Designing an All Terrain Vehicle for Armed Forces of India

Submitted in partial fulfillment of the requirements
of the degree of

Masters of Design

by

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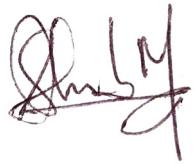
INDIAN INSTITUTE OF TECHNOLOGY BOMBAY

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 any idea/data/ fact/source in my submission. I understand that any violation of the above will be cause for disciplinary action by the Institute and can also evoke penal action from the sources which have thus not been properly cited of from whom proper permission has not been taken when needed.



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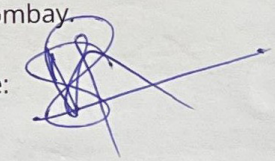
APPROVAL SHEET

This Mobility & Vehicle Design Project II titled 'All Terrain Vehicle for Armed Forces of India' by Shubham is approved in partial fulfillment of the requirements for Master of Design Degree in Mobility & Vehicle Design, IIT Bombay.

Project Guide: 

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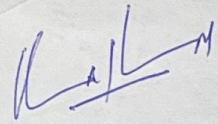
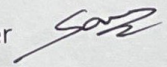
Internal Examiner: 

External Examiner 

ACKNOWLEDGMENT

My project Design of ‘All Terrain Vehicle for Armed Forces of India’ has been a great experience overall. It has taught me how to look at the problems faced by soldiers on day to day basis and how to design for the people. All these wouldn’t be possible without proper guidance so I would like to sincerely thank my guide, Prof. Nishant Sharma for his valuable guidance throughout this project.

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CONTENT

1. INTRODUCTION

All-Terrain Vehicles (ATVs) encompass a range of robust, off-road vehicles designed to conquer diverse landscapes. They come in various configurations, including three-wheel and four-wheel models, with the latter being more prevalent due to enhanced stability and maneuverability. These vehicles feature large, low-pressure tires, a straddle-style seat, and a sturdy chassis.

Among the diverse types, Side-by-Sides (also known as Utility Terrain Vehicles or UTVs) are a significant category. Unlike traditional ATVs, Side-by-Sides accommodate multiple passengers seated side by side, offering improved seating capacity and often more cargo space. They come equipped with roll cages, steering wheels like those in cars, and are typically used for both recreational and utility purposes. Side-by-Sides are popular in off-road adventures, agricultural tasks, land maintenance, and industrial applications due to their versatility, ruggedness, and ability to traverse challenging terrains.

Side-by-sides may be included in the category of all-terrain vehicles (ATVs) but do not include vehicles with saddle-seats that are operated using handlebar-type controls that are the conventional meaning of that term.

ATVs are powered by engines ranging from 150cc to 1000cc or more, enabling them to navigate through rough terrains such as dirt trails, sand, mud, rocks, and hills. These vehicles are utilized for various purposes, including recreational activities like trail riding, racing, and hunting, as well as practical applications in agriculture, forestry, search and rescue operations, military use, and land management tasks.

ATVs and Side-by-Sides have become integral assets in military operations worldwide due to their versatility and agility in navigating diverse terrains. These vehicles are employed for reconnaissance, surveillance, and patrolling missions in rugged and hard-to-reach areas, allowing military personnel to swiftly maneuver through varied landscapes, including deserts, mountains, forests, and challenging off-road terrain. Equipped with specialized attachments, ATVs and Side-by-Sides serve as efficient platforms for transporting troops, supplies, and equipment, enabling rapid deployment and enhancing mobility in tactical situations.

Their relatively small size, agility, and ability to traverse rough terrain make them invaluable tools for border security, rapid response operations, and providing logistical support in remote or inaccessible areas where conventional vehicles may struggle to operate effectively.

The adaptability and multi-functionality of ATVs and Side-by-Sides make them indispensable assets, enhancing the operational capabilities of military forces across a spectrum of challenging environments and scenarios.

1.1 TYPES OF ATVs

Utility ATVs
These are versatile and used for various tasks. They often feature racks and towing capacities, making them suitable for work on farms, ranches, or for outdoor recreational activities

Sports ATVs
Built for high-performance and speed, sport ATVs are designed for racing and aggressive riding on off-road trails. They typically have a lighter build and enhanced suspension for maneuverability.

Youth ATVs
Specifically designed for younger riders, youth ATVs come in smaller sizes and have reduced engine power for safety. They are suitable for children and teenagers learning to ride.

Side by Side or UTV(Utility Task Vehicle)
These vehicles can accommodate multiple passengers side-by-side and are commonly used for heavy-duty work, recreational riding, or off-road adventures. They often have a cargo bed and are suitable for various terrains

Special Purpose ATVs
Special purpose ATVs refer to vehicles designed for specific tasks or activities beyond the typical recreational or utility uses. These specialized ATVs are adapted or customized for particular functions or industries
Some examples include:

Military ATVs: Designed for military use, often featuring camouflage paint, enhanced durability, and the ability to carry weapons or supplies. They might also have specialized communication or navigation systems.

Search And Rescue ATVs: Built for emergency response teams, these ATVs are equipped with features such as emergency lights, sirens, winches, and medical equipment. They are used in rough terrains to assist in rescue operations.

Agricultural ATVs: Specifically designed for farm or agricultural use, these ATVs may have attachments for plowing, seeding, spraying, or hauling farm equipment. They often feature larger cargo racks, towing capabilities, and durable tires for farm work.

Track Conersions ATVs: Some ATVs can be modified with track systems instead of traditional wheels for better traction and maneuverability in snow, mud, or challenging terrains. These conversions enable the ATV to navigate through snow-covered landscapes or swampy areas more effectively.

These specialized ATVs cater to specific industries, tasks, or user needs, showcasing adaptations and features tailored for their intended purposes.

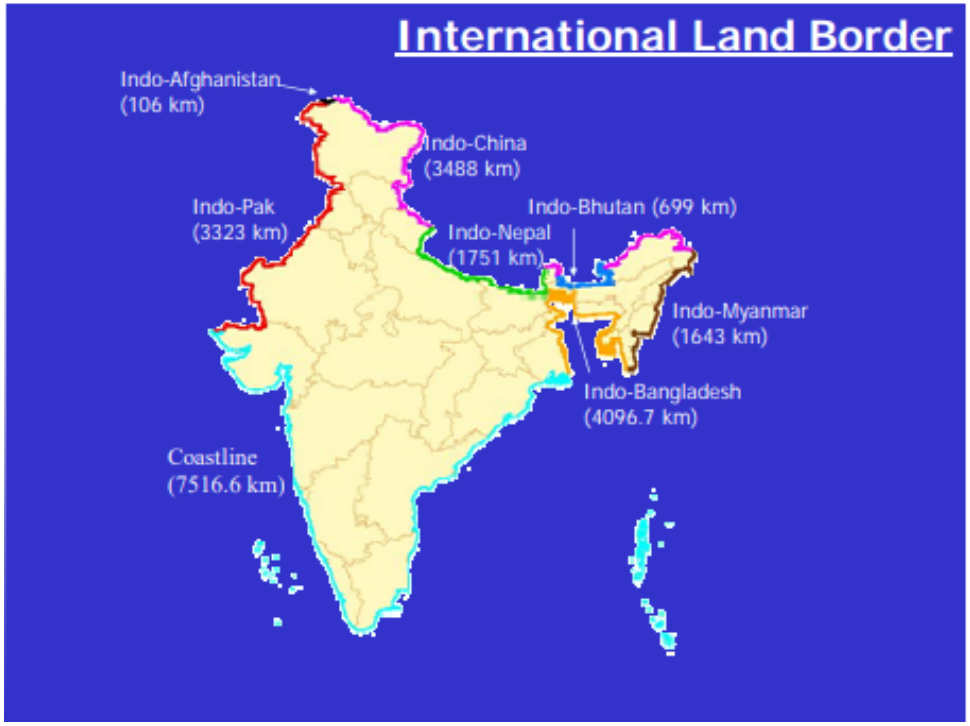


figure . International Borders of India (Source: https://www.drishtiias.com/images/

2. BACKGROUND RESEARCH

2.1 CURRENT SCENARIO

India shares its borders with several countries. These international borders collectively span various terrains and landscapes, contributing to India's geopolitical significance in South Asia and beyond.

India shares its borders with the following countries:

Pakistan - India shares a land border with Pakistan in the northwest.

China - India shares a border with China along the northern part of the country, including the regions of Ladakh, Himachal Pradesh, Uttarakhand, Sikkim, and Arunachal Pradesh.

Nepal - India shares a border with Nepal along its northern region. Bhutan - India shares its border with Bhutan in the northeastern region.

Bangladesh - India shares a border with Bangladesh in the east and some parts of the northeastern region.

Myanmar (Burma) - India shares a border with Myanmar in the northeastern part of the country.

Afghanistan - India doesn't share a direct border with Afghanistan, but they have a proximity through Pakistan-occupied Kashmir.

Borders with Escalated Tensions

LoC(Line of Control) and Indo-China Border usually have the most escalated tensions

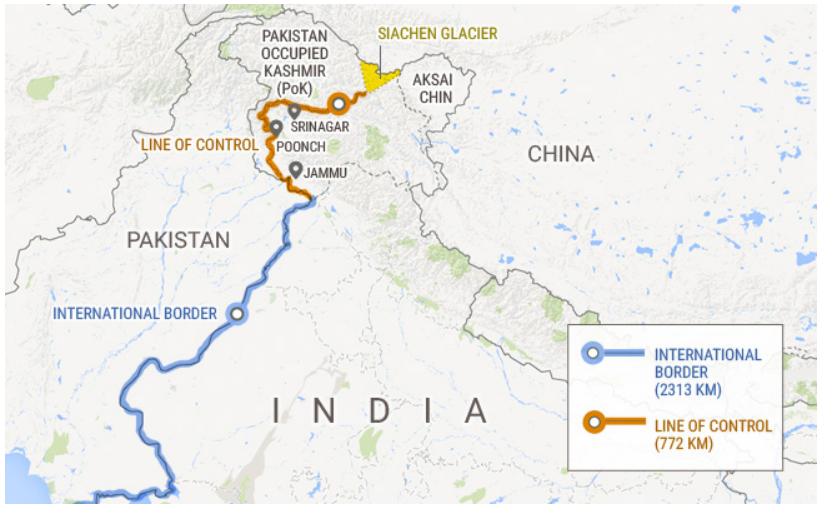
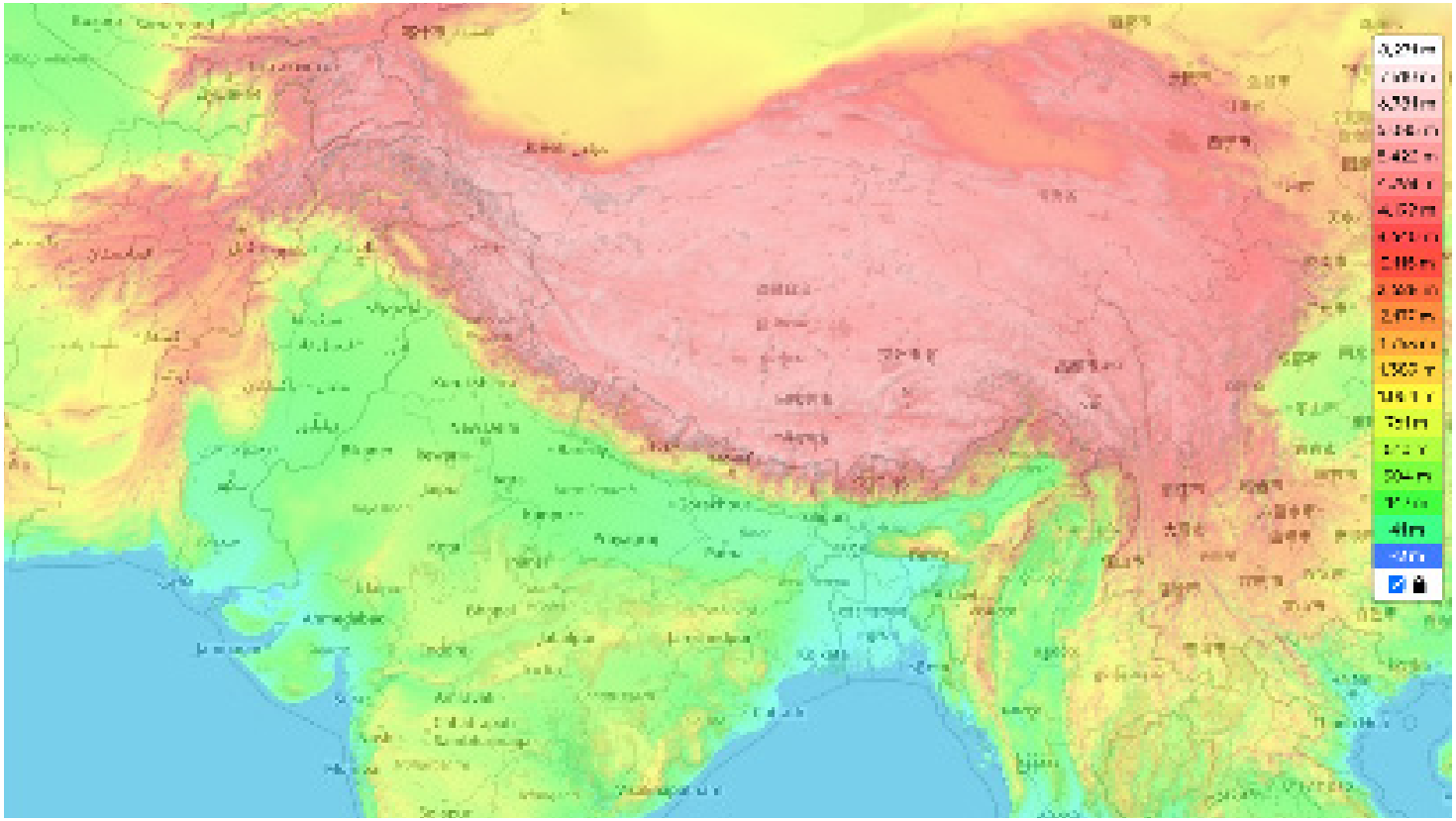


figure . LoC (Source: https://commons.wikimedia.org/wiki/File:India-Pakistan_border.png)

LoC(Line of Control) : The Line of Control (LoC) is a military demarcation line that serves as the de facto border between the Indian-administered union territories of Jammu and Kashmir and Pakistan-administered Jammu and Kashmir and Gilgit-Baltistan

figure . Indo-China Border

Indo-China Border: The border between India and China is known as the Line of Actual Control (LAC). The Line of Actual Control is the effective boundary that separates Indian-controlled territory from Chinese-controlled territory. It stretches over approximately 3,488 kilometers (2,167 miles) along the Himalayas, covering various terrains, including mountains, rivers, and plateaus.



LoC and Indo-China Border is mostly High Altitude region as seen in the image below showing altitude levels in the regions

figure . (Source: https://en-gb.topographic-map.com)

High Altitude Warfare is even more challenging for the forces

Logistics issues
Movement of troops, weapons, drinking water, fuels etc.

Medical consequences
Rarefied Air, Load on Nursing Staff, cold-related injuries such as pulmonary and cerebral oedema, hypothermia, chilblains, and frostbite

Human Factors
Decreased Efficiency, Increased Fatigue.

Why ATVs?

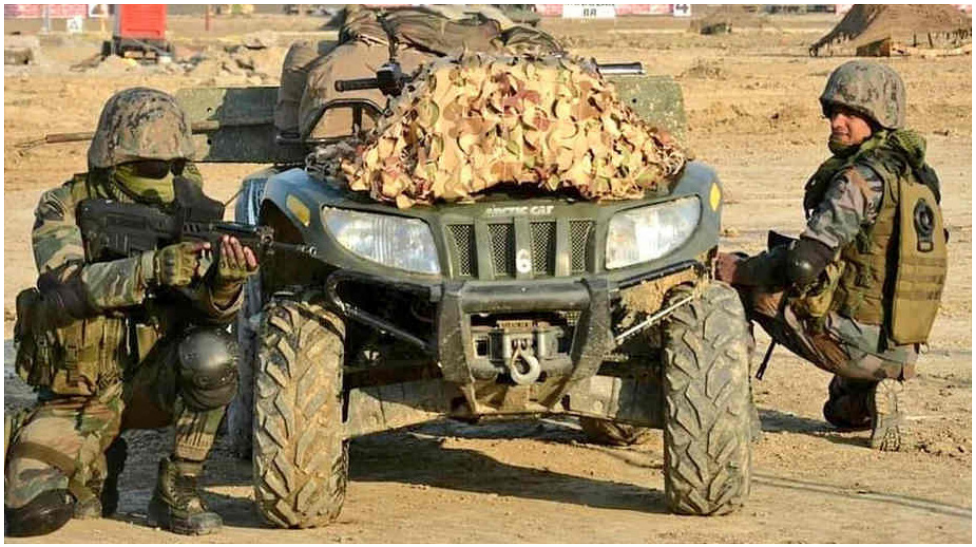
When a soldier is at hight altitude, his efficiency comes down to 40%. Because he is fighting against the weather also.

Where big cars cannot go ATVs go there. We need swift movemment in narrow and difficult terrain.
-**Colonel, Indian Army**

2.2 EXISTING VEHICLES IN USE

Polaris Sportsman

Polaris Ranger



Arctic Cat Alterra TBX

Polaris MRZR 4

3. PRIMARY RESEARCH

3.1 User Interview

Captain, Indian Army

24yrs (4yrs in service)

What are the environments conditions you operate in?
Army operates everywhere. Deserts, hills, plains, snows, mountains everywhere.

What is your daily routine most of the days? Any problems do you face in your routine operations?
We wake up in the morning. Do our P.T. and stuff and we have or daily tasks specified, they can be different for different days. Different for peace and different for field. For field we have tasks like Patrolling, setting up check posts and checking people and tasks like these.
There are not any issues as such that I feel we face, just that if it rains then there is a slight problem in walking etc. Otherwise, I do not think there are any issues.

What kind of drills do you have?
It depends on the unit and where it is placed. We have different drills. War time drills are different and peace time drills are different. In deserts we tank and any 4x4 high mobility vehicle along with it. Deserts usually have tank warfare. In mountains if there is snow, we usually wrap chains around the tires of 4x4 vehicles so they do not slip or anything. Otherwise, it is generally the same everywhere. We have 4x4 trucks and sometimes 6x6 also.

Let's say in Mountainous regions where accessibility is difficult with trucks and 4x4 SUVs, What do you do and how much on an average a soldier has to carry with him?
If it's like a difficult to access Mountain regions where our 4x4s cannot reach then soldiers will have to carry 10-20kgs. And it takes a lot of time to climb. Even a 1km climb will take around 20mins average.

What equipment do you carry and handle?
We carry Radio sets, weapons, PPJs, personal stuff also. Equipment differs from unit to unit. Armoured units have Tanks, infantry has rifles and AAD (Army air defence) has missiles, AAC (Army aviation Core) has Helicopter fitted with missile systems.

Any suggestion that you feel should be looked upon for army soldiers.
Uhhh..... if someone is listening to you then get us a salary raise, otherwise it is all fine.

Colonel, Indian Army

17yrs in service

All Terrains Vehicles as the name specifies is a vehicle for all terrains. By terrains you mean snow, marshy, desert, plains. When we talk about a all-terrain vehicle in high altitude it has to be designed in a way that the performance of the machine doesn't dips in high altitude. Reason? The fuels burns in an IC engine under certain compression ratio of mixture of fuel and air. And at high altitude there is Rarefied air. So, automatically the performance of vehicles also dips. So, you have to design a toughened vehicle which has the capability to carry load effectively keeping efficiency in mind.
So, that is very the concept of all terrain vehicle comes in mind.
In all terrain vehicles generally there is a driver and a co-passenger. Two are seated.

