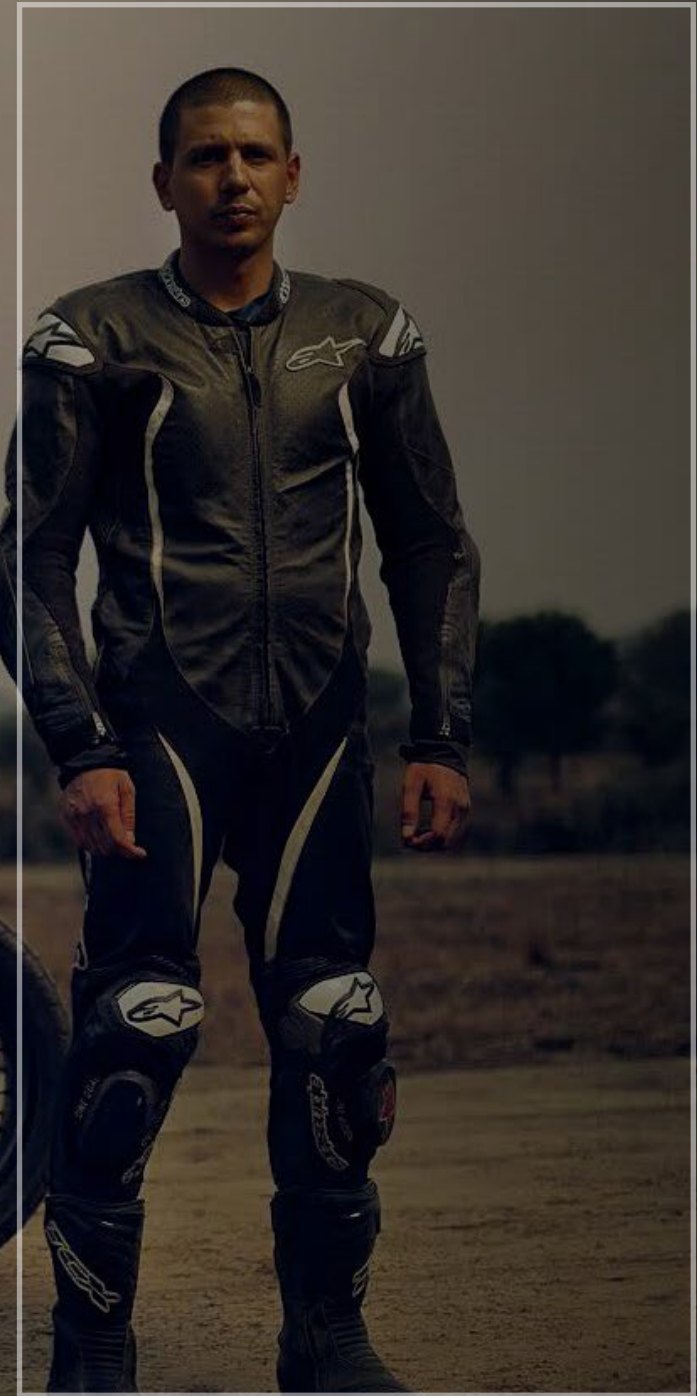


## Rajputana Custom Motorcycles

Born in Jaipur and educated at Mayo College, Ajmer, Vijay's dad put him on his first motorcycle - a BSA Falcon AKA a BSA Bond - when he was 7 years old. Ever since then he was at the motocross track, learning how to ride and later race in the 75cc class. They showcased their first bike - 'Original Gangster' - at the New Delhi Auto Expo 2010. After a very positive response and overwhelming affection for the bike at the expo they started taking orders to build motorcycles for customers as well. RCM continues to produce highly stylized, exquisitely detailed, awe-inspiring machines, with flawless functionality.

### Mission:

To not conform to "demand & supply"; they are happy building 12 odd bikes a year. It goes without saying that RCM will give those 12 bikes everything they have got.



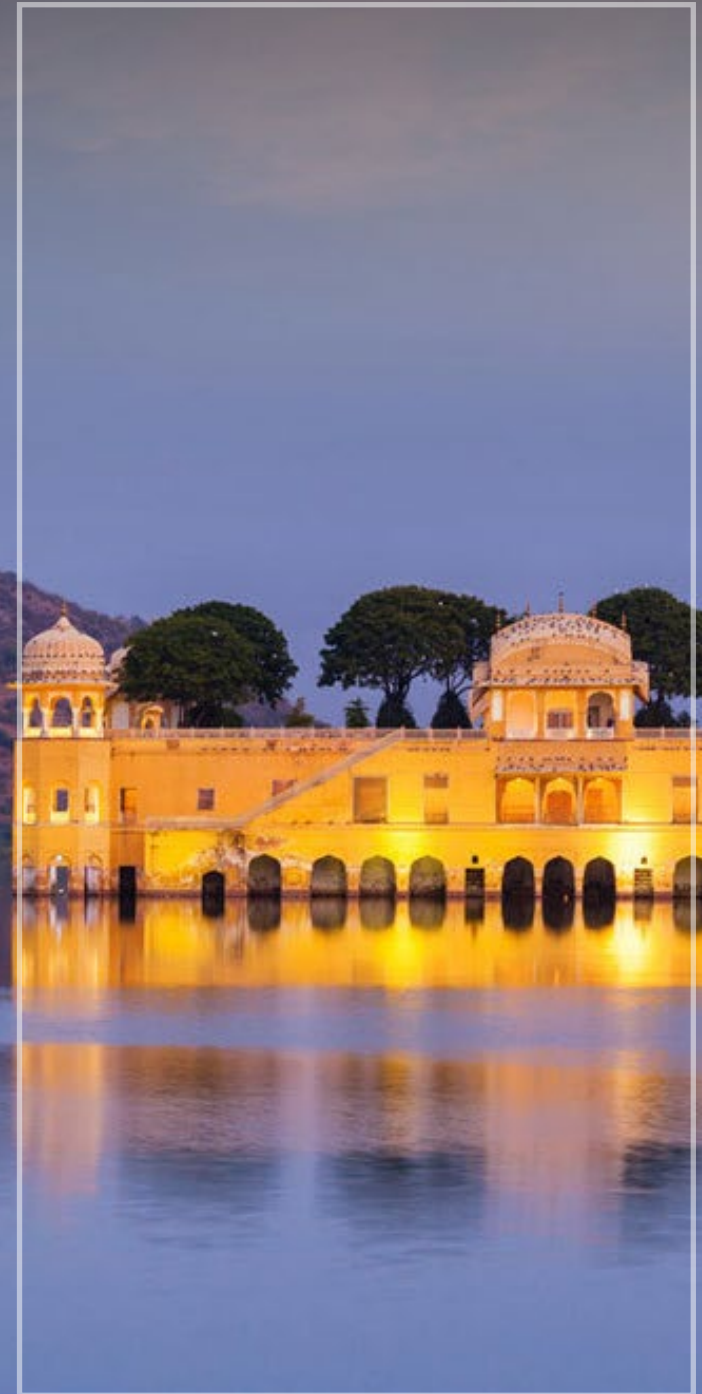
## Understanding RCM's Taste

One can find extensive use of brass components instead of chrome on their motorcycles which is a part of their design strategy to make their creations time-less. RCM avoids use of candy or vibrant colors and flashy paint jobs, uses more shades or tones of hue to decrease the lightness. Their work have been heavily influenced by rich cultural and artistic heritage of Rajasthan's.



## Influence of Rajasthan's Culture, Architecture and Art

Rajputana's work showcases influence from various aspects of Rajasthan weather it be Culture, Architecture or Art. Weather there have been very harsh and one have to work hard to put days meal on table, this have made people hard working and polite at the same time as this actually reciprocates to finer detailing in their work. Attention to details is something to look up to. Koftgari, Sword making and Dagger making are finest of art found in rajasthan. Influence of Rajasthani Minia-ture painting is very evident on their Motorcycles. RCM collaborates with different Artisans who master in craft of koftgari, silver inlay and gold inlay.





