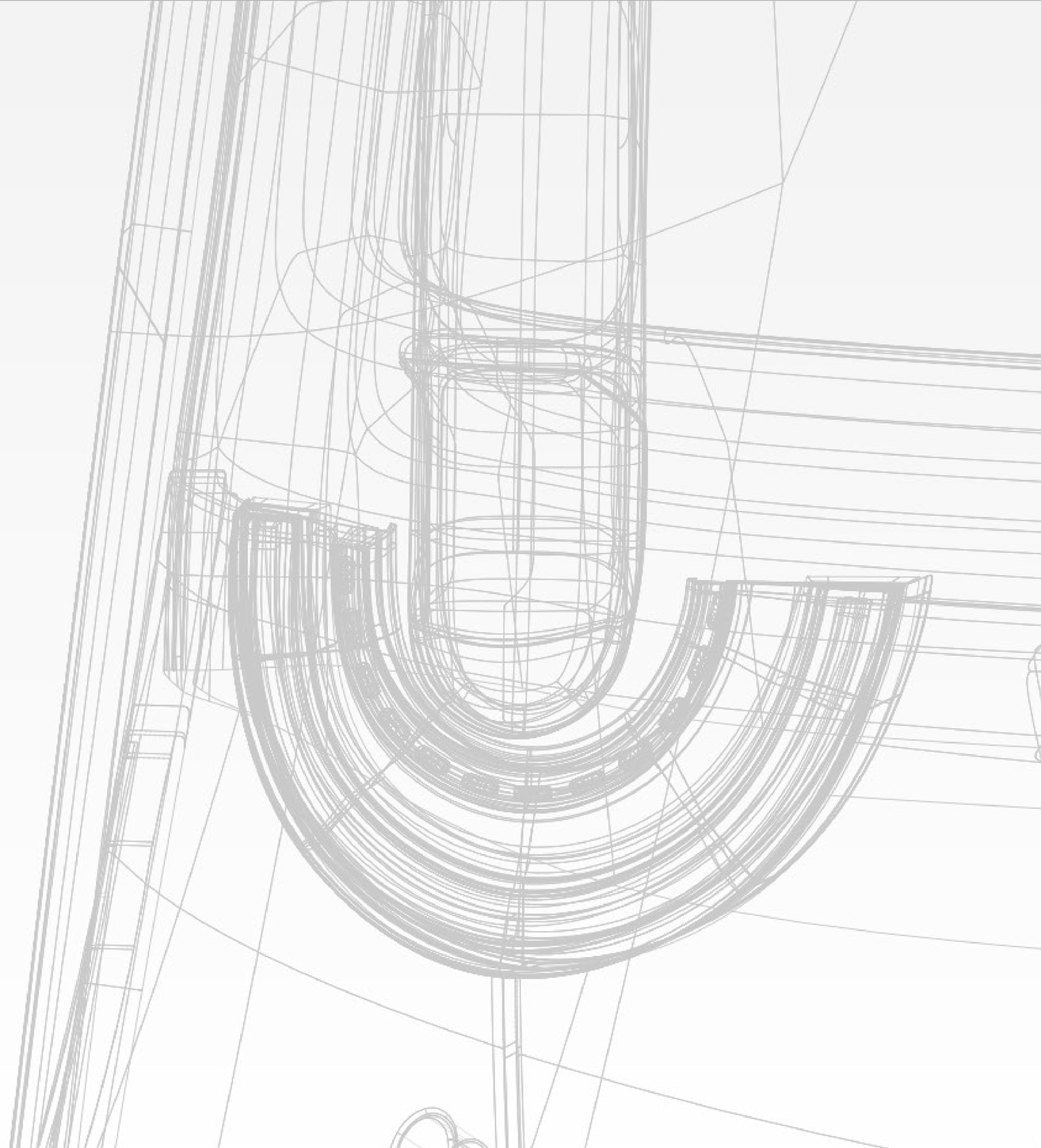
Jeep Adaptive.

AN URBAN CAR BUILT FOR ADVENTURES.

Jeep Adaptive
Valtteri Valli
LAB University of Applied Sciences
Institute of Design
Bachelor of Design
Spring 2021



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URBAANI AUTO MAASTOSEIKKAILUILLE.

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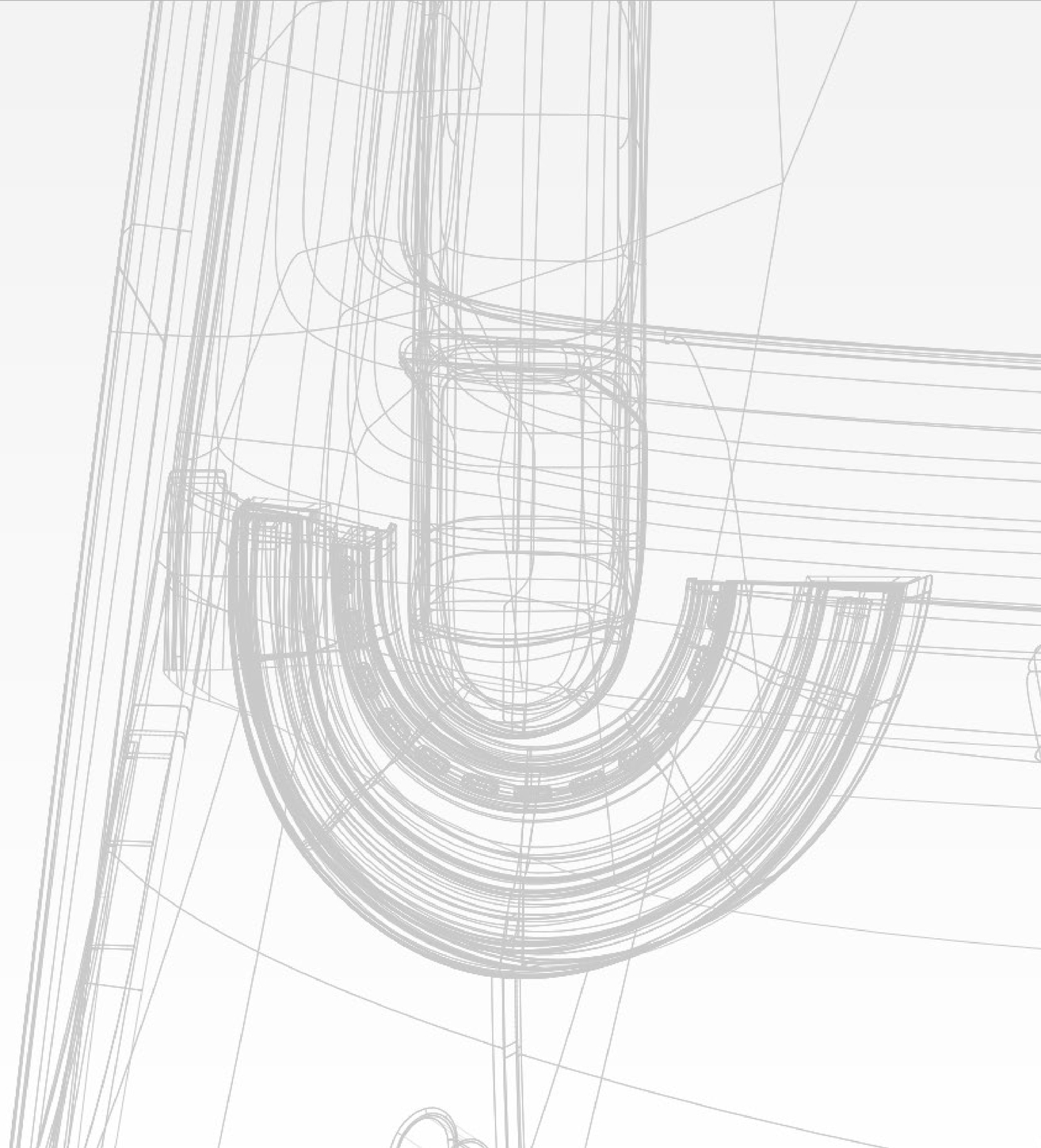
Valtteri Valli
LAB Ammattikorkeakoulu
Muotoiluinstituutti
Muotoilija (AMK)
Kevät 2021

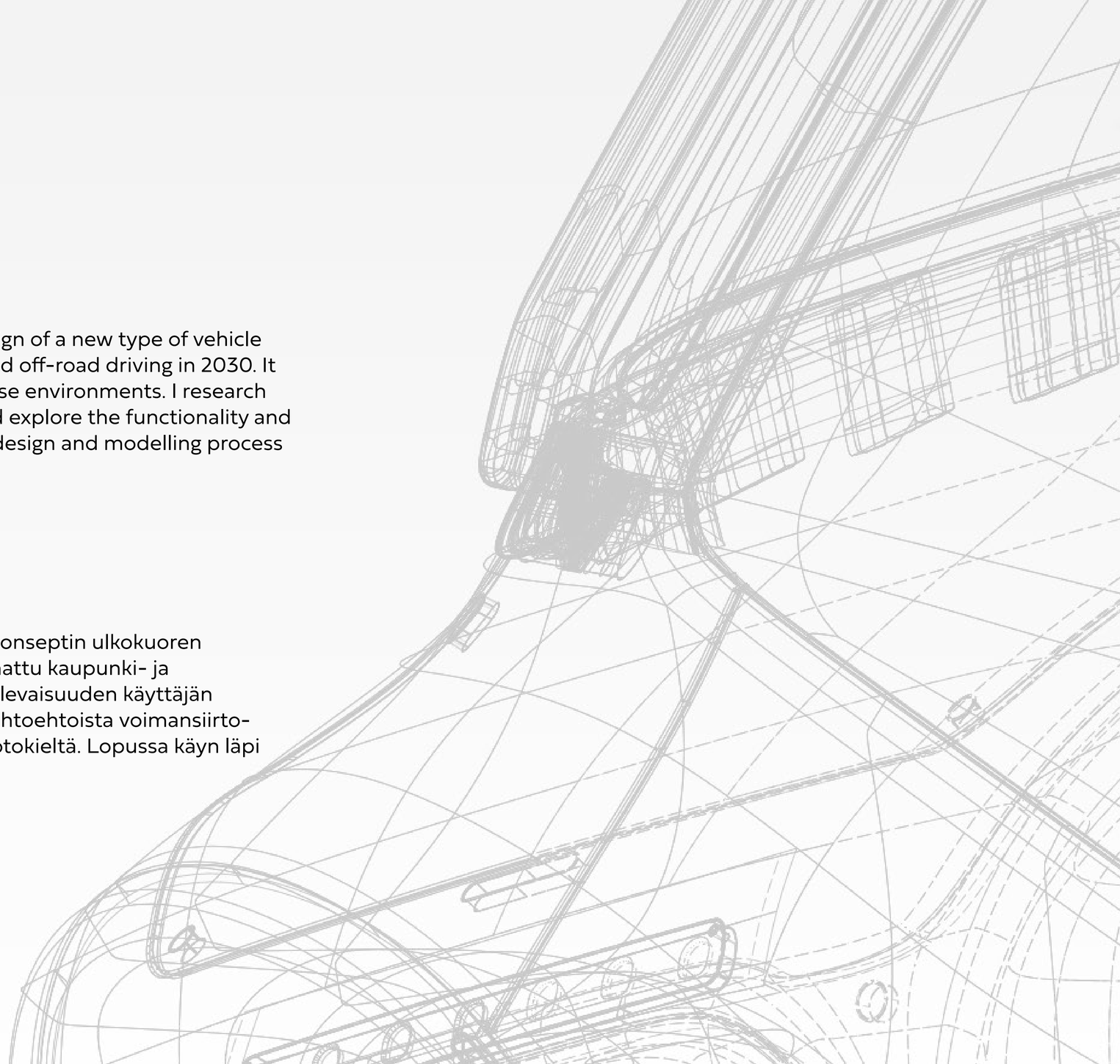


ABSTRACT

In my graduation project, I deal with the exterior design of a new type of vehicle concept for Jeep. This concept is intended for city and off-road driving in 2030. It aims to answer to the needs of the future user in these environments. I research an alternative drivetrain and suspension solution and explore the functionality and styling for such a vehicle. In the end, I showcase the design and modelling process of the final concept.

TIIVISTELMÄ

Opinnäytetyössäni käsittelen uudenlaisen ajoneuvokonseptin ulkokuoren muotoilua Jeep autovalmistajalle. Konsepti on suunnattu kaupunki- ja maastoajoon 2030-luvulla ja se pyrkii vastaamaan tulevaisuuden käyttäjän tarpeisiin näissä ympäristöissä. Tutkin ajoneuvolle vaihtoehtoista voimansiirto- ja jousitusratkaisua sekä sen toiminnallisuutta ja muotokieltä. Lopussa käyn läpi valmiin konseptin muotoilu- ja mallinnusprosessia.



1. INTRODUCTION

1.1 SUBJECT

The inspiration for this graduation project came from an interest in functional design, compact vehicles and outdoor lifestyle. Through these interests, I had the idea to design a product that I saw answering a need of the future.

This project deals with a vehicle concept with which I wanted to explore the idea of having a truly capable vehicle for both urban life and off-road adventures. I wanted to try to diminish the contrast of an off-roader and a city car by trying to combine the best of both worlds, into a true two-in-one vehicle concept.

The vehicle should be suitable for the city and answer urban life's requirements, but have all the capability when moving off-road into challenging terrain.

With this, I had set a brief for creating a compact vehicle concept for Jeep, for the year 2030. Focusing on building functional solutions and using new technologies, I planned to design a visually captivating and believable concept for both off-road and urban driving. The vehicle had to be electric and have space for maximum of 1+1 passengers. The package was to be as small as possible and possess the capability to transform from a city-going into an off-road capable vehicle.

1.1 OBJECTIVE

The goal for this project was to showcase a different solution for a future urban off-roader vehicle. A new category in which a vehicle would have functionality to suit both use cases, urban and off-road.

The main challenge was to keep the package as small as possible while maximizing functionality in a convincing manner. I aimed to find and use more innovate solutions in this project. As a concept for the near future, finding new and alternative technology was a key factor.

As a design exercise, combining two vehicle categories into one was also a big focal point. Balancing between two themes to provide a cohesive and clear design language was important. I wanted to achieve a unique design theme, while keeping a functionality first mindset. A strong and recognizable, yet new visual language was key.

My personal objective was to broaden my tool set by improving upon my 3D modelling skills. The goal was to model a complete vehicle using Autodesk Alias software. Mastering these tools would help to elevate my design work to higher levels and make virtual prototyping a more essential part of my design process.

I also wanted to improve upon my personal design process and be more efficient in every stage of the project to produce better results. Mastering new tools and by learning to be more effective and decisive, it also gives me better preparedness when moving on towards professional work life.

2. CONTEXT

2.1 WHY

Some of the factors that lead into making this project came from certain inefficiencies surrounding the current vehicle market, and how those could be addressed in the near future with smarter design. Current megatrends that shape our ideologies within modern society, thus the future of design, also heavily affected the themes behind this project. From the very beginning, however, there were personal interests that guided me into making this project.

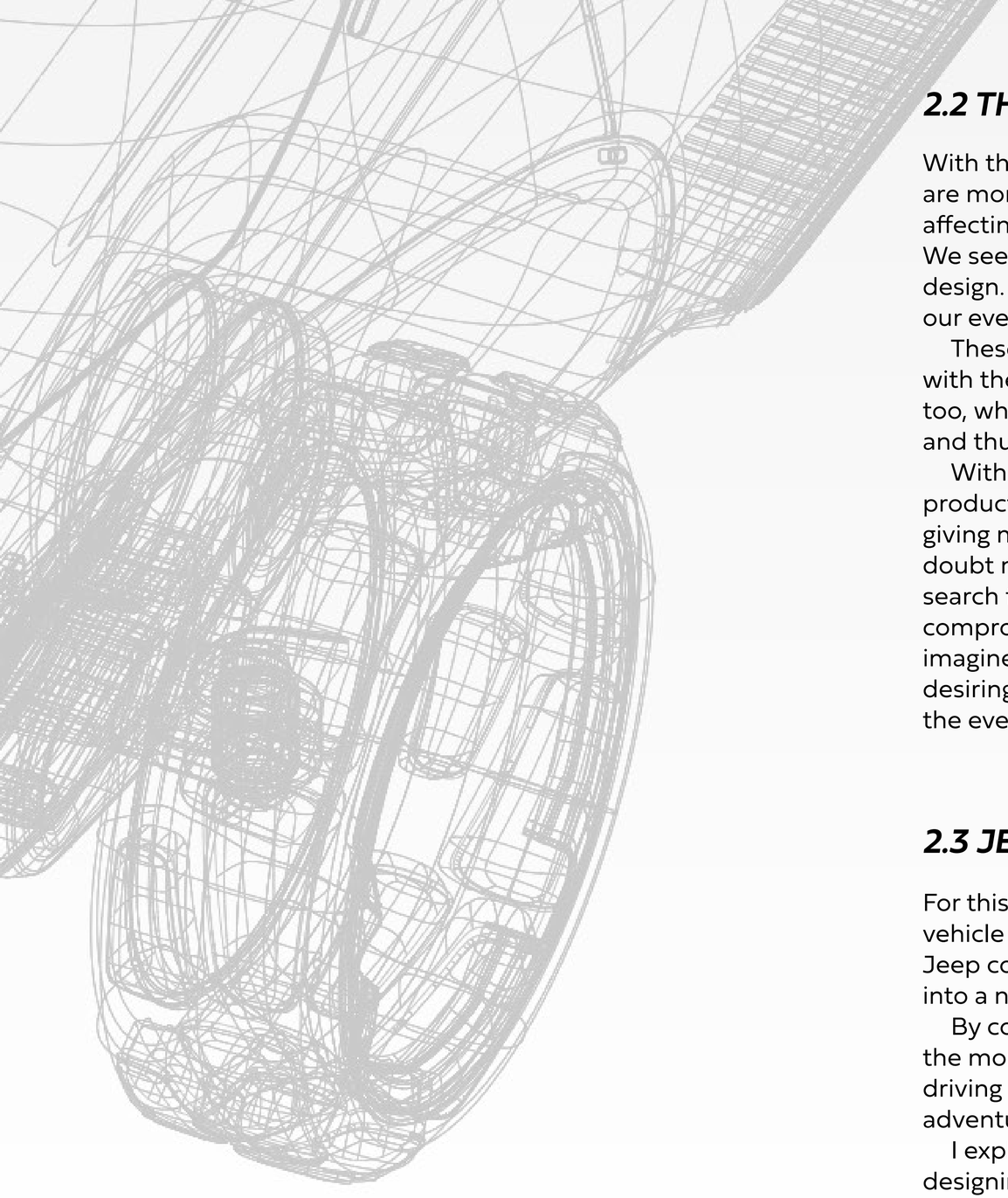
In the past few years of my vehicle design studies, I have grown fascinated by small cars and how much can be achieved with a small package. Therefore, I chose to do a compact car in the first place for my graduation project. As an advocate for these types of cars, I aimed to see how far the small city car could be taken out of its habitat and enhanced in its abilities, without compromising the core functionality and size.

I have also been interested in how nature can be used to balance life. This is especially true as most work and life happens in cities and urban areas nowadays, and even more so in the future. Amid all that, loosing oneself in nature can be a great way to escape the hassle, relieve stress and rebalance. Eventually there is a need to return to those everyday roles in the city, and the cycle goes around. Here is where the idea for this project came to be, as with that journey into nature and back, we often use cars. They are still the most freeing transport method readily accessible for most people. I wanted to see if I could translate this into vehicle design thinking.

Nature locations often need travelling to from large urban areas, and they can be difficult to access with a regular small car. Whereas a city car is often perfect for everyday life, they are not the perfect companion for these adventures. When the roads get rough, their abilities can often run short. And in the near future, 2030, where cities are growing larger, nature could become ever more distant. This is where I based the core idea of this project, as I saw an opportunity to design a product that would combine the aspects of city and adventure into one.

Img 1. Smart off-roading

Img 2. Jeep off-roading



2.2 THE FUTURE USER

With this project, I wanted to keep in mind the future user of 2030, where consumer's choices are more and more ecologically conscious. Consumers are aware of their every purchase decision affecting the directions big corporations take and how industries operate. Even the car industry. We see this with the raising popularity of electric cars now, and sustainable materials in product design. The demand for greener design is rising, which is why eco-elements are more present in our every-day products, and electric technologies are seeking to make cars more efficient.

These realizations will be relevant in the future, where current younger generations, surrounded with these predicaments, are growing older and becoming the new users. In the vehicle market too, where choice is still abundant, this changing user base will no doubt shape the industry further and thus, the way we think about cars.

With this project however, I wanted to approach these factors from the standpoint of the product actually giving more to the user. Targeting multiple needs or desires with one product, by giving more functionality. This would be ideal in the future, where the global need to own less is no doubt more essential, affecting the consumer's purchase decision of a car as well. However, in the search for less - Smaller, more efficient and practical vehicle for all life - Users should not have to compromise in functionality. Scenarios vary greatly amongst users, which is why I felt the need to imagine a vehicle with not just a singular focus or use case in mind. In this project, I targeted those desiring adventure, but needing a solution for everyday life in a city. A vehicle that would answer to the everyday life requirements of 2030, yet still give all the possibilities to escape far into nature.

2.3 JEEP

For this project, I found Jeep to be the desirable brand candidate to design such a vehicle for. This vehicle would serve the users of 2030, where consumer choices arise from needs of the urban life. Jeep could take a foothold in this market, by redefining the classic notion of an off-road vehicle into a new type of adventure vehicle.

By considering where the adventure itself often begins for these users (the city) Jeep could take the more niche market of "off-road" and cater to a wider audience. This way, making adventure driving more accessible and desirable for the average user. Jeep could give users the possibility to adventure and explore, while still catering to the needs of the urban jungle.

I explore how Jeep could achieve this by researching an alternative drivetrain solution and designing an exterior for a new urban-off-road segment vehicle.

2.4 THE SUV

One of the factors that lead to the decision of working with a small package was the rising popularity of the SUV in the modern cityscape, and some of the inefficiencies that comes with them.

The SUV is essentially a large class of different road cars that borrow features from off-road vehicles, such as four-wheel drive and raised ground clearance. Rarely are these vehicles used in such conditions, however. They are often not truly capable nor designed to be used where their features would suggest they are.

Despite this, the SUVs market share has risen exponentially over the past years, especially in the US and Europe, and the trend is predicted to continue. In the United States for example, SUVs came in with 63% of total passenger vehicle sales. In Europe, the number has reached 44% in 2021 (Best-selling-cars 2021) Despite their rising popularity, they are often faced with many criticisms. They are regarded as the new arrival into our urban centers, where cars are already abundant, which might be the reason why their reception is often very two-sided.

