

Designing a Micro Sports Car for India
Submitted in partial fulfillment of the requirements
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by
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Designing a Micro Sports Car for India

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Dissertation Approval

This report entitled Designing a Micro Sports Car for India by Harsh Vardhan Tripathi is approved for the degree of M.Des

Examiners

Supervisor(s)

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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 or from whom proper permission has not been taken when needed.

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Abstract

As the younger earning class in India expands, there are more people with more disposable income. This means that they look for lifestyle vehicles. While this market niche is being effectively tapped by the motorcycle industry, the car industry lacks any suitable alternative, as such leisure vehicles, especially sportscars tend to be expensive imported vehicles.

As a result, the users tend to buy either used imported cars or buy a regular car and invest in modifying it to suit their tastes and performance needs.

The project was to develop a light and inexpensive sportscar that would cater to this market. By keeping the overall length under 4 meters and using a small but powerful engine, it can take advantage of the tax breaks, and be available for a low price.

The focus was on the form of the car which should excite the buyers and connect with them, as well as grab attention of onlookers.

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Introduction

The young earning population of India is looking for lifestyle vehicles. This market is being effectively tapped by the motorcycle industry, with both homegrown brands and foreign majors launching cruising and sports bikes in the country. Even imported bikes are doing fairly well in the country. However, the situation is different in the car industry. Such lifestyle cars like GTs and sports cars tend to be expensive. Add to it the import duties, and they move well beyond the purchasing power of this market.

This results in some of these buyers buying used imported cars for less money, but then they have to deal with shady paperwork and hunt for elusive spares. Most of the buyers, however, end up buying regular cars and modifying them both visually and performance-wise. These modifications are most often than not up to the mark and result in poor user experience and reduced life of the vehicle. Moreover, they represent a missed opportunity for the manufacturers.

The scope of this project is to style a small and low cost sports car that would cater to the needs of these individuals. By being less than four meters in length and having a small, but powerful engine, such a car can take advantage of the tax breaks for small cars, and present itself to the buyers at a low price point. The form of the said car should be exciting to the buyers. Since this is a lifestyle product, it should cater to the aspirations of the consumers. The form should express a sense of power and speed visually to onlookers, while remaining within the constraints of the package of a small sports car.

Part One

Research

Sports car

The definition of sports cars is a bit unclear. The common definition found in dictionaries speaks of a low bodied, two seater vehicle purpose-built for spirited driving and high speeds. But there are many sports cars which have a rear bench in the cabin while some have four doors.

Legal bodies and insurance companies in different countries try to define sports cars in their own way[1], using formulas which include variables like wheelbase, power-to-weight ratios, and the like. But again, these are not a hundred percent accurate always, as many times discrepancies creep up, like a two door small hatchback gets classified as a sports car by virtue of its small wheelbase and light weight.

Sports Car

noun

a low, small, usually 2-passenger automobile, designed for quick response, easy manoeuvrability, and high-speed driving

Merriam Webster's Dictionary[7]

A sample formula from Belgium[1], used to define a Sports car:

$$\frac{W}{P} \sqrt[3]{S} \sqrt[4]{cc} < 17$$

Where:

W Weight of the car in kgs

P Engine power in DIN horse-power

S Number of seats

cc Engine cubic capacity in litres

Insurance formulas aside, there are two common schools of thought among enthusiasts: the first is that a sports car is a car that is purpose-built for motorsports. Such a car can, with little to no modification, be used to participate in motorsports, primarily road course. According to this school of thought, performance modifications of regular production cars like Sport compacts, Sports sedans, Muscle cars, and Hot hatches are not considered sports cars. The second school of thought is much more inclusive. It says that any car which delivers greater performance over the standard offerings is considered as a sports car[2].



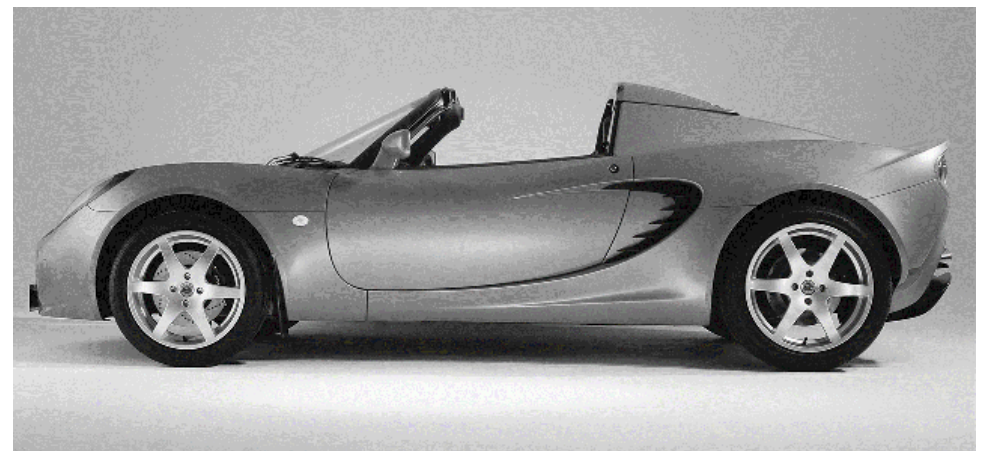
Small Sports Cars

British motor industry was the world's number two at before the World War Two, with many car manufacturers producing many driver focussed cars[3].

Since European roads are known for their twisty nature, and add to that the bracing European weather, and the result was that most of the famous British cars were small convertibles. These offered a very engaging driving experience, complete with the wind-in-your-hair and bugs-in-you-teeth top down experience. Also, they were a pleasure to drive.



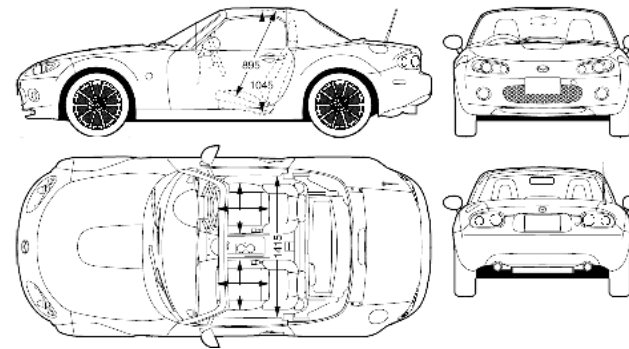
The experience was so charming that American GIs in Britain fell in love with them, and brought them back to the United States with them. This helped in popularising the light sportscars internationally. Brands like Lotus, Jensen, and TVR were famous across the Atlantic. However, given the dubious build quality of these cars and gross mismanagement at British motor companies meant that their fame dwindled gradually, and by the end of the eighties decade, there were none left in the American market.[3][5]



Character of a Sports Car

Light Weight Sports (LWS) is the class of small sports cars that became popular by the start of the nineties. The trend was started by the arrival of Mazda's MX-5 convertible. Soon others followed with different variations of the formula like Honda CR-X, Pontiac Solstice, Toyota MR2/S, and the like. Some were very successful and went on to have cult following, while others not so much.

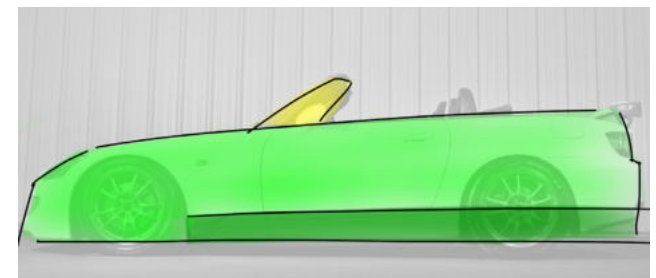
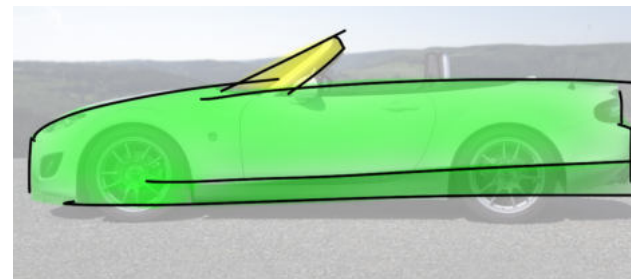
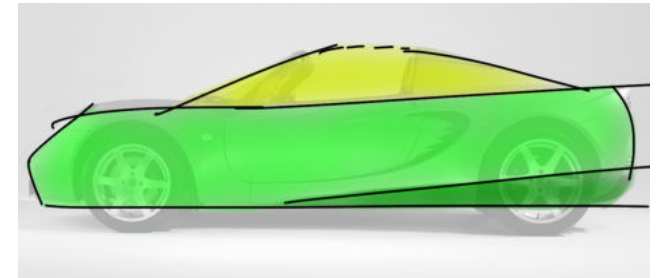
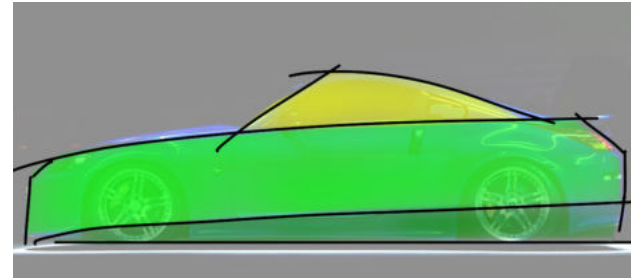
In essence, these Lightweight Sports cars were the spiritual successors of the British small sportscars. Just like their British predecessors, these were small and nimble convertibles. Their overall length would be less than four metres. In spite of this, they would have a



generous wheelbase of around 2.3m. This meant that the overhangs were minimal to keep most of the mass in between the axles for proper weight distribution. Most of them featured a mid-engine (MR) or front-mid engine (FMR) layout for the same reason.

The ground clearance would be low, as would be the overall height of the car, which would lie in the range of about 1.2m. Also, in proportion, the window sill height would also be quite low, giving the overall body a very low-slung feel.

The overall proportions of the body, with the small length and tiny overhangs gave the car feeling of lightness and nimbleness. As these vehicles were actually very light and built for handling corners rather than tackling straight line speed, this enhanced the playful and nimble character of the car.

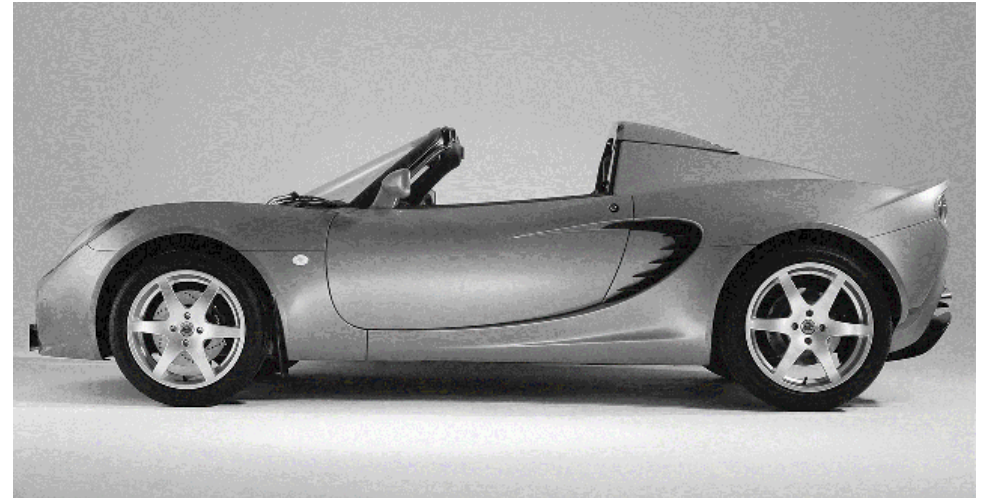


The overall form of the bodies of the Lightweight Sports cars is highly directional. This is achieved in part by the wedge-shaped profile most of them have. This treatment adds a strong sense of direction to the basic form. The main mass is made sloping in the forward direction to hint a movement in that direction.