They come in both option 2seater and 4seater also.
yeah, but then there will be a difference of cc capacity of engine. Former will have less displacement and latter will have more. And it will all depend on the need of the user. If you want a frisk high speed movement, you will need a 2 seater ATV.
'2 sipahi baithe hain. Hathiyar weapon dala aur target par rawana hogye'
If your need is that there is a critical target and you need concentration of soldiers. Then you will need 4-seater ATV. But in 4-seater your engine capacity needs to be heavy and fuel consumption will be more. Former will have less fuel consumption and more frisk movement. While the latter will have More fuel consumption and less frisk movement but can carry more soldiers.
Now if we talk about average load. You will get the information from the Polaris website, just get the datasheet.
Now talking the load each soldier carries that you asked. For individual soldier fully Combat mode is 30-32kgs over its own weight. So, if a man is weighing 80kgs add 32kgs to it. Backpack on its back and weapons are in front.

What is it that they carry with themselves?
Backpack carries Sleeping bag, 4 days of ration, ammunition, Emergency first aid kit, Night Vision.

And who carries the Radio kits etc?

There is a specific trained person for the radio kit who operates as a radio operator. On him, there is only his Radio kit, weapons, and light package. His load will be carried by the person ahead of him. If you are operating in cold region and you know your operation will take few cold nights outside then you will take it.

So, Now tell me the scope of your project. What do you want to target.

My work is to work on the architecture of the vehicle i.e. the packaging. Working on the Exterior and the interior keeping in mind the specified requirements and the ergonomics of it. While another person will be working on the materials and testing of other parameters.
You will have to do trials. You'll need to go to Leh Ladakh and Sikkim t carry out the trials.

From what I've read from across the sources on web, these ATV are used in the Indo-Tibetan Border.
ITBP. Indo-Tibetan Border Police uses it. BSF uses it and Army uses it. Army Commander Lieutenant General Rank officer has the special financial powers to make their purchase. So, recently in the conflict with China, A lot of ATVs have been purchased from Polaris.

Are these ATV only used at the Indo-Tibetan Border or they are also used in deserts? Because from what I've come to know is that there is Tank Warfare in Deserts.
Till now Tank Warfare was only in Deserts but now THhere is tank warfare in Ladakh also. When you go above 14,000 ft there are flat lands. Both India and China has their Tanks positioned there.

Troops use chains around their tires of 4x4s in snowy conditions for better grip. And we also use ATVs. So, at what point we start using them.
4x4s are going with chains on tires because we need to take the troops to a location. Then troops need to go to a certain point where 4x4s cannot go. If they go there on foot they will get tired before they reach there. So, ATVs do that.

So, Are ATVs serving in the last mile?
Not that, depends on the task. See... ATVs are simply used to ferry troops, Period.
'frisker movement, less fatigue to the troops'
When climbs are steep, passage is narrow, where big cars cannot go ATVs go there. But Fatigue!!! Less fatigue, Quicker Movement. Here you are breathing normally but in Ladakh at high altitudes you can't breathe normally. You will get blood from nose, throat and what not. You get terrified of what is happening to me.
See, there is China and facing it is India. China's task is to Enter India and India's task is to stop them form entering. And when a soldier is at hight altitude, his efficiency comes down to 40%. Because he is fighting against the weather also.
'apni jacket, apna hathiyar,

apna sharer samhalega ya pahaad ki chadhayi krega?'
This is where this automation comes. To make his work and life easy. To keep his power intact to attack the enemy rather than burning it in climbing.

You can get the data and specs different from manufacture's websites and specs you can also get from RFP (request for proposal) of Army.
Now that you know all this, you need to really define the scope of your project.

Mostly we will work along the lines of architecture, packaging, and ergonomics. And problem statement will be more defined as we research more into it.
See, ultimately in this everything comes down to money. Polaris will also work on the order of only 500 vehicles. But the COST!!! It is so expensive. Just check the price of their engine oil.

Rs4,500 in US but here it shows Rs16,000 in India
I've bought them so I know how expensive these are. If there is free service pending from Polaris then they would come with all their oil and everything but if is paid then everything is about 10x in cost. Because they different grades of oil and everything.

How easy is it maintain and service them? Like in case of Gypsy, we all know everything is easy and simple.
both have different aims. Gypsy is for ferry of soldiers and officers and it is not sophisticated. It has very defined laden and unladen weight. Just load and get on with journey. Polaris is a specialised vehicle. Swift movement at high altitude.
'Full throttle it at high altitude and the performance doesn't dips.'
We are trained for snow scooters. We have two workshops in Siachen and Nyoma. Their role is to repair ATVs. For that we have trained people. Spare Parts, Oil and Everything has a process. Meaning everything is purchased in an official and documented way and serviced by our people.

What is the average day for a soldier there?
Day starts at 4.30 in the morning.
You are given tea and till 5.30 you've to freshen up.
Then PT for 1 hour.
Then you take bath and all and get ready.
9:00 am to 2:30 pm is office.
Then Lunch.
1 hour sleep.
Evening is games following (1 hr games)
Night Duty – Patrolling and other things. Shifts also change accordingly.

24Hrs done.

You were posted in Ladakh for 2yrs and seen high altitude warfare. You have used and drove these ATVs. Do you think are any problems there with the vehicles?

Poor maintenance by the user, otherwise there is no problem with user. It is an American Vehicle and Indian People have difficulties using it. I think there is no issues design wise and never

faced any problems with it. Polaris is a high-end vehicle.
Then why do you say Indian people find it difficult to drive these?
Poor training. Every car has way of driving to it. Mercedes is different, Gypsy is different, i20 is different.

Is there a learning curve to it?
You have to learn and you have to be trained on ATV to drive it efficiently. Like what gear to be used in which situation, when to engage 4x4 and when to disengage it. When to change engine oil, when to change coolant, what should be the tire pressure and everything.

Will electric work there?
No, I don't think so. It won't work there.

Do the heavy-duty vehicles and other vehicles use different type of oils and fuels?
Grades are different. We have a tie-up with Indian Oil Corporation. They supply us with fuels that don't freeze.

Further research with an officer(Colonel, Indian Army) was done on the key tasks and drills done within the Indian Army during War time and Peace time.

3.2 Structure of Indian Army

Combat Arms
Armoured Corps
Mechanized Infantry
Infantry

Supported by combat support arms:

Artillery
Corps of Engineers
Corps of Army Air Defence
Army Aviation Corps
Corps of Signals

Services
Army Service Corps
Army Medical Corps
Army Dental Corps
Army Ordinance Corps
Corps of Electronics and Mechanical Engineers
Remount and Veterinary Corps
Military Farms Service
Army Education Corps
Corps of Military Police
Pioneer Corps
Army Postal Service Corps
Intelligence Corps
Judge Advocate General's Department
Military Nursing Service

3.3 Key tasks within Indian Army

Patrolling (short and long distance)

Transportation of troops

Aid in medical emergencies

Transport/delivery of ration, weapons, spares

Maintenance of vehicles, equipments

Immediate mobilistaion (quick reaction team)

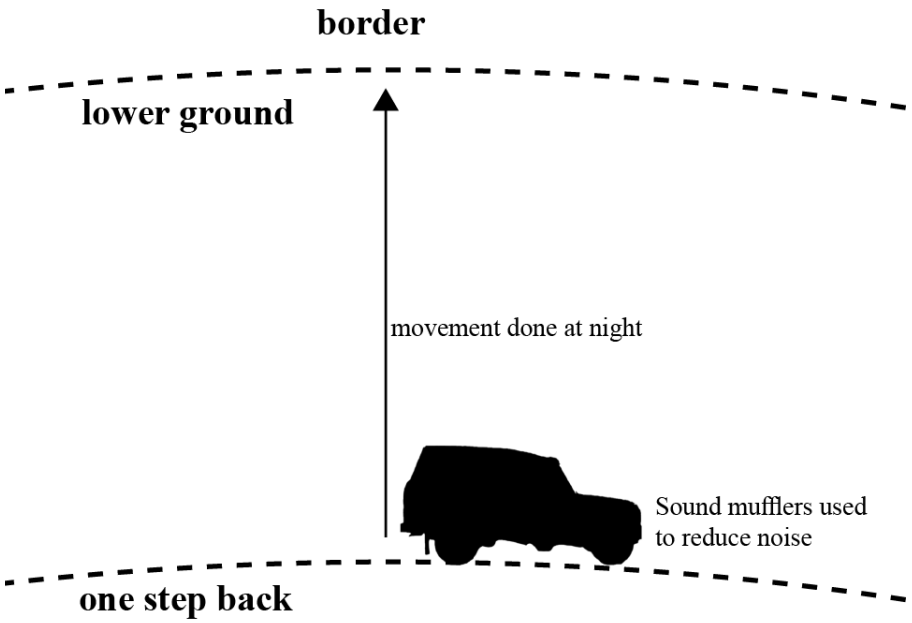


figure . Patrolling strategy during critical war time drills

3.3.1 Patrolling

Patrolling is all about saving your land

Soldiers carry 120 rounds (30 in magzine and 90 extra) with their guns (cocked)

Strength of patrol party depends on the area and situations

Generally a 8-10hr opertaion

In mountaineous regions, mine detection equipment is also taken with other equipment

During critical situations movement is done at night and Sound mufflers are used on vehicles

figure . Ashok Leyland Stallion

Vehicles Used

ALS and other 2.5 tonnes are used

Casspir mostly used in areas with mines and naxalite areas

Gypsy and other vehicles are also used deending on the terrain

figure . Casspir (mine protected Vehicle)

figure . Maruti Suzuki Gypsy

3.3.2 Aid in Medical Emergencies

AMC (Army Medical Corps)

The Indian **Army Medical Corps** is a specialist corps in the Indian Army which primarily provides medical services to all Army personnel, serving and veterans, along with their families.

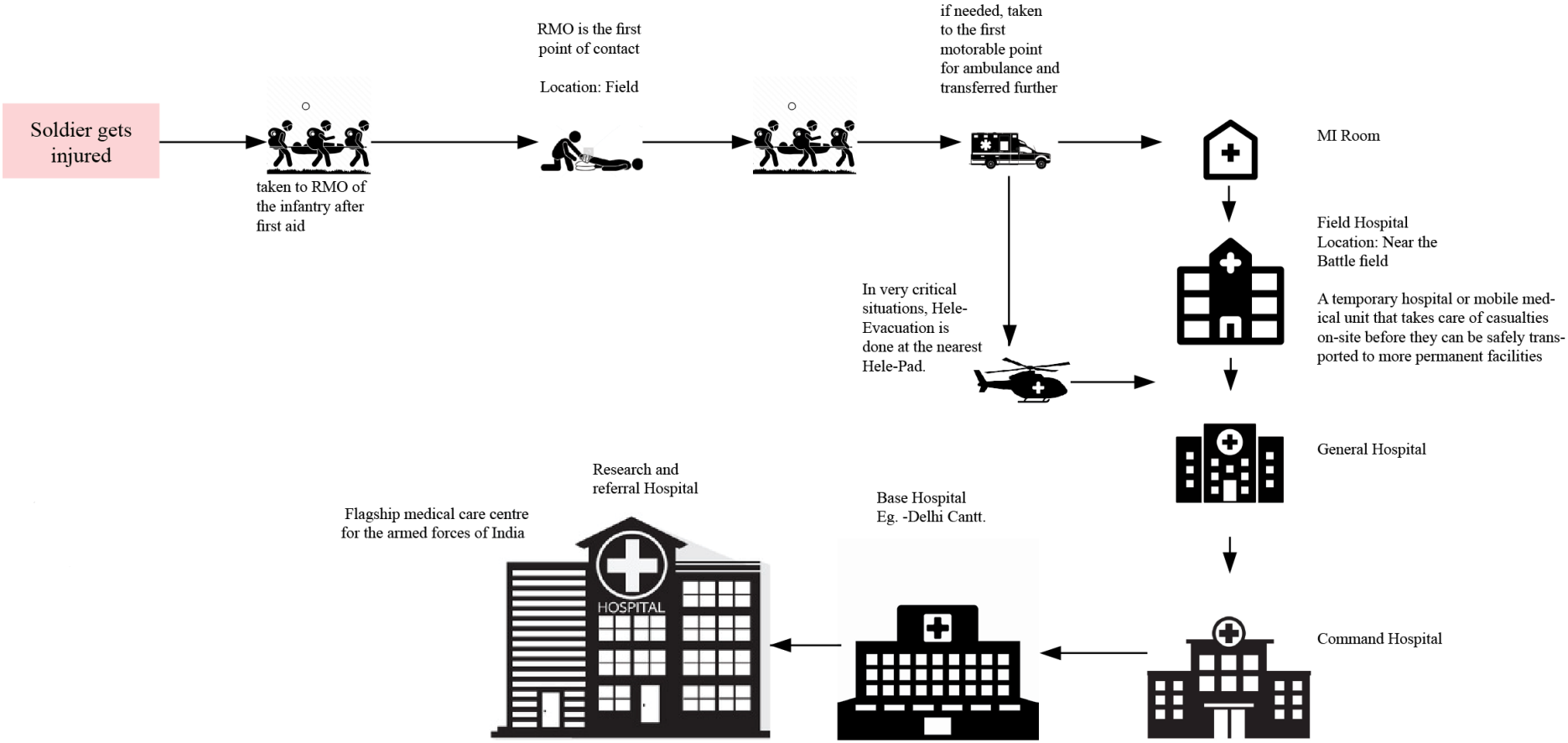
RMO = Regimental Medical Officer (normally an army general practitioner with additional training in pre-hospital emergency care and occupational medicine)

RMO is first point of contact for injured soldiers on battlefield and serve with Infantry, Armoured Regts, Para, etc

What happens when a soldier gets injured on field?

When a soldiers gets injured he is taken to RMO for first aid and pre hospital emergency care and then if need be he is taken to the ambulance on a stretcher. The ambulance is stationed at the nearest motorable point. The nearest motorable point may or may not be close to the battlefield. After reaching the ambulance, soldier is taken to a hospital depending upon the urgency of medical care.

What happens when a soldier gets injured on field?



Vehicles being used as ambulances

figure . Mazda Swaraj

figure . Tata Sumo

figure . Ashok Leyland

3.3.3 Transport/delivery of ration, weapons, spare

Field Formation of Indian Army

Fields	Commanded by	Types	Consists of
Commands	Lieutenant General	Northern, Central, Eastern, Southern, South-Western, Western, Training command	2 or more corps
Corps	Lieutenant General	-3 'Strike' corps -10 'Holding' corps	3-4 army divisions
Division	Major General	37 divisions, including4 RAPID divisions	3-5 infantry brigades
Brigade	Brigadier	5 brigade-Infantry/mountain, mechanised, parachute, armoured, artillery	3000 combat troops
Battalion Regiment	Colonel	Artillery and armoured formations	4 Rifle companies/more than 900 combat forces
Rifle Company	Lieutenant Colonel or Major	-	3 infantry platoons with strength of 120 soldiers
Platoon	Junior Commissioned Officer (JCO) usually Subedar	Fighting unit	3 sections of 33 to 36 soldiers

Transportation of Weapons and Spares

Each unit raises its requirements for equipments/spare parts/ weapons etc. and and maintained by **Army Ordnance Corps**.

The AOC is an active corps of the Indian Army and a major formation responsible for providing material and logistical support to the Indian Army during war and peace

The proper functioning of this equipment is critical to the success of a mission. Equipment failure can lead to fmission delays or failures, putting military personnel in harm's way

COD

Central Procurement of Spares, weapons, vehicles etc. for the Army is done by COD

↓

FOD

Defence Procurement Manual procedure is followed in making all purchase and procuremnets

↓

DOU

Since, AOC procuremnet satisfaction rate in not 100%

EME Officers of OC Workshops have special powers to buy on their with NAC (Non Availability Certificate) from AOC

All this keeps army vehicles, weapons and their maintenance routines

Vehicles Used

figure . Trucks used for transportaion of weapons, spares, ration

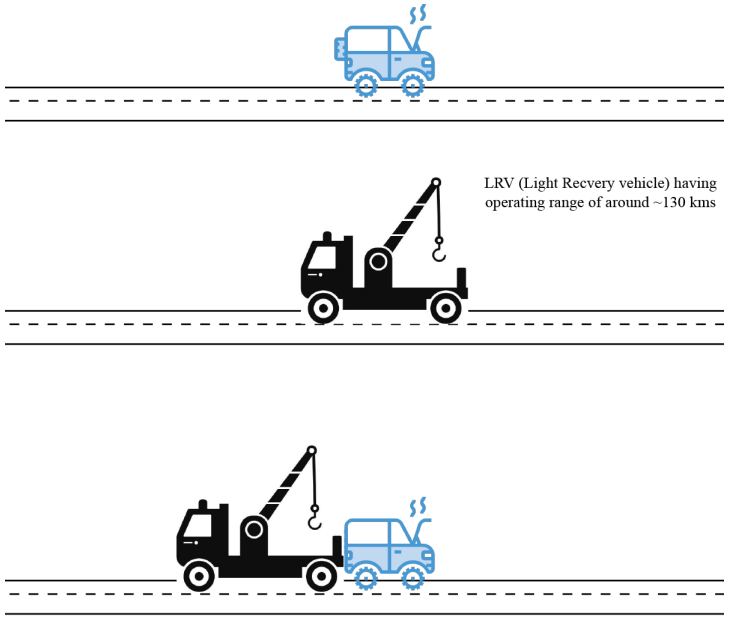


figure . LRV recovering a vehicle

Transportation of Vehicle Spares

The **Corps of Electronics and Mechanical Engineers (EME)** is an arms and service branch of the Indian Army. The Corps has varying responsibilities related to the design, development, trial, inspection and refit of weapon systems and equipment.

The Corps of Electronics & Mechanical Engineers (EME) is the first one to enter and last one to leave batlefield.

EME is the key that unlocks all doors and helps the Indian Army kick, punch and moves- anywhere, everywhere, always and anytime. It is the foundation or pillar on which the Army depends to fight and win war.

Most engineering tasks are handles by this unit.

What happens if a vehicle breaksdown mid journey?

Before leaving for Long routes vehicles are inspected, passes through road worthiness test and given fitness certificate for long routes. All the routes are marked on which these vehicles travel and in case a vehicle breaksdown, LRV (Light Recovery Vehicle) is dispatched. Each LRV has a recovery mechanic, driver, electrician and carries onboard running spares repairs such as clutch plates, brake pads, clutch wires, etc.

LRVs are essential part of logistical support of Army.

Large trucks are used for this purpose.

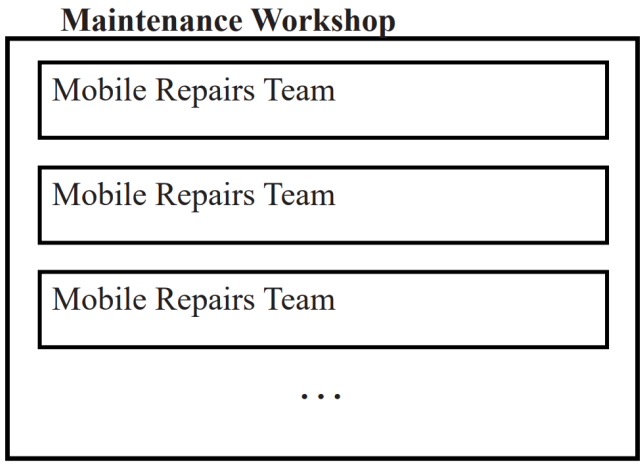


figure: Division of Maintenance Workshops during war

What happens if a vehicle breaksdown mid journey during

During war, maintenance workshops are divided to form mobile repair teams. Only 15-20% remain back while, all others are sent with the units. MRTs do the small running repairs on the field and whenever needed during transit. MRTs use big or small trucks, gypsies or any convenient medium.

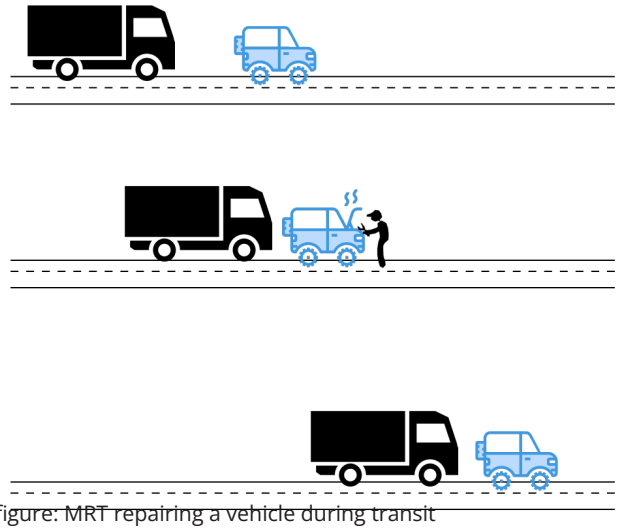


figure: MRT repairing a vehicle during transit

Each Unit durng the war time operations is accompanied by a MRT (Mobile Repair Team) and handles all the running repairs that might be needed by the unit.
Uses **Trucks, Gypsies , whatever suits** the need of the terrain.
They carry spares, running repairs of both weapons and vehicles

What happens when specialised vehicles and tools need repair?