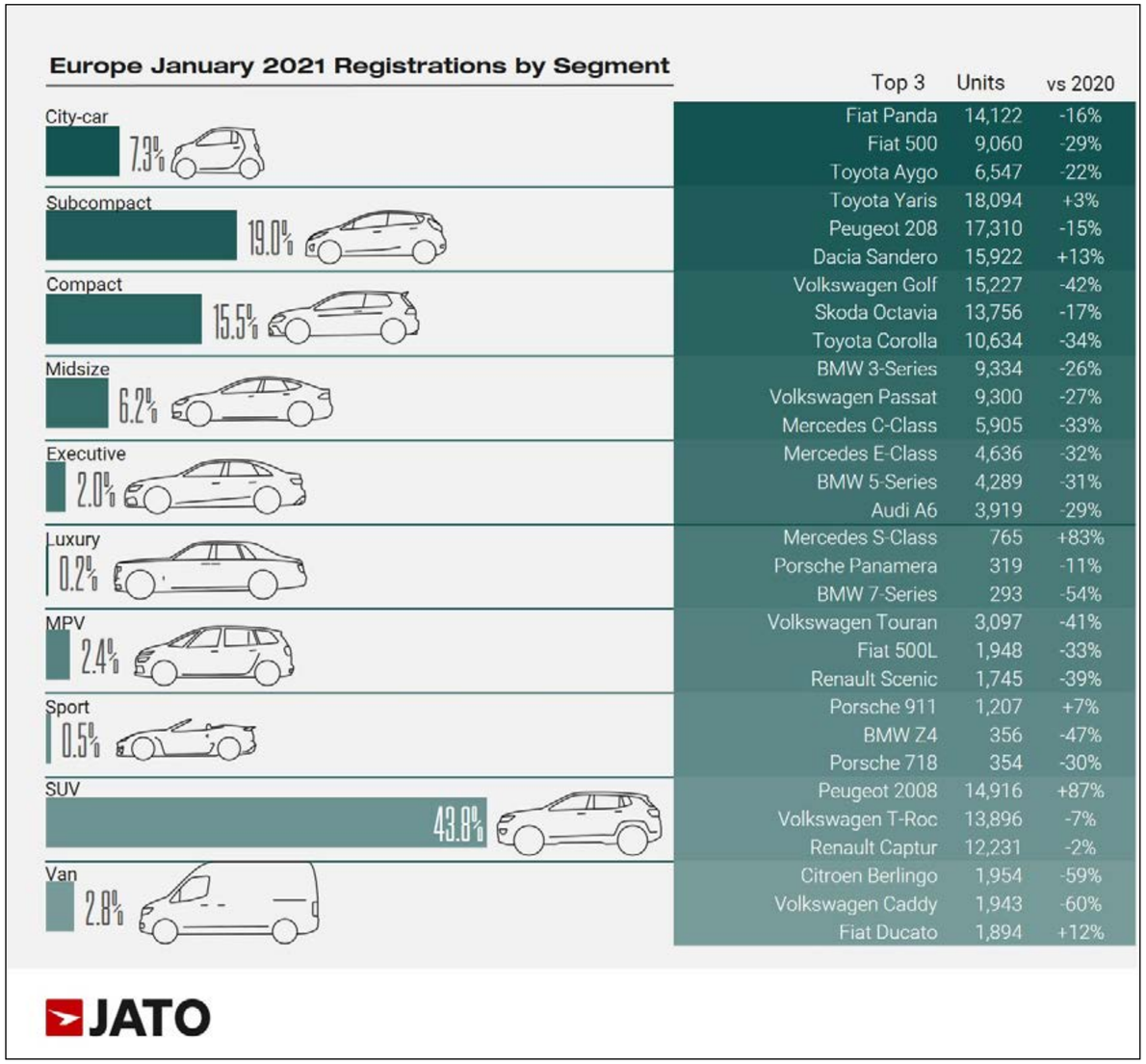
The major critisism these vehicles are often faced with are linked to their larger size and charasteristics similar to an off-road going vehicle. Despite these qualities, they are deemed as one of the least efficient and impractical vehicle types in our cities today. Other large cars, such as the estate (or wagon) and the mini-van, have all been popular classes of large cars as well, but the SUV is quickly taking the seat as the most popular car type in the market.

As the SUV is rising in popularity, it's giving way to a new era of excessively large cars. In the car market, small city cars are no longer deemed a good option next to these vehicles, and this begs the guestion - Why? The SUV is is perceived to give more value and function through its charasteristic, though, this is hardly the case in the every-day use these cars see.

Their main use is most often seen in urban areas, like with any other vehicle. This comes as no surprise of course, as most people live in urban areas after all. Though, this sees no benefit inside city centers that are as dense as ever, where navigation is made difficult and inefficient, while parking areas become sparse. Large cars are not practical or ecological, especially in these scenarios, where small cars thrive.

Img 3. Large and small car

Img 4. An SUV



Top 3	Units	vs 2020
Fiat Panda	14,122	-16%
Fiat 500	9,060	-29%
Toyota Aygo	6,547	-22%
Toyota Yaris	18,094	+3%
Peugeot 208	17,310	-15%
Dacia Sandero	15,922	+13%
Volkswagen Golf	15,227	-42%
Skoda Octavia	13,756	-17%
Toyota Corolla	10,634	-34%
BMW 3-Series	9,334	-26%
Volkswagen Passat	9,300	-27%
Mercedes C-Class	5,905	-33%
Mercedes E-Class	4,636	-32%
BMW 5-Series	4,289	-31%
Audi A6	3,919	-29%
Mercedes S-Class	765	+83%
Porsche Panamera	319	-11%
BMW 7-Series	293	-54%
Volkswagen Touran	3,097	-41%
Fiat 500L	1,948	-33%
Renault Scenic	1,745	-39%
Porsche 911	1,207	+7%
BMW Z4	356	-47%
Porsche 718	354	-30%
Peugeot 2008	14,916	+87%
Volkswagen T-Roc	13,896	-7%
Renault Captur	12,231	-2%
Citroen Berlingo	1,954	-59%
Volkswagen Caddy	1,943	-60%
Fiat Ducato	1,894	+12%

Img 5. Passenger vehicle sales in January 2021

Recognizing the fact that there are, for instance, geographical differences to the use of big cars versus small cars in urban areas. It is evident that certain car models sell better depending on factors like city size, and the distances between cities, as well as seasons. In Finland for example, where cities are comparably small yet distances big, driving changes from city to highway often and weather varies heavily depending on the season. Whereas in a large metropolis like Paris for example, dense cityscape is extended over huge distances, and weather stays mild throughout the year. This, however, did not affect my reasonings for choosing a compact car for this project.

From personal experience during my exchange studies in Paris, it quickly became clear what was prioritized in such a large city, which was small cars. This was an inspiring sight, to see how effectively these vehicles were roaming the streets and having everything you could need in such a small package. This further pushed me to develop this concept and rethink a small car's purpose.

Compact electric cars would unquestionably be the more cost effective, efficient and sustainable solution when it comes to driving. Yet, the average car is rated for 4.5 passengers, for the average family. Often however, these cars are driven by single occupants, at least when it comes to their average use. This adds to the contradictory element of having large cars in the first place, especially when looking at practicality, efficiency, and ecological factors.

This no doubt comes down to the appeal factor between these vehicles, both design wise and functionally. Where the design choices of one vehicle is made to be perceived more capable than the other. These capabilities often flatten out in the city, however, where small size is and should be prioritized. Though, it is arguably true that a small city car is not the most appealing choice for exploring unpaved roads far from the urban area. But could that be changed?

In this project I did not want to dive too deep into the reasons why large vehicles are so popular, nor to replace them. Rather, I used it as research basis for this concept. Broadly interpreting the ideas that are behind the branding of large vehicles, to whom and what they are for. And by exploring some of the contradictory elements of such vehicles versus the actual real-world use they see, my aim was to explore a new type of vehicle for the future market. I aimed to use solutions that would be better suited to the real-world scenarios faced in the city first, and this way look at solutions for moving outside of it. I focused on functionality and technology that could be more efficient and beneficial in both use cases.

2.5 URBAN LIFE, OUTDOOR LIFESTYLE

Looking broadly into the marketing of this genre, a common theme is often found in the emphasis of adventure and exploration. Romanticizing the idea of being able to go outside city bounds into the “unknown” when desired.

Amidst the hectic city life, escaping into nature to relieve stress and to rebalance, is important. This has become even more true in the era of a pandemic, where lockdowns restrict life and people have discovered the great outdoors differently than before. In future this trend will continue, as urban areas and cities will only get bigger.

This became the core theme behind this project, the relationship with these two sides in our everyday lives, the concepts of “urban life” and “outdoor lifestyle”. With this realization, I aimed to create a design, both visual and functional, that would bridge them into one cohesive theme.

I wanted to approach the idea of adventure from a different standpoint. Eventually, all adventures lead back to the city, back to where they started. There, scenarios and needs are very different to those of country locations, exploring desolate mountain or forest roads for instance. Therefore, I wanted to imagine a singular vehicle that would be capable in both scenarios, embracing the idea of essentially “a city car for adventures”. From urban to adventure and back. I wanted to embody this journey, to the design of a near future vehicle.

2.6 CITY VS OFF-ROAD

The notion of an “off-road” car compared to that of a “city” car, is often separated by the vast contrast in design trends, functionality and, of course, the end user and their needs. Despite this, and besides status factors, users are in the end separated by what they prioritize most. With this vehicle concept I investigated the most important aspects and features that are within these classes of cars.

In the end the selling point of the “SUV” is trying to be that of not having to prioritize, by combining aspects from one genre to another. However, this also means that often the users end up getting a lot of what they don’t actually need or use. One could want the possibility to explore and adventure, but without the impracticalities of a large car. With this I wanted to explore how the traditional styling, package and functionality of these vehicles be challenged, by combining aspects and features with them found in the notion of modern urban cars.

Img 6. City

Img 7. Mountain road

3. RESEARCH

3.1 BENCHMARKING

While looking at other similar solutions with compact packages in the off-road vehicle sector, none were quite as close with their small size as the he Polaris Ranger (left), And BRP Can-Am Defender (right). They are very similar in their construction and dimensions of approximately 3 meters in length and 1.9 meters in height. Therefore, I leaned towards similar package as a baseline to build this concept and set an approximate limit to similar dimensions.

Compared to the average small car's height of 1.450 meters, these models are quite tall, which is mainly to provide better ergonomics for the passengers. With a higher sitting position and larger headroom, moving in and out of the vehicle is easier especially in challenging surroundings.

These models at base tier offer a 1+1 passenger solution, which is often quite enough for off-road use but also for the city setting, which is why I based this concept around a very similar package.

These are utility vehicles built for carrying out various tasks in challenging terrain. They have a distinct utilitarian aesthetic, and a rugged body and wheels. These vehicles are for work use and have the possibility to carry small cargo. They are best suited for local transport and not for long distance driving. And despite their compact size, they are not purpose built with urban driving in mind.

The Suzuki Jimny is another very small off-road car, its length being approx. 3.6 meters. It also has a package and style that is similar to other off-road vehicles. The picture below shows the early 2000's model in the center of the image. It showcases the size difference over other conventional off-roaders.

Img 8. Polaris Ranger

Img 9. BRP Can-Am Defender

Img 10. Suzuki Jimny

Img 11. Swingcar

Img 12. Menzi Muck M545X

3.2 SOLUTIONS

As this concept is to be fully off-road capable, I looked for existing advanced suspension and drivetrain solutions of vehicles built to roam difficult terrain, both for inspiration and for proof of concept. As opposed to a typical off-roader with massive ground clearance and huge tires, I was looking for a non-intrusive yet innovative solution to suit urban environments better, but also to keep the main package compact. This meant that some kind of active wheelbase mechanism would be better, as it would allow the size of the vehicle to be as small as needed, while still allowing the wheelbase to transform for off-road use.

Early on with this project I came across various vehicles of different sectors that utilize technologies to help them to “adapt” to their environments. Such as the Swingcar, which is a super agile leisure vehicle using multiple joints in its “wheel arms”, allowing the wheels to roll and move independently. This diminishes the need for ordinary suspension. It also uses a pendulum (swing) system to always keep the driver upright by using gravity, despite the gradient or terrain. Electric hub motors are used to power the wheels, freeing the frame space entirely for passengers.

Another example was the Menzi Muck M545X, which is an excavator that uses heavy-duty hydraulics to maneuver and position its wheel armatures independently, giving this heavy industrial machine great mobility whatever the terrain. These were some of the existing solutions that I used as a model for designing a plausible solution for this concept.

3.3 HUB MOTORS

It became very clear that an opposing solution to a typical electric vehicle drive train system were to be used. Although an electric vehicle rids itself of the large combustion engine and gear box, other rigid components such as the driveshaft are still present. Therefore, electric hub motors, also known as in-wheel motors, are a great alternative for this concept.

Future hub motor systems incorporate many advantages over the conventional electric vehicle drivetrain solutions. Not only are they set to be more efficient in power transfer and torque regulation, but they also provide great advantages in space and weight saving.

Hub motors work as their own independent units, which allows for greater control over each wheel. Conventional drive shaft systems experience some time lag as power is transferred through the long shaft to wheels. With an in-wheel motor system however, this lag is next to none. As there is only a very small drive shaft driving the wheels inside the system, power transfer from the motors is instantaneous. (Nissan Global 2021)

As this project is heavily focused on off-roading as well, the torque controlling factor which this system provides would be an advantage as well, as torque can also be applied separately. This would provide great use in difficult terrain, as each wheel has its own motor and therefore power can be greater in one wheel or the other, when needed. Since the wheels aren't dependent on each other, it reduces the risk of losing torque in one wheel, while the others are doing the work. Also steering the vehicle would be more efficient as more or less torque can be applied to either side of a vehicle, depending on the turning direction and how much the driver steers. This concept is utilizing electric hub motors inside each of the four wheels.

Img 13. Hub motor

Img 14. Jeep in a city

3.4 BRAND

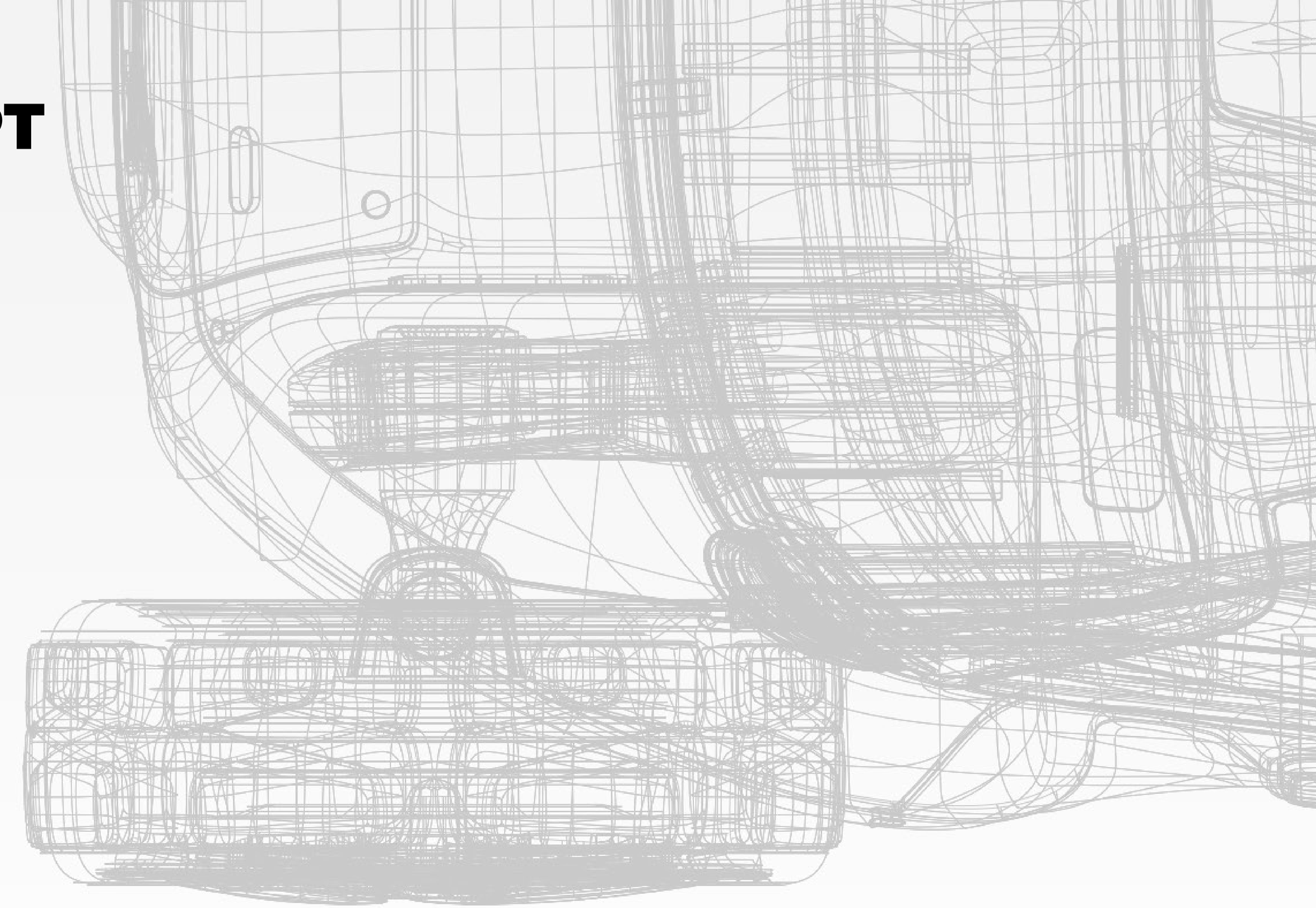
Beginning the design stage, at this point it wasn't very clear what the brand of this concept would be. While the main idea was the same from the very beginning, in the early stages I had a different approach in mind. I had chosen a city car brand for this project initially, but I had difficulty justifying the idea of taking a such a car brand into an off-road context. It was quite clear that selling the idea would be difficult. Therefore, instead of sticking to a potentially hit-and-miss idea, where the context was not really understood, I moved onto a different brand.

I decided to embrace the off-road aspect of the idea more. After all, "off-road" is the more niche and therefore demanding area of the concept. Having labeled this project catering to that area, it needed more careful and thorough explaining. Having a vehicle that could essentially transform into an off roader from a small city car package, was still the idea I wanted to pursue the most. To give this project the proper context it needed, I decided that the better solution was to completely change the brand, which is why I chose Jeep.

There was not a clear contender for the branding choice at any point of the project. The decision was made more from the standpoint of what brand would best suit the design I already had in mind. Changing the brand proved to be a positive change however, both design and context wise, and it gained better response in the following seminars.

Designing such a concept for Jeep proved to be an interesting task, nonetheless. Taking aspects from a brand known for its off-roading heritage gave this concept a clearer identity that was easy to move forward with. Though, not forgetting the urban aspect of this project, the challenge was to combine themes and elements which would be suited for the city as well.

4. CONCEPT

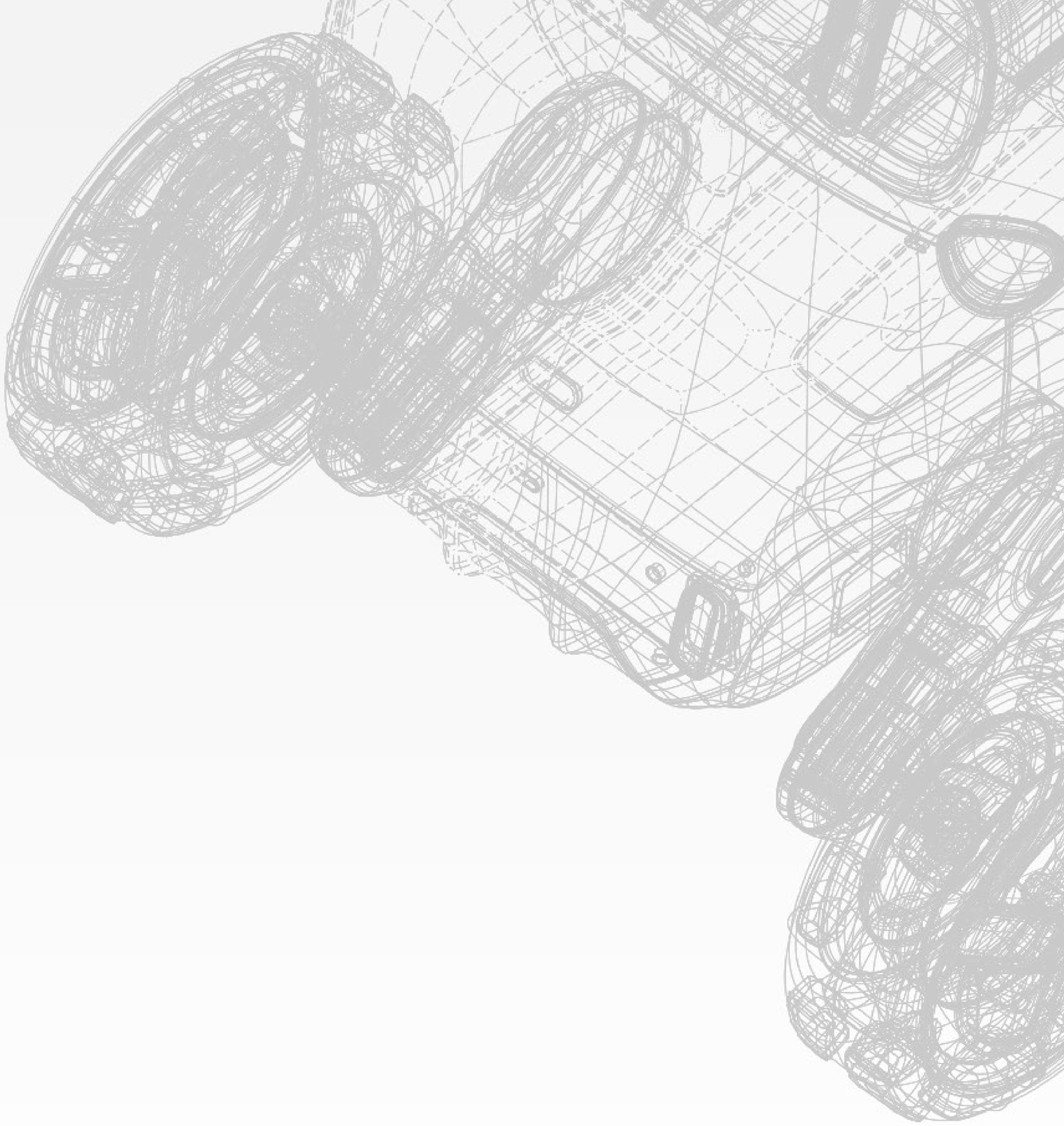


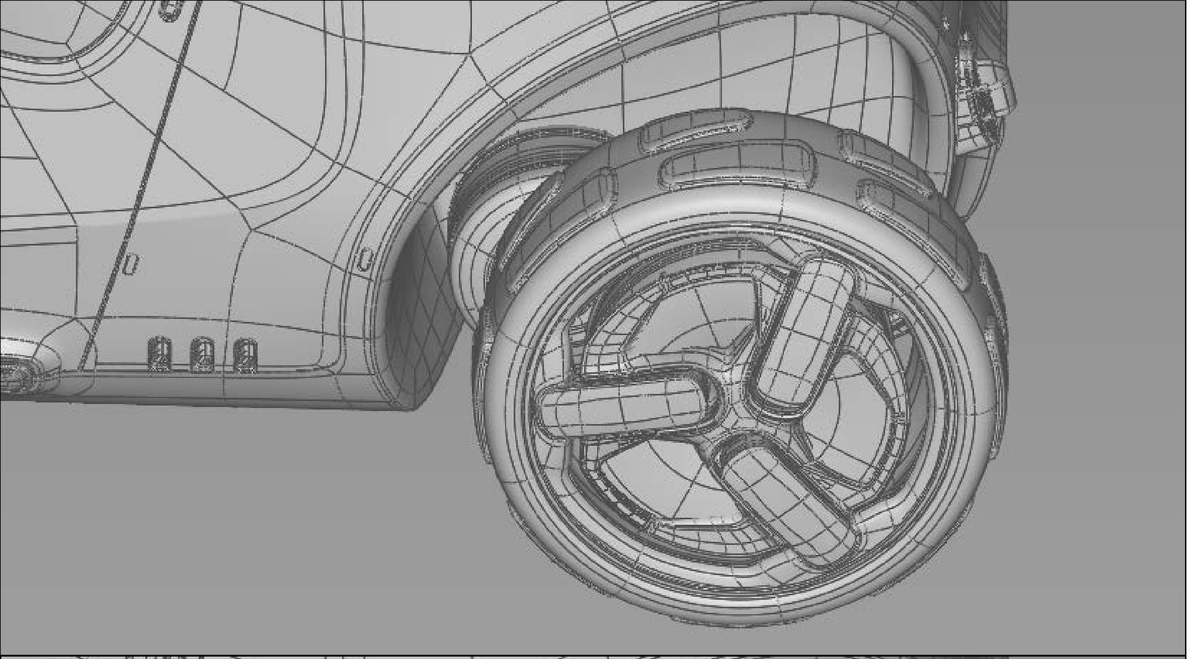
4.1 THE IDEA

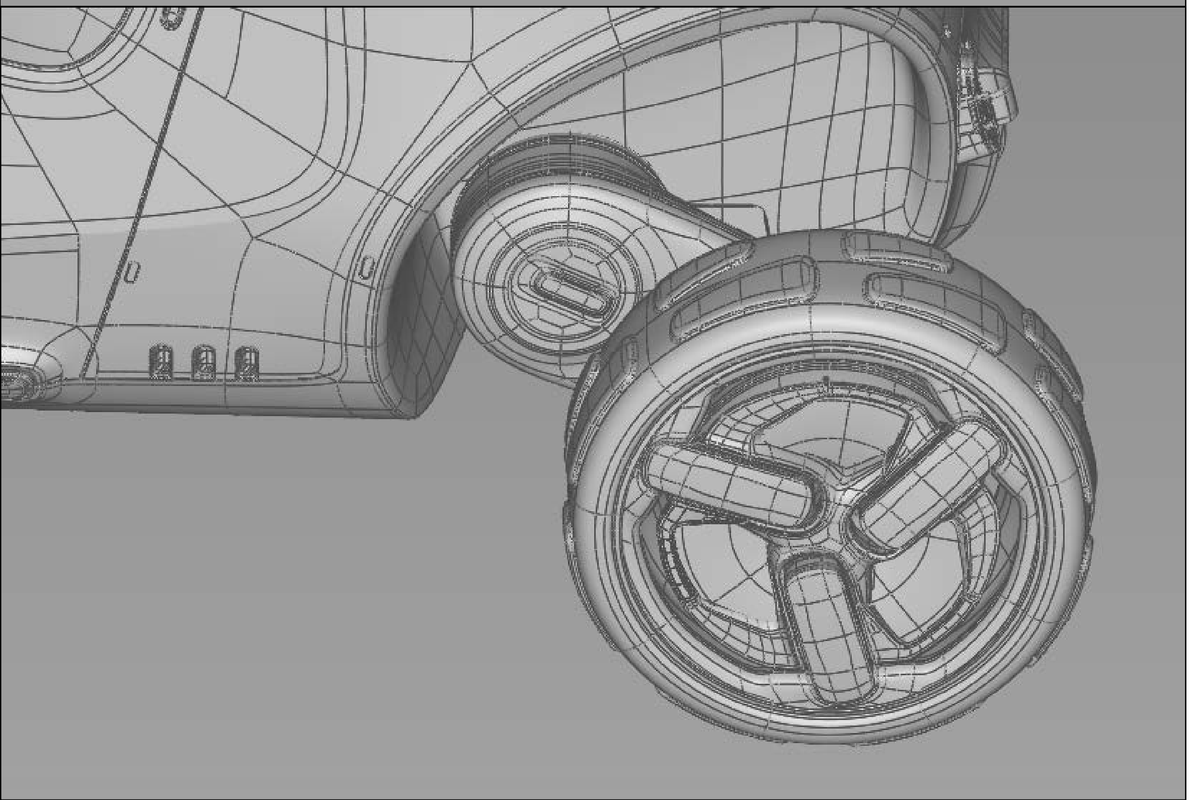
From the start, the key concept for this project was the idea of being able to transform, essentially a city car, to an adventure capable vehicle on the fly. A vehicle that would have the ability to adapt to changing terrain without impacting the size or functionality of the package itself.