This basic movement of the form is enhanced by either a small and sloping daylight opening (DLO) or the presence of a highly raked windscreen (in case of an open top car). Also, the basic volume of the car is split in most cases by either a strong character line or a different colour treatment. This split mass then acts a force on the main volume, visually pushing it forward.

This split mass also slightly makes the overall form feel a bit more planted. This is necessary, as otherwise the form tends to become too mobile, and feels very airy and inconsequential.

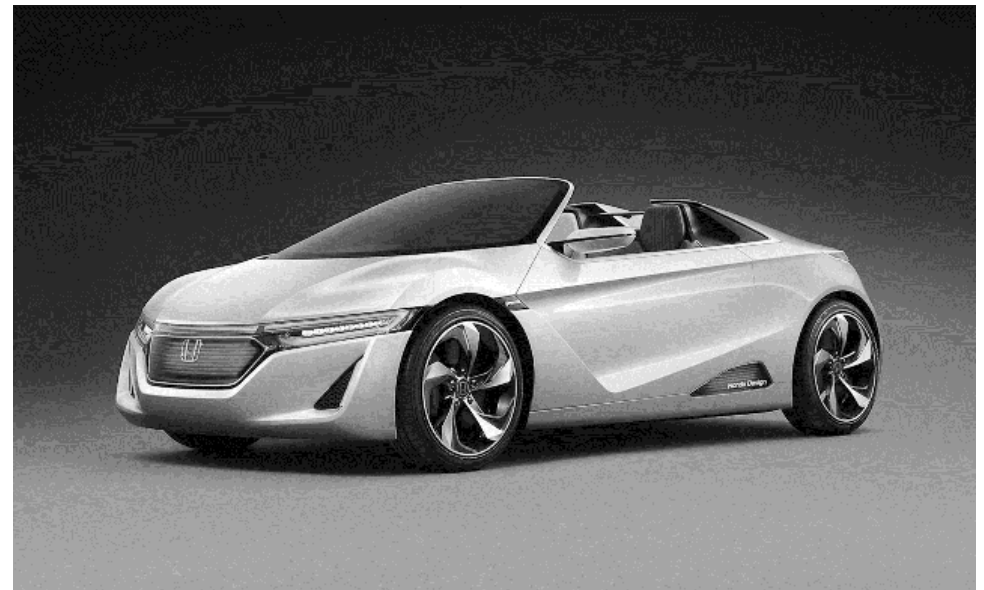
The lines of these lightweight sports cars have to complement their forms. The lines must thus enhance the feeling of forward motion that their forms have. They should also bolster the feeling of speed in them.



For this, the lines on these sportscars are generally very upswept. The lines also flow along the bodywork in long and smooth motions. They originate at the front of vehicle from a central point, and pull back along the length. As they move, they widen at the middle of the body and then converge again at the tail. This fluid flow of these lines emphasises the motion of the form, and celebrates the general direction of this motion.

And the way the lines pull back from a single point at the front, gives a tension to the form, as if a force was pushing the form forward, breaking free from the ground. This tension emphasises the sense of speed and gives a feeling of power to the form.

To exaggerate the planted feeling of the form, the wheel arches of these sports cars are also very pronounced. This also adds some visual bulk and muscle to the otherwise airy form, and gives it some strength.



Although these cars are not quite narrow, if compared proportionately to the bigger sports cars and the exotic hyper-cars, they are not as wide as their bigger siblings. In fact, in the Mazda MX-5, at one point in the design process, the passenger cabin ended up being the widest point in the vehicle.[3][5]

As already mentioned, these cars are tailored for cornering, rather than straight line speed, the power output of their engines is not exorbitantly high. It lies somewhere in the range of 150 to 200 BHP. But this does not affect the



character or performance of the car, as they are built with a low weight target in mind, and this low weight translates into a marvellous power-to-weight ratio.



International Market



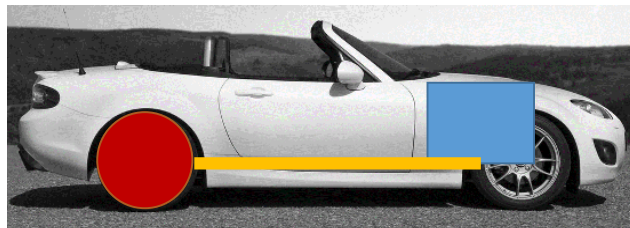
Mazda MX-5

The Mazda MX-5 is one of the bestselling sportscars internationally. It is widely known for its nimble handling, light weight

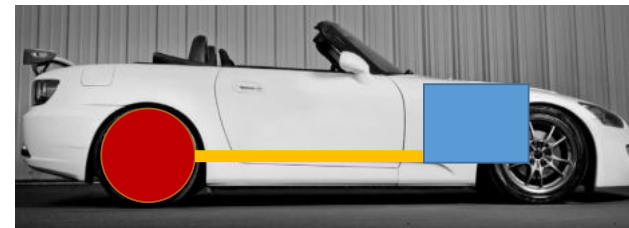


Honda S2000

Honda's S2000 is slightly larger, more powerful and more expensive.



FMR Layout



FMR Layout



Toyota Sera

Toyota's Sera does not fit the puritan definition of a Sports car, but its 8-piece bubble glass canopy and scissor doors, made it a staple among those looking for an affordable Sportscar.



Toyota Celica



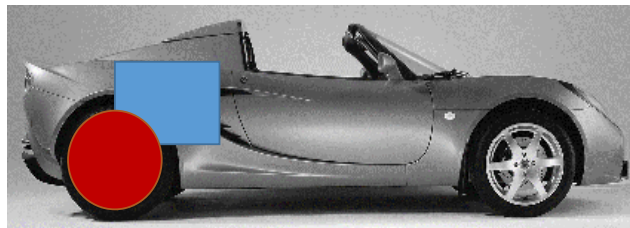
Toyota MR2





Lotus Elise/Exige

Lotus Elise/Exige is one of the few Mid-engine LWS cars. This package, combined with Lotus' expertise in vehicle dynamics, makes it a popular car among enthusiasts.



MR Layout



Suzuki Cappuccino

The Cappuccino is an extreme example of a small Sportscar, as it was based on the K-car platform, which is essentially a small car platform.

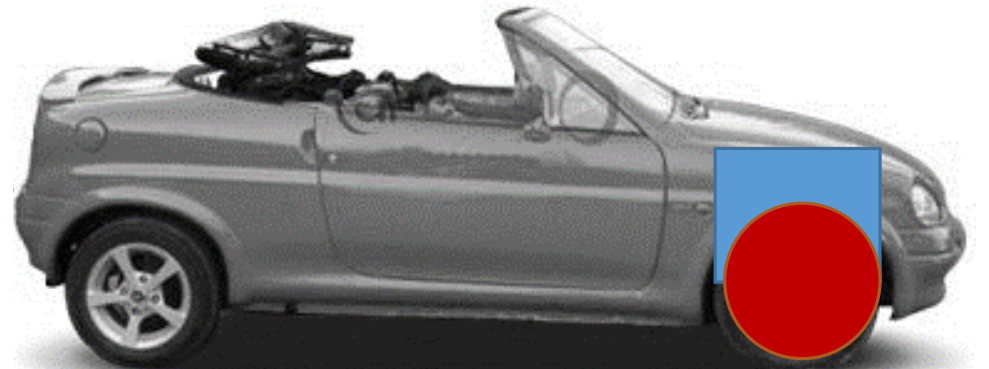
Indian Market

San Storm was a small sports car manufactured by San Motors based in Goa. The car used a 1.2litre Renault petrol engine mounted at the front, and driving the front wheels, and making just 60PS of power. Although the power developed was less, the car itself weighed about 800 kilos, so the power to weight ratio was decent for its time. This powertrain was encased in a steel chassis covered with double skinned fibreglass panels. It had a manual soft-top and interiors made from parts sourced from different cars. It could seat two adults up front, and had a rear bench for an additional two (2+2).

San Storm



Although the car sold initially on its novelty value in a market starved of affordable sports-cars, its poor build quality and poor mechanicals killed sales quickly. Enthusiasts everywhere slammed it poor handling, wheezy engine and rickety build. Lack of after sales support was a big problem too.



FF Layout

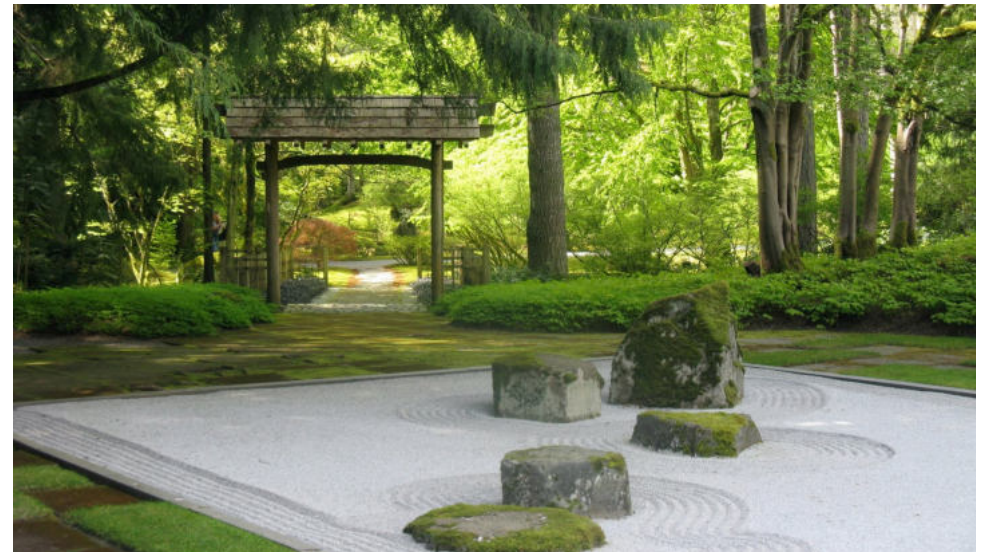
Case Study: Mazda MX5

Bob Hall is credited with single-handedly not only orchestrating the creation of the Mazda's MX-5, but also revitalizing the entire Light-weight sports car genre. [4]

When the MX-5 was being conceptualised by the Mazda's think tank, the theme chosen was the Japanese character "Jinba Ittai", which means "One-ness of rider and Horse". It is this synthesis of the rider and horse, man and machine, driver and car that Mazda set out to celebrate with the MX-5. The concept of Jinba Ittai went beyond just the way the car looked. It encompassed how the driver and the car touch, hear and feel. [4][5]

At MANA, the styling was led by Tom Matano. His vision for the MX-5 was for a pure design, which focussed on the pure experience of a sportscar. The key to his vision was simplicity, especially given his

dislike of sharp creases. According to him, the surface treatment of the car should be looked at from the perspective of a water droplet falling on the car's roof and then sliding down its side. He said that if the droplet has to stop and think which way to move, the design is not complete.[3][5]



After his design was selected, it was taken forward by Shunji Tanaka. Shunji was an expert in traditional Japanese Noh masks. These masks have a fixed shape, but their expression changes with the way it is being looked at and the direction of light bouncing off it. Shunji wanted to capture this feeling in the surfaces of the MX-5.

Apart from the Noh masks, he took inspiration from various Japanese elements. For Peace, he took inspiration from the statue of Goddess of Mercy. For motion, he took inspiration from a wild animal on a hunt. And for peace, he took inspiration from tranquillity of nature. His wanted the car should melt away into its environment.

When the latest iteration of the MX-5 was being designed, it was decided to make it a natural evolution of the car, by preserving its wedge like silhouette. The headlamps were moved

inboards to emphasise on the compactness of the form. Pronounced wheel arches were added, and a new grille was added to update it to match the current Mazda design language. However, the soft detailing was maintained.[3]
[5]



Why Micro makes Sense?

Small cars in India get substantial tax breaks if they comply with a set of regulations. They must be less than four metres in length and have an engine displacement of less than 1.2litres if it's a petrol engine.

This loose definition of a small car has spawned new segments in the market like Compact sedans and crossover mini SUVs that take advantage of these tax breaks. This enables the manufacturers to offer sedans and SUVs at price points that were not possible before. And the market has responded very positively to these segments, as it enables them to buy a car with a much bigger image at a lower price.