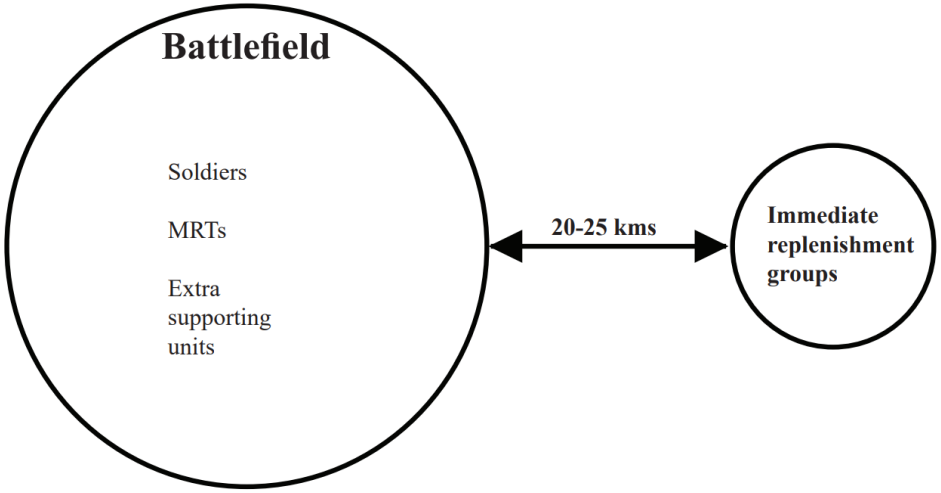


figure: Stationing of IRGs during war

There are immediate replenishment groups that stay one station behind the battlefield and cary special spares and parts and carry out repairs.

Any major repair or machinery requiring special repair is brought to IRGs at night in Large trucks for eg.Tatra Trucks.

RATION

Dry	Fresh
Rice	Vegetables
Wheat/atta	Fruit
Sugar	Meat
Tea	Milk, etc
Edible oil	
Dal	
Dry fruit	
Canned food	

Canned Food: Meals Ready to Eat (MRE)

figure: Stationing of IRGs during war

Transportation of Ration

The Army Service Corps (ASC) is entrusted with the responsibility of providing rations to the Indian Armed Forces.

Primary responsibility of the Corps to provide wholesome and nutritious food to troops to meet their calorific and nutritional requirements so as to enhance their performance in various terrains and climatic conditions.

During Wartime it is critical to maintain supply of food to troops because any delay or missed meal might lead drop in their Morale on field.

figure: MREs(Meals ready to eat) for Soldier

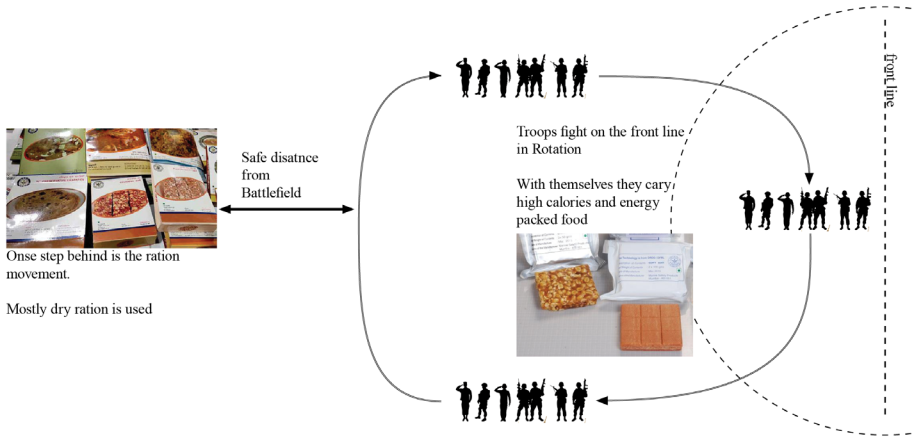


figure: Movemen of ration on field

Troops carry some sweet packed meals with them on battlefield while the rest of the ration stays one step behind.

Ration is carried along with troops in Vehicles suited for the terrains.

figure: Ration being carried in trucks

Vehicles Used

Trucks are used for movement of ration and if not possible in trucks, then smaller vehicles are used. Ex- Gypsies, SUV, Smaller Trucks, etc.

If not even possible by Smaller Vehicles, for example, in mountain areas or areas with difficult to access terrains mudy, rocky, etc. then Porters are used

Porters are people from within the army or local people of that region that are hired to carry material, and help in movements of troop

3.3.4 Transportation of Troops

Troops use all kind of vehicles for their mobility and depending on the terrain they can vary from trucks to gypsies to quads.

They also carry some luggage with them.

What troops carry?

Each Jawan Carries 300 rounds and 2 magzines with him

Bagpack: Survival ration, Water, Personal First-Aid Kit, Night Vision, Ammo, compass, mission specific gear, knife, personal item, etc.

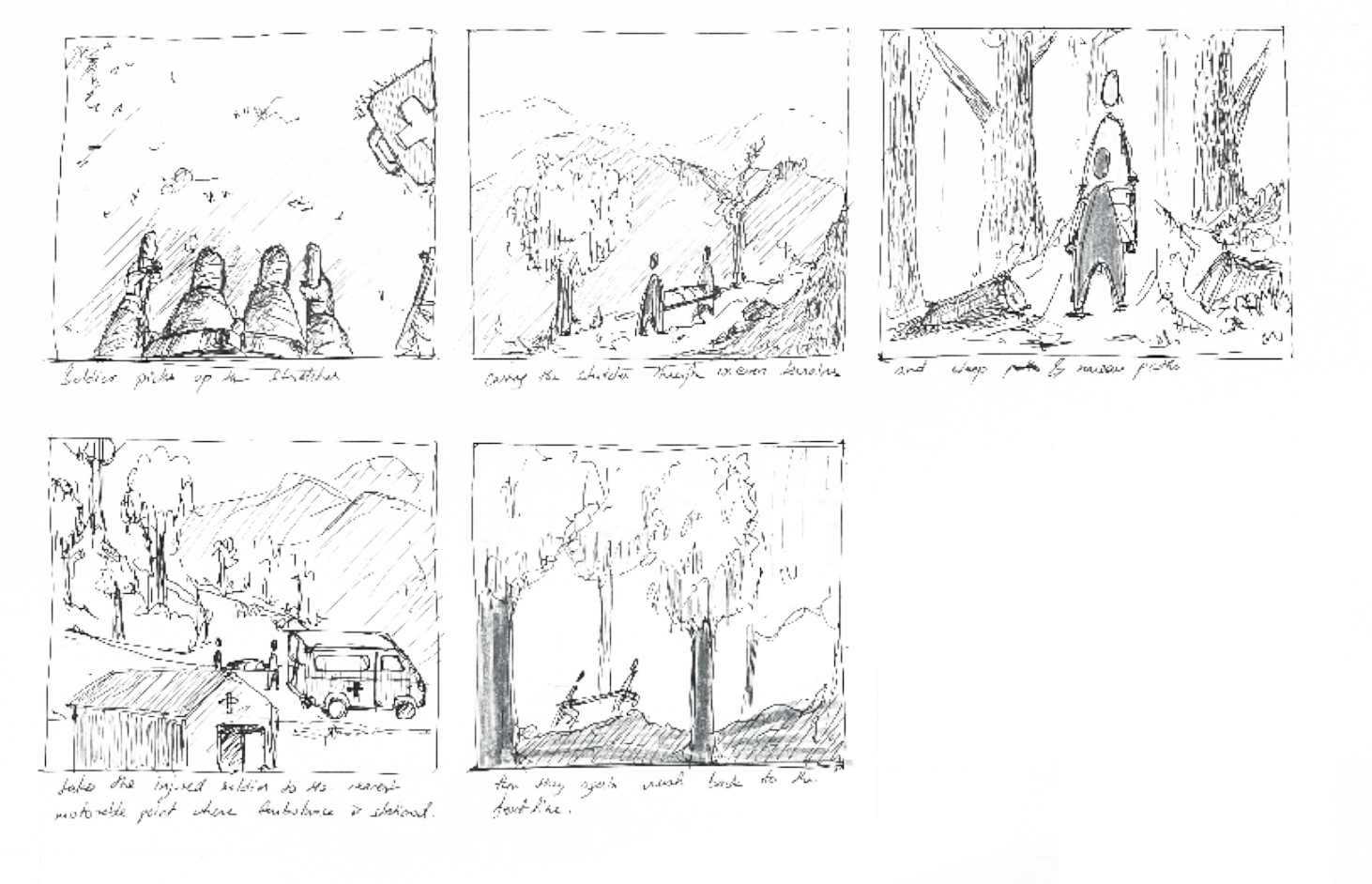
And with that they also have to handle and carry other exrta weapons.

Extra Ammunition is carried in truckor any covenient medium suited to terrain

Unit’s coach replenishes the supply when needed.

4. SCENARIO BUILDING

Various scenarios were sketched out to visualize the problems faced by the soldiers on field. And key insights were derived from them.

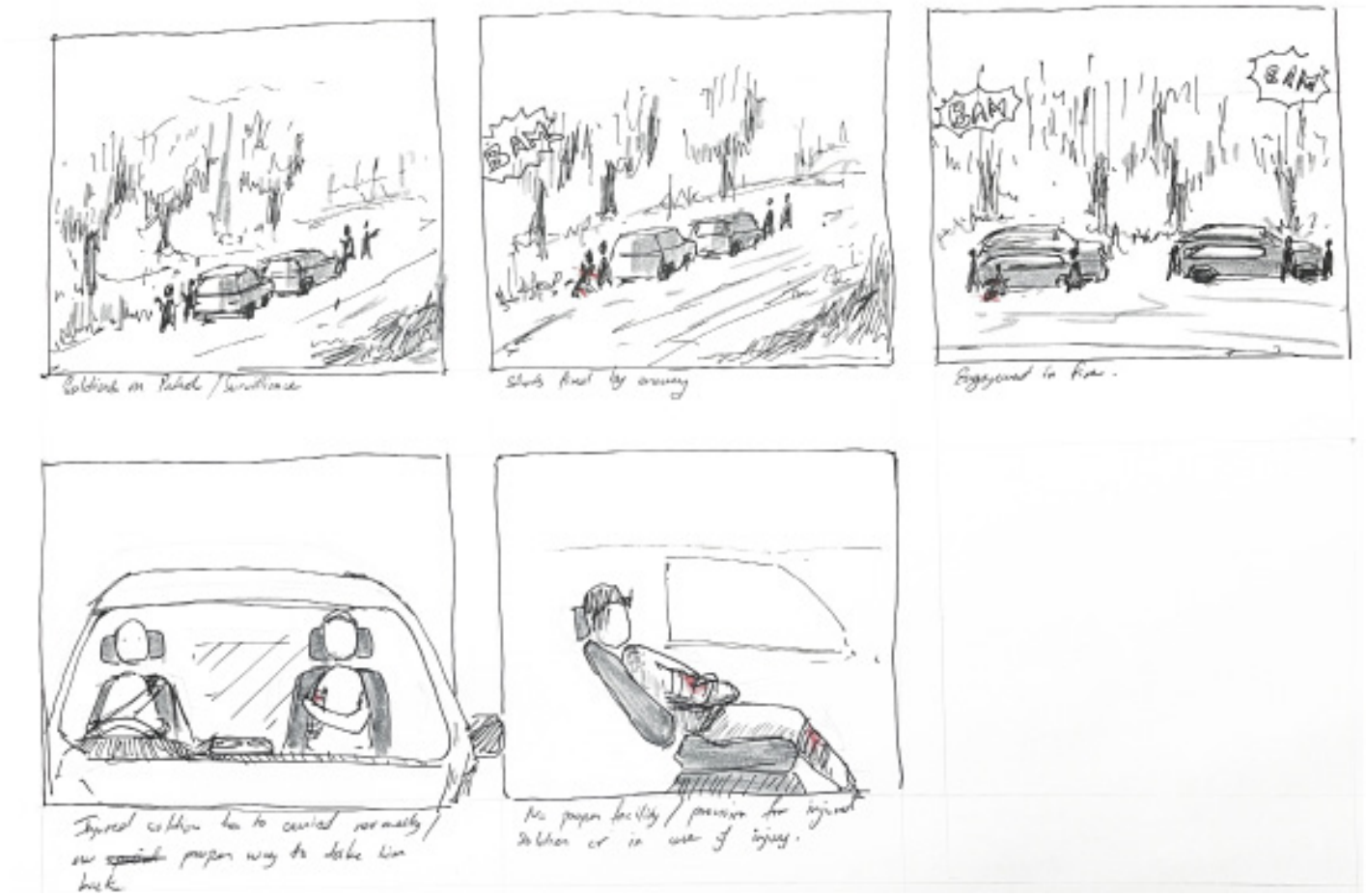


4.1 Scenario 1

Soldiers have to carry their injured mates on stretcher to the nearest stationed ambulance.

They have to travel uneven terrain and carry the load by themselves.

This way of carrying is both in-efficient, slow and results in the soliders carrying the strecher geting tired quickly.

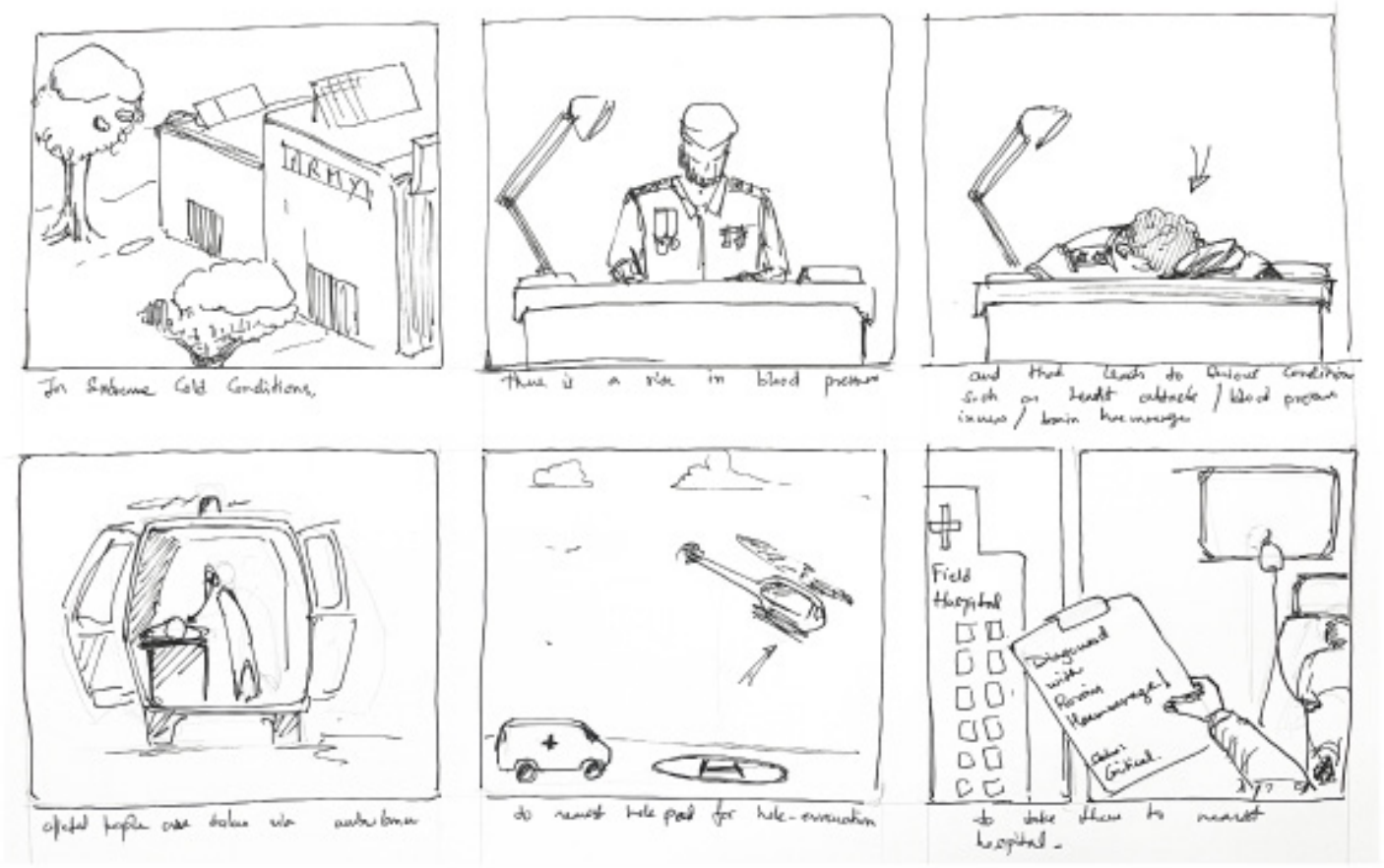


4.2 Scenario 2

Soldiers sometimes get injured during patrol and small operations where cease fire is broken. Then the injured soldiers has to carried back and there is no way of seating him up comfortably while coming back.

Sometimes the seating position can be uncomfortable for the soldier.

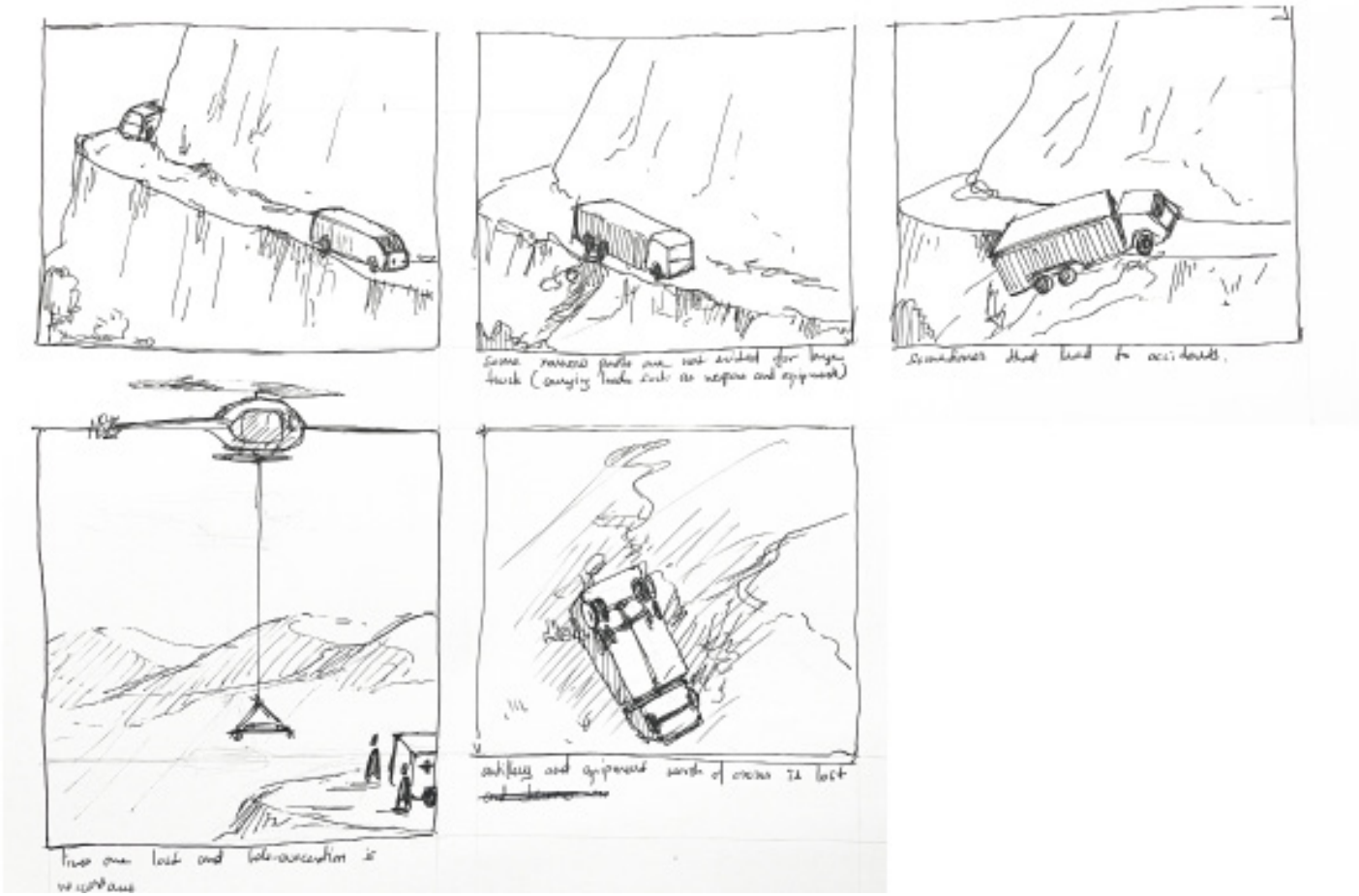
This also highlights the need for protecting the gun men.