Since one of the main components of my brief was to keep the vehicle as small as possible, and to maintain maximum usability in urban environments, it was important to have a mechanism that would be as non-intrusive as possible. Although this mechanism had a more visible role in the sketching phase, I later dialed it down to be more minimal for this very reason, but to also give a more believable impression. Whereas in the early ideation I had the mechanism to be part of the whole body, where the armatures housing the wheels would “slide” out, but otherwise sit flush within the body. However, in the final version I took the armature idea, but made it much smaller, so the mechanism would sit entirely inside the wheel arches. This way the body of the vehicle would be untouched, proving to be a better and a more credible solution technically, but also in terms of execution later on when moving into 3D modelling.

This project was not to be a technical explanation of the deeper workings of such a mechanism, but rather a design exercise. It was still important to make an impression of a possible and working solution and make it cohesive with the design. I started calling this idea “adaptive wheelbase”.







4.2 ADAPTIVE WHEELBASE SYSTEM

The adaptive wheelbase system effectively gives the vehicle two “modes”. The default state being for urban driving, and the other for off-road driving. While in the city, the vehicle would be in its smallest form, giving it all the advantage in urban driving. Short wheelbase and low ground clearance give the vehicle greater agility in the city environment, and the small size gives more freedom when navigating dense areas and tight roads.

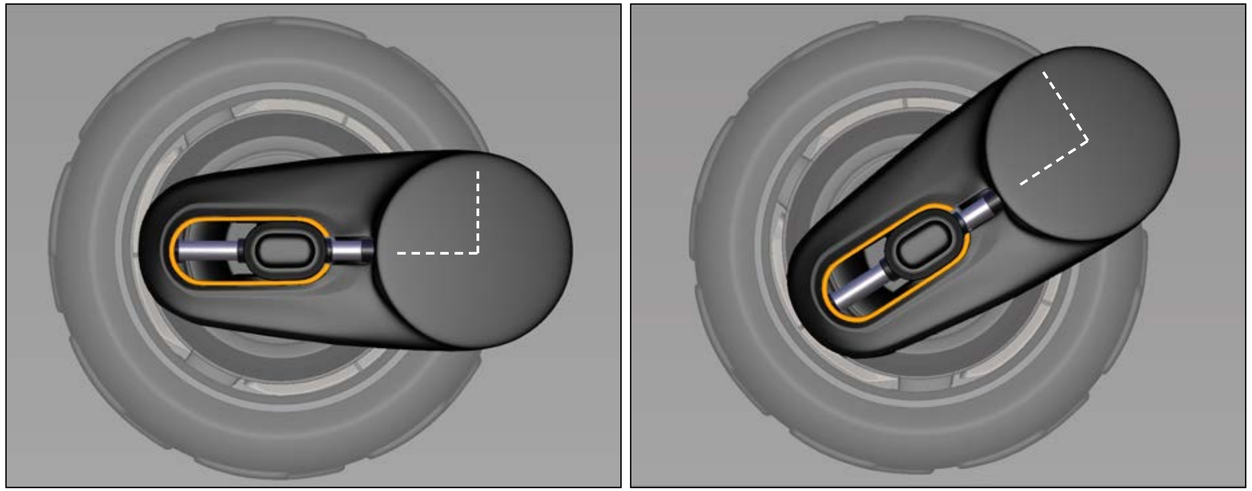
When exploring and wondering off tarmac into more challenging terrain, the wheelbase can be extended, and the ground clearance lifted. This way the vehicle gains stability and mobility on difficult roads, making it possible to go further, no matter the terrain.

With this relatively simple adaptive wheelbase system, the vehicle is able to have considerably more control when off-road. Driving would be more fluent, ideally giving the driver more confidence in this otherwise small vehicle.

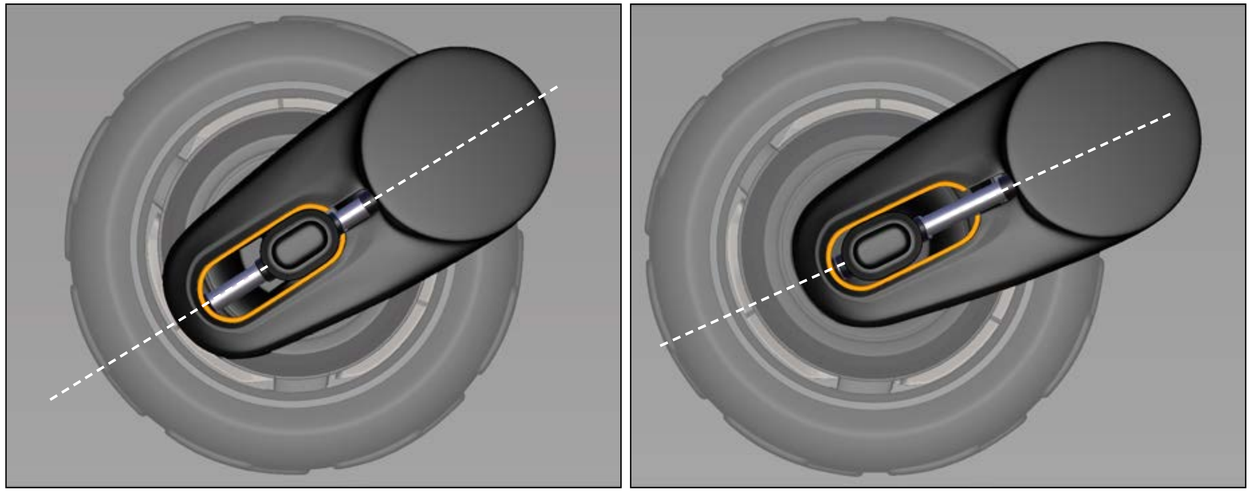
4.3 HOW IT WORKS

The benefit of the adaptive wheelbase system over conventional drivetrains is in maximizing the control the user has by adapting to the terrain.
In principle, it is a simple mechanism with an armature, to which the wheel and hub motor is attached to via an axle. The armature itself has a pivot point from which it is connected to the vehicle, allowing movement along its axis, not only providing the vehicle with suspension (instead of a traditional spring mechanism), but also allowing to raise or lower, or adapt, the ground clearance to every terrain. The wheels can extend forward, giving the vehicle a longer wheelbase, improving the small vehicle's balance when needed.
By lifting the vehicle and extending the wheelbase, the vehicle is ideal for off-road use. In this "mode", it is the most stable and capable for such conditions. As the wheels are extended outward via the system, they are first to contact any obstacles or impacts. The body is raised higher and further from the ground, which helps keep the body from being damaged in rough or otherwise unpredictable terrain.
This works by having a fixed rail, along which the wheel can slide back and forth by a piston pushing or pulling the wheel axle. Besides the main suspension, this fore-aft movement of the wheels give the vehicle further dampening effect. This way, there's not only vertical suspension but horizontal as well, albeit slightly less. With this system driving is made even more supple.

Up - Down



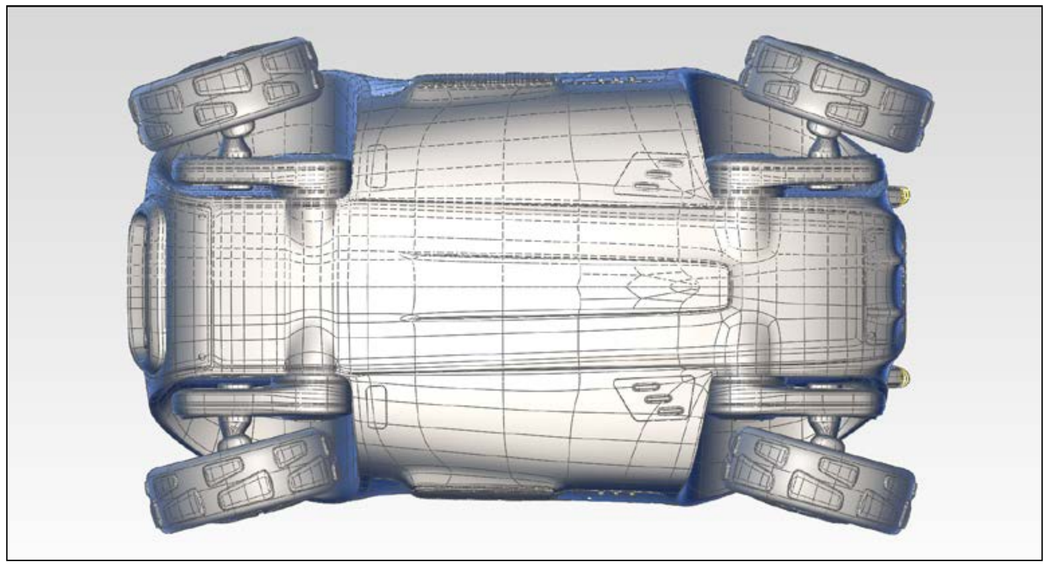
Fore-Aft



Each of the four armatures work independently, which allows for great mobility and fluent driving even in challenging off-road conditions. By being able to control each wheel's position and height, to a degree, the vehicle is able to stay upright relative to the ground more easily. This way the passengers are more upright as well, helping to keep the driver more comfortable and confident.

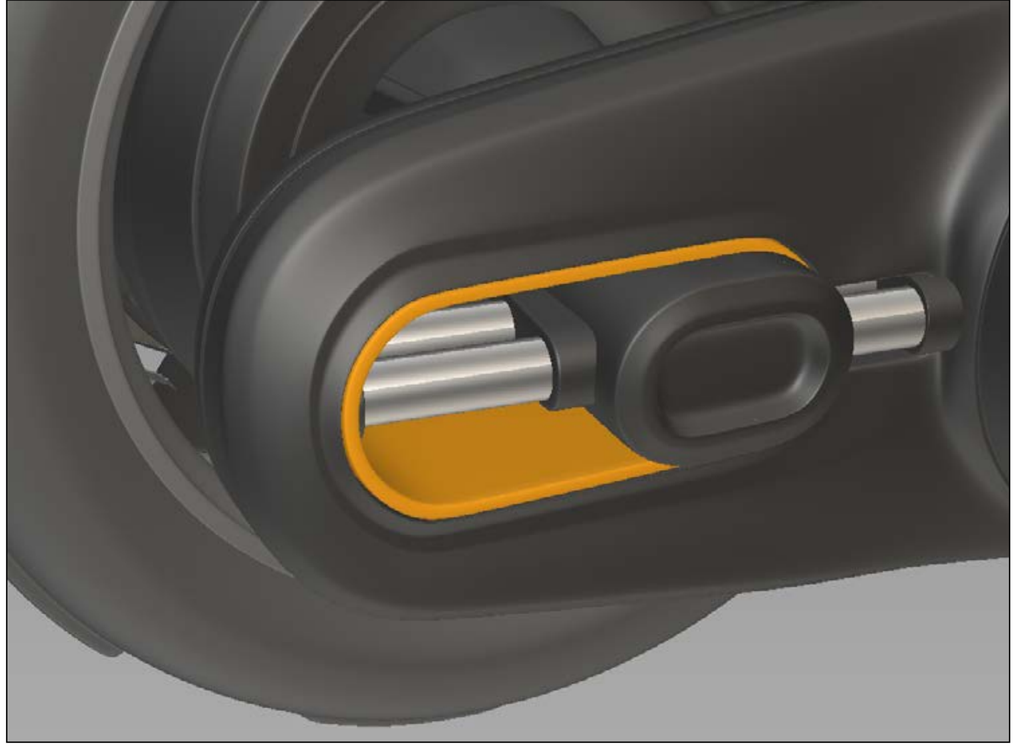
The system would make driving much more enjoyable in urban areas as well. Being able to lean the vehicle into tight turns by raising the other side of the vehicle against the turn, or gravity, would keep the vehicle more stable and the passengers more comfortable even at higher speeds. This would arguably make driving in the city more efficient and fluent, but fun as well.

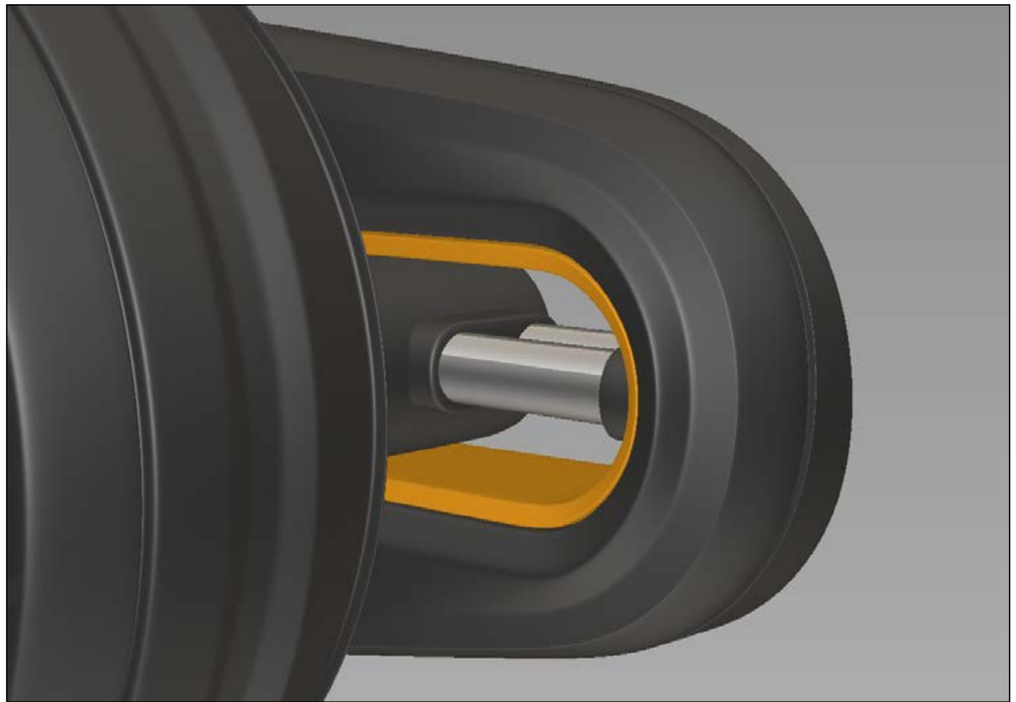
Controlling the system would ideally be automatic, but if needed, the controls could be turned to manual mode. Manually controlling the system could prove to be useful in situations where speeds are low and space is limited, or otherwise extremely challenging, where a "crawling" mode is necessary. Four-wheel steering makes the vehicle agile and nimble in every condition, was it off-road or parking in the city.



There was a clear concern for the durability of the system in the varying conditions it would be faced with while exploring off-road. There, dirt, mud and other debris are bound to gather around and into these components that are open to the surrounding elements. With the first ideas, imagining a real-life scenario of cleaning the mechanism and components easily was difficult. This forced me to think about a less complicated system, that would also require less construction.

As there are moving parts on the system, their functionality needed more careful evaluation. I avoided any unnecessary holes or other details in the design that could possibly gather dirt. I also imagined the system to be self-cleaning. The rails which allow the wheel axles fore-and aft movement are open, allowing the axle movement to push away any accumulated mud or debris off the rails. The open design could also be easily cleaned afterwards if necessary. In its final form, the adaptive wheelbase system is designed so that cleaning and maintaining it would, ideally, be more straightforward and easier for the user.





5. DESIGN

5.1 STYLING

This project was not only to be functional, but an exercise in creating good aesthetics as well. I strived for a design that would be captivating yet purposeful. Balancing between the two distinct aspects of “city” and “off-road” and finding a cohesive theme and design language between them was a challenge, but one that I wanted to tackle, nonetheless. The aim was to take the two very different faces found within these vehicle genres and aim to combine them into one singular concept. It was important that the design of the vehicle would be able to clearly display its purpose.

Keeping in mind the small size, there wasn’t a lot of room to play with, so I focused most importantly on building a strong graphic and the overall silhouette of the vehicle, I wanted to have some sort of surprising element on the design as well.

In the end, I chose to combine sculpture with utilitarian elements as the main design theme. Sculpted body gives the vehicle a certain elegance, blending the vehicle into the modern city. The utilitarian details and rugged base remind the user of the vehicle’s capabilities off-road, giving it more seriousness.

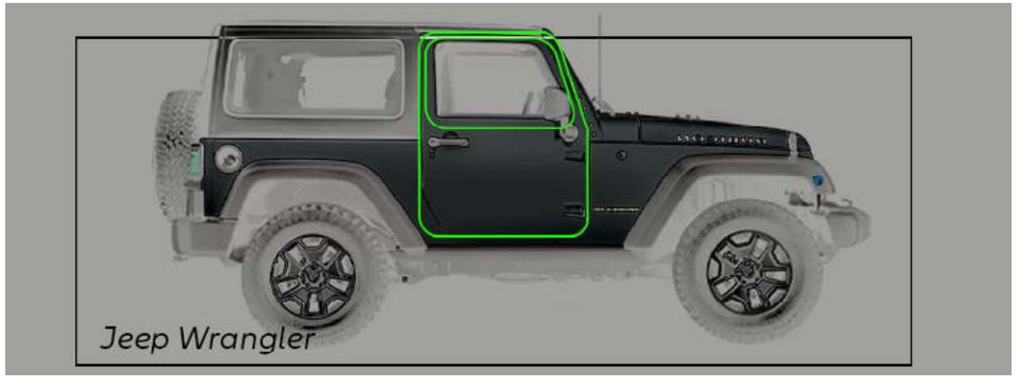
As I knew that I wanted to focus on the surfacing and create an encapsulating atmosphere with it, I focused on building flowing, softer forms, that would be intersected by the hard surface and lines on the side profile. This allowed me to create a strong contrast between these elements, and thus tie the theme together. The lower, utilitarian details, are a different material from the body’s metal surface, giving a tough and durable look, while working as visual contrast. Some of the detail elements are inspired by Jeep’s off-road cars. Bolder shapes in the details help make the vehicle look robust. The base of the vehicle and the dark matte material gives contrast to the metallic body, visually lifting the vehicle, but it also gives more protection against impacts on off-road adventures.

Img 15. Sculpture

Img 16.Utility

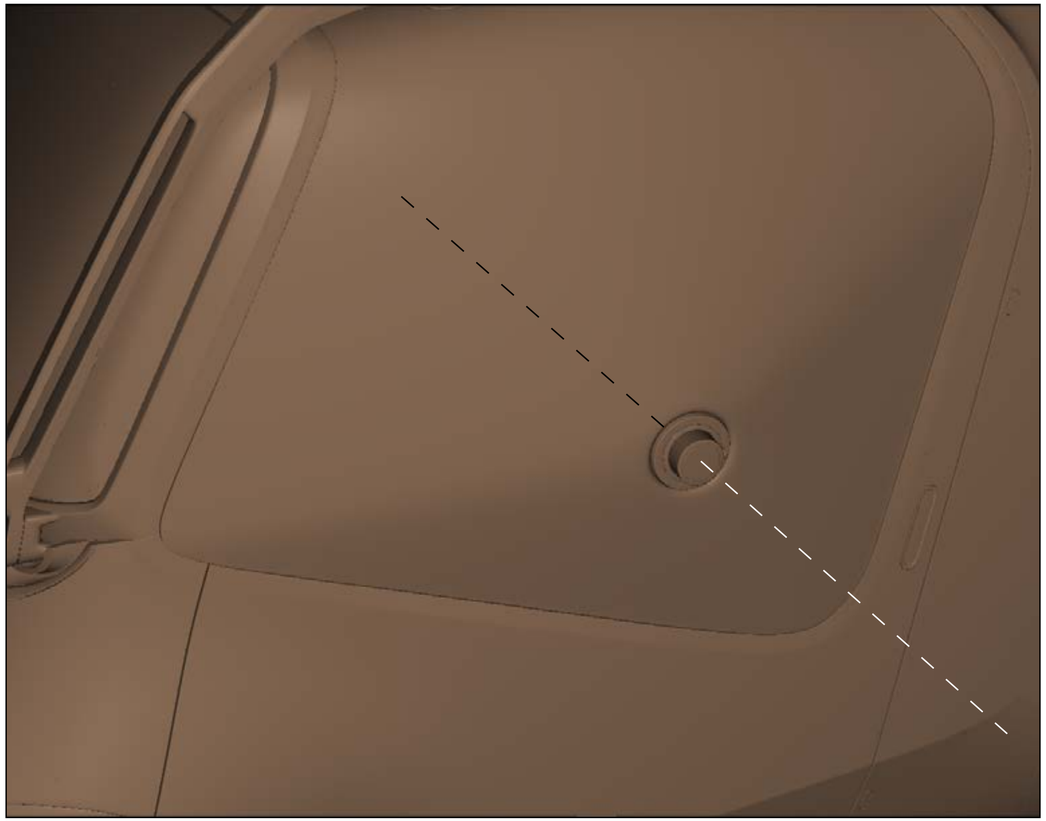
5.2 SIDE GRAPHIC

As I was ideating and trying to find a strong design graphic, a key element, I quickly saw an opportunity to play with the side window and surface. I looked at Jeep's other models, especially the Wrangler, which has timeless off-road styling. Looking it from the side and tracing its key lines, they can be seen forming different square shapes, which gives the car's strong and familiar silhouette. With this quick study, I started to combine these shapes, trying to find a strong graphic for this concept, something familiar but new. With the final design, I essentially took those squares and imposed them on the side, which ended up forming two shapes, the window and side surface graphic. With this I had a striking element intersecting the otherwise soft and flowing surface. This became the core design element for this concept.



Img 17. Jeep Wrangler edited side view

With further development, I played with the curvature of the side window, wanting to create further interest to this large element. Therefore, I took the center point of the window, essentially pulling outward from that point, creating an intriguing reflection to the otherwise flat side square surface. This way, I achieved a play of different reflections where every viewing angle would reveal an interesting contrast of light and shadow. The center point of the side window is placed so that the curvature, therefore the reflections, would follow the vehicles direction. This creates a strong horizontal line starting from the front hood extending to the sides, effectively helping the vehicle to visually lean forward giving it more direction and determination.



5.3 PROPORTIONS

When it came to the proportions, I wanted to achieve a unique look and appearance. I knew early on that I wanted to have playful elements in the vehicle's design and proportions. My goal being to give it a fresh and young look, instead to those of heavy-looking off-roaders. I wanted to create an iconic vehicle for the future Jeep.

I was inspired some of the 90's and early 2000's concept cars and wanted to borrow some of the fun and quirky character they possessed. Some of these concepts were efforts to combine off-road aspects to into sports car chassis as seen with the 1995 BMW Z18 and the 1996 Heuliez Intruder, based on a Mercedes Benz G320. Some were more futuristic than others, for example the Mitsubishi Pajero Field Guard Concept from 1993, that was an amphibious off-road vehicle. They had bold yet gentle shapes in their design, and often challenged the conventional proportions and blurred the line between different vehicle segments.