This same formula can be used to make a small sports car available to the market at a low enough price point. As modern engines offer more and more power per cc of displacement, power output of such a car won't be a problem either, what with current generation of engines churning out 125PS from just 1litre



of displacement. Stretch it out to the 1.2litre limit, and the car can be surprisingly quick.

The smaller footprint of the car would also translate into better handling and manoeuvrability, which is more important than straight line speed in the Indian context, given the lack of suitable roads.



Part Two

User Study

User Profile

25-40 years

Young earner

Already drives a regular car

Aware and sensitive towards international sports cars

Questionnaire

- How many kilometres do you drive on an average?
- Average daily commute, or average trip length
- Imagine a small, affordable sports car in India with a reasonably powerful engine (120+ HP)
- What all would you desire from such a car? What would your expectations be?
- Can you see yourself using such a car for your daily commute
- Why? What benefits/problems do you foresee?
- Do you think it is important that a sports car should be a convertible (open roof) car
- Especially in India
- On a scale of 1 to 5, rate how important you think to this car is:
 - Styling
 - Power
 - Comfort
 - Efficiency
 - Luggage Space
- Which Sports Car do you like best?
- What makes it so special for you?

Responses

Ravi Jakhar

37 yrs old

2500kms of commute in a month

1 road trip a year of more than 2000kms

1 short trip of 200kms once every 1.5-2months

Cars owned:

- Audi A6
- Suzuki Grand Vitara
- Toyota MRS Spyder (sold)
- DC Avanti (booked)
- Toyota MRS

Touota MRS:

- Fun to drive
- Great feeling of a convertible
- Felt underpowered
- Bad as a closed-top car
- Manual soft-top was cumbersome
- Seating position not very sporty

DC Avanti:

- Much better performance
- May have a fixed roof, but likes its sport-back

Feels sportiness comes from the whole design, not just from a soft-top

Feels a sportscar should "feel like a toy"

At entry level price point it will have to act first car be a bit higher, be soft-top

Loves Audi R8 and Ferraris



Parul Pokhriyal

Age 36

1800kms of commute in a month

Road trips of 200 kms every 3-4 months

Cars Owned:

- Ford Fiesta & Honda City (sold)
- Hyundai Verna

Would like to buy it as a second car

Not for daily commute as accidental damage would be costly

Feels a sportscar should compliment the driver's personality

Feels having a convertible would not be such a great idea

Feels that ground clearance might be an issue in Indian roads, so it should be higher

Loves Lamborghinis



Insights

- Vital
- Should not be a convertible, as most find it unsuitable for Indian conditions
 - Ground clearance should be at least that of a regular sedan, as people don't want speed breakers to damage bodywork

- Essential
- Should be fun to drive
 - Should not feel underpowered
 - Should have the fun feeling to it, and add to the personality of the driver
 - Should seat two people

- Desirable
- Should be able to cruise at high speeds on highways
 - Should take some luggage for two people

Design Brief

Aesthetic Intent

Since the car is targeted at young earners looking for a fun vehicle, its aesthetics should make it look playful and inviting to drive. It should reflect the playfulness and agility of the car's character, and how it beckons the driver to take it to its limits and extract most fun out of it. Even when parked, it should convey a sense of speed

At the same time, it should give the feeling of a much larger, more planted car, and should not feel light and inconsequential.

The driver should feel powerful and connected with it. He should feel as if the car is not just an extension of his personality, but an extension of himself.

Technical Specifications

Length < 4000mm

Ground clearance > 135mm

Engine capacity: 1-1.2l

Power > 120PS

Lightweight construction using light (yet low cost materials and processes).

Packaging

Two seater, front engine car

FMR layout

Preferably not a soft top

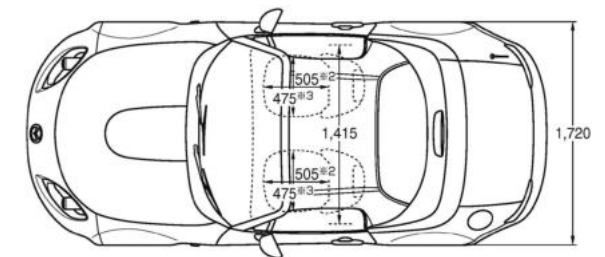
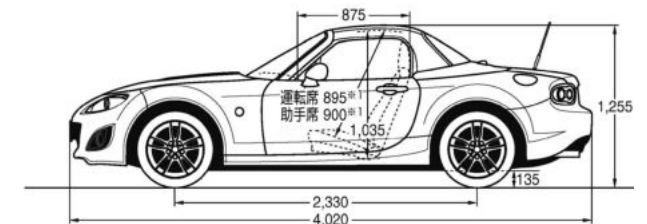
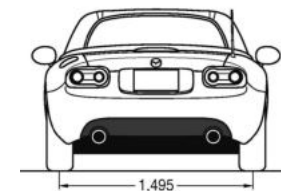
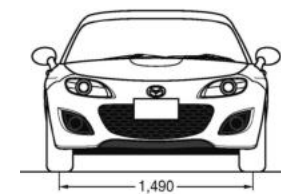
Packaging

Benchmark

Hence, according to the design brief, we require a lightweight and small package (under 4m), with decent ground clearance.

The Mazda MX5 satisfies all these criterion, with a 3,970 mm overall length and 140mm ground clearance [8] (more than Skoda Octavia at 134mm[9]). It is one of the bestselling Sports cars in the world, with more than 900,000 sold as of February 2011, hence, it is a tried and tested package. Its engine bay can easily accommodate a 1.2litre engine with turbocharger and intercooler, as it was designed to fit a 1.8l NA power plant.

Hence, we take the Mazda MX5 as the benchmark and our basic package layout. As the brief also specifies the package to be a hard top one, we take the hard top variant.



Part Three

Explorations

Image Board



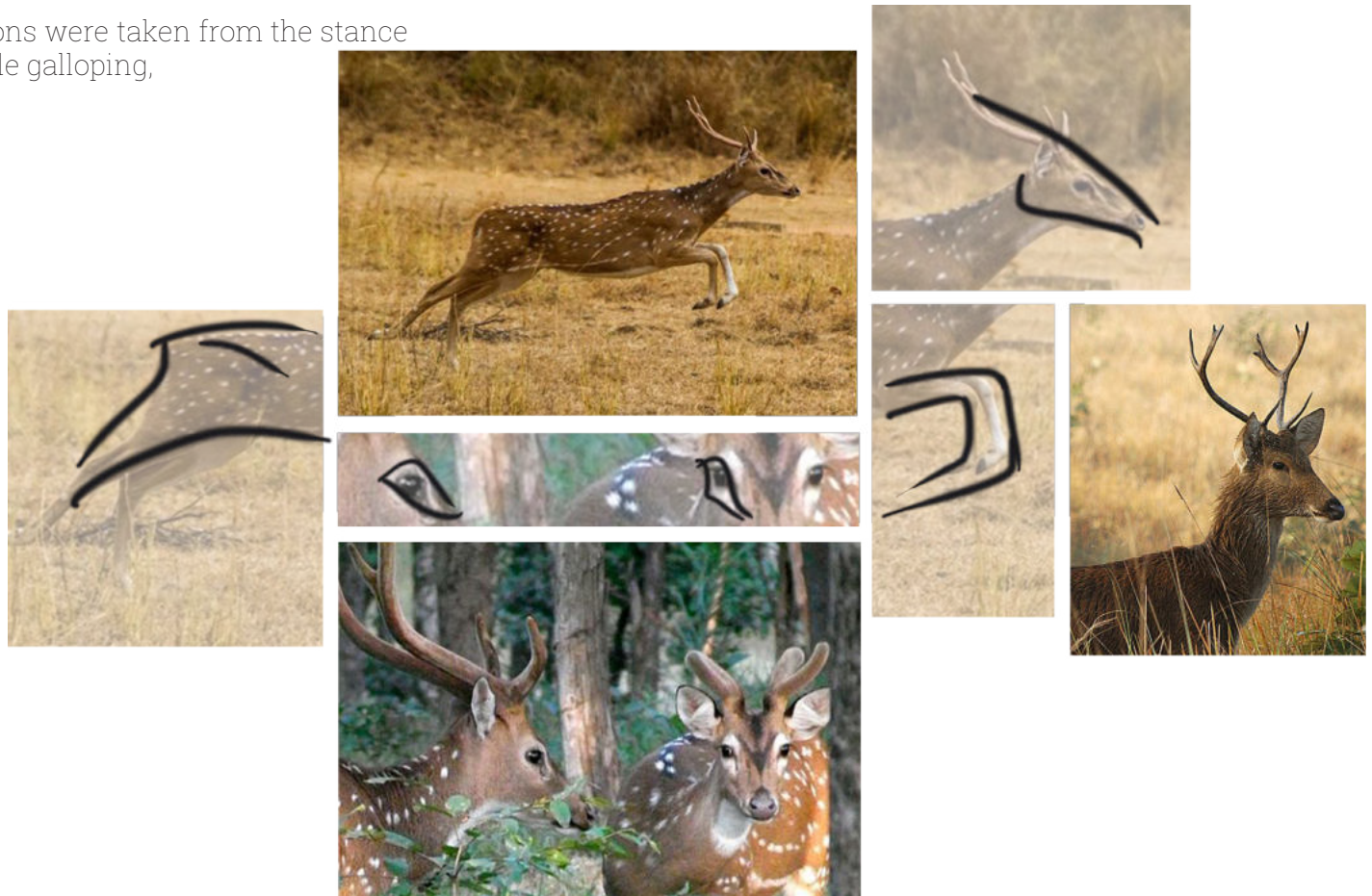
These words emerged from the User Study:

- Playful
- Fast
- Powerful
- Indian

Chital

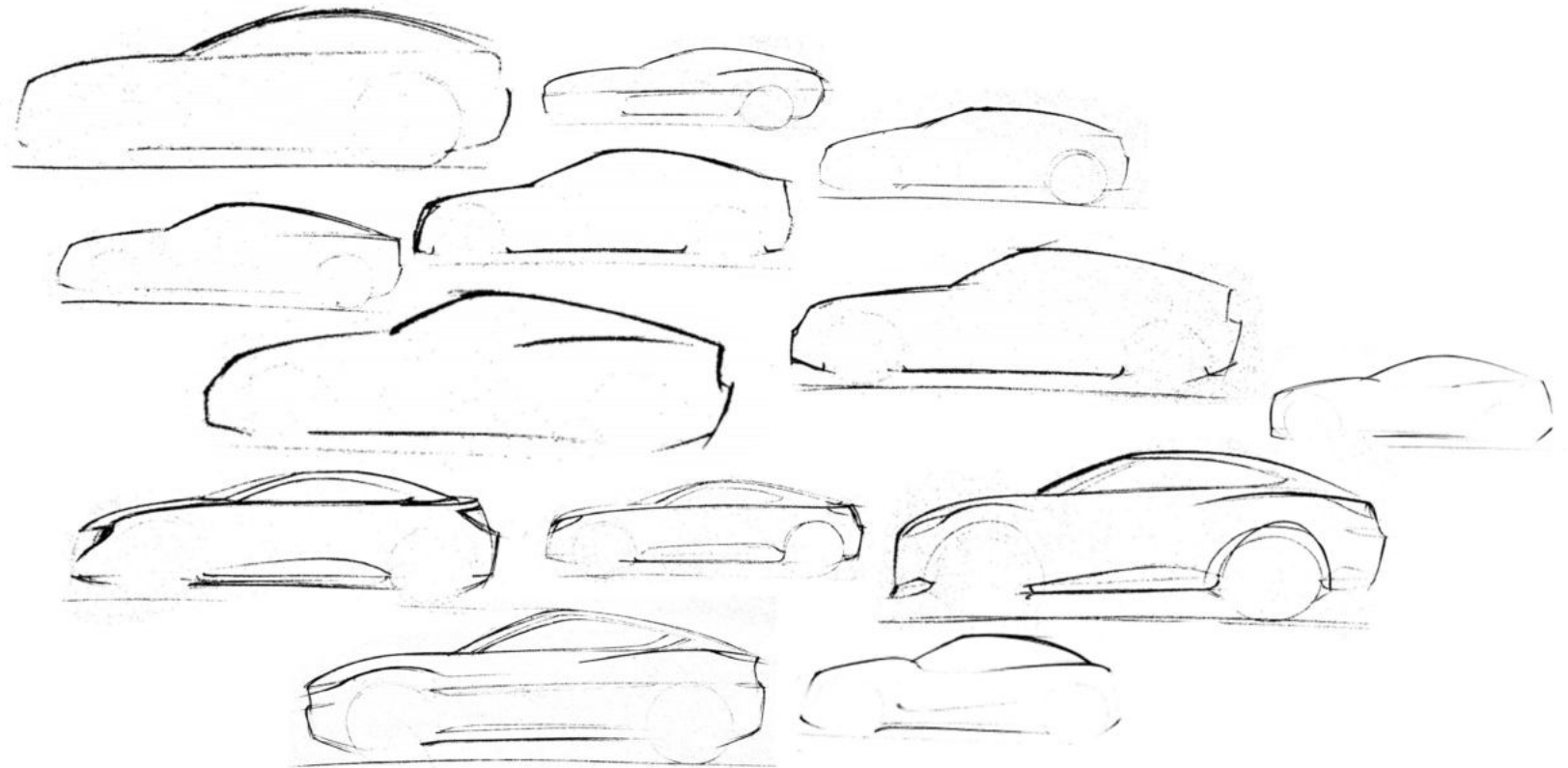
Chital Deer, indigenous to India, was chosen as the metaphor as it embodies the themes chosen quite well: It's fast,, playful, and very much Indian.

