Design of a race car for

LE MANS 2030

Design Project 3

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Guided by Lance Rake &
Nishant Sharma

APPROVAL

This Mobility & Vehicle Design Project 3 titled 'Design of a race car for Le Mans 2030' by Rishi Soman is approved in partial fulfilment of the requirements for Master of Design Degree in Mobility & Vehicle Design.

Prof. Nishant Sharma (Project Co-guide)

Prof. Lance Rake (Project Guide) 30 MAY 16

Chair Person

Internal Examiner

External Examiner

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 ant 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.

Rishi Soman
146390004
Mobility & Vehicle Design

ACKNOWLEDGEMENT

I would like to sincerely thank my guide Prof. Nishant Sharma and Prof. Lance Rake for their valuable guidance throughout this project.

A huge shoutout to my friends and batchmates for all their inputs and support throughout the project.

And finally, I'd like to thank my folks and crew for their unconditional support and inspiration.

CONTENT

1 INTRODUCTION

Michelin North America, Inc. hosts the annual Michelin Challenge Design to support creative thinking and innovation in vehicle design. Michelin challenges the international design community, individuals, small and large companies and universities, to enthusiastically create innovative and aesthetically pleasing design solutions that will meet the theme requirements of the Michelin Challenge Design 2017. [1]

1.1 Challenge for 2017

The challenge for 2017 is “Le Mans 2030: Design for the win” Michelin encourages creative individuals to create a breakthrough race car to win the Le Mans 24 Hours in the year 2030. Entrants are encouraged to utilise future-looking technologies, innovations, and pioneering problem solving skills to design a car that reinforces the premium brand image of a company that is either famous for its historical successes, or ready to elevate its brand through a Le Mans 24 Hours win.

1.2 Aim of the project

The aim of the project to is propose a competitive, winnable concept for the Michelin Challenge Design. The final proposal should be innovative in it’s use of technology and aesthetically pleasing in order to win the competition.

1.3 Scope of the project

Designing a race car for Le Mans relevant to the year 2030, involves study of future technologies and process of the human civilisation. Le Mans being a prestigious endurance race, the study of it’s legacy should help extrapolate the future racing scenario. The project would embark on a futurist, conceptual journey, trying to understand the future of mankind.

[1] http://www.michelinchallengedesign.com/the-challenge-for-2017/how-to-enter/

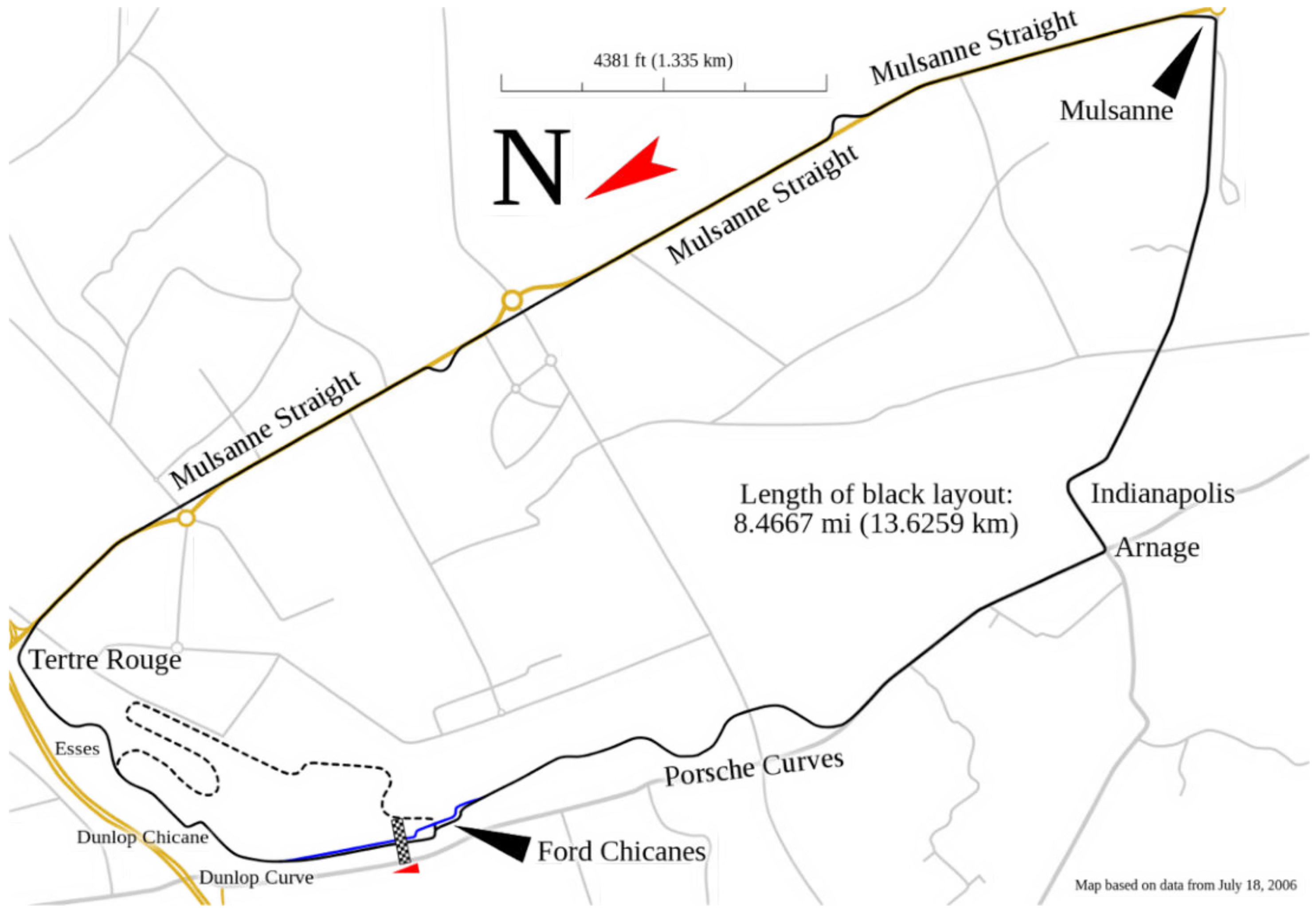
2 **HISTORY OF LE MANS**

The 24 Hours of Le Mans (French: *24 Heures du Mans*) is the world's oldest active sports car race in endurance racing, held annually since 1923 near the town of Le Mans, France. It is one of the most prestigious automobile races in the world and is often called the "Grand Prix of Endurance and Efficiency”. [1]

The race is organised by the Automobile Club de l'Ouest (ACO) and runs on the Circuit de la Sarthe, which contains a mix of closed public roads and a specialist racing circuit, in which racing teams have to balance speed with the cars' ability to race for 24 hours without sustaining mechanical damage.

Since 2012, the 24 Hours of Le Mans has been a part of the FIA World Endurance Championship. In 2016, it will be the 3rd round of the season.

[1] https://en.wikipedia.org/wiki/24_Hours_of_Le_Mans



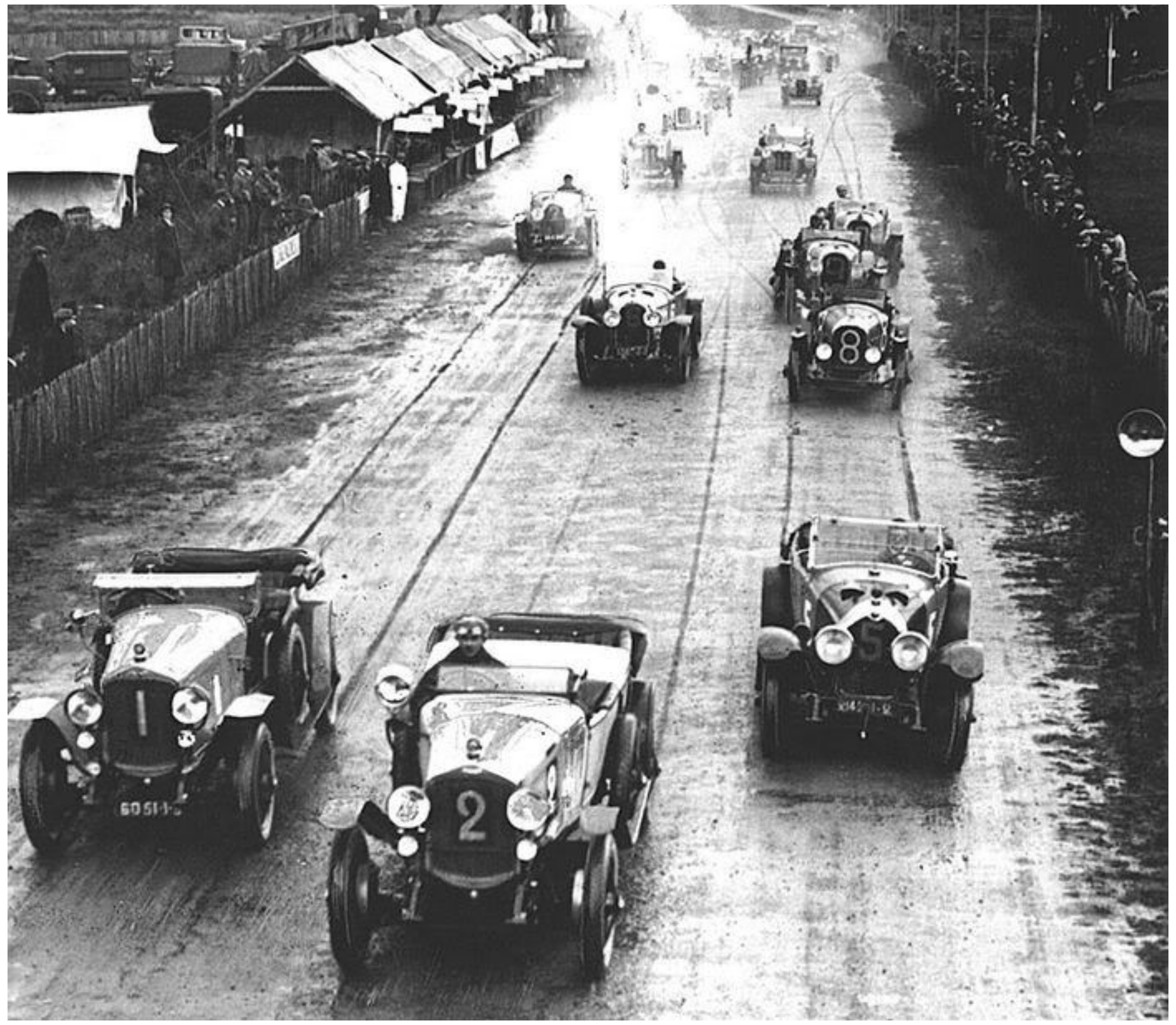
Circuit de la Sarthe, located in Le Mans, Maine, France
https://en.wikipedia.org/wiki/24_Hours_of_Le_Mans

2 HISTORY OF LE MANS

2.1 Why did it start?

The 24 Hours of Le Mans was first run on 26 and 27 May 1923, through public roads around Le Mans. At a time when Grand Prix racing was the dominant form of motorsport throughout Europe, Le Mans was designed to present a different test. The 24 Hours of Le Mans would concentrate on the ability of manufacturers to build sporty yet reliable cars. This encouraged innovation in producing reliable and fuel-efficient vehicles, because endurance racing requires cars that last. [1]

[1] https://en.wikipedia.org/wiki/24_Hours_of_Le_Mans

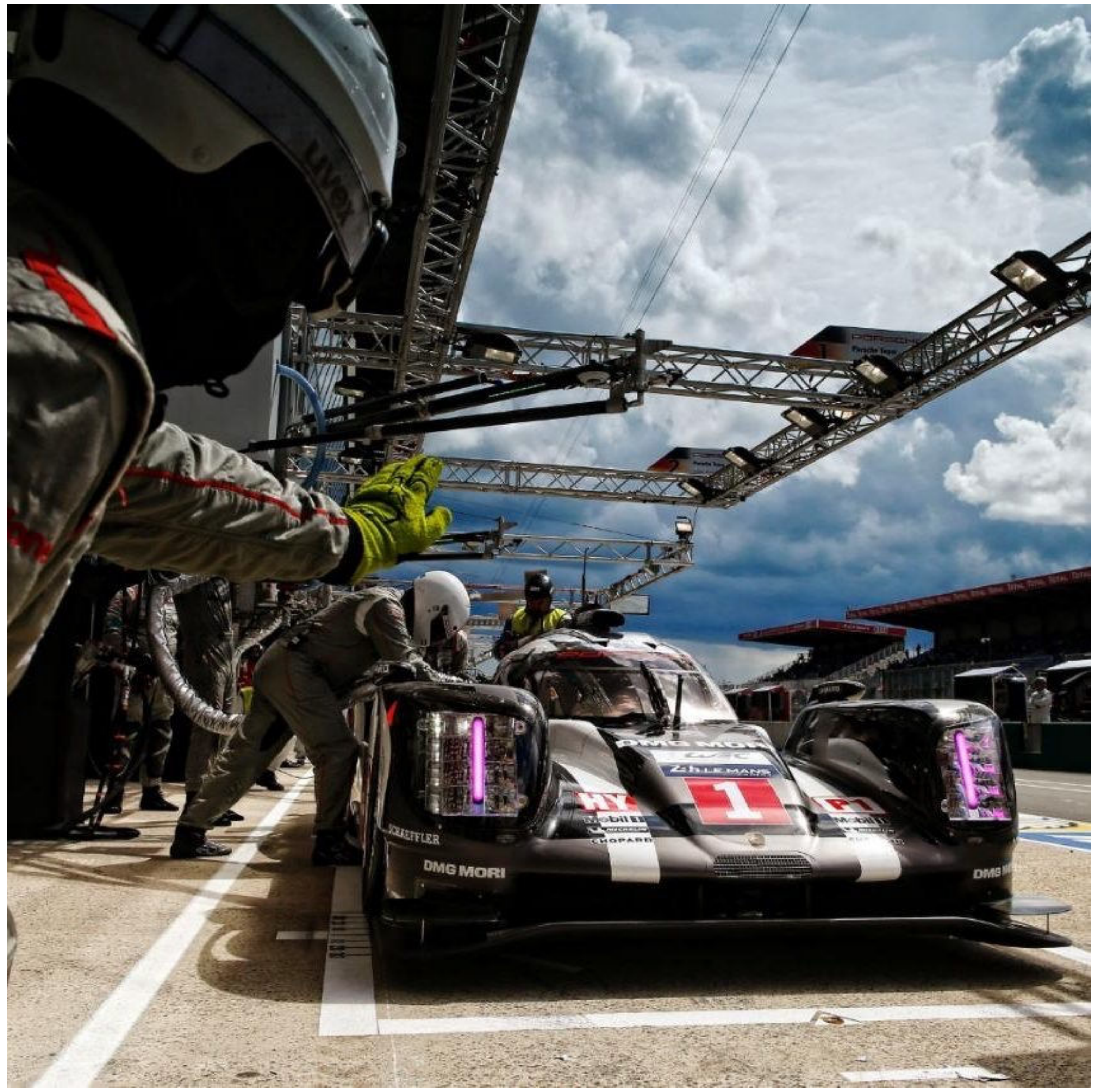


The first races
26 May 1923
These first races were different from todays Le Mans, in that the winner was declared after three years of racing. The races were 24 hours long and the distance traveled was added up after 3 years or 3 races, and then the winner was declared.
http://www.totalarseracingteam.co.uk/images-info/Info-History-003.jpg

2 HISTORY OF LE MANS

2.2 Evolution of technology

As the years passed, Le Mans became a proving ground for innovations in safety, efficiency and performance of cars. Night racing helped develop efficient headlight technology that later trickled down to road cars. Advancement in seatbelt technology is a direct result of Le Mans strive towards driver safety. Currently, all the top dog race cars in the LMP1 category are hybrid, a testament to Le Mans drive for efficiency.

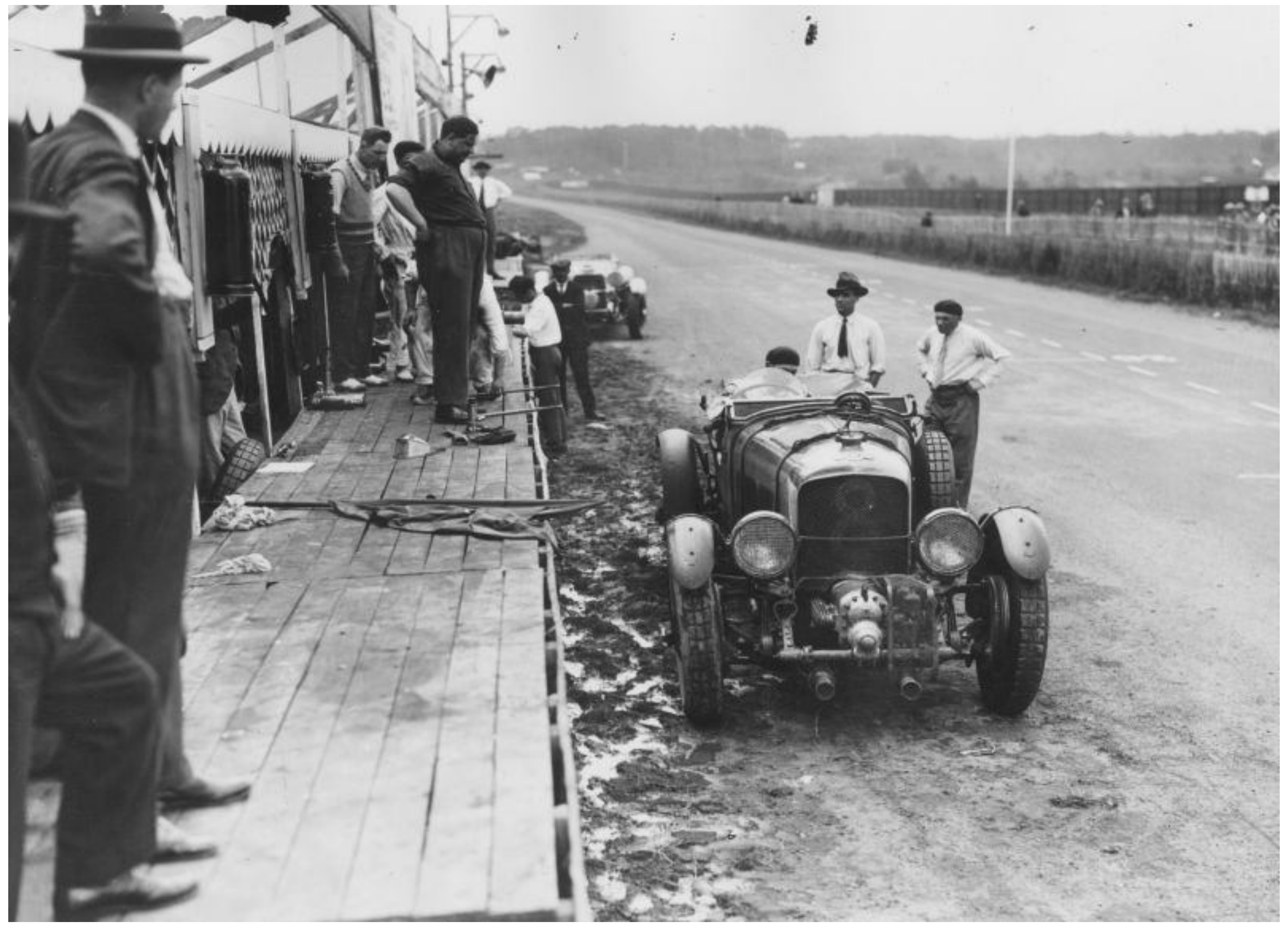


The 2016 Le Mans race winning Porsche 919 Hybrid. *Notice the laser headlamps*
http://www.telegraph.co.uk/luxury/motoring/24-hours-of-le-mans-the-innovation-accelerator/

2.3 **Evolution of form**

Early Le Mans race cars had open wheel layout. Soon engineers realised that adding a cowl or integrating the wheels into the main body of the car reduced drag considerably. Most early cars were front engined, today, almost all race cars are mid-engined with the exception of Aston Martins and Corvettes. The Porsche 911s in the GTE class have rear engines. Engine layout has hugely defined the shape of the race cars. Advanced aerodynamics have lead to complex fins and Ventures on the surface of today's race cars.

Few examples of race cars from various time period are shown on the following pages. A complete study of all race cars and it's history is not in the scope of this project.



1923
A supercharged Bentley motor car at the 1923 Le Mans 24-Hour Race.
http://jalopnik.com/these-incredible-photos-show-how-le-mans-evolved-over-8-1589918204

2 HISTORY OF LE MANS

British entrepreneur Sir David Brown at the wheel of a new 12-cylinder Lagonda racing car during trials, **22nd April 1954.** Brown's company, David Brown Ltd., owns the Aston Martin and Lagonda car companies. The new Lagonda car is intended to compete at Le Mans.
http://jalopnik.com/these-incredible-photos-show-how-le-mans-evolved-over-8-1589918204

The pre-race line up of cars before the 24 Hours of Le Mans, **15th June 1985.** In the foreground is a Rothmans Porsche 962C, driven by Jacky Ickx and Jochen Mass, which eventually came in tenth.
http://jalopnik.com/these-incredible-photos-show-how-le-mans-evolved-over-8-1589918204

2 HISTORY OF LE MANS

Vern Schuppan of Australia drives the #18 Shell/Dunlop Porsche AG Porsche 962 C ahead of team mate Derek Bell in the #17 during the FIA World Sportscar Championship 24 Hours of Le Mans race on **11th June 1988** at the Circuit de la Sarthe, Le Mans, France.
http://jalopnik.com/these-incredible-photos-show-how-le-mans-evolved-over-8-1589918204

A McLaren F1 GTR, of the Harrods Mach One Racing team, makes a pit stop during the 24 Hours of Le Mans, France **17th -18th June 1995.**
http://jalopnik.com/these-incredible-photos-show-how-le-mans-evolved-over-8-1589918204

2 HISTORY OF LE MANS

Sebastien Bourdais of France and Team Peugeot leads into the first chicane at the start of the 75th running of the Le Mans 24 Hour race at the Circuit des 24 Heures du Mans on **June 16, 2007** in Le Mans, France.
http://jalopnik.com/these-incredible-photos-show-how-le-mans-evolved-over-8-1589918204

Ford GT won in it's LM GTE Pro class on **19 June, 2016.** Celebrating 50 years of the original win by Ford GT40.
http://blackflag.jalopnik.com/ford-gt-beats-ferrari-again-at-le-mans-america-rules-1782242093

3 TODAY’S LE MANS

Over the past 93 years, Aston Martin, Audi, Bentley, BMW, Chevrolet, Dodge, Ferrari, Ford, Honda, Jaguar, Maserati, Mazda, McLaren, Mercedes-Benz, Nissan, Peugeot, Porsche, Renault, Toyota, and others have used the Le Mans 24 Hours to build international awareness. Each era’s winning cars have reflected the brand ambitions of the competing companies and represented a breakthrough in technology.

As of 2015, Porsche remains the most successful manufacturer with a record 17 overall victories, including a record seven in a row.

After Audi's recent dominance of the event, Porsche returned to Le Mans in 2014 with a new factory LMP1 program to challenge Audi. Toyota has fielded competitive cars since 2012, and Nissan returned to run an LMP1 program in 2015.

In 2015, Porsche once again won the race with its #19 car.

3.1 **2016 24 Hours of Le Mans**

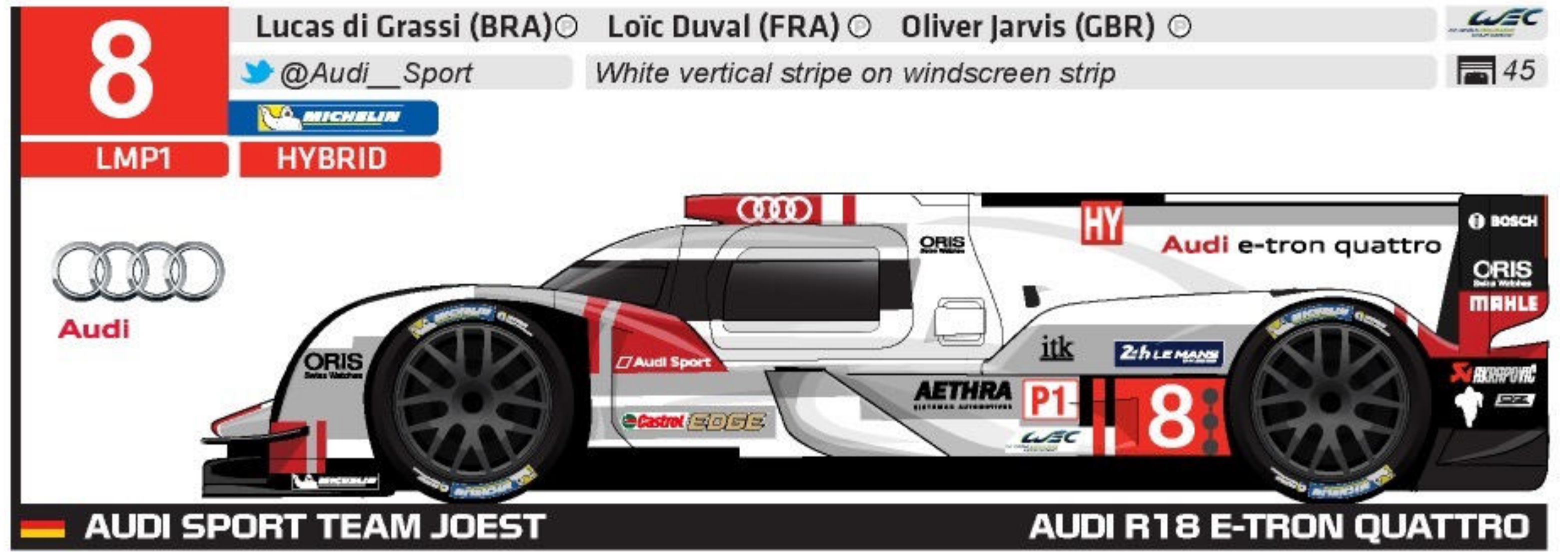
The 84th 24 Hours of Le Mans will be held from 15 to 19 June 2016 at the Circuit de la Sarthe, Le Mans, France. There are four categories of cars as usual for the 2016 Le Mans. These classes are governed by engine capacity and weight of the car. LM P1 and LM P2 are the lightweight prototype cars. While LM GTE Pro and LM GTE Am are endurance race cars based on production car chassis.

Since 2012, Garage 56 has been reserved for innovative projects promoting ground-breaking technologies.

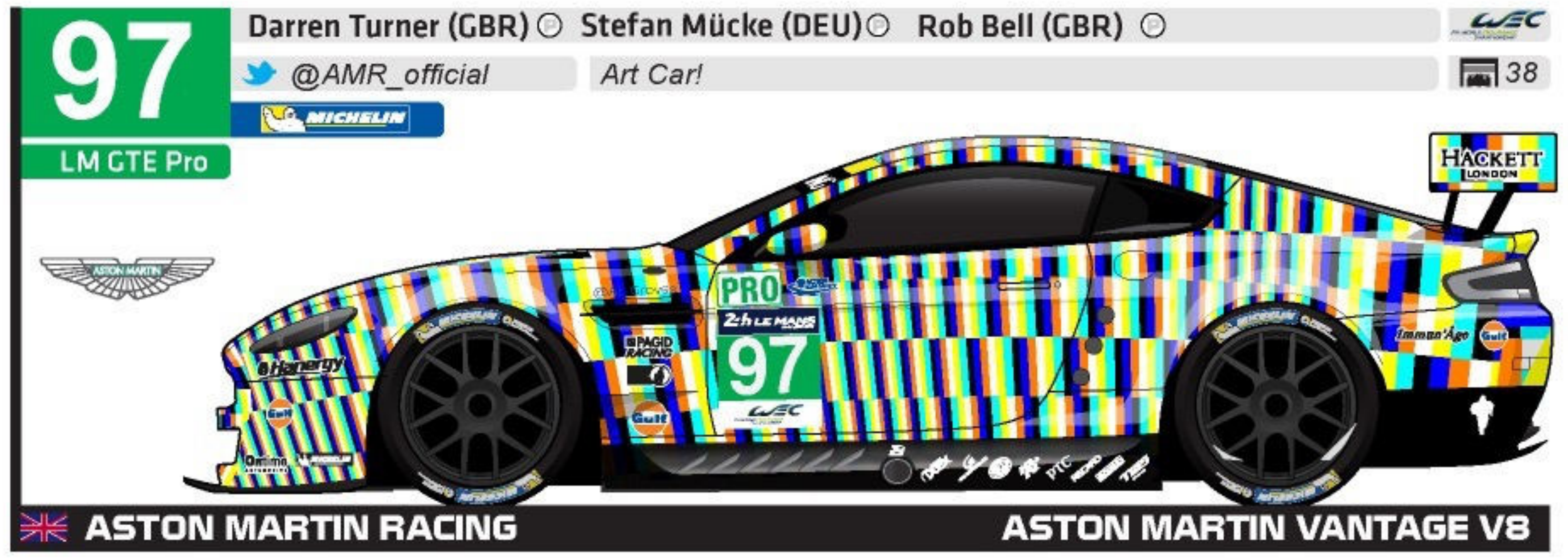
[1] https://en.wikipedia.org/wiki/24_Hours_of_Le_Mans

3 TODAY'S LE MANS

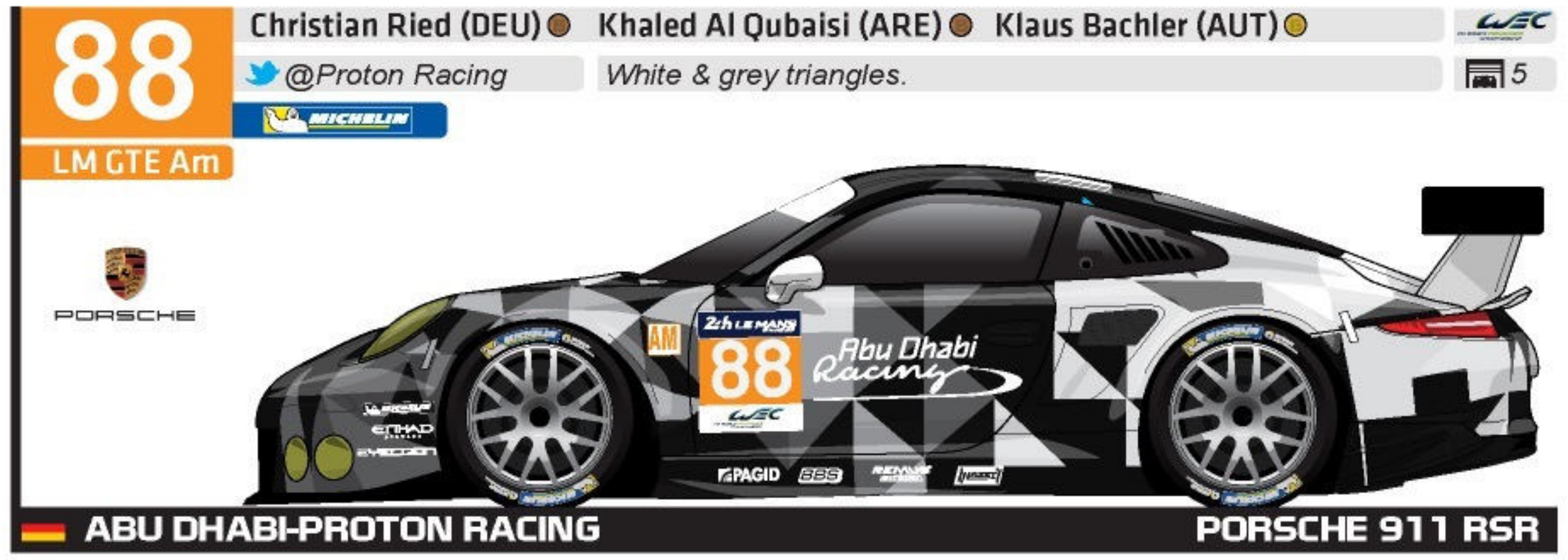
LMP1 2015 Audi R18 E-Tron Quattro



LMP2 2015 Pegasus Racing Morgan-Nissan



LM GTE Pro 2015 Aston Martin Vantage V8



LM GTE Am 2015 Abu Dhabi-Proton Racing Porsche 911 RSR

4 WHAT MAKES LE MANS RELEVANT?

In recent years, Le Mans organisers have pushed for significant reductions in fuel, energy and tire usage. The open formulas available to achieve those results have made Le Mans the most relevant and exciting form of competition for manufacturers worldwide. This approach has inspired the creation of Audi's diesel and diesel hybrid technologies, Toyota's ultra-capacitor hybrid, Porsche's V4 hybrid and Nissan's radical DeltaWing and GTR-LM concepts.

The 2012 Nissan DeltaWing ran from Garage 56. It had a radical delta wheel arrangement which didn't require wings for downforce. The 2015 Porsche 919 Hybrid had two energy recovery system, one being an advanced flywheel kinetic energy recovery system.

4.1 **Aerodynamics**

Early Le Mans race cars where stripped off of body panels in an attempt to reduce weight. Pre-war Bugattis pioneered aerodynamic body fairing using simple geometric curves to, give the great advantage over the competition. Aerodynamics have been constantly improved upon ever since. Le Mans saw the first ever active aerodynamics pioneered by Porsche. Since Circuit de la Sarthe consists of long straights, manufacturers prefer low drag over high downforce for corners.

At the1989 event, the Mercedes-Benz C9 reached 400 km/h (249 mph) under qualifying conditions with advanced aerodynamic fairings.

4.2 **Engines**

A wide variety of engines have competed at Le Mans, in attempts to not only achieve greater speed but also to have better fuel economy. Engine sizes have also varied greatly, with the smallest engines being a mere 569 cc (Simca Cinq) and the largest upwards of 8,000 cc (SRT Viper GTS-R). Supercharging was an early innovation for increasing output, first being raced in 1929, while turbocharging would not appear until 1974.

In 1963, Rover partnered with British Racing Motors to run a gas turbine with mixed success, repeating again in 1965. The American Howmet Corporation would attempt to run a turbine again in 1968 with even less success. Although the engines offered great power, they were hot and fuel-inefficient.

After many years of developing rotary engines, Mazda succeeded in being the only winner of the race to not have a piston-powered engine, taking the 1991 event with the 787B. Rotary engines were banned by the ACO following Mazda's win.

Alternative fuels like bio-ethanol and bio-diesel have also been used at various times at Le Mans.

4.3 **Energy Recovery**

Beginning in 2009, new regulations allowed hybrid vehicles, with either KERS or TERS (Kinetic/Thermal Energy Recovery System) setups. In 2012 the first KERS-equipped car won; the Audi R18 e-tron with a flywheel hybrid system by Williams Hybrid Power activated and drove the front wheels. This was only allowed in certain zones, after the car had accelerated to at least 120 km/h, in order to cancel out the acceleration advantage that four-wheelers could gain out of corners.

4.4 Brakes

With increased speeds around the track, brakes become a key issue for teams attempting to safely bring their cars down to a slow enough speed to make the Mulsanne Corner turn. Disc brakes were first seen in 1953 when the Jaguar C-Type raced at Le Mans. In 1955 the Mercedes-Benz 300 SLR introduced the air brake using a large opening hood on the rear of the car. [1]

In the 1980s, anti-lock braking systems became standard on most Group C cars as a safety measure, making it less likely that cars lose control at high speeds. By the late 1990s, reinforced carbon-carbon brakes were adapted for better stopping power.

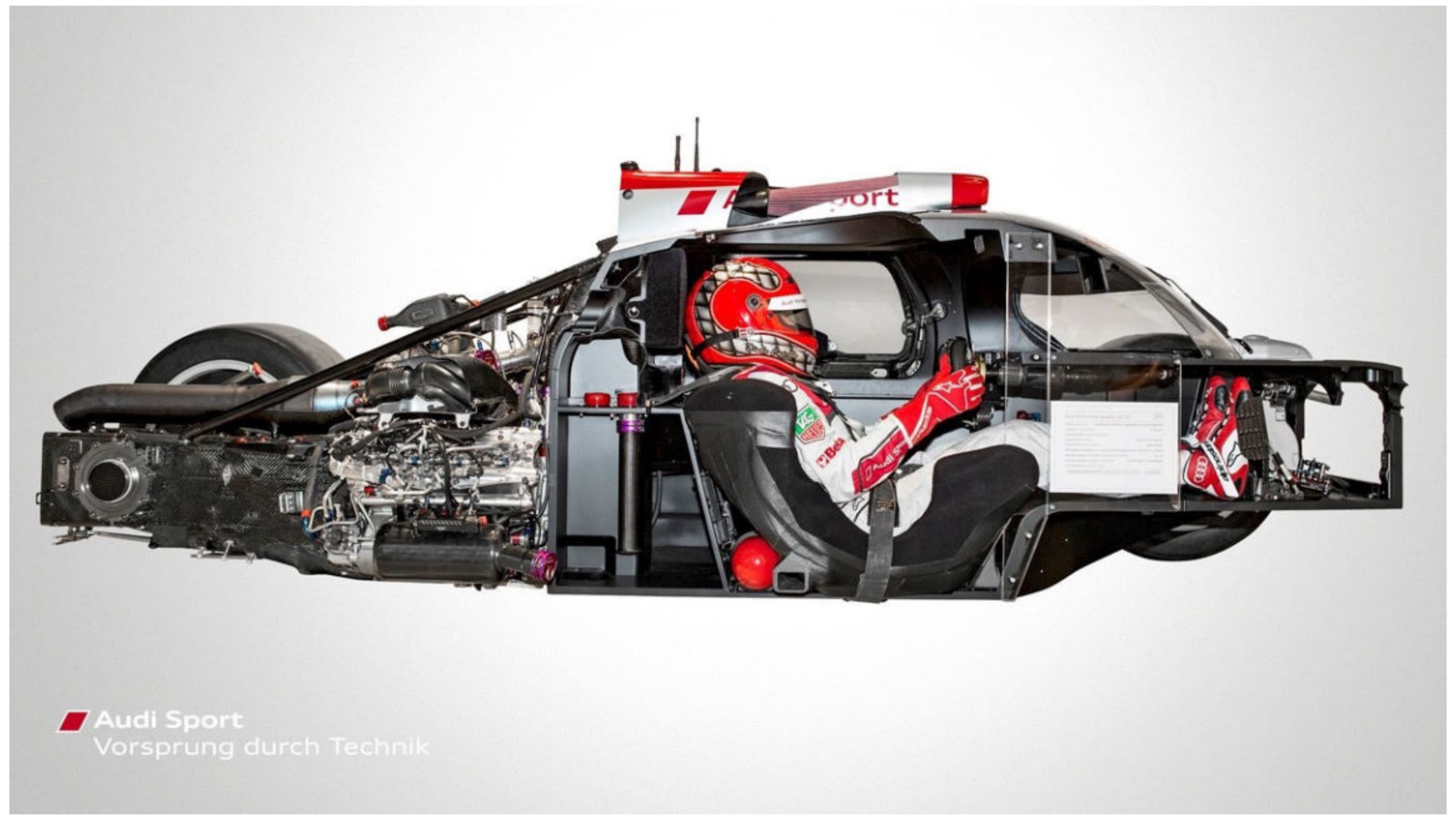
4.5 Safety

Le Mans operates under high safety standards. Stringent safety regulations dictating driver-cell, racing-suits, safety harness, fuel-cell, headlamps to name a few. Track safety like marshall flag system, runoff area, crash barriers, radio communication, onboard cameras make racing safe. While on-location doctors, air-ambulance, driver recovery, fire fighting make post accident mitigation effective.