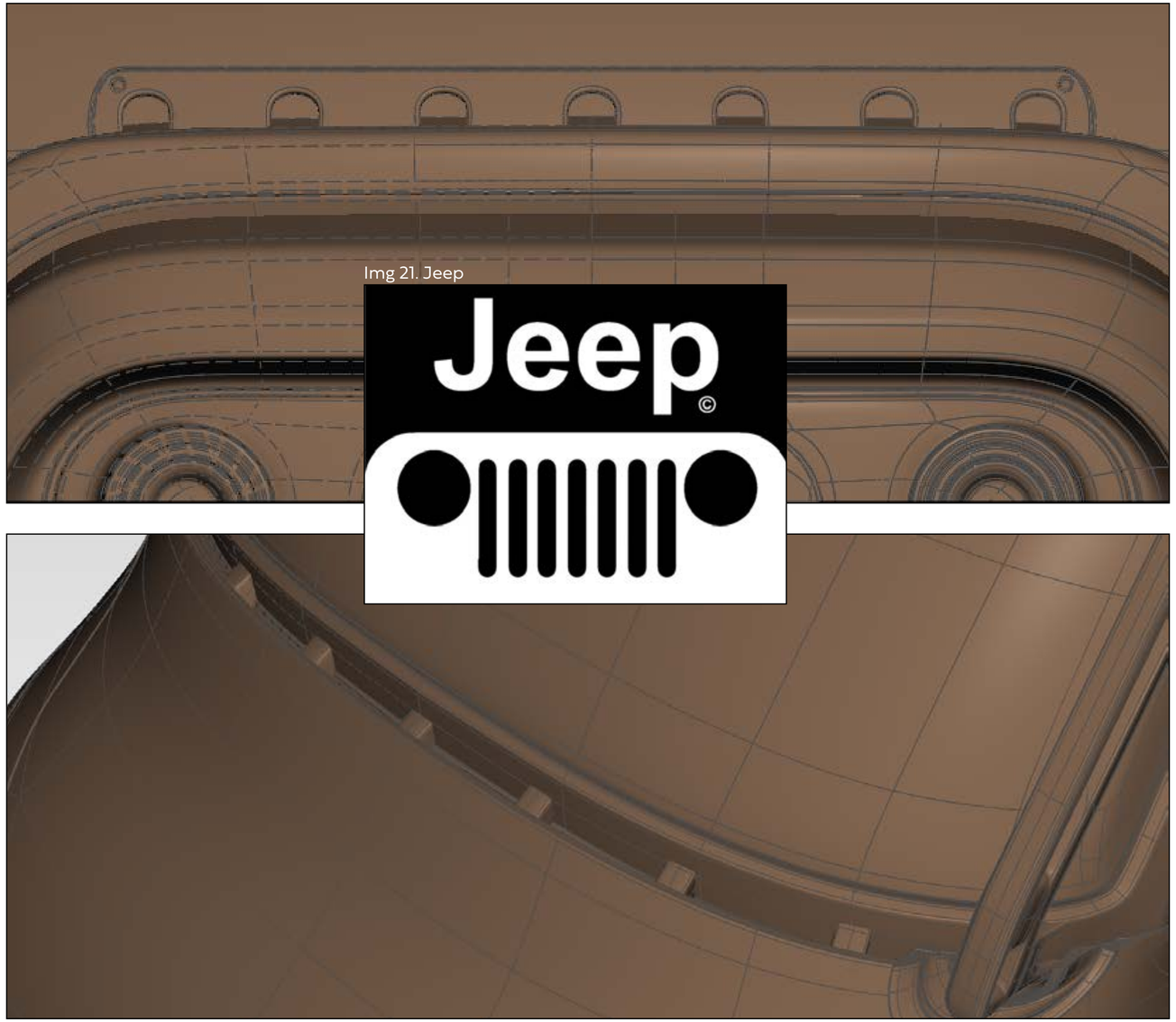
For this project, the vehicle had to give away certain strength and own a powerful stance, despite its compact size. As the vehicle lacks the conventional hood or trunk, the "greenhouse", or the passenger space, is the dominating element centering the vehicle. Essentially squeezing the package to be shorter, yet taller. This allows for the compact size while still giving maximum room for the passengers. As the vehicle is relatively high yet short, I needed to make sure it would sit well with the ground. Thus, I gave a lot of emphasis to the wheels themselves. Having large wheel arches is not only functional for allowing space to the underlying adaptive wheelbase system and for improved off-road clearance, but it also gives the wheels room to breathe, making the body appear smaller. In addition, with the vehicle's short nose and back, having the wheels in front helps to protect the vehicle's body from impacts off-road or in the city.

On the a-pillars of the vehicle, I added metal rails on both sides. Before this choice, the vehicle was lacking on the front, feeling weaker compared to the other body. This was due to the window frame, or the one-piece a-pillar, which was relatively slim to improve passenger visibility. Therefore, the addition of these rails gave the vehicle the added forward stance that I was looking for, and visually strengthened the front end of the vehicle. This moved the balance forward from the relatively heavy and high back of the vehicle.

Img 18. BMW Z18


Img. 19. Heuliez Intruder


Img. 20. Mitsubishi Pajero Field Guard



Img 21. Jeep

5.4 JEEP

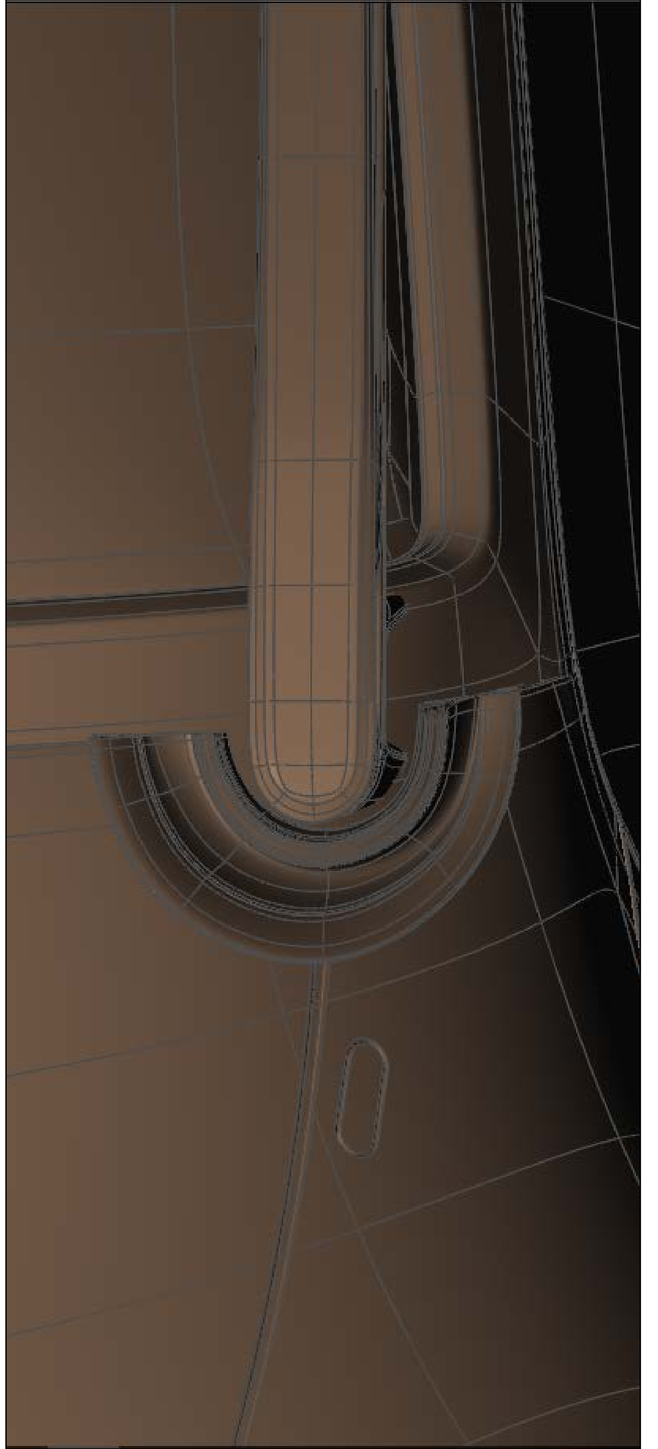
As the brand changed during the design phase, I started looking for the key elements of Jeep's vehicles, to find factors that would identify this concept as that brand. Jeeps key identity, from which it's mostly recognized, is undoubtedly the iconic 7-slot-grille. Among the grille, round front lights are almost always found, especially on their off-road cars. These were the main elements that I wanted to incorporate from Jeep. However, I wanted to give a minimal appearance, and therefore keep the branding minimal as well, yet recognizable.

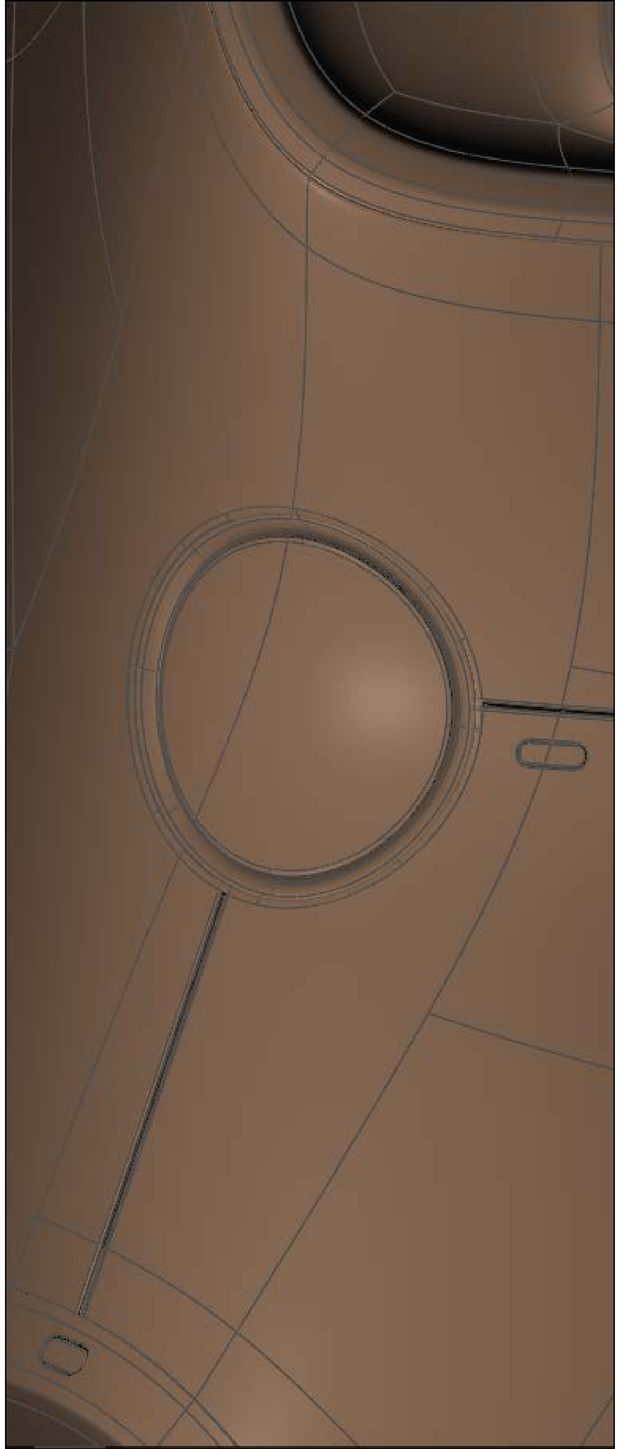
As Jeep is strongly tied to its off-road heritage, which is what users are most familiar with, I had to look at how to best combine the brand with the notion of a city car. I wanted to keep a clear indication that this vehicle is after all a Jeep, and also capable in the surroundings they are often faced with. However, it was just as important to bring this concept to a more unfamiliar side for the brand, which is the cityscape.

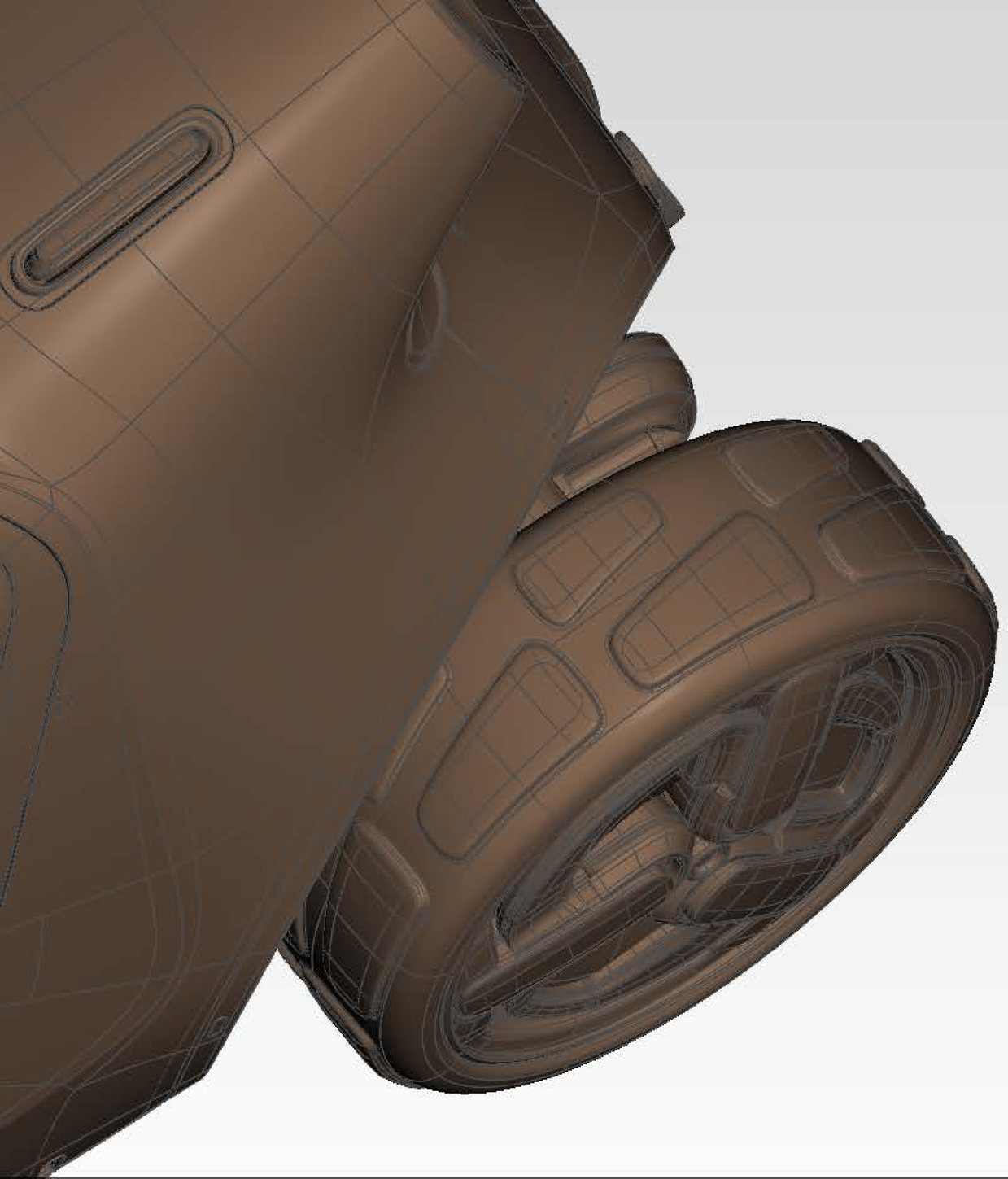
With the visual branding, I went with a less is more approach, and focused more on trying to give away Jeep's character through the details and look, though there are clear indications to the brand. For example, the iconic 7-slot grille signature is placed above the lower light housing. Although this is an important detail, I wanted it to be minimal to not take away from the surfacing, but to still be noticeable. While on the sketching phase, placing the signature on a more noticeable spot simply did not work. Thus, this was the optimal place for the detail, and allowed for a more balanced face for the vehicle. Another detail is found on the front, between the frame and the front window, where I placed a seven-pillar structure, giving yet another hint at Jeep's iconic signature.

5.5 FACE

Creating a recognizable face of any vehicle is crucial for giving a good first impression. There is no doubt that a vehicle's lights play a big role in achieving that, which is where I spent a lot of time in the design phase. I wanted to create an expressive face, that would immediately spell "Jeep". I wanted the aspects of exploring and adventure to be readable in the vehicle's expression, to have it not only feel, but look capable. However, as is the theme with this project, the vehicle would have to feel at home in the city as well. I incorporated the familiar rounded lights found in many Jeep's, but wanted to create a certain edge, to give the vehicle more presence and a slightly mean gaze. Thus, using half round lights at the front intersecting them with the body worked best to achieve the appearance of seriousness I was looking for. But to appear more friendly and fun in the urban jungle, I used large round lights at the back for the brake lights. This combination of hard and round became a theme with this concept.







5.6 WHEELS

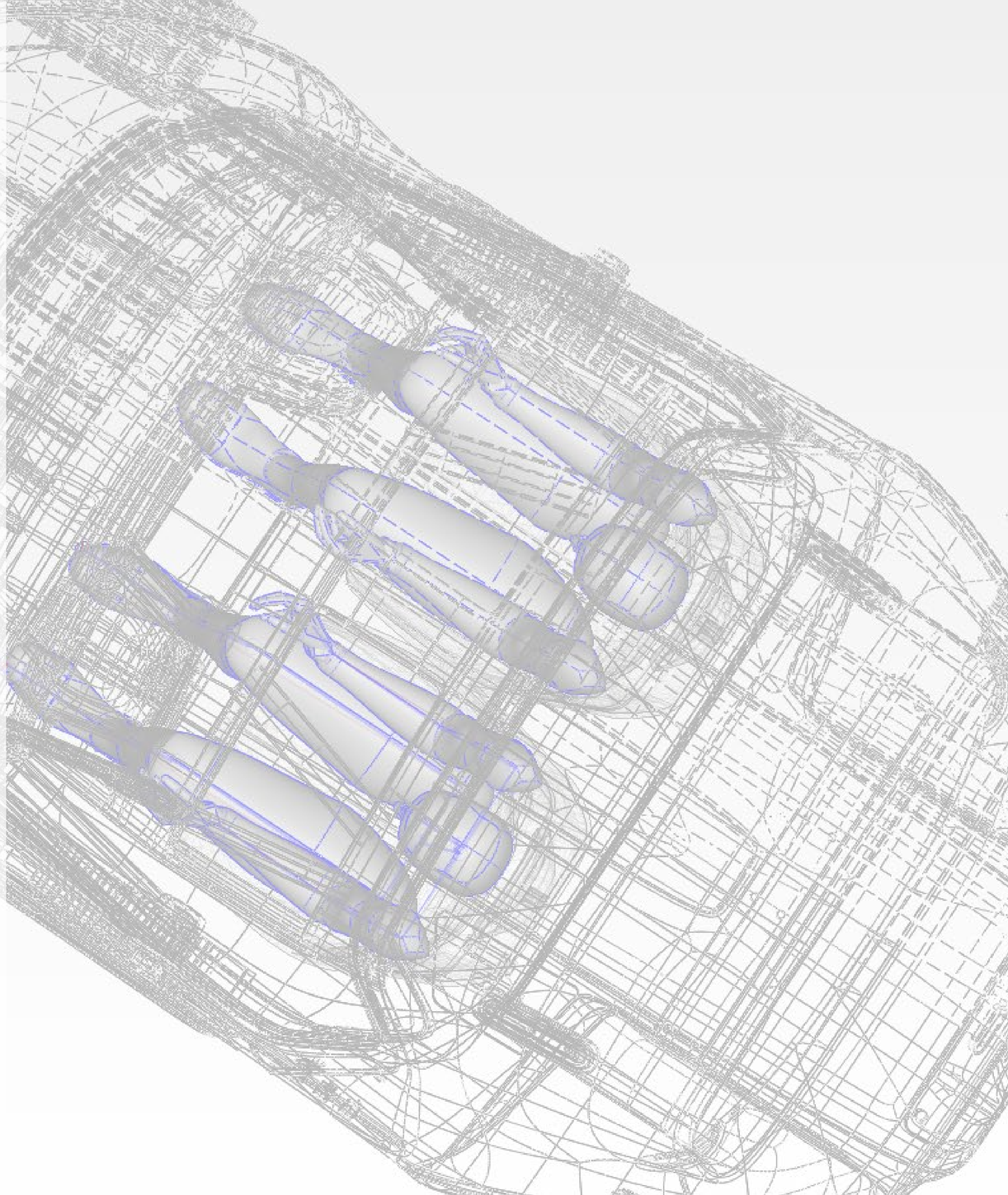
I wanted the wheels to feel suitable for every condition the vehicle would be faced with. They had to feel strong to handle different roads and terrain, but still look in place with the rest of the vehicle. I wanted to achieve a concept car wheel -look to have a more futuristic feel. I started with a simple three-spoke design already in the sketching phase, which I wanted to develop further. I felt the three-spoke design suited the vehicle's small size well, and it does not make the wheels too heavy compared to the body. I slightly tilted the spokes to give the wheels slightly more edge and sportiness. The spokes connect visually to the tires, making them stand out as one part. The tyre tread is a simple all-road design, which makes the vehicle look capable but not out of place in urban areas.

Complimenting the simple three-spoke design, I added sharp details to reflect the vehicles confident character. A blade design is found in between the large spokes, adding sharpness and direction to the wheels. I wanted to highlight this design by adding different material to this element, which makes a visually strong appearance that stands out even from far away. The sharp detailing contrasts the body's fluid surfacing and gives the vehicle a stronger lower body.

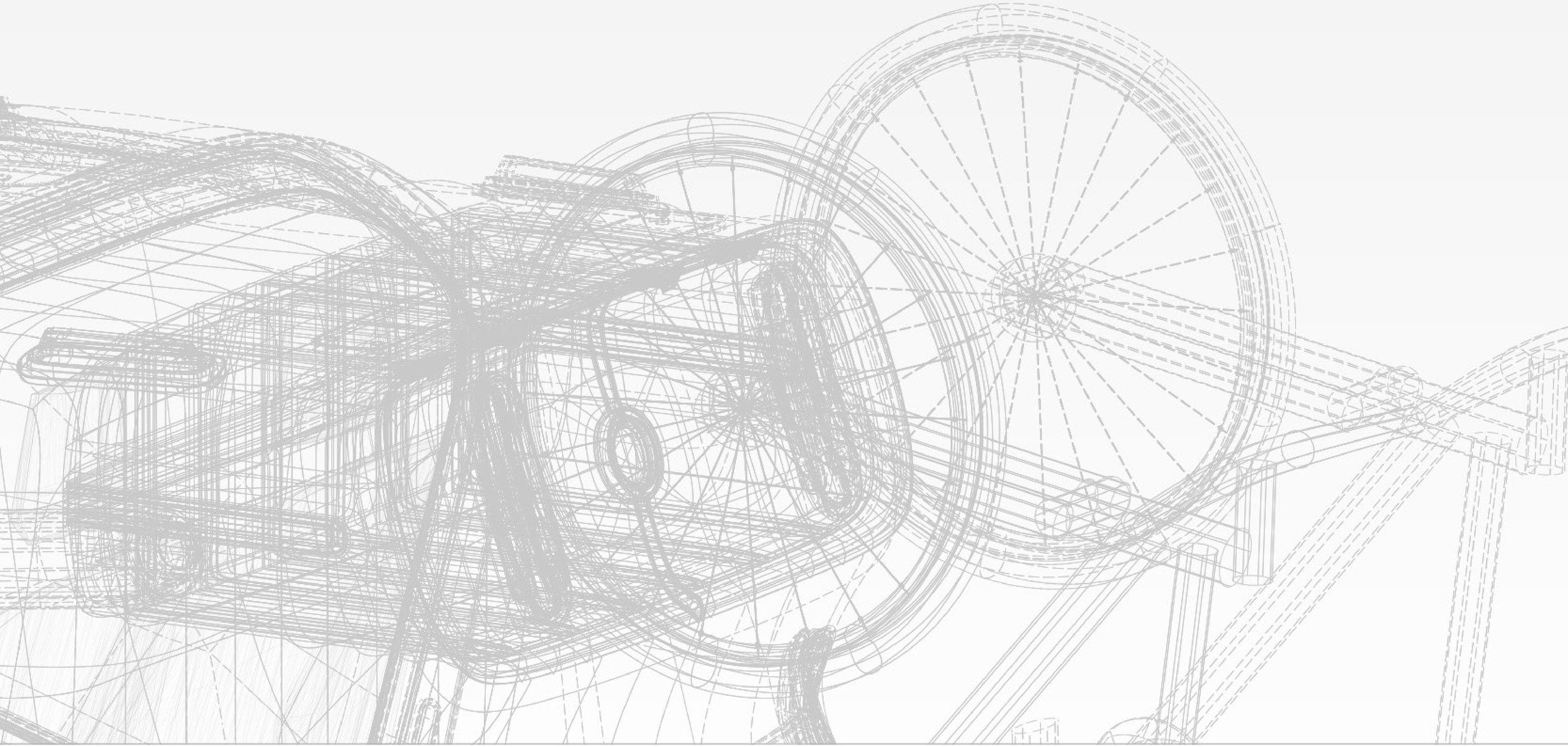
5.7 PACKAGE

Knowing that the vehicle was to be as small as possible and for maximum two passengers from the very beginning, it was easier to focus on optimizing the package. By making the vehicle taller than normal, it allowed me to place the passengers in a more upright position, both for improved ergonomics and a less cramped feeling interior. It allows the passengers to more easily enter or exit the vehicle, which is especially useful in off-road conditions or dense city area, where space is limited. As the doors are large as well, passengers are readily in more control, not having to crouch down low as would be with a shorter package. This upright position, often found on large cars already, places the passengers' head above other traffic or possible obstacles blocking sight. Together with the large windows, this would give the passengers a sense of space in an otherwise small vehicle. The added visibility sees a benefit in any situation, off-road or in the city. Passengers are also right in the center, which gives more spatial awareness of the front and back of the vehicle.