Form inspirations were taken from the stance of the deer while galloping,

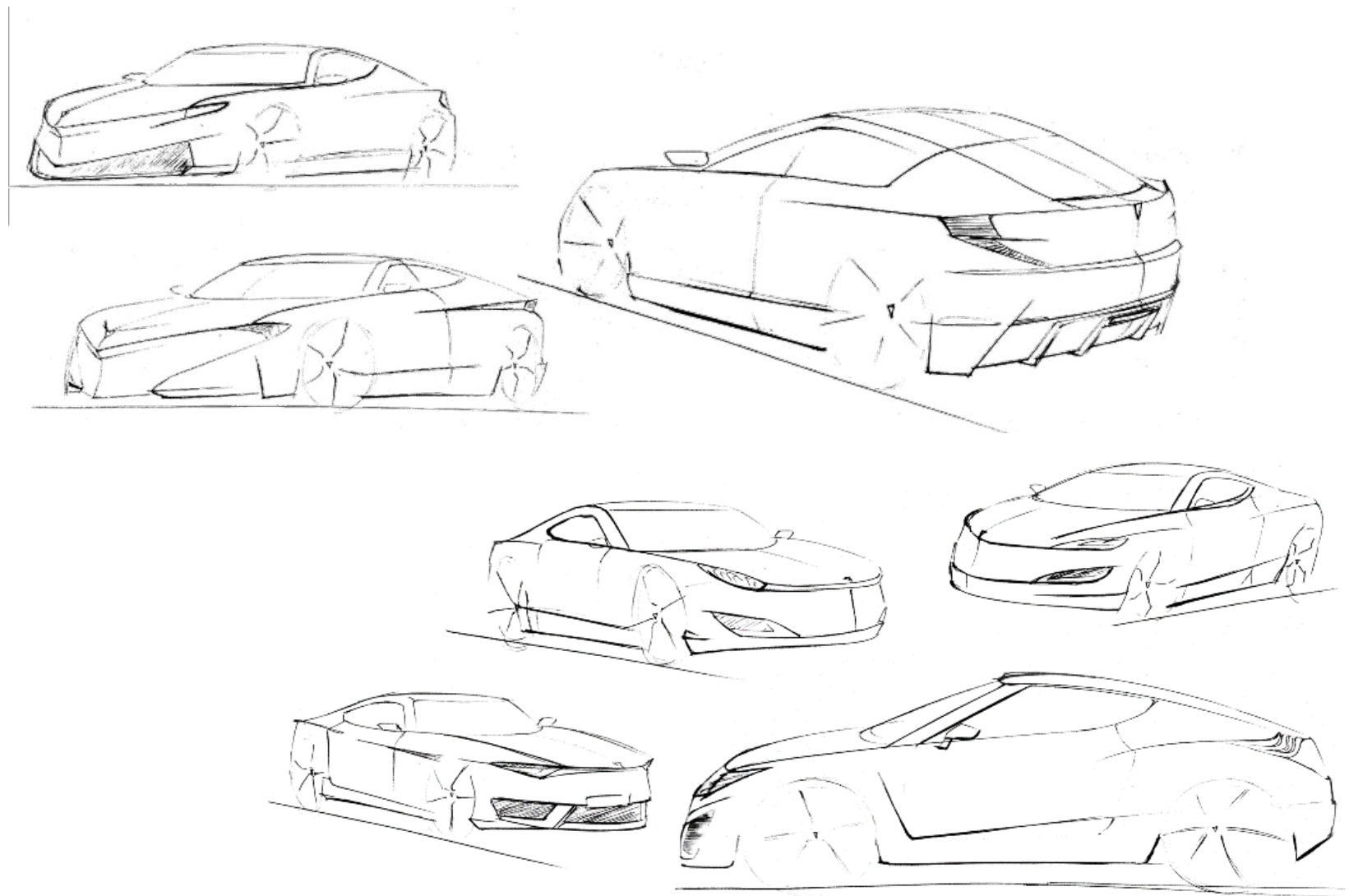


Initial Explorations

Initial Silhouette explorations. Trying to capture the feeling of a deer in motion.



Trying to explore lines flowing from the front all the way to the rear, as studied in sports cars previously.

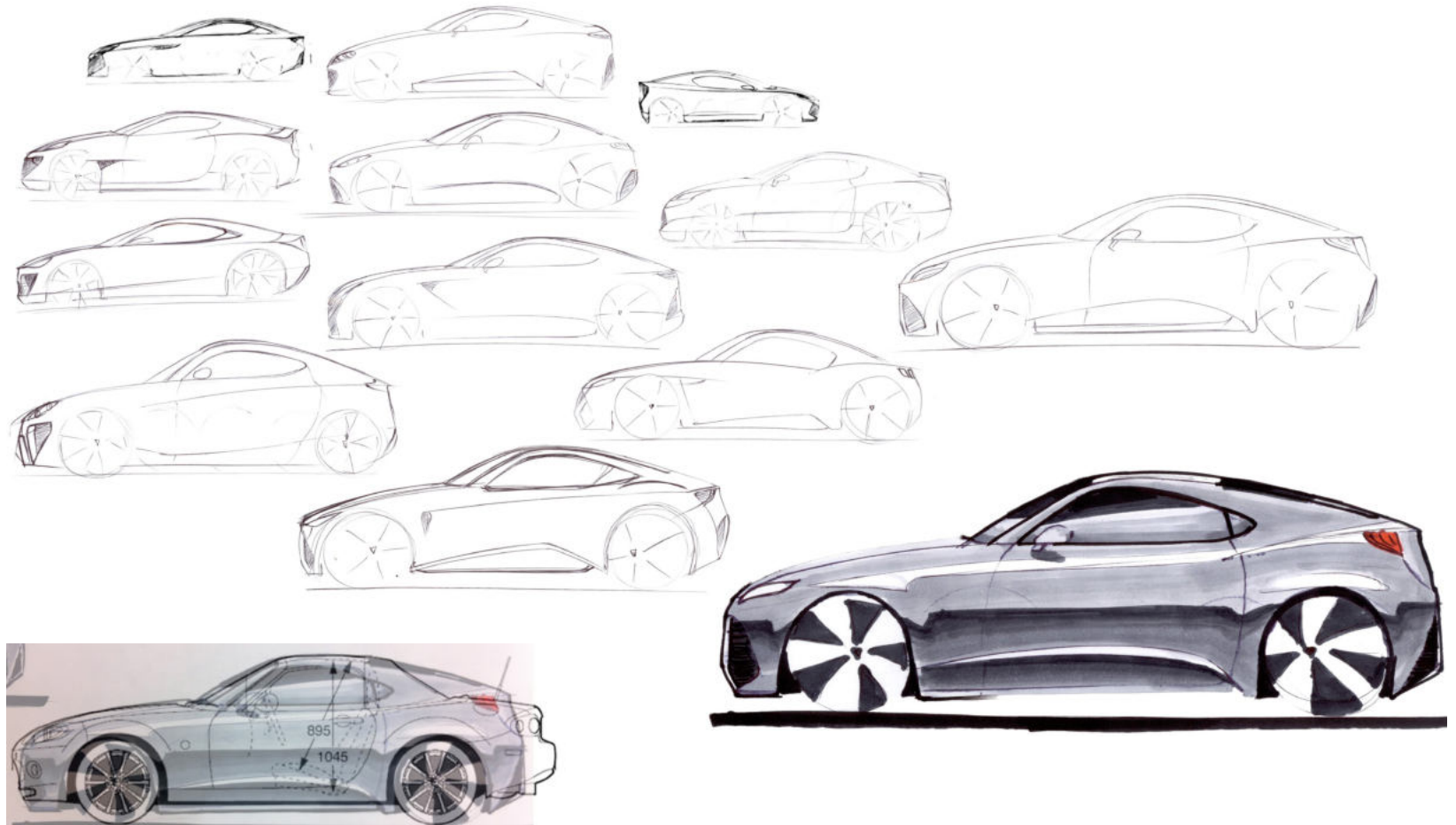


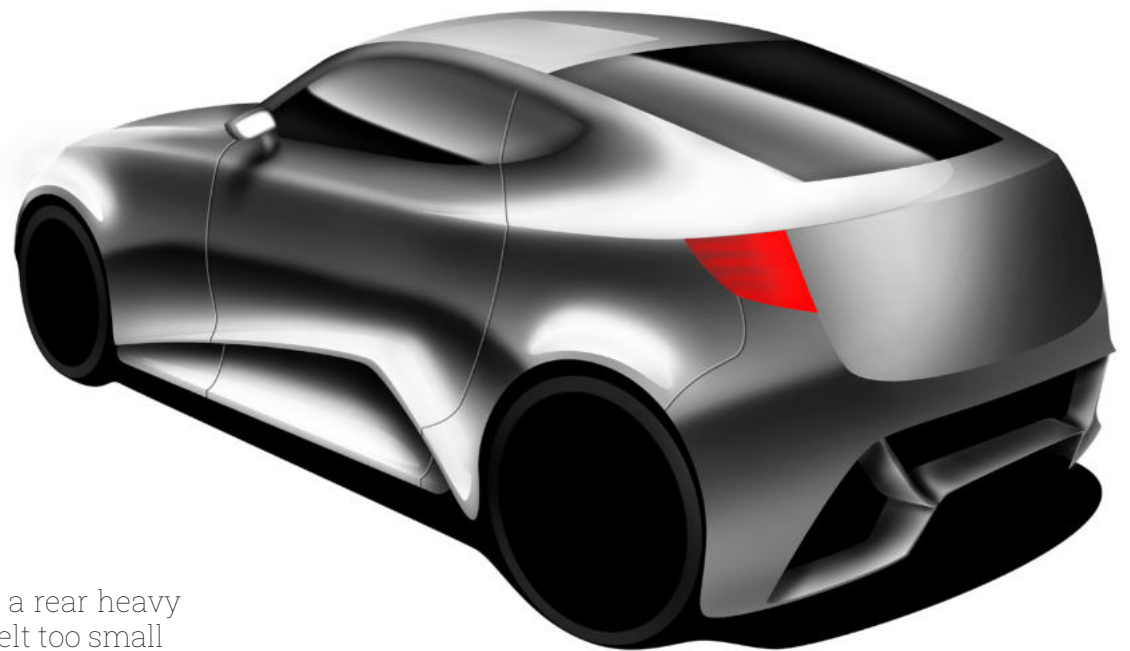
Directions

After initial explorations, trying to define a few distinct directions to explore more in.