# Current Builds



Custom Harley Davidson Cafe Project



Basic RE Customization



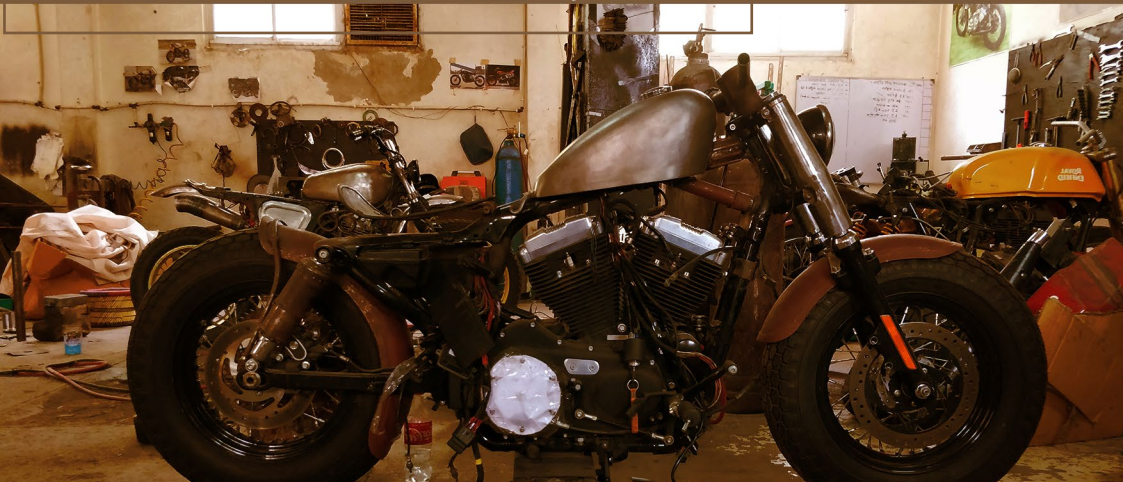
Classic Norton Restoration Project



Honda Scrambler



Dadwaal - American Style RE Bobber



American Style Bobber Harley Davidson 48



Brat style RD 350



# After-market Accessories Design

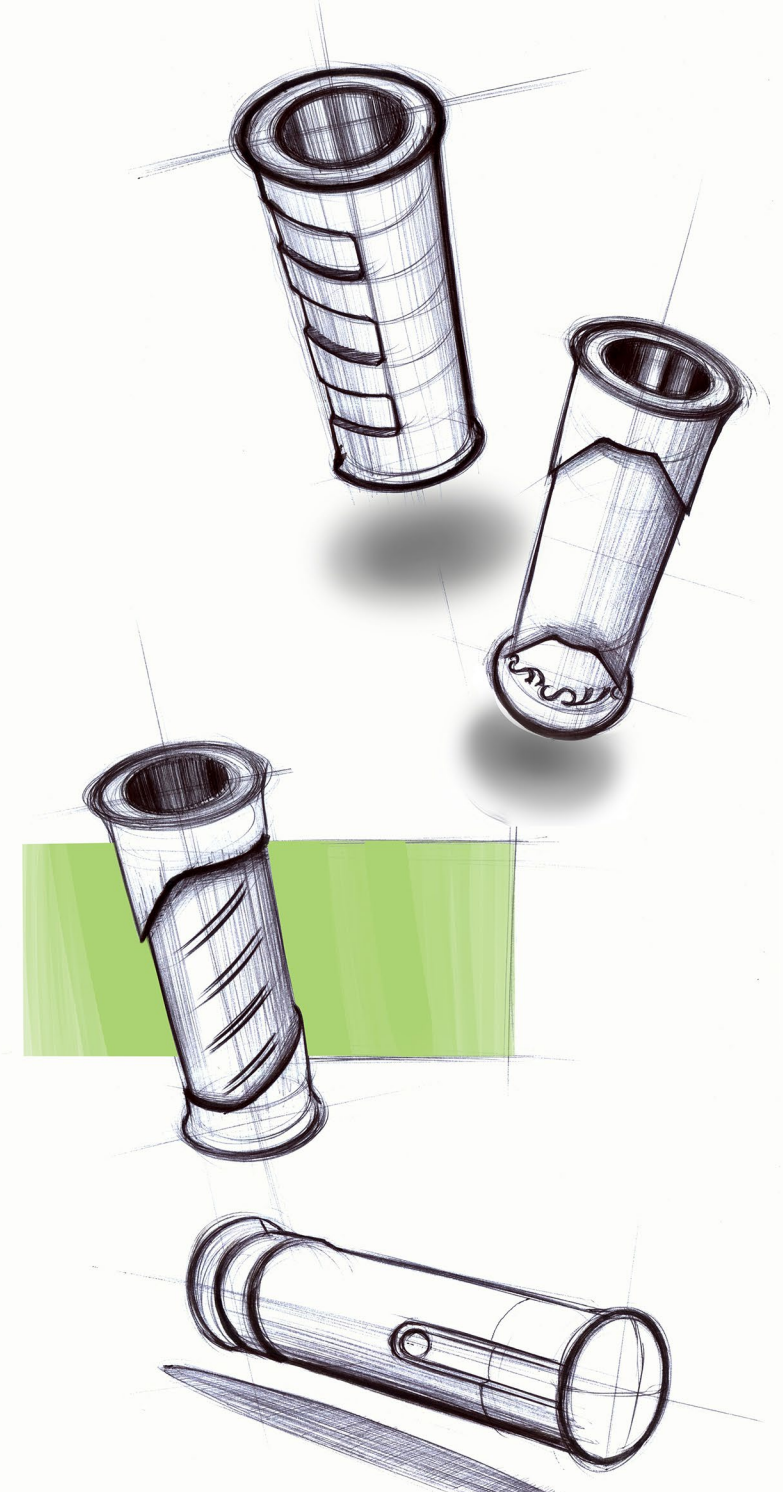
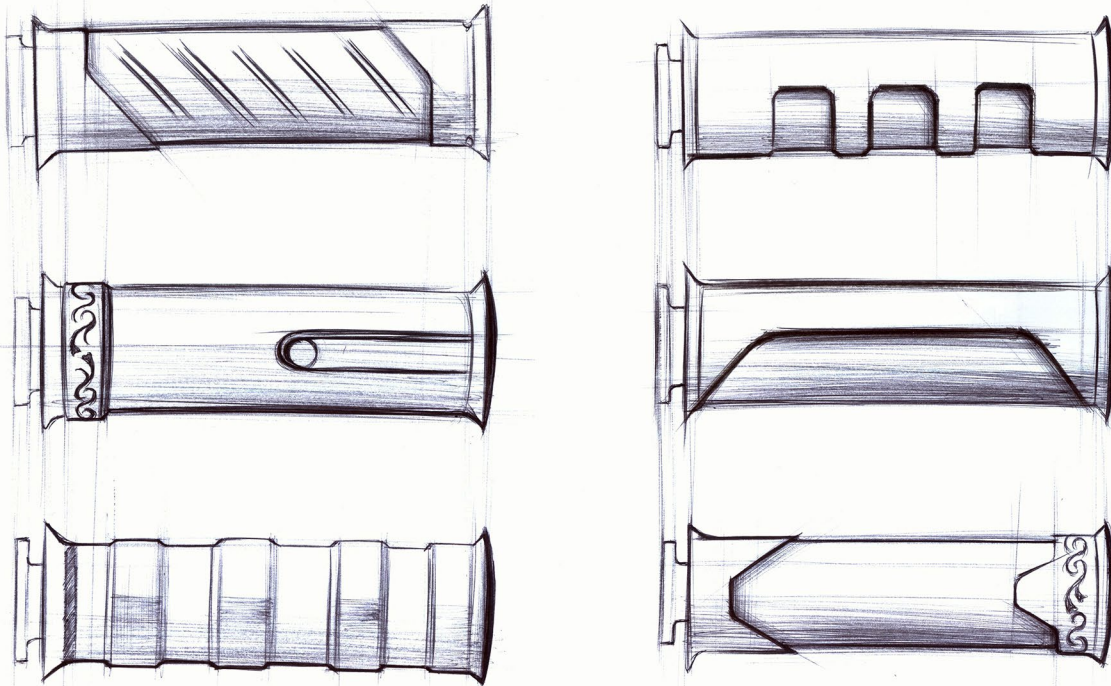
## Design of Handle Bar grip for Royal Enfield