4.3 Scenario 3

At high altitudes, there is increased blood pressure and there are cases of blood vessels bursting due to that.
This case shows a soldier falling on his desk due to brain haemmorage and has to be taken to the nearest helipad quickly in the ambulance.

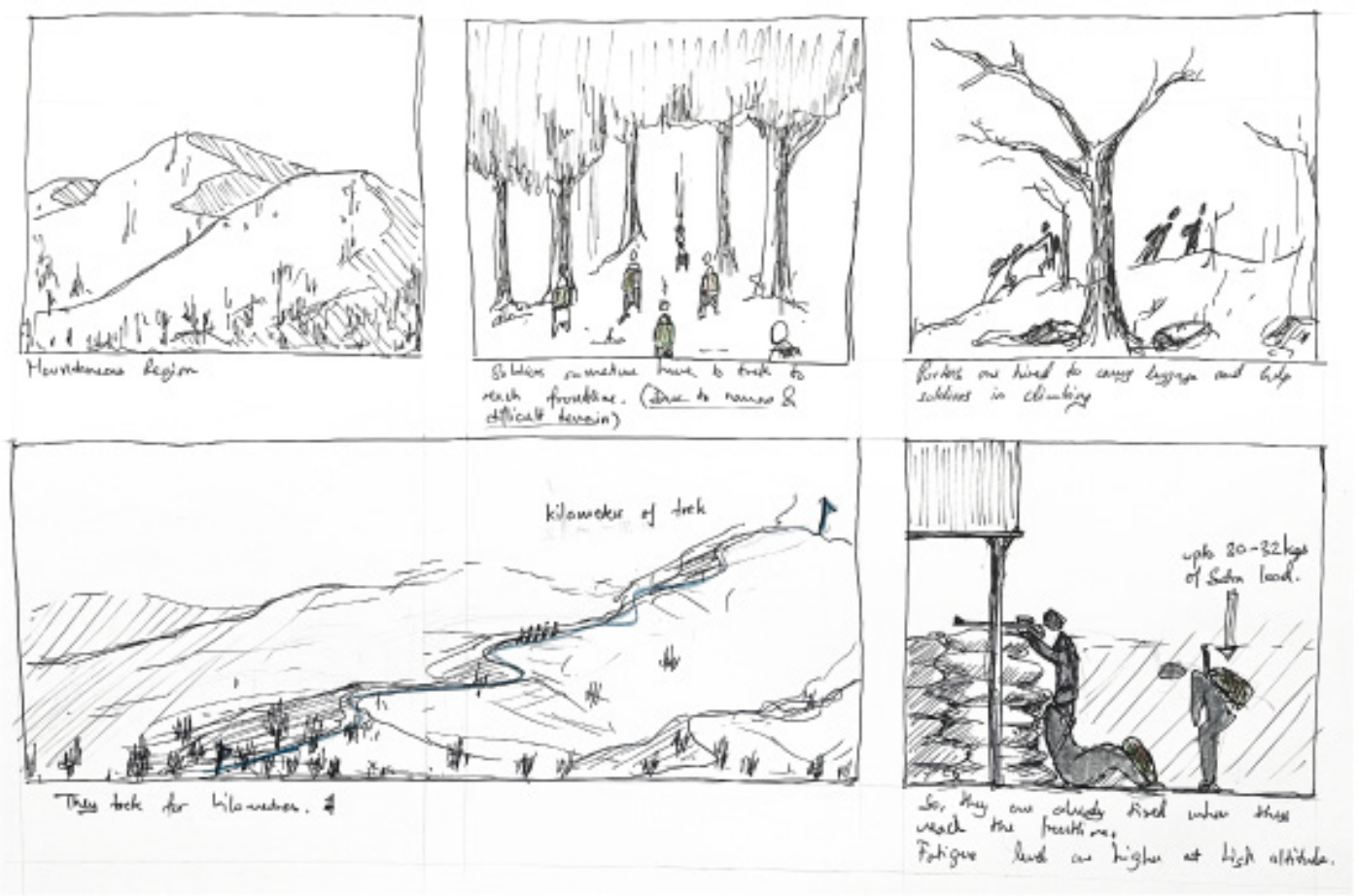
It shows the effects of working in extreme weather conditions and the need for having a vehicle which can be used to transport soldiers in all terrains.



4.4 Scenario 4

Weapons are carried to the army bases in trucks and other large vehicles.
In some routes, the path is so narrow that the vehicles slip and fall downin valley, resulting in death and injury of soldiers as well as loss of crores of weapons and equipment.

this highlights the need of vehicle which can do haul luggage when neededand has a smaller footprint.



4.5 Scenario 5

At high altitude regions, soldiers sometimes have to trek for many kilometeres because vehicles having larger footprint cannot tread in the rough terrains and extreme weather.

Because of this, soldiers are already tired when they reach the front line and cannot perform to their full efficiency.

This highlights the need for smaller footprint and light vehicle which can reduce the distance which soldiers have to travel.

4.6 Scenario 6

Mobile repair teams in mountaineous regions have to carry the spares themsleves or hire porters to carry the luggage to the battlefield.

Their efficiecy also depend upon the factors that are how much they have to travel themselves carrying the luggae and how quickly the supply of spares is replenished.

4.7 Scenario 7

Due to decreased effieciency in extreme cold weather and rarefied air. Soldiers can fall due to any of the many diseases that come with working in extreme cold altitudes.

There must be a vehicle so that they do not have to walk in open cold air as much as they do now.

When a soldiers gets injured, the load and burden on other soldiers get 2-3x.

5. KEY INSIGHTS

Based on the research and scenario building some key insights were derived:

- The vehicle shold be accomodate stretchers
- The soldiers should be protected from while firing
- Indjured soldiers should be seated comfortably
- Vehicle should have a small footprint and able to carry loads in uneven terrains
- Vehicle should not be open and have a closed space to protect user from extreme weather

6. BENCHMARKING

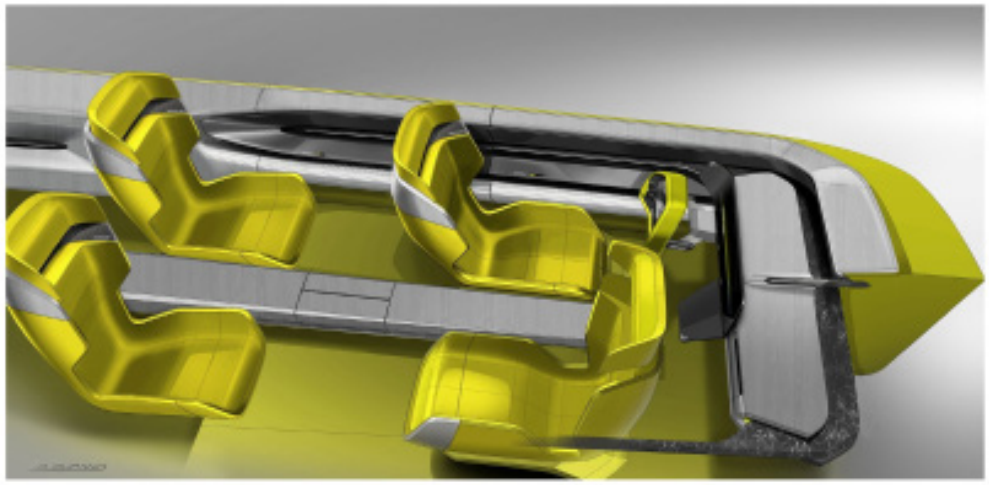
Based on the key insights some products were benchmarked

Seating

Renault Morphoz

Seats that rotate backwards

Idea:
To use this concept to make seat configurations that can adapt to comfort of an injured soldier
Make them foldable from the traditional hinge point



Audi Activesphere

Renault Morphoz

Can adapt to create more volume

Idea:
use this idea to create space at rear which can be expanded when needed

Citreon Oli

Symmetric Panels and rear & front bumpers to reduce cost

Uses composites to reduce weight and increase range

Idea:
Make symmetric panels and lights to reduce manufacturing costs
Uses Engineering plastics and composites to reduce weight

Audi Activesphere

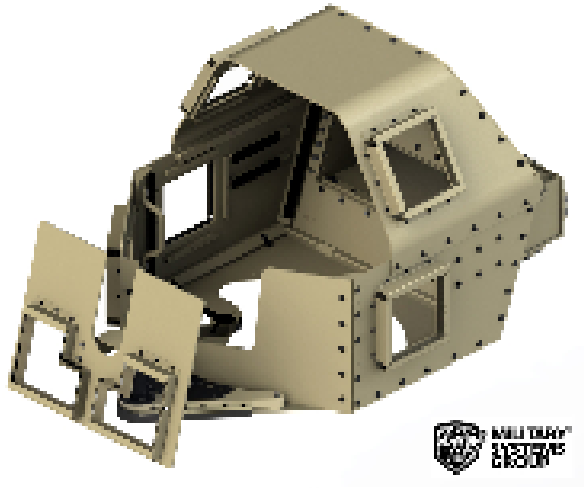
Dashboard goes in when in autonomous mode and pops out in normal mode

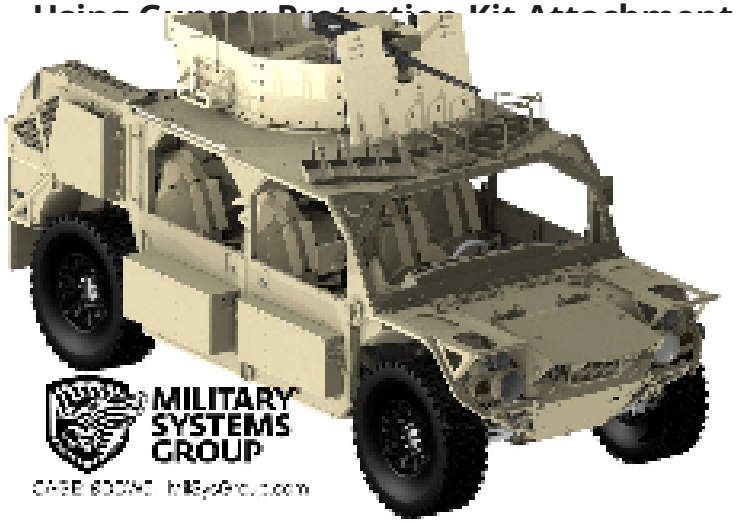
Idea:
keep the dasboard only to the driver side to make more room on the passenger side

Renault 4ever

easy color accented strap-on mechanisms that blend in with the overall design

Idea:
implement built in strap-in system and rails to attach and carry additional luggage





Military Systems Group

Designing car seats with plastic

The assortment of available materials includes not only thermoplastics such as the polyamide Ultramid, thermoplastic polyurethanes such as Elastollan, foams based on expanded polypropylene (Neopolen) and aromatic polyurethane (Elastoflex W) but also the transfer coating technology Steron, binders for natural fibres (Acrodur) and Catamold, BASF's powder injection technology.

Regional winner concept by Pantila Debhakam (design agency shakes bkk , Bangkok, Thailand)

Shakes BKK

using plastics and non-conventoinal ways to make seating solution

Idea:
using light and foldable seating options that occupy less voulme in space

Polaris MRZR D4

Polaris MRZR D4 foot print comparison

Mahindra Scorpio

Maruti Suzuki Gypsy

Polaris MRZR D4

Polaris MRZR D2

8. PACKAGING

8.1 Indian Anthopometric Data

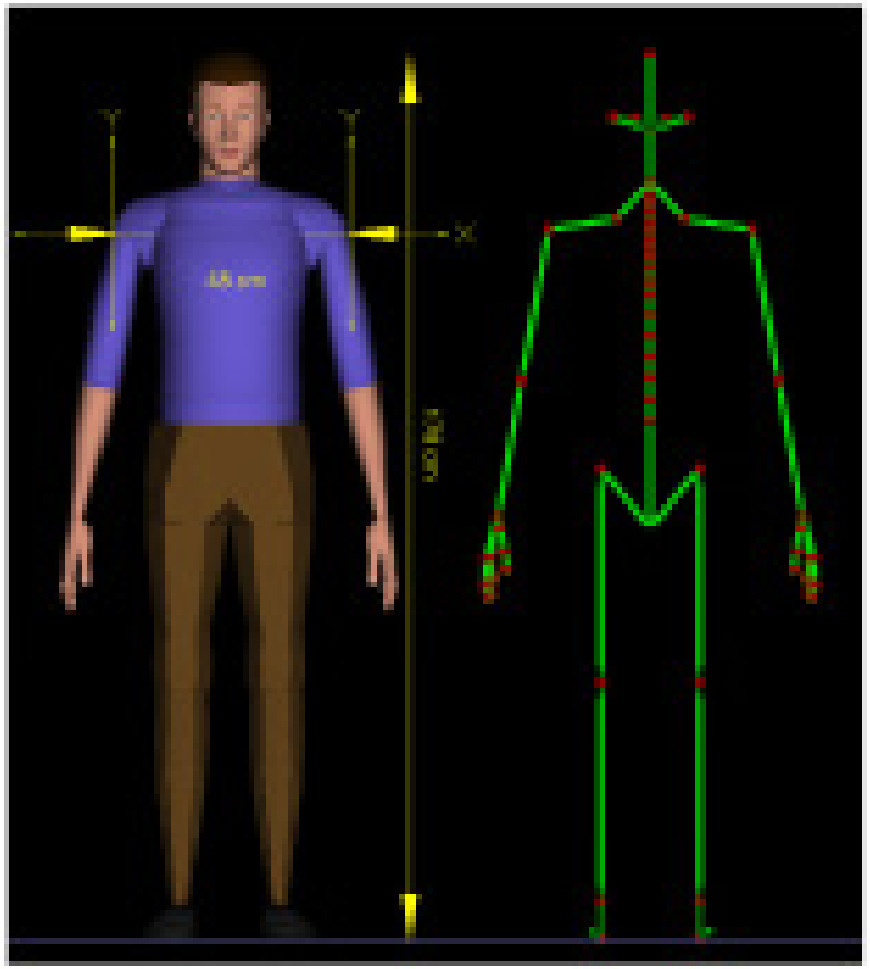


figure . Digital Human Model based on Indian Anthopometric data

Stature	1780 mm
Sitting Height	880 mm
Shoulder Height	620 mm
Lower leg height	487 mm
Hip Breadth	380 mm
Elbow Height	245 mm
Buttockpopliteal length	520 mm
Buttock-knee length	610 mm
Eye Height (Sitting)	780 mm
Shoulder breadth	480mm
Knee height	570 mm
Body Mass (kg)	76

8.2 Occupant Packaging

Digital Human Modelling program Jack by SIemens was was used to do

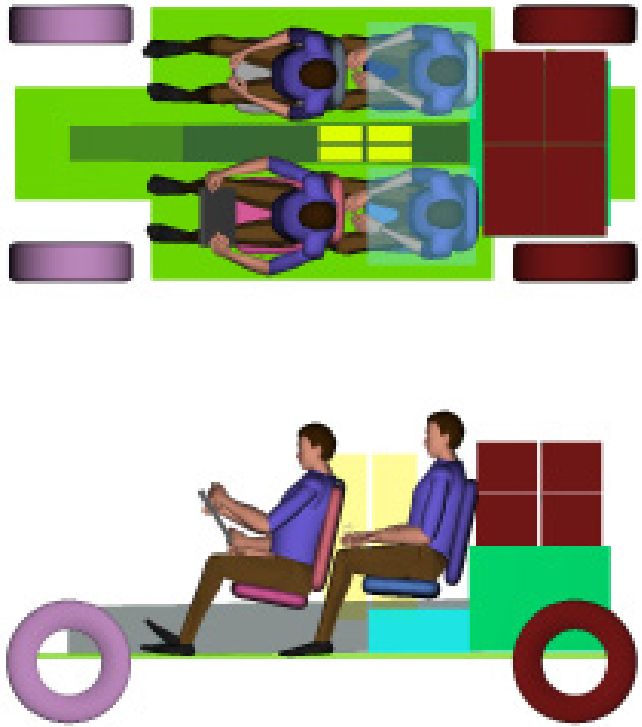


figure . Packaging with all the cargo and 4 AK47 Rifles (yellow Color)