ONE:

Trying to capture the classic and conventional proportions

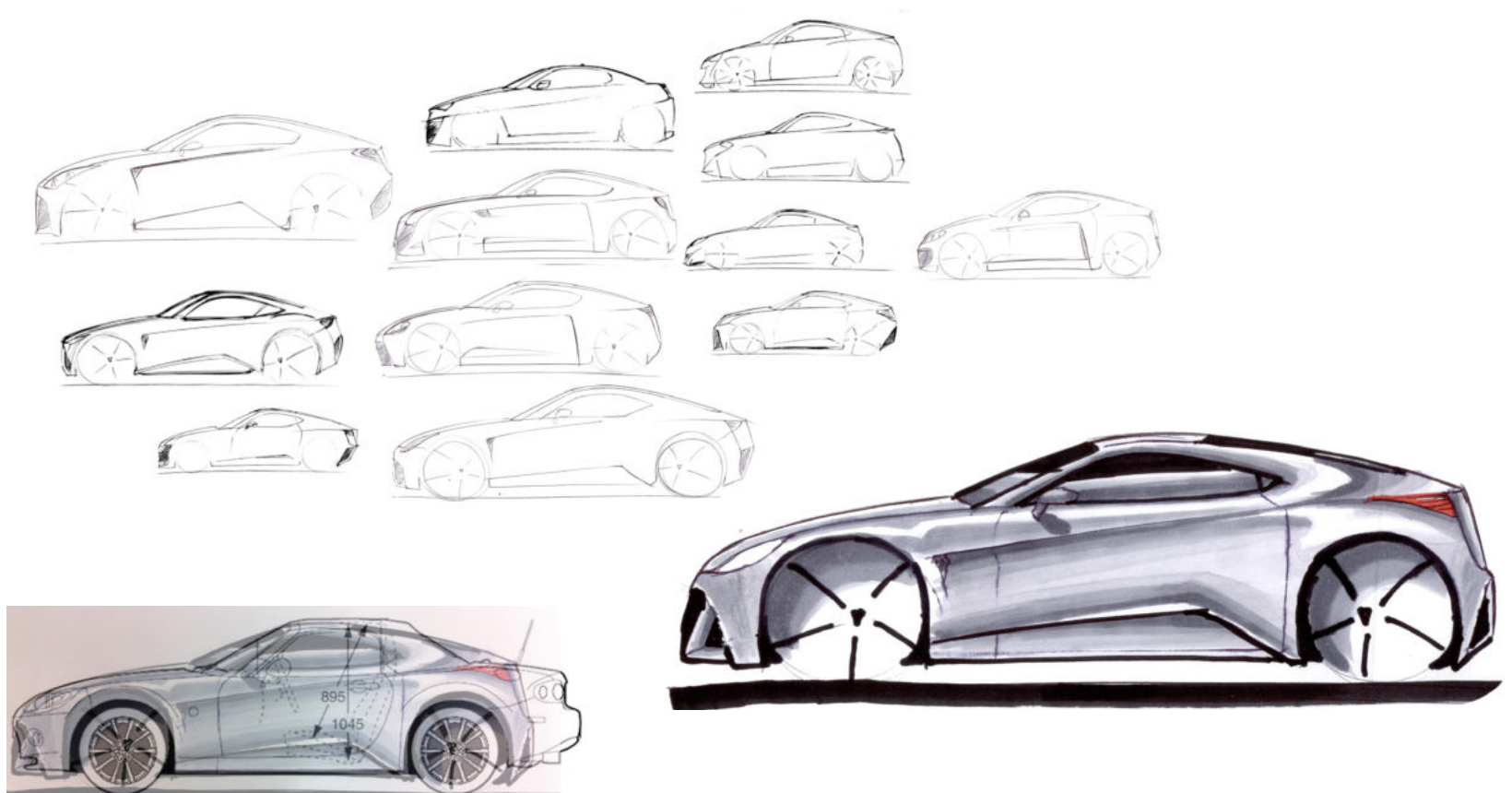


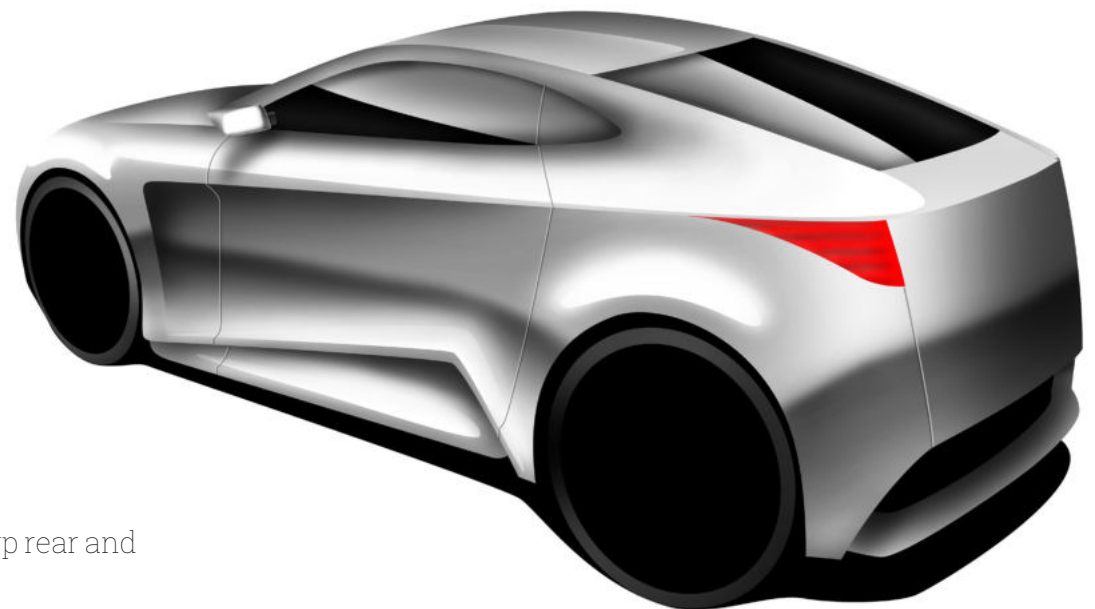
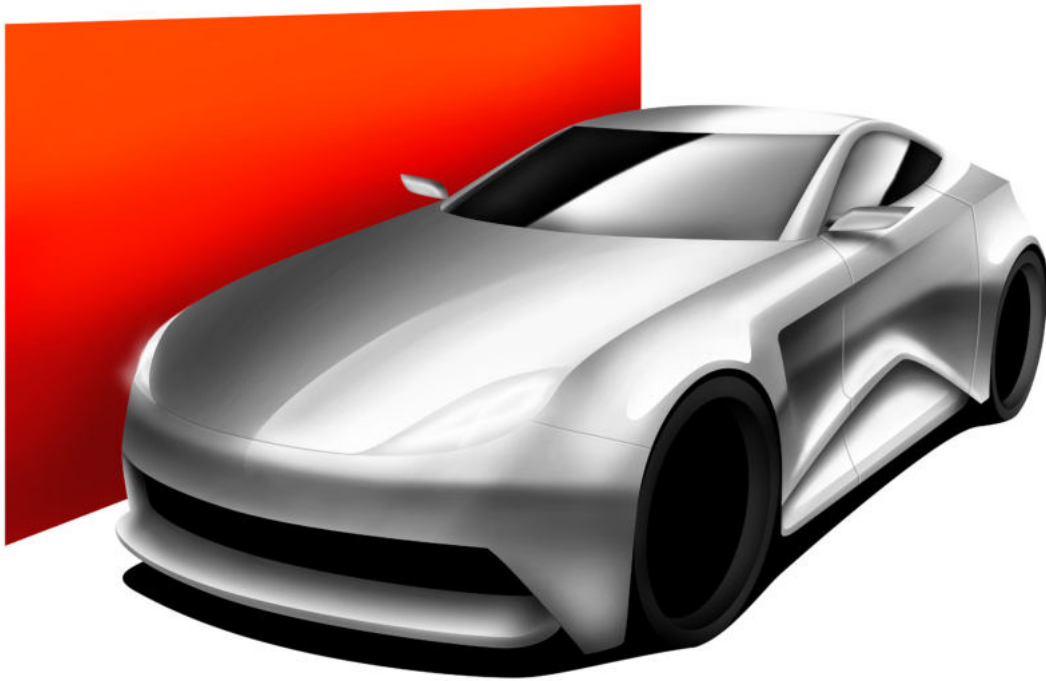


Felt too much like a GT car, with a rear heavy feeling. Also, the rear overhang felt too small

TWO:

A Sharper direction, with bolder lines. Stronger character line at the bottom to divide the visual mass, as well as lifts it for the prancing stance of the deer.