Not only did this kind of package allow for better ergonomics for the user, but it gave room to shorten the passenger space, as more space is needed vertically with the upright position. This way it became easier to house crucial components to the already short front and back of the vehicle, such as the adaptive wheelbase system and storage compartment. Batteries are placed low on the vehicle, below the passengers, which also helps with the tall vehicle's balance, as it lowers the center of mass. As the electric hub motors are placed in each wheel, there was even more room for other components in the body.



6. FUNCTIONALITY



6.1 WINDOWS

Besides the adaptive wheelbase system, I wanted to incorporate other functionality to the concept as well. Solutions that would suit scenarios in the city and when adventuring outside it.

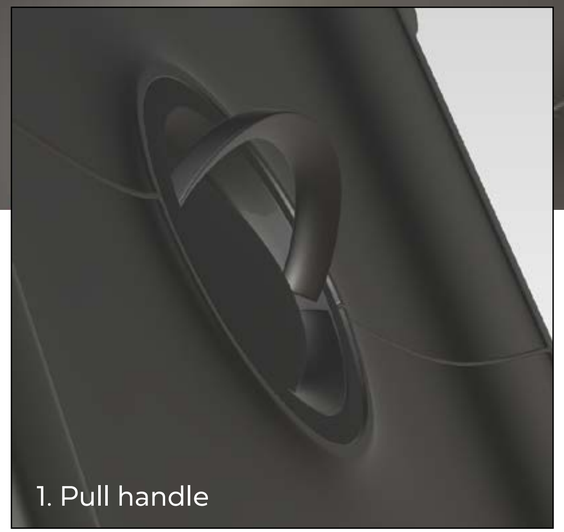
Starting with the largest element of the vehicle, the side windows, as this was to be one of the core designs features. Not only did I want to create the interesting visual graphic for the window, like with everything in this project, it needed to be functional. I decided to curve the window outward, creating a reflection on the window, which follows the vehicles forward momentum. This curvature and large surface area allow for great visibility and gives the user the possibility to view the terrain below. Wether parking in the city, or checking blind spots while off-roading. Furthermore, the interesting curvature that was now formed on the window, I saw an opportunity to place a camera at the center point on both sides. The cameras would work in the place of rear-view mirrors but could also be rotated to further eliminate blind spots of the vehicle. Effectively, there would be 360-degree visibility on vehicles sides. This, combined with the window's curvature, allows for greater ergonomics for the user.

The addition of the window rails, present on the front window pillars, work well for protecting the front of the vehicle, making the large glass area less prone to impacts and this way less fragile. While exploring off-road, the rails help clear debris such as tree branches, from the more fragile parts of the vehicle. In conventional off-road vehicles, usually a wire rope connected from the window to the hood, is used for this very reason. Though, the short nose of this concept required a different solution. The rails connect from the front lights to the underlying metal window frame, or roll-cage, effectively making it a one-box design. Ideally giving more protection to the passengers in an unfortunate situation. The rails are made visually lighter by the added cutouts, which also helps to see through them better.

6.2 STORAGE

Having a storage solution was also something I wanted this vehicle to have. As I wanted to create interesting proportions, I placed a storage compartment on the back, extruding from the body. This created an interesting flow to the surface and most importantly gave more functional value to the design.

The storage compartment works almost like a backpack for the vehicle. It can be slid out of the main body via rails on the sides to allow for easier access to items. It also has a lid system working on hinges, and in the center suggested by the visual round graphic, is the handle to lift the lid or pull the system out entirely.


1. Pull handle


2. Slide out (if necessary)

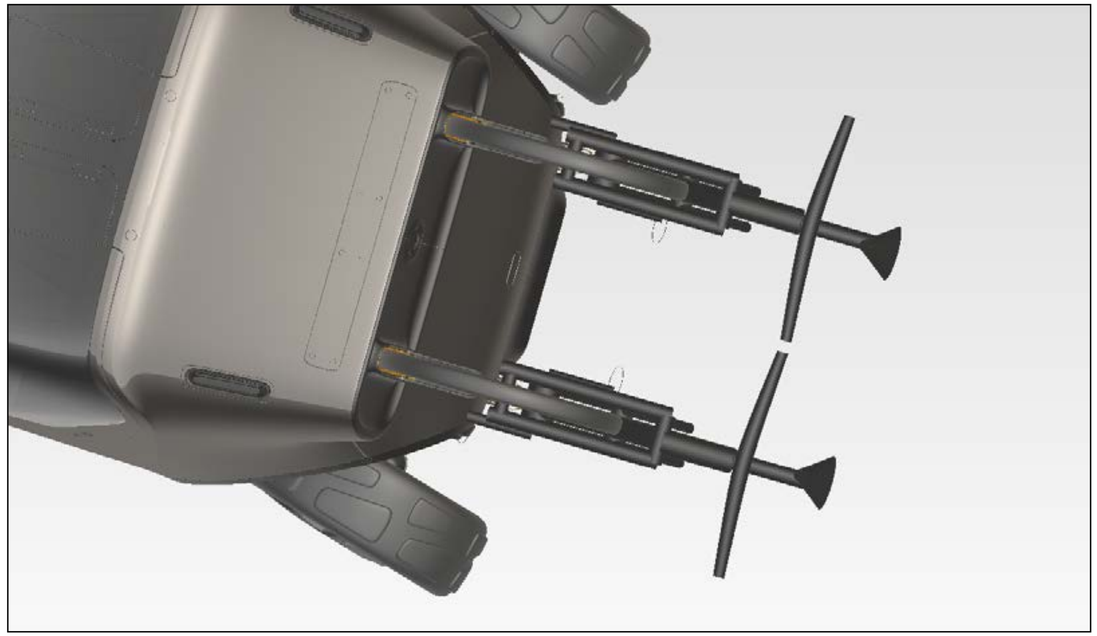

3. Open lids


4. Insert storage

6.3 BICYCLE RACK

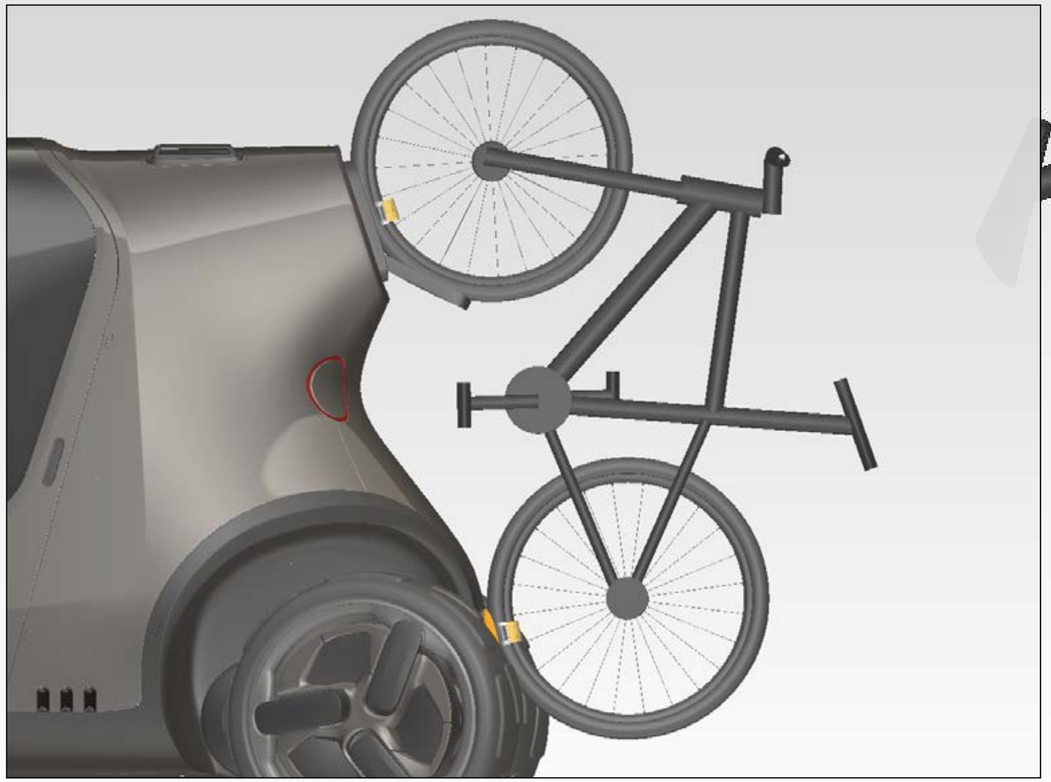
For further improving the range of functionality, I included a bicycle rack to the design. Whether it was for the last mile to work in the city, or taking a mountain bike to the forest trails, having the option to easily take a bicycle with them gives ultimately more freedom to the user, not having to rely on third party systems, or perhaps a different vehicle for that matter. The system ideally accommodates every common type of bicycle and tire size.

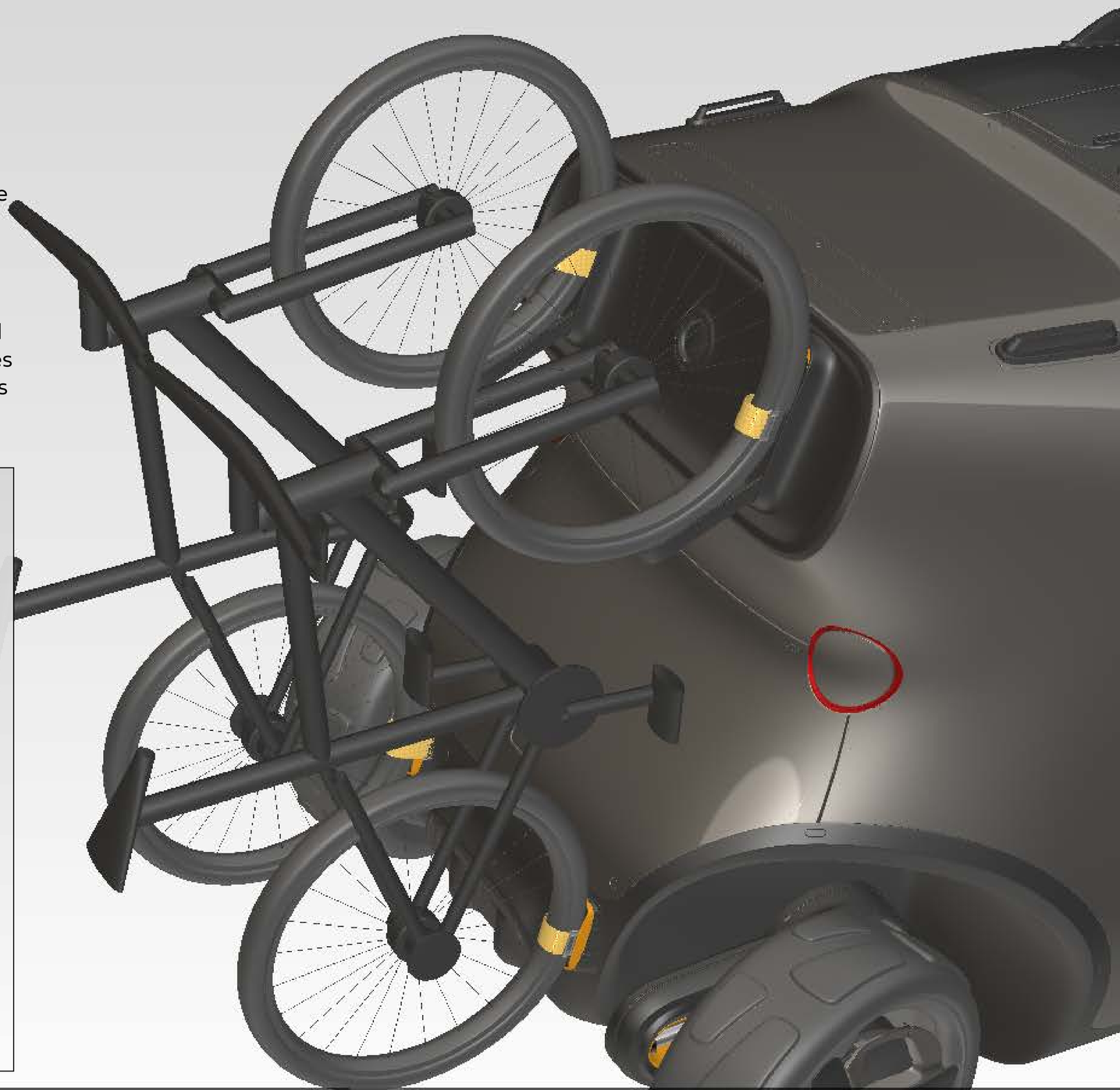
The optimal place to fit the included bicycle rack was on the back of the vehicle, giving the storage lids a secondary function. There are two mounts for two bicycles, and it is a “plug-and-play” system. First, the upper wheel holder is folded out, to which the front wheel is then placed. The front wheel fits snugly between the holder and stand. After that, the front wheel is fastened via a strap that is pulled out of it’s housing included in the system, securing it further and ensuring the mounted bicycle won’t sway sideways or fall off. The rear wheel is then simply rested against the lower stand and fastened via an included strap.

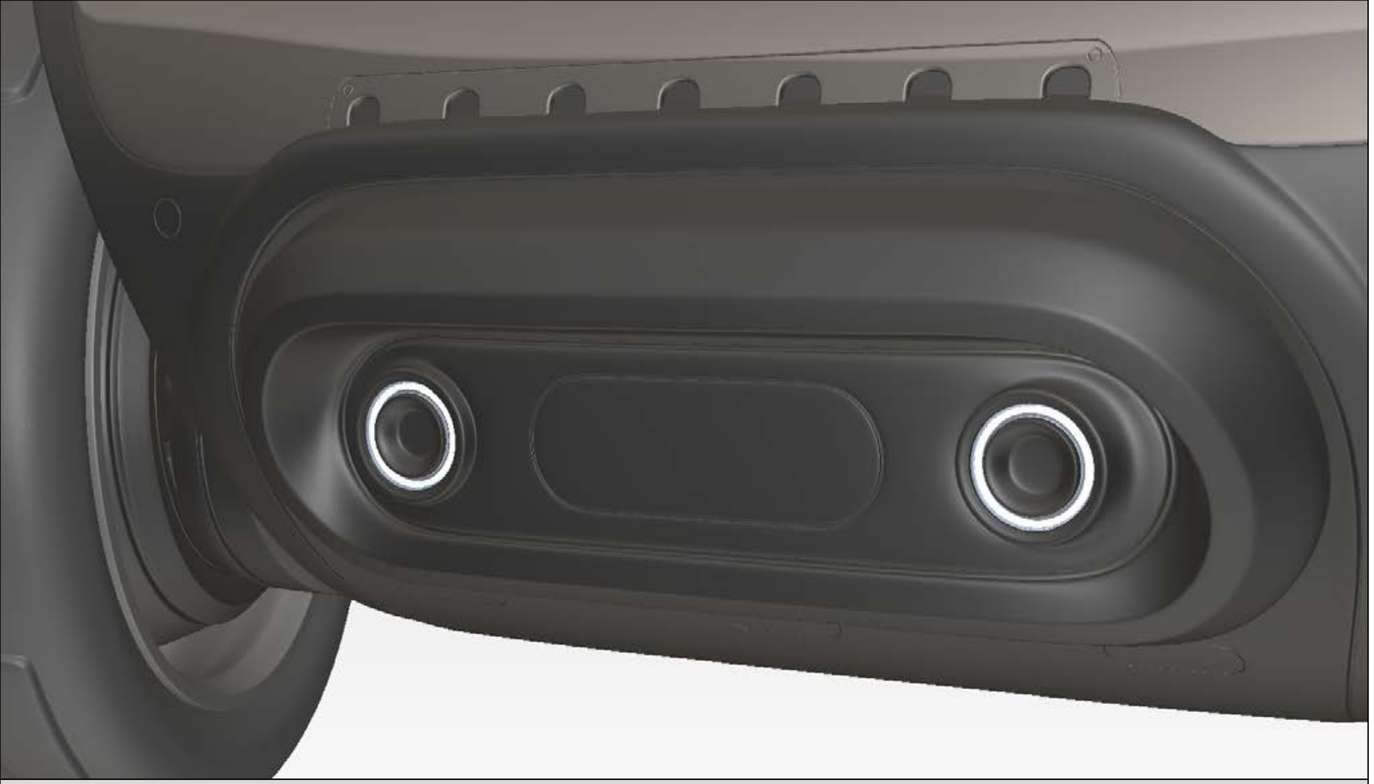


I chose to have the bicycles be mounted straight up against the vehicle, instead of sideways. Sideways mounting would free space form behind the vehicle when bicycles are mounted but would require a more complicated system to fit two bicycles at the same time. This system allows the user to simply fold the front wheel holder outward and lift the bicycle on to it. And when access to the storage compartment is needed, dismounting the bicycle would be just as easy.

Unlike with some other systems, or sideways mounting, this solution eliminates the need to loosen the bicycle's stem bolts and having to fold the handlebars to fit, since there is enough room to fit two bicycles side by side. Thus, this system worked best to not overcomplicate the design. I also found that the curved back of the vehicle, besides the interesting silhouette, creates a convenient space to accommodate a bicycle's cranks and pedals easily. This way I did not have to further modify any existing design choices.







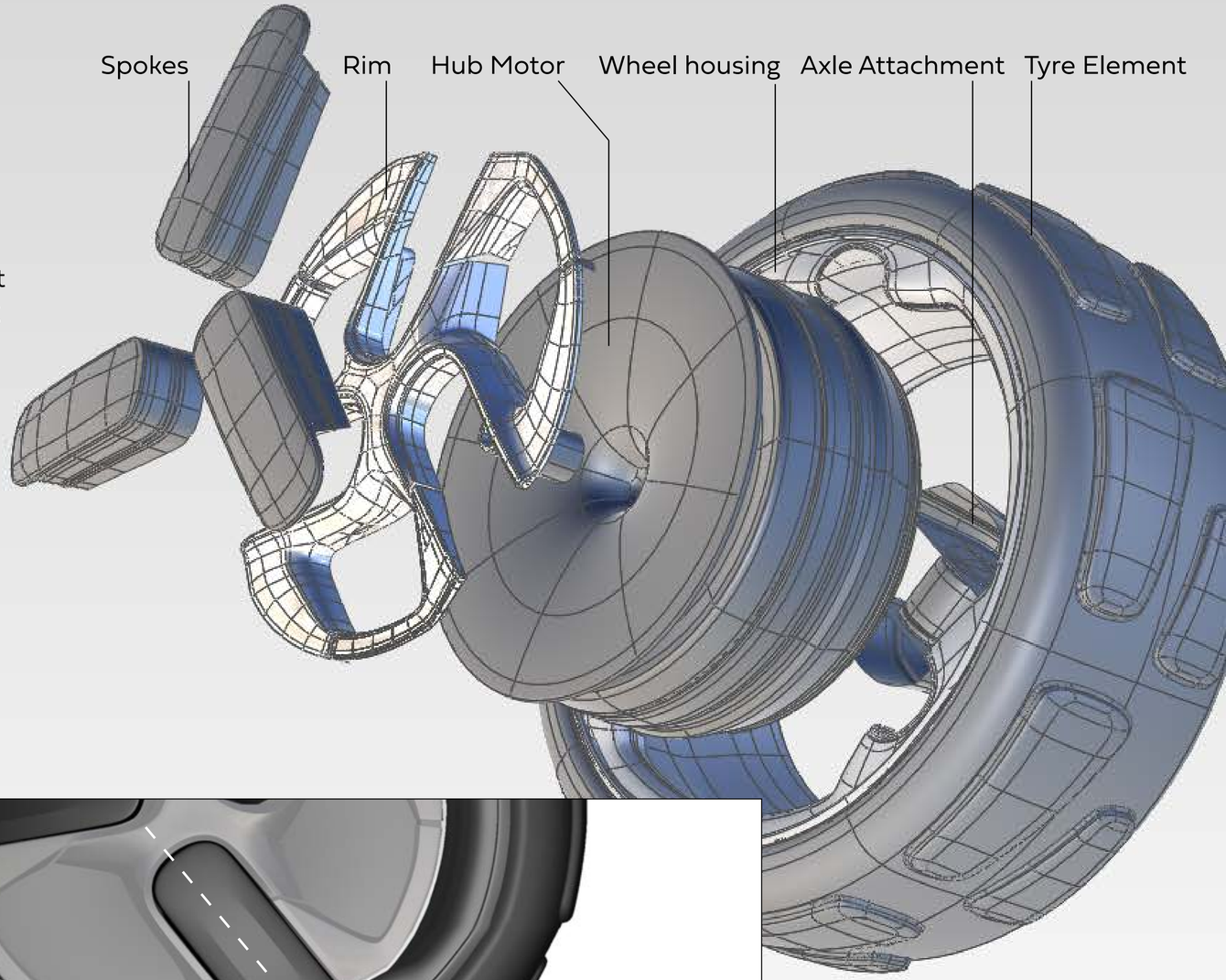
6.4 LIGHTS

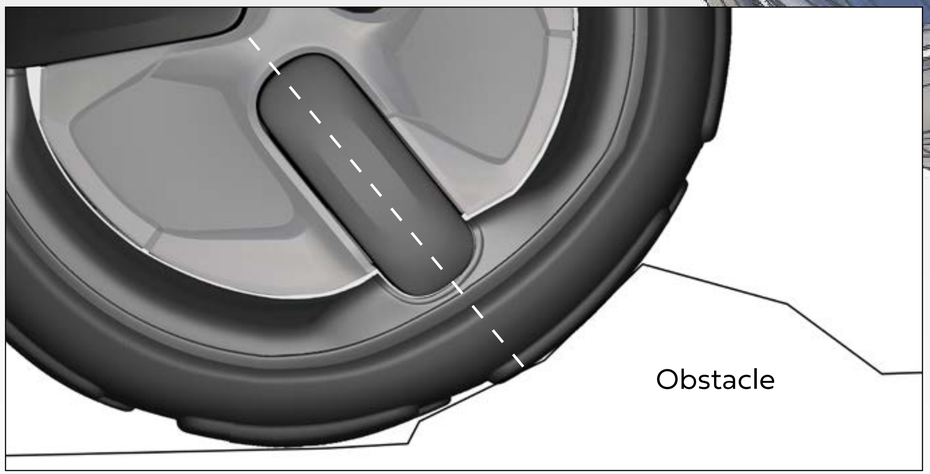
Besides the daytime running lights, there are added lighting on the front, both high and low. This is for better illumination in the dark and in challenging terrain, where visibility is key. The lower front component, or the crash box, houses two round led lights, complementing the overall theme. They are low to the ground, helping to illuminate the closer terrain ahead. Higher on the vehicle, protruding from the window frame, are two high beam led lights, namely lighting the road far ahead. These lights are flatter in their appearance, to give an edge to the vehicle's look, but mainly to maintain the vehicles height.