Safety innovations like seat-belts, ABS, ESC have been pioneered first at the Le Mans, and later trickled down to regular consumer cars.

[1] https://en.wikipedia.org/wiki/24_Hours_of_Le_Mans

4 WHAT MAKES LE MANS RELEVANT?



Audi R18 E-Tron Quattro cutaway

Nissa DeltaWing

5 **2030 THE FUTURE**

The world will need at least 50 percent more food, 45 percent more energy and 30 percent more water than it did in 2012, according to United Nations High Level Panel on Global Sustainability estimates. [1]

India will surpass China as the most populous country this year or earlier.

According to projections by the United Nations, the world population of humans is estimated to be between approximately 7,800,000,000 (7.8 billion) and 8,500,000,000 (8.5 billion) people.

Of the world's population, 60% will live in urban areas due to rapid urbanisation. It is also estimated that there will be 41 megacities that will collectively contain 9% of the world's population. All but one will be in Asia or Africa due to rapid urbanisation on those continents.

Developed countries will have very low birthrate, inviting immigrants looking for jobs from less developed countries.

Ever progressing technology will lead us into a new paradigm much different from our current lives. Population boom put enormous strain on energy resources. Energy usage will be strictly governed, with developed countries having surplus

Artificial intelligence, quantum computers, 3D printing, nanotechnology and advanced robots will replace most jobs.

Human and AI hybrids that are capable of superhuman tasks will become a reality.

[1] https://en.wikipedia.org/wiki/2030

5 2030 THE FUTURE

5.1 The technology

Architectural advances will see taller and taller skyscrapers appear, including new "megatall" buildings, with the possibility of a kilometer-tall tower by this time.

3D printing will have grown dramatically in usage, and even buildings and human organs will be printed.

Healthcare will become largely automated, with machines replacing 80% of doctors. In addition, new advances in medical technology will greatly improve human health, particularly nanobots, which will be implanted in the human body to augment the immune system. Researchers are aiming for the ability to regenerate human limbs to be achieved by this time.

Self-driving vehicles will dominate the roads, and Elon Musk has projected that operating a non-self-driving vehicle on public roads may even be illegal by this time. Cars being built during this time, which will be smaller than the vehicles of previous decades, will all be plug-in electrics or hybrids.

Ships may be fully capable of running themselves and running on different types of fuel, will require less maintenance due to sensors and robots locating and repairing problems, while construction using advanced materials will make them lighter.

Hypersonic passenger airliners may be in use.

A quantum computer trillions of times faster than a supercomputer may have been developed.

6 DESIGN BRIEF

Today's Artificial Intelligence is as intelligent as a 4 year old human. By 2030, AI will be as intelligent as a human being capable of making high cognitive actions. [1]

Advances in robotics will replace many jobs done by humans, and the growing capabilities of artificial intelligence will mean that white-collar jobs will also be increasingly automated. In particular, Ray Kurzweil estimates that humans will become hybrids with AI by 2030, due to human brains being able connect with computers and being fed information. [2]

6.1 The theme

A symbiosis of a human driver and AI, a hybrid organism capable of super human tasks. A Le Mans race car driven both human and AI, capable of performing for the entire stretch of 24 hours.

How will the machine and AI help the driver win the race? A test of both man and machine endurance.

Throughout the design phase, this idea of man and AI working in harmonious unison will be explored.

6.2 Design brief

Design a breakthrough race car to win the Le Mans 24 Hours in the year 2030. [3]

The Michelin Challenge Design 2017 – Le Mans 2030: Design for the Win – invites young designers to envision a revolutionary design that would win the Le Mans of 2030.

[1] http://www.independent.co.uk/life-style/gadgets-and-tech/news/computers-to-match-human-brains-by-2030-782978.html
[2] http://money.cnn.com/2015/06/03/technology/ray-kurzweil-predictions/
[3] http://www.michelinchallengedesign.com/the-challenge-for-2017/how-to-enter/

6 DESIGN BRIEF

6.3 Design process

Following is the diagram that represents the design process employed in this design project.

DEFINE
the problem

COLLECT
information

BRAINSTORM & ANALIZE
ideas

DEVELOP
solutions/build a test model

present your ideas to others for
FEEDBACK

IMPROVE
your design

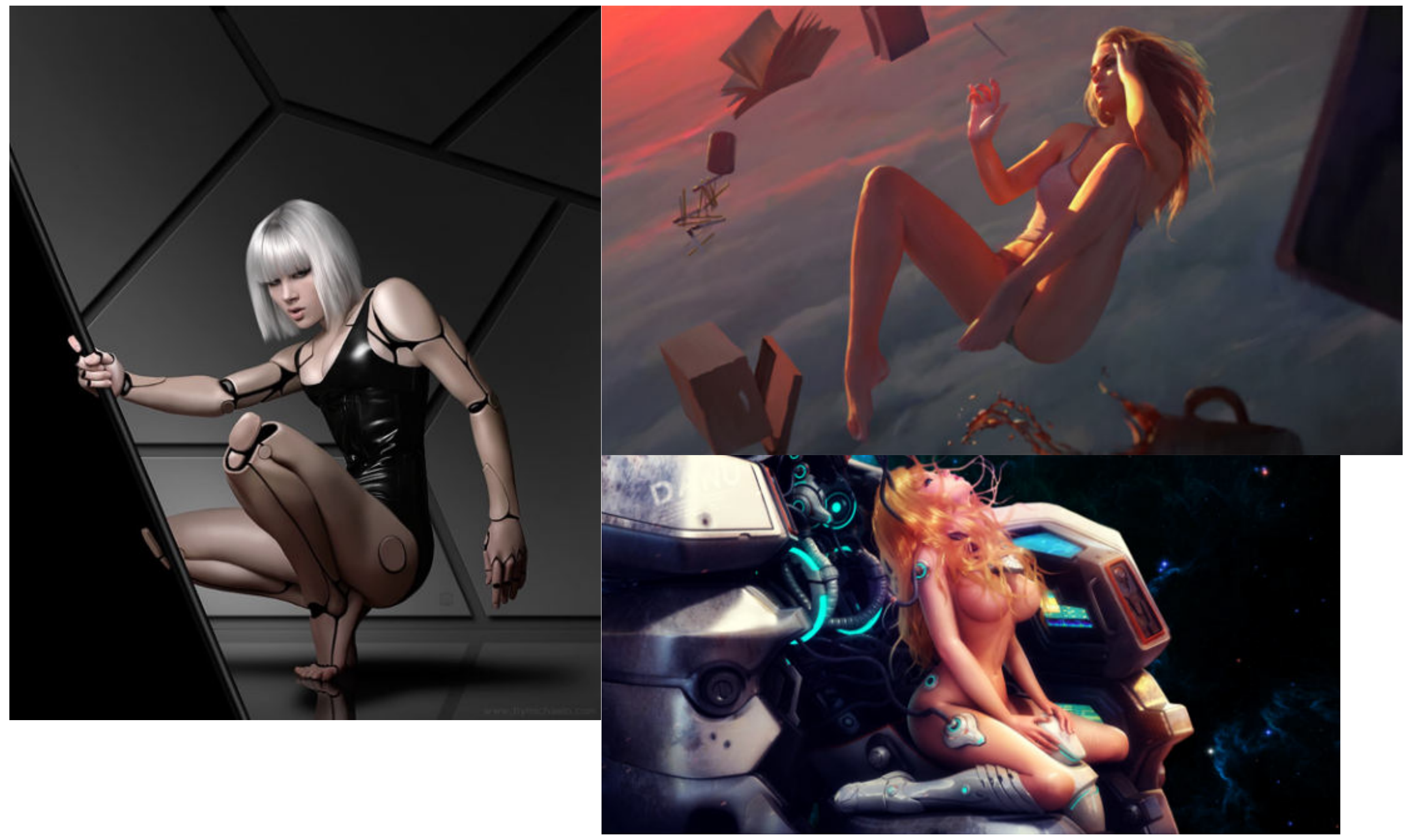
BUILD IT

After initial idea generation, a linear design process was followed. All or most ideas generated during the initial stages are carried forward to the main concept development. This method helped refine the concept multiple times leading to a sophisticated concept with rich design details.

6 DESIGN BRIEF

6.4 **Inspiration board**

Following is the inspiration board for this project, that helped the initial ideation process.



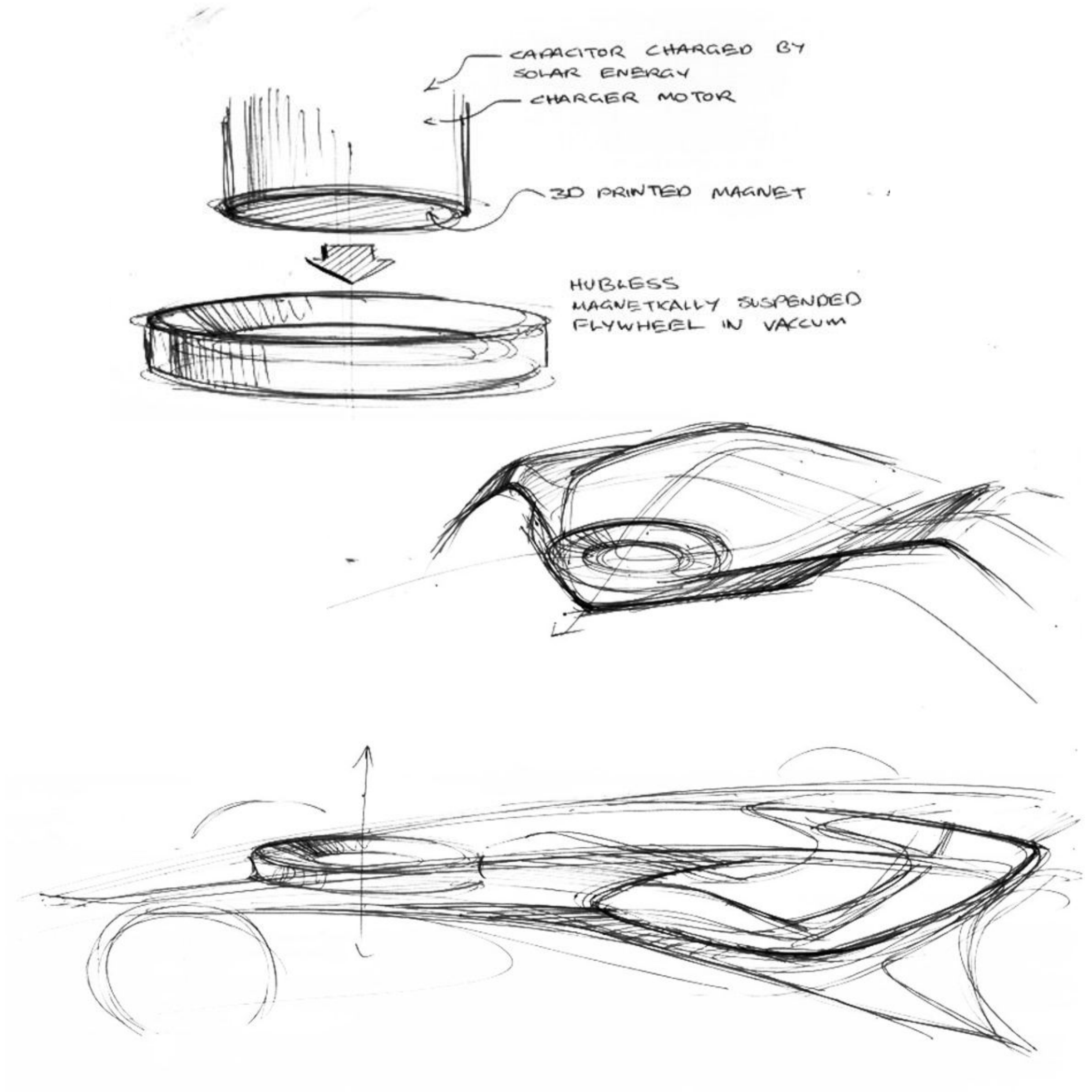
7 **INITIAL IDEAS**

Following are the initial ideas for the Le Mans 2030 race car.

7.1 **Kinetic Energy Storage**

Why carry around fuel while you can store energy in it’s most elemental form right on the vehicle itself. **Flywheel energy storage** (**FES**) works by accelerating a rotor (flywheel) to a very high speed and maintaining the energy in the system as rotational energy. When energy is extracted from the system, the flywheel's rotational speed is reduced as a consequence of the principle of conservation of energy; adding energy to the system correspondingly results in an increase in the speed of the flywheel. [1]

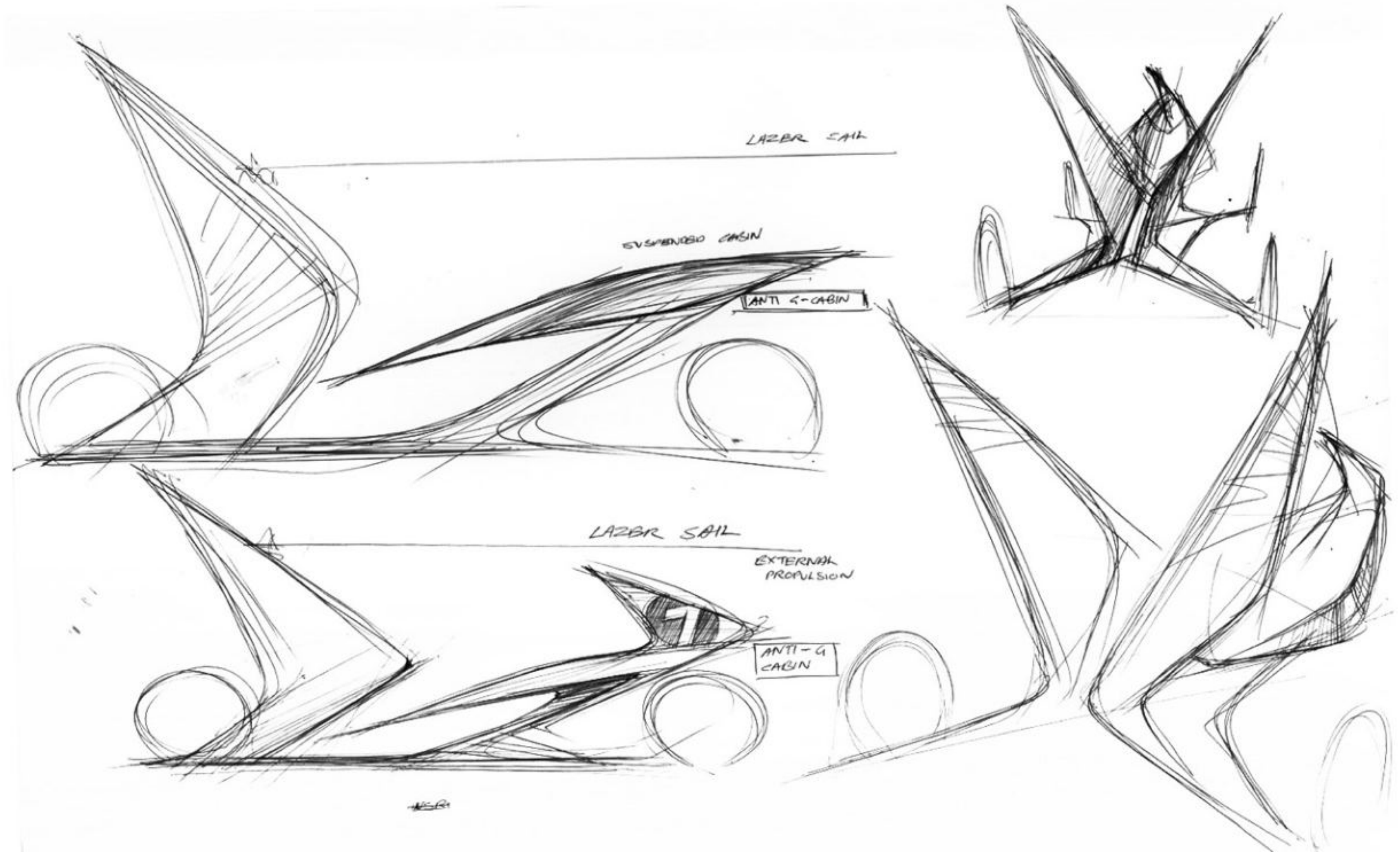
[1] https://en.wikipedia.org/wiki/Flywheel_energy_storage



7 INITIAL IDEAS

7.2 **External propulsion**

External propulsion eliminates the need to carry fuel on the vehicle itself. Laser beam placed along the racetrack will be used to propel the vehicle. **Laser propulsion** is a form of beam-powered propulsion where the energy source is a remote (usually ground-based) laser system and separate from the reaction mass. This form of propulsion differs from a conventional chemical rocket where both energy and reaction mass come from the solid or liquid propellants carried on board the vehicle. [1]



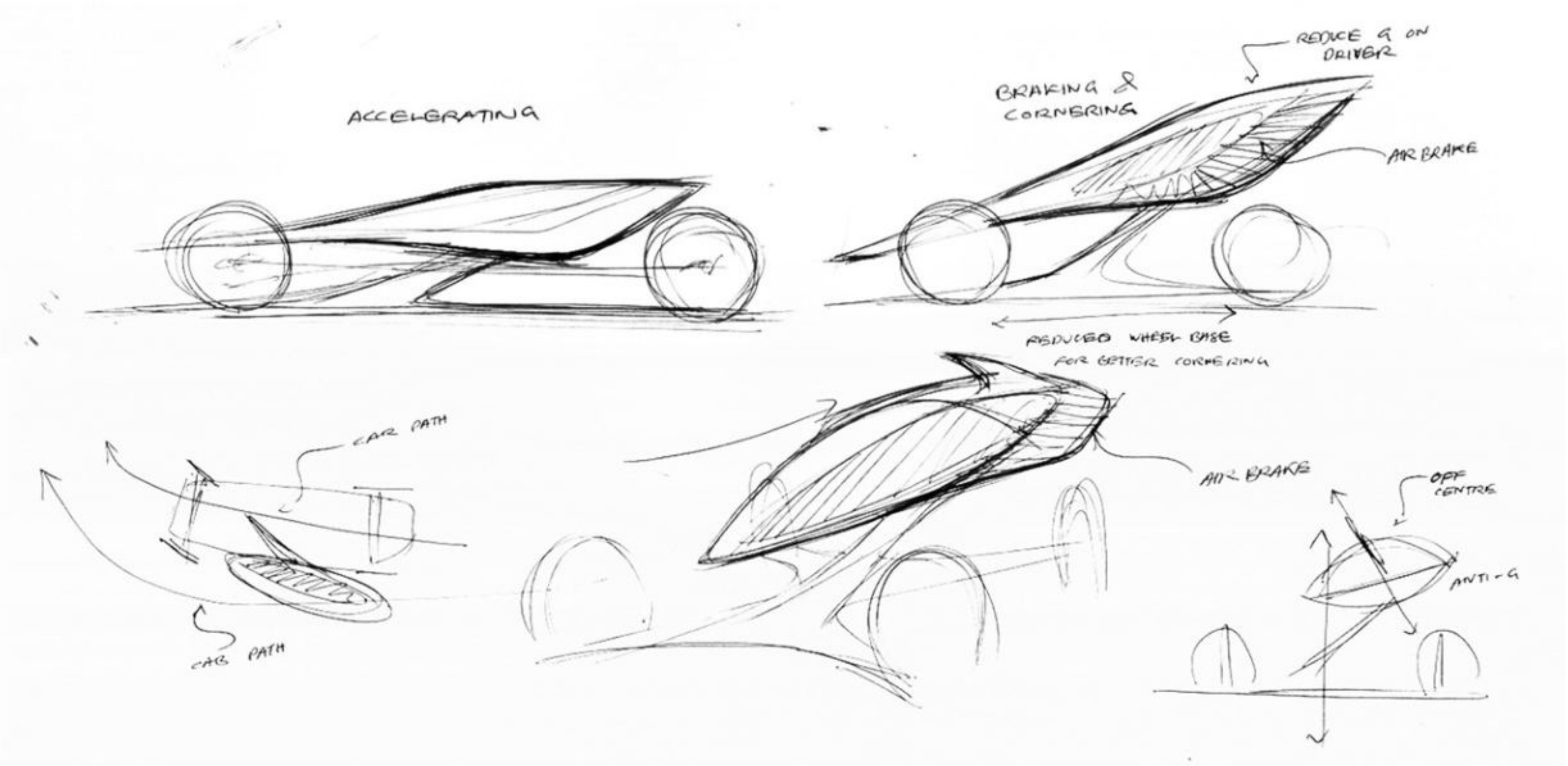
[1] https://en.wikipedia.org/wiki/Laser_propulsion

7 INITIAL IDEAS

7.3 **Adaptive vehicle**

Adaptive aerodynamics are the cutting edge technology today, enabling supercars to have variable aerodynamic properties along various driving scenarios. Like, the cars can have high downforce setting at a corner, and a low drag setting for high speed straight.

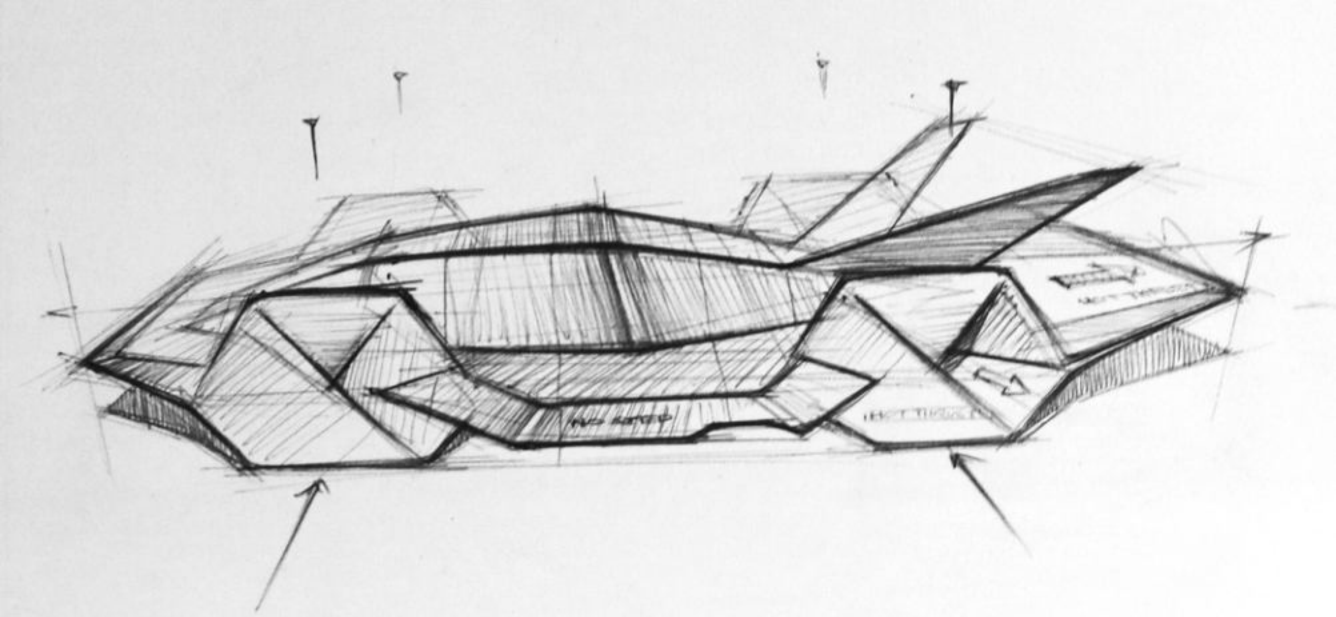
Future vehicles could have variable wheel footprint, banking, crash mitigation capabilities to name a few.

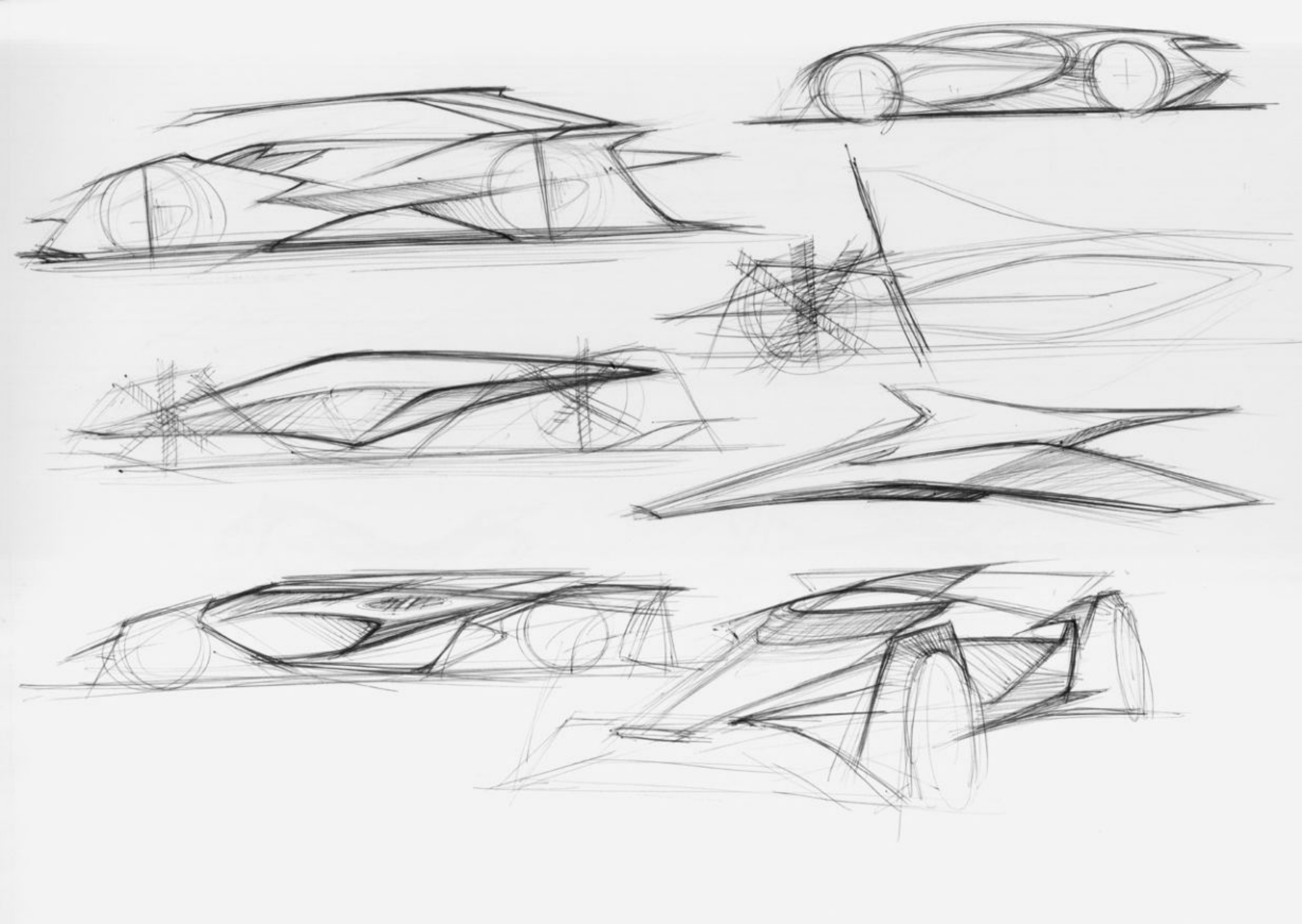


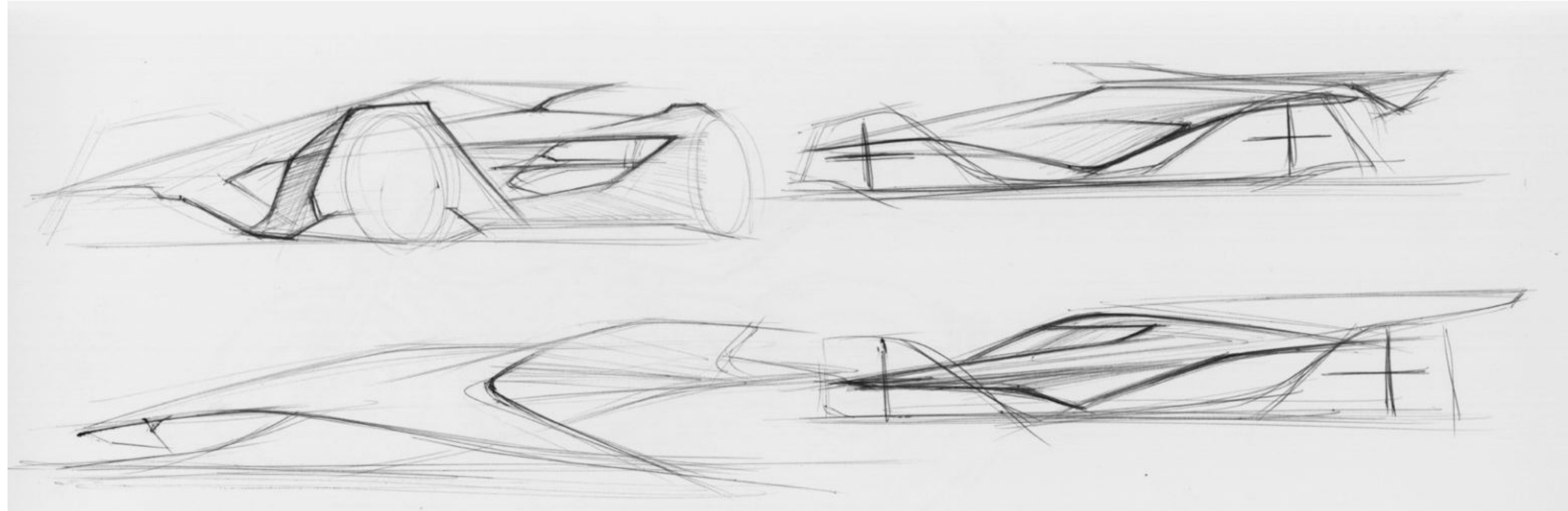
7 INITIAL IDEAS

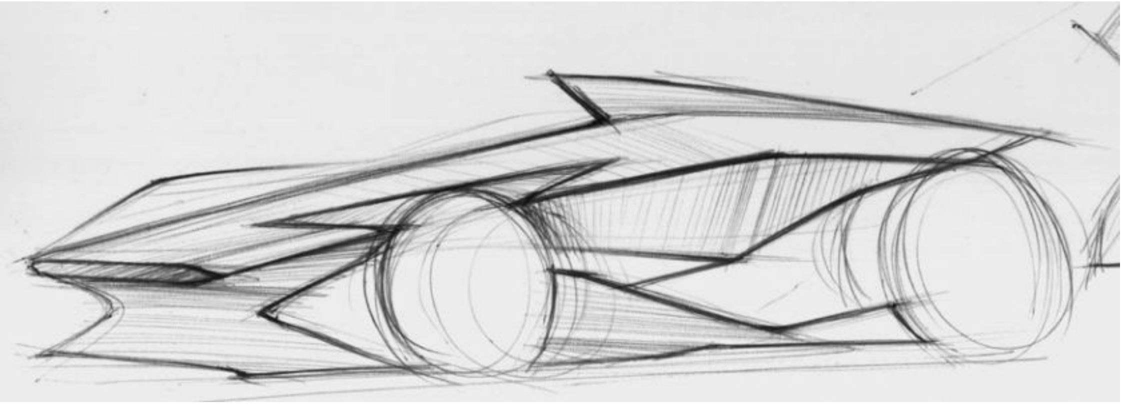
7.4 Early form explorations

Following are early form exploration exercise of the Le Mans race car for 2030.





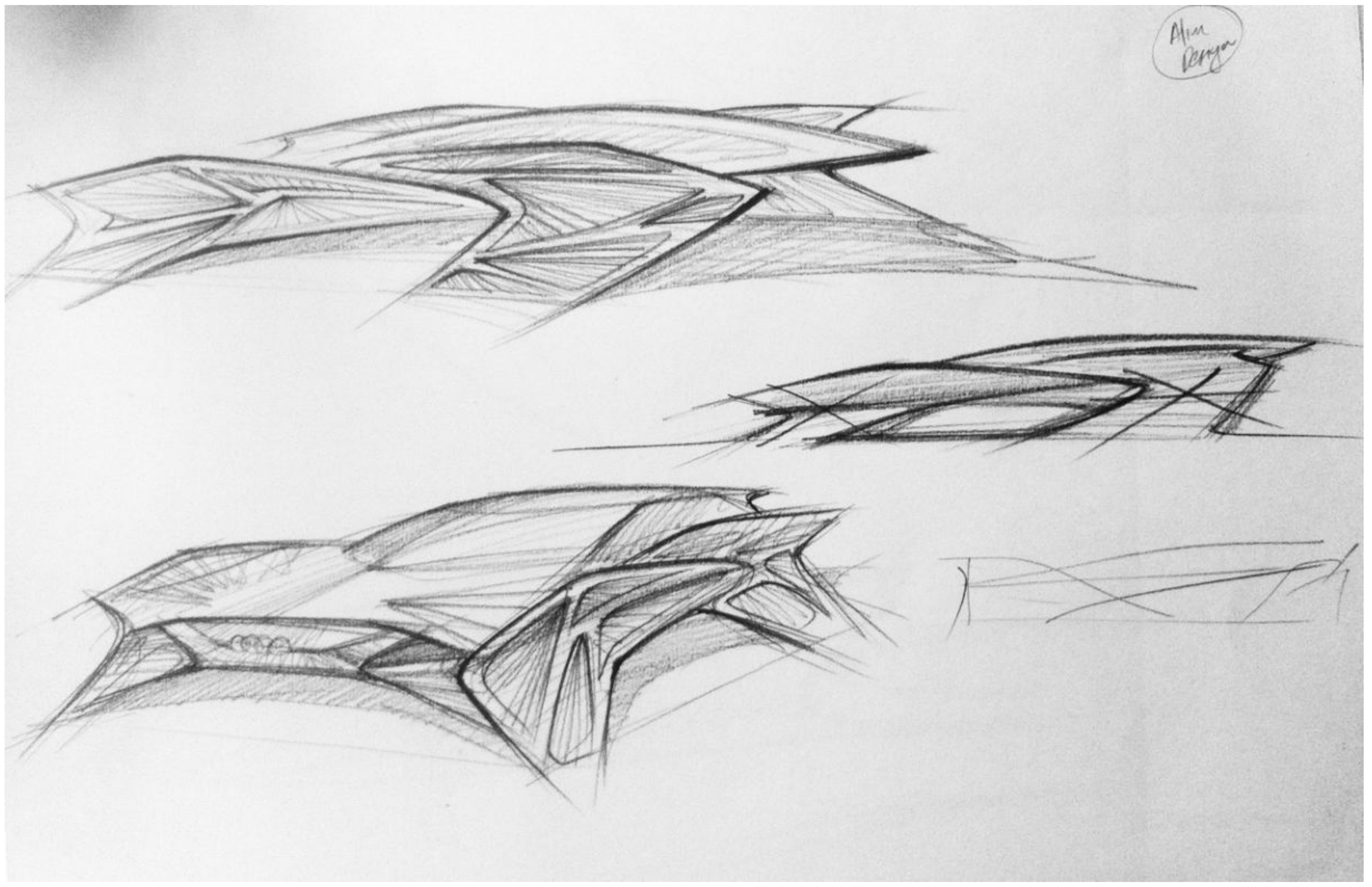


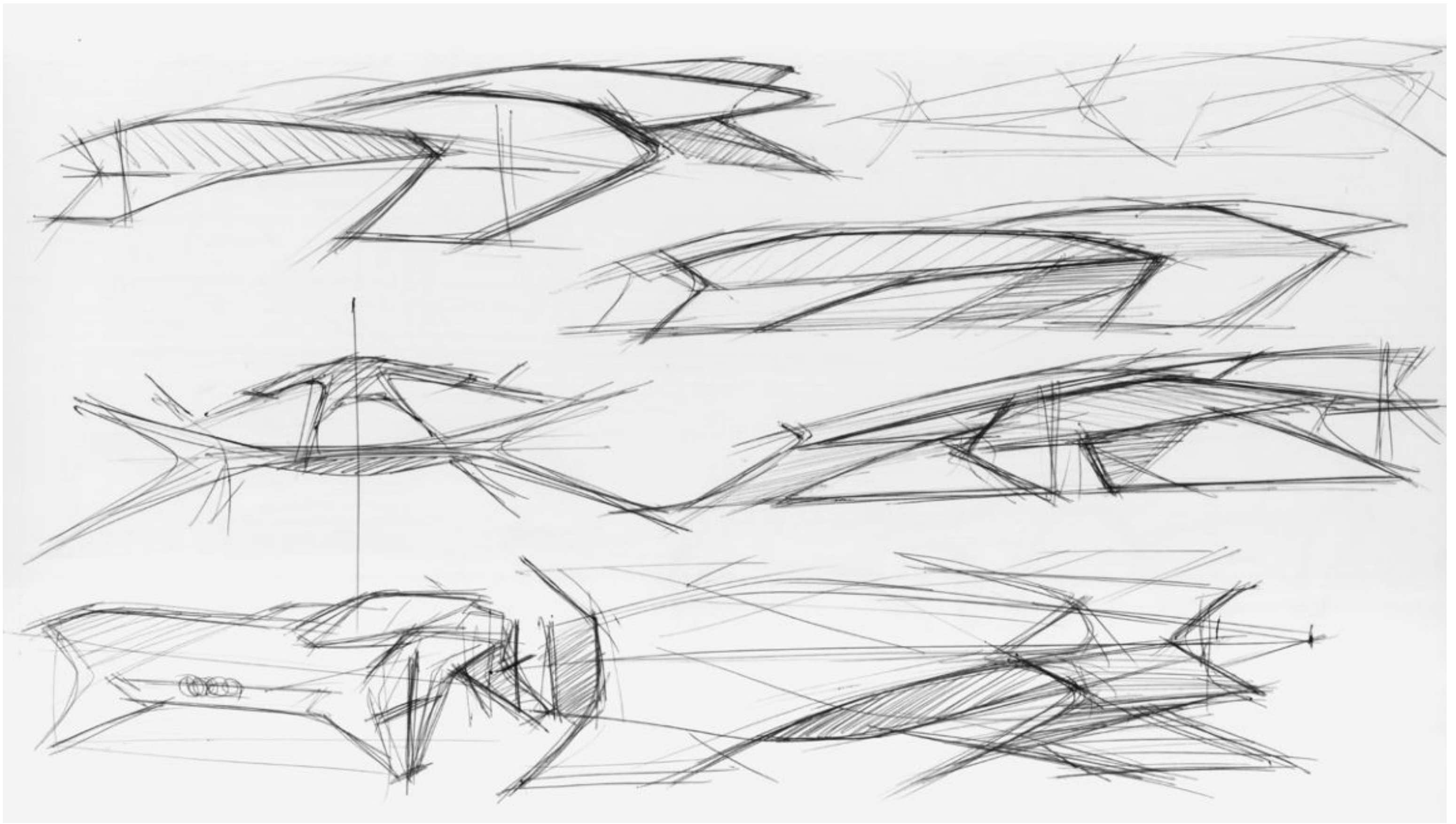


8 CONCEPT DIRECTIONS

8.1 **Minimal surface area**

Streamlined and minimal surface results to reduced drag, hence a more efficient vehicle. This concept direction focuses on skeletonising the vehicle and letting air pass through the vehicle instead of pushing air around the vehicle.