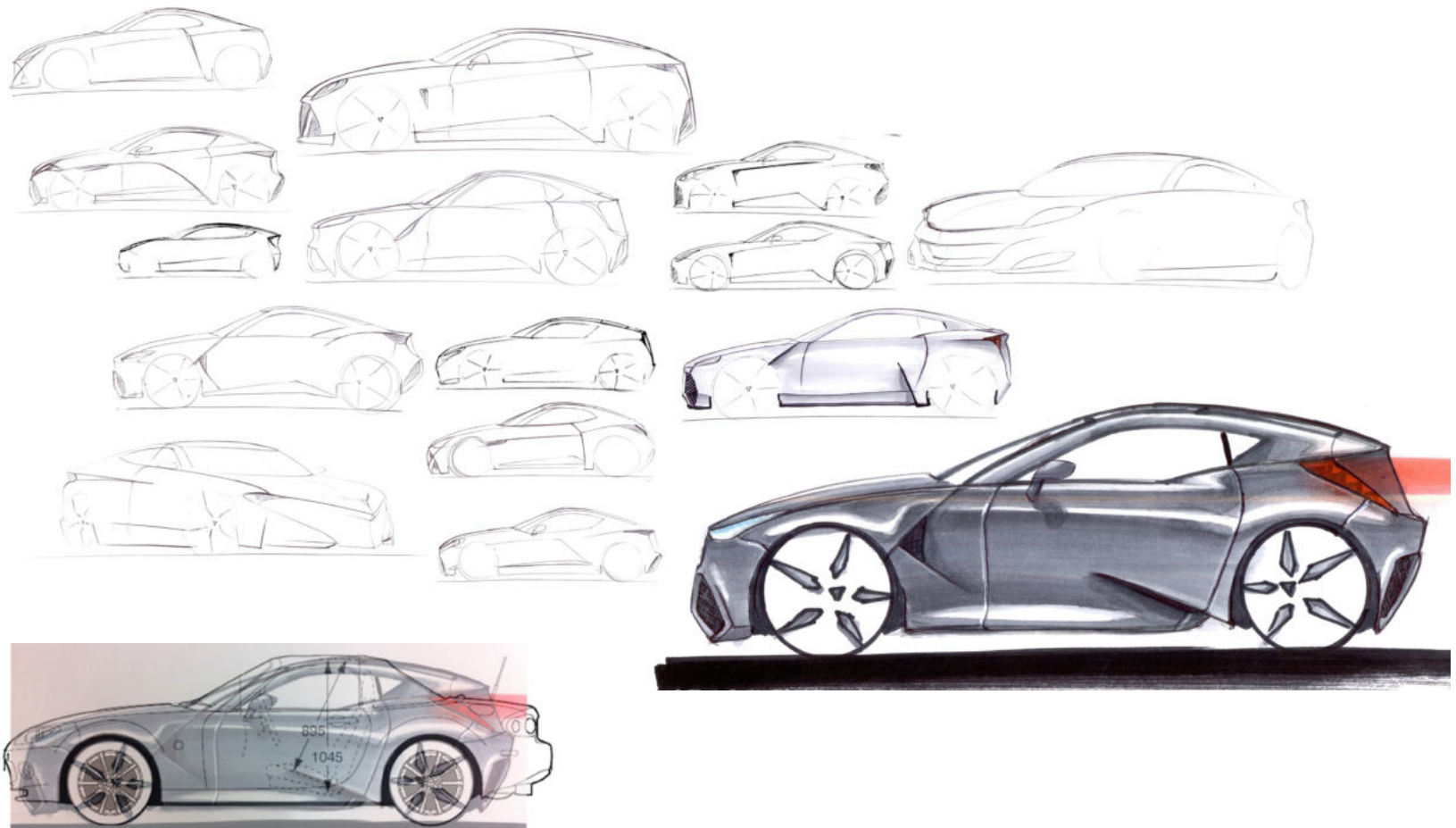


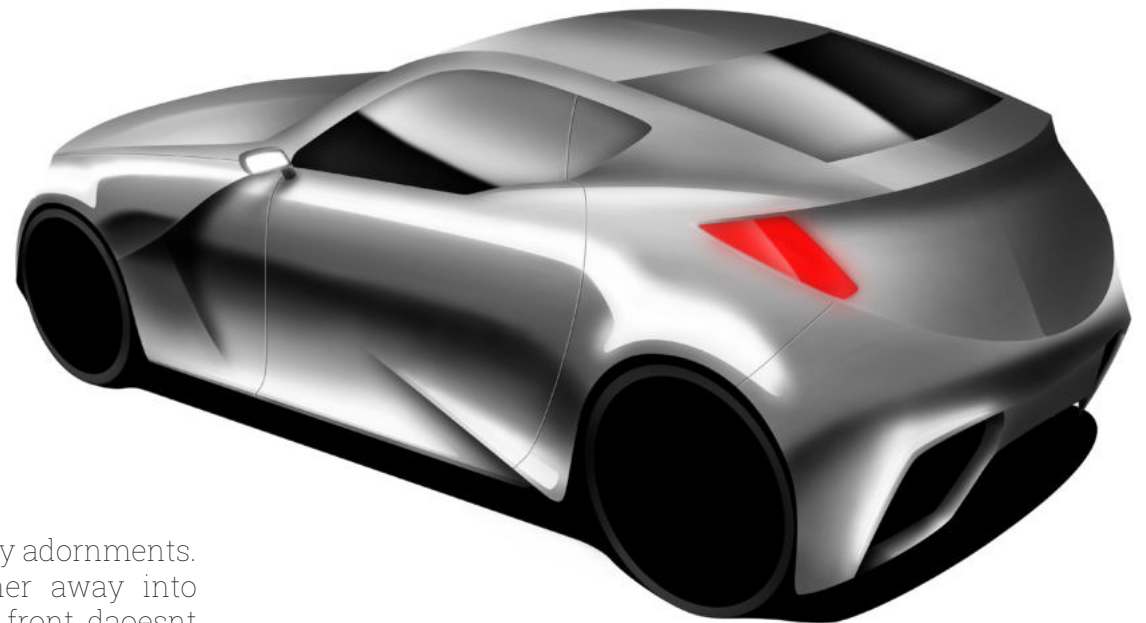
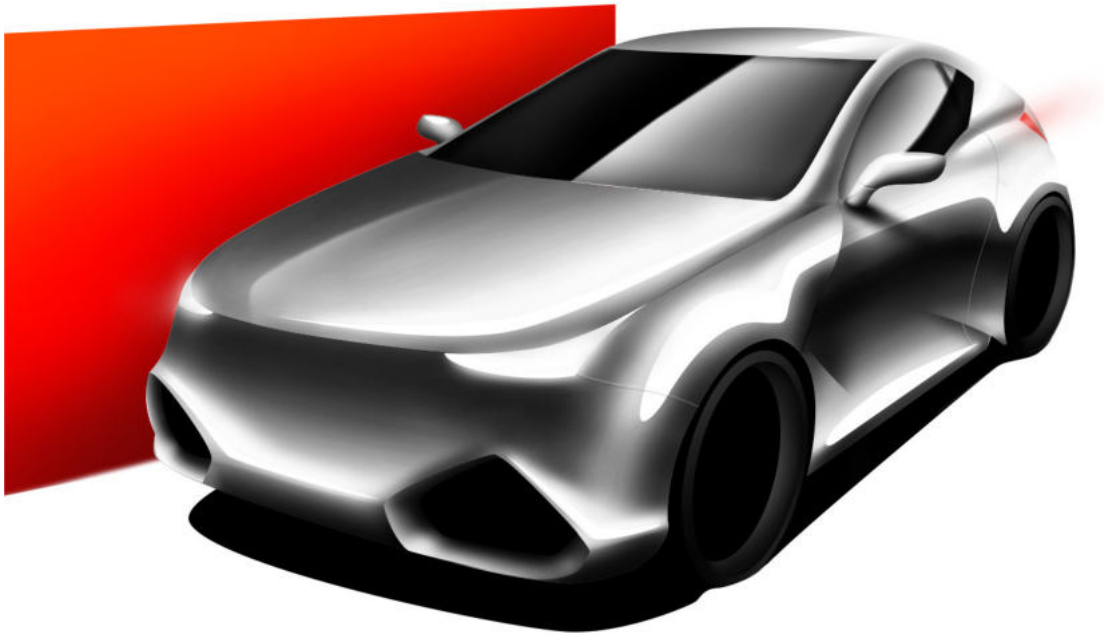
Rear is a bit lighter this time, but sharp rear and side makes front feel out of context

THREE:

Trying to capture the multi-faceted nature of Indian arts and crafts, with GT-car like propor-

tions, to give a powerful stance. Strong line from air vent to the windshield tries to capture the majestic stance of the deer's horns.



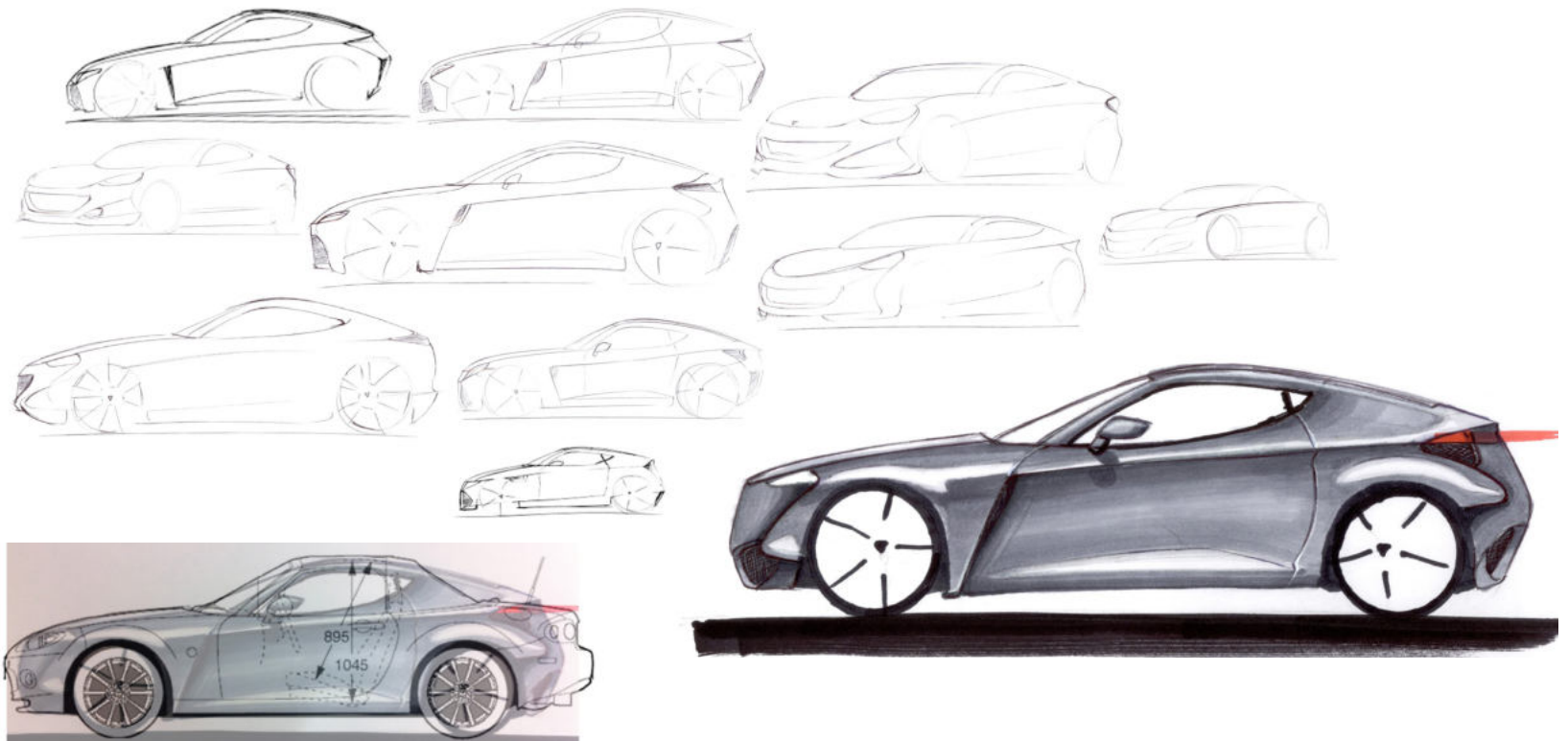


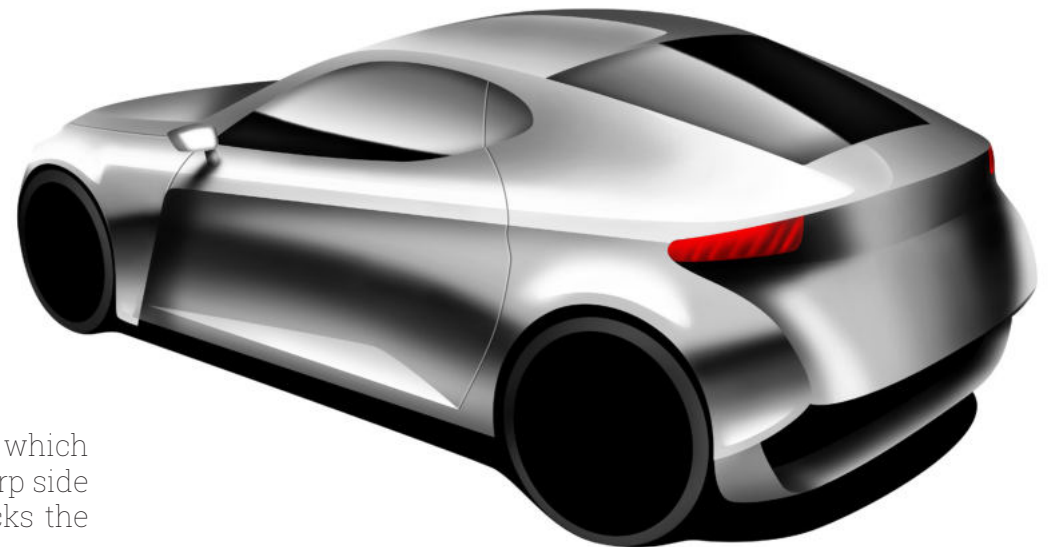
Felt too overdone, with too many adornments.
Also, proportions drifted further away into
shooting brake category. Plain front daoesnt
feel in sync with dynamic rear

FOUR:

A more curved approach with large, curvy face, to enhance the “playful” feeling.

Line trying to emulate the deer's horns is seen here too.