6.5 WHEELS

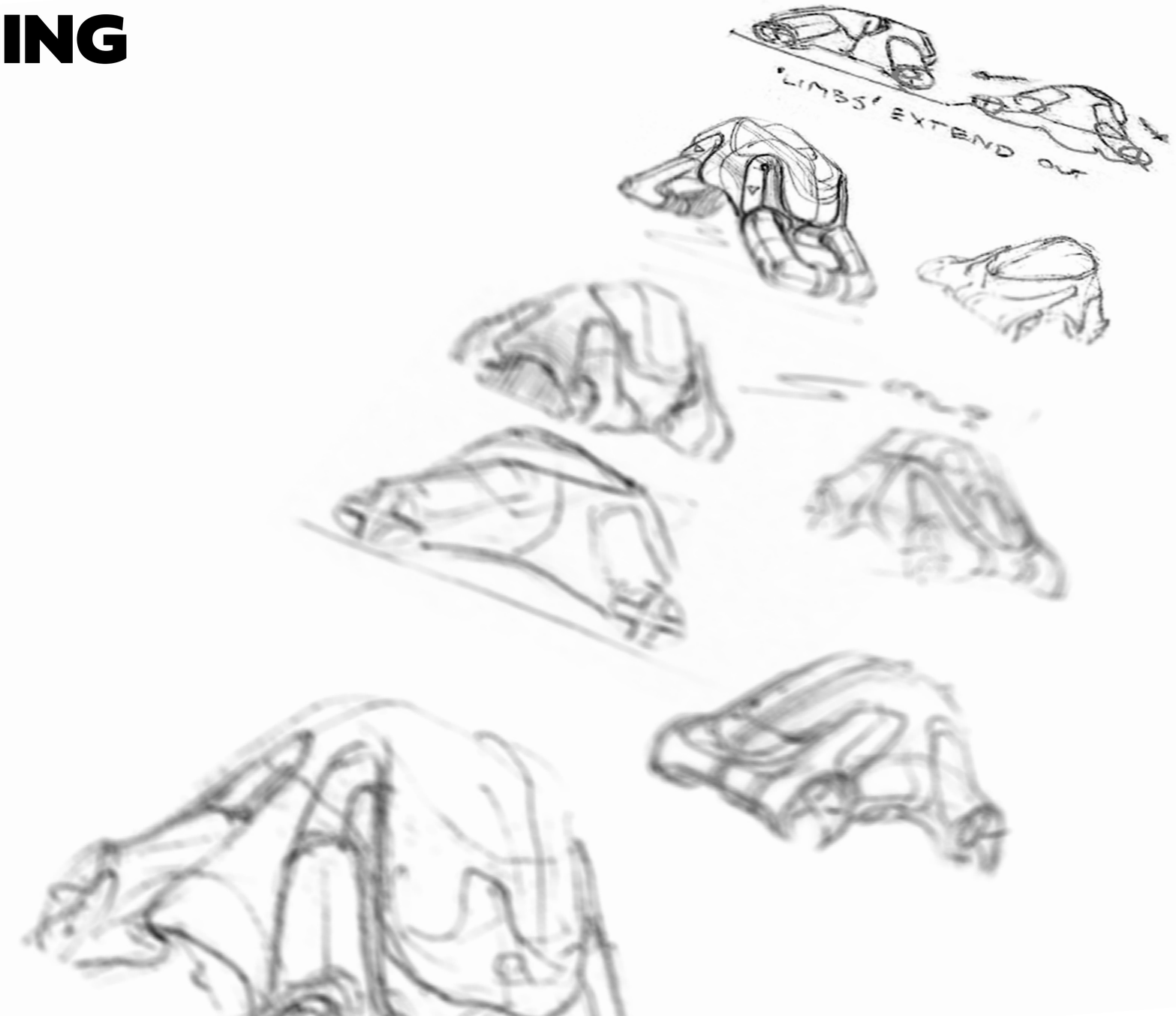
Later, in the modelling phase of the wheels, I saw an opportunity to add a functional aspect to their design. As I had the three-spoke design to be visually part of the tyre, I wanted to see if I could make it functional as well. I realized that by having the tyre element be separated from the rim element, and connecting them via the spokes themselves, I could have floating design where the wheels can provide slight suspension.

The spokes, that are now connected to the tyre element, are allowed slight movement towards the center of the wheel. This way the spokes are working as small suspension elements. Although visually like the tyre element, the spokes are made of stiff and durable metal alloy. The spokes are placed along a “rail”, which is incorporated into the design of the rim, to keep the spokes in line of movement. The center of the rim works as a dampener to stop any excessive movement. The elastic tyre element flexes (like any other conventional tyre) when rolling through an obstacle or rough terrain, and the slight travel of the spokes is able to dampen any direct impacts. The system is entirely static, only coming into effect when the tyre element experiences enough force to push the spokes inward. The suspension effect is subtle but allows for enough dampening for a supple feel and so that a thinner tyre can be used even when off-road. I wanted to incorporate this idea into the project, though further research would be necessary to see how centrifugal forces in high speeds would affect the function.





7. SKETCHING

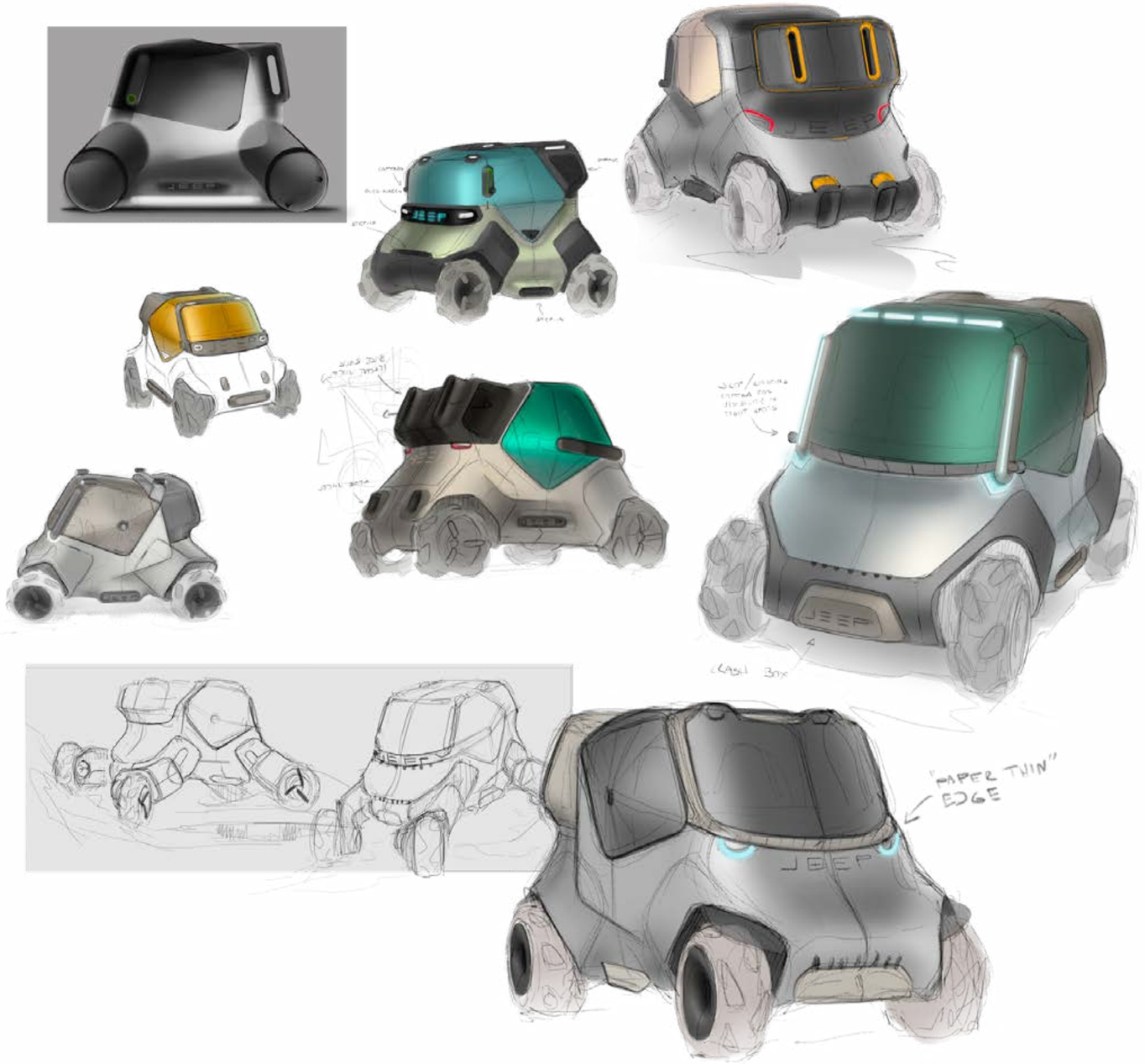


7.1 INITIAL IDEAS

Sketching with pen and paper was the first step in this project. It was the fastest and easiest way to translate my ideas into existence. First sketches were rough and small thumbnail drawings on endless post-it-notes, where I was searching for different ideas.
I started to explore small vehicles early in the sketching phase, and the fascination for them only grew. I knew I wanted to have some sort of function in the vehicle, a clear concept. Therefore, I quickly begun to have the vague idea of extending the wheels to have effectively two modes, which would later on evolve to the adaptive wheelbase system that it is now. The first ideas were very futuristic, essentially having the whole vehicle transform with the wheel armatures, which was beginning to be the theme. Even on the small thumbnail sketches, however, I began to wonder the usability of such an idea from the user's standpoint. As this concept was to be functional and focus on the user and ergonomics, I started to dial down the futuristic ideas and focus more on how such a system could actually work. At this point the idea of some kind of wheelbase changing system was locked in, and I began to further develop the idea.

7.2 REFINEMENT

Keeping the idea of the small vehicle with two modes, the new chosen brand, Jeep, meant some design changes. This luckily did not set me back the process too much. Since I had a clear concept and a theme around it, at this point it was just about taking the idea to a convincing resolution.
Further sketching this idea, I added a lot of the off-road characteristics found with Jeep and its heritage. The ideas started to become overly off-road-like, and I found myself not too happy with the results as the original idea was starting to fade away further. This led me to effectively go full circle with the process, back to the initial designs. I started simplifying until I found a design language I was confident to go forward with again, which ultimately was most reminiscent to the early sketches I had done. Afterall, more is less.
Taking the ideas,I had so far, I started to play with larger volumes, and the side silhouette of the vehicle. In Photoshop, I placed a pair of circles as wheels knowing the rough package I wanted to go with. I took large brushes and started to paint around the wheels, trying to find volumes and shapes. Ultimately this gave me a lot of success for my design process. This was the point where I found the idea for the side surface and window and I wanted to use this as the core design element. Using the same method, I quickly had the silhouette and proportions set that I wanted to develop further.

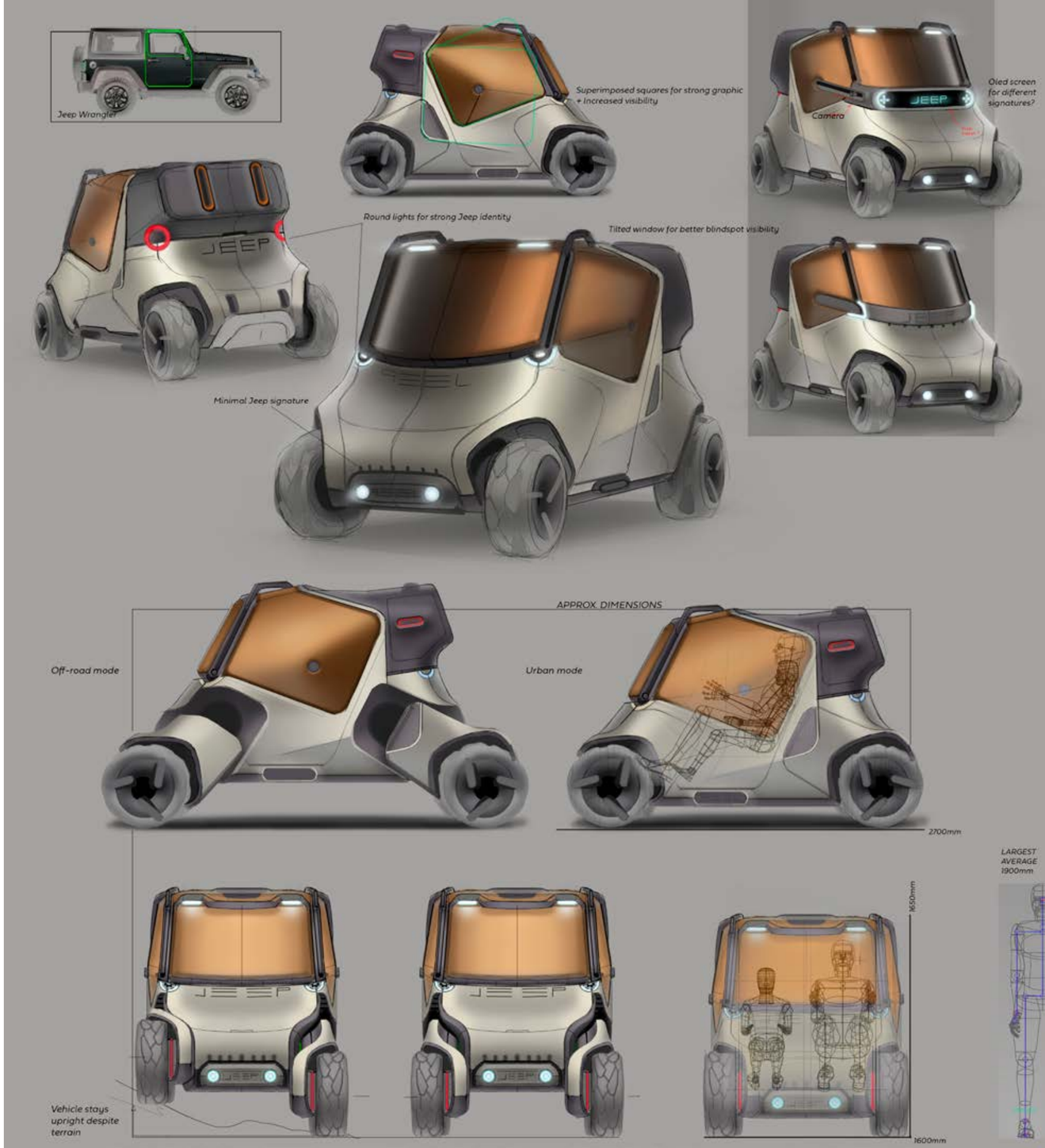


7.3 FINAL RENDERS

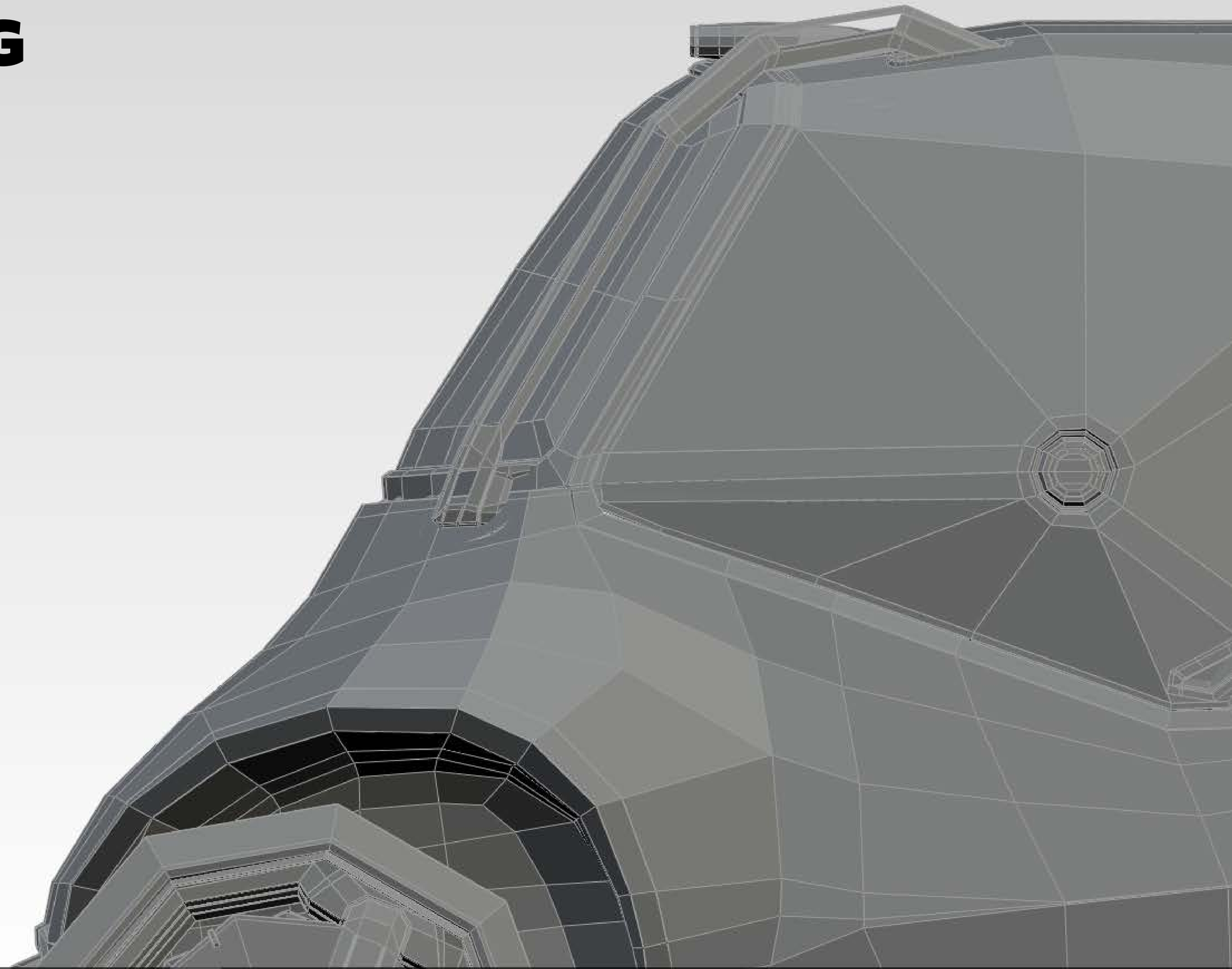
Happy with the design process at this point and not wanting to waste any more time in the sketching phase to save time for the 3D-model, I moved on to producing the final renders of the ideation phase. I used the upcoming design seminar as a deadline for any 2D work.

At this stage, the adaptive wheelbase system was still the key concept for this project, though still quite vague in its execution. Similar to the early sketches, the system was largely dominating the design. Though dialed down, in its current form and dimensions it was especially compromising the user ergonomics, namely still being the question of entering/exiting the vehicle. The biggest obstacle still untackled, however, was the technical plausibility of the system. From the start, the idea was to have the system be a part of the main body of the vehicle. Meaning, the armatures would extend out of the body when changing modes, otherwise sitting flush with the body surface. Besides the above-mentioned worries, the challenge would have also been the execution itself later, when moving to 3D-modelling. Knowing this, I decided to overcome the problem at a later stage when moving to the modelling. This way I would have a better picture of the proportions and dimensions, making it easier to place the system and other components and especially the passengers.

With the final 2D renders I wanted to showcase the final design of the vehicle and the functionality I wanted to include. Some of these features would not end up in the final model, however. I had already set the idea of the storage and bicycle rack, which were roughly visualized at this point. The design of the body, the main surfacing, was the most developed element in this stage, which allowed me a good base to start the 3D-modelling phase next.



8. MODELLING

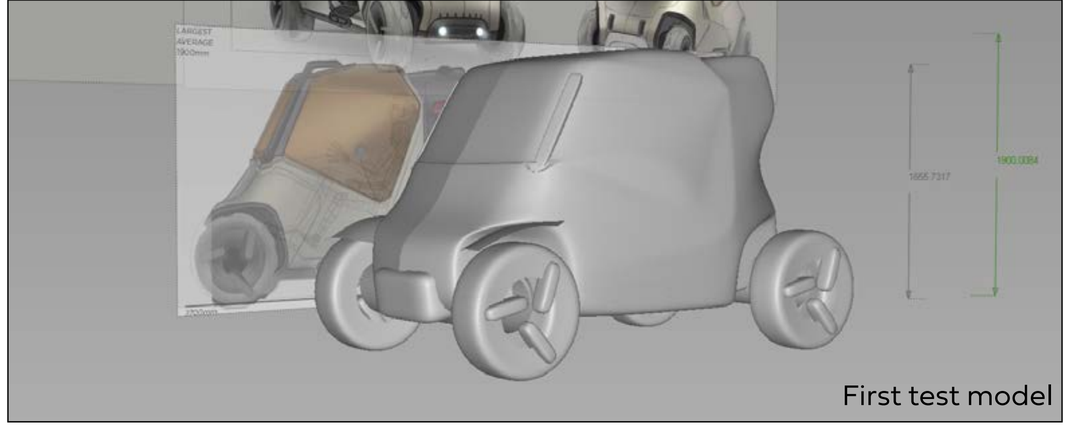


8.1. SOFTWARE

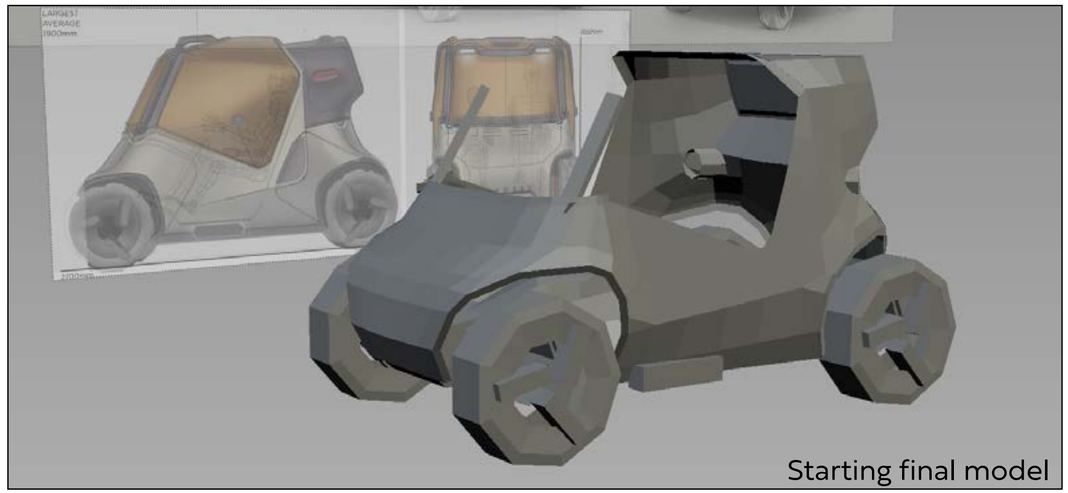
I started the 3D-modelling in Autodesk Alias, using their Subdivision modelling tool. It is a relatively new method in modelling and is found with other software as well, gaining in popularity as more people are discovering it for design work. Essentially, it allows to model with real nubs surfaces without the conventional, and often complicated, tools found with these software. “Nurbs” standing for the mathematical model used with these surface building tools.

This method is more similar to polygon modelling in terms of workflow, therefore it allows to model complicated shapes more easily. It is not the most exact method, however, as it is not a tool for production where accuracy is key, but with concept design such as this, the results are more than enough. The advantage is in its effectiveness, as it gives the possibility for fast design exploration and quick changes if needed.

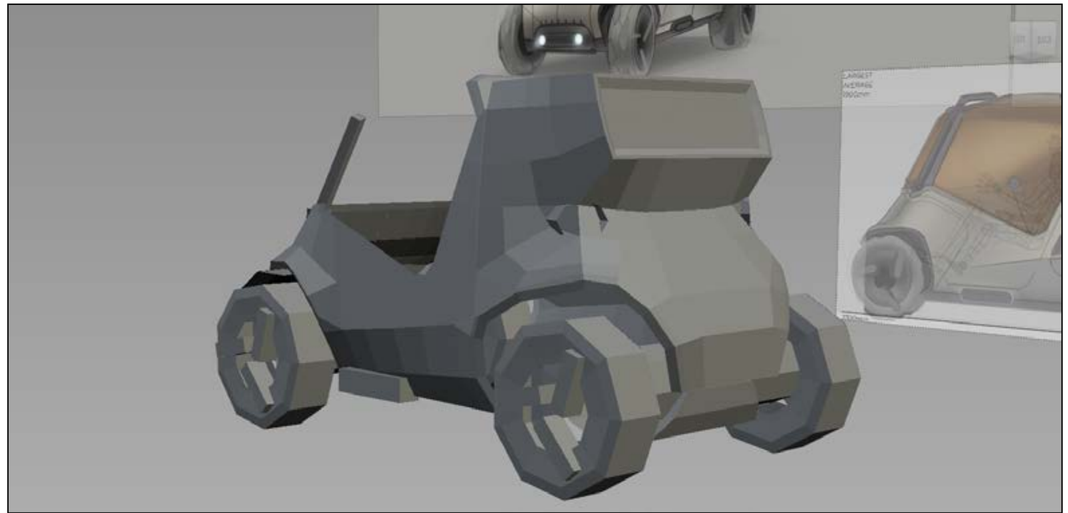
During my exchange period in Strate School of Design in Paris, I got my first real try at this software, getting to know its unconventional user-interface. This inclined me to use it for this project and I modeled the entire vehicle using this tool.