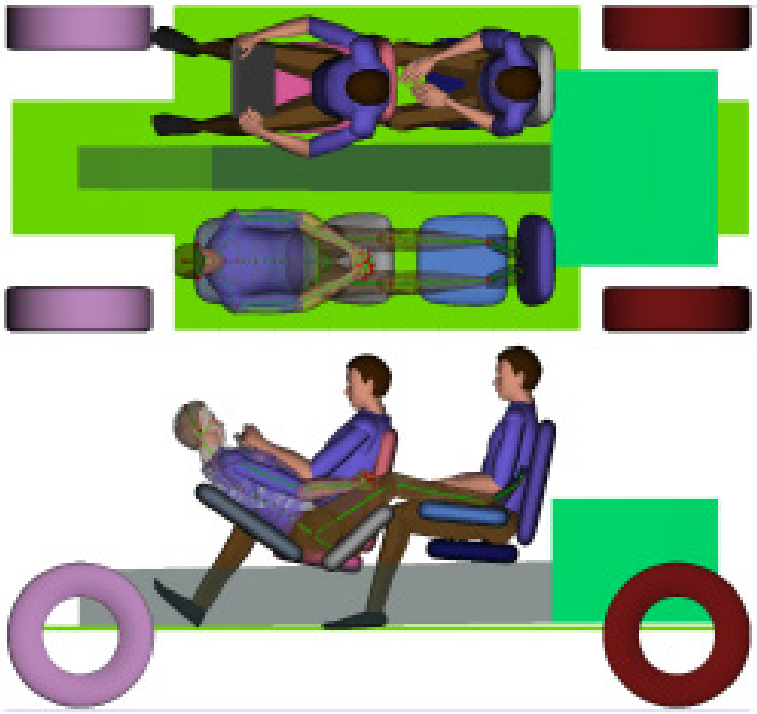


figure . Packaging with Injured soldiers lying down

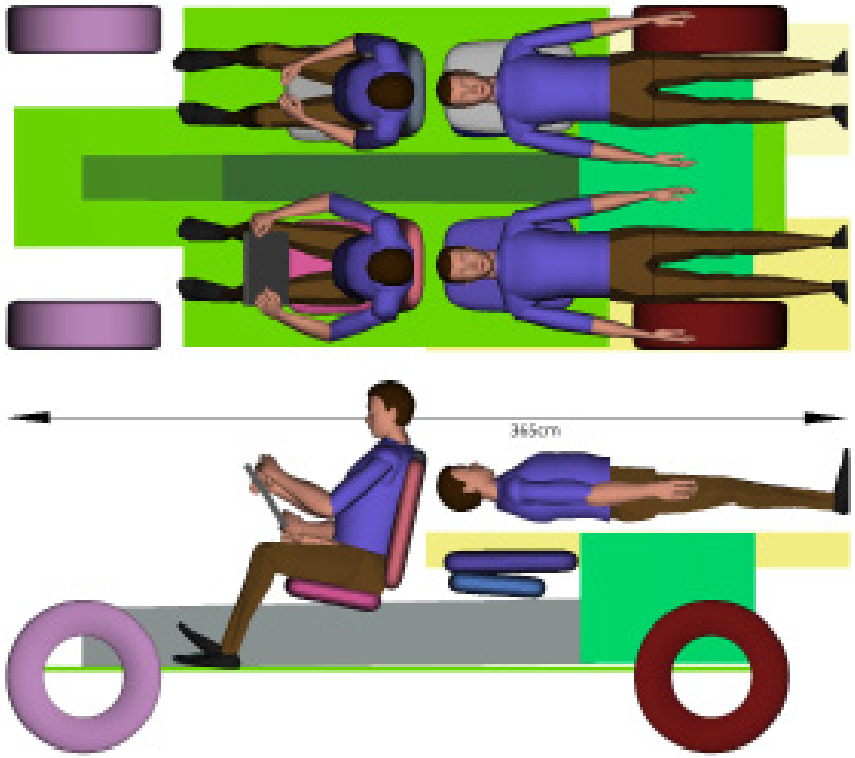


figure . Packaging with two Stretchers in the rear

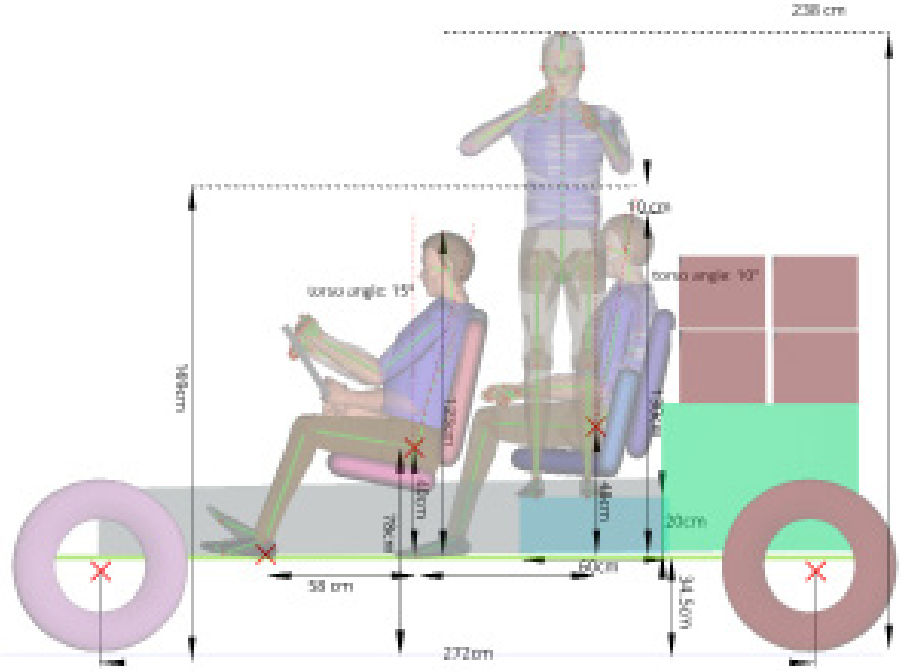


figure . Packaging with the Gunner aiming outside

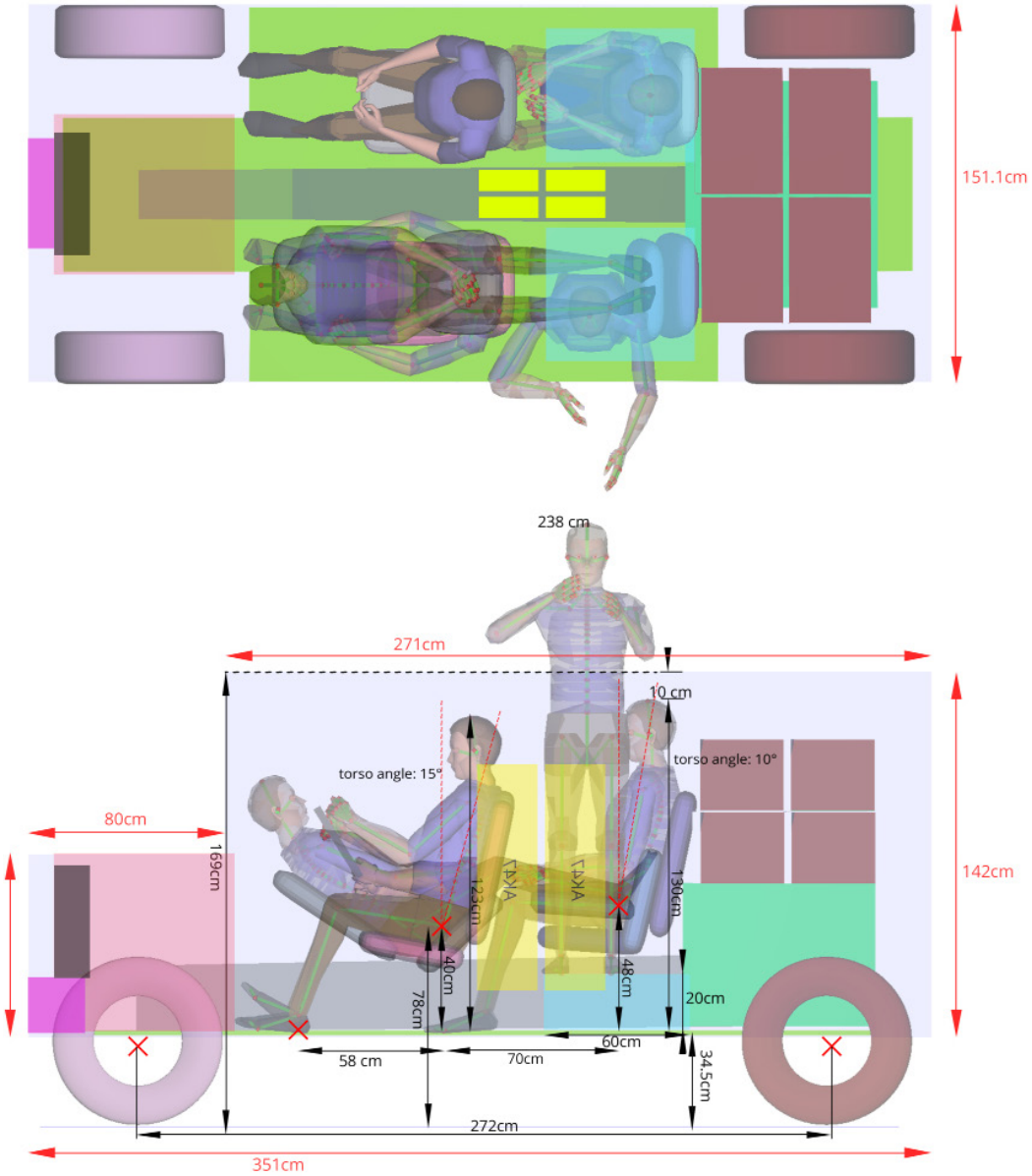


figure . Packaging overlaying all use cases without the stretcher

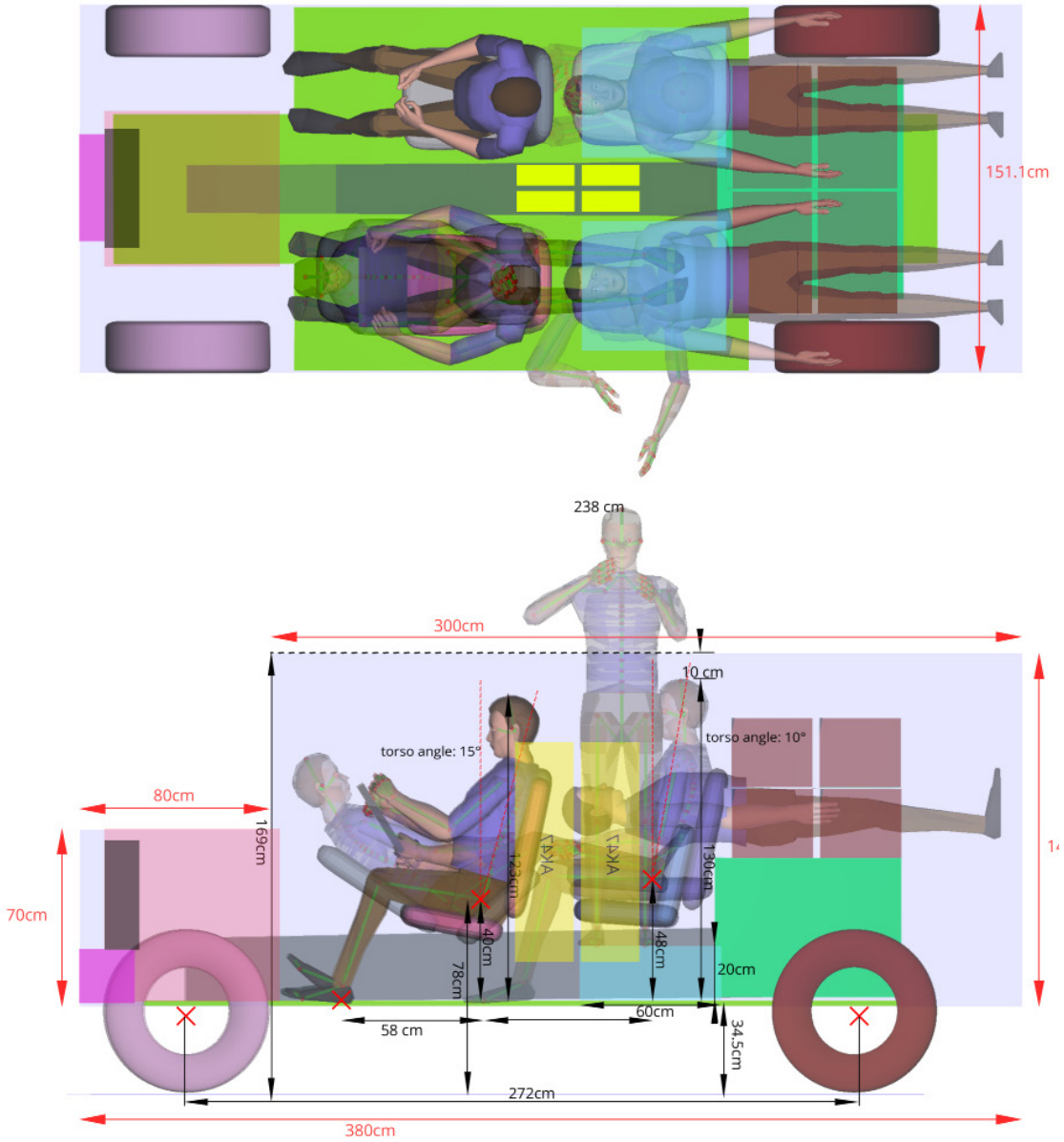


figure . Packaging overlaying all use cases with the stretcher

8.3 Final Technical and Occupant Packaging

Final Packaging (overlaying all the use cases) showing all the Hard

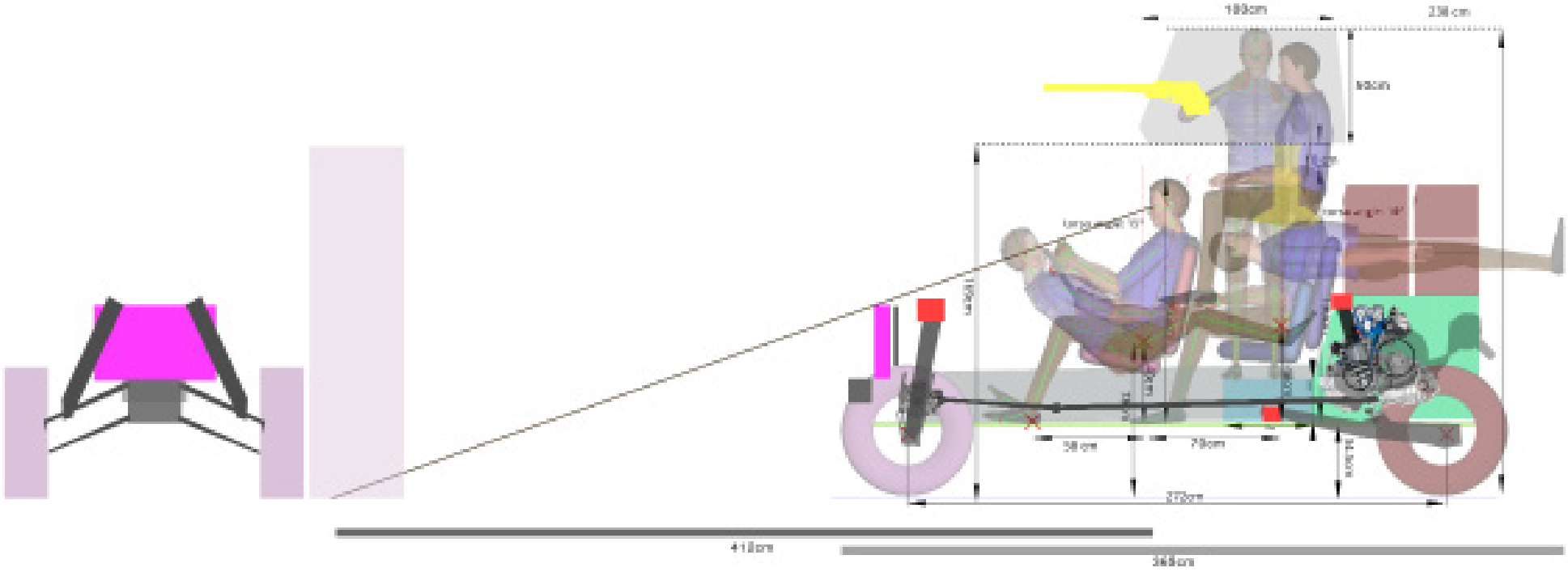


figure . Final Technical package overlaying all use cases and all hard points after

7. PRODUCT BRIEF

To design an ATV for armed forces of India that provides an easier, safer and comfortable way of Patrolling, Transportation of troops along with their luggage, Providing on-field assistance in carrying injured soldiers on stretcher, Carry cargo and Design a seating solution that facilitates above mentioned activities in extreme weather and terrain conditions.

Functions and Features:

1. A Gunner Protection Kit Terret as an attachment to provide safety to the gunner on patrol
2. Expandable Cargo area to accommodate stretchers
3. Provide Customisable/Modular seating
4. Quick Rail system and Strapping system to hold cargo in place
5. Accommodate two stretchers in the rear
6. Place for soldiers to keep their Rifles/Guns to keep while travelling

Dimensions (approx.):

1. Length: 355cm
2. Width: 152cm
3. Height: 238cm
4. Ground Clearance: 34.5cm (approx. 13.5 inch

Operating Environment:

1. Extreme Weather conditions (Both cool and hot weathers)
2. Uneven Difficult Terrains
3. Vehicles being used as a workhorse

9. USER PERSONA

User Persona 1

Captain. Chirag Arora (Indian Army)

Location
Jammu And Kashmir

Scenario
Chirag is 26 year old soldier who is the point man of one f the patrol teams at LoC. He goes for daily patrol and long range patrol when required.

Goals and Aspirations
Use grid reference and find the best route
Go upfront and guide the team
Use a patrol vehicle that is reliable, robust and safe
Vehice that cam carry load and sometime injured soldiers

Personality
Active
Aware
Focused
Technicaly literate
Geographical awareness

User Persona 2

Colonel. Sushant Singh (Indian Army)

Location
Jammu And Kashmir

Scenario
Chirag is 42 year old soldier with 17 years of service. Posted in Jammu and Kashmir as a part of EME corps. He goes out in battlefields and patrols when required. And is responsible for the team that goes along with him.

Goals and Aspirations
Find the best route for his team
Guide the team
Use a patrol vehicle that is reliable, robust and safe
Use a vehicle that cam carry load and carry out logistics operations

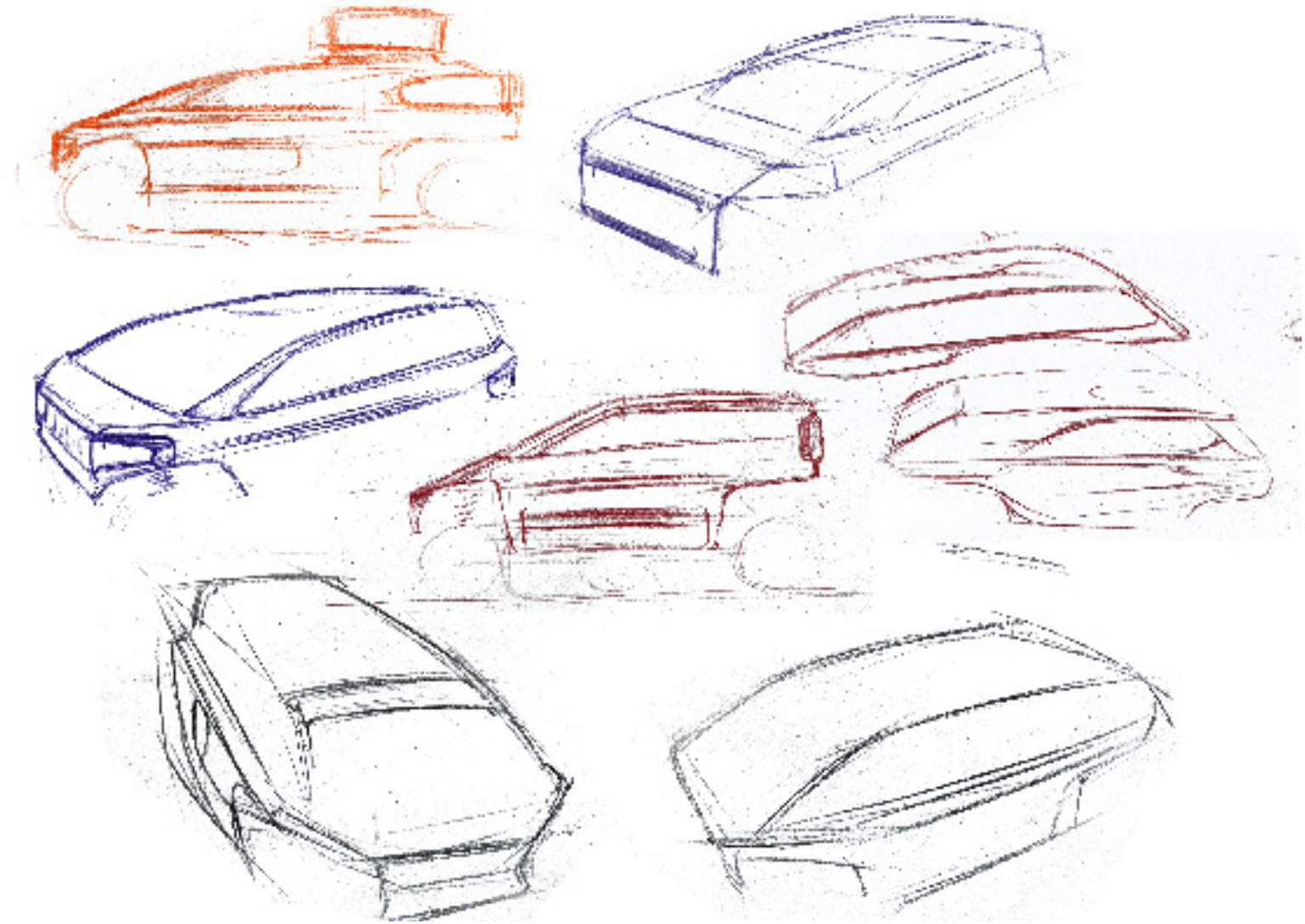
Personality
Active
Aware
Focused
Technicaly literate
Experienced in Battlefield
Geographical awareness