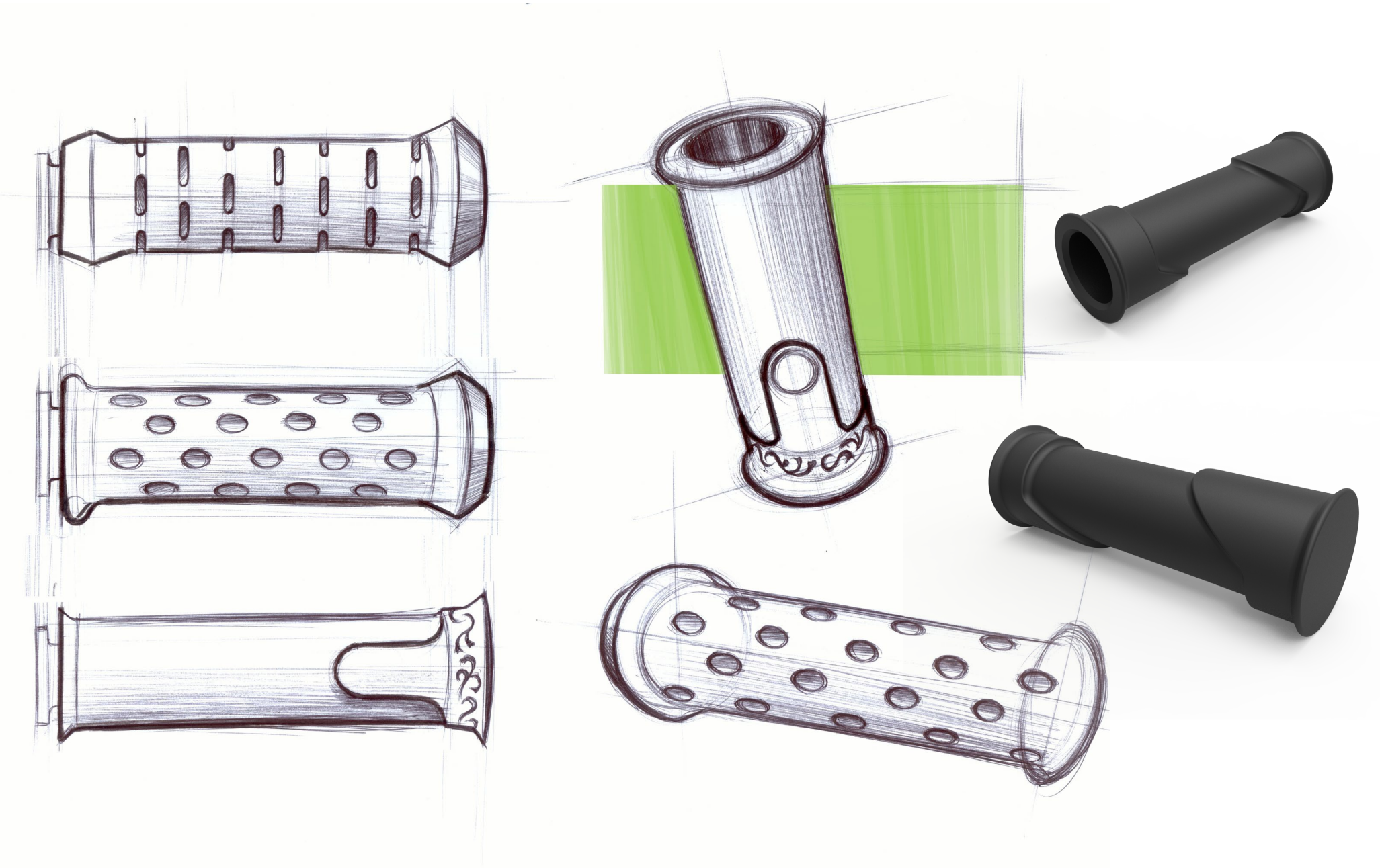
### Task

Task allotted was to design handlebar grips for Royal Enfield Bullet which is to be sold online on shopping platform of RCM's website.

### Objective

Objective was to enter accessories market specially targeting young customers who keep upgrading their bikes with after-market add-ons to keep it refreshing as ever.



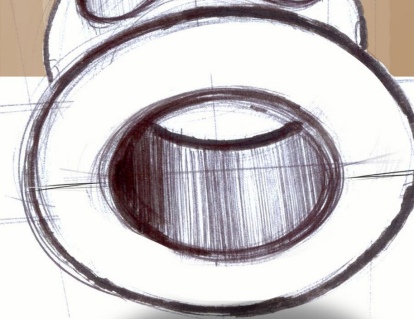
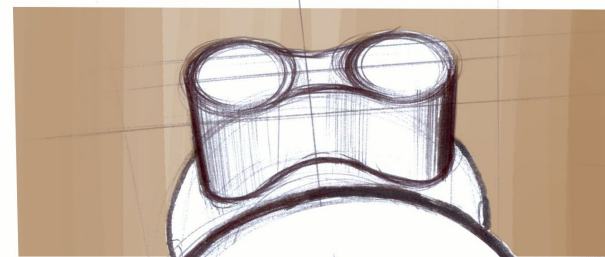
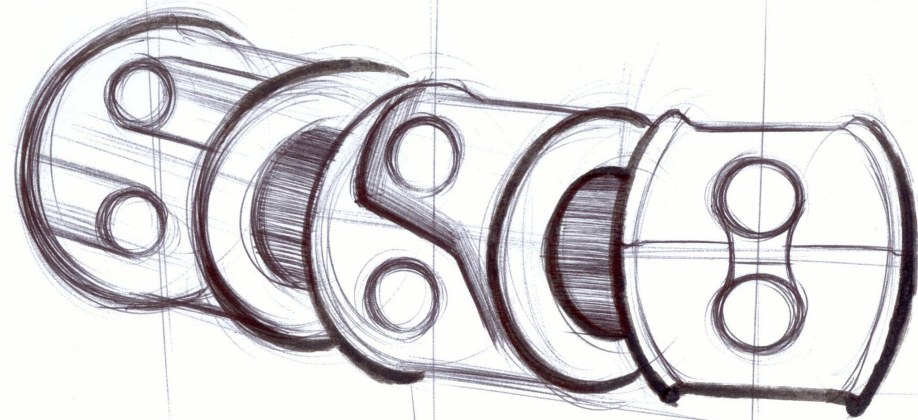
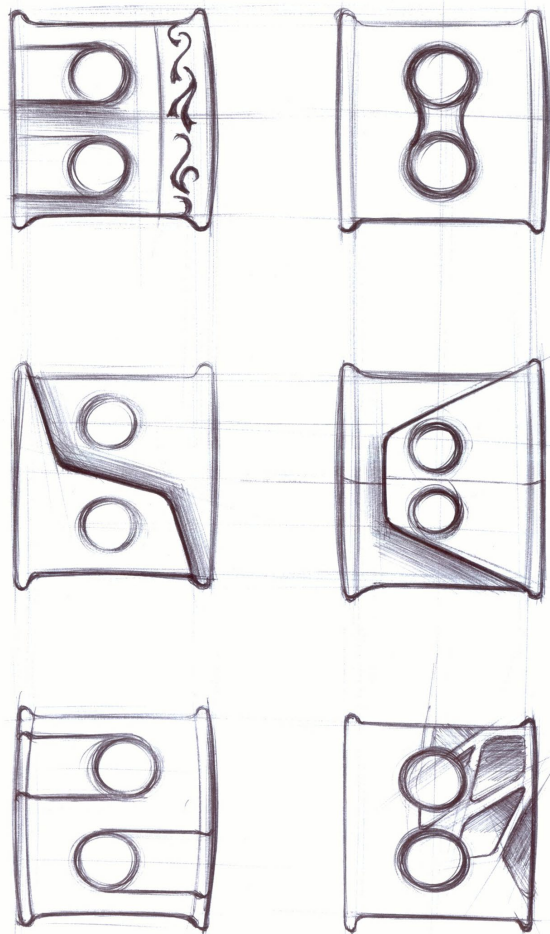


# Designing Micro switch Housing

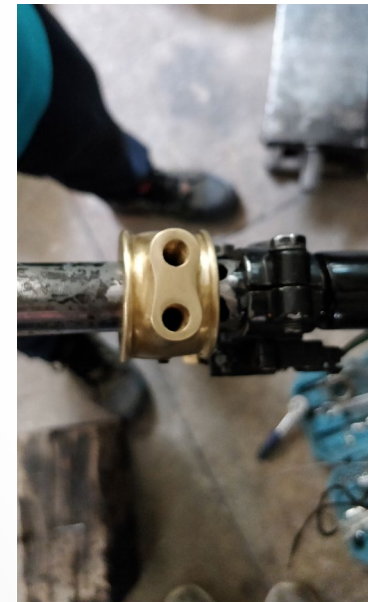
## Task

Task in Hand was to design micro switch housing which would replace the existing plastic housing so that it matches the language of rest of bike.  
(Material - Cast Aluminum Alloy coated with Brass)

Bike - Dadwaal (A custom RE standard 350)



Photograph of actual Product being manufactured and fitted on bike



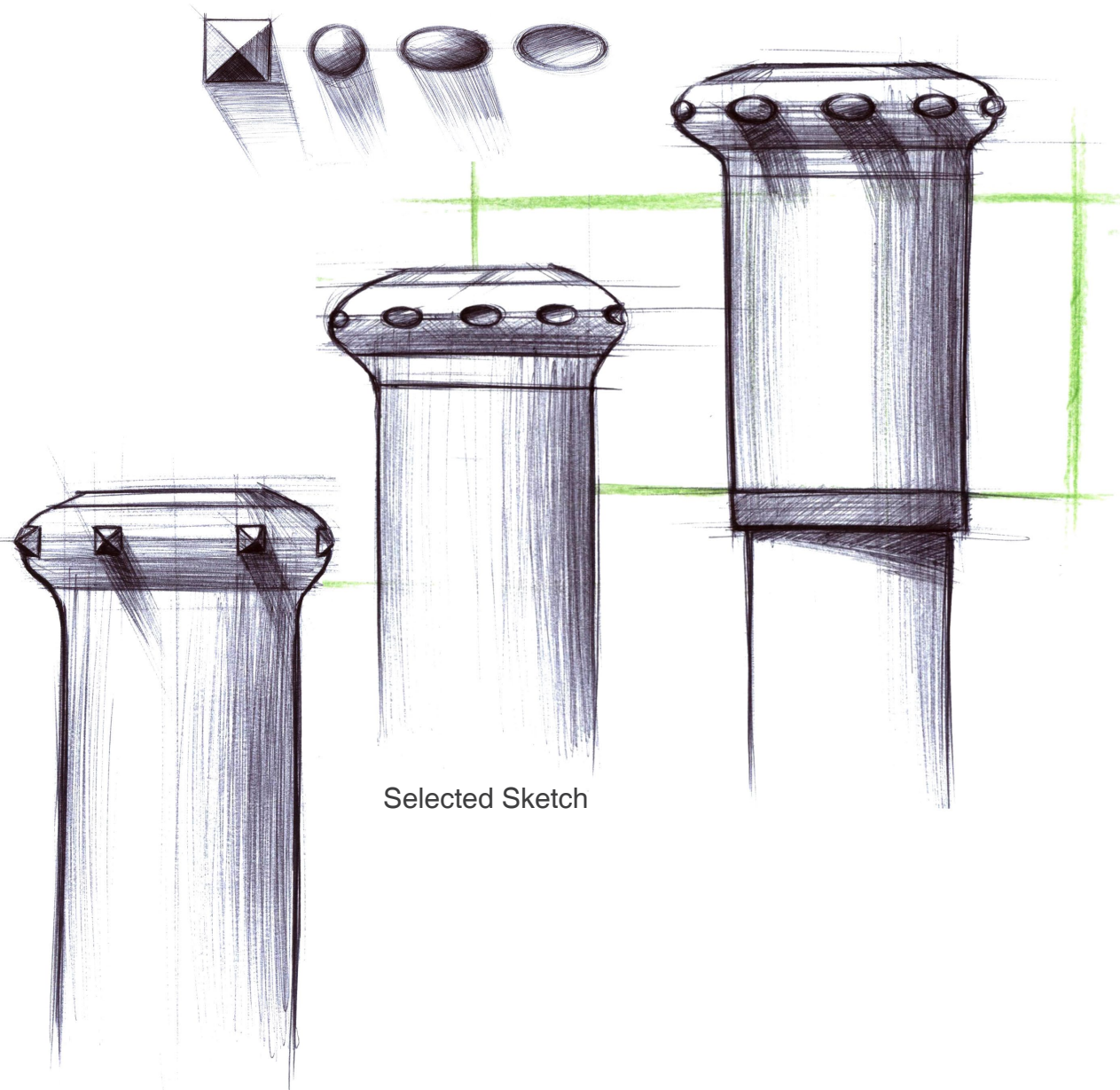
# Designing Rear Shocker Cover for RE Bullet