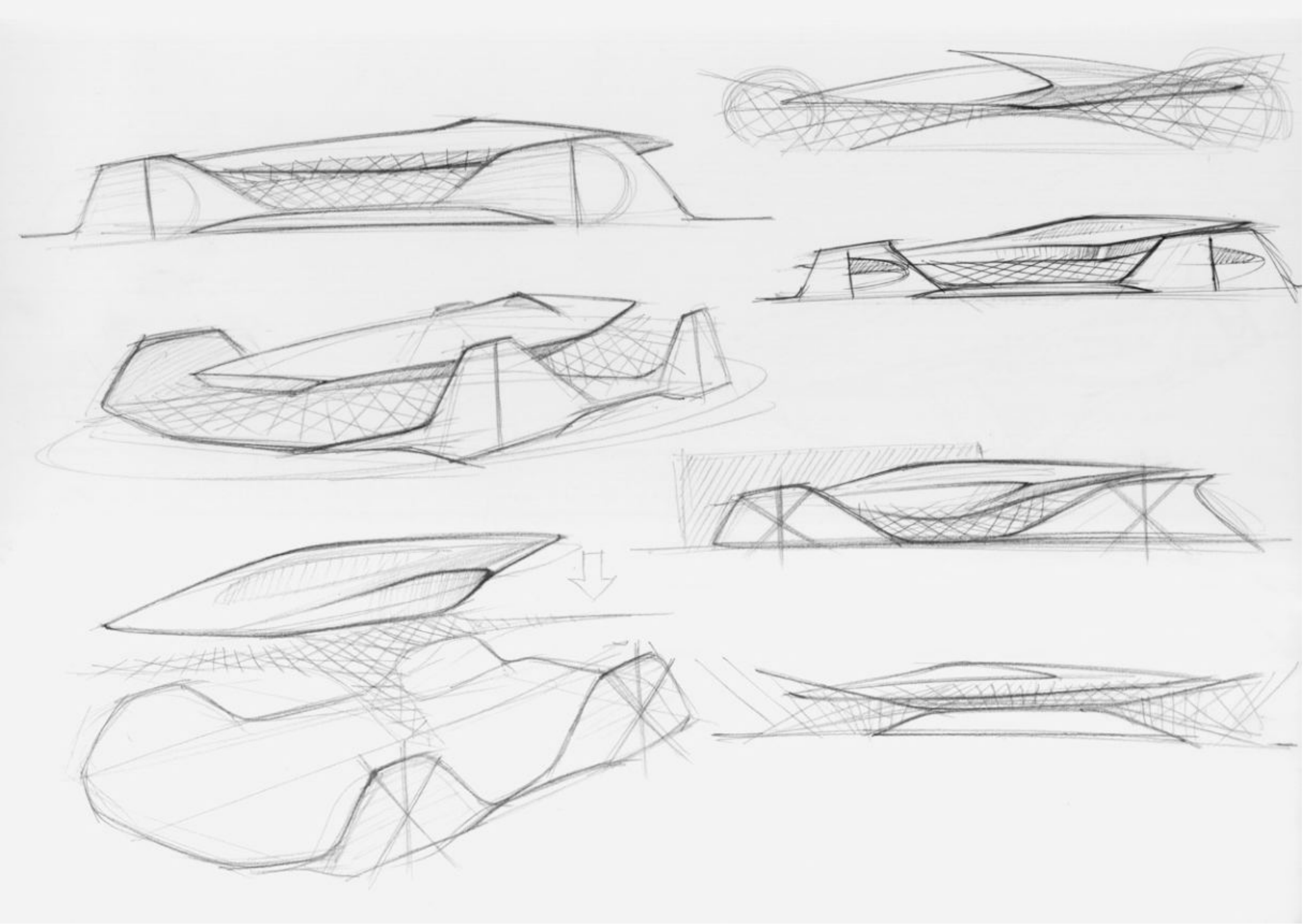


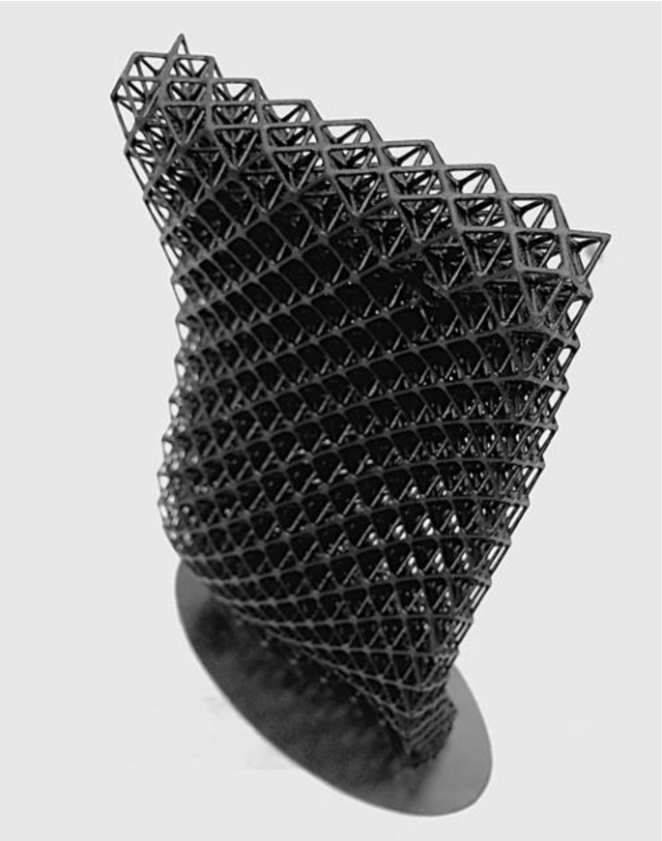


8 CONCEPT DIRECTIONS

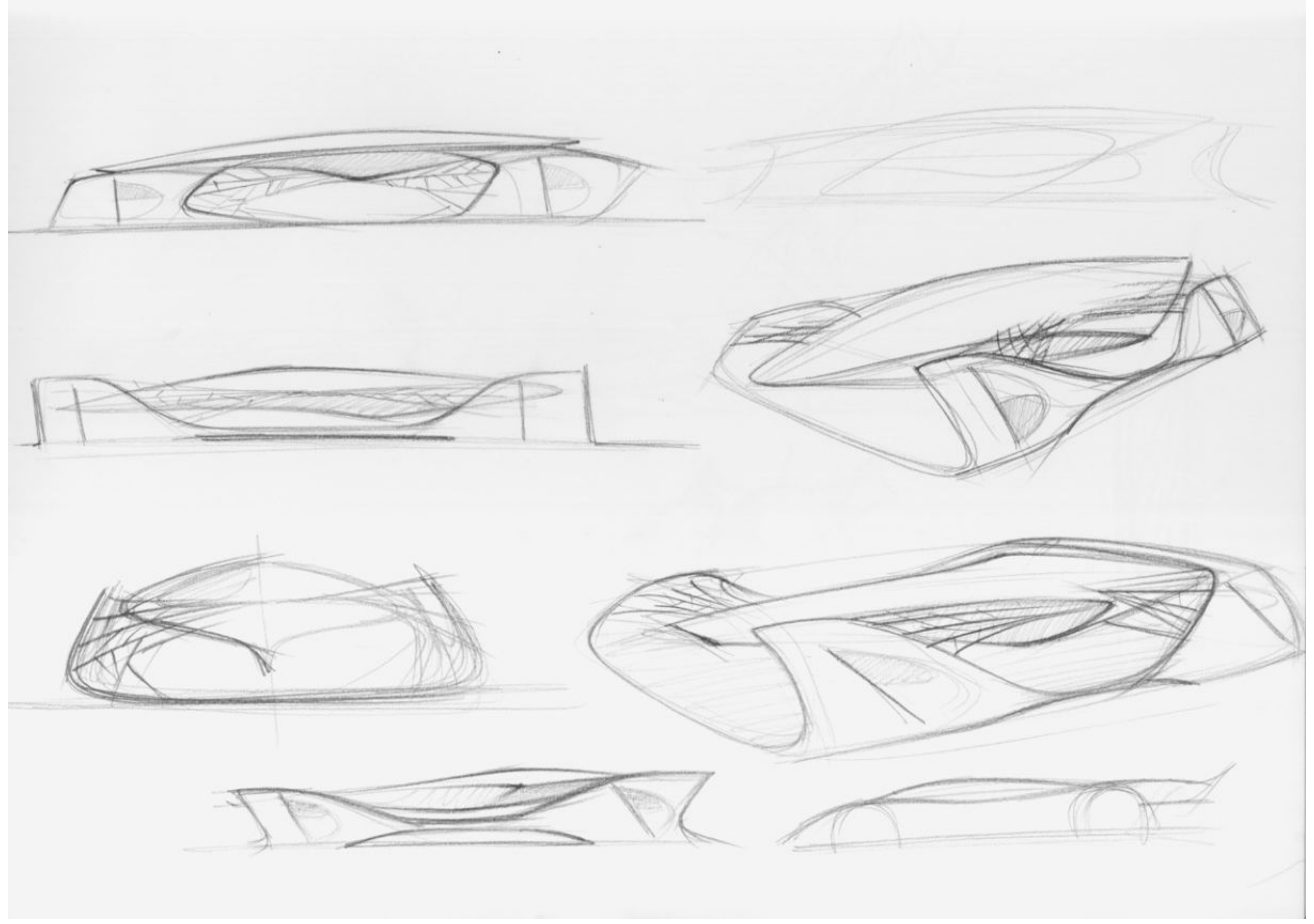
8.2 **3D printed nanostructure**

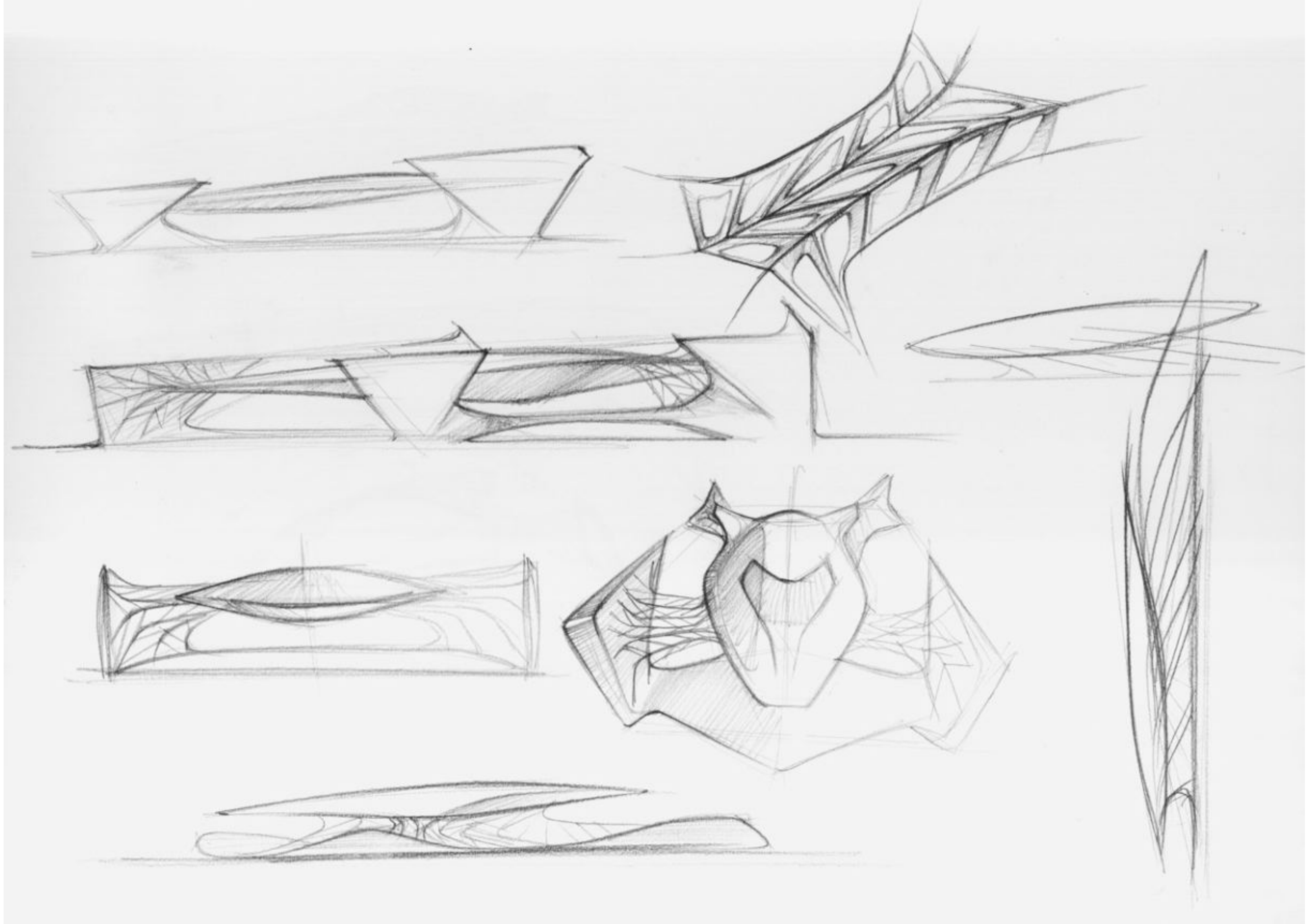
Intricate 3D printed nanostructure make up the chassis of the vehicle. Nanostructures provide exceptional strength while being super light weight. Nanostructure's can also be electrically controlled to either expand or contract. These structures allow the vehicle to dynamic, rather than being a rigid structure.





8 CONCEPT DIRECTIONS

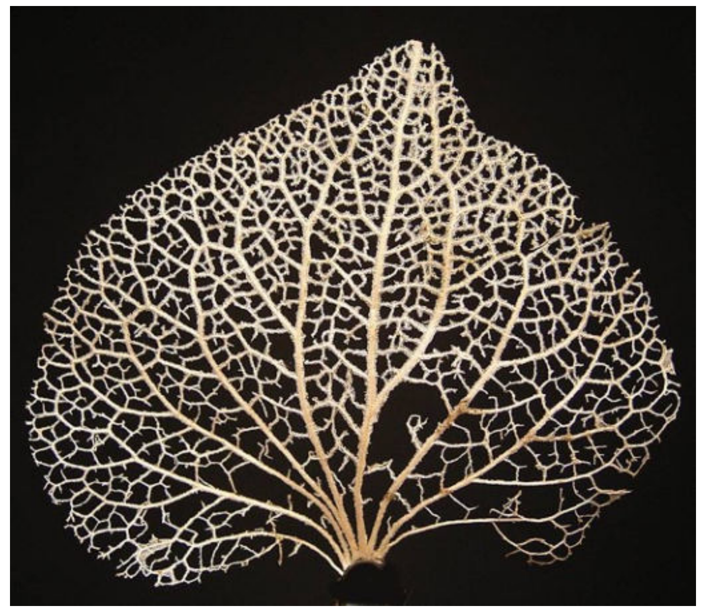


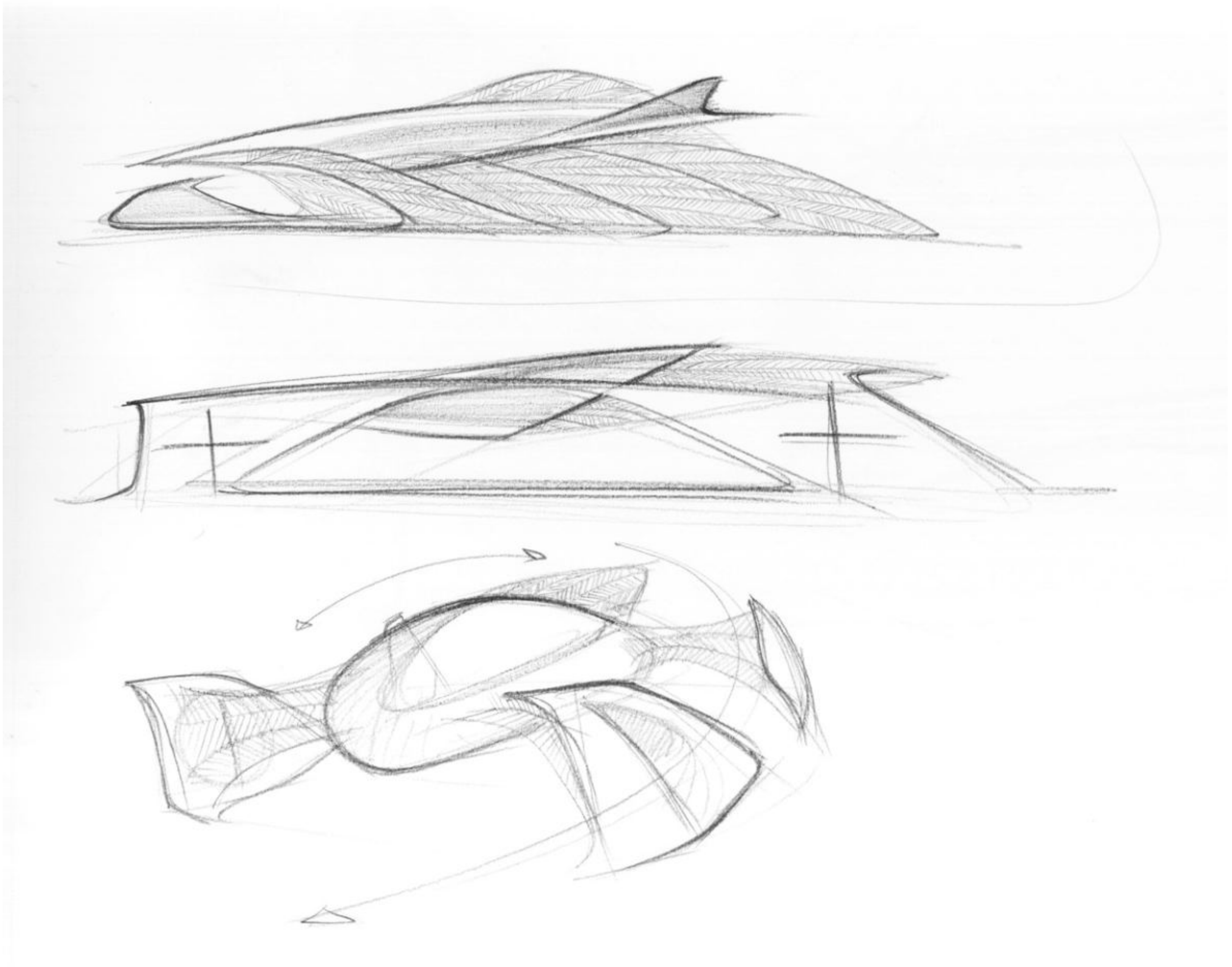


8 CONCEPT DIRECTIONS

8.3 **Organic fractal structure**

An evolution of the nanostructure concept, this concept direction explores organic fractal structures in nature. Learning from nature, like from the vein structure of leaves.

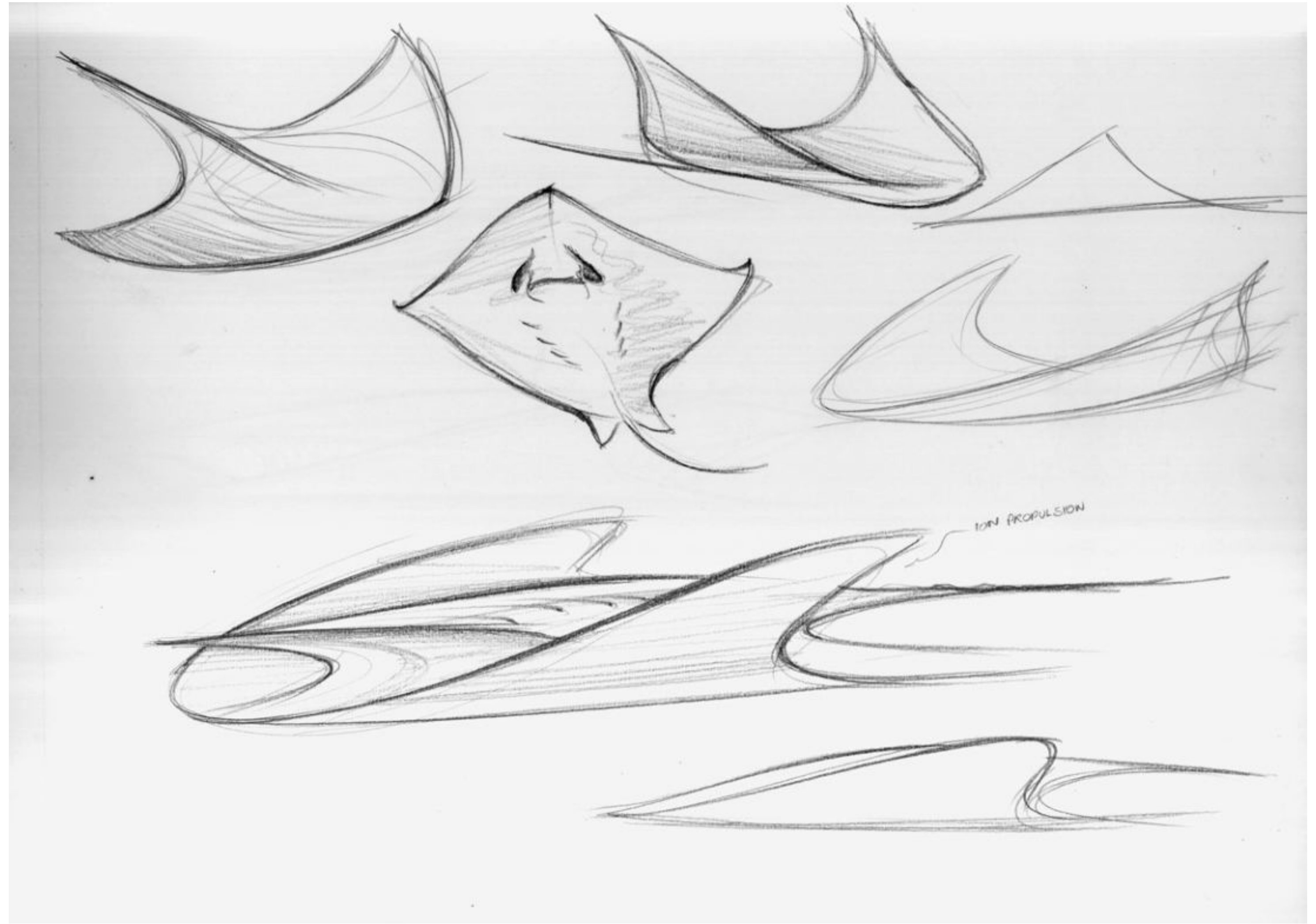


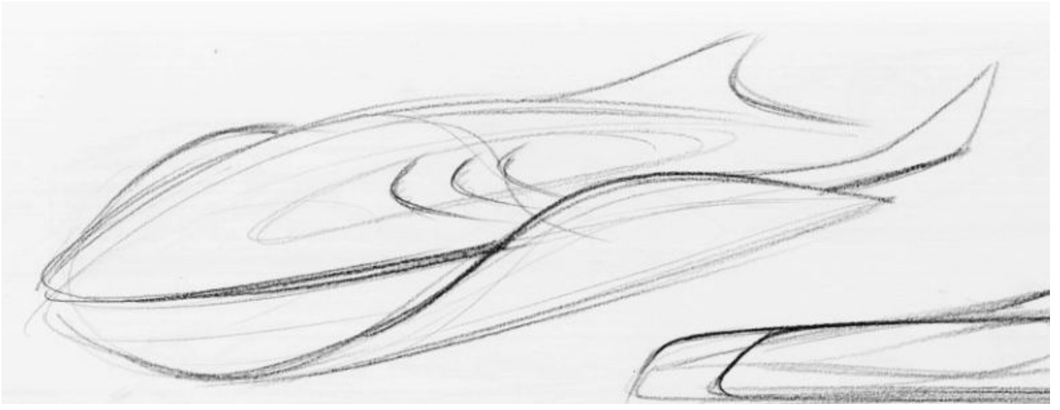


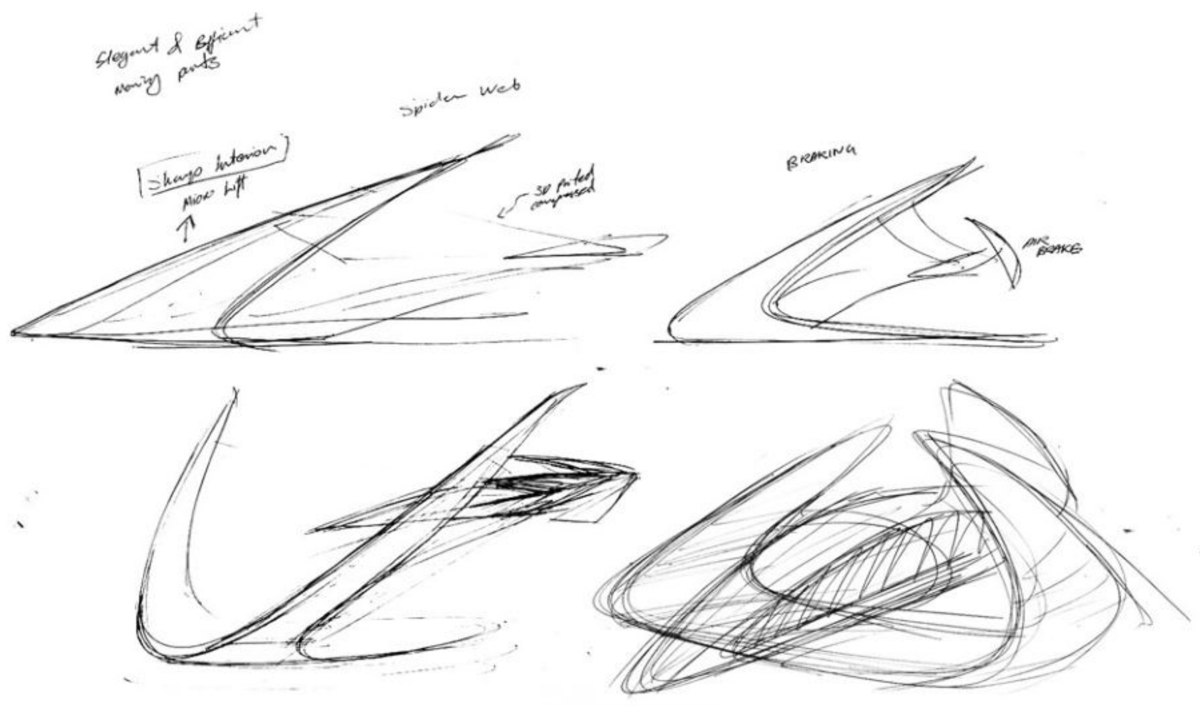
8 CONCEPT DIRECTIONS

8.4 **Motion inspired from nature**

Stingrays fly underwater. The beautifully evolved stingray swims in an almost effortless, elegant fashion, quite similar to flying. This motion has been studied and reflected in the concept direction, which exhibits a wheel-less vehicle.



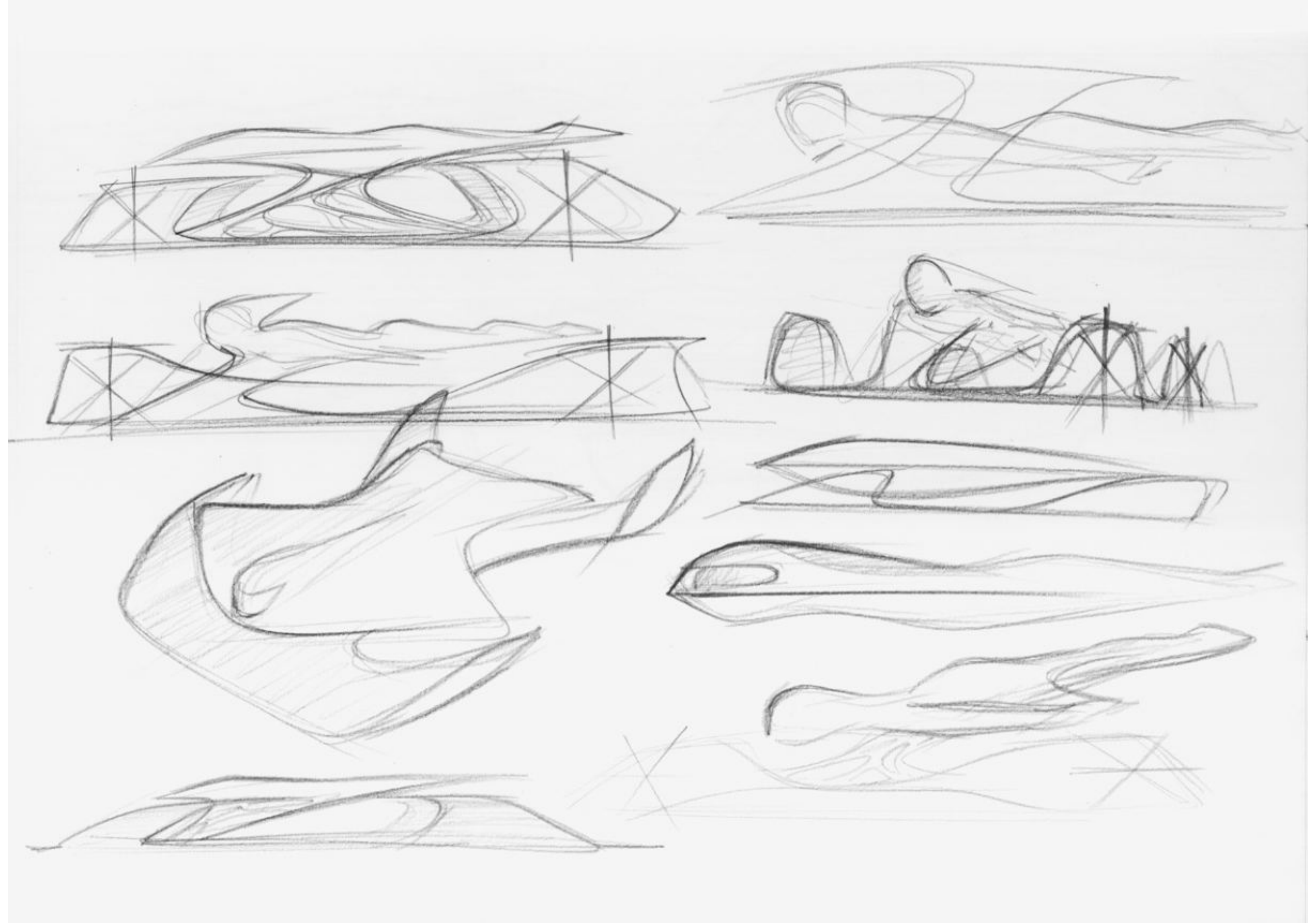




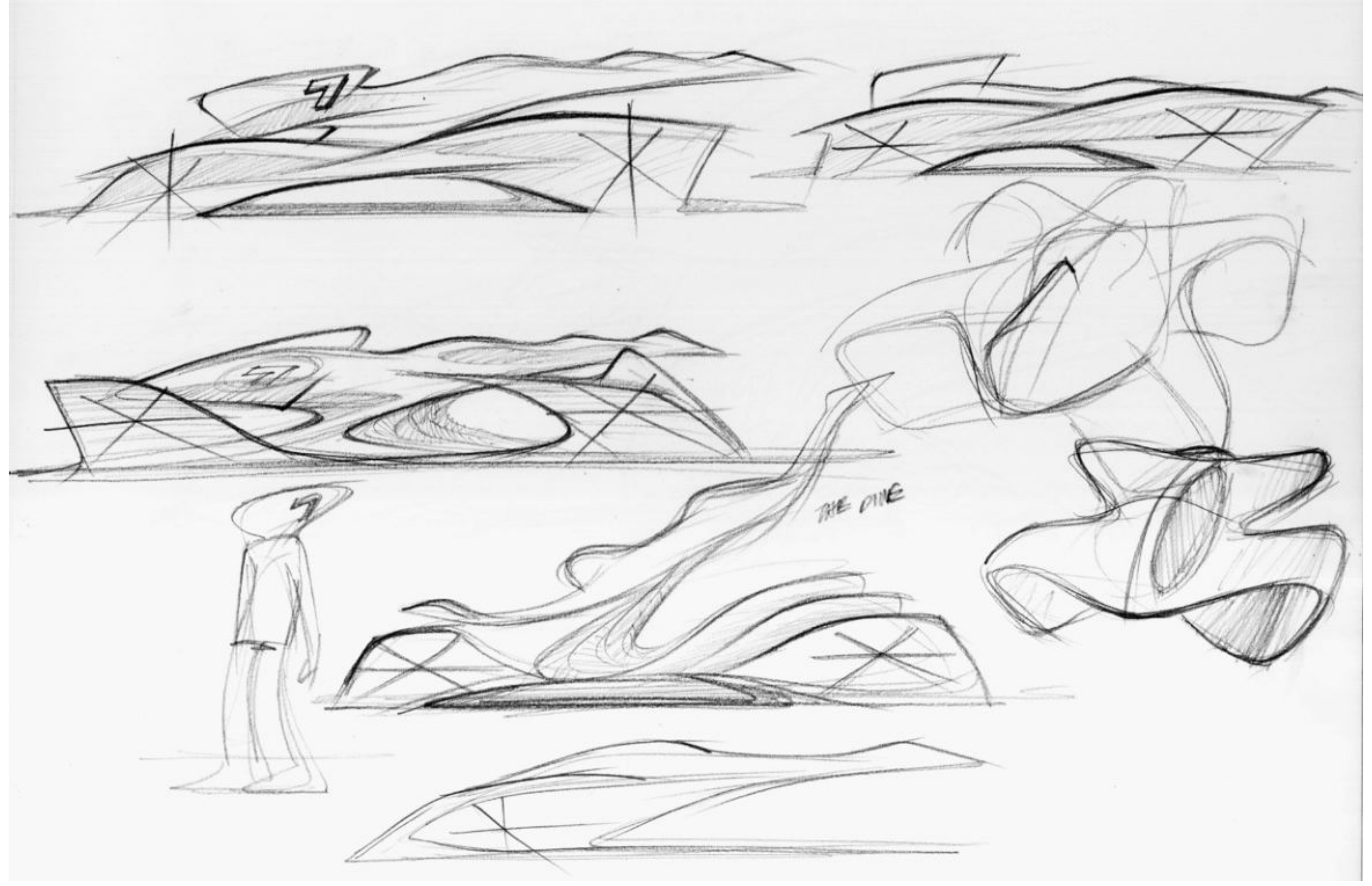
8 CONCEPT DIRECTIONS

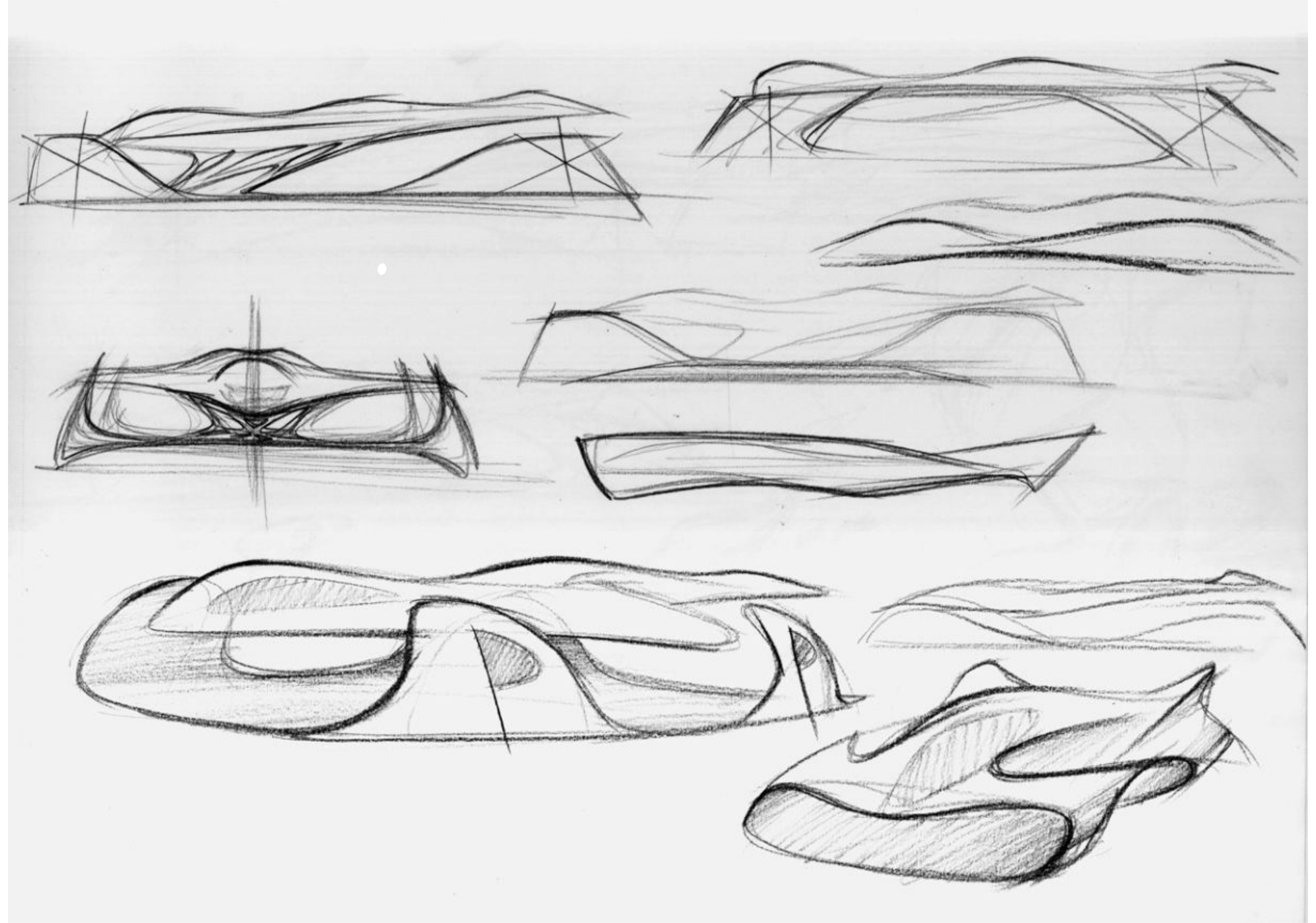
8.5 **Wing-suit/Athlete**

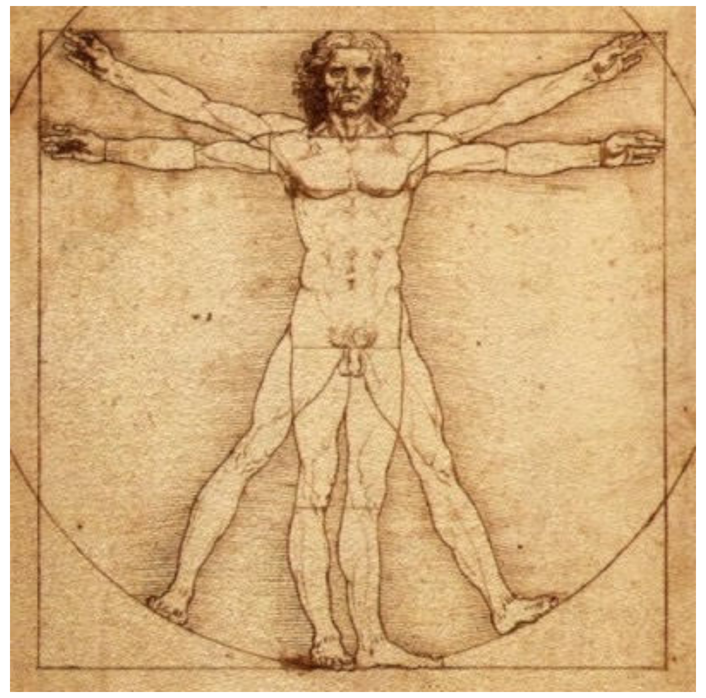
A wing-suit is the closest us humans have to come flying. A very exhilarating and involving experience. When studied alone with athletes and dancers, a new driver experience is born for the Le Mans of 2030. The driver steers the vehicle by articulating his body.