First test model



Starting final model



8.2. PACKAGE

Establishing the package in three dimensions allowed me to visualize the proportions easily from the get-go. I had made several very rough models before starting the final model, making sure everything was in their approximate places first. Modelling in 3D space, starting with just primitive shapes, I could immediately see how the sketches were translating from two dimensions into a turnable object. This way I could see the changes needed from a simple wireframe. This is why I aimed to move on to this stage as soon as possible, as any errors were now easily visible.

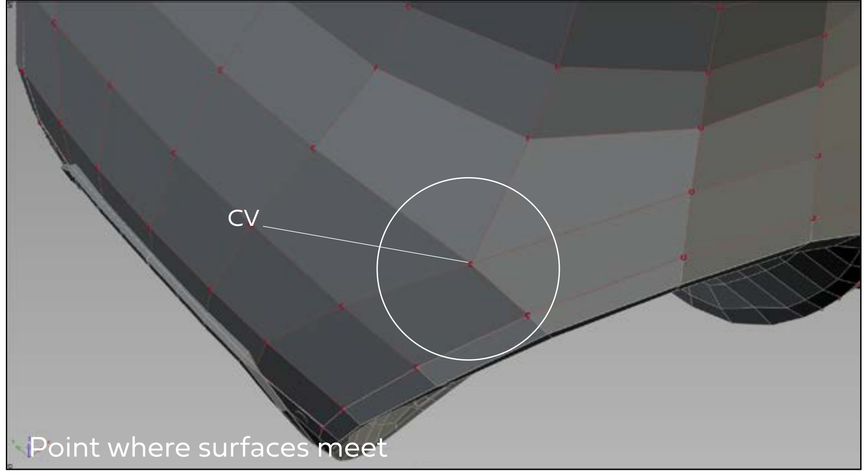
I placed simple volumes over the blueprints I had made based on the final renders of the vehicle, using a similar method as in the sketching phase. Effectively, starting from the wheels (simple cylinders at this point) and then building around them, tracing the key shapes first. Building the basic model went relatively fast, but to get the surfacing and detailing done would be the most time-consuming part to come. Defining the big shapes and key lines were important to get right in the first steps. Having to move or modify the major elements later with every detail would be difficult at best, so I made sure I was happy with the key elements.

At this point, having laid the main volumes and tweaking the proportions, one of the first things needing changing were the wheels. Although simple shapes at this point, I could see they were too small and tucked into the body and not being able to turn. Although basing the model from the sketches, the vehicle was not carrying itself properly in three dimensions, thus the stance needed much tweaking. The wheels being an easy fix, I enlarged and pushed them outward. This way the wheel arches needed to be larger as well.

Before the modelling, it was crucial to make sure the two passengers would fit comfortably inside the vehicle. In the final sketch render, I had already taken the largest average, 190 cm tall male, and placed pre-modeled mannequins that I used for the blueprints. This made it easier to model as I knew the two passengers would fit. Later, the mannequins were always present for reference when modelling. This way I could made sure the vehicle would be proportioned correctly.

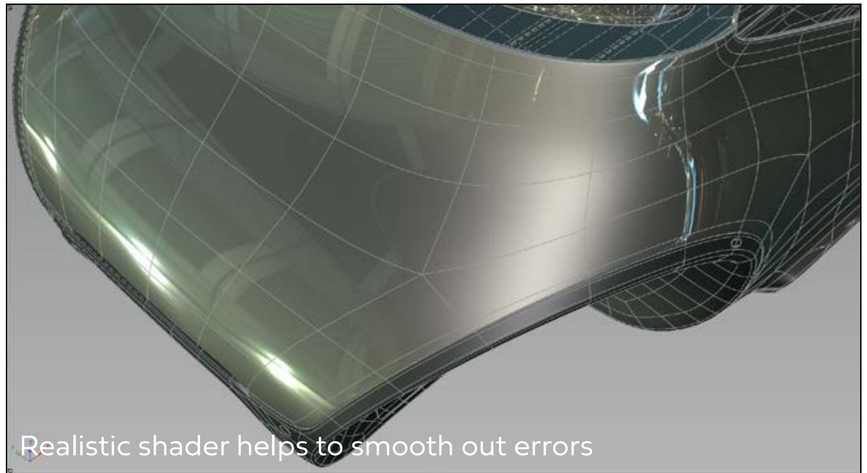
8.3 SURFACING

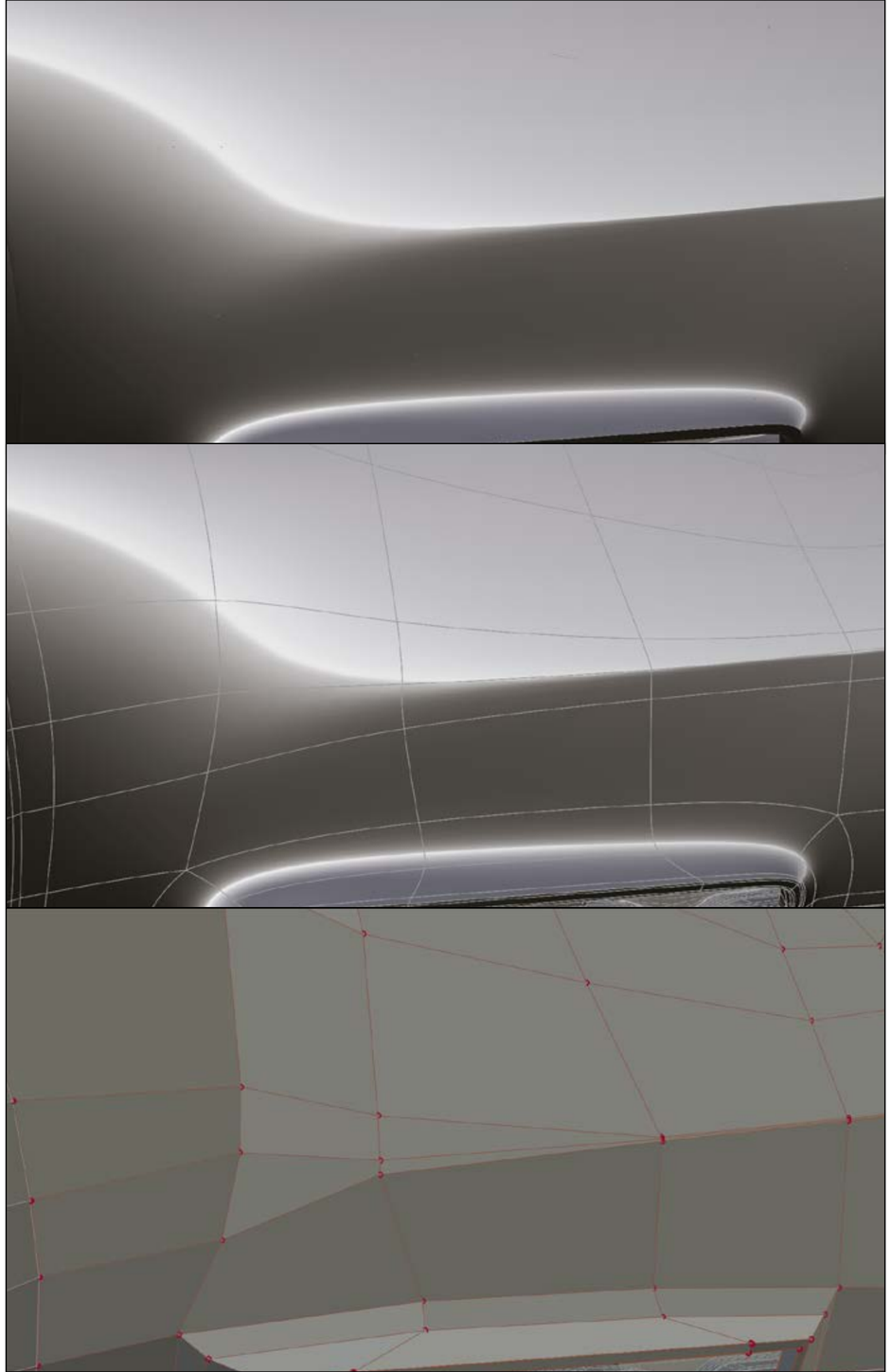
The surfacing was one of the most time-consuming aspects of the modelling phase. I wanted to make sure that the surface quality would be the best I could make it, which is why it required the most focus. I had to practice the topology, or the surface structure, several times before achieving a satisfying result with flowing and continuous reflections. Subdivision modelling is not the most exact method in getting the most pristine quality, but it allows for very fast design changes and the quality can be very good for concept modelling. Subdivision modelling uses a “box mode” where the underlying square, or box, structure of the surfaces is visible, and this is where most of the modelling is done.
As with many other modelling methods, it is important to try to build with squares, as more or less points in a surface slab, or face, can result into defects on the surface. Knowing this, one of the challenges was to get a well flowing surface structure and eliminate any surfaces like this. Defects can also arrive from points where multiple surfaces meet, unless carefully controlled, which is why I spent plenty of time adjusting the topology on those spots. However, a change in one spot results in a change somewhere else, which is why there are several points where I had to leave such a surface, as I was not able to fully eliminate those. With careful manipulation of the surface control vertices (cv) I could improve the quality, although the result wasn’t perfect, but good enough. These defects can also be masked with different shaders and highly reflective materials, such as a metallic car paint, which I used on the body. Matte materials are not so forgiving, as there are no sharp reflections covering the surface.
I could evaluate the surface quality and continuity with various evaluative shaders that the software provides. These shaders are all different and can display many different lighting scenarios and zebra stripes for evaluating the surface, which are helpful to reveal the tiniest of flaws in continuity. I wanted to make sure the reflections had proper tension and flowed smoothly on the surface from every angle when rotating the model. I tried to eliminate all unsure and wobbly reflections where possible. This required patience, but in the end, I was able to achieve the quality I was after.



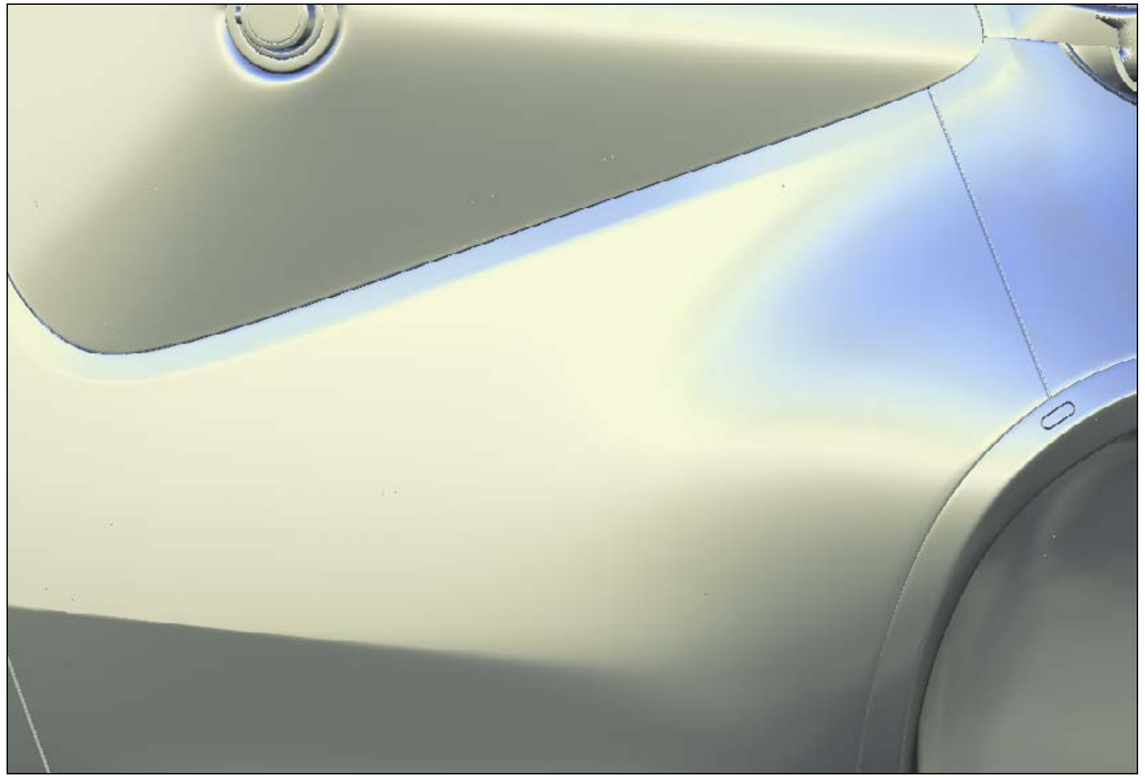
Point where surfaces meet


A defect in the surface

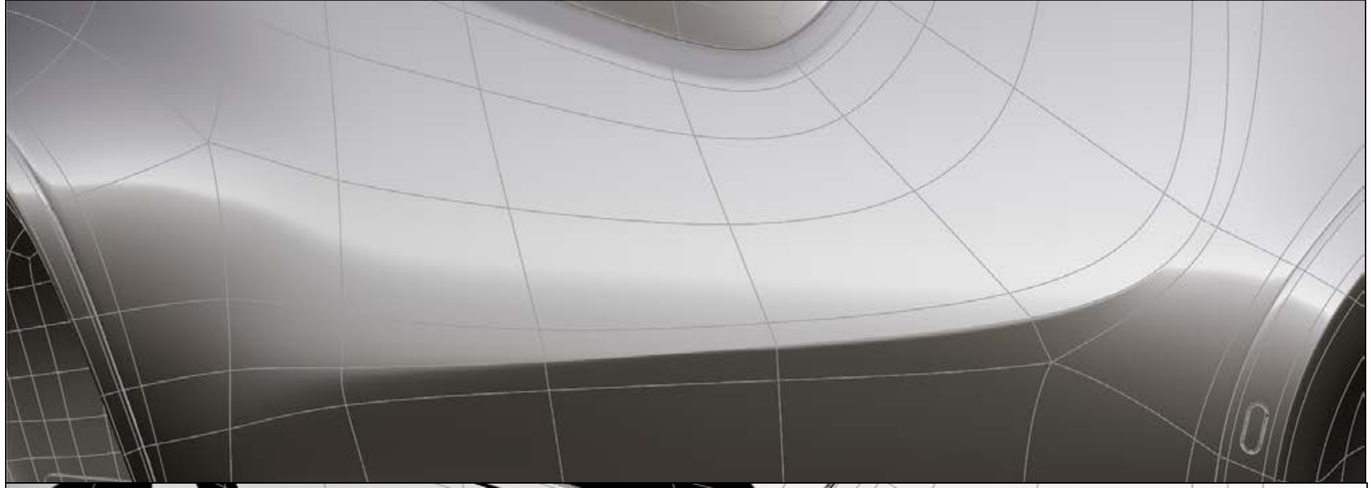

Realistic shader helps to smooth out errors

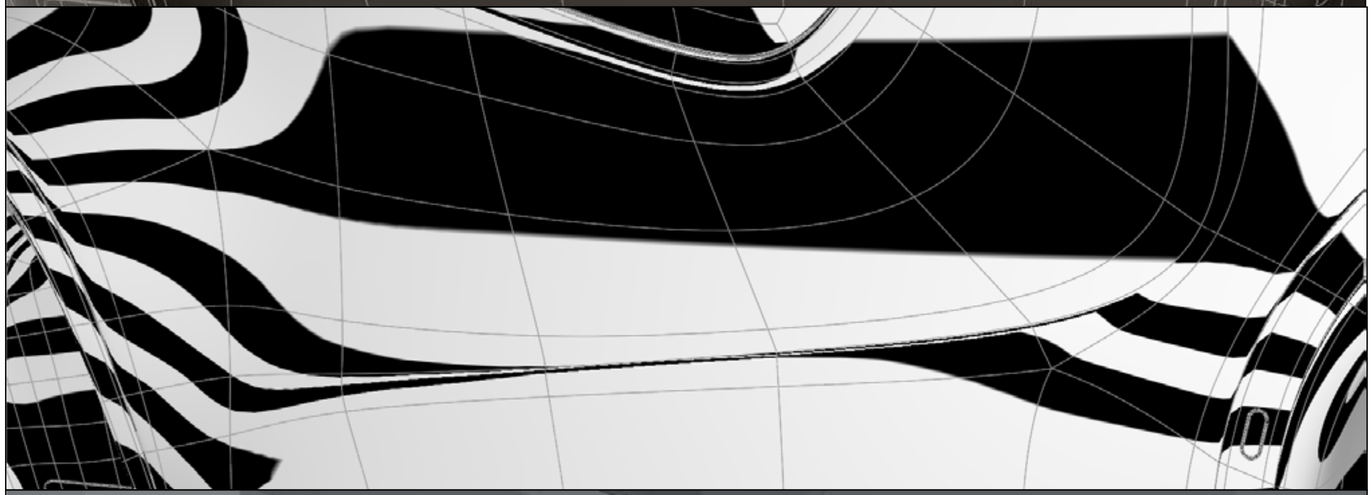


Though the fluid surfacing was time consuming to get right, the square element on the side proved the most challenging so far in the project. I wanted the surface of the square to be flat so it would contrast with the soft surfacing, and this required thorough planning on how such a hard surface would fade into the softer surface around it.



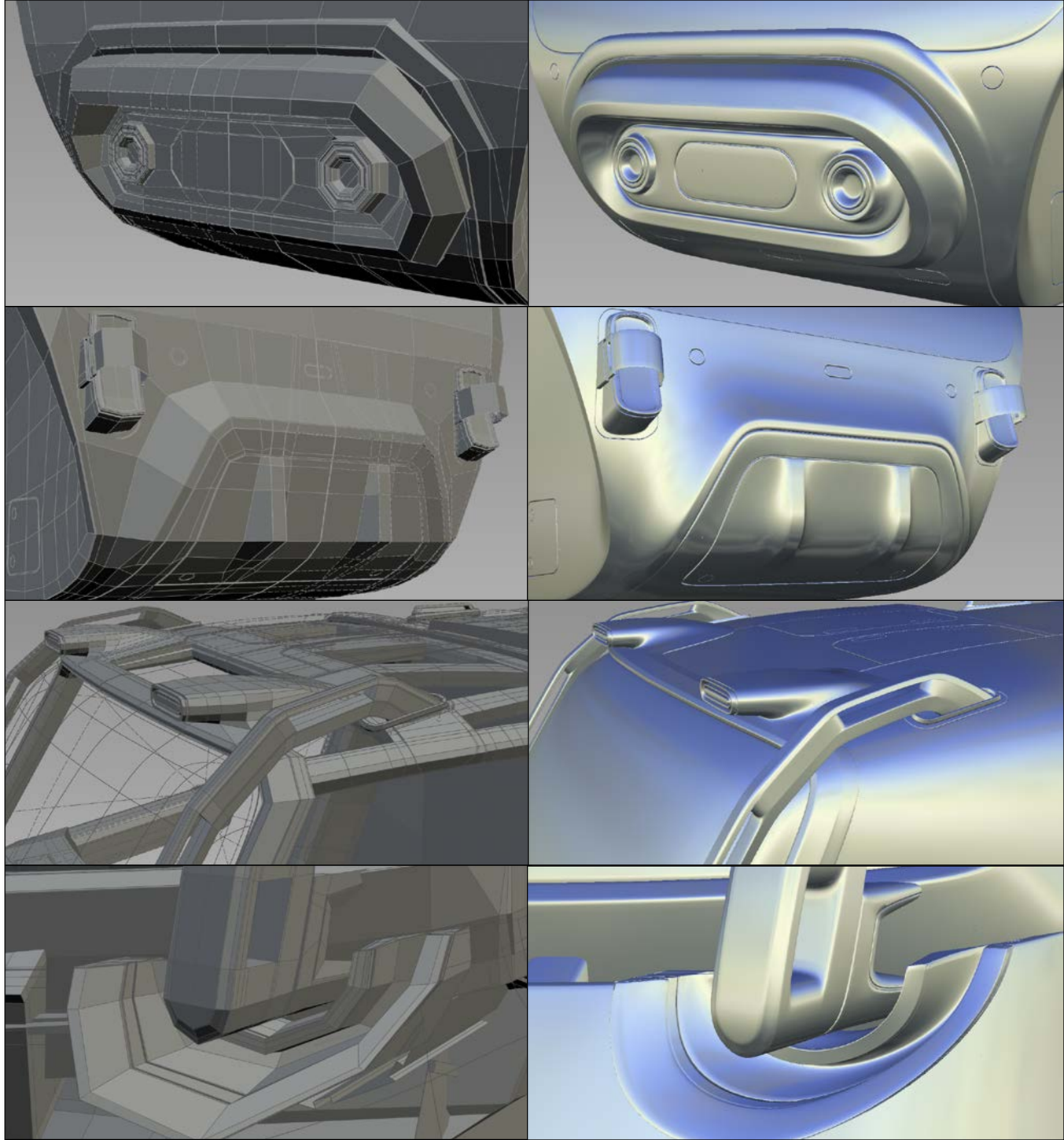
Finding the correct angle and placement of this feature relative to other surface elements needed planning as well. I wanted the square to be clearly visible but be subtle enough for it to almost blend into the surfacing around it. Therefore, even small shadows cast by the edge of the square would not be ideal. Fading the hard edge to the rounded surface of the front fender was difficult, and this is where I spent the most time. The fading effect required careful cv control, as the tiniest change resulted in an unfavorable result in the fender and square surface continuity. With subdivision modelling, this was a recurring theme, where patience and manual cv manipulation in the smallest scale was needed. In the end however, the result was convincing enough.





8.4 DETAILS

After the main surfaces were done, I would start to move on to the details. Details make a model look more realistic in the end. As with any other part on the model, most of the detail components were done with simple volumes first, and then moving closer to layer elements. Adding details was the matter of deciding what goes where and what is enough. I had many of the detail elements decided in the sketching phase already, which it easier when moving on to modelling.
After adding most of the details with subdivision tools, I moved onto planning the cutlines, knowing that they would require more attention. Adding cutlines and cutting holes with basic subdivision tools is not ideal, as it would risk any surface continuity that was carefully built at this point. Therefore, it required me to use other tools found within the software for making the panel gaps and holes for the lights. Luckily, Alias provides relatively simple tools for this purpose, which allowed me to precisely cut the surface. I saved this step last, as it was best to do when the surfacing was set and finalized. This was because any subdivision surface that needed to be cut, had to be converted to nurbs surfaces, which Alias gives tools for. This was done by separating the underlying surface from the subdivision body, of which a copy was made in case modification was necessary. Later, however, I found this step to not be strictly necessary, as cutlines and other features can be added directly to the main model, without separating the surfaces. This makes it possible to modify the surface despite any cutlines. With every part needing cutting into the surface, I did it with this method.
The lights were made by placing their shape on the surface and intersecting to make a hole. This way I didn't have to compromise the surface structure. I then built the light components with the subdivision modelling tools. With such small tolerances, this was arguably not the best method, as it required a lot of precision to layer all the small components without any clipping occurring.