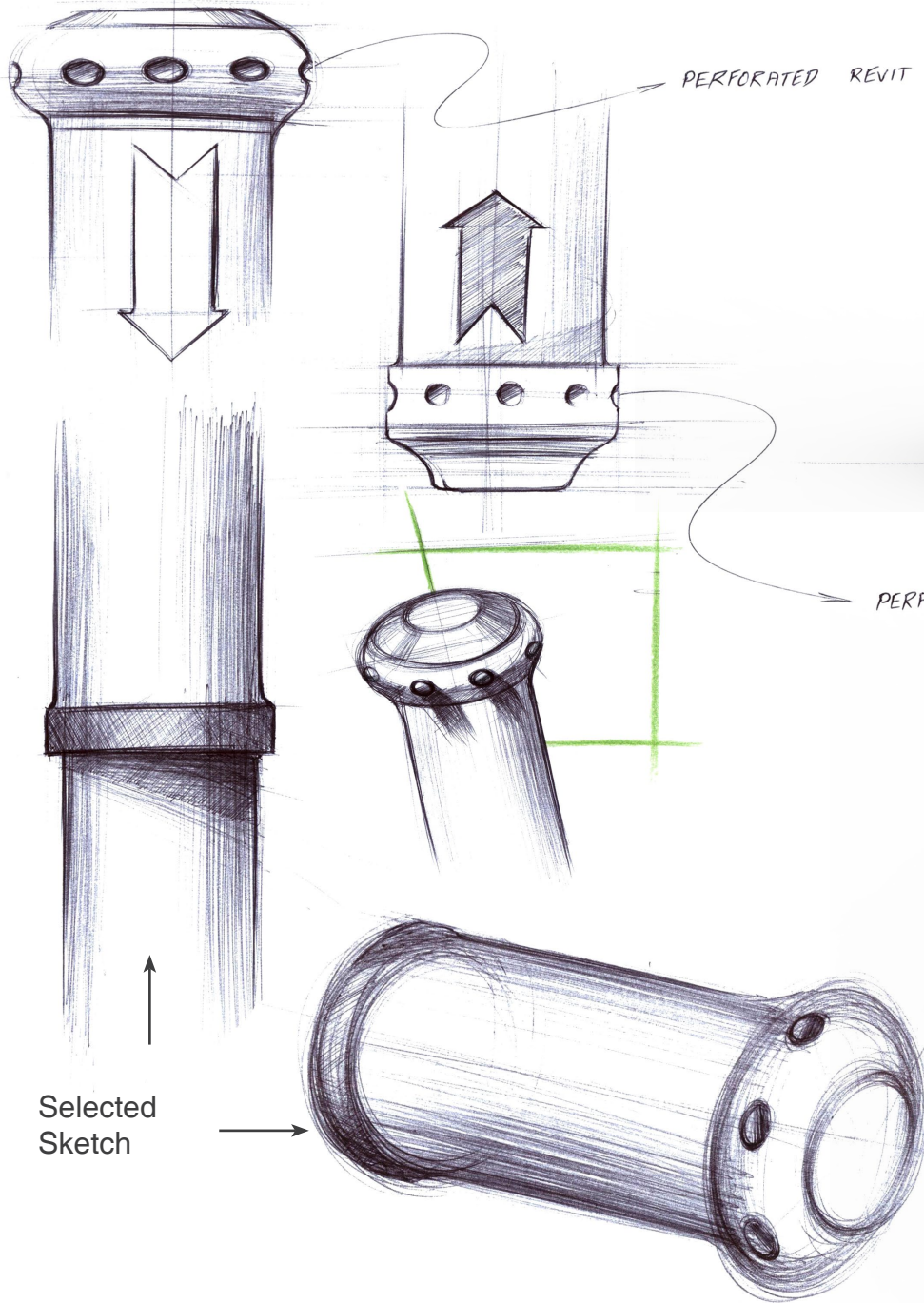
## Task

Assignment was to design rear shocker cover which would be used in current RCM builds such as Harley Davidson Iron 883 and RE Bullet standard 350 and also to be sold as after-market accessory.

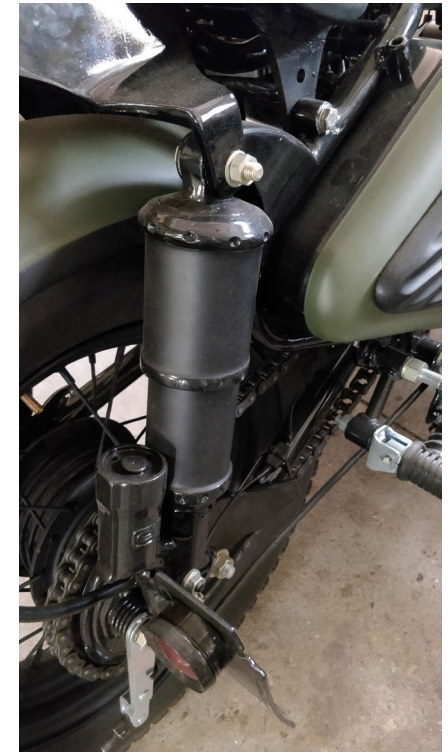
Design Direction - BSA type shocker covers (as instructed by Vijay Sir)