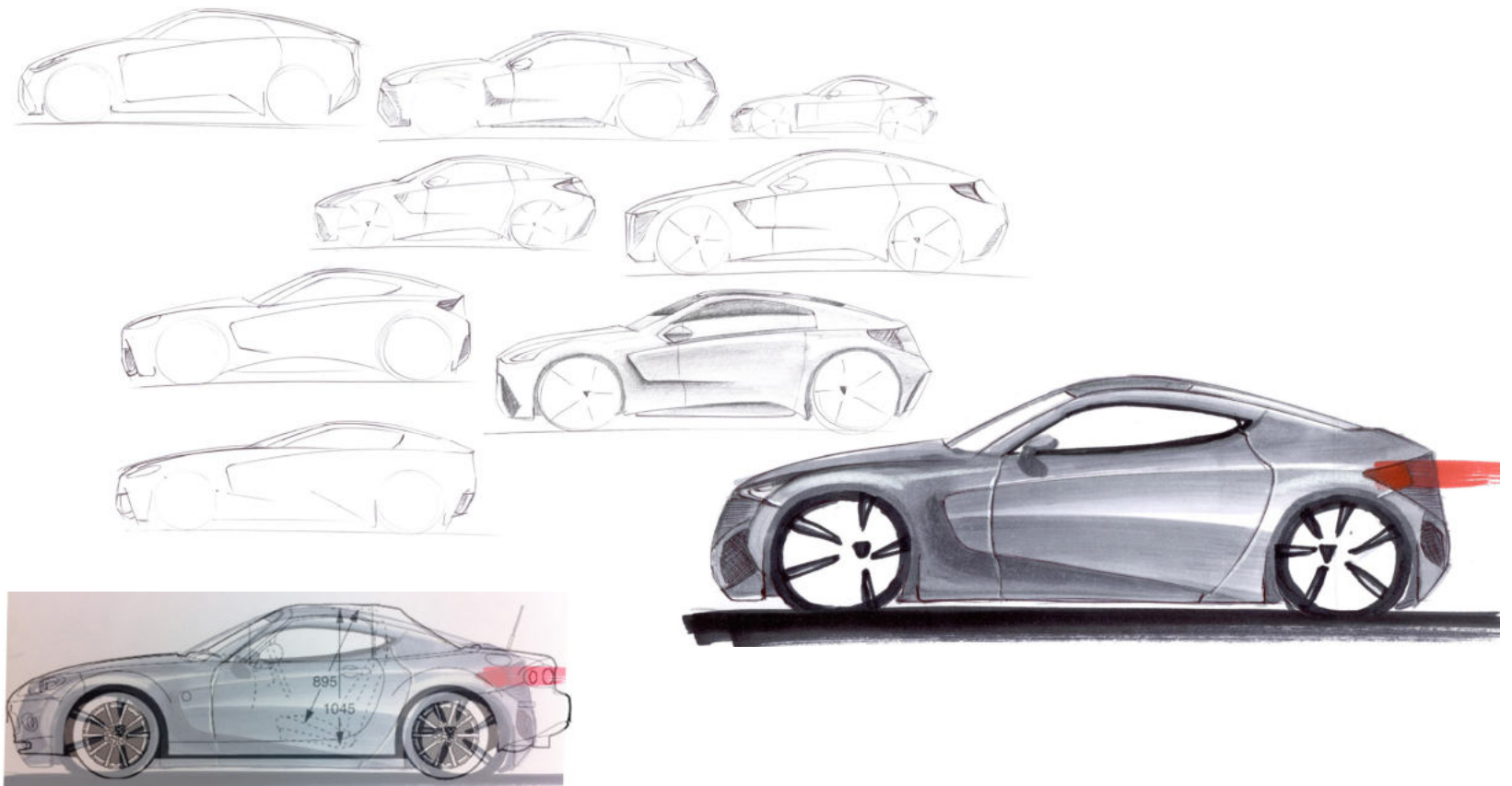


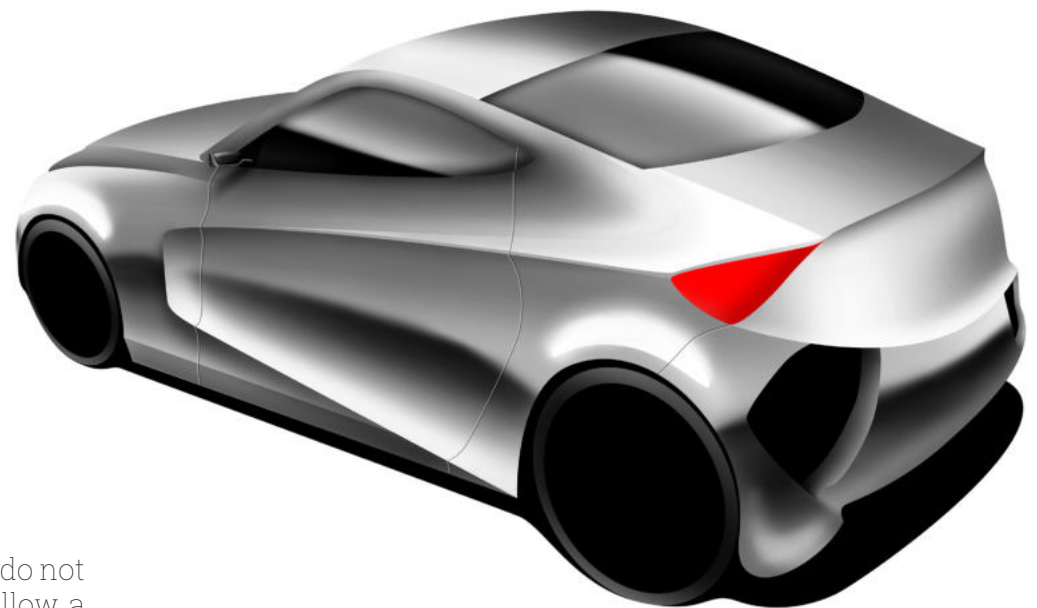
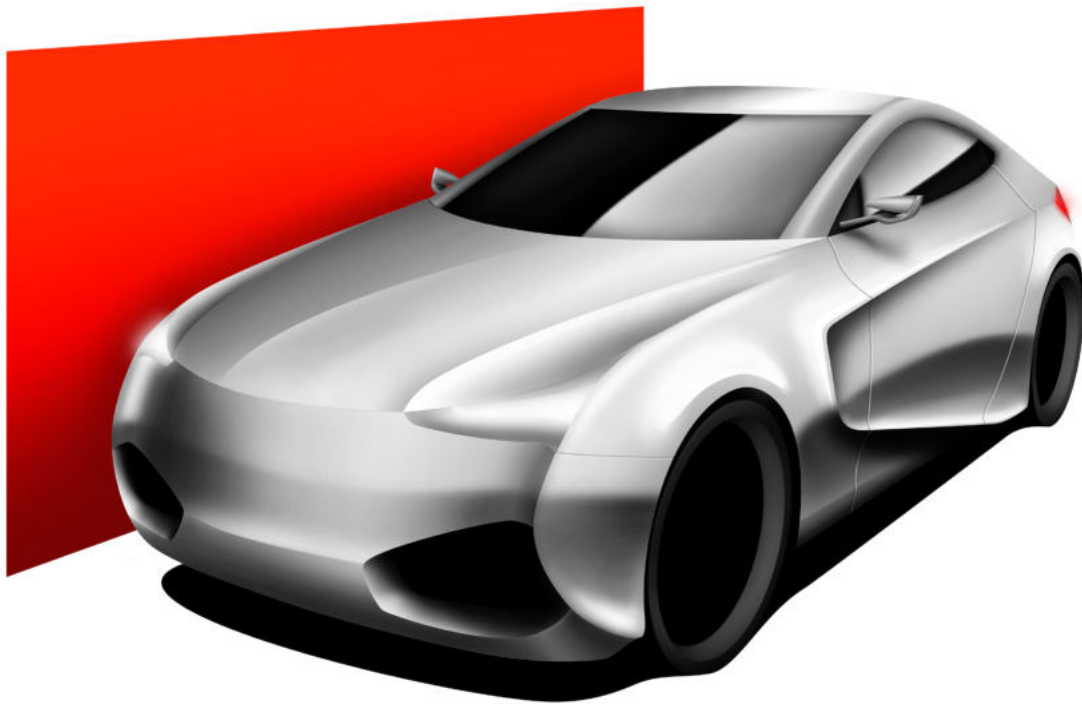


Front has turned out to be too curvy, which does not befit a sports car. Also, the sharp side crease feels out of place. Front also lacks the level of definition found in the rear

FIVE:

A different direction, trying to capture the stance of the legs of the deer mid-prance, with the side treatment, which is an embossed concavity, unlike regular character lines.



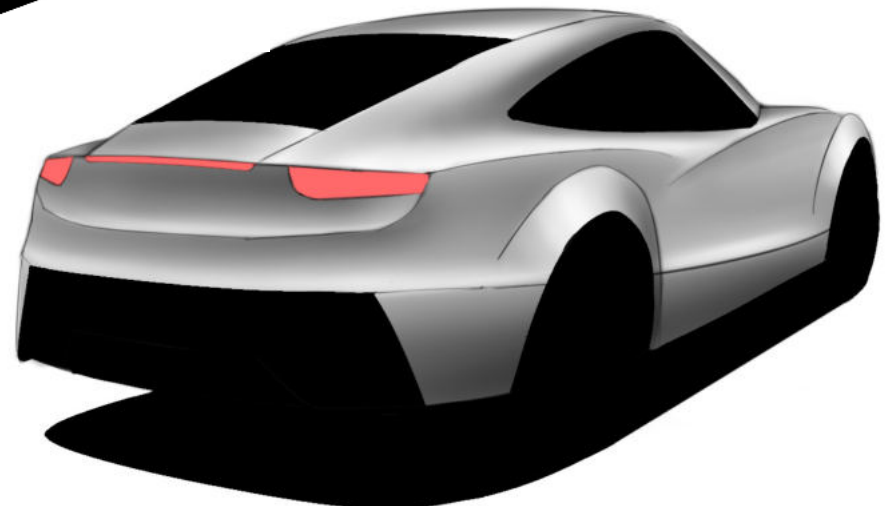
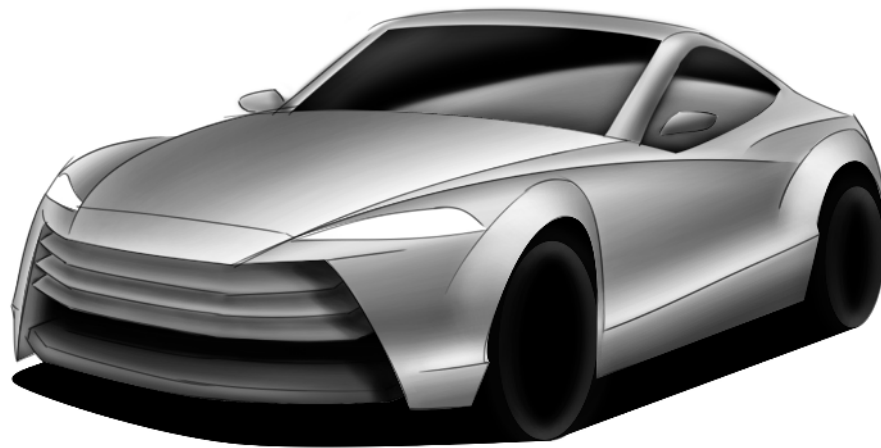


Rear heavy feeling again, with lines that do not seem to flow. Side treatment is too shallow a metaphor of Deer's legs.

Further Development

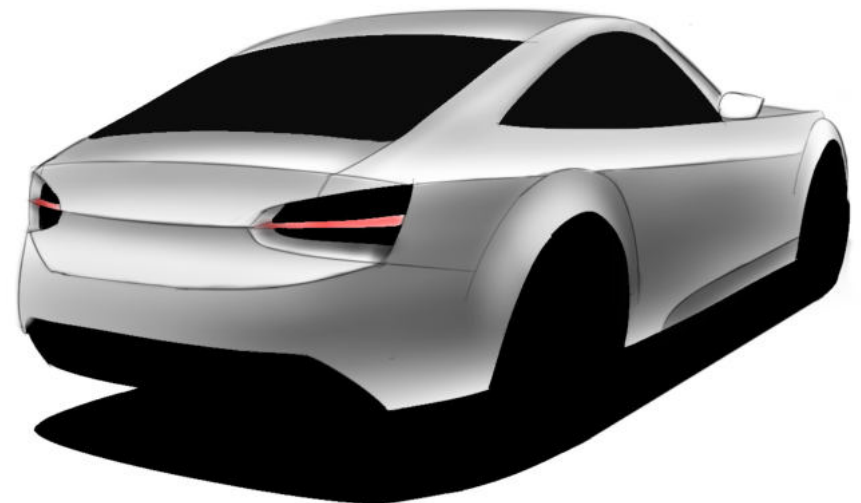
ONE:

Rear was made visually lighter and proportioned to be much closer to the benchmark MX5.