8 CONCEPT DIRECTIONS







8 CONCEPT DIRECTIONS

8.6 **Racing scenario concepts**

According to the theme set for the project, AI plays a huge role in the Le Mans of 2030. Following are possible racing scenarios

8.6.1 **Only AI**

Only AI race at the Le Mans, the race likens to a super futuristic hound race.

8.6.2 **VR**

Democratisation of motorsports. Motorsports is a gentleman's sport now, virtual reality will let anybody race a Le Mans car remotely, even from the comfort of their houses. AI will nanny the racers, making sure accidents are avoided.

8.6.3 **AI & Man**

AI and the human racer drive taking turns. A team of one driver and one AI could pull a stint of 24 hours, requiring no stopping for driver change.

8.7 **Arrival at the final concept**

The nanostructure concept can work complementary to other concepts, as it deals with structural elements. Motion inspired from nature could lead to interesting and functional forms. The wing-suit element adds a new and never before seen aerodynamic advantage to the concept. Also, this concept opens up a new territory of driver inputs and experience.

The final concept is an amalgamation of all the previous concept directions into a single optimum solution.

9 FINAL CONCEPT

Final concept is an evolution of the wing-suit concept. The concept consists of a two wheeled race car, that has nanobot elements that act an interface between the racer and the vehicle. This nanobot act as the active aerodynamics, channeling air though the vehicle for generating downforce and air-braking. The driver inputs are understood by the nanobots and translated into vehicle movement.

9.1 **The Le Mans of 2030: Endurance of man and machine**

Virtual reality has made theatres, physical monitors, advertising obsolete; basically the way we consume and perceive visual data has moved onto the mixed reality realm. Personal transportation has become a service, a direct effect of autonomous vehicles.

Artificial intelligence has matured and has intelligence of a grownup adult. Everyday interaction between human and AI could be comparable to our relationship with smartphones today. Design and engineering is heavily influenced by AI, often giving an alien or rather a whole new perspective to our day to day problems.

The pursuit of perfection has resulted in ever so efficient machines. Man has become even more self conscious and personal healthcare is of paramount importance. Athletes have concurred new zeniths of endurance. A selfish and intimate mode of transport has become the new aspiration of the human psyche.

This is where the Le Mans comes in, the holy mecca of motorsport. New advancement is energy storage and materials have ensured vehicles look like nothing that we see today. Well, at least the wheel hasn’t been reinvented. The race car is designed around the driver. So here is how the race would be like.

9 FINAL CONCEPT

A wing-suit is the closest man has ever come to flying. And now technology lets you fly a car. The racer is suspended on morphing suspended nanobots, capable of adapting to racers of all sizes and sex. At the beginning of the race, cars are parked along the paddock. The racers run in and dive into their cars, like how a competitive diver would gracefully dive off a diving board. This is a futuristic take on the classic Le Mans start. The racer pulls and banks into corners as if he were flying, he stretches and pulls his legs together and makes himself as aerodynamic as possible when he hits the high speed straights. He braces himself and pulls his legs close to his torso while braking. The car slows down at the pits and the supportive nanobots launch the racer out off the vehicle while the vehicle is still in relatively slow motion, letting the driver land in a light sprint, kind off like jumping off a moving bus. The next racer dives straight into the cockpit and continues racing. The racers carry a small backpack, consisting of vital food and fluid supply and most importantly, the battery pack for their stint.

The interface between the racer and car calls for the use of an intelligent material, and here comes in the use of nanobots. They are capable of understanding the racers's intentions and also create a cushioning interface between the racer and the vehicle. The racer's suit has bracing elements that support the racer's body and rids any possibility of fatigue. The suit also incorporates wing elements that provide downforce for the vehicle. At an event of an inevitable crash, the nanobots launch the driver away from danger and away from the track, and the winglets will create a parachute effect while landing. The AI will take over the car and make sure that it is away from all traffic.

9 FINAL CONCEPT

The AI is like the nanny here, it'd make sure crashes are avoided but will never interfere the racer, as a professional racer's will will always be trusted. The AI keeps the car going at pit during driver change and whenever the driver requires rest while on the track. The AI never races, it will never make an aggressive or overtaking manoeuvre, it's more like a race cruse control. It will also track the vitals of the racer and provide the racer with important information and statistics.

Training for the Le Mans will be as a triathlete would, immensely gruelling. Training rigs with VR input could almost simulate lifelike simulation for training purposes.

The race becomes more of a test of human endurance as technology has evolved to a point of sustainable efficiency.

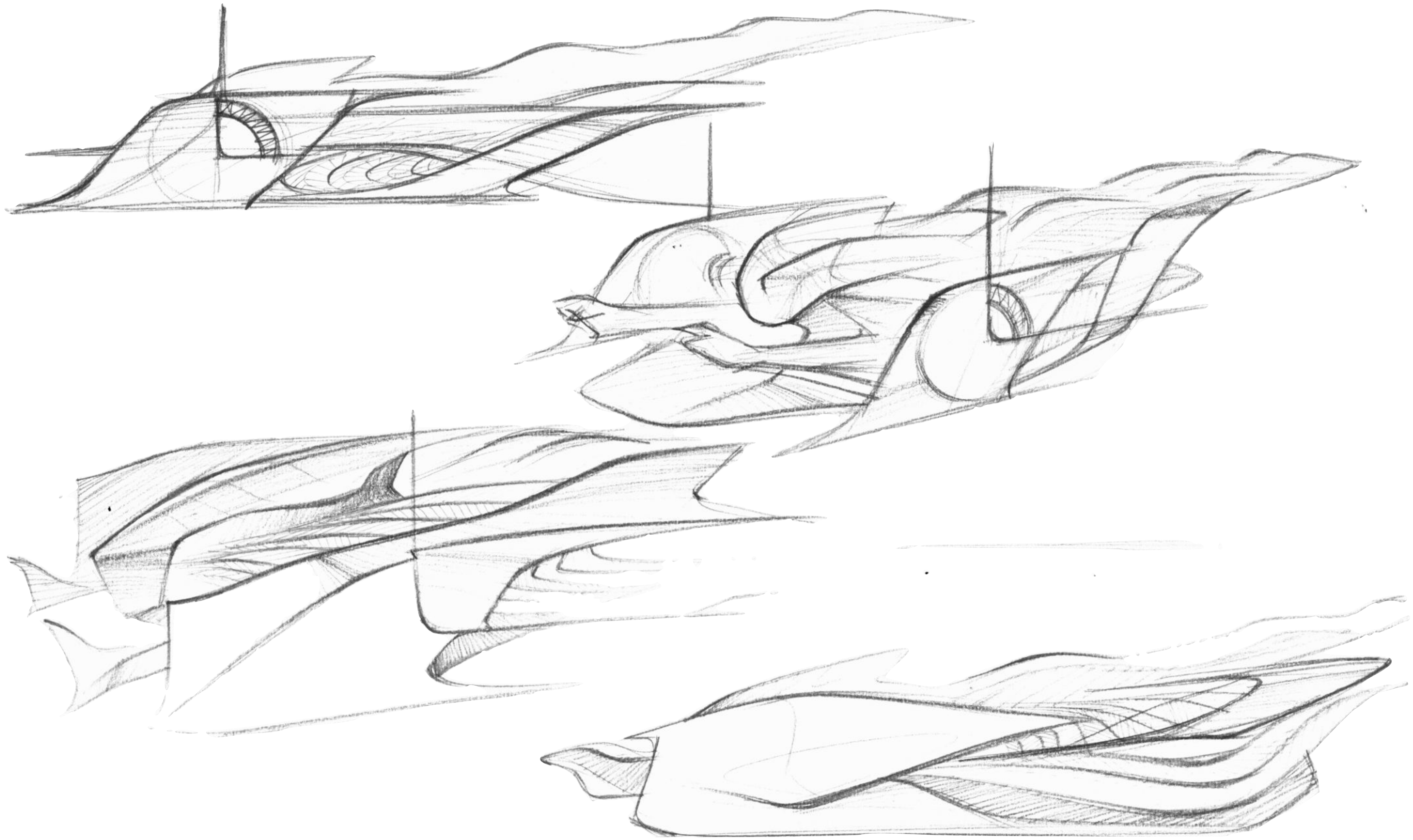
9 FINAL CONCEPT

9.2 Mood-board for final concept

Following is the mood-board for the final concept.

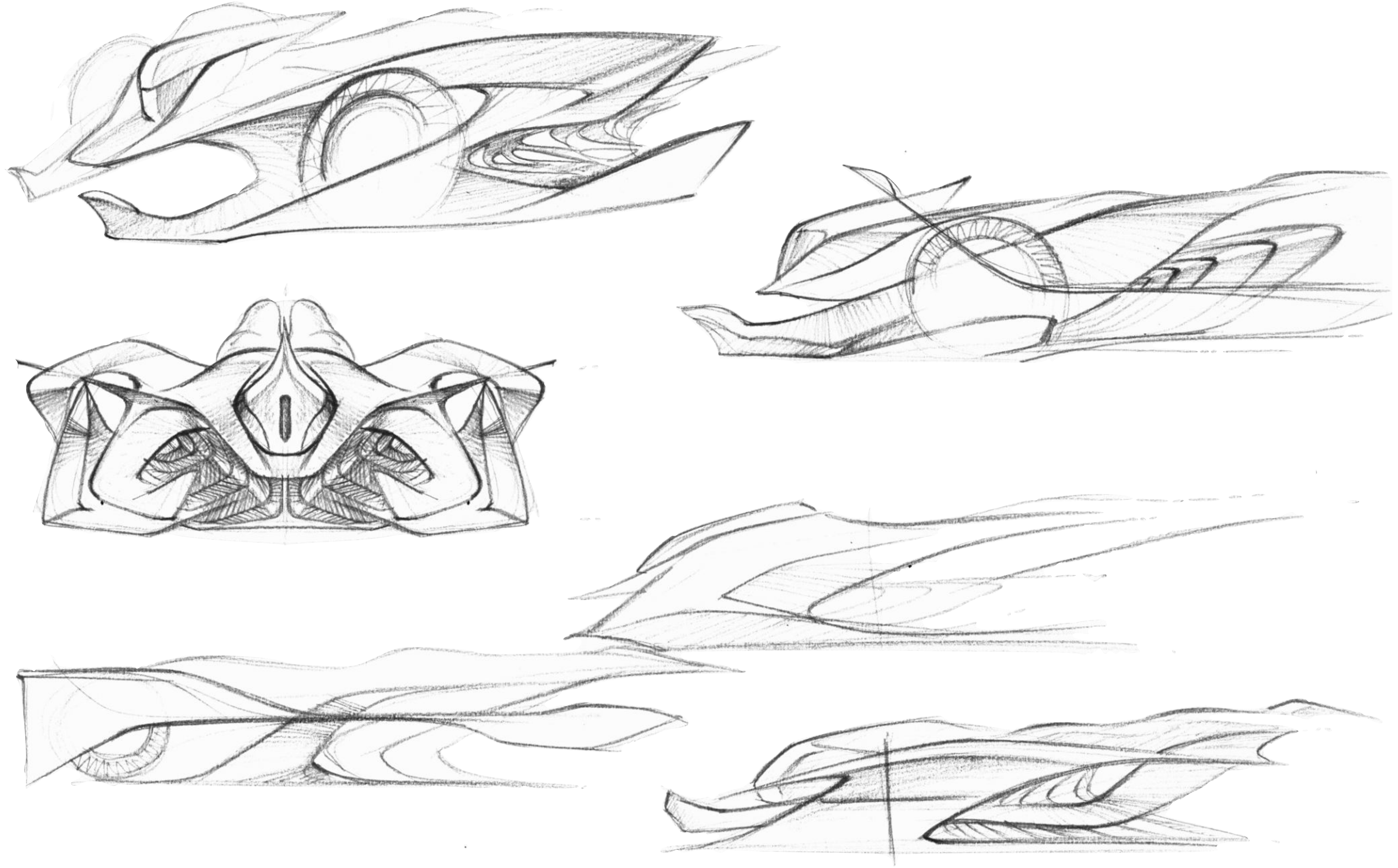
9 FINAL CONCEPT

Exploratory sketches of final concept.



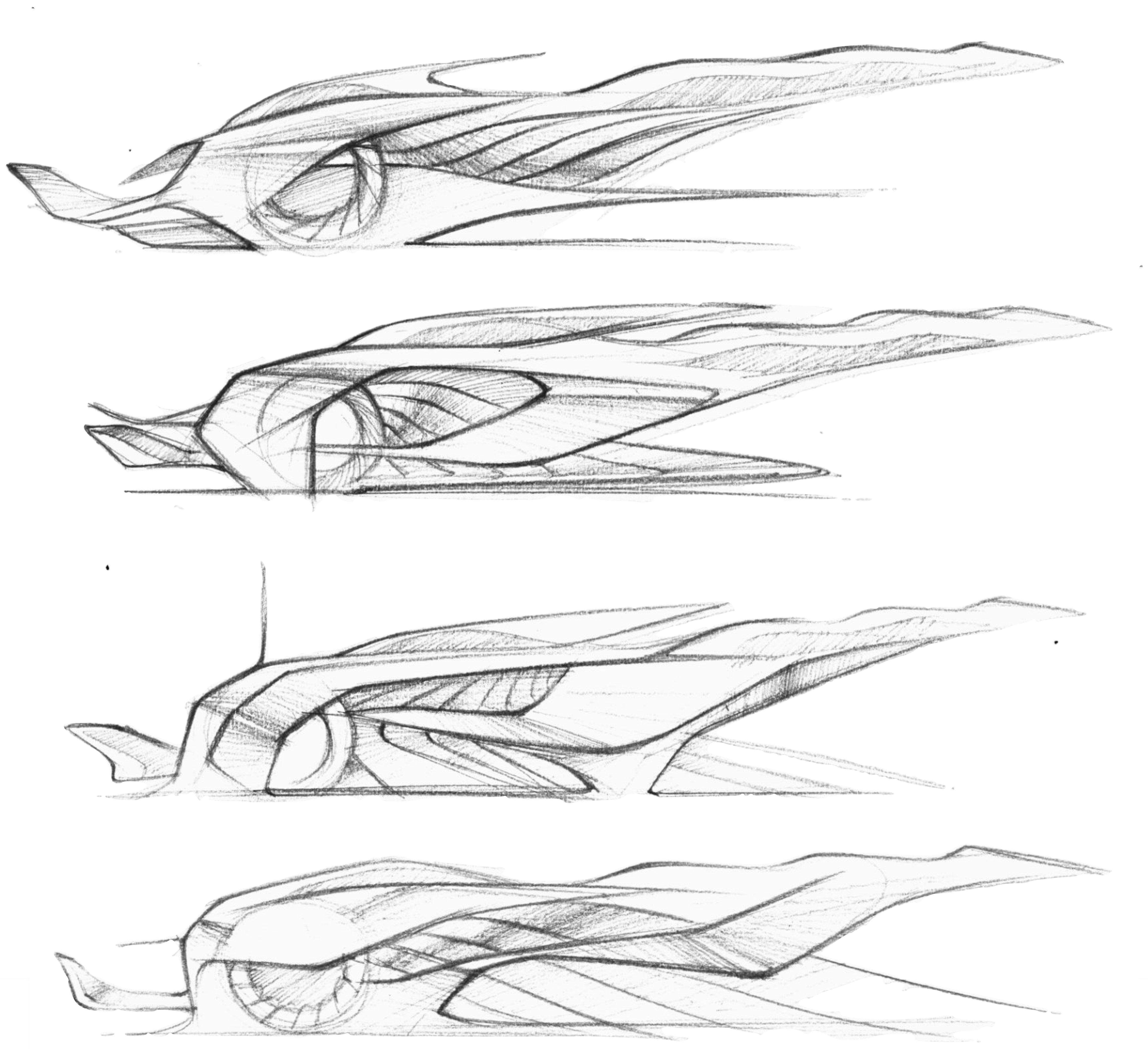
9 FINAL CONCEPT

Exploratory sketches of final concept.



9 FINAL CONCEPT

Side view iterations.

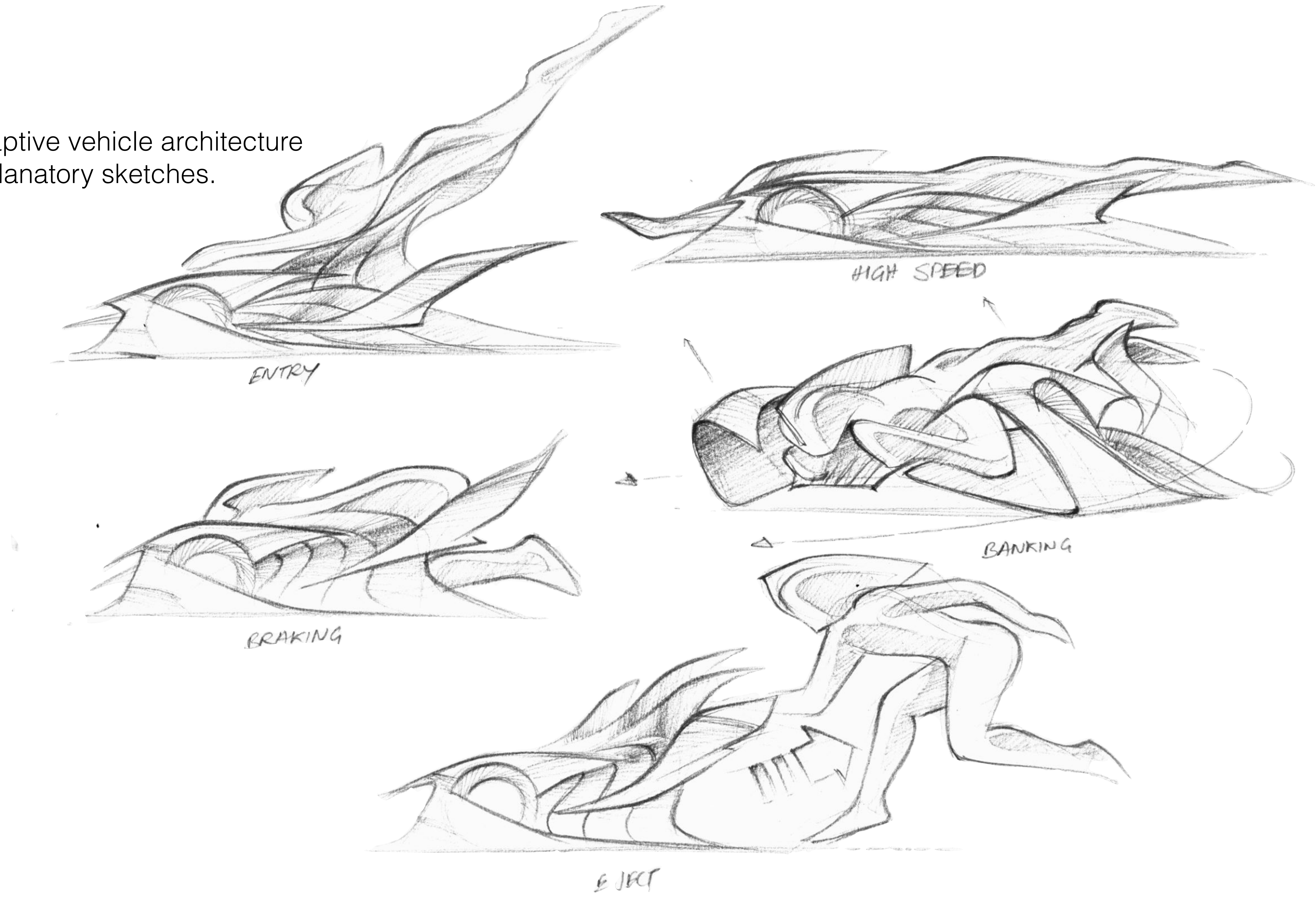


9 FINAL CONCEPT

Refinement sketches.

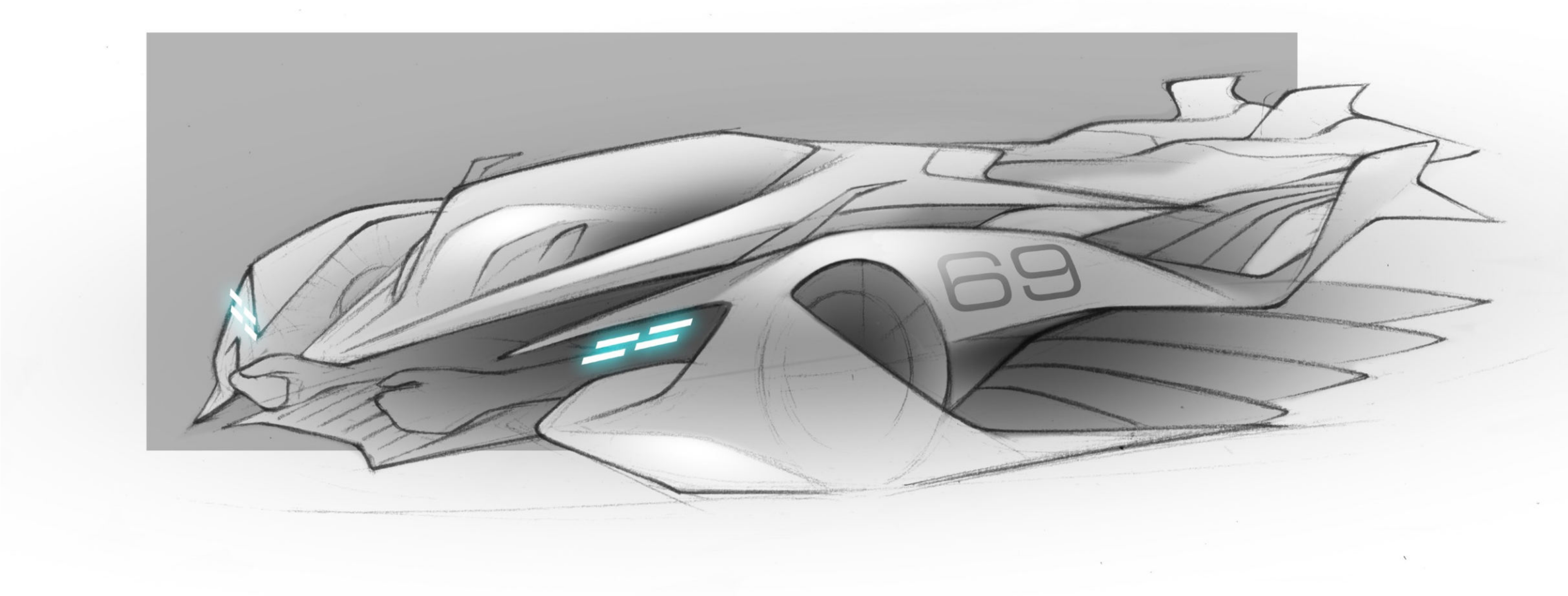
9 FINAL CONCEPT

Adaptive vehicle architecture explanatory sketches.



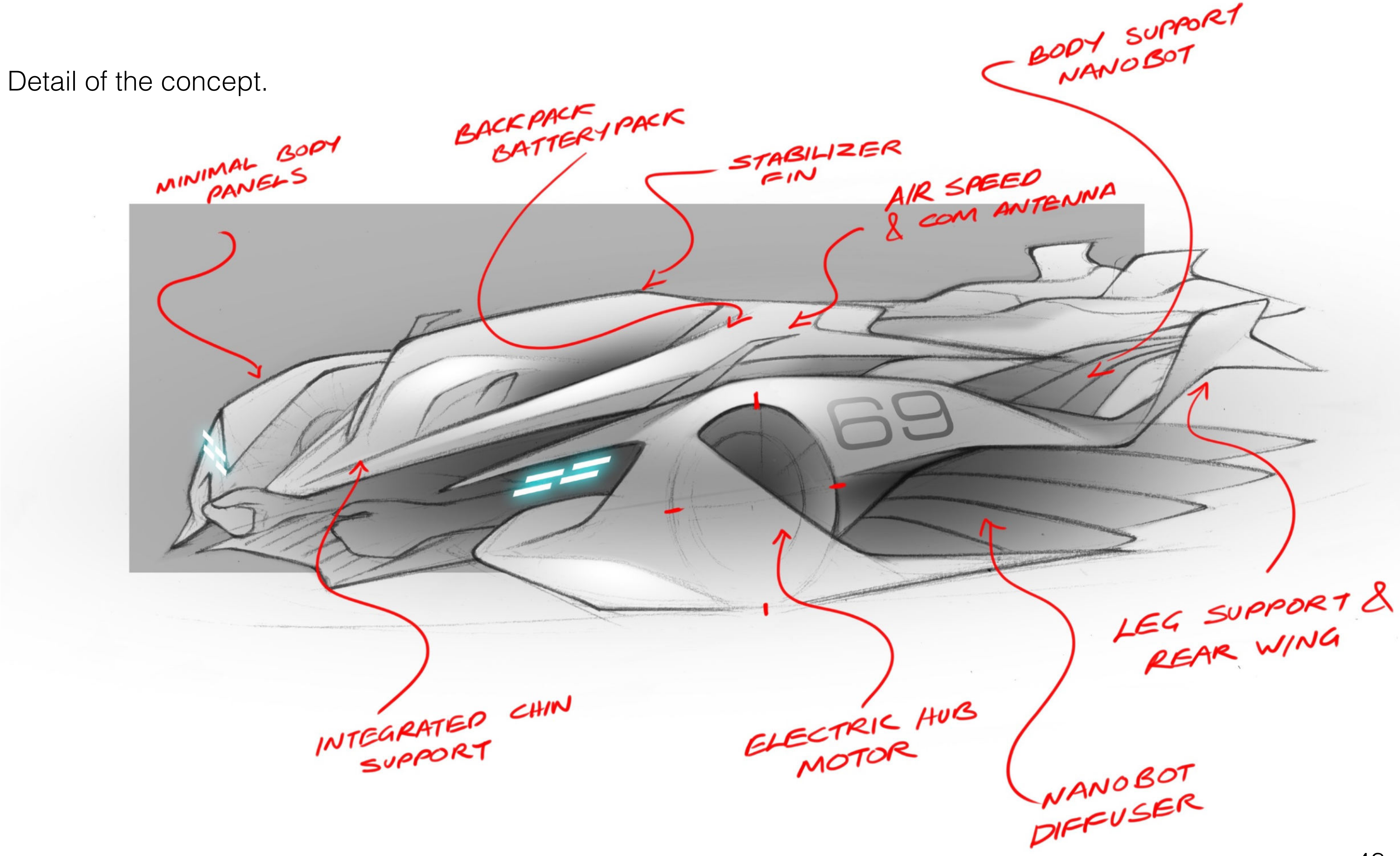
9 FINAL CONCEPT

Front 3/4 view.



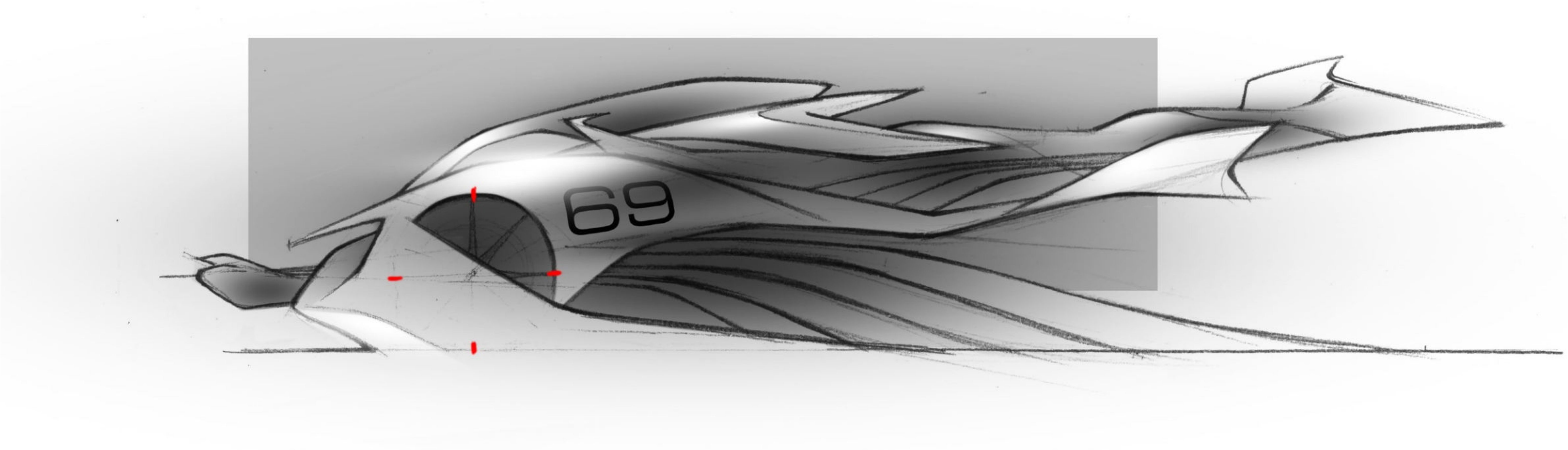
9 **FINAL CONCEPT**

Detail of the concept.



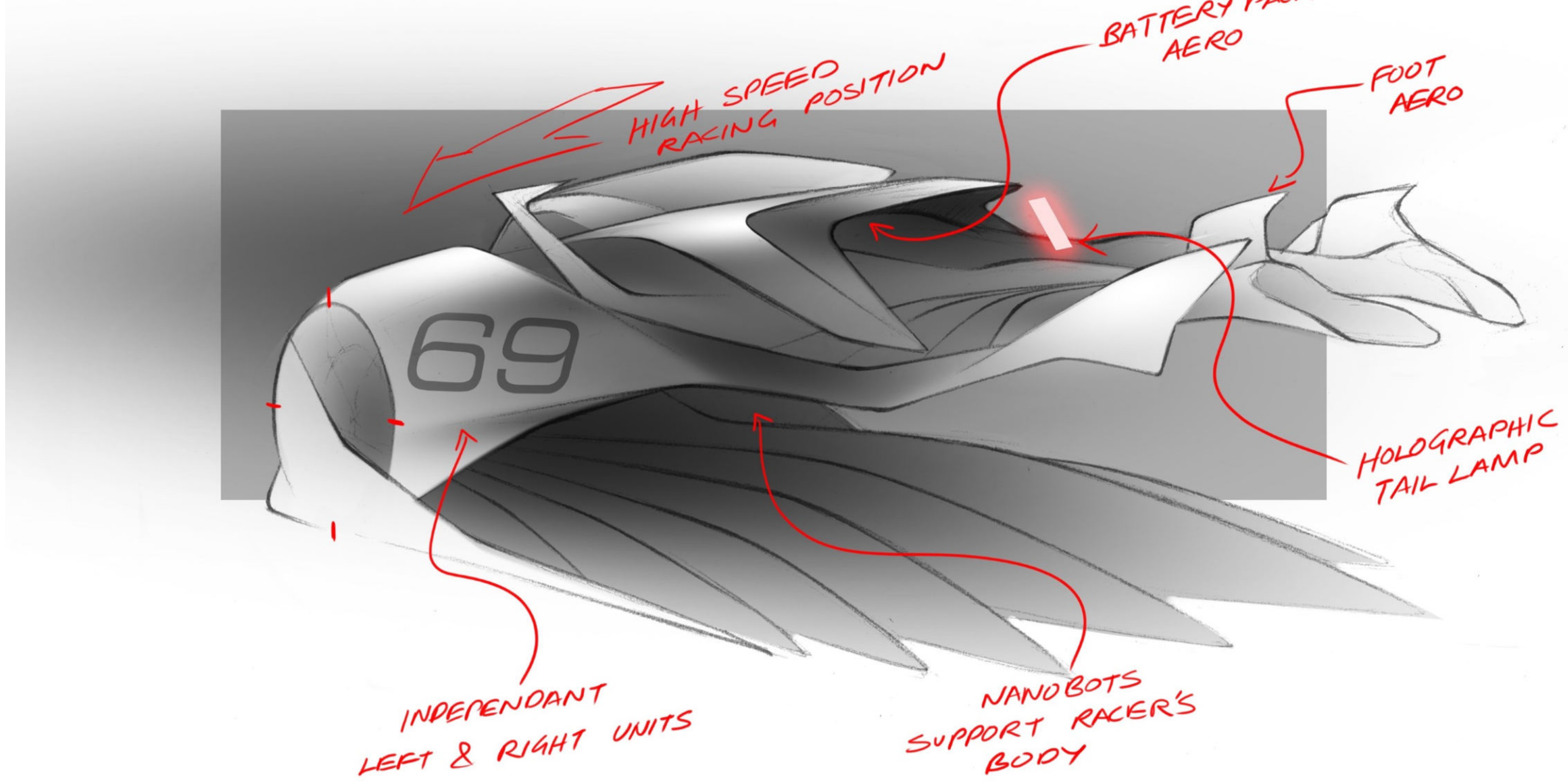
9 FINAL CONCEPT

Side view.



9 FINAL CONCEPT

Rear 3/4 view.



9 FINAL CONCEPT

9.3 **Ergonomic study**

The concept revolves around a unique wing-suit inspired driving position. The racer is set very low in the vehicle to reduce the CG of the vehicle. This driver position is inherently more aerodynamic thanks to it's wing-suit origins.

Driver position mockup helped understand various discomfort caused to the human body due to this abnormal position. Considerable cushioning was required at the chest area. A gentle chin support would reduce the stress on the neck muscles. A VR display of the road ahead could mean that the driver can relax his neck and look down while still maintaining a good view of the track ahead.