## Visual References





Photograph of actual Product being fabricated and fitted on bike

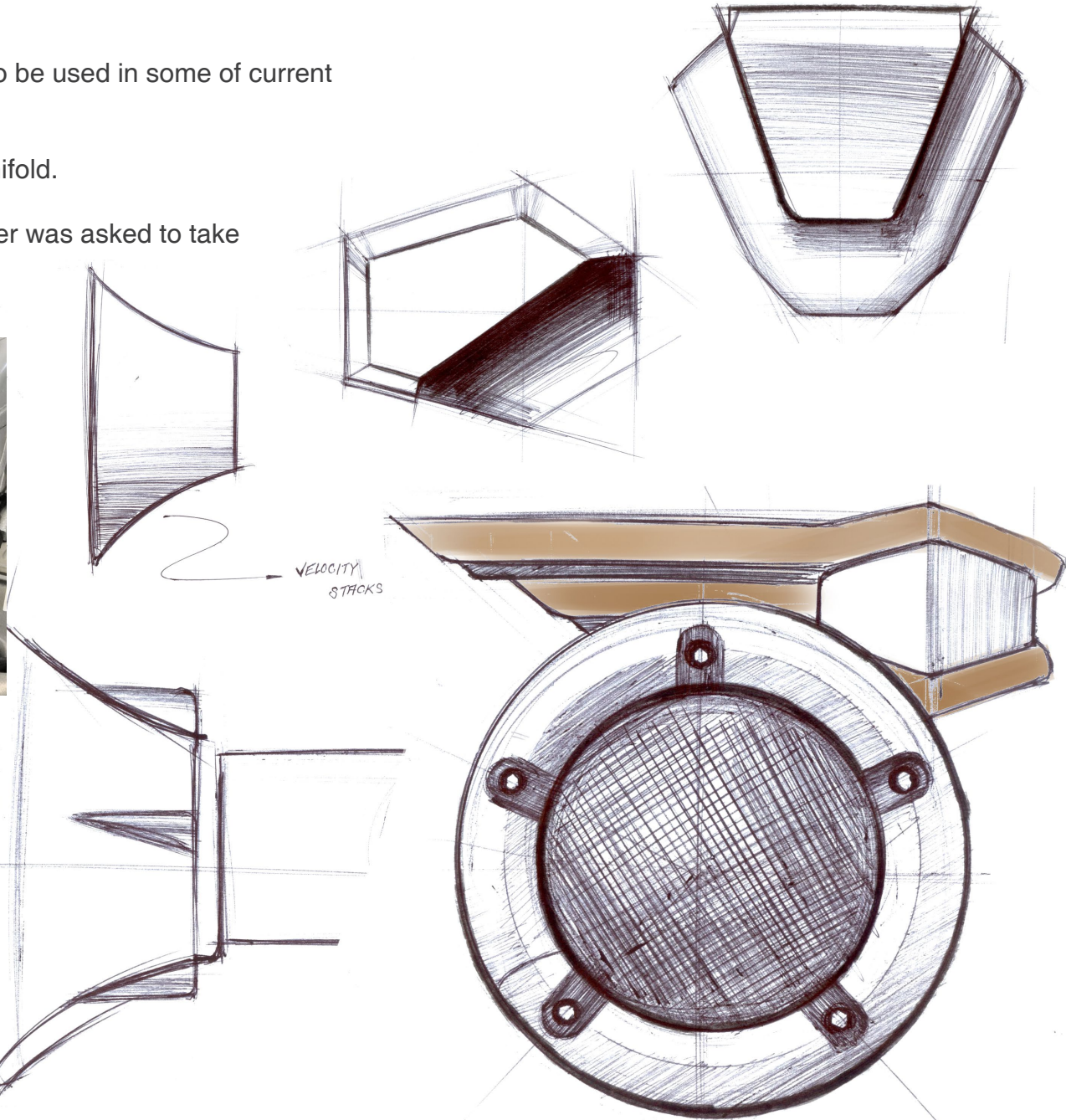


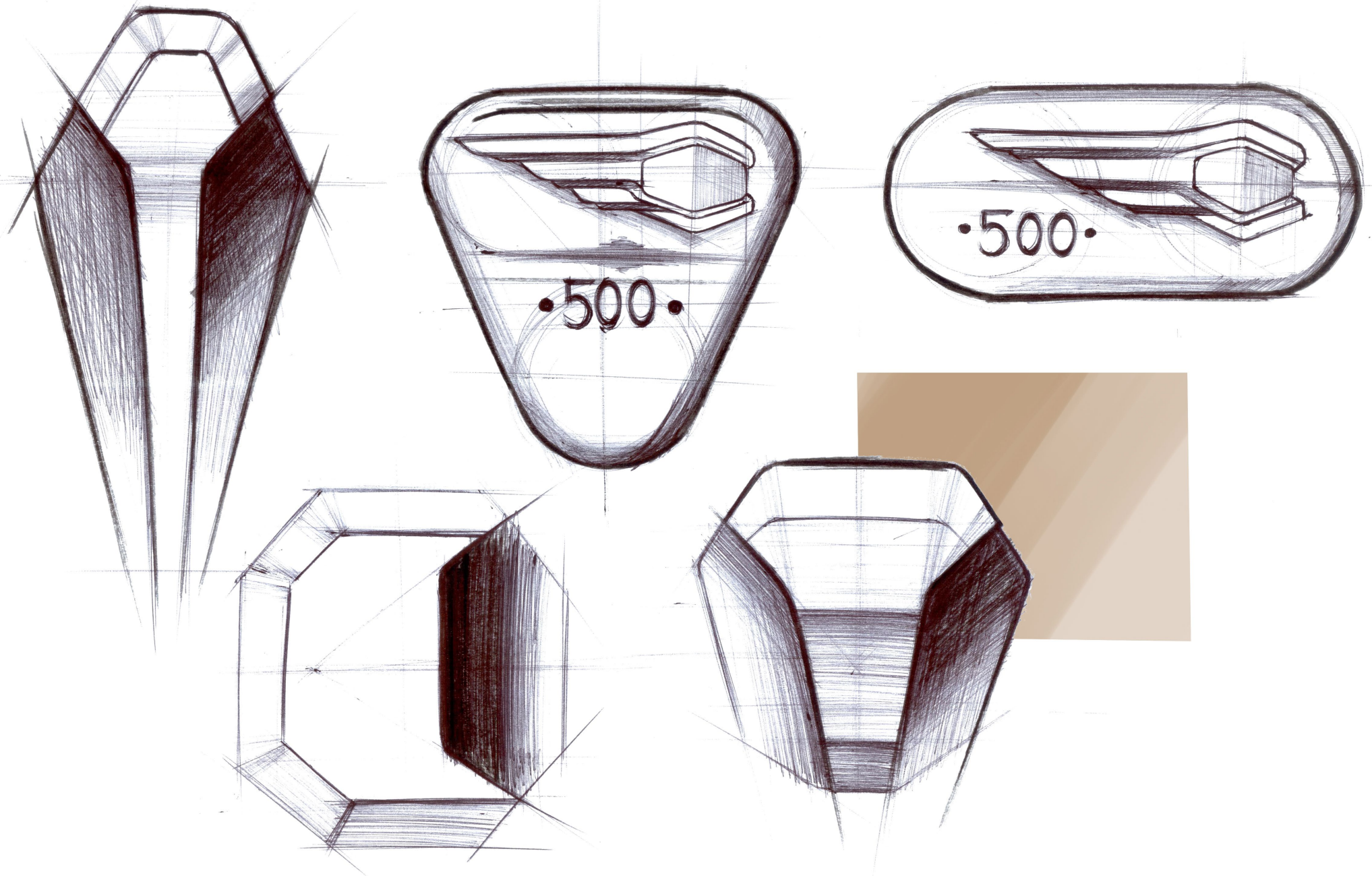
# Design of Air Filter Kit for Royal Enfield

Task in hand was to design Air filter kit for RE Bullet to be used in some of current RCM Builds.

Components includes Filter foam housing, intake manifold.

Initially I was asked to generate random ideas and later was asked to take References from Velocity Stacks in Cars







RE Bullet fitted with custom Air filter Kit



Assisting in Visualizing the paint scheme on a bike after fabrication  
(Tool Used - Photoshop)

Royal Enfield Bullet standard 500





25th Anniversary Special Edition Ducati Monster 797

Brush Metal finish Tank and Panels





Harley Davidson Iron 883





Yamaha RD 350

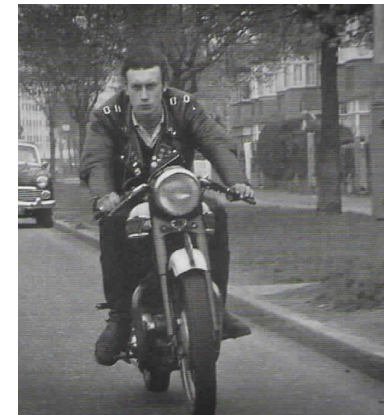


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potential Client

## Cafe Racers - A ride back to its Origin

This is not intended as a complete history, rather a look at the highpoints in the café scene which is timely because in recent years, it seems that the term “Café Racer” can be applied to any old motorcycle that has been spray-painted black and fitted with pipe wrap. However, motorcycle enthusiasts who raced each other from café to café were the true Café Racers in the UK during the 1960s. The most famous of which is the Ace Café, in London, which is still in existence today.

A cafe racer is an extraction of the “rockers” subculture back in the 50,s and 60’s. Due to the lack of (affordable) sports bikes people started building their own versions of Moto GP Bikes. The Ace Café in London (England, Europe) was a popular meeting point those days and people raced against each other with their custom bikes, usually from café to café. This is why they’ve called these bikes cafe racers.



Predominantly most of the early Café Racers were British bikes – Triumph, BSA, AJS, Norton etc and none of them were particularly quick. But, the objective of most of the riders at the time was to try and achieve the ton – or 100 mph. If you could demonstrate your bike was capable of going at that speed or faster you could call yourself a member of The Ton Up Club. It was, though, an expensive hobby, so over time as a rider added more and more parts the traditional Café Racer motorcycle, the look that we know today started to evolve.

Ostensibly for a bike to be a Café Racer it had to have a combination of some of these things: clip-on bars, swept back pipes, a racing seat, large carburetors, and a fiberglass or aluminum gas tank. Fundamentally a Café Racer had to be light and powerful and able to achieve 100 mph. They often looked like stripped-down racers with anything that was considered superfluous or unnecessary or heavy taken off the bike.

Other features that were adopted to make a bike a Café Racer included an elongated fuel tank (similar to Grand Prix racers of the 1960s) often with concave depressions to allow the rider's knees to grip the tank, low-slung clip on bars and a single seat with a faired-in rear end.



Platform  
Royal Enfield  
Continental GT 500

# Possible Performance Upgrades/ Modifications of Existing GT platform

## Vehicle Dynamics

Motorcycles were first developed out of the bicycle frame, which certainly is rigid. Suspension systems were progressed over the years after critical researchers to filter out ground disturbances in more efficient ways.

## Understanding the Suspension Geometry

### Rake Angle

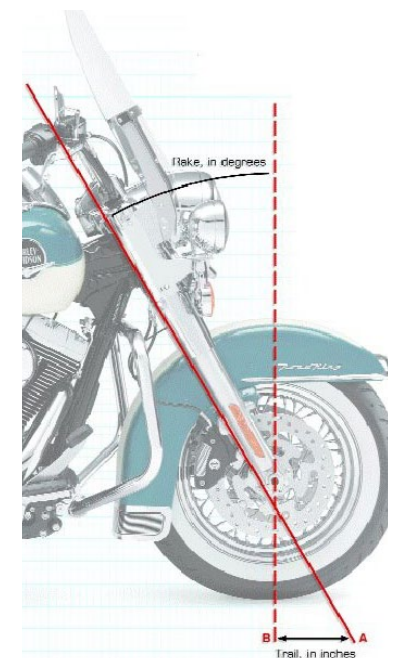
Rake is defined as the angle between the vertical and steering axis. The steeper rake reduces the trail and trail itself is also affected by the longitudinal fork offset. More offset decreases the trail. The trail is also affected by axle offset. The trail increases in the case if the axle is coupled to the forks in front of their center.