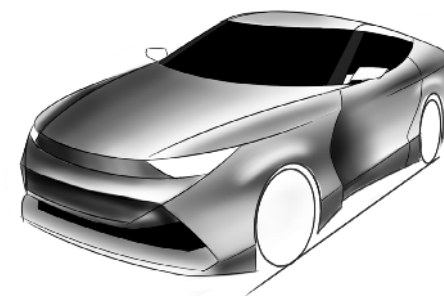
TWO:

Rear weight was further reduced and the it were made to be more in sync with the front.



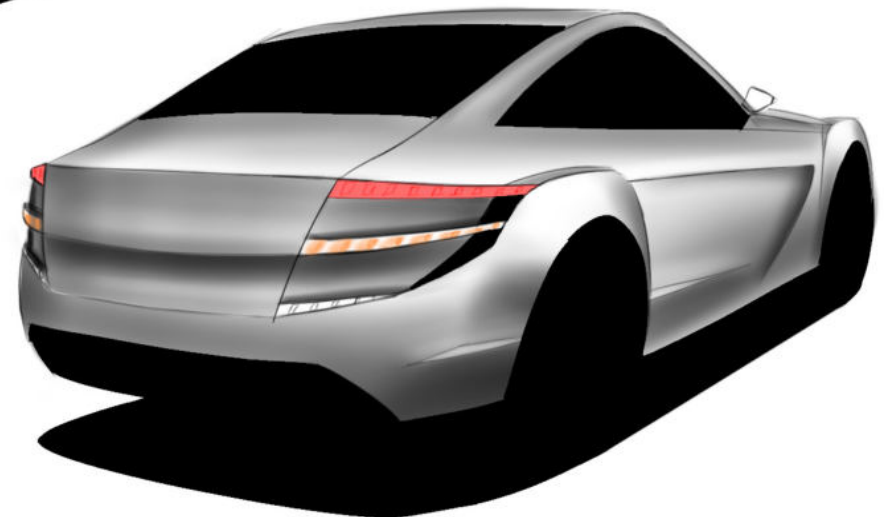
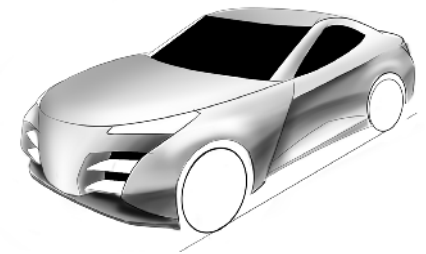
THREE:

Adornments were flattened out, and front given more definition to match the rear



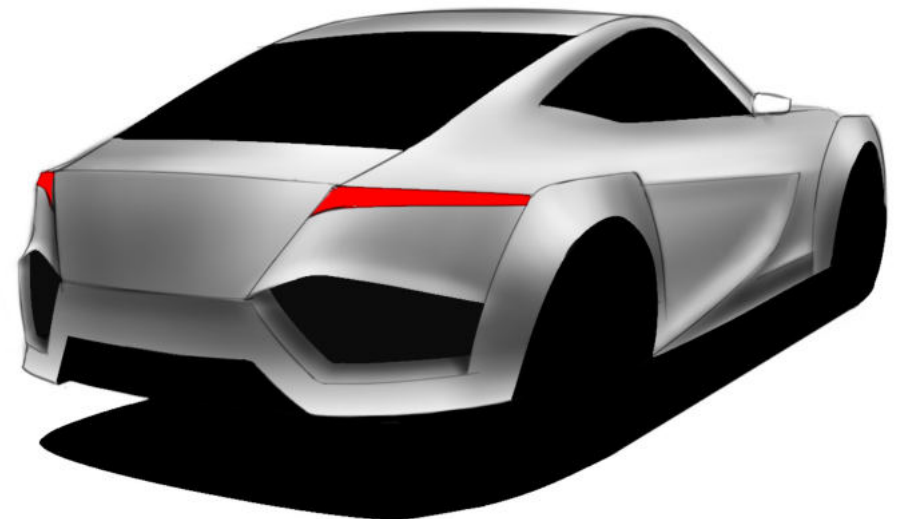
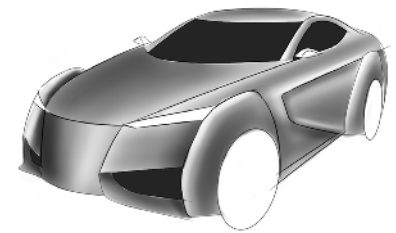
FOUR:

Theme modified into a sharper, more aggressive one, with "fangs" in both front and rear. Pumped up wheel arches add muscle to the form.



FIVE:

Tried to make lines more flowing, and side treatment flattened out slightly.



Part Four

Final Concept

Consumer Evaluation

The consumers were shown the different versions made, and were asked to evaluate the versions based on:

Hence, the second variation was selected as the main concept.



ONE



TWO



THREE



FOUR



FIVE

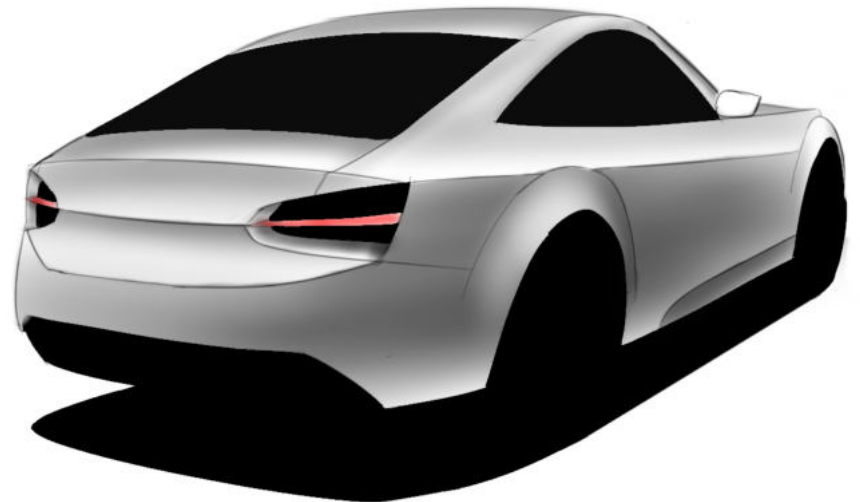
- How well the consumers felt that the designs conveyed the feeling of being playful, powerful and fast
- How much they liked the vehicle overall

The results were then tabulated, and appropriate weightage was attached to them, depending on their importance to the design brief. The final scores were summed up to decide the final scores.

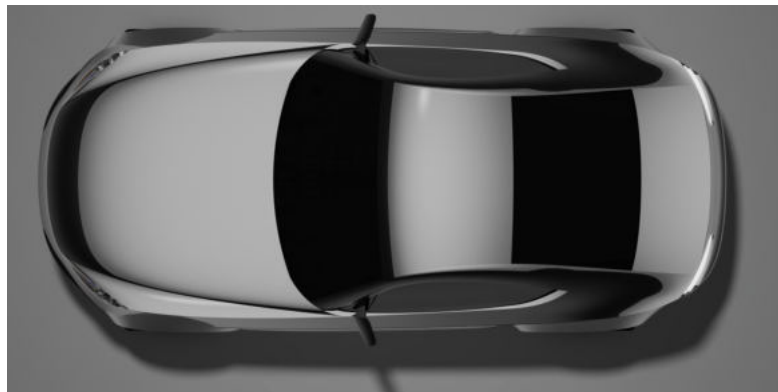
	Playful		Fast		Powerful		Total Score
Variants	Weight = 1		Weight = 0.7		Weight = 0.4		
ONE	37	37	31	21.7	35	14	72.7
TWO	38	38	36	25.2	34	13.6	76.8
THREE	31	31	36	25.2	35	14	70.2
FOUR	31	31	32	22.4	38	15.2	68.6
FIVE	30	30	37	25.9	38	15.2	71.1

Final Concept

Concept TWO selected as final concept

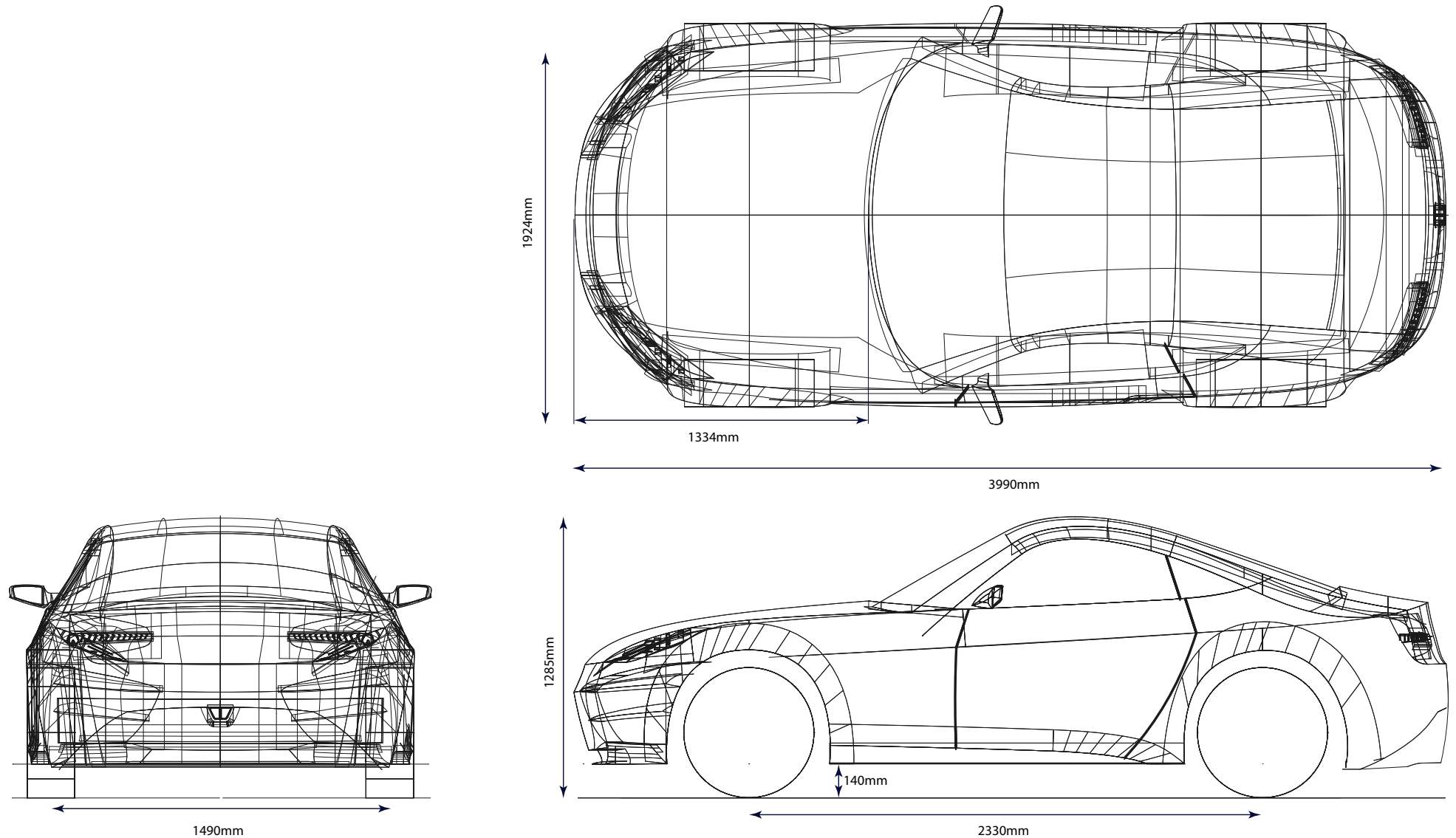


Alias 3D Model





Dimensions



Model



References

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