10. MOOD BOARD

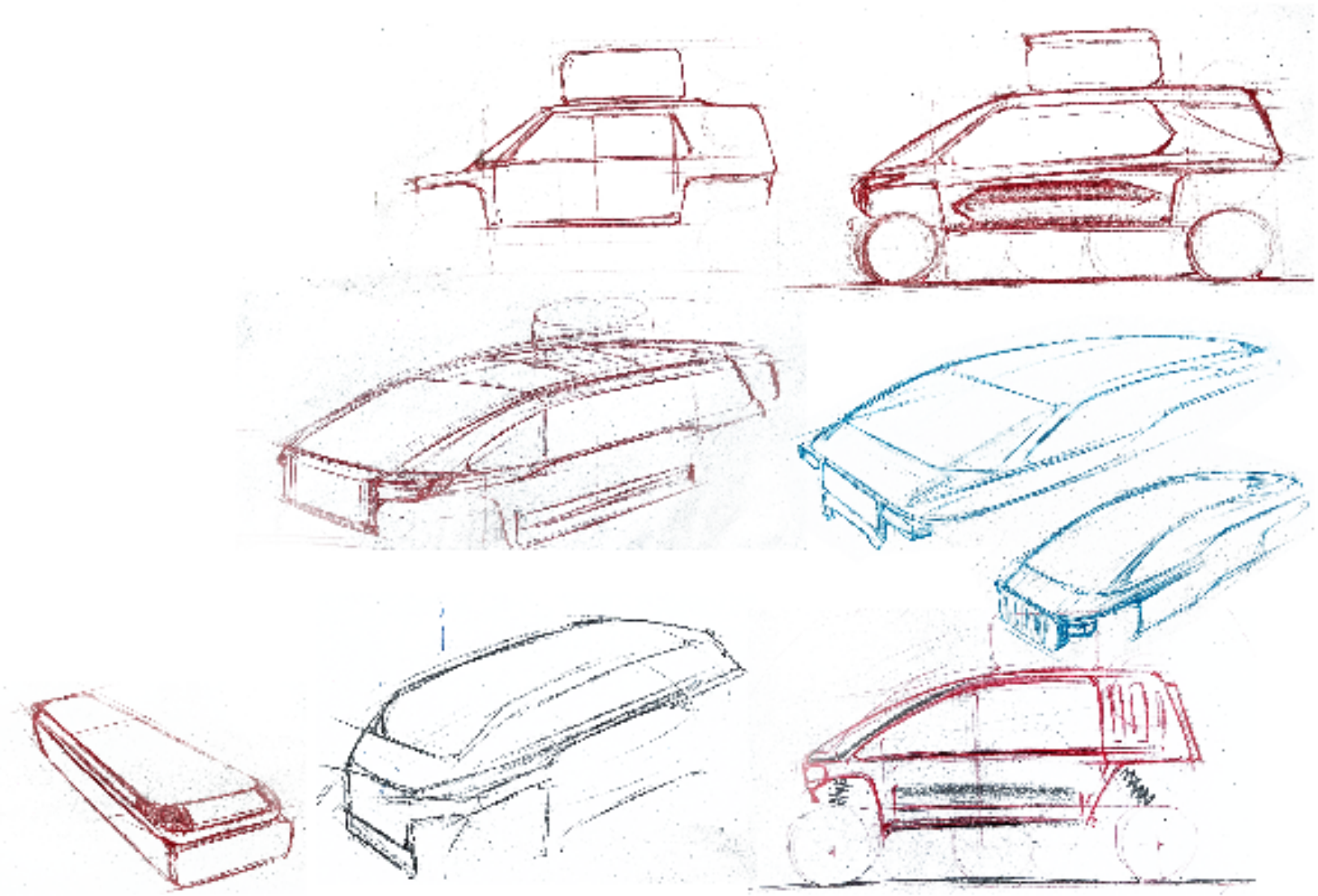
11. THEME BOARD

13. IDEATION SKETCHES

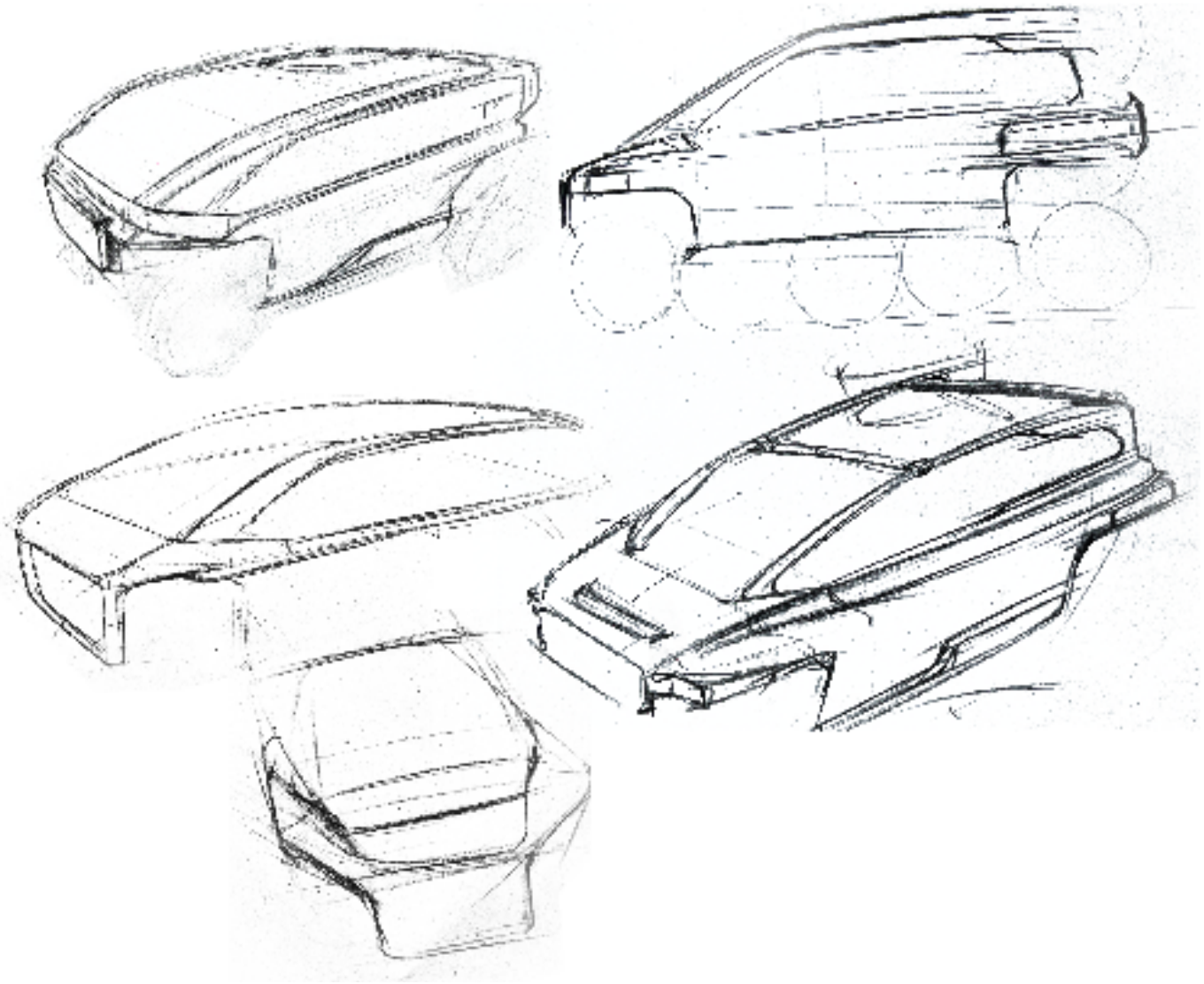
13.1 Form Exploration



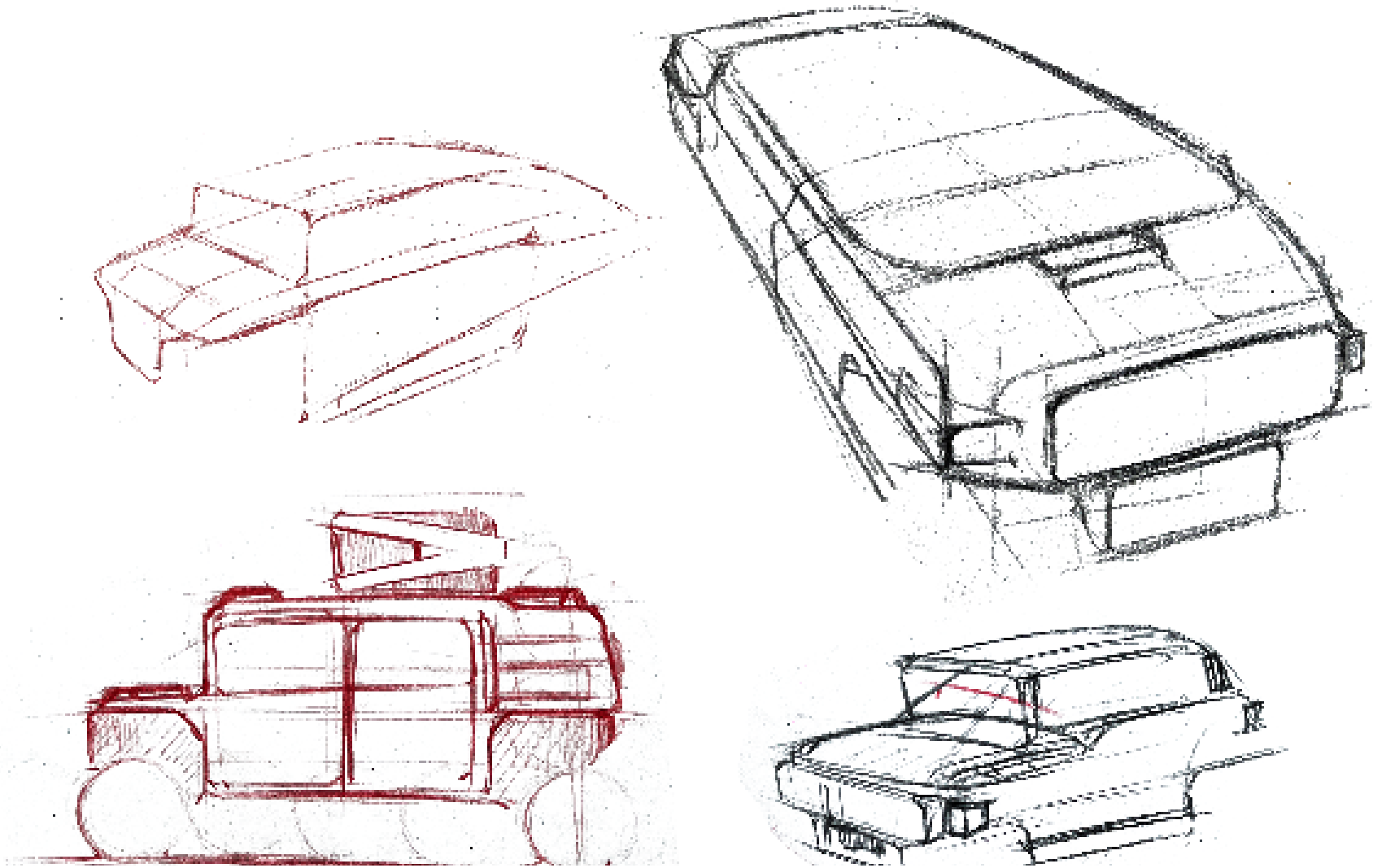
Form Exploration



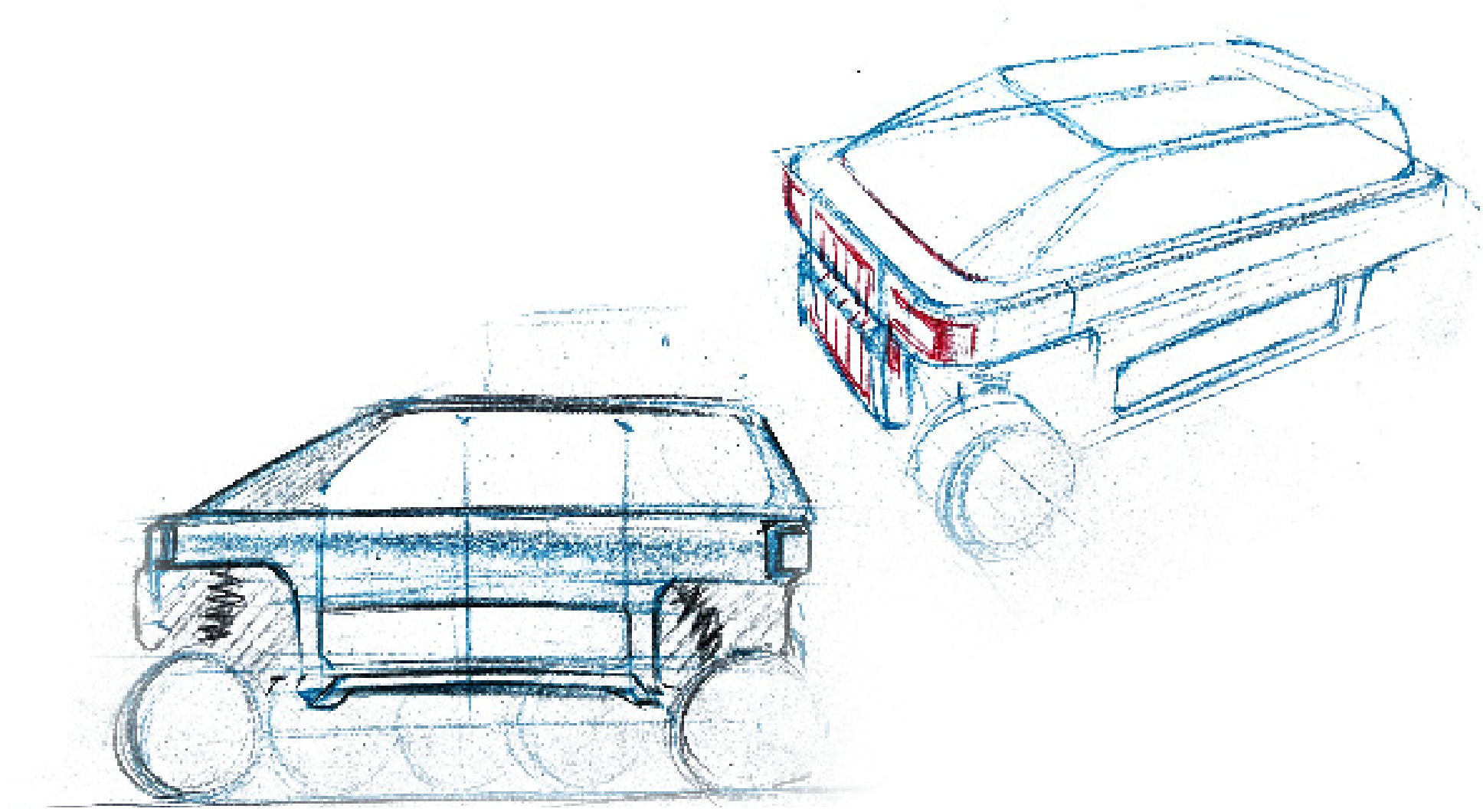
Form Exploration



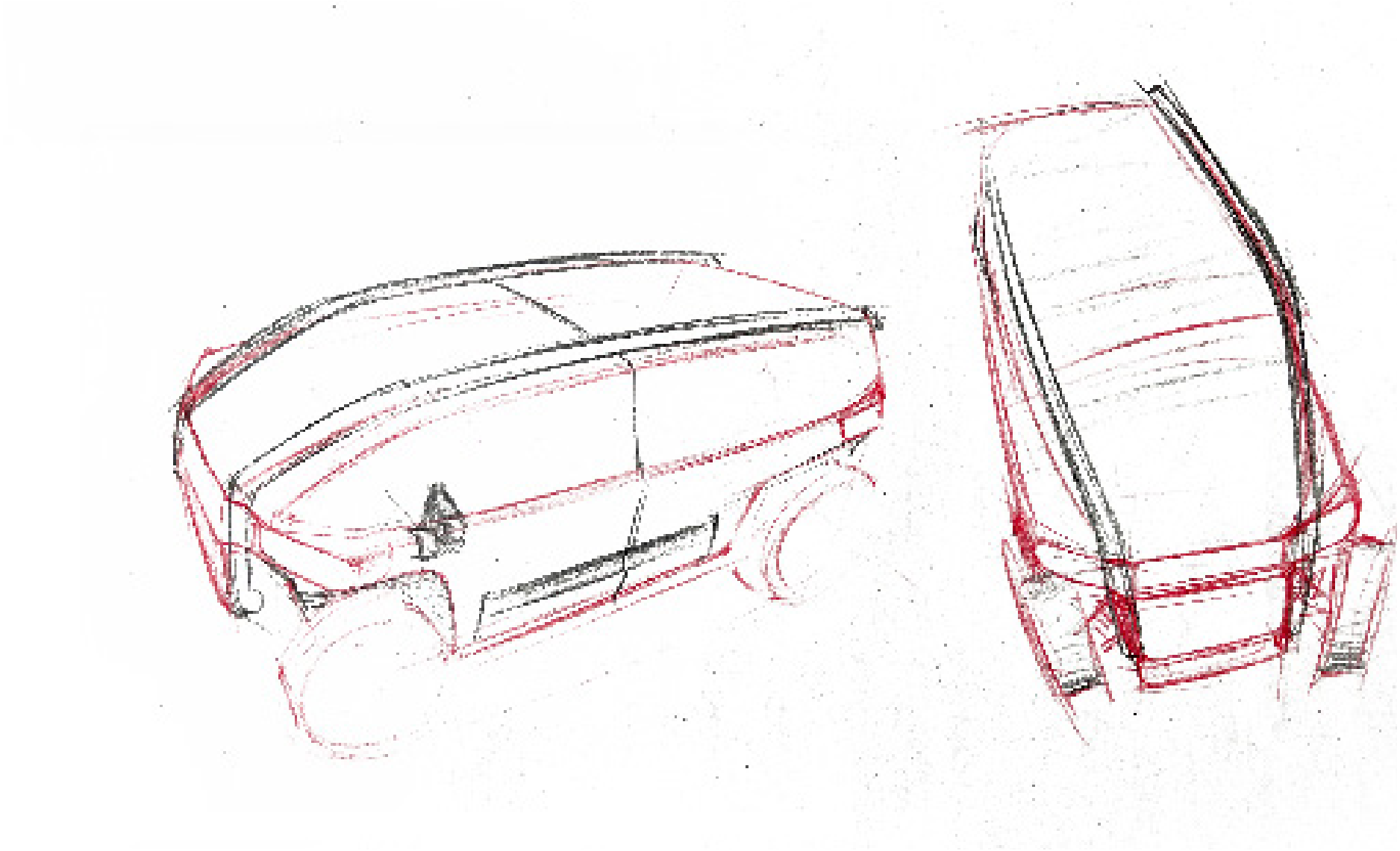
13.2 Design Direction 1