More Rake implies to more of a cruising experience. and hence is more stable for long straight stretches

Least amount of rake is in Moto GP bikes. (most popular superbikes fall in range of 23-25 degrees of rake)

### Trail

Trail' is the measurement, on the ground, from a point which is projected through steering axis to the center of the tyre's contact patch below the axle. Trail determines the self centering stability of the steering as well. The triple clamps provide good lateral offset that the forks clear the sides of the front tyre. Usually Triple clamps are introduced to provide some measure of longitudinal offset as well, to alter the trail.



Trail impacts directly on the steering stability of the motorcycle and its 're-turn-to-center' force. The trail is much affected by rake. Think of it as how far the contact patch trails behind the steering axis.

Too much trail makes a motorcycle difficult to turn; too little makes it unstable. Trail produces stabilizing or self-aligning effect for you.

What we want is best compromise between both..

GP Bikes usually have 23.5 degree rake and 95 mm trail

What I am proposing is a 2 degree steeper rake i.e. 24 degrees and trail reduced by 1.2 inches i.e. from 5 to 3.8 inches

**Hossack Noir Suspension (Duo-lever Suspension as called by BMW)**

In the whole history of motorcycling, there have been only four front suspension systems that reached full commercialization. One of them is the HOSSACK motorcycle suspension system.

In terms of kinematics the Duo-lever front suspension comprises a four-bar linkage in which two semi-trailing arms made of forged steel are secured to the frame by means of roller bearings. These guide the extremely torsion-resistant fork slider which is made from aluminum gravity die casting and visually resembles a conventional fork. A central suspension strut, which is linked onto the lower of the two semi-trailing arms and is supported against the frame, performs suspension and damping.

One might expect the Ducati to have the more aggressive number, but it doesn't. That 3.38-inch number would likely give a bike with a conventional fork such quick steering that it would verge on instability.



But the HP2 doesn't have a conventional fork; it has a Telelever. While a conventional fork's rake angle and trail decrease as the fork compresses, the Telelever's and duo-lever's rake angle and trail increase as the suspension moves from full extension toward full compression.

## Perimeter Disc Brakes

The frictional force which acts on the tire during braking travels through the rim of the wheel. In a conventional disc brake set up, the force is transferred from the rim or periphery of the wheel to the hub via spokes of the wheel. The force then travels from hub to disc via fasteners connecting disc and hub. The disc reacts to the force as it is fixed by braking action of the caliper.

The peripheral disc brake on the other hand has disc mounted near to the rim of the wheel, at greater radial distance than conventional disc brakes. As a result, force is almost instantaneously transferred from the rim to the disc and passes through the spokes for no or very less distance. This means that the spokes can be made considerably lighter since they no longer have to carry braking load. It can be seen that peripheral disc brakes need lesser brake force for same end effect, induce lesser bending and shear stress in wheel spokes and lesser radial thrust at the wheel bearing. All these factors allow for a very light weight Motorcycle front wheel. Lighter weight means more efficiency, reduced unsprung mass and a higher power to weight ratio.



## Steering Damper

A steering damper/stabilizer is a suspension system for the side-to-side motion of your front end. If you have ever watched racing you may have witnessed what a violent head shake can do. A steering stabilizer works in a way that's similar to your bike's front forks. Internal circuitry and hydraulic valving adjusts the amount of shock transferred through the bars to your arms. There is an attachment point to the frame and this sometimes violent motion is transferred to the frame, allowing you to maintain control of the motorcycle and even helping to reduce rider fatigue.

Here are 4 equally important reasons why a steering damper is highly beneficial:

- Reduced Headshake
- Reduced wheel deflection
- Better corner entry
- Less fatigue



## Legal requirements

India actually has minimum and maximum requirements on rake and trail for “manufacture, sale, and safe operation of a motorcycle upon public highways.

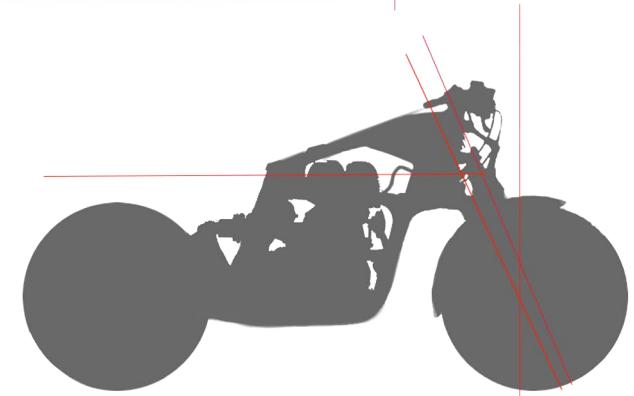
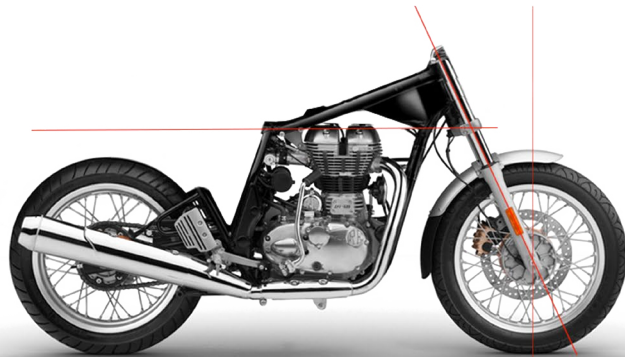
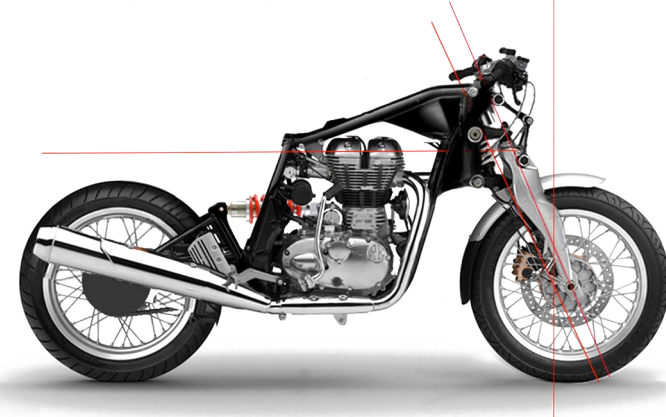
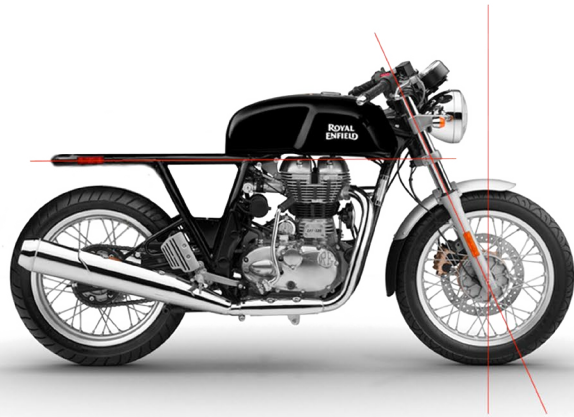
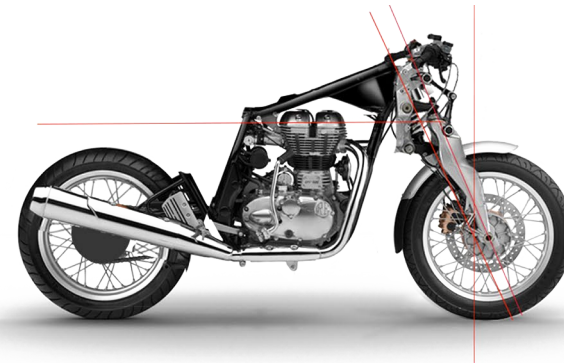
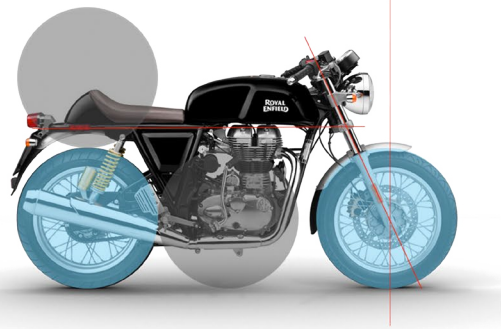
All motorcycles, except three-wheel motorcycles, must meet the following specifications in relationship to front wheel geometry:

**MAXIMUM:** Rake: 45 degrees - Trail: 14 inches [35.56 centimeters] positive

**MINIMUM:** Rake: 20 degrees - Trail: 2 inches [5.08 centimeters] positive

Manufacturer’s specifications must include the specific rake and trail for each motorcycle or class of motorcycles and the terms “rake” and “trail” must be defined by ARAI.”

# Packaging



## Highlight Features



Hossack Noir Front  
Suspension



Perimeter Disc Brakes



Steering Dampers

## User Persona

Aman Bhatia (29) (Changed name)

Resident of New Delhi

Jewelry by profession ,Weekend Racer (Races in Buddha International Circuit)



He asked for something very Exciting, New and Refreshing, something which is Performance Oriented as he is a racer himself.