9.4 **The racers**

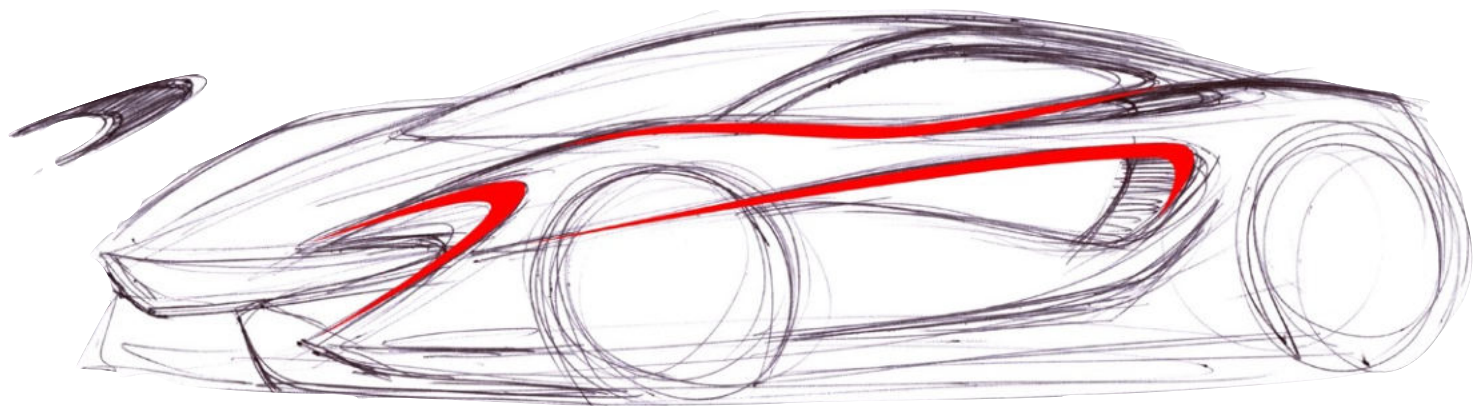
Concept sketches for male and female racer.

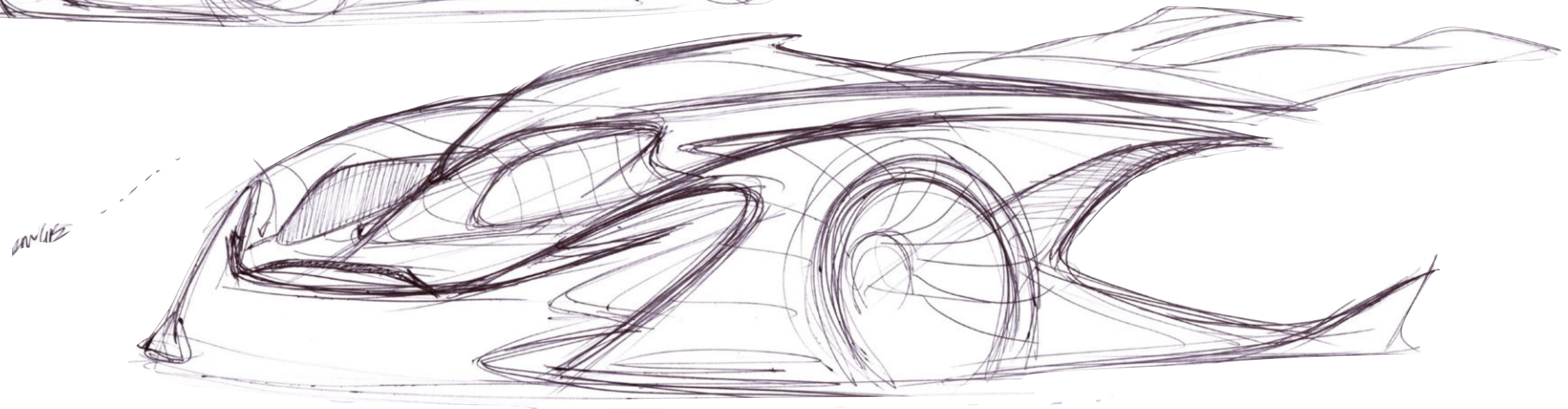
Racer experience and a new kind of driver input method unlike the traditional pedal and steering input, will be studied further and elaborated.

9.5 **Brand study**

McLaren Automotive relaunched itself as a standalone luxury sports car manufacturer in 2010. The company gained it’s reputation through their respectable performance in Formula 1. The LM GTE Pro class, known for race cars based on production road going race cars is imagined as a fitting class for McLaren Automotive to show off their technological prowess in the year 2030.

McLaren 570S
https://en.wikipedia.org/wiki/File:McLaren_570S_1.jpg

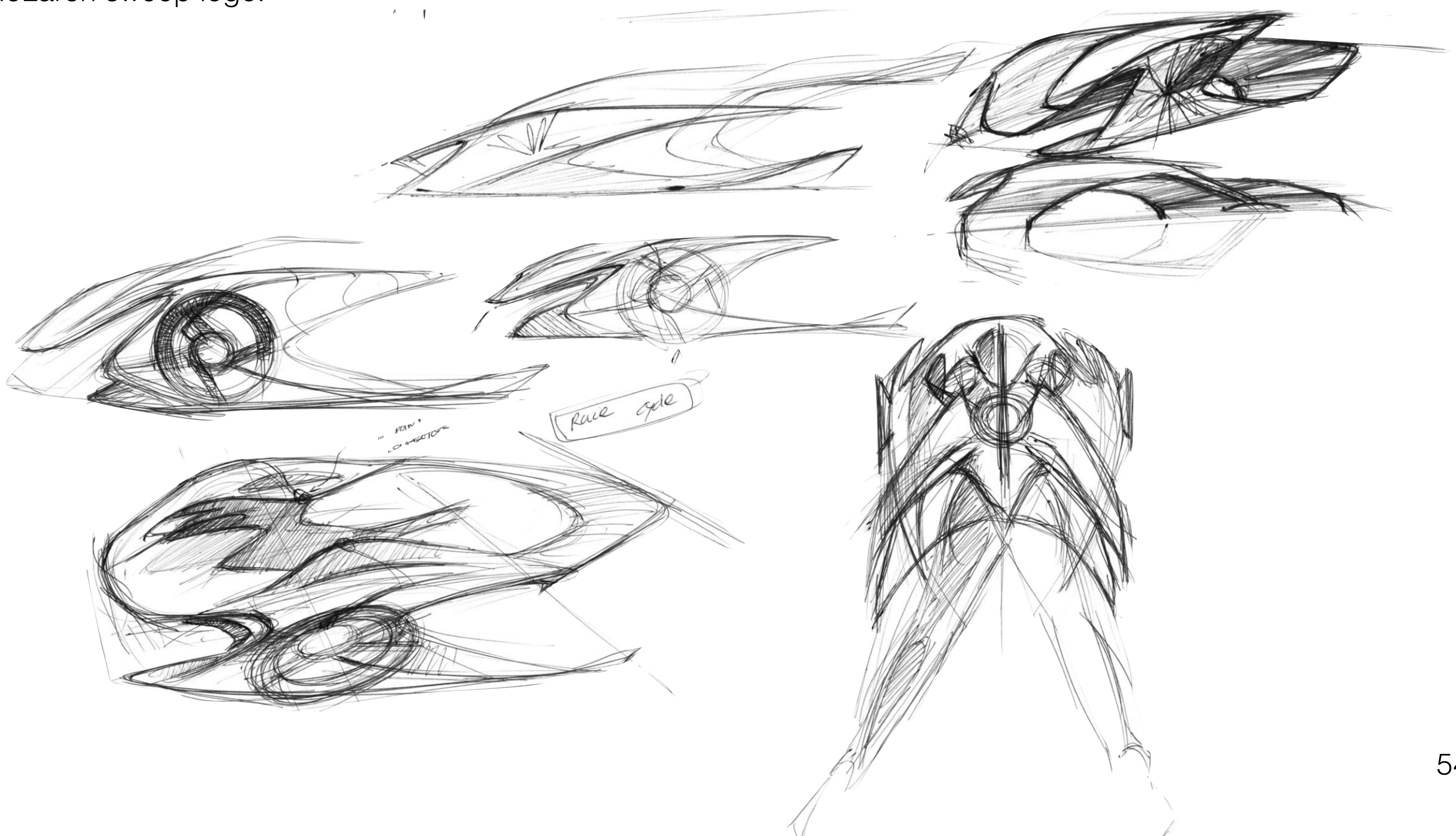




9 **FINAL CONCEPT**

McLaren cars of today are characterised by soft surfaces with the swoop character, inspired from the McLaren swoop logo.

This theme was retained and experimented in both soft and sharp treatments.



9 FINAL CONCEPT

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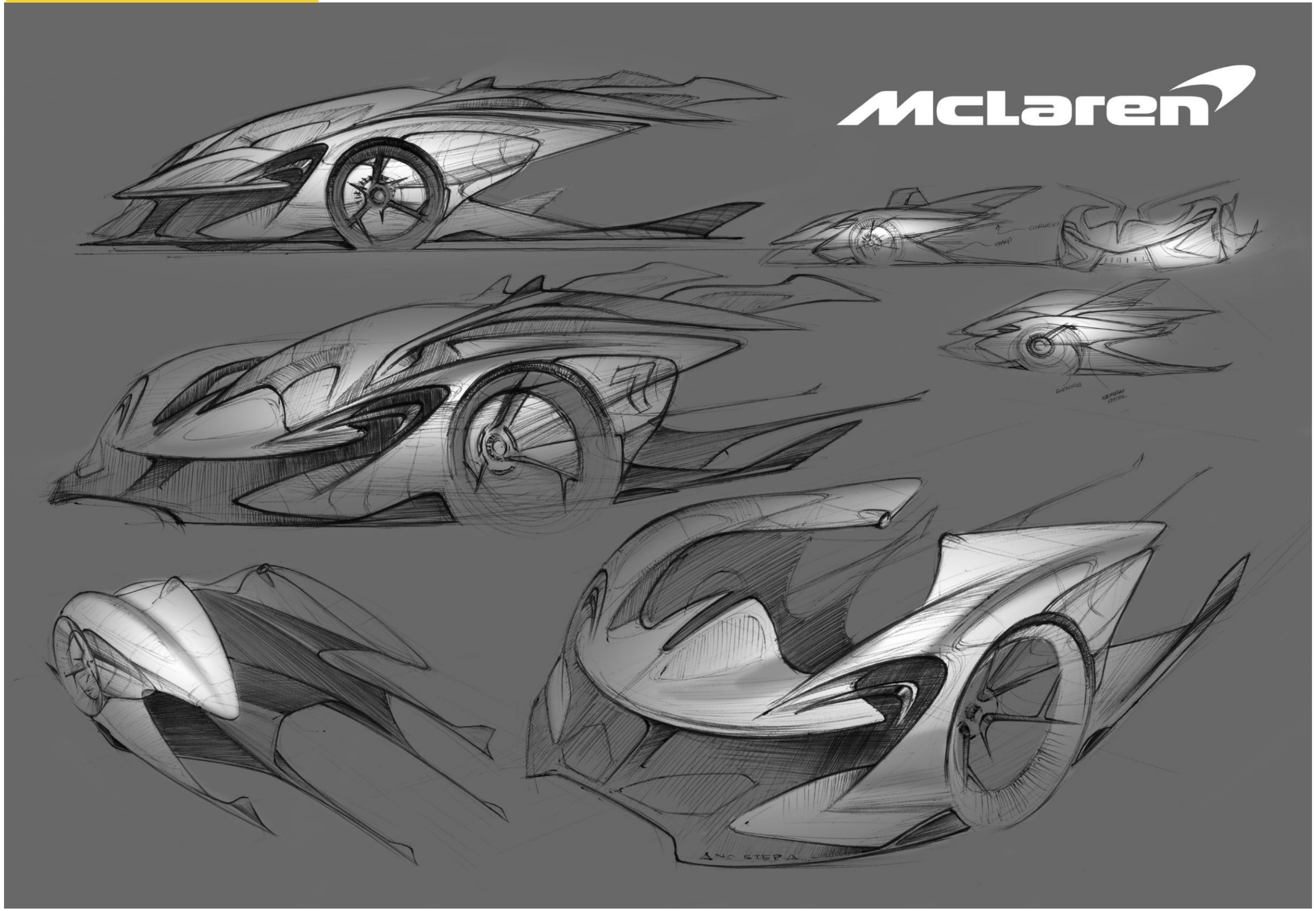
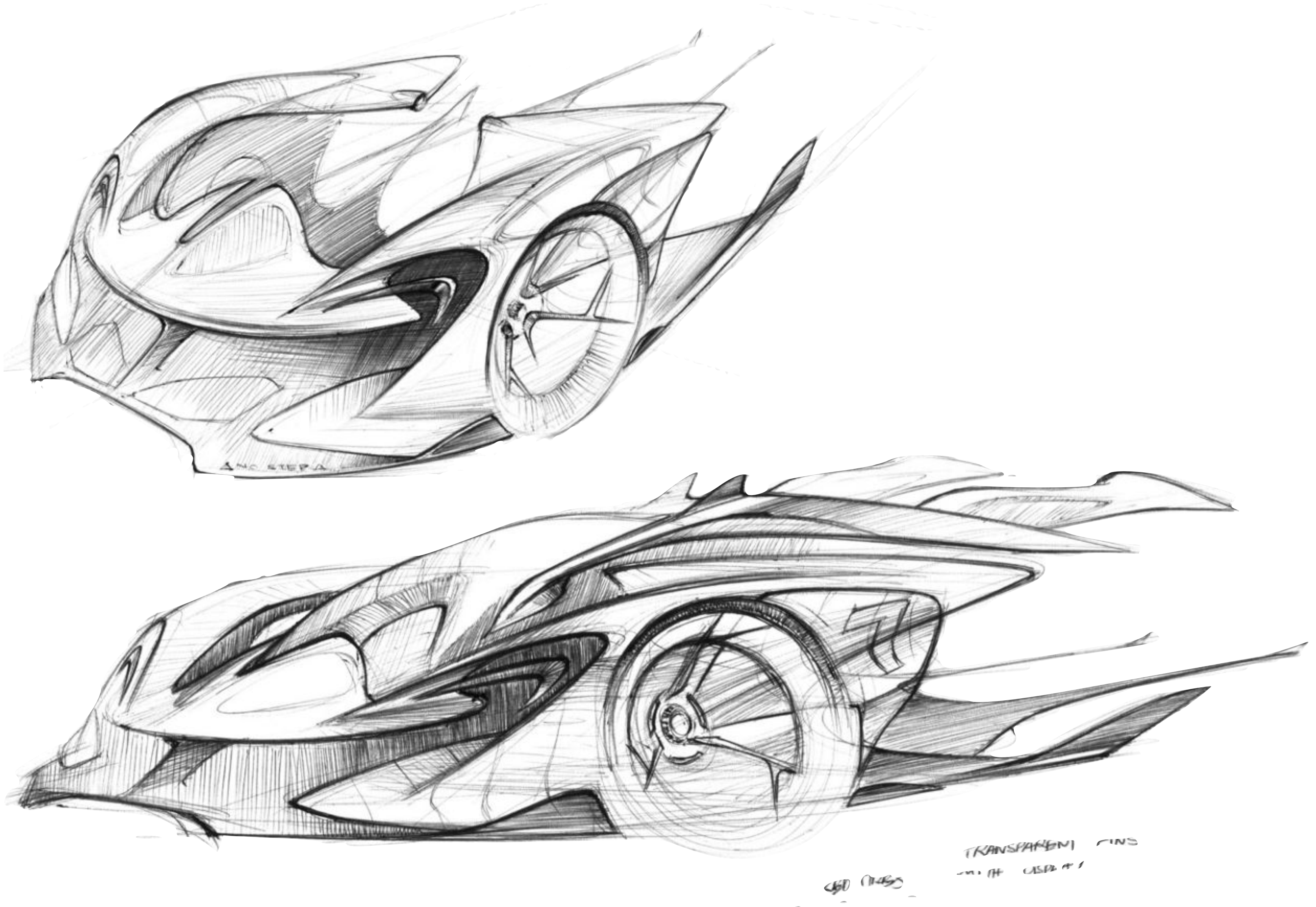


9.6 Self evaluation of design

It was realised that the design had heavy resemblance to the McLaren P1, especially the front facia and the surface treatment.

McLaren P1
http://st.motortrend.com/uploads/sites/5/2013/10/2014-McLaren-P1-outside-factory-right-front-close-up-1.jpg

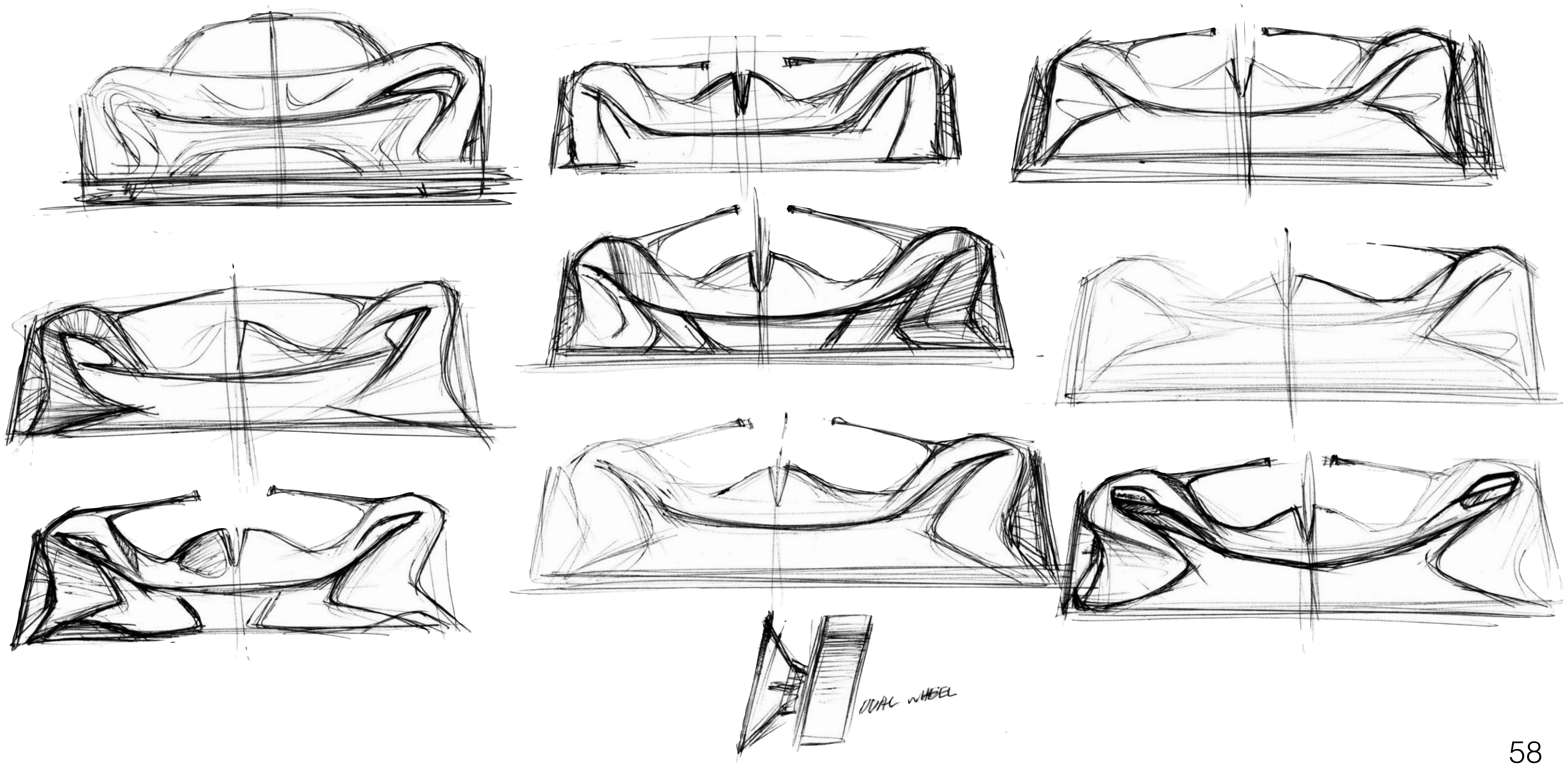
Moreover, by 2030, the design would obviously evolve, so the front facia and a more contemporary treatment was explored.