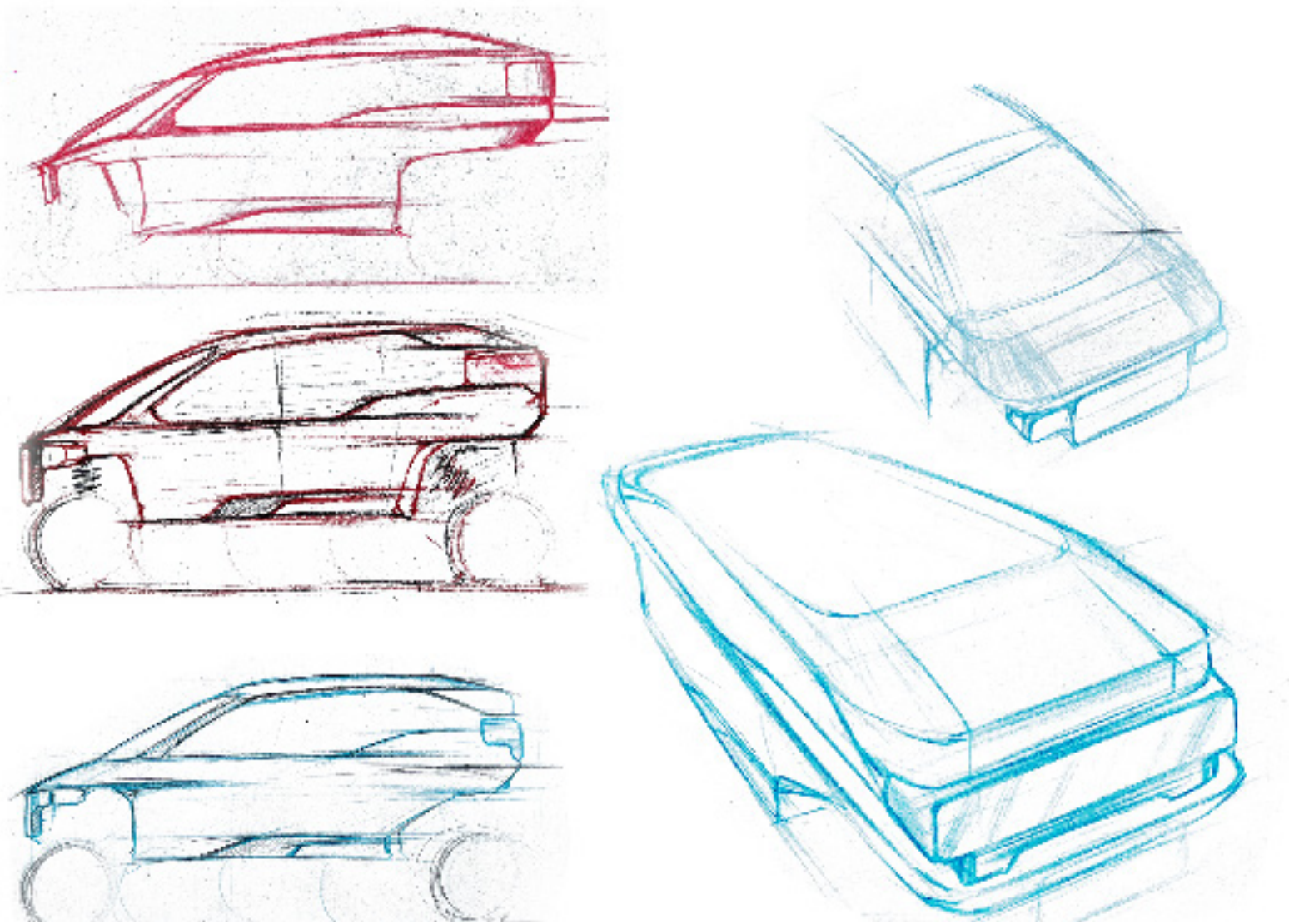
13.3 Design Direction 2



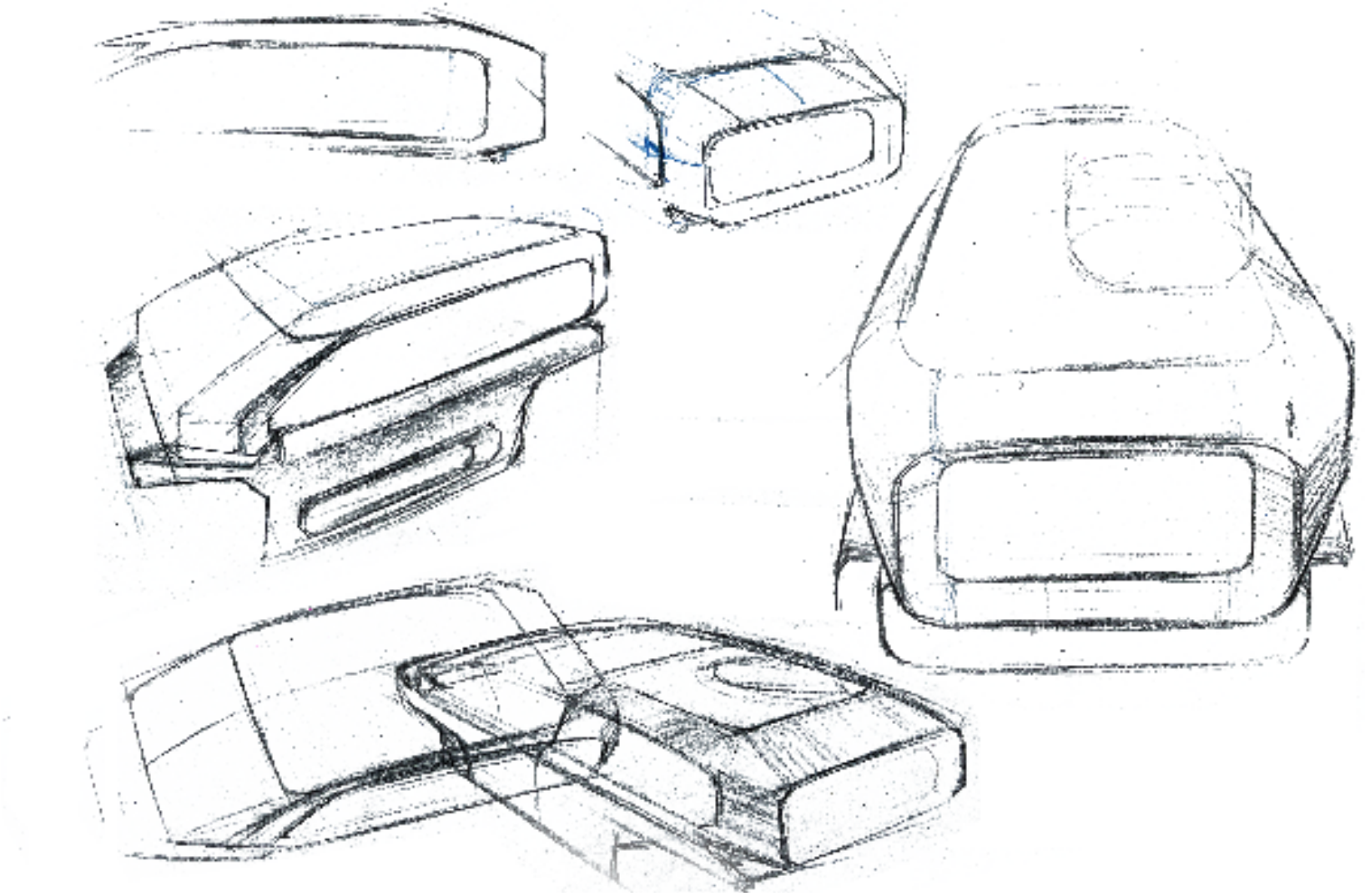
13.4 Design Direction 3



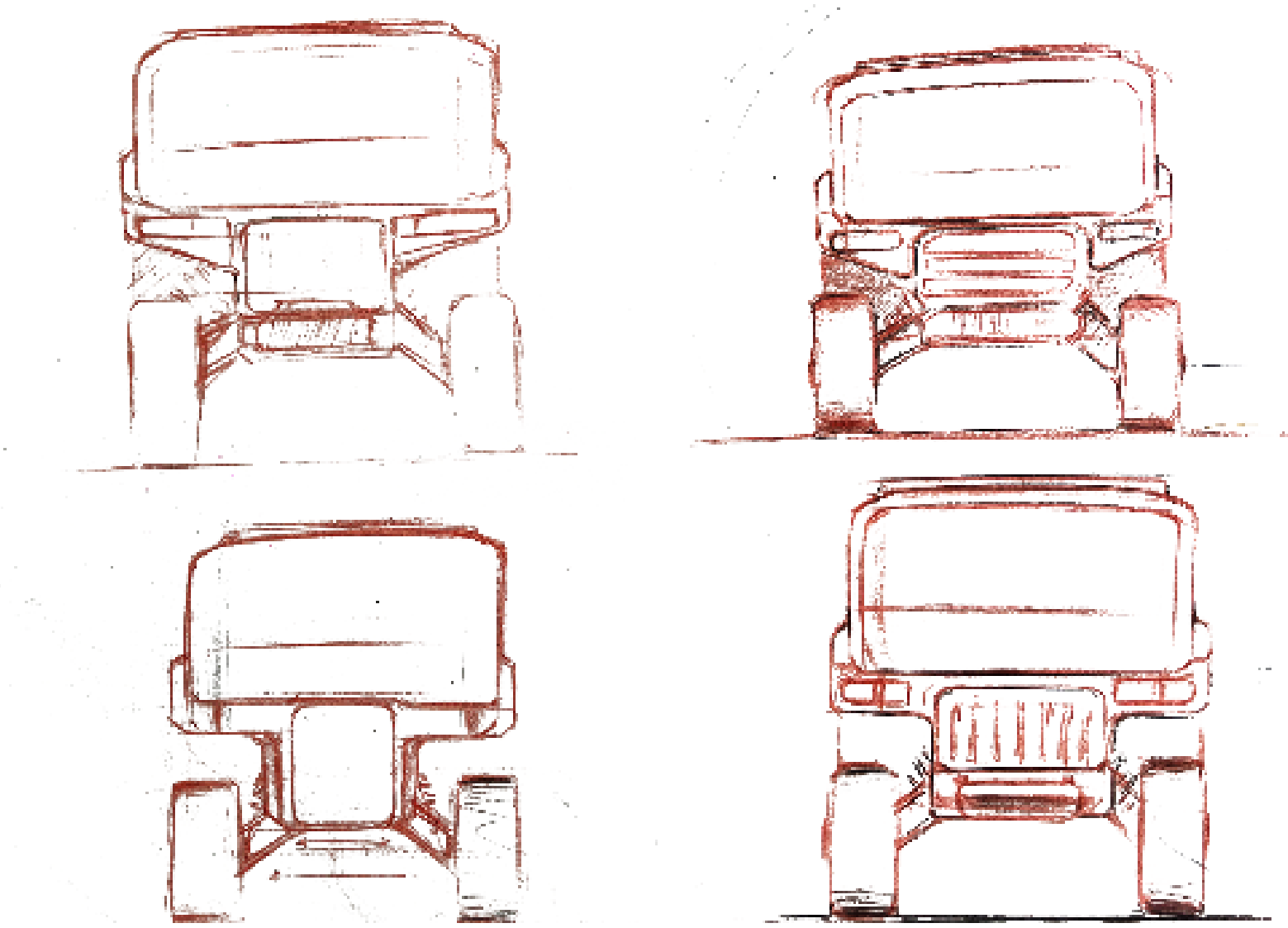
13.6 Design Direction 4



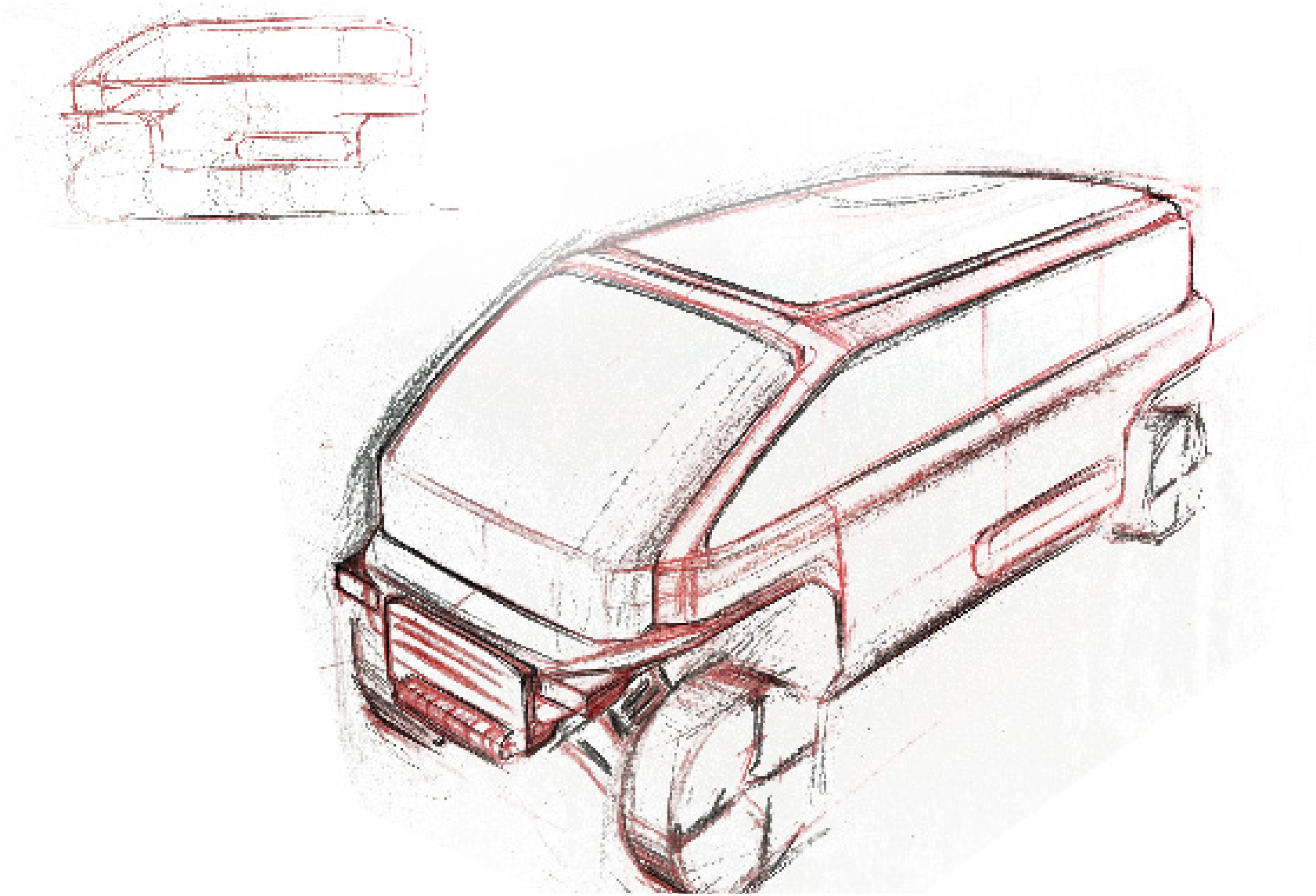
13.5 Design Direction 5

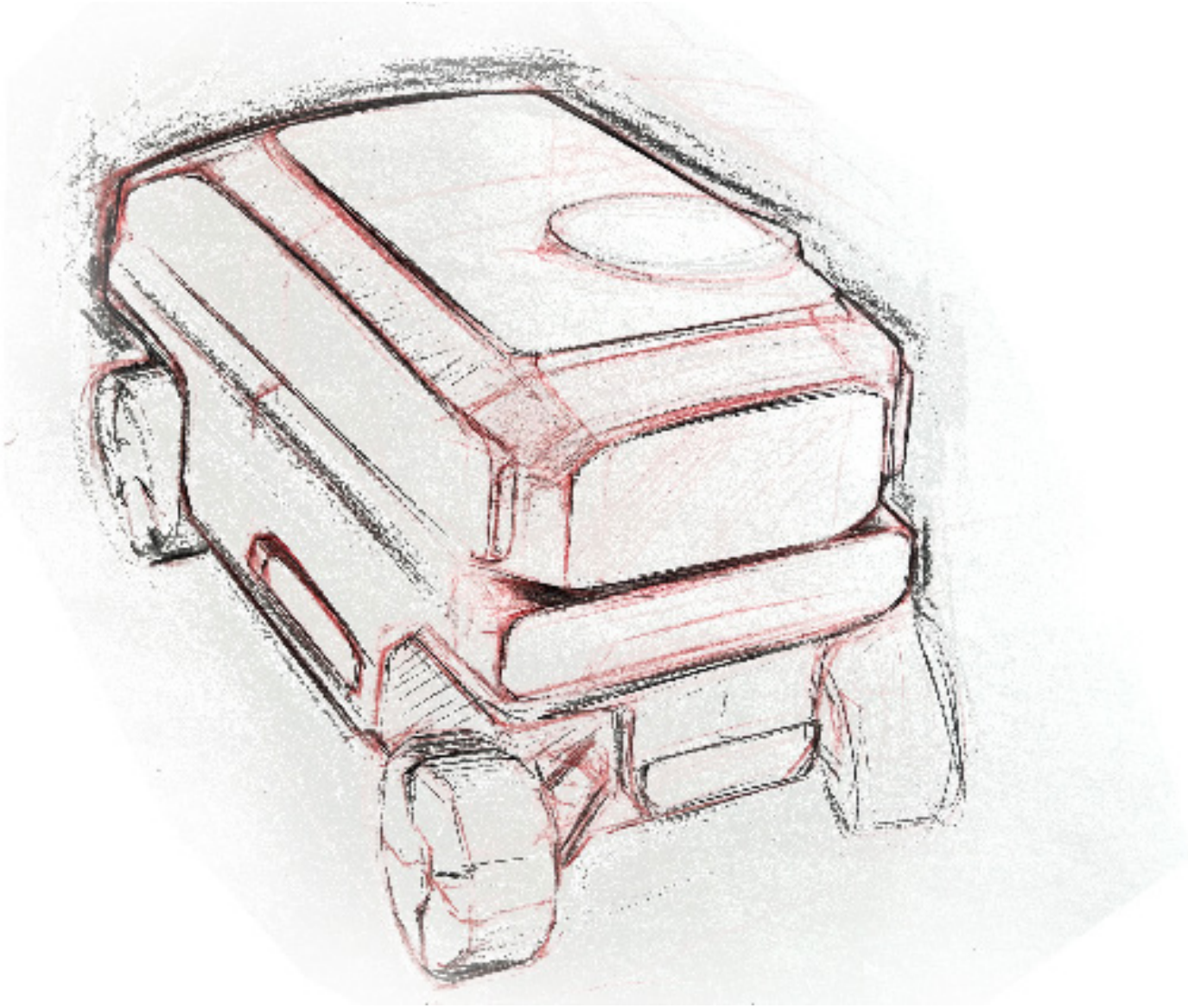


13.7 Front Fascia Ideations