And must be Mechanical looking though the engine should not be exposed as in a naked street bike.



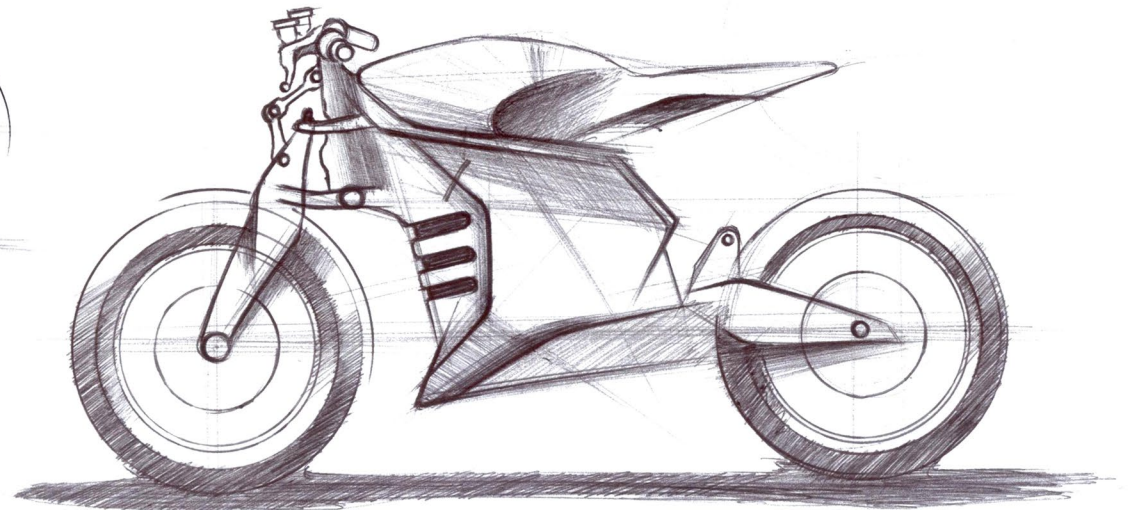
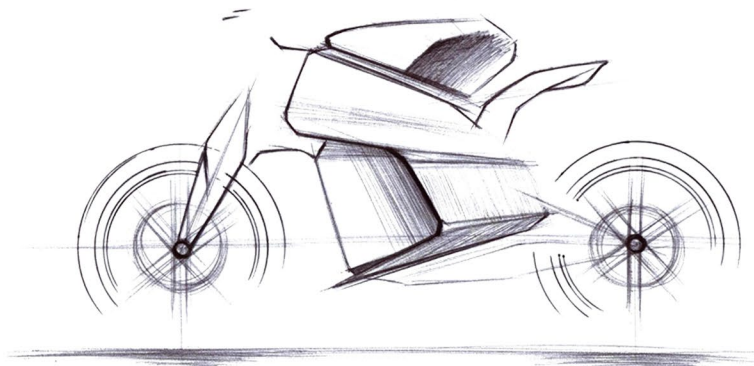
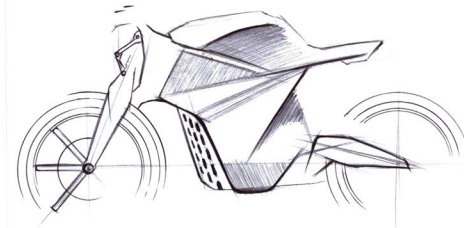
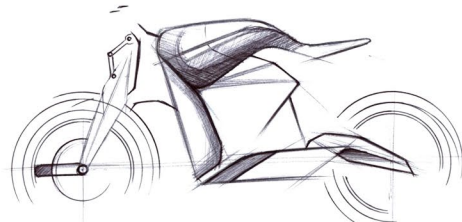
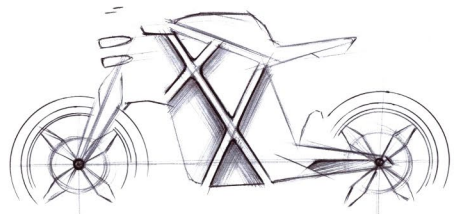
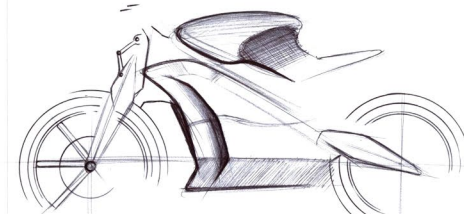
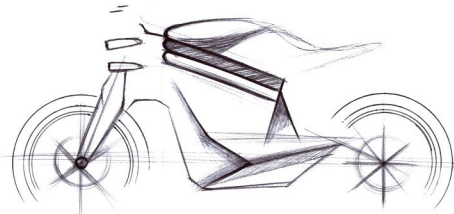
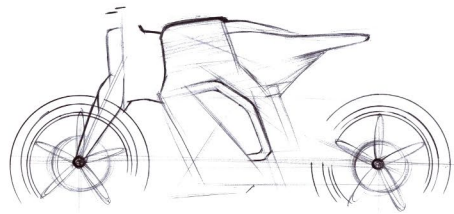
Industrial