Heavy resemblance of the front facia with the McLaren P1

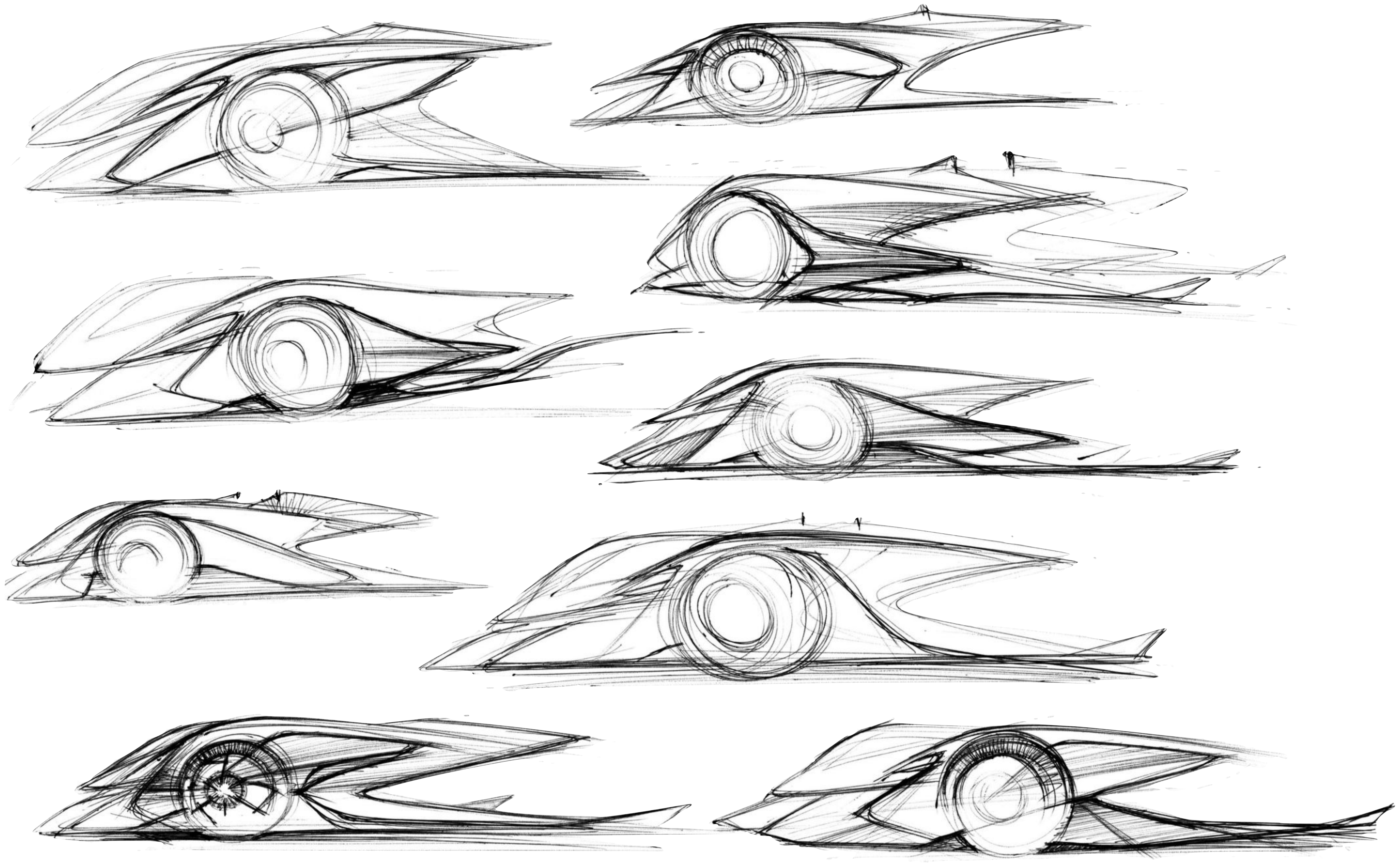
9 FINAL CONCEPT

Development of front facia



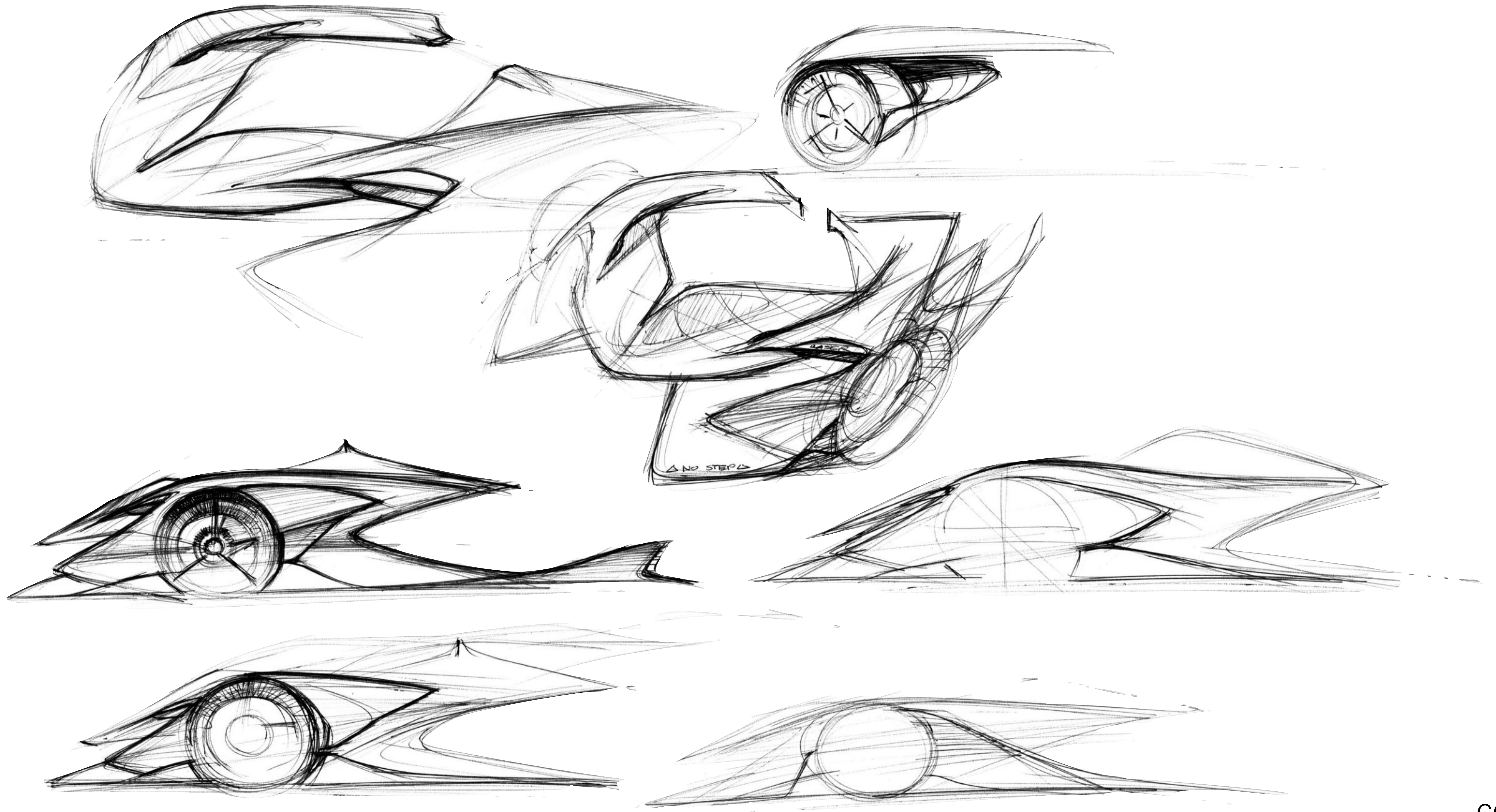
9 FINAL CONCEPT

Further development of side view



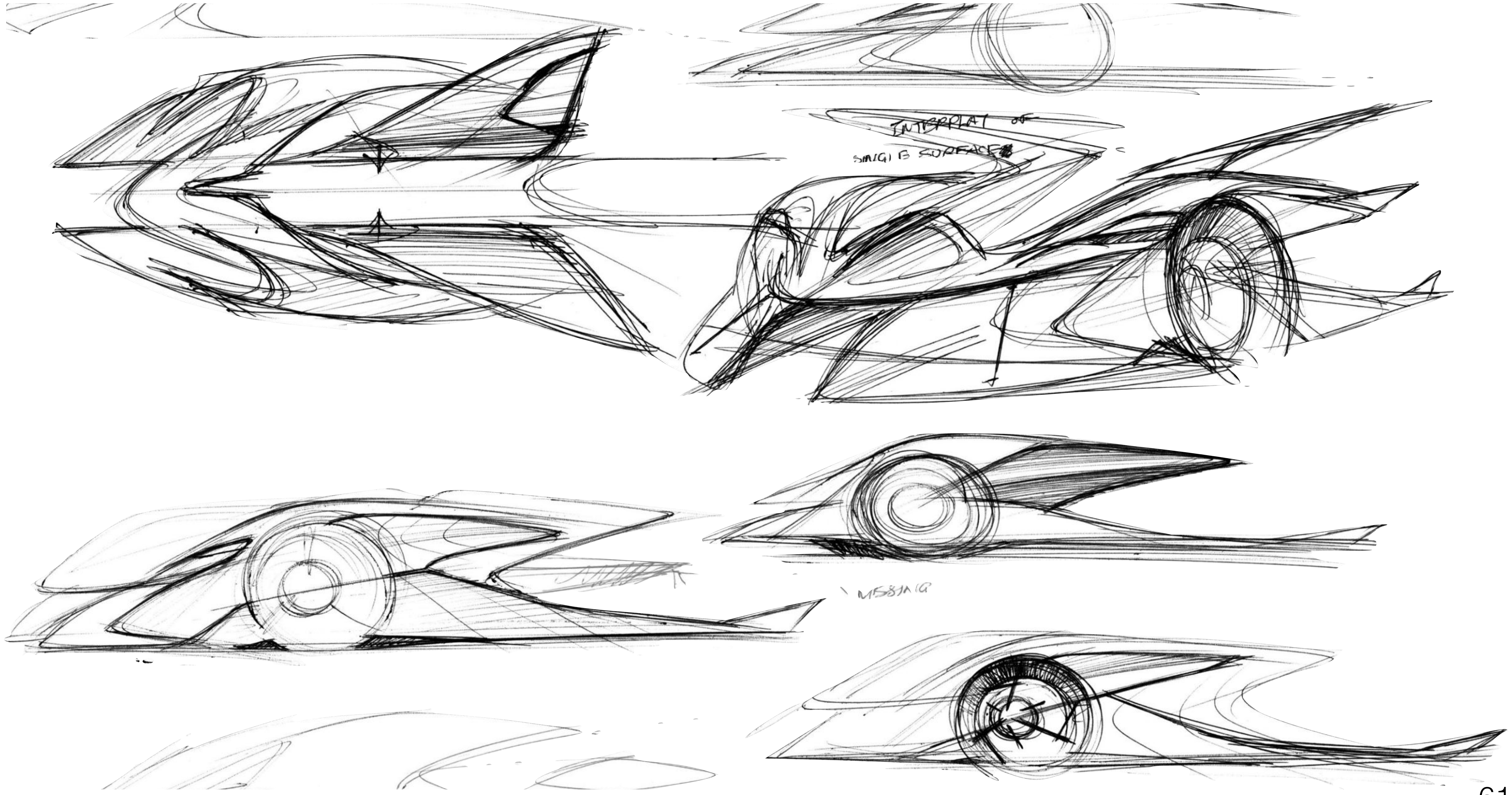
9 FINAL CONCEPT

Further development of front and top views



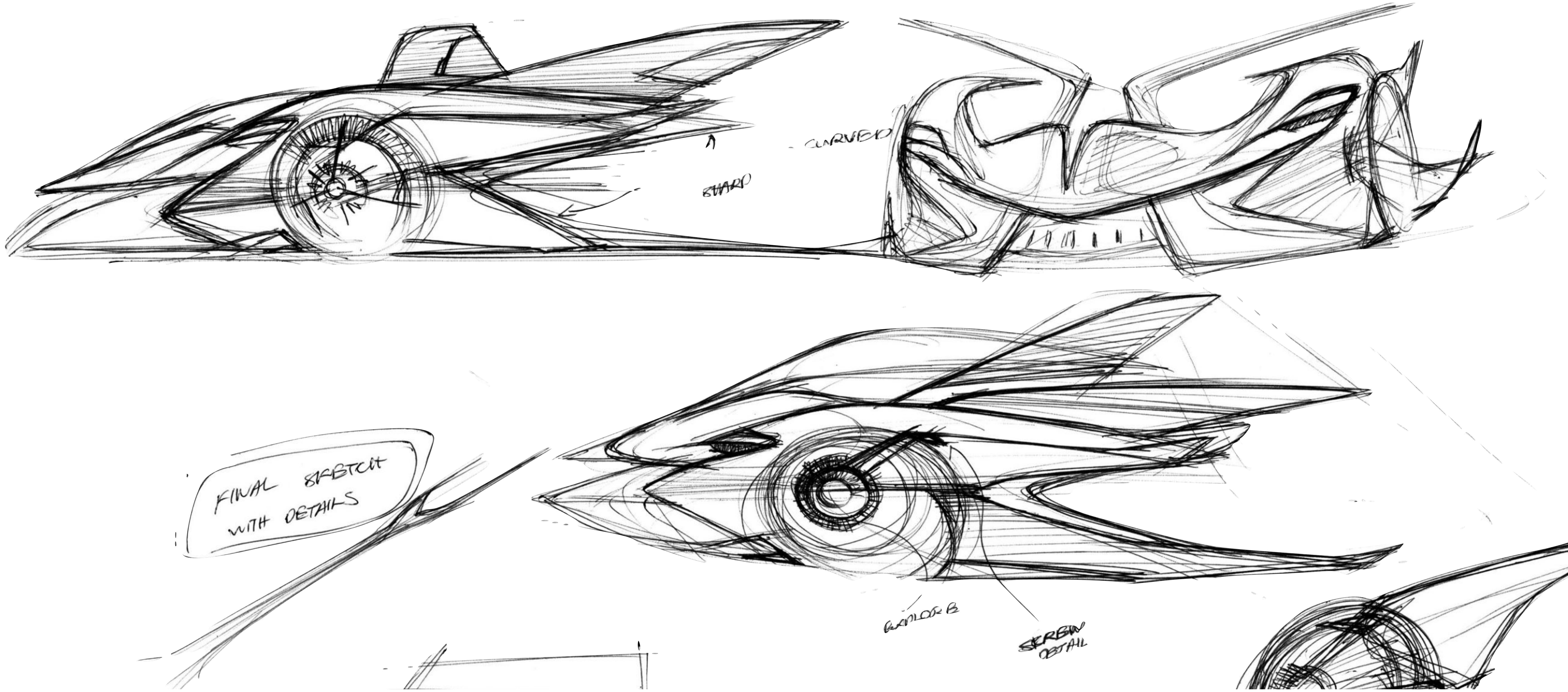
9 FINAL CONCEPT

Further development of front and top views



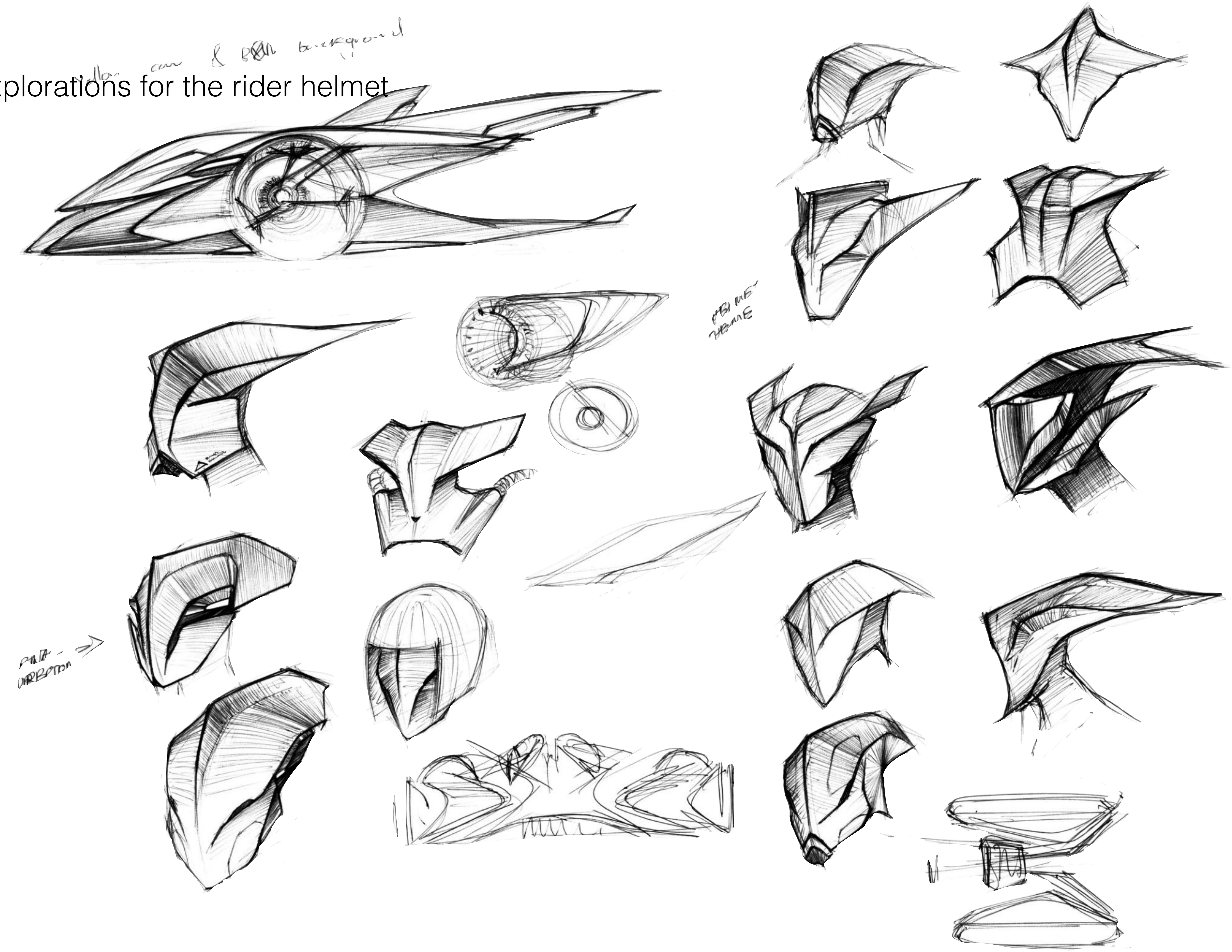
9 **FINAL CONCEPT**

Further development of front and top views



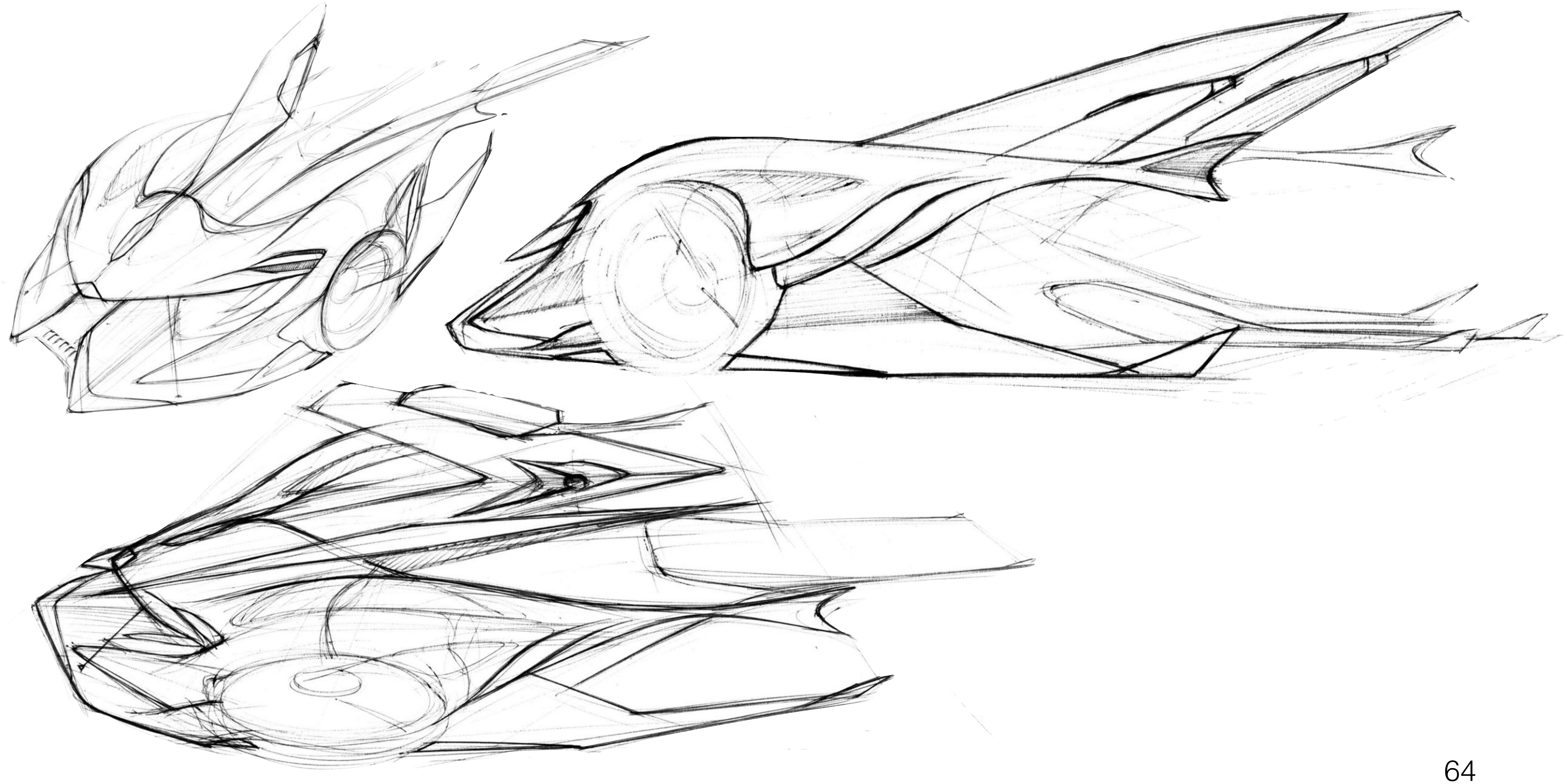
9 FINAL CONCEPT

Form explorations for the rider helmet



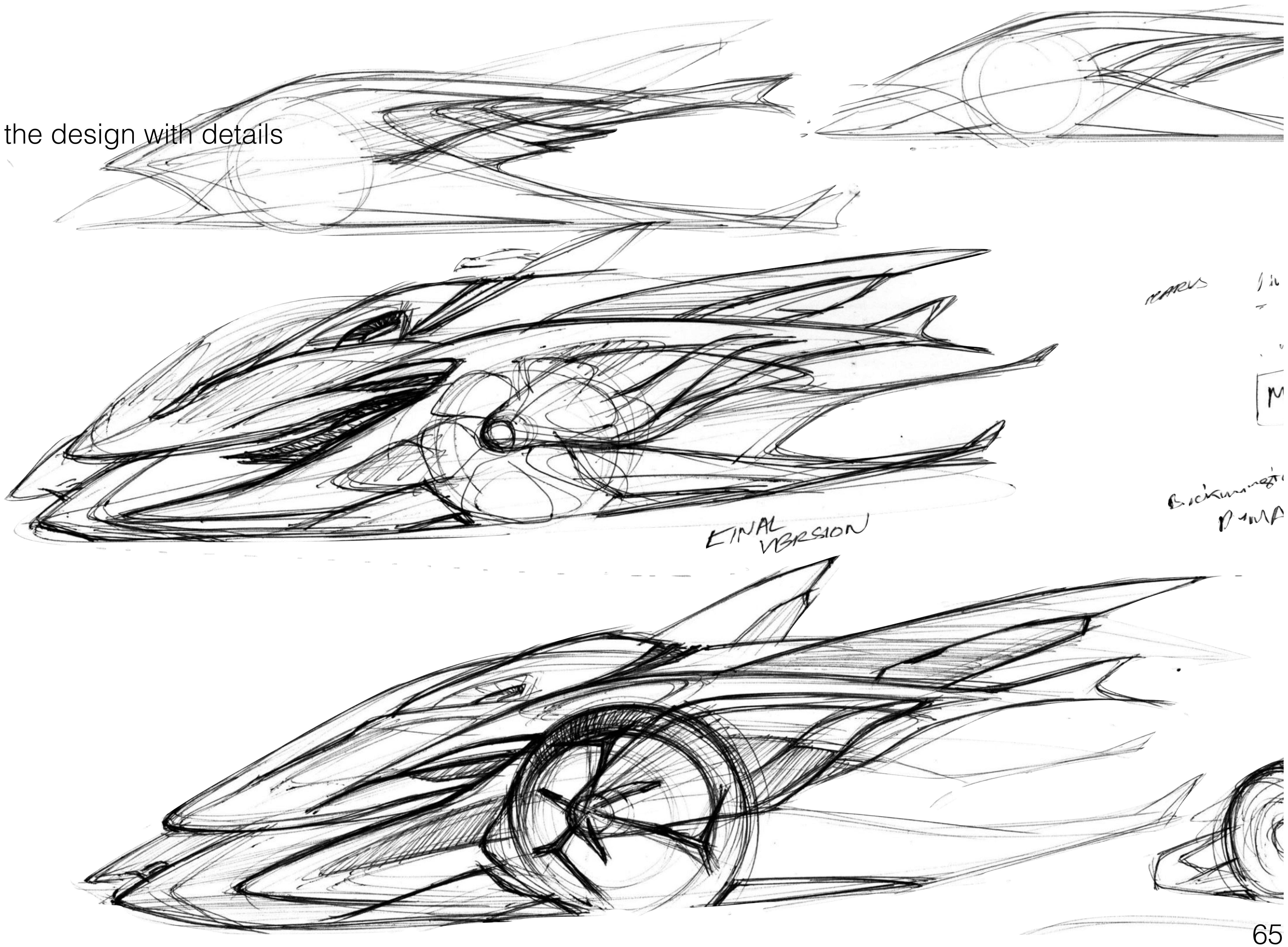
9 FINAL CONCEPT

Resolving the design with details



9 FINAL CONCEPT

Resolving the design with details

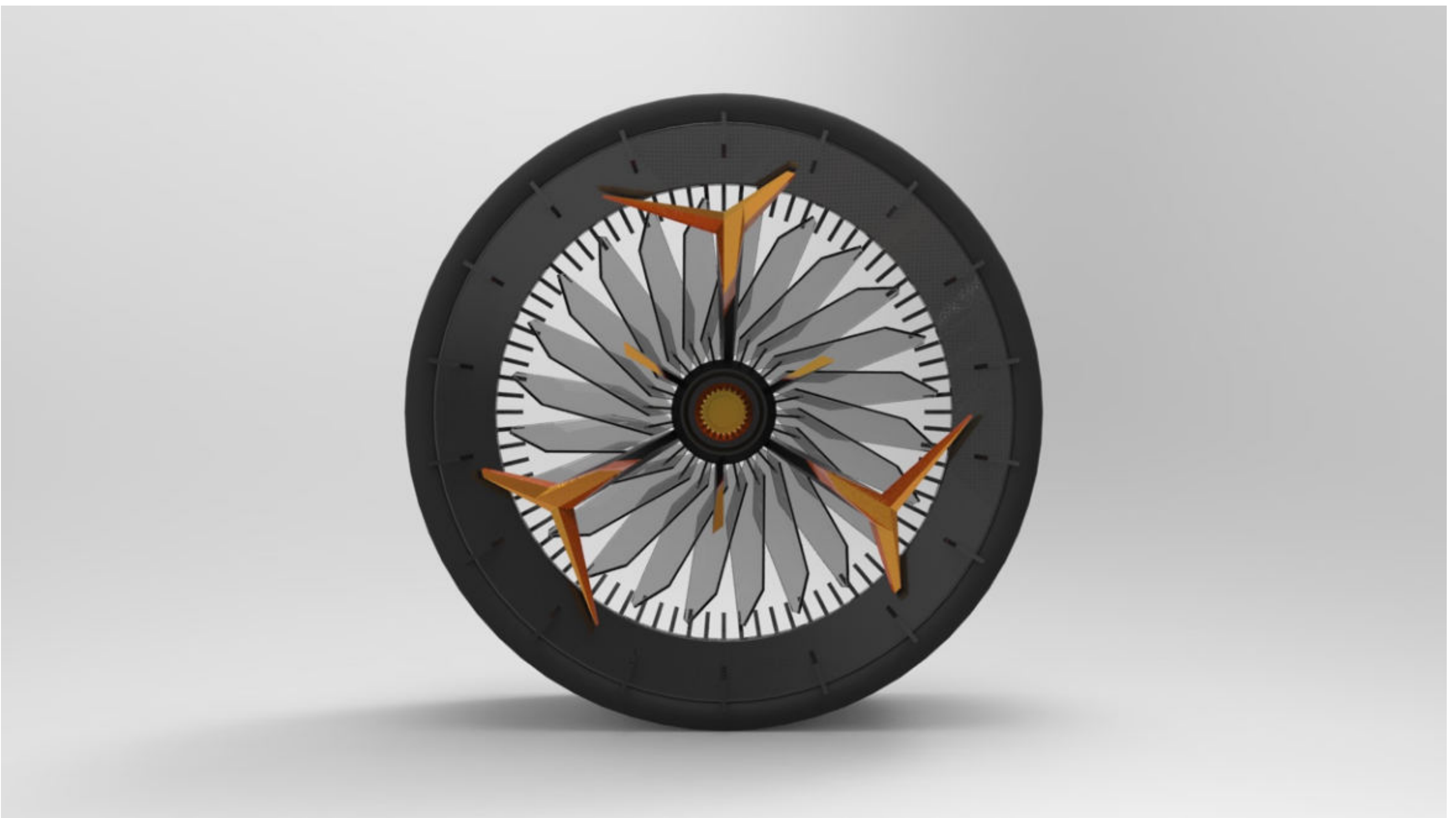


9 FINAL CONCEPT

9.7 **Wheel design**

The wheel design is inspired by a DC electric motor. Here the wheel is imagined as if it were an exploded view of a DC motor. The hub of the wheel remains static, while the rim is the electromagnet armature.

The electromagnetic field generated also acts as a magnetic suspension. The central transparent fins push turbulent air away from the wheels also cooling the motors and the brakes in the process.



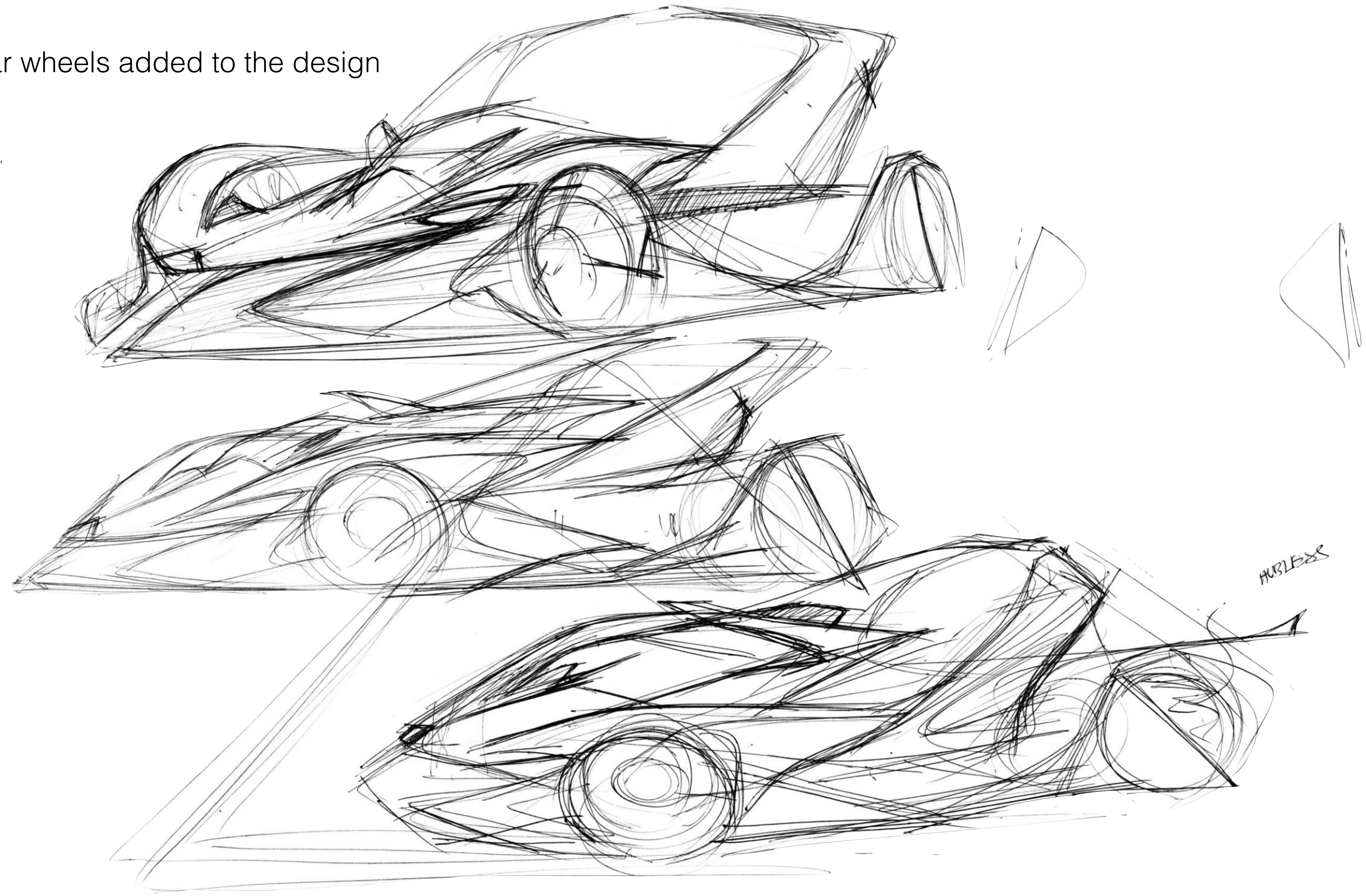
9.8 **Peer review and self evaluation of design**

The lack of rear wheels was one of biggest concerns brought up during the peer evaluation. It was realised that the design no more resembled a car. Also the wing element looked comical and did not gel in with the rest of the design. One of the classmate felt that it looked like a chopped car.

These feedbacks were taken into consideration and a new image board was created. The concept felt strong, but the design seemed to hold it back. A back to the drawing board method was undertaken, but without killing off the original concept.

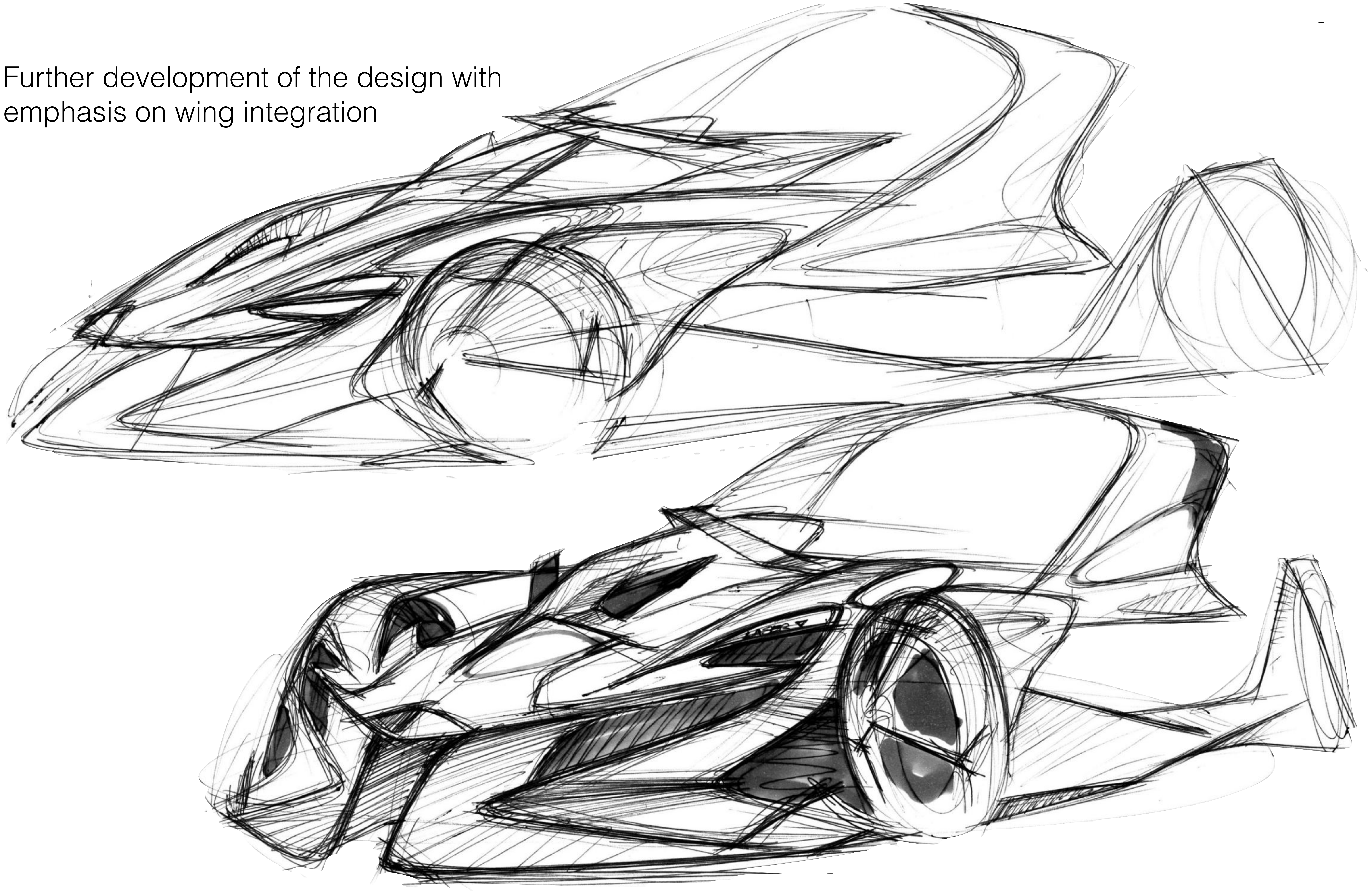
9 FINAL CONCEPT

Rear wheels added to the design



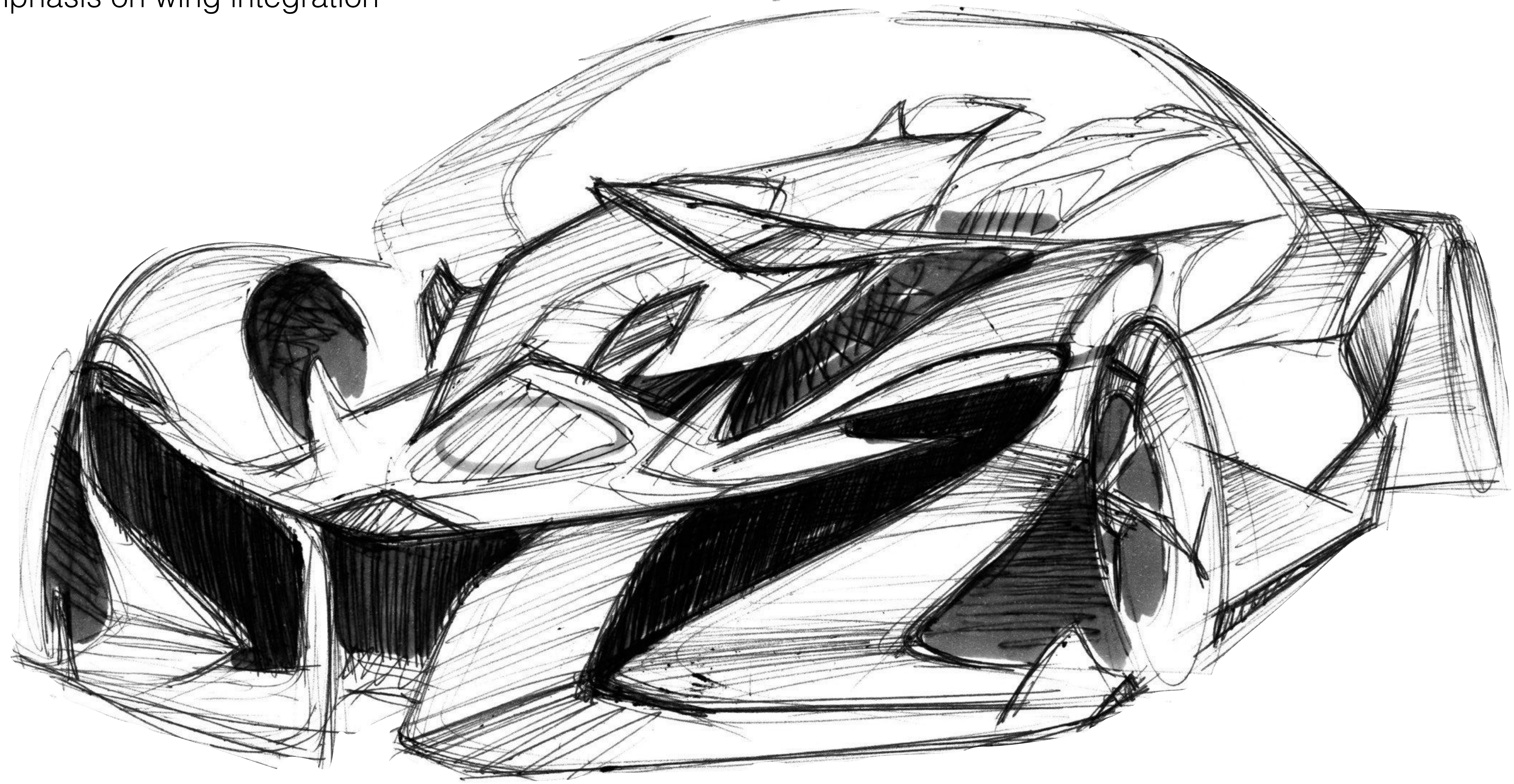
9 FINAL CONCEPT

Further development of the design with emphasis on wing integration



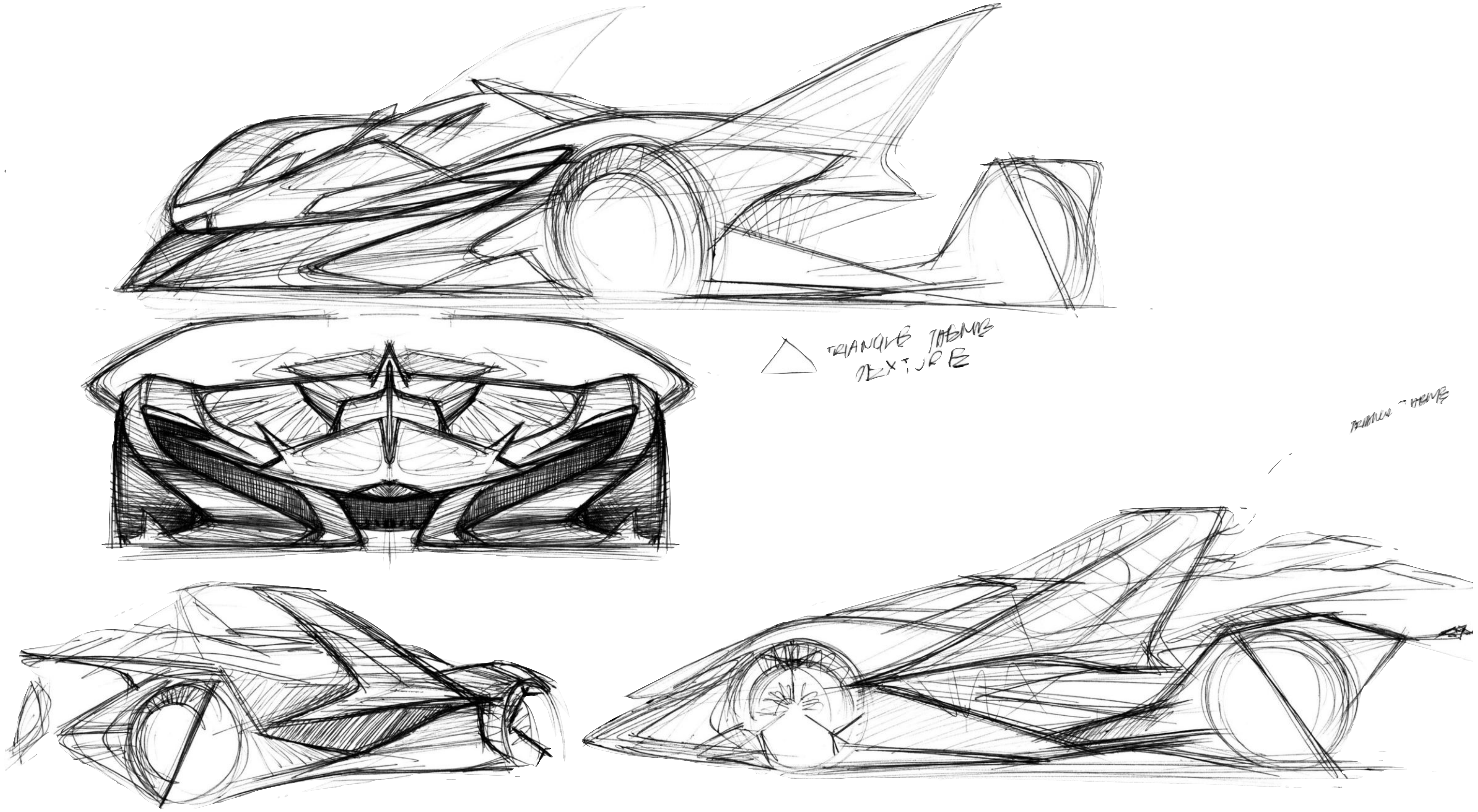
9 FINAL CONCEPT

Further development of the design with emphasis on wing integration



9 FINAL CONCEPT

A sharper treatment of the graphics and surfaces



9 FINAL CONCEPT

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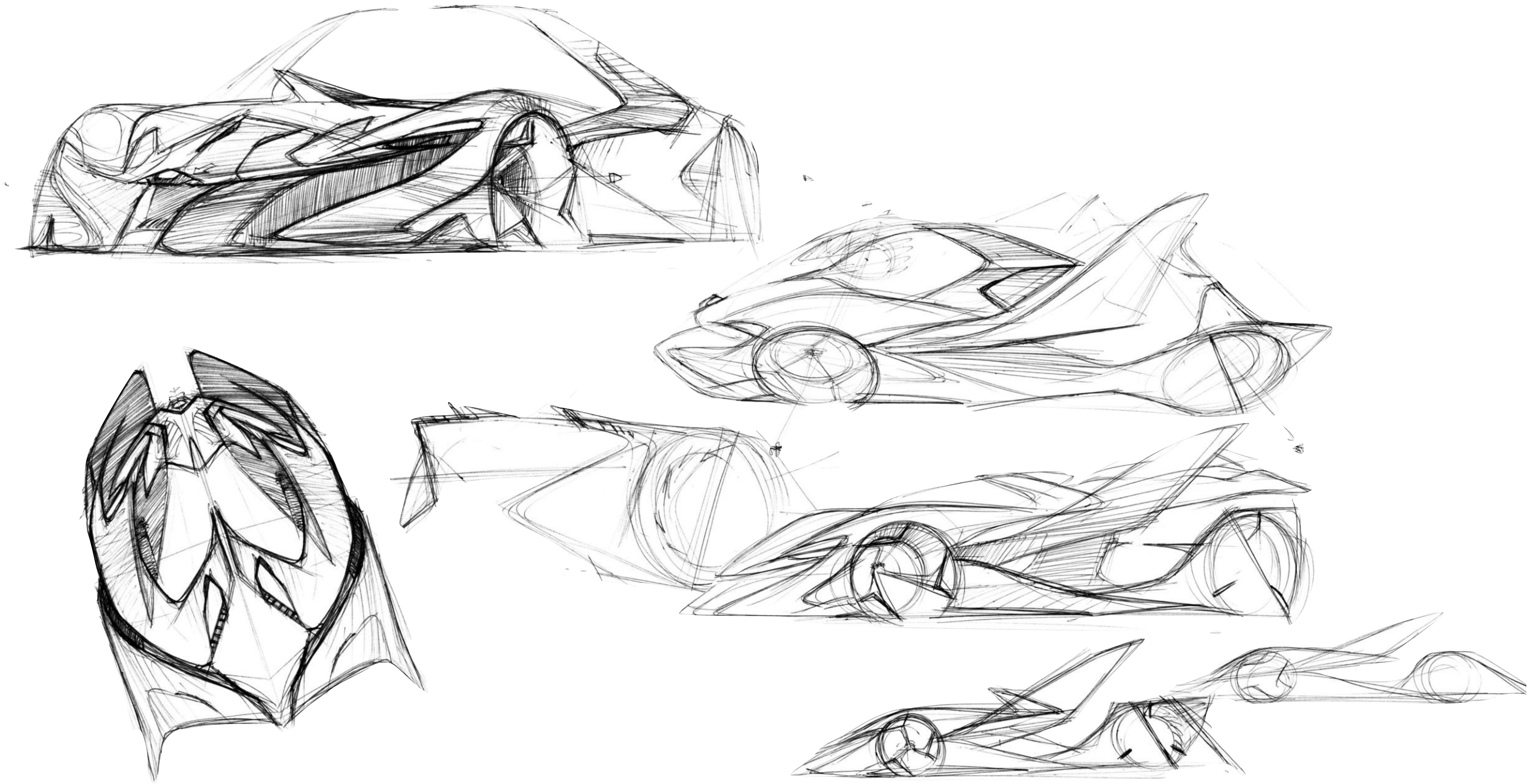
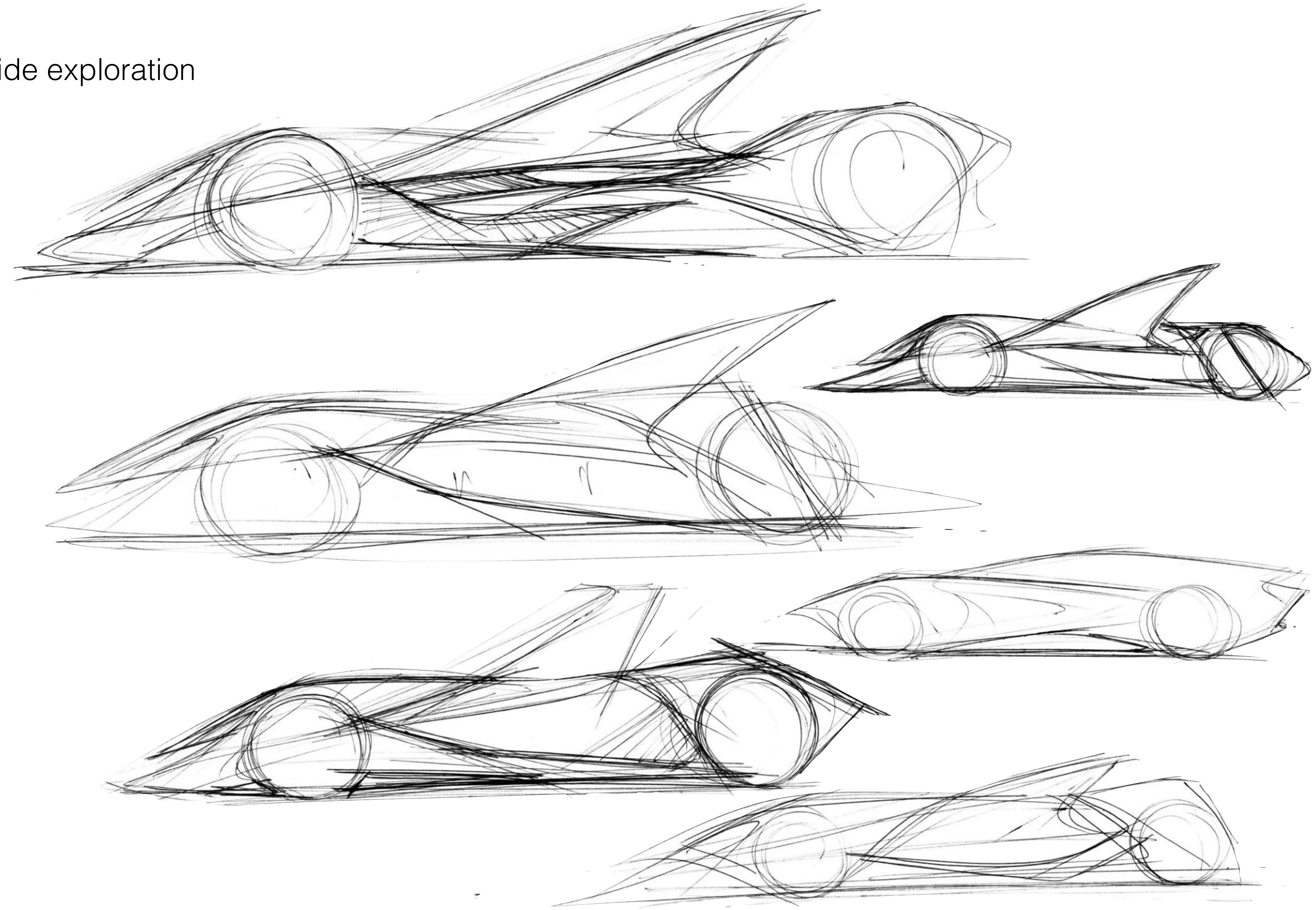


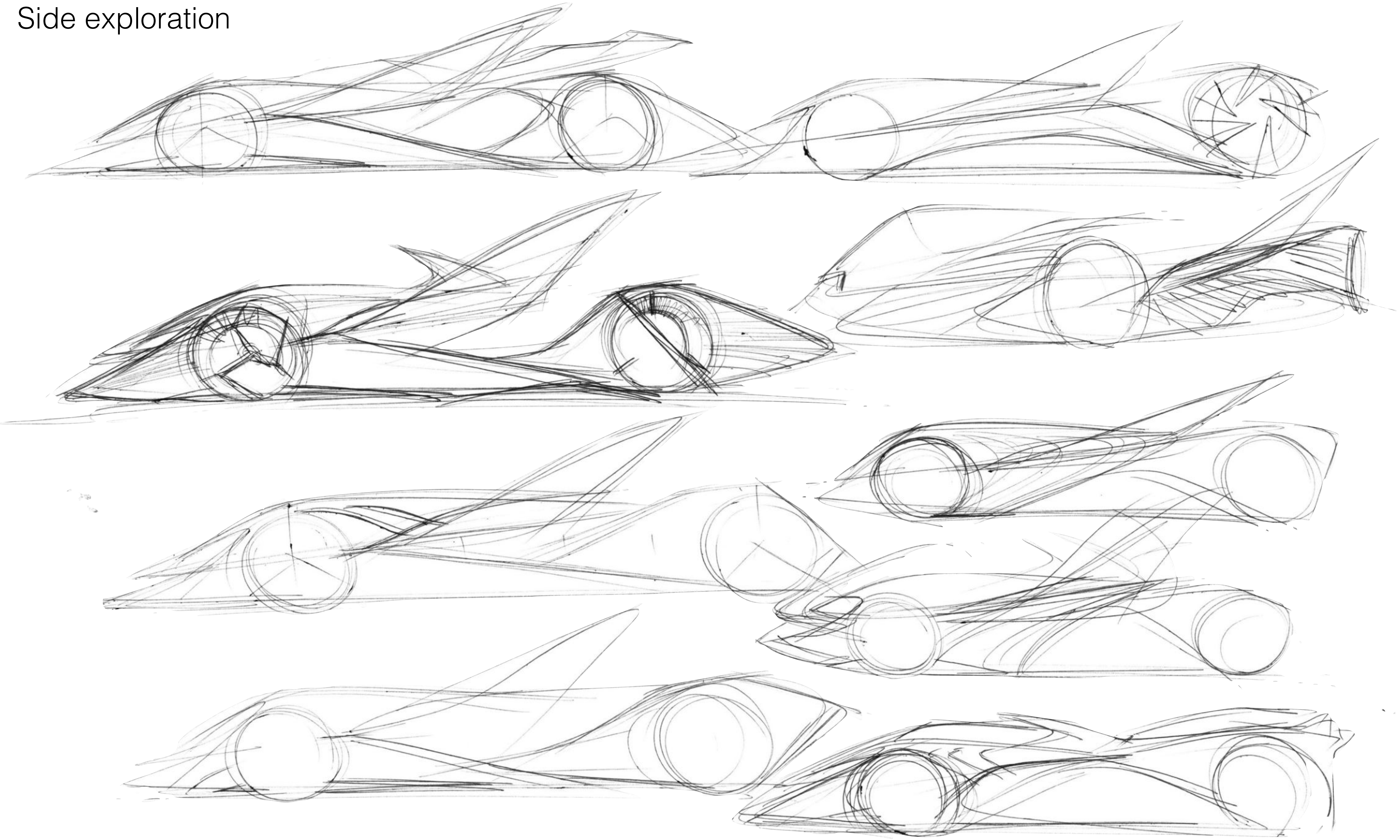
9 FINAL CONCEPT

Side exploration



9 FINAL CONCEPT

Side exploration

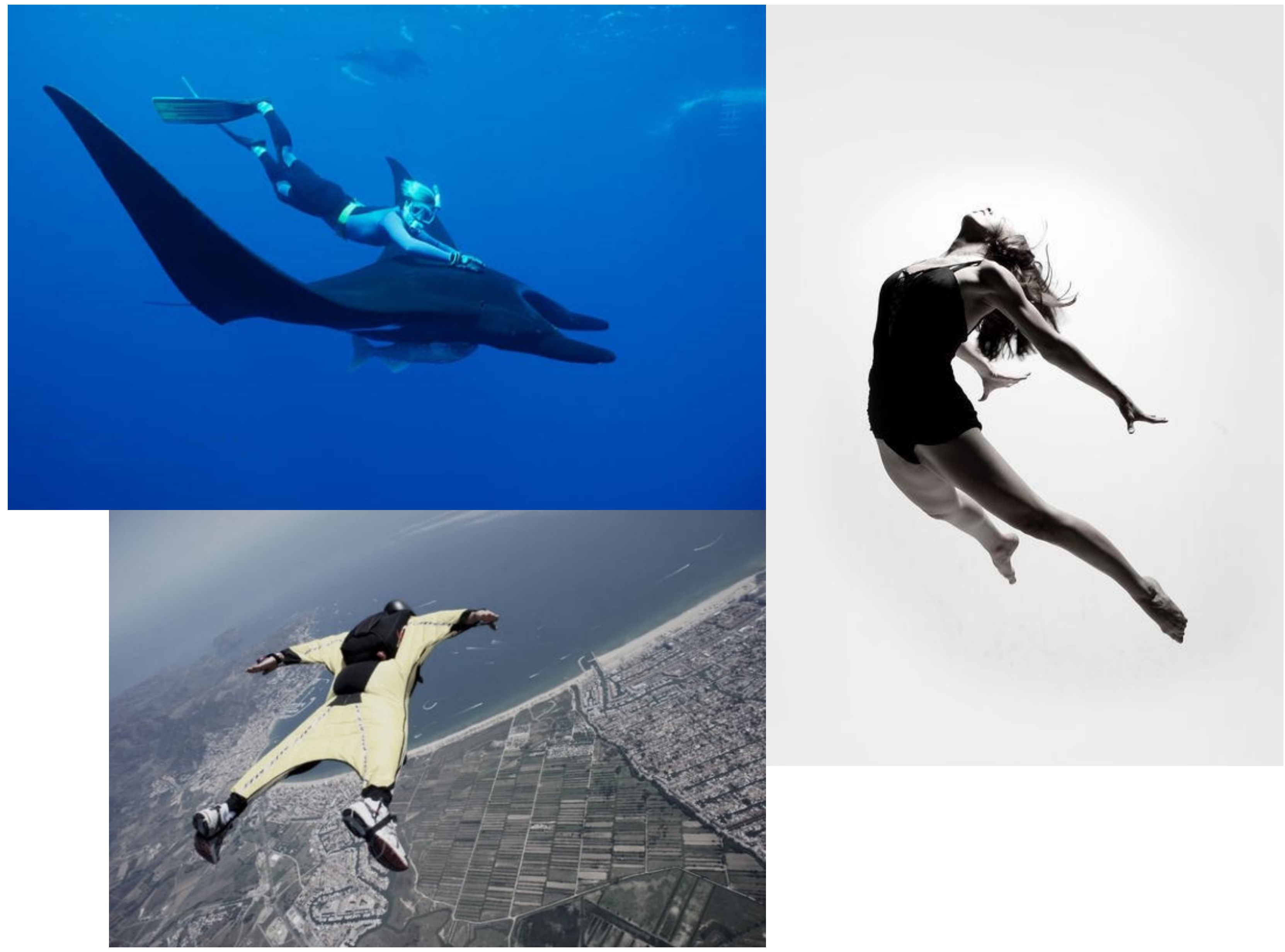


9 FINAL CONCEPT

9.9 **New mood-board for final design**

It was released that the design language had considerably drifted away from the initial mood-board.