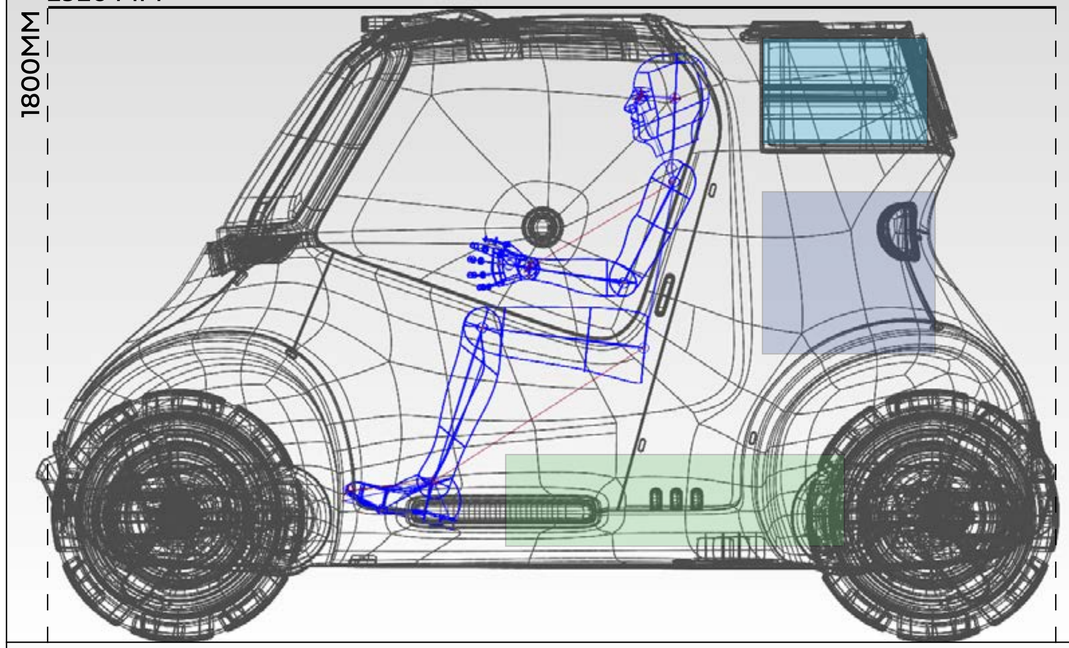


8.5 PACKAGE DRAWING

URBAN MODE

2920 MM

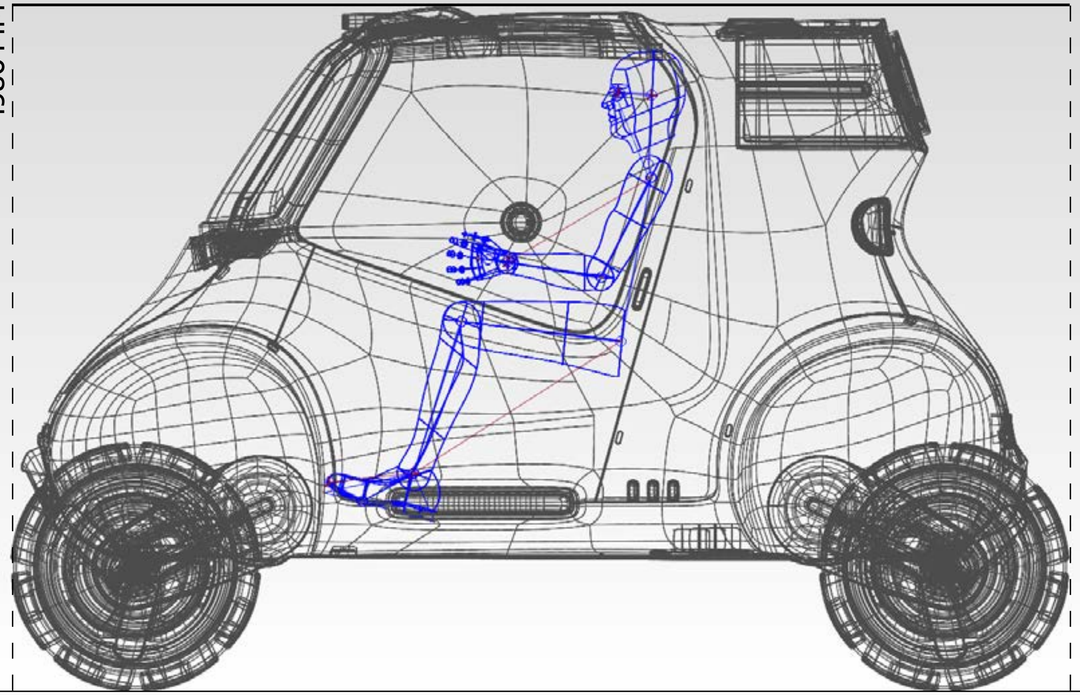
1800MM



3060 MM

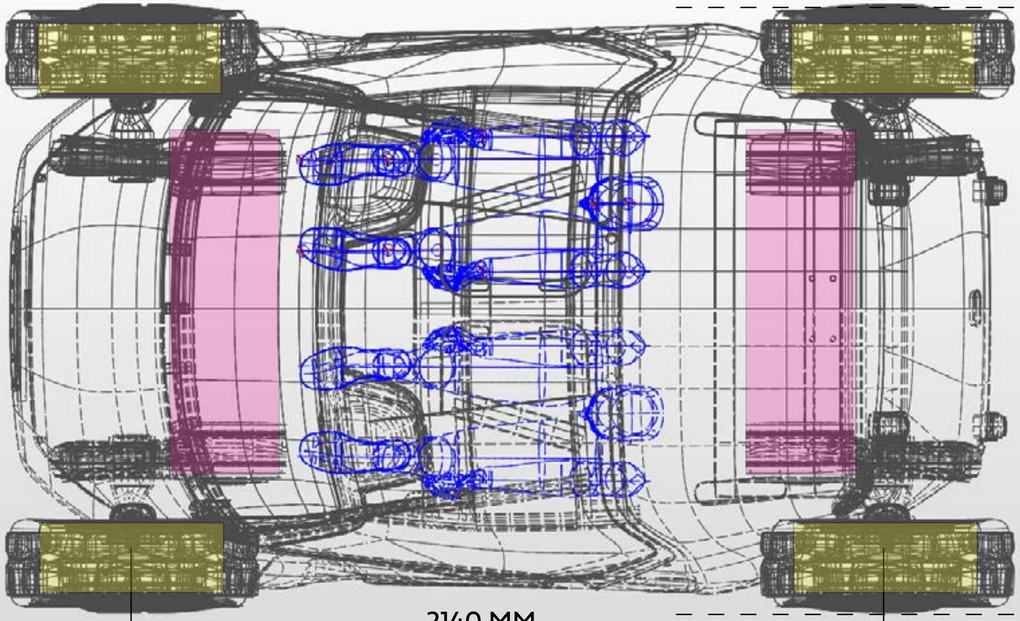
1980 MM

OFF-ROAD MODE



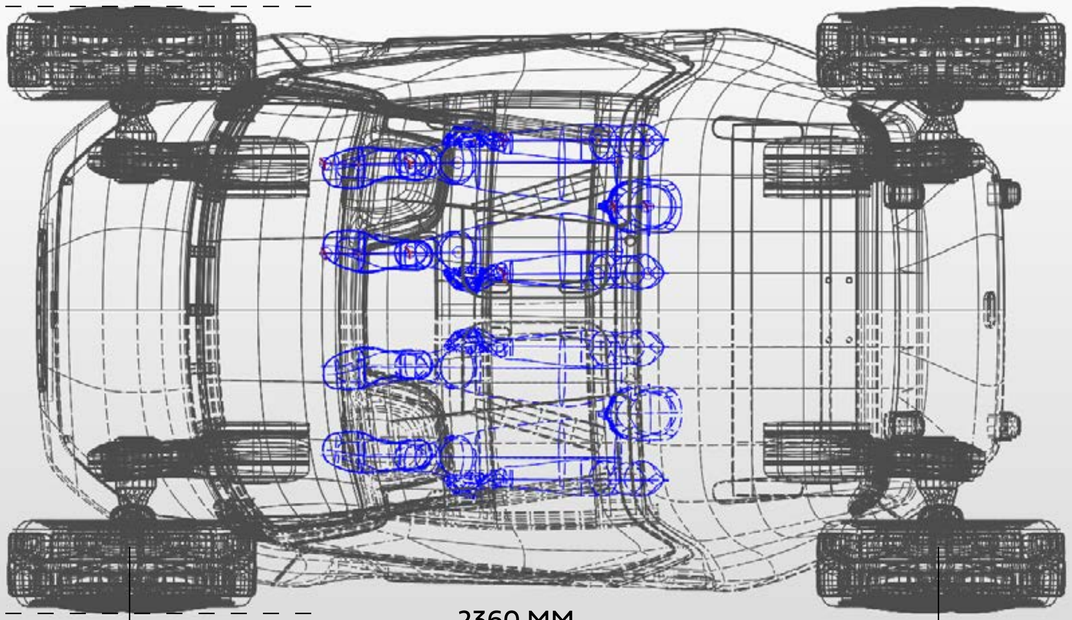
BATTERIES TRUNK STORAGE

AW-SYSTEM HUB MOTORS



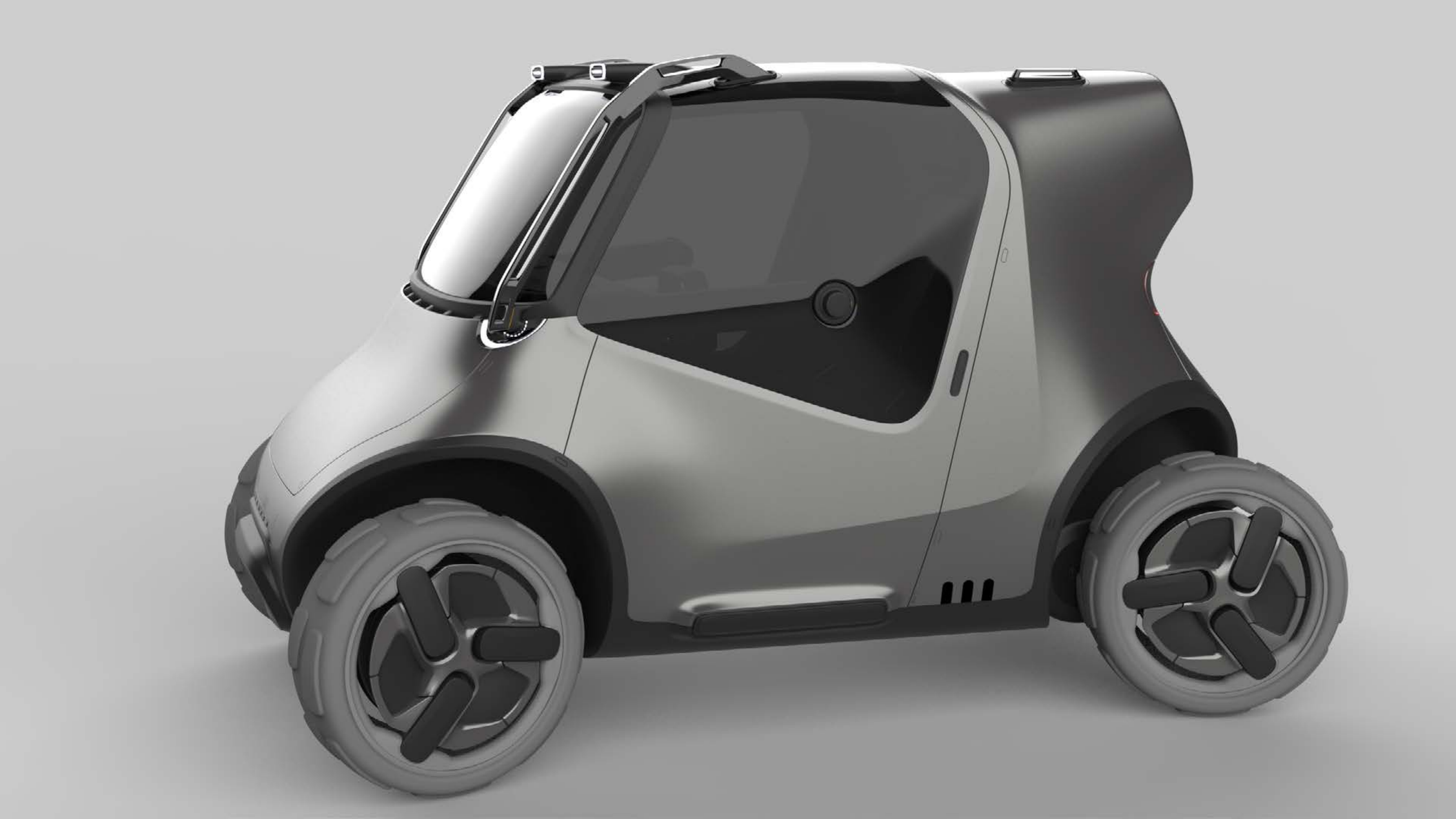
1720 MM

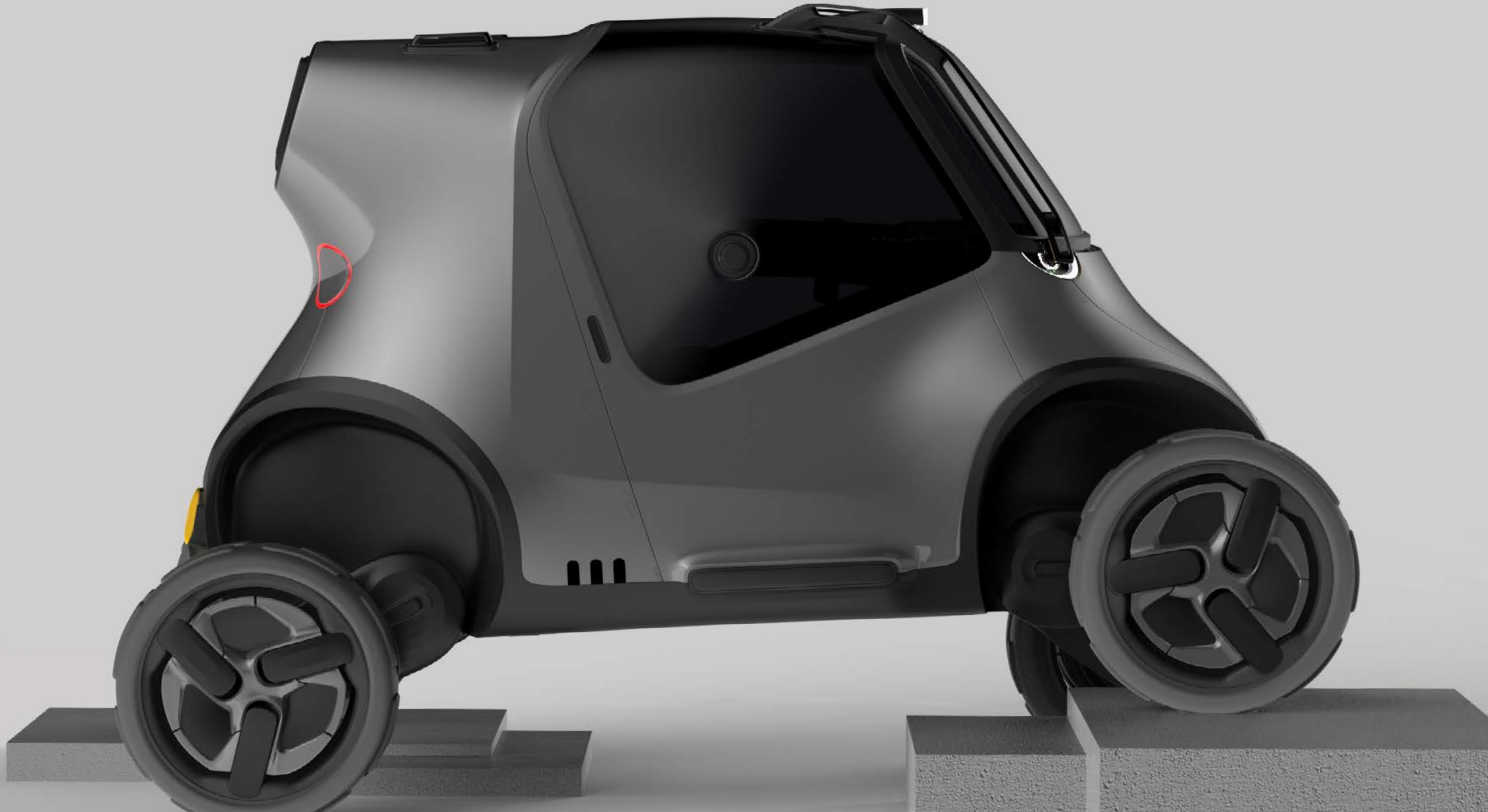
2140 MM

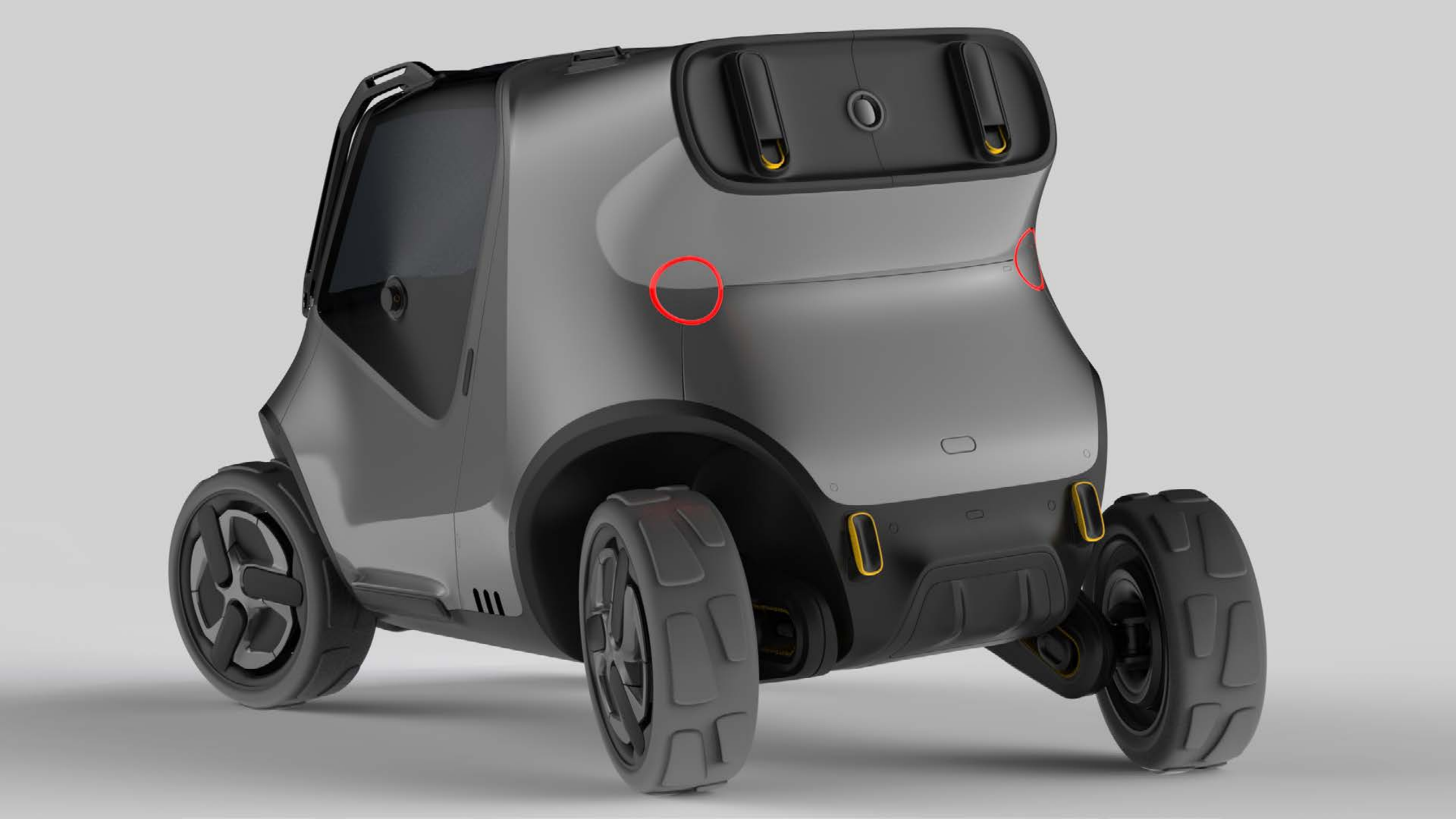


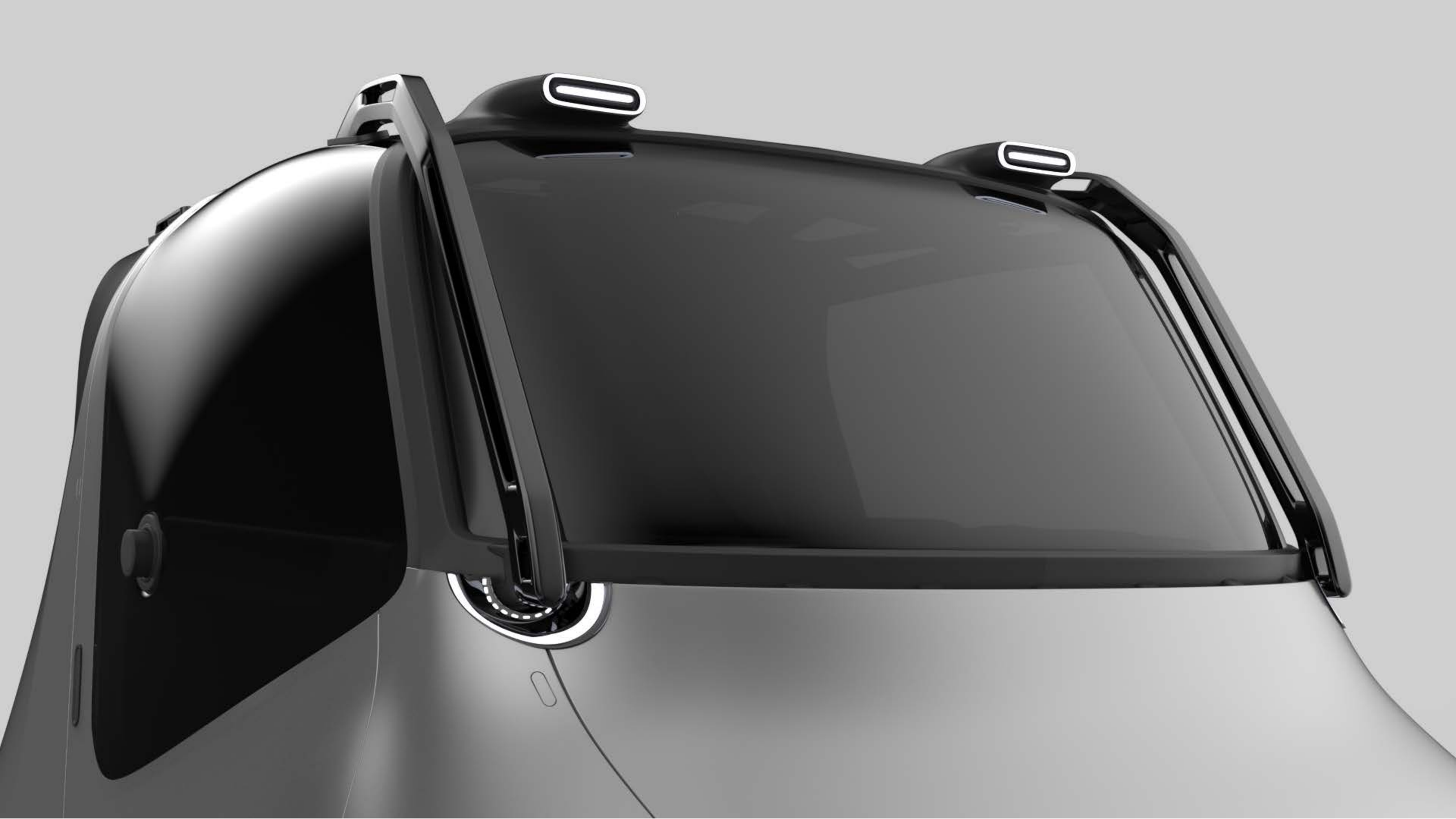
2360 MM

9. FINAL DESIGN









10. EVALUATION

Beginning my graduation project, I was pleased with the early design process I was able to do. I did not spend excessive time over design choices, and I was able to move forward quickly and produce results I was satisfied with. I was determined throughout this phase, and in the end, produced a final design that exceeded my expectations. Therefore, I succeeded in my goal to be more efficient and confident in the design choices I made.

Similarly with the modelling phase, I was able to model the entire vehicle using a relatively new tool and learn a lot in the process. After this project, I am more familiar with the tools I use, which helps me to be faster with my process. I wanted to incorporate more 3D into my workflow and use sketching only as a quick tool to help me visualize ideas. I was overall satisfied with the 3D model, though some areas, such as the drivetrain, would need more precise modelling methods.

The written report of my work should have been more included in the entire process. I didn't use the research as a tool to help with my design as much as I should have, and documenting the process could have been more thorough.

Overall, I was satisfied with the process. I was able to move forward decisively and efficiently using tools I had available, to produce research and a design.

Evaluating the final product, I am happy with the design I was able produce. Focusing on interesting surfacing and functionality was the goal, and I feel I achieved good results. The adaptive wheelbase system could have been more carefully thought out from the beginning, as it needed to be re-designed. Similarly with the wheels, more time would be needed to perfect the complicated construction.

However, the end result was a visually working design, that I am pleased with. I was able translate the design I had in the sketching phase, and the package stayed intact. The product ended up being visually interesting, and the functionality that I wanted to incorporate is present.

SOURCES

IMAGE SOURCES

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