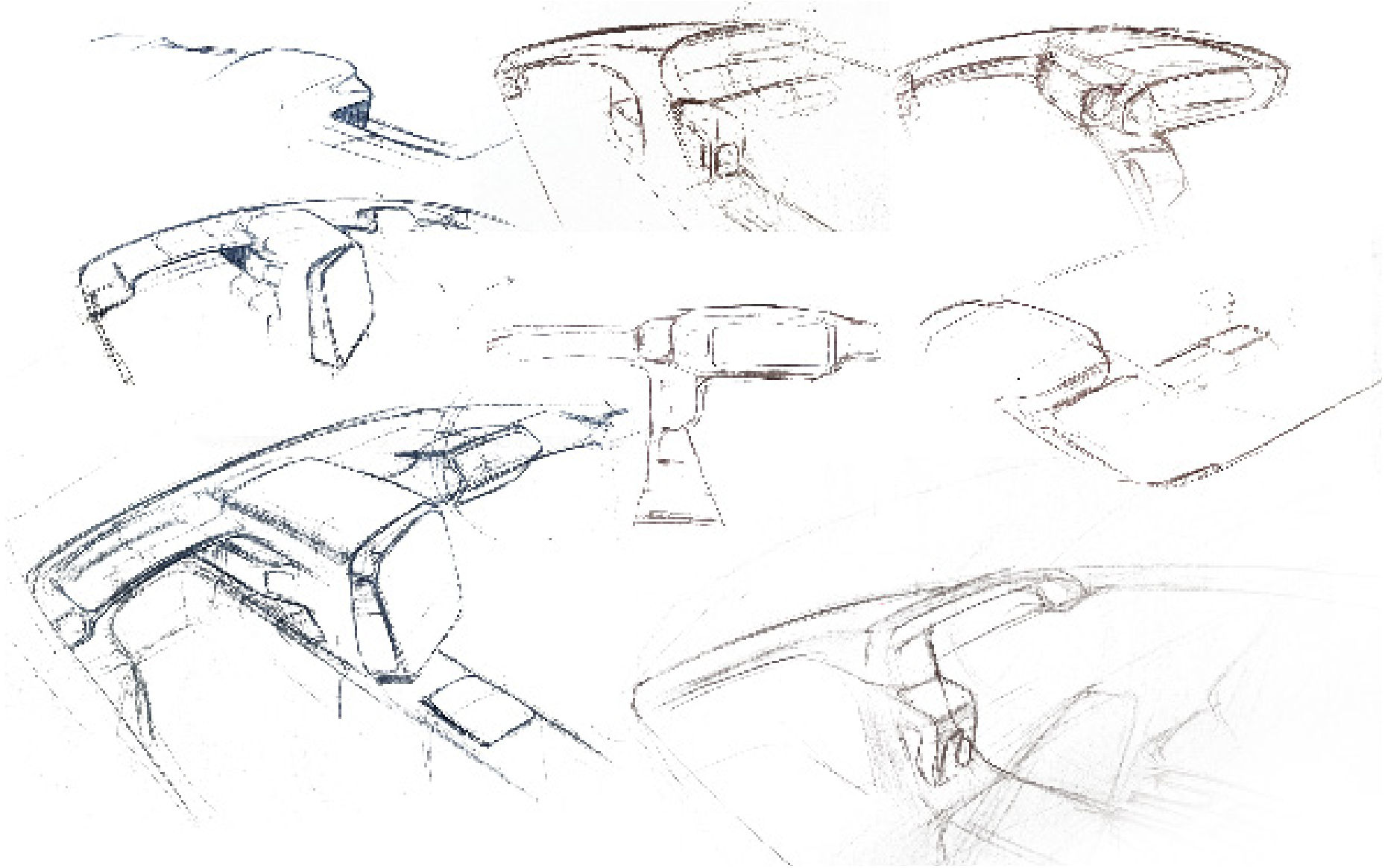


13.8 Finalised Exterior Sketch

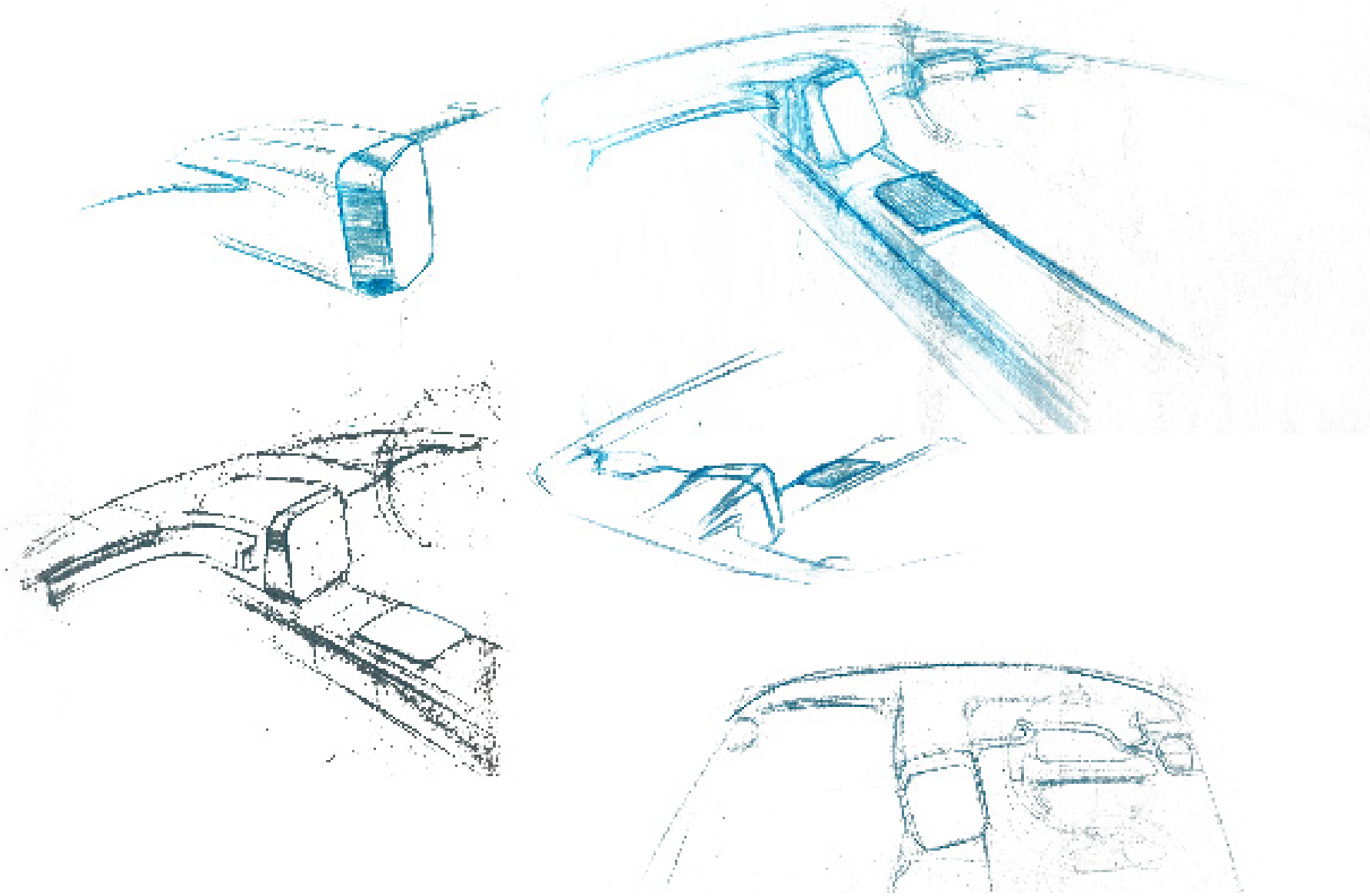




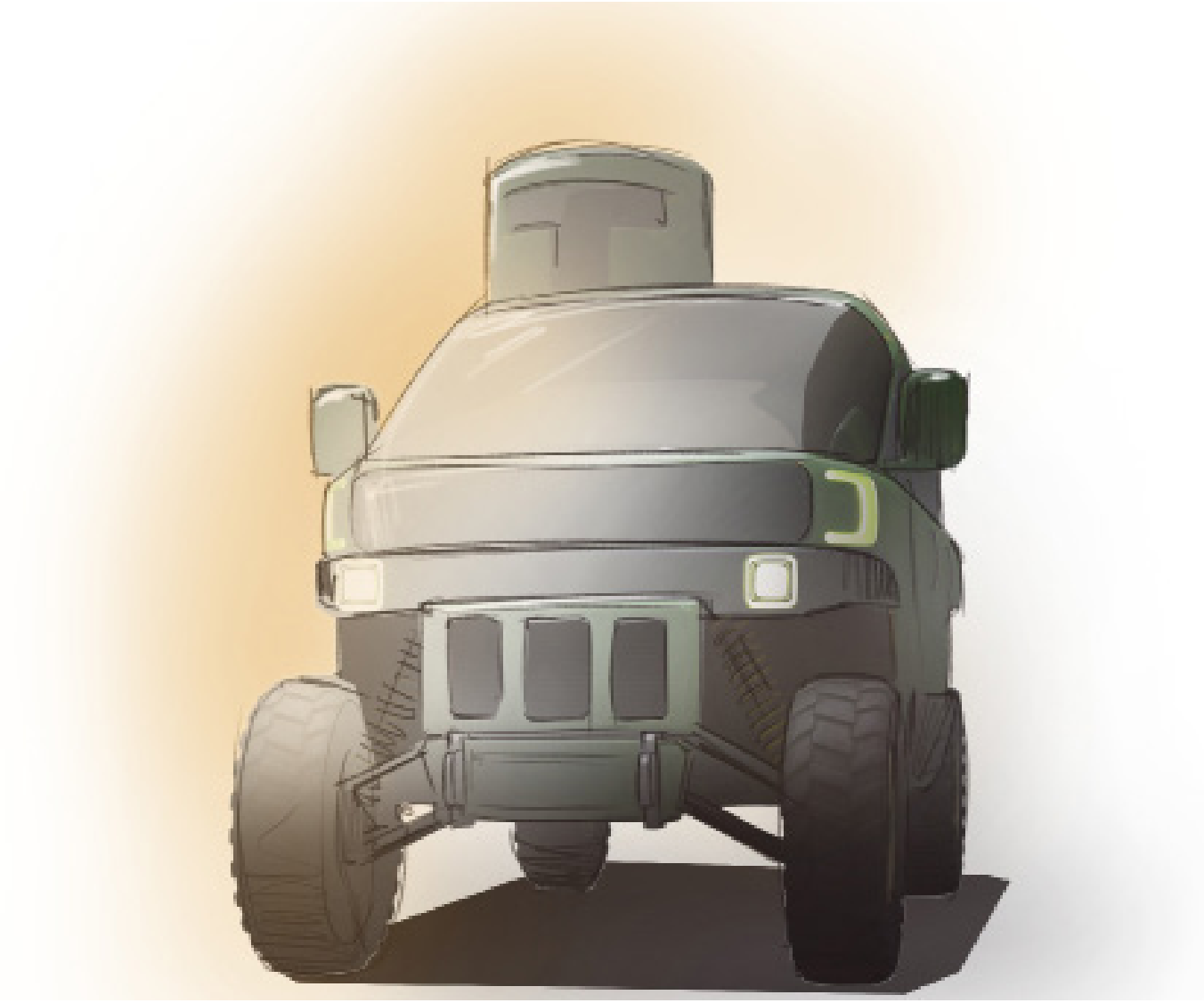
13.9 Interior Ideations

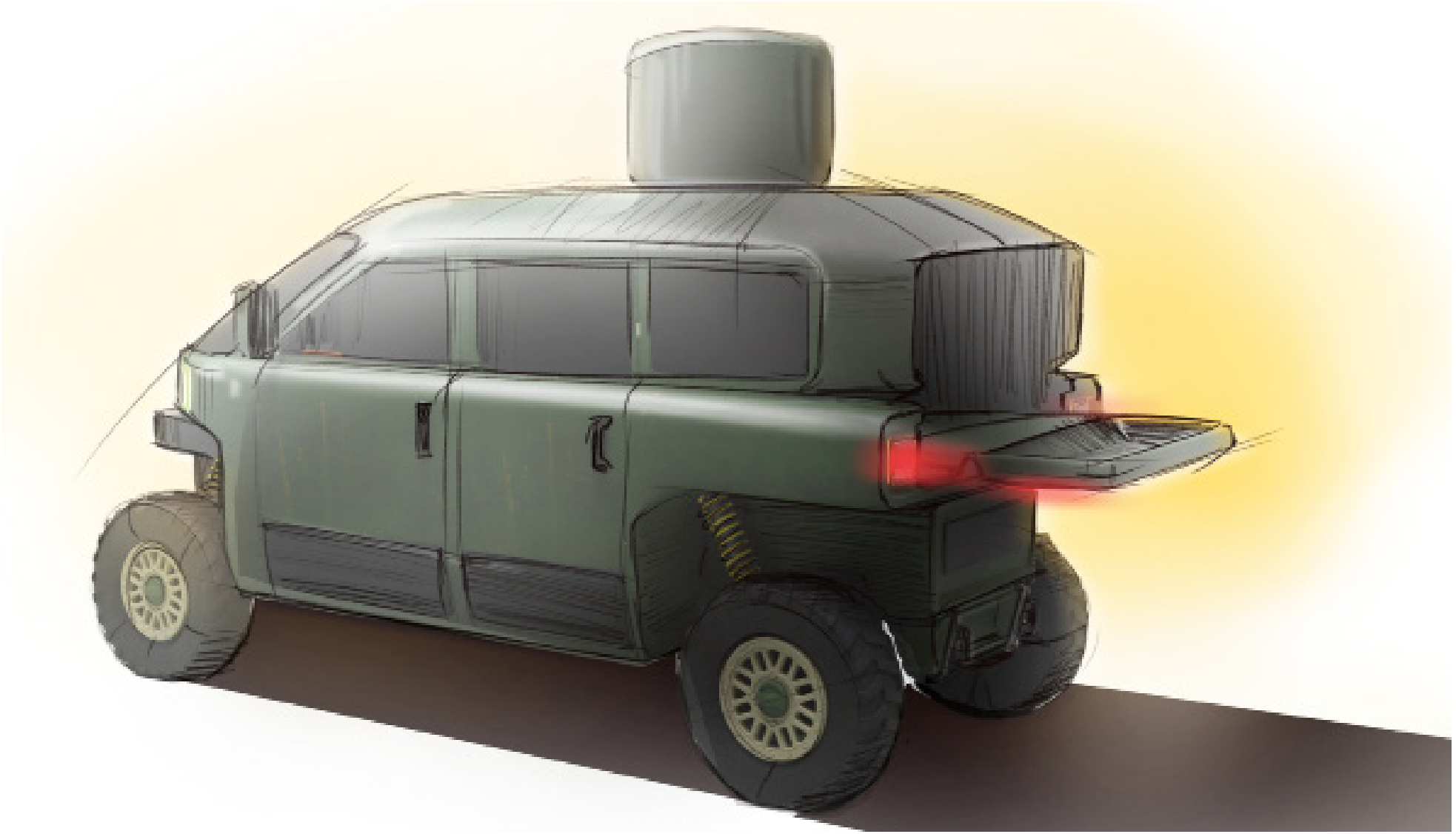


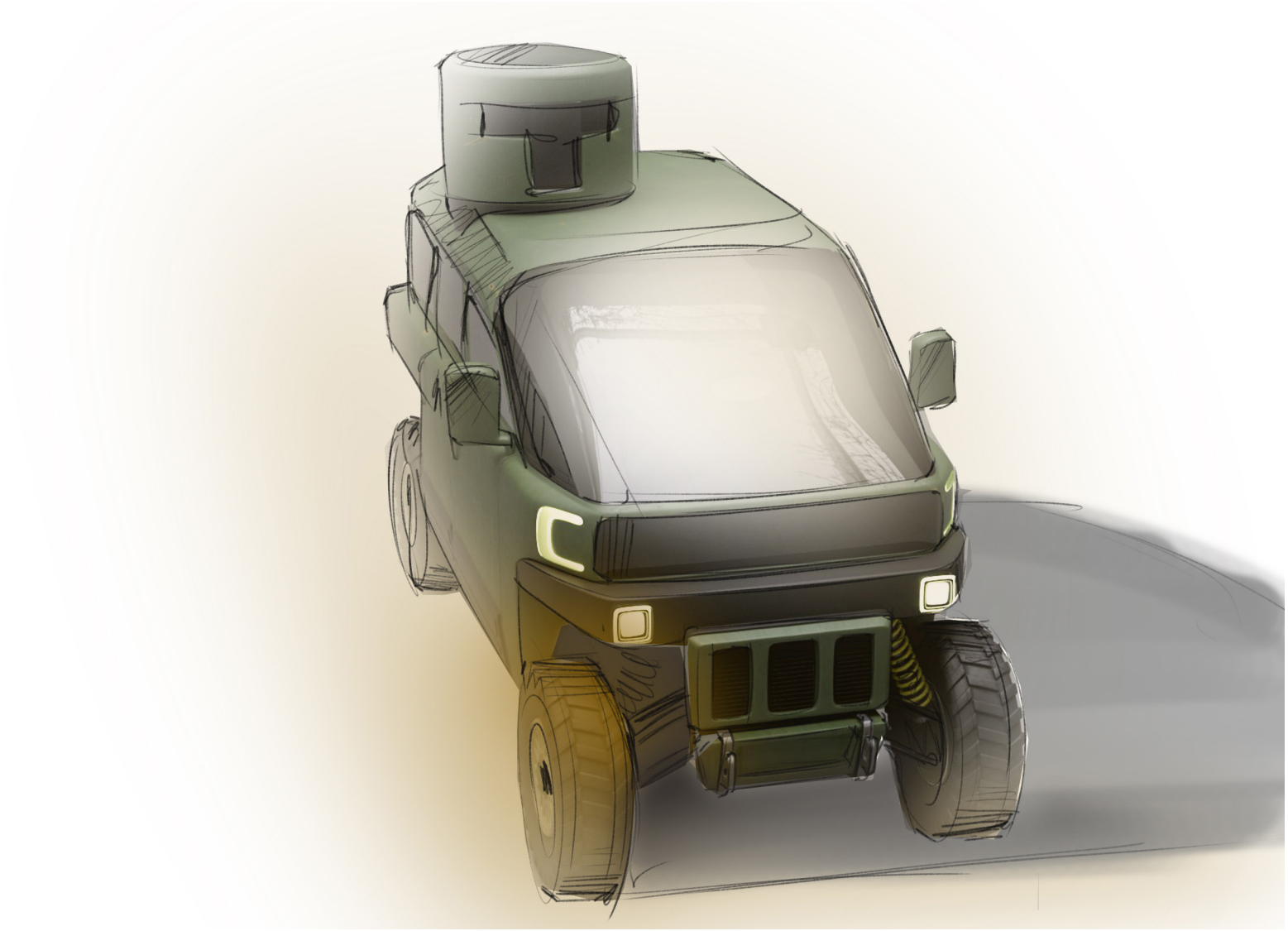
13.10 Finalised Interior

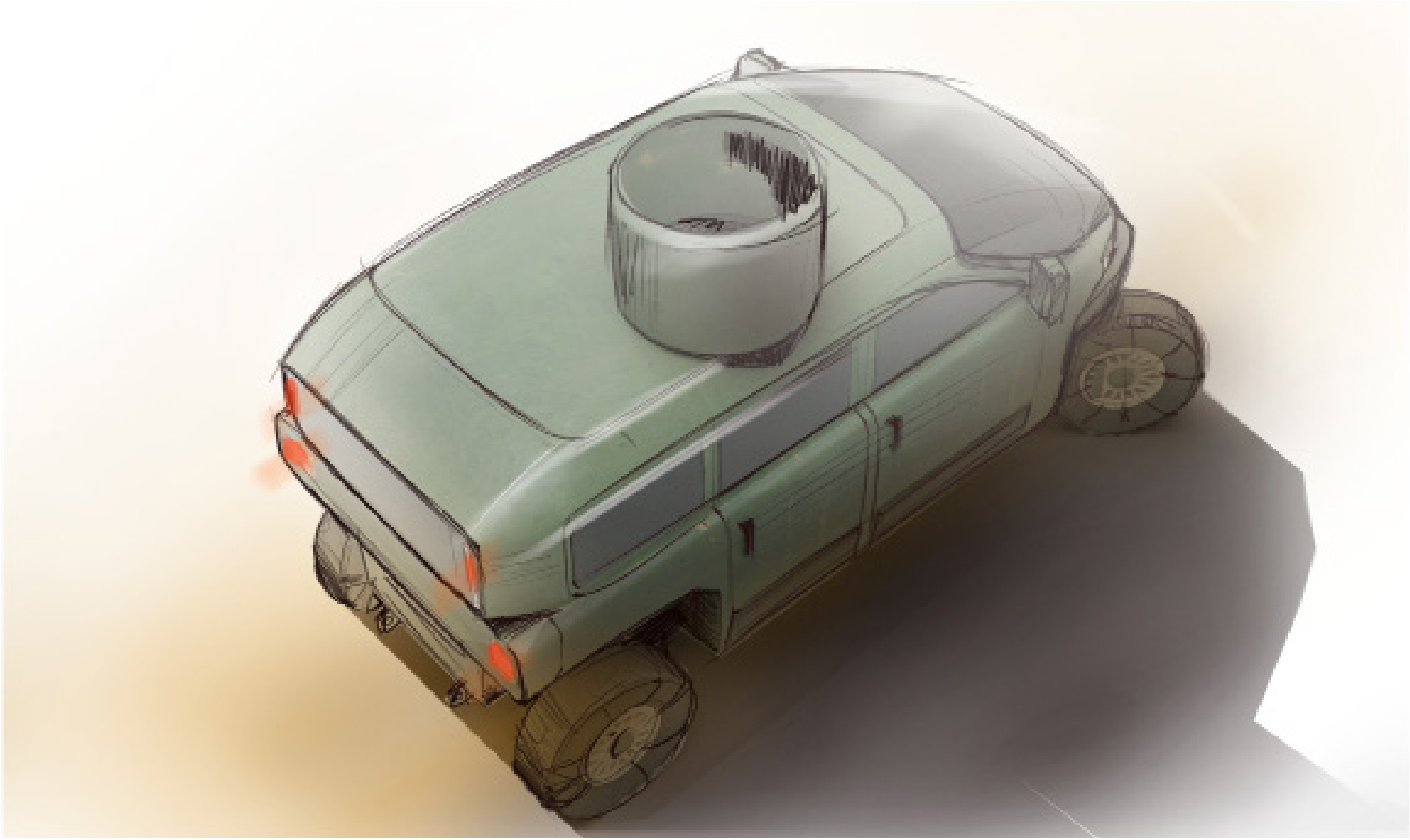


14. CAD MODEL AND RENDERS