The new mood-board is more true to the concept, heavily inspired from the idea of creating a new driving experience, similar to flying.



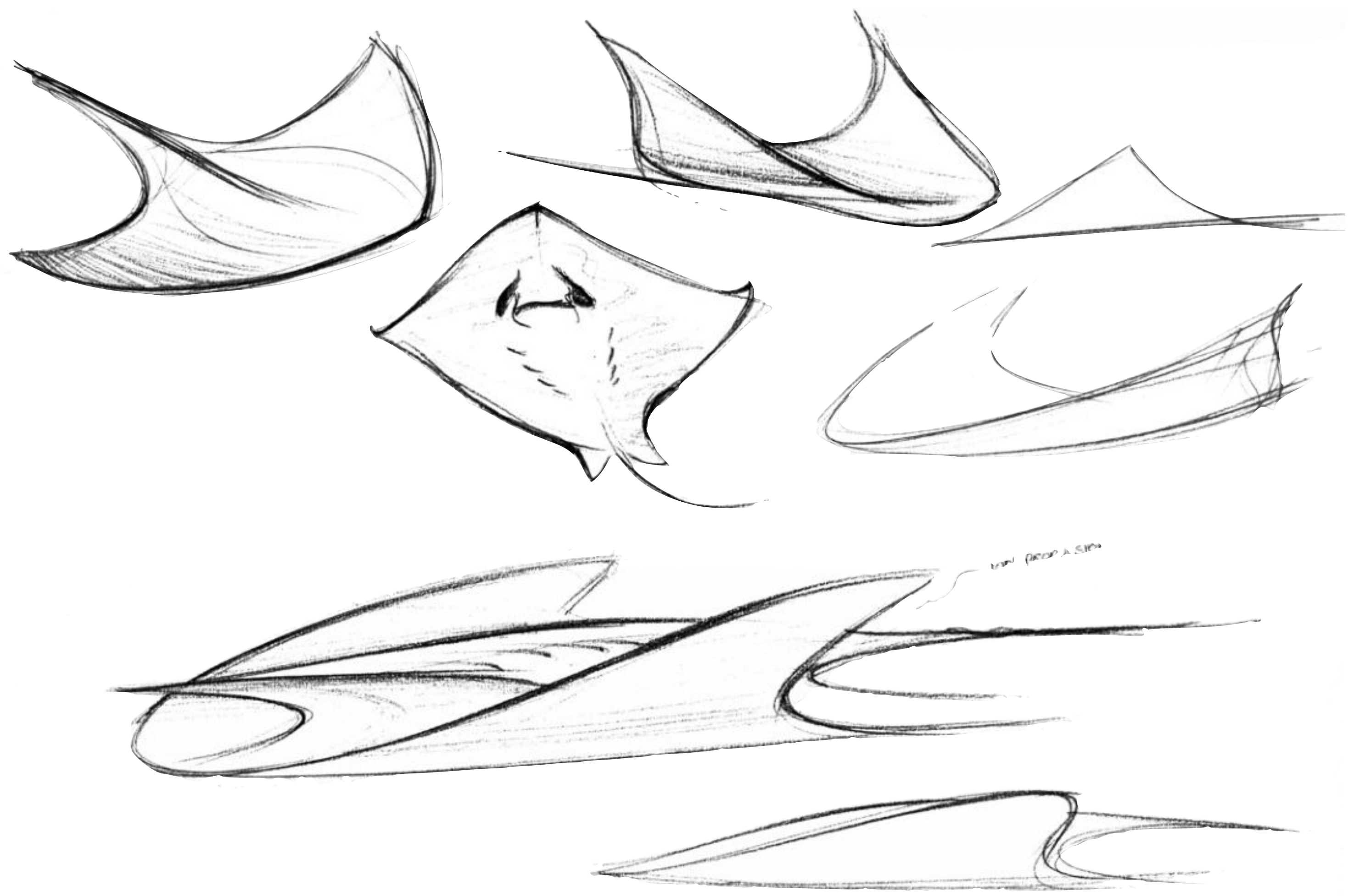
9 FINAL CONCEPT

9.10 **Design motif for the final design**

An image of a diver tugged on a manta ray was taken as the key reference for the final design.

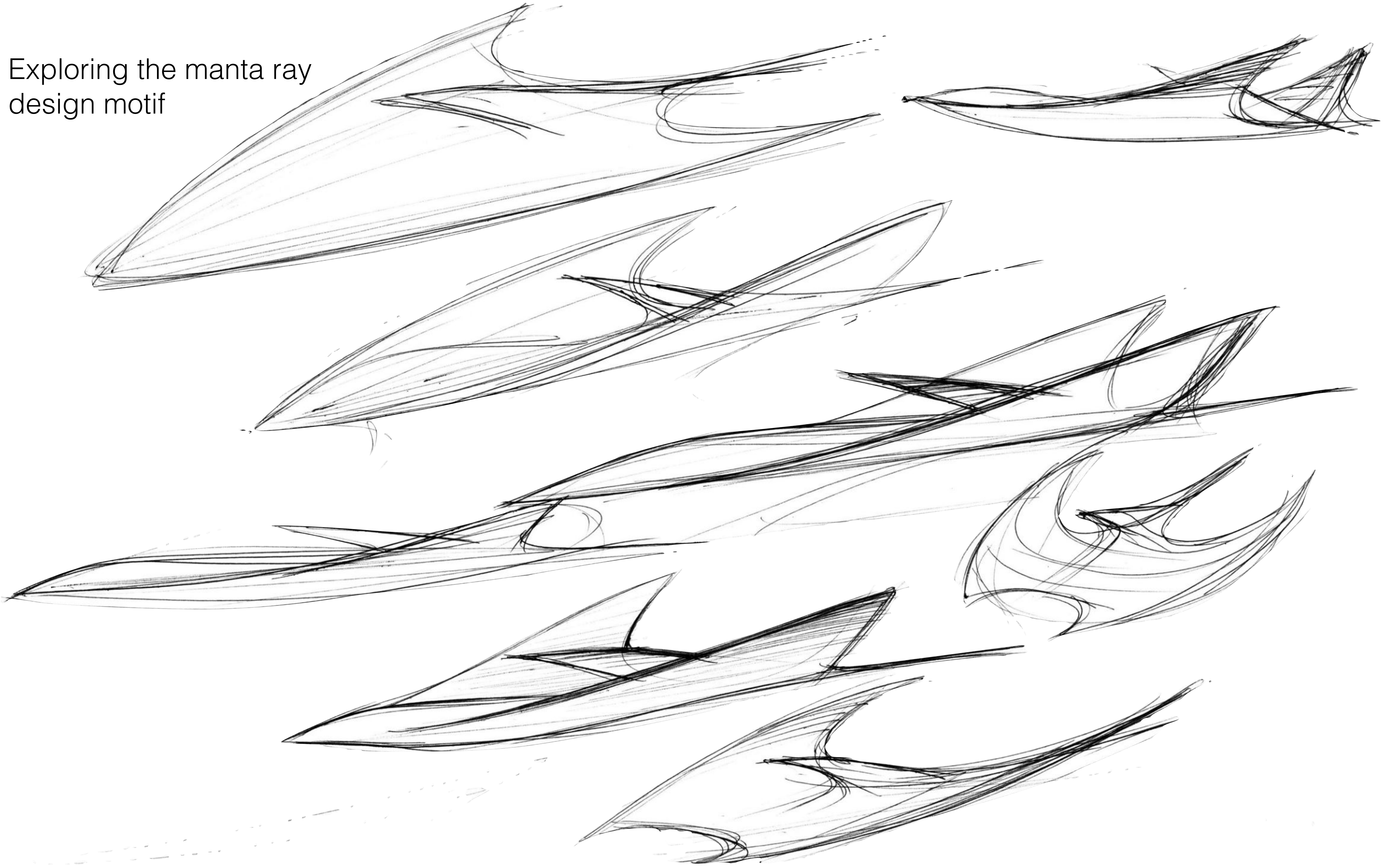
Understanding the motif of the concept was important, as it'd give clarity to the concept and an intellectual depth or rather purpose to the form.

The theme of man and AI racing along is further emphasised by the addition of the manta ray design inspiration. The race car can be likened as a living, breathing machine, as the AI gives it soul. A new theme of man and mecha-beast is evolved from the previous idea.



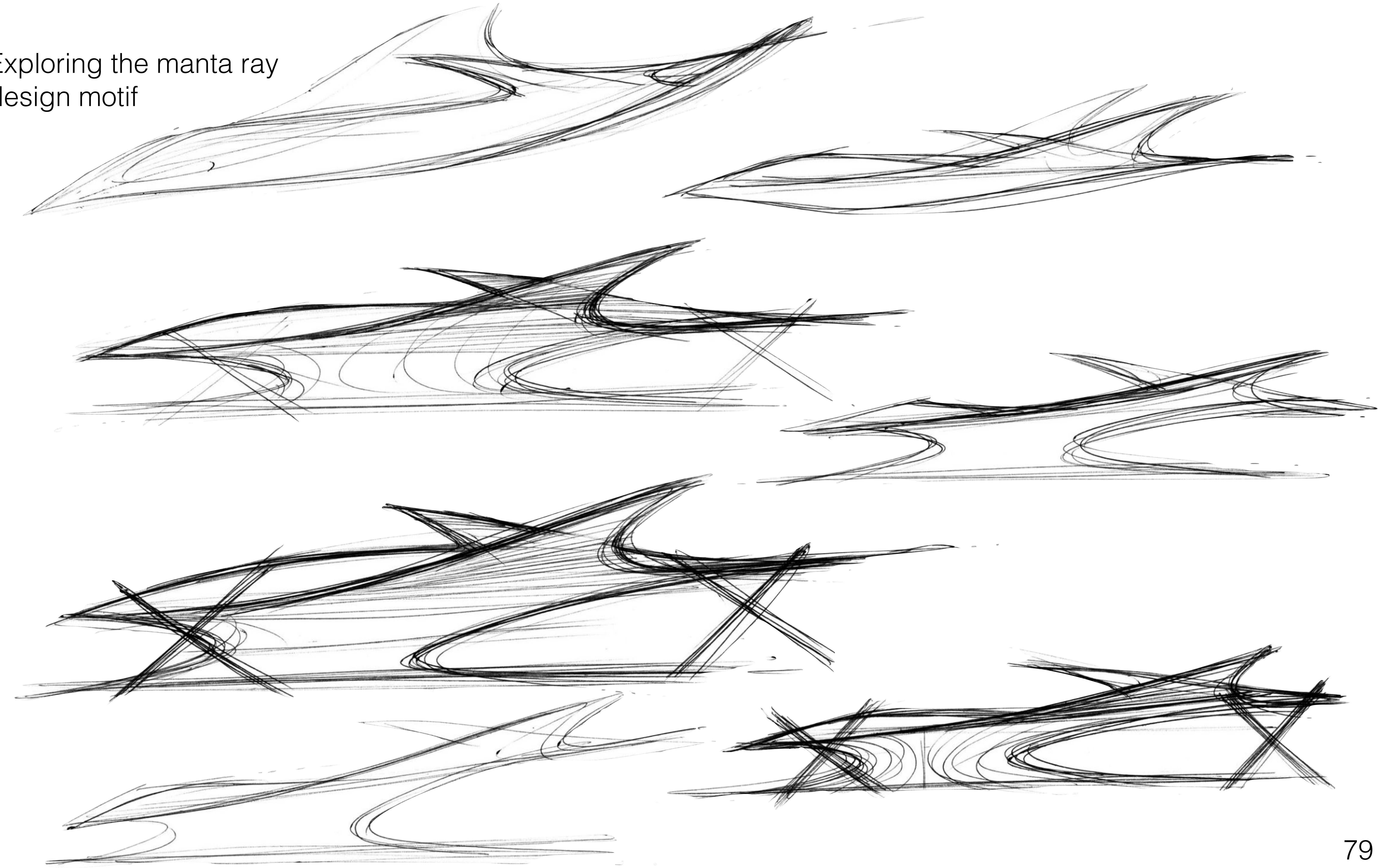
9 FINAL CONCEPT

Exploring the manta ray design motif



9 FINAL CONCEPT

Exploring the manta ray design motif



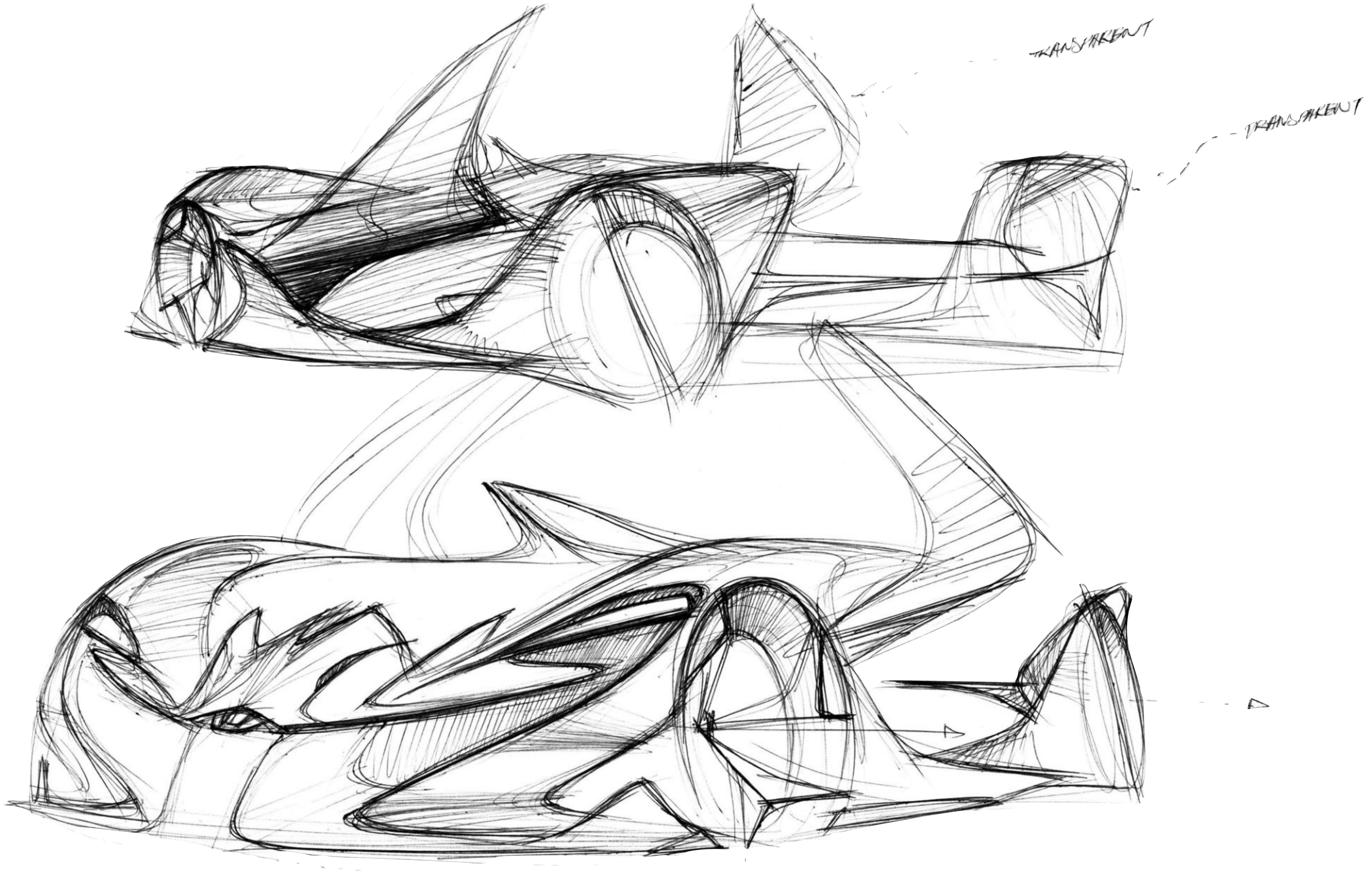
9 FINAL CONCEPT

Exploring the manta ray design motif

10 **FINAL DESIGN**

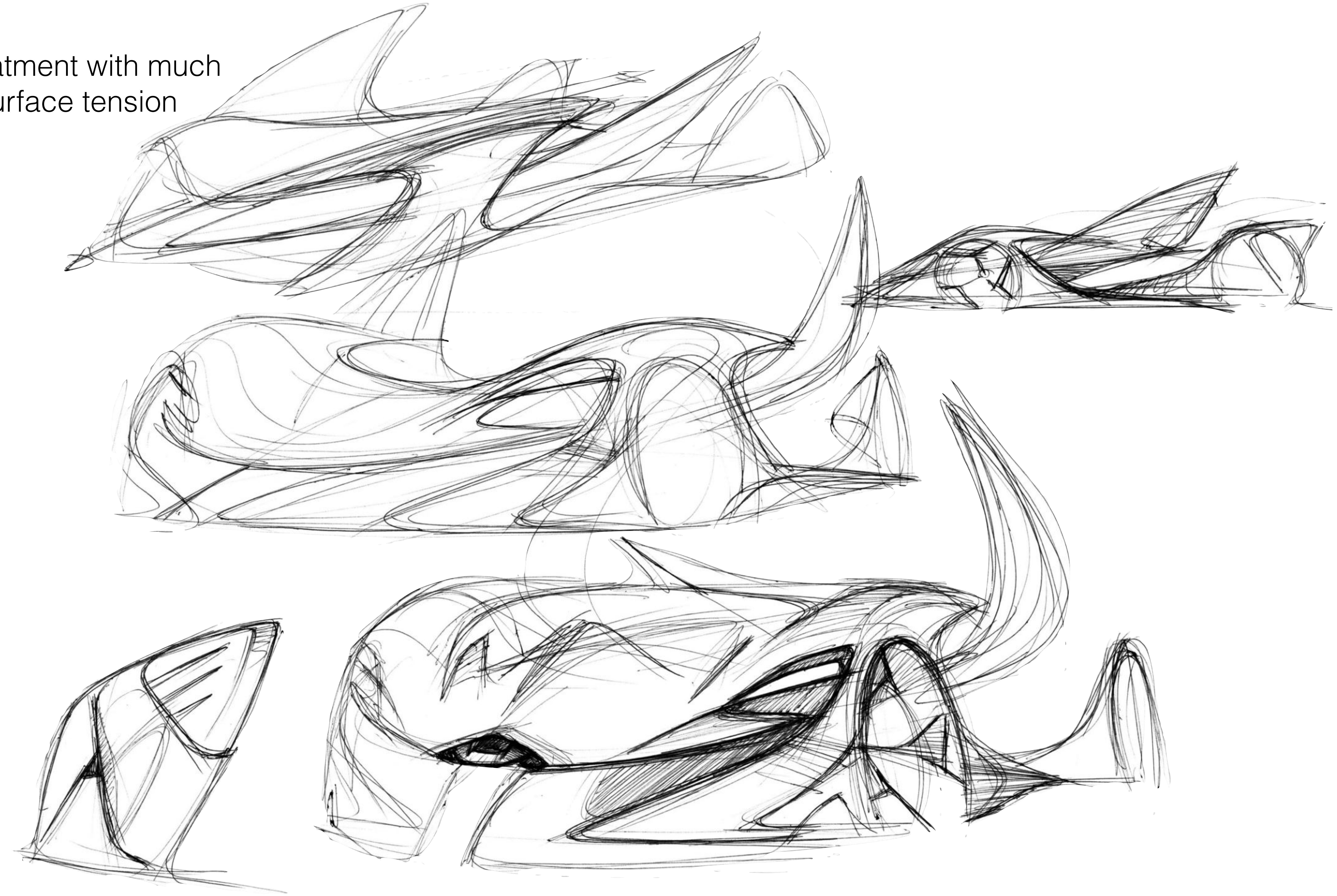
After studying the manta ray design motif, more clarity in form language was gained for developing the final design.

Following are the developmental sketches done before arriving at the final design. A softer fish-like form is evolved in the sketches.



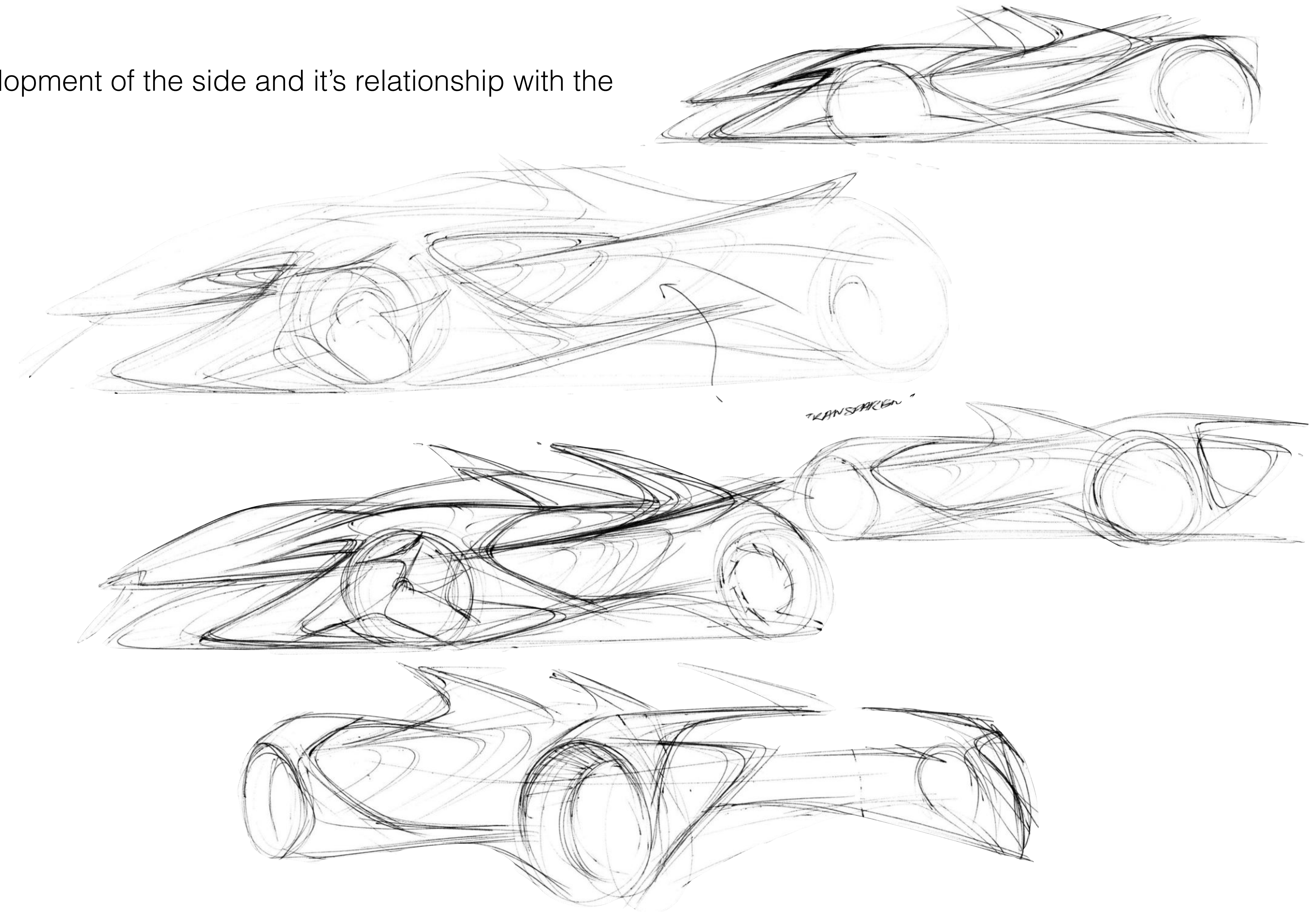
10 **FINAL DESIGN**

Softer treatment with much relaxed surface tension



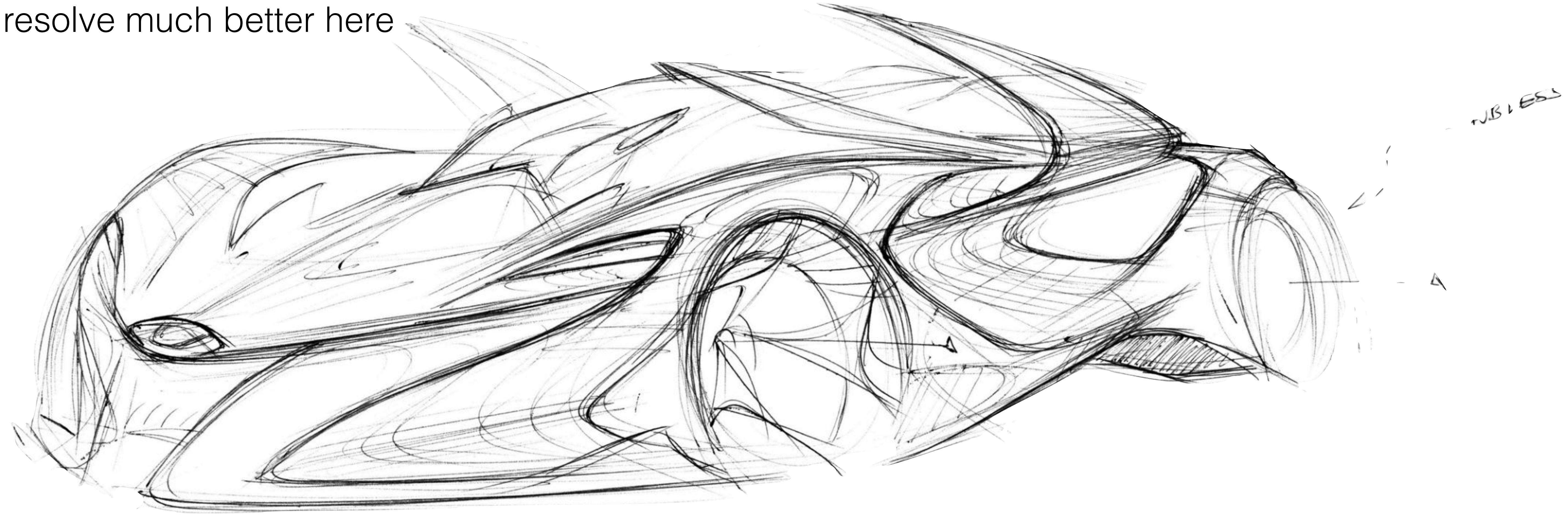
10 **FINAL DESIGN**

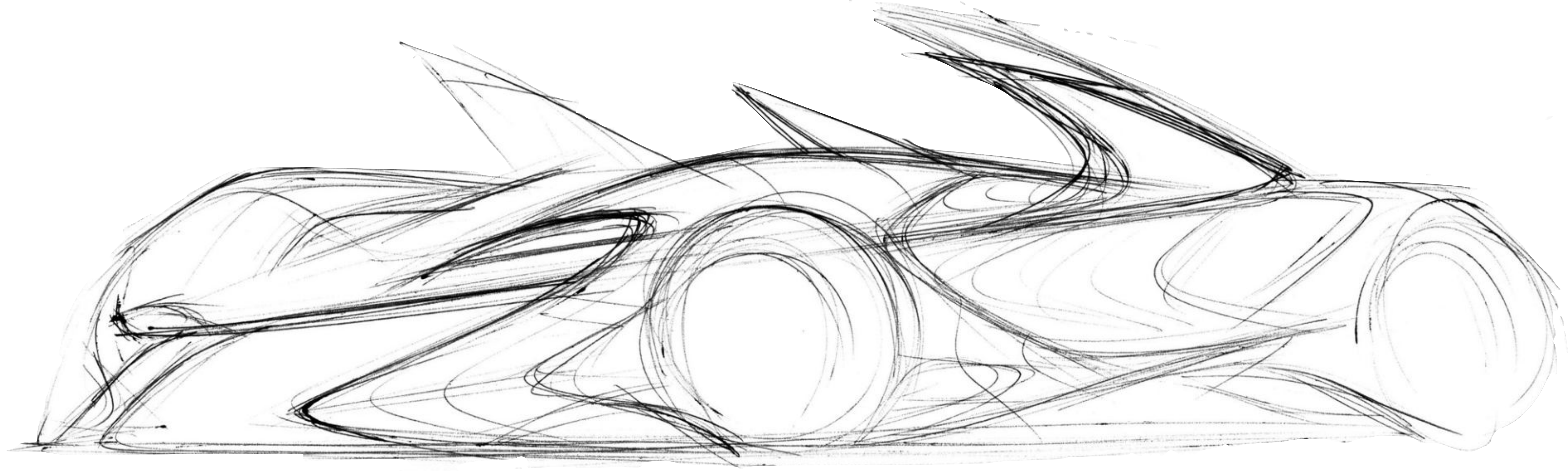
Development of the side and it’s relationship with the rear



10 **FINAL DESIGN**

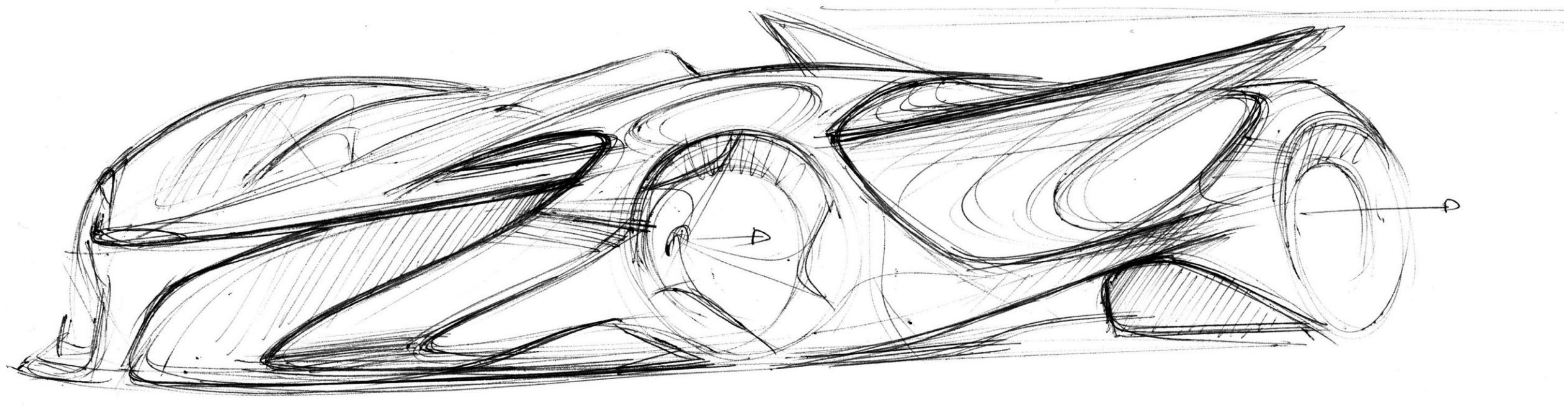
Development of final design, the surfaces and lines seem to resolve much better here





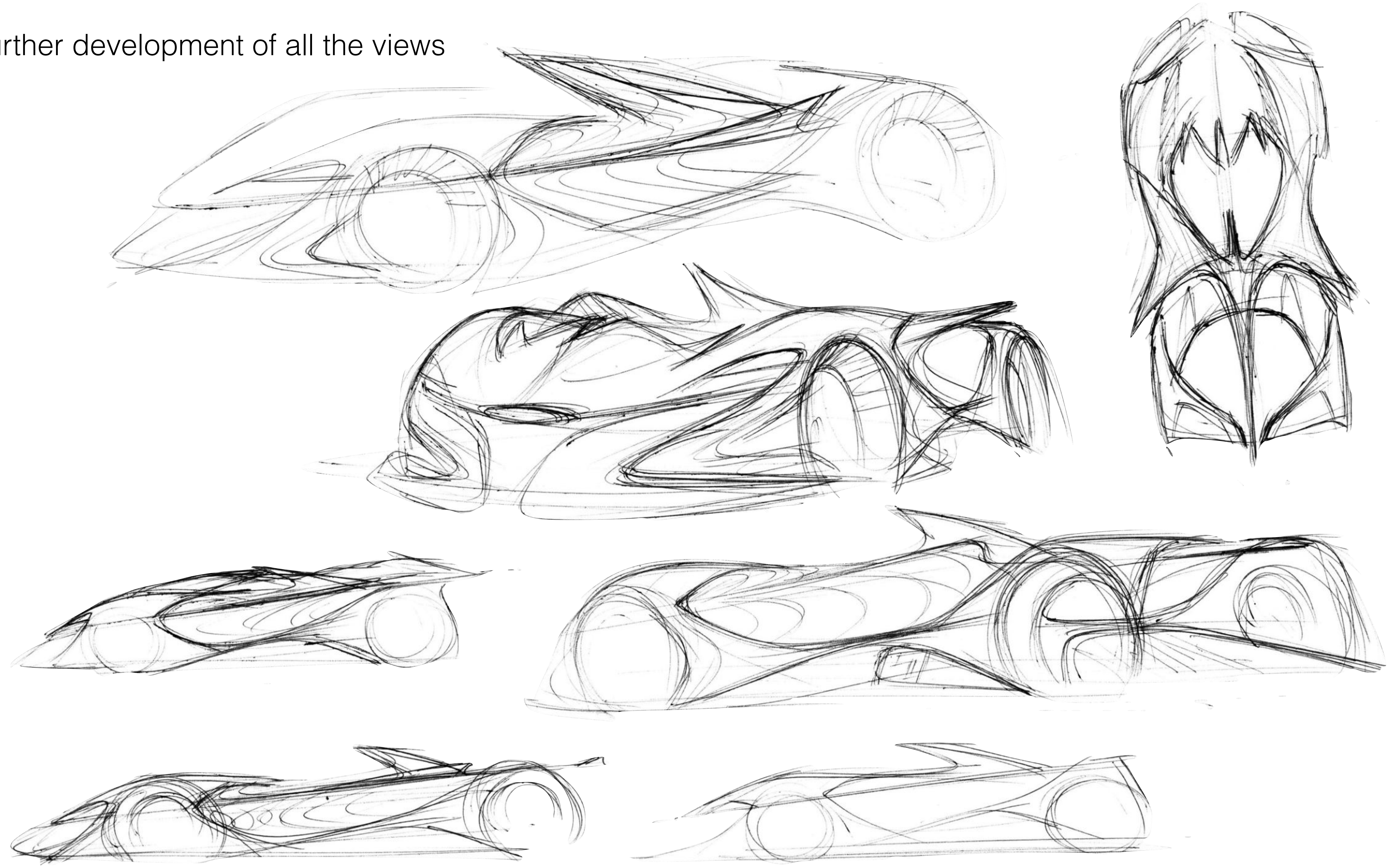
10 **FINAL DESIGN**

The wing element has been toned down and the design seems to look more sophisticated and more car-like.