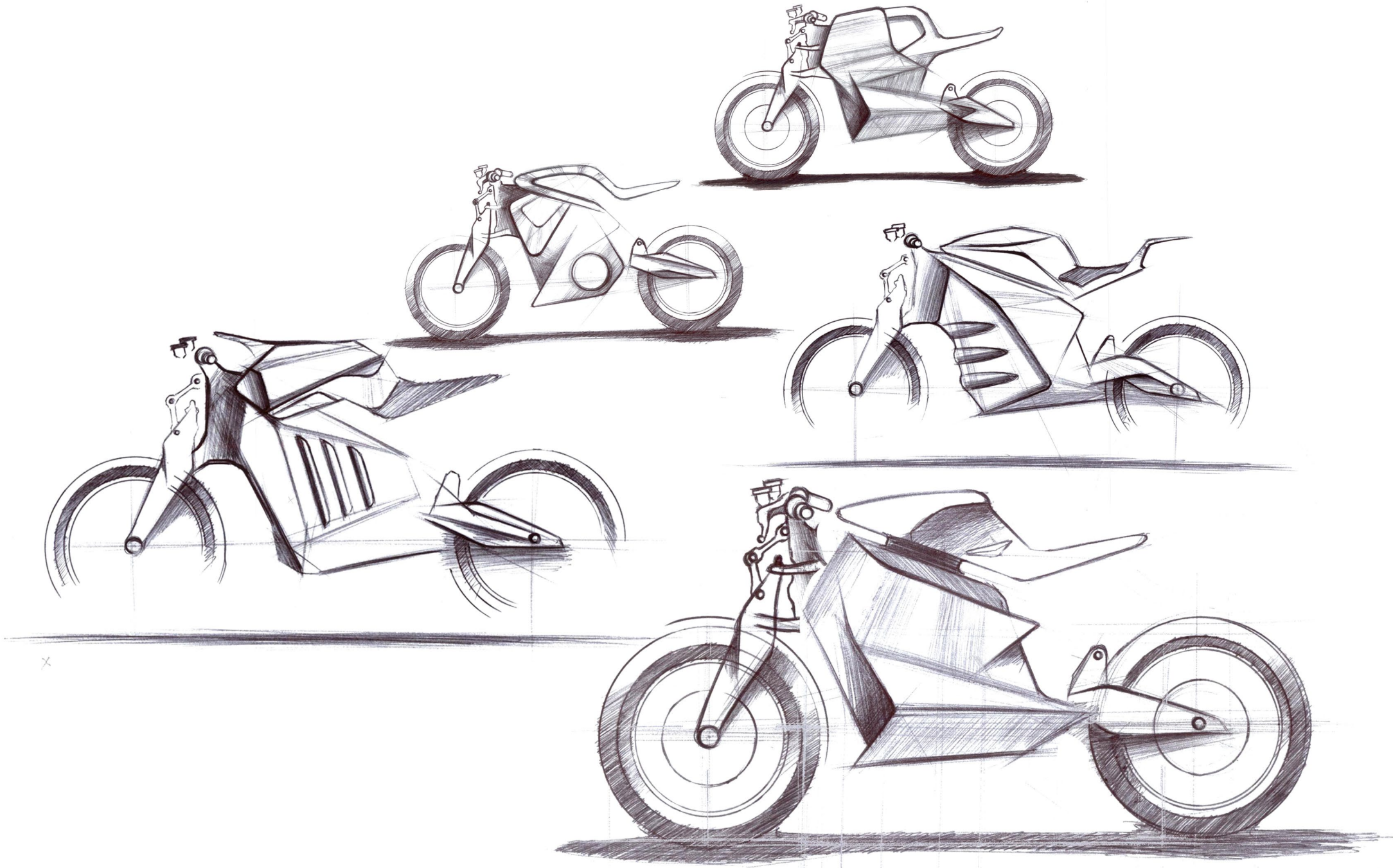


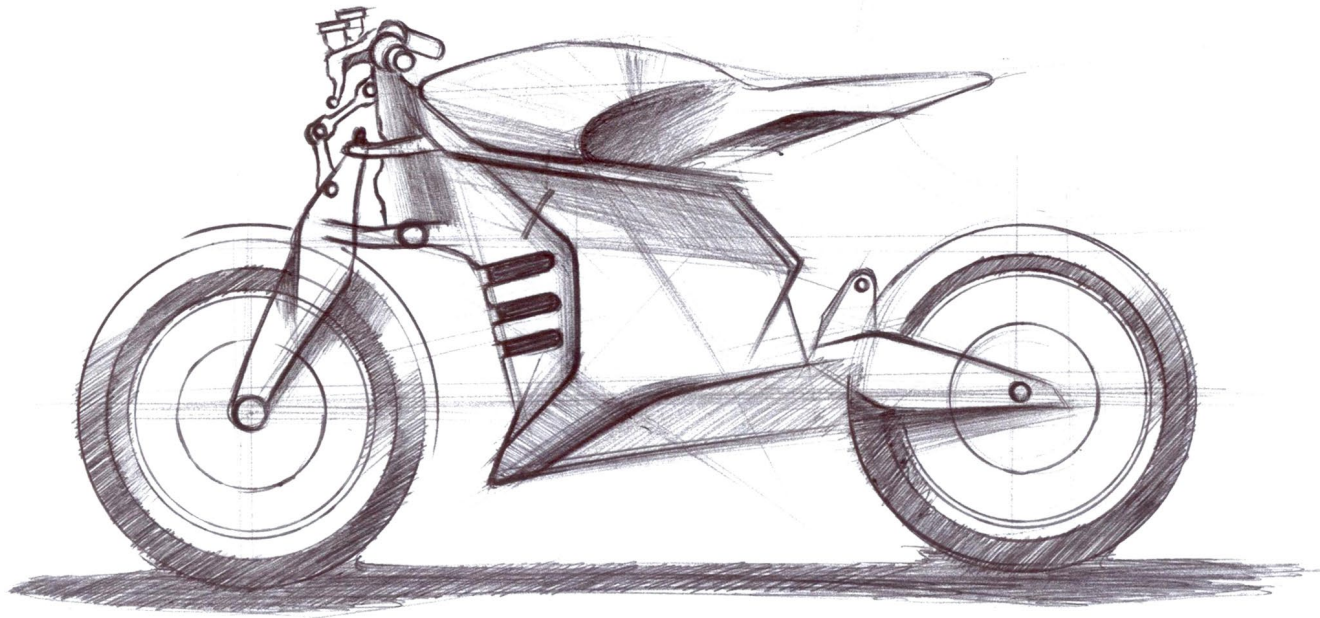
Performance



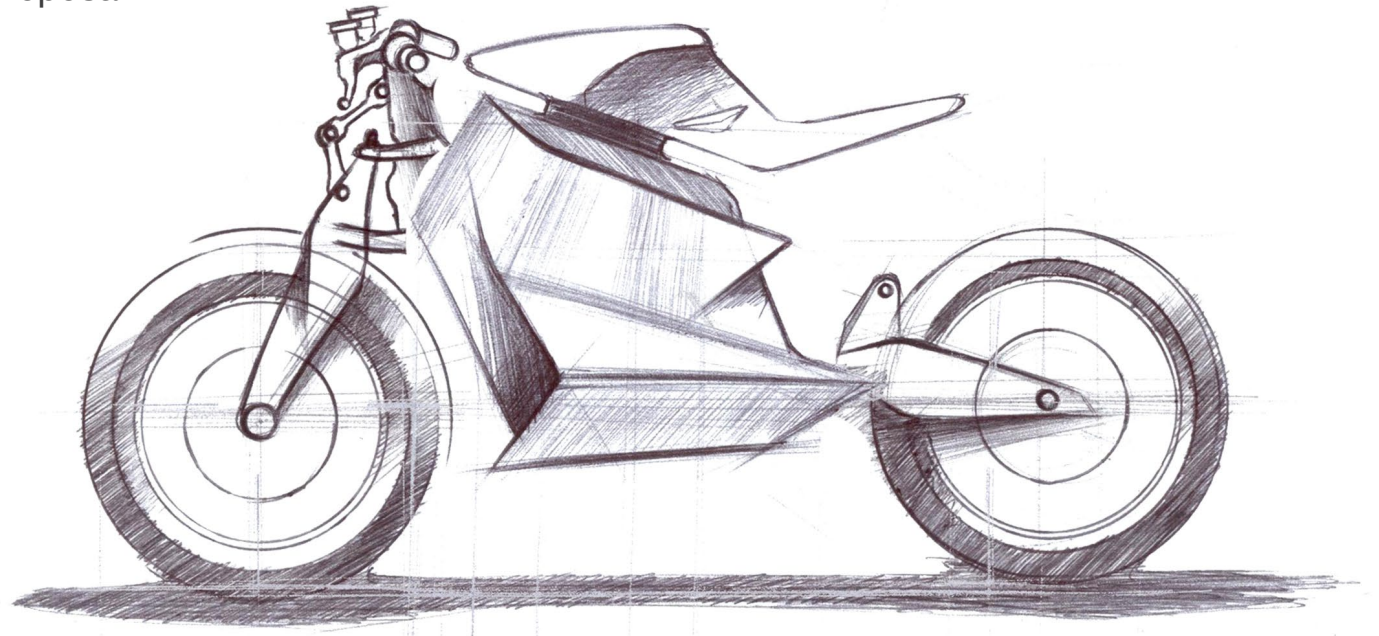
Exciting



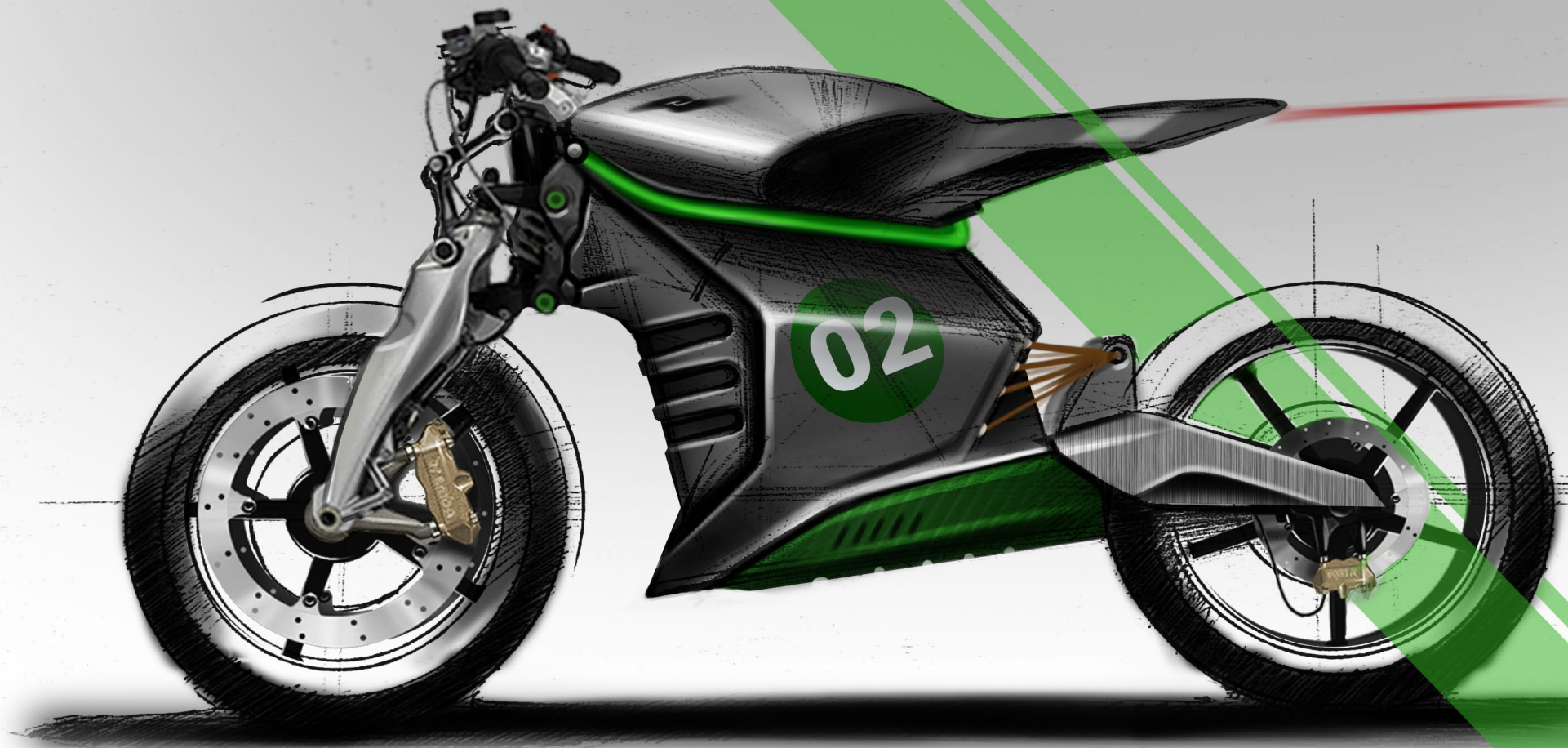




Proposal 1



Proposal 2



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- 9) [https://en.wikipedia.org/wiki/Motorcycle\\_fork](https://en.wikipedia.org/wiki/Motorcycle_fork)
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