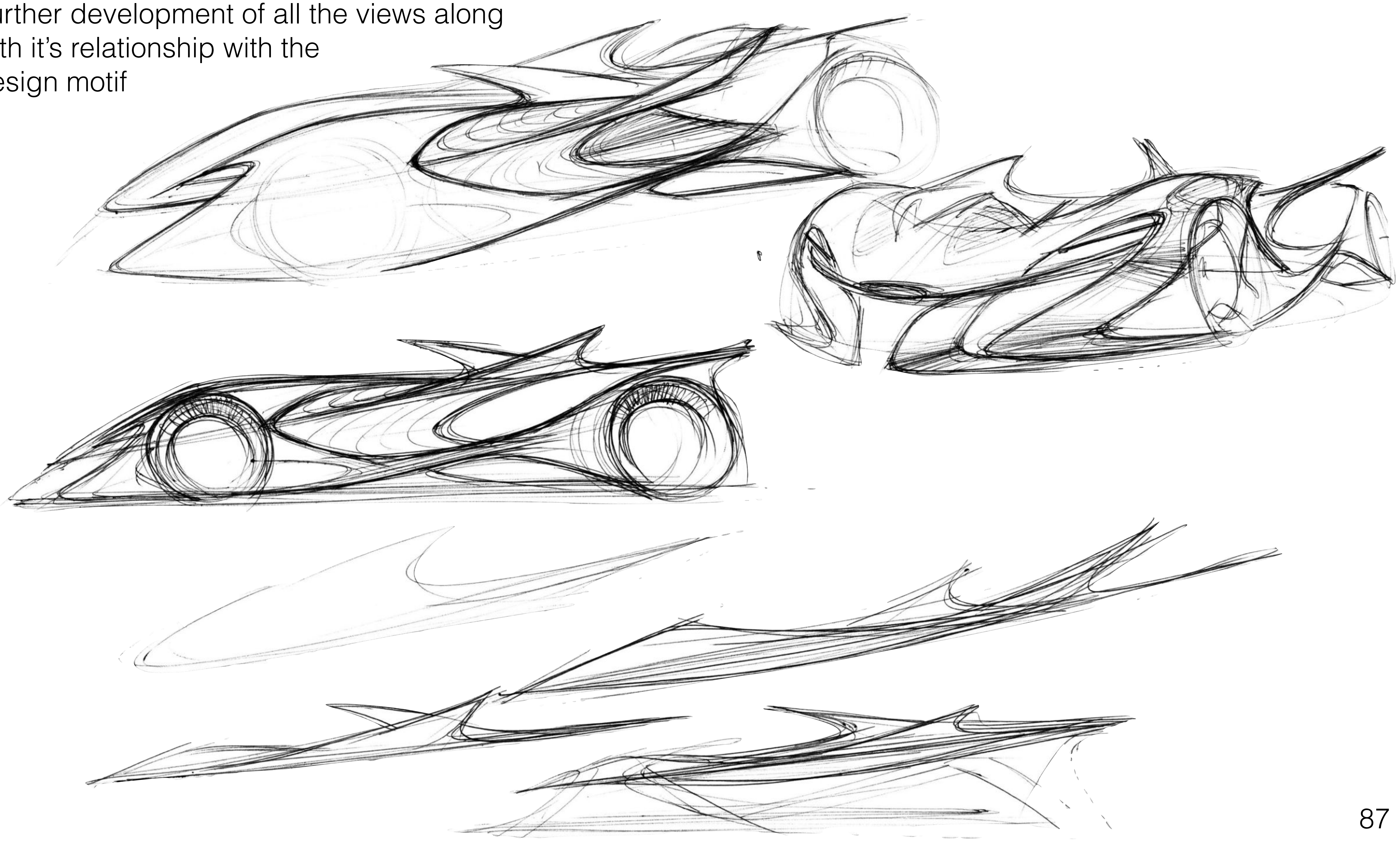
10 **FINAL DESIGN**

Further development of all the views



10 **FINAL DESIGN**

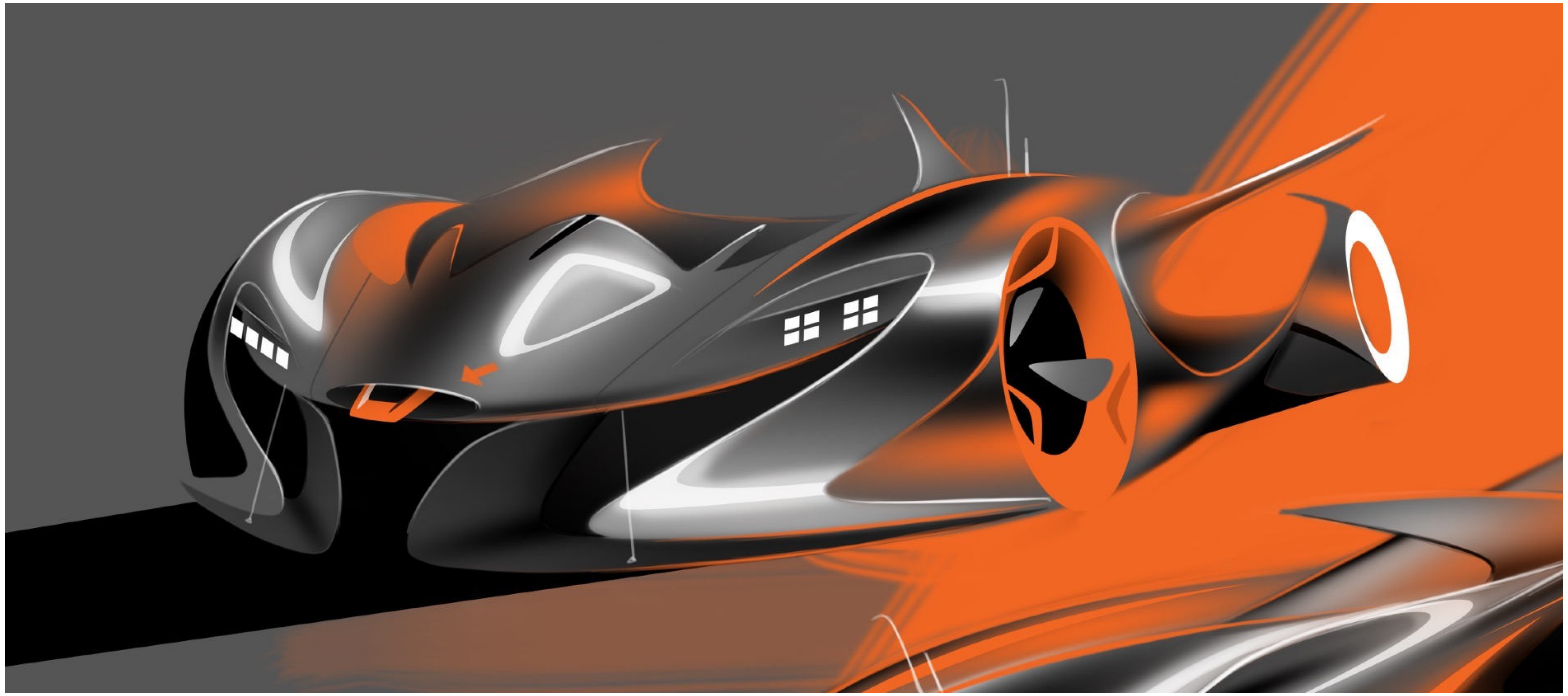
Further development of all the views along with it's relationship with the design motif



Resolving the lines in all the views

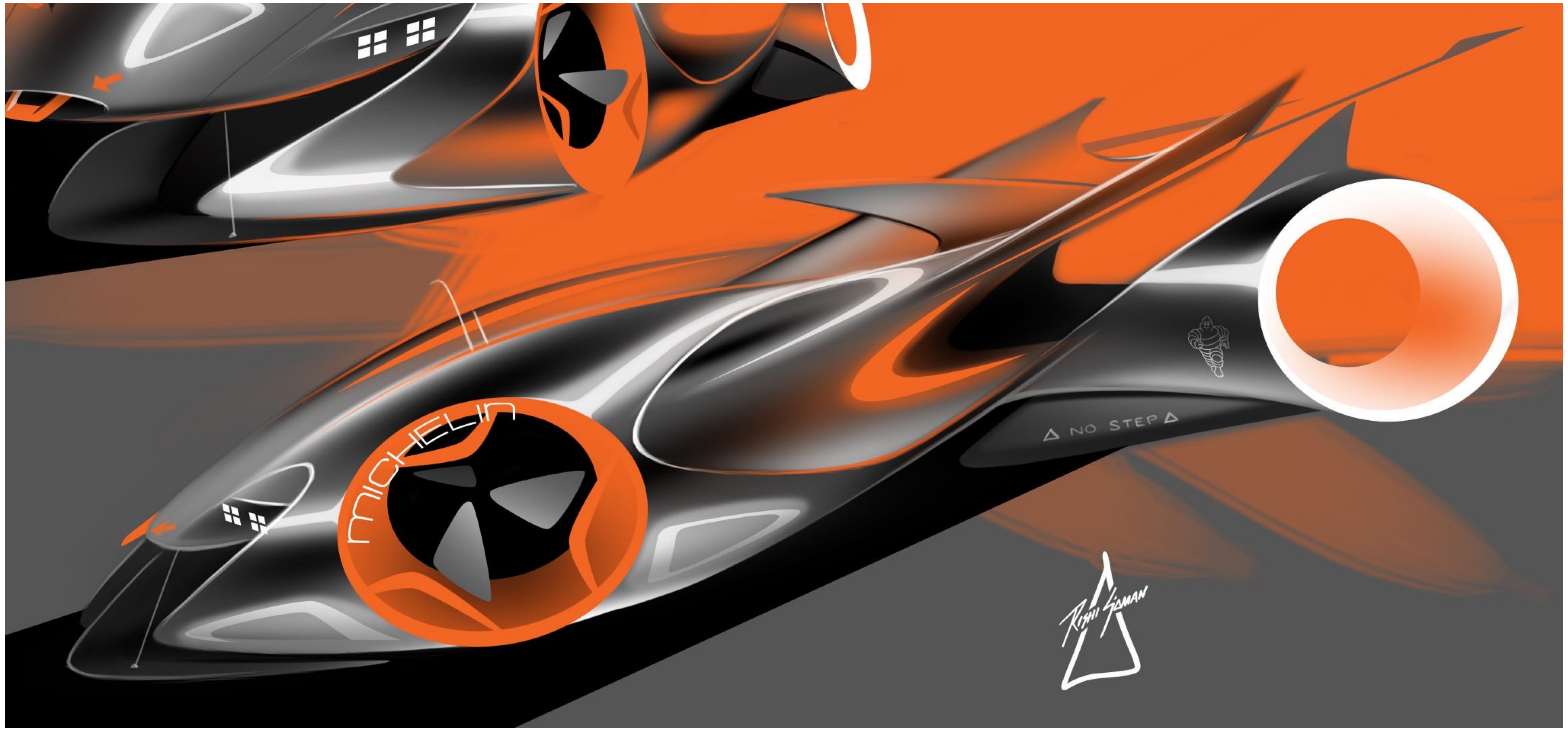
10 **FINAL DESIGN**

Front 3/4 view of car without racer



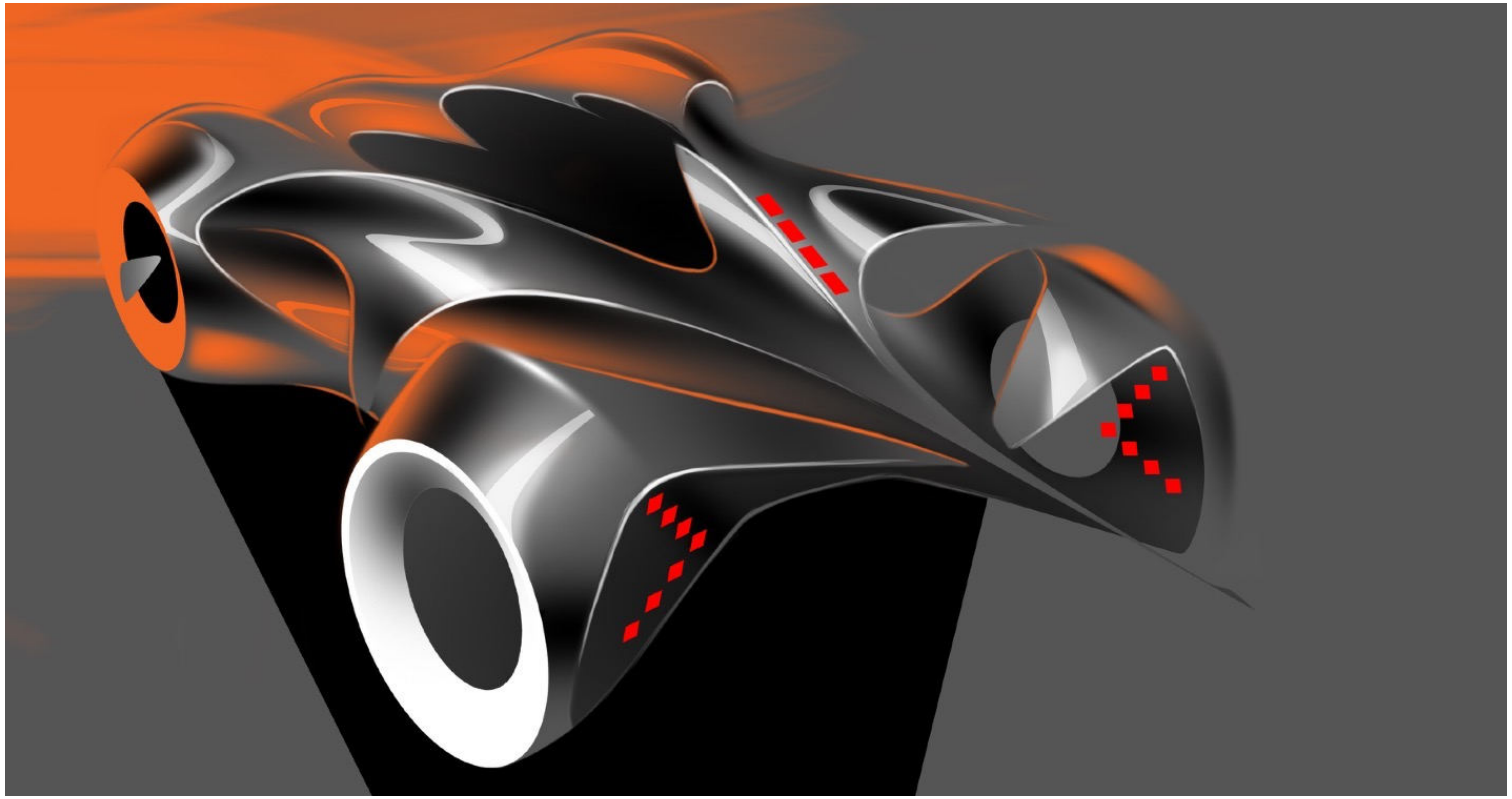
10 **FINAL DESIGN**

Side view of car without racer



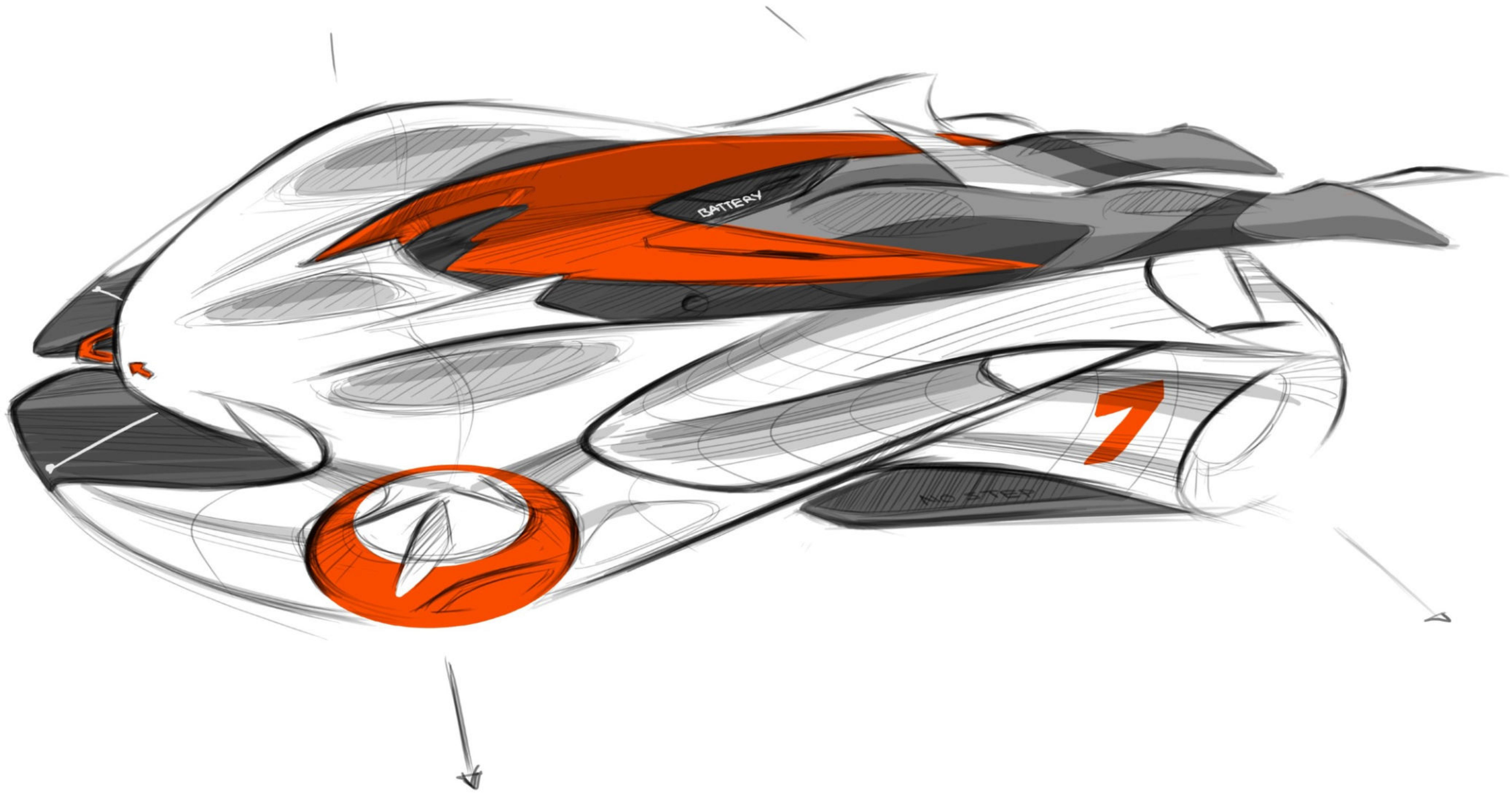
10 **FINAL DESIGN**

Rear 3/4 view of car without racer



10 **FINAL DESIGN**

Top view of car with racer



10 FINAL DESIGN

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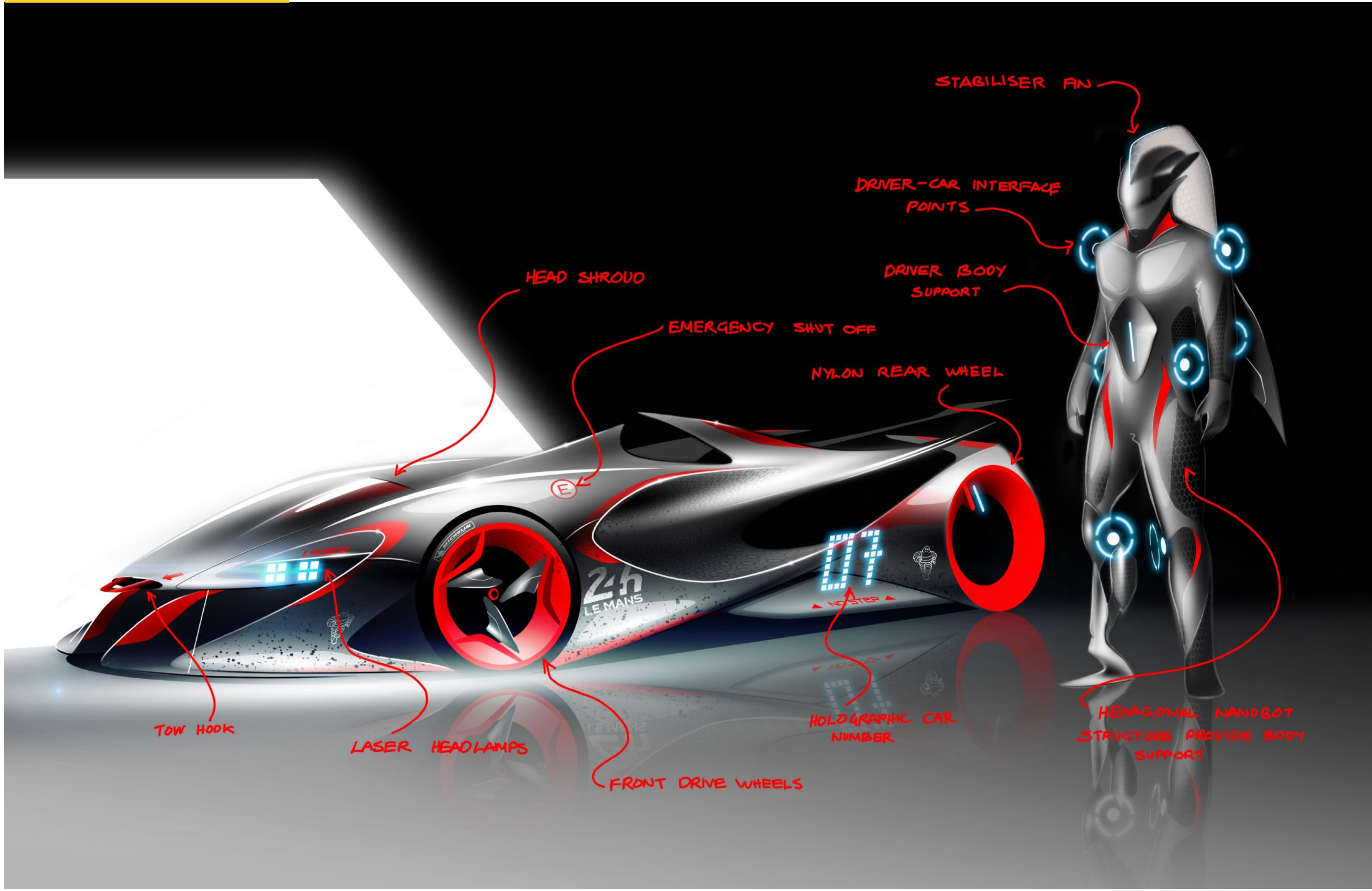
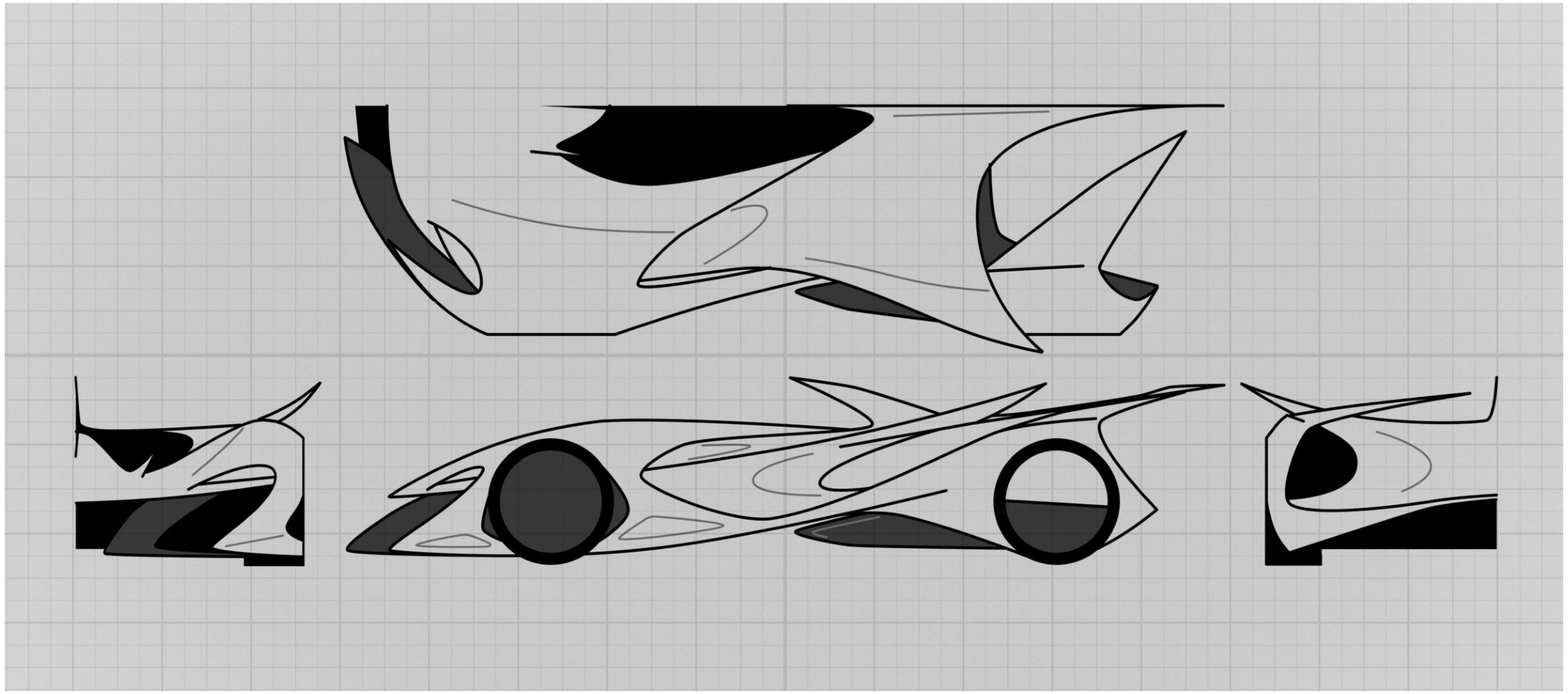


10 FINAL DESIGN

10.1 Elevation drawing

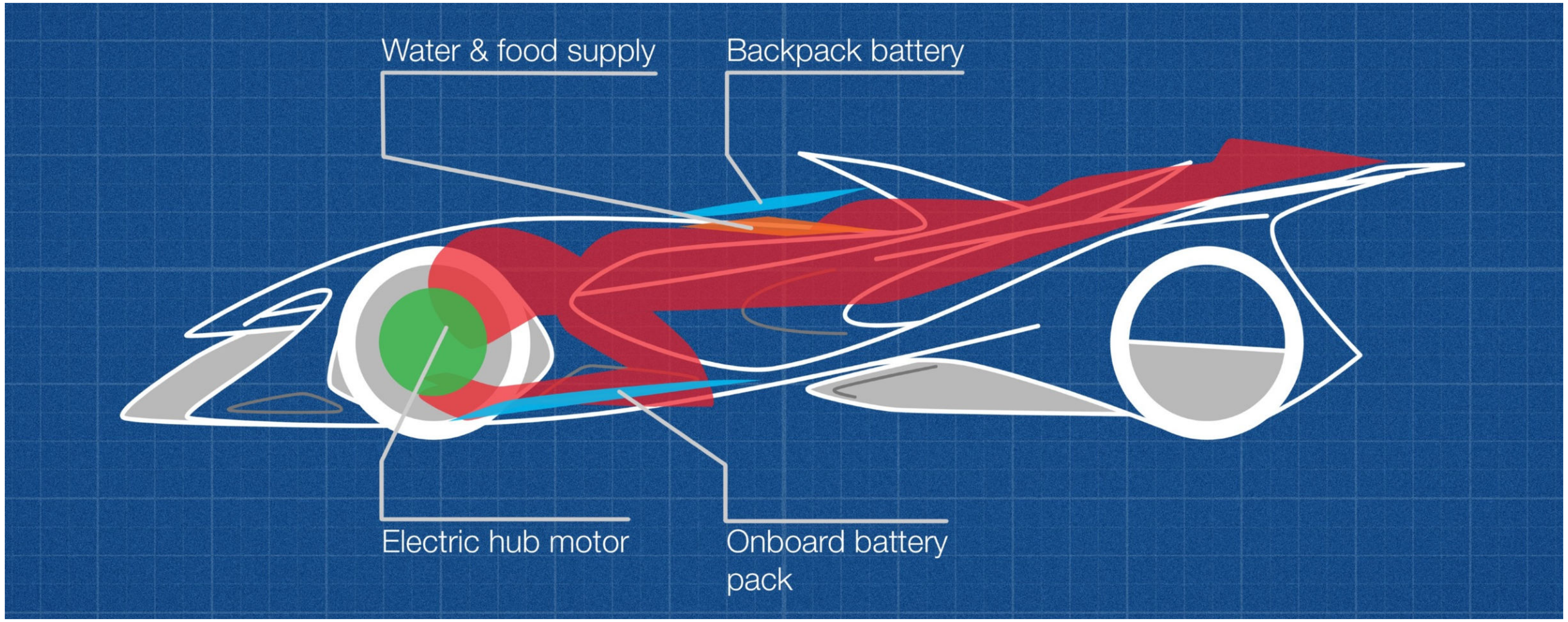
Following is the elevation drawing of the final concept.



10.2 **Vehicle package**

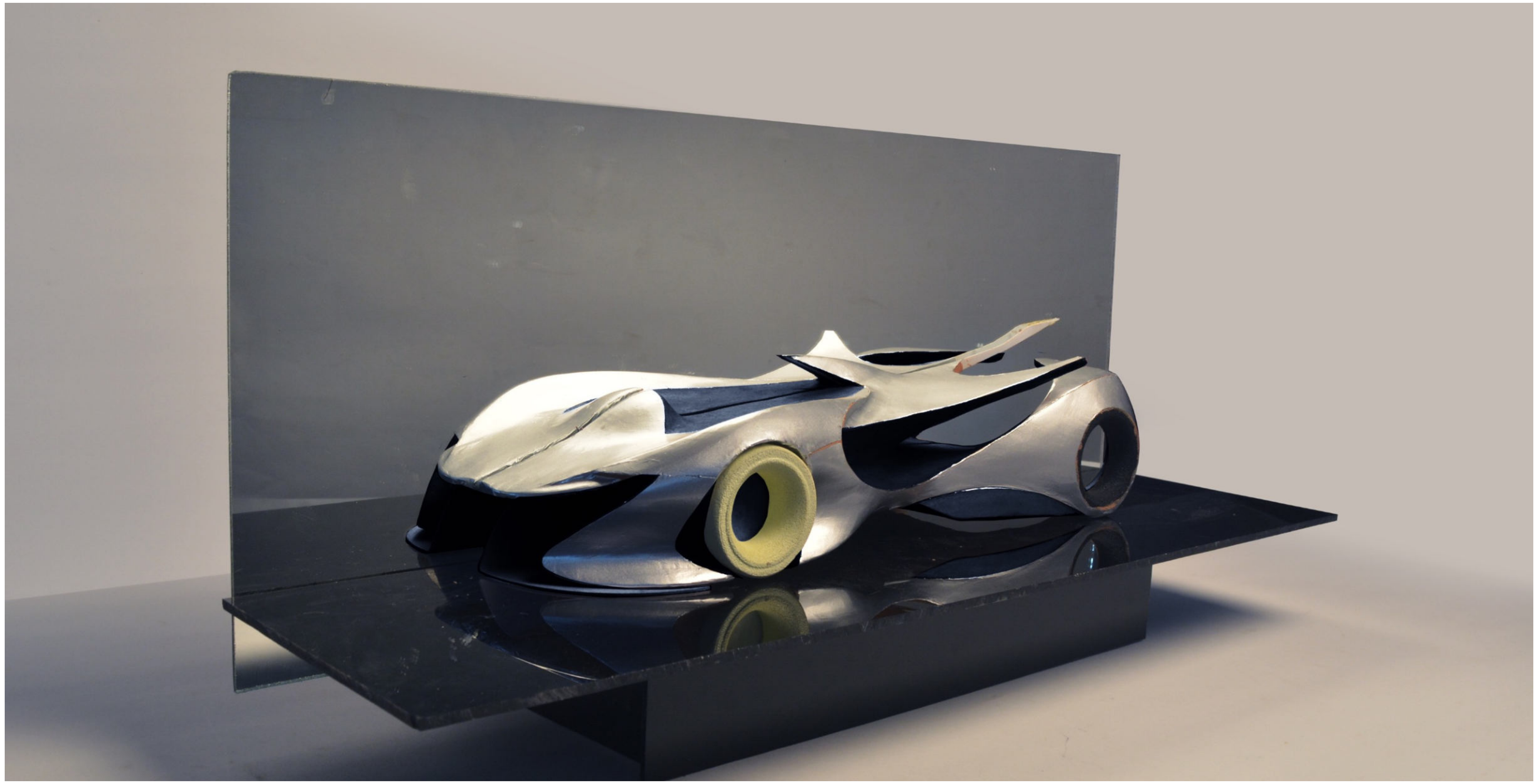
Indian anthropometric dimensions were referred from Indian Anthropometric Dimensions by Debkumar Chakrabarti (ISBN: 81-86199-15-0) and simulated on side elevation of the concept.

The racer gets a virtual projection of the racetrack ahead, optimising his visibility. A primary battery pack carried as a backpack by the racer itself means that there is no need for a separate battery change at a driver change pit-stop. A secondary onboard battery pack keeps the nanobots charged.

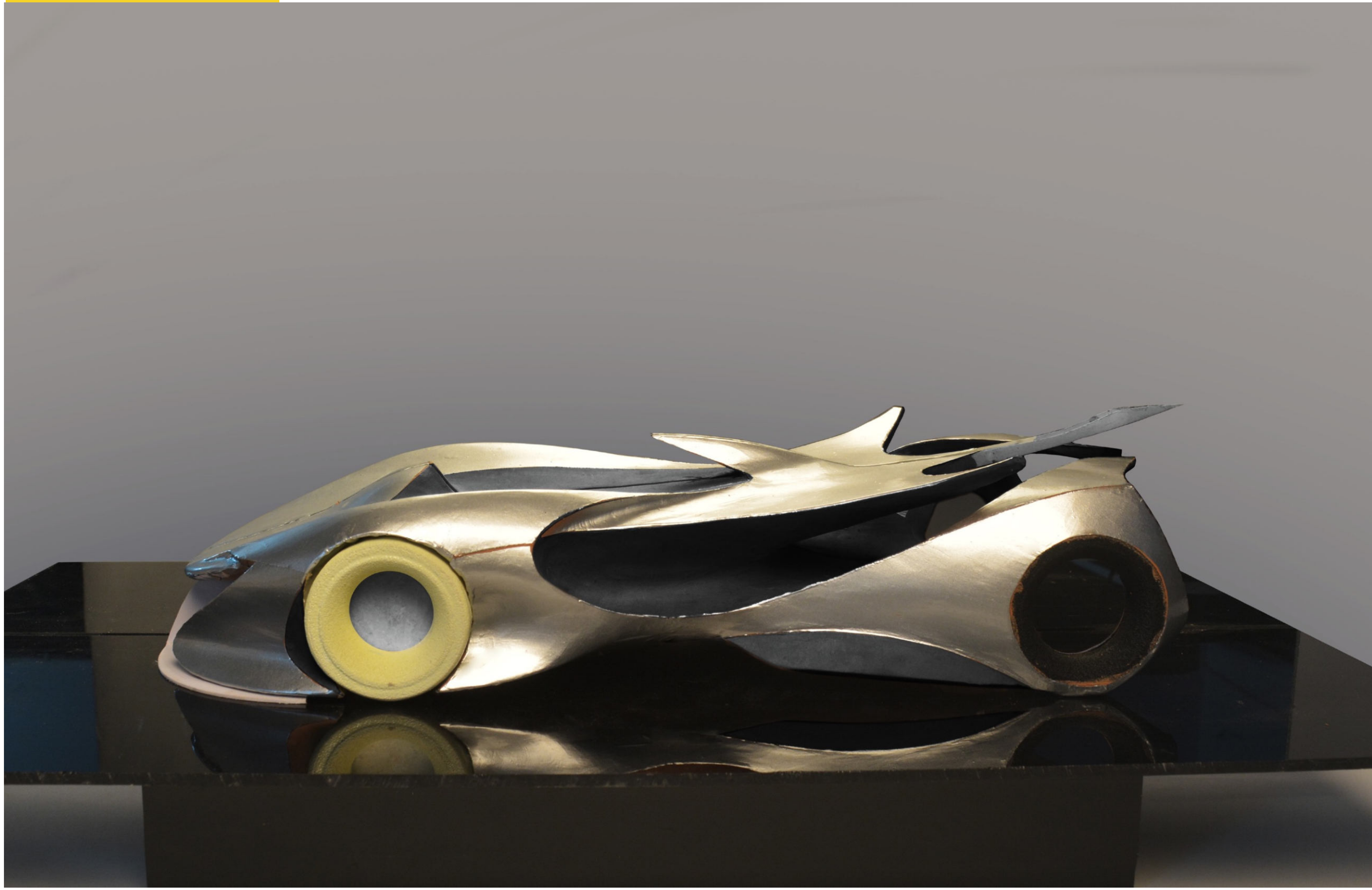


11 CLAY MODEL

A 1:5 scale model made out of industrial clay was made to represent the final design.



11 **CLAY MODEL**



11 CLAY MODEL

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DESIGN OF A RACE CAR FOR LE MANS 2030
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MVD III-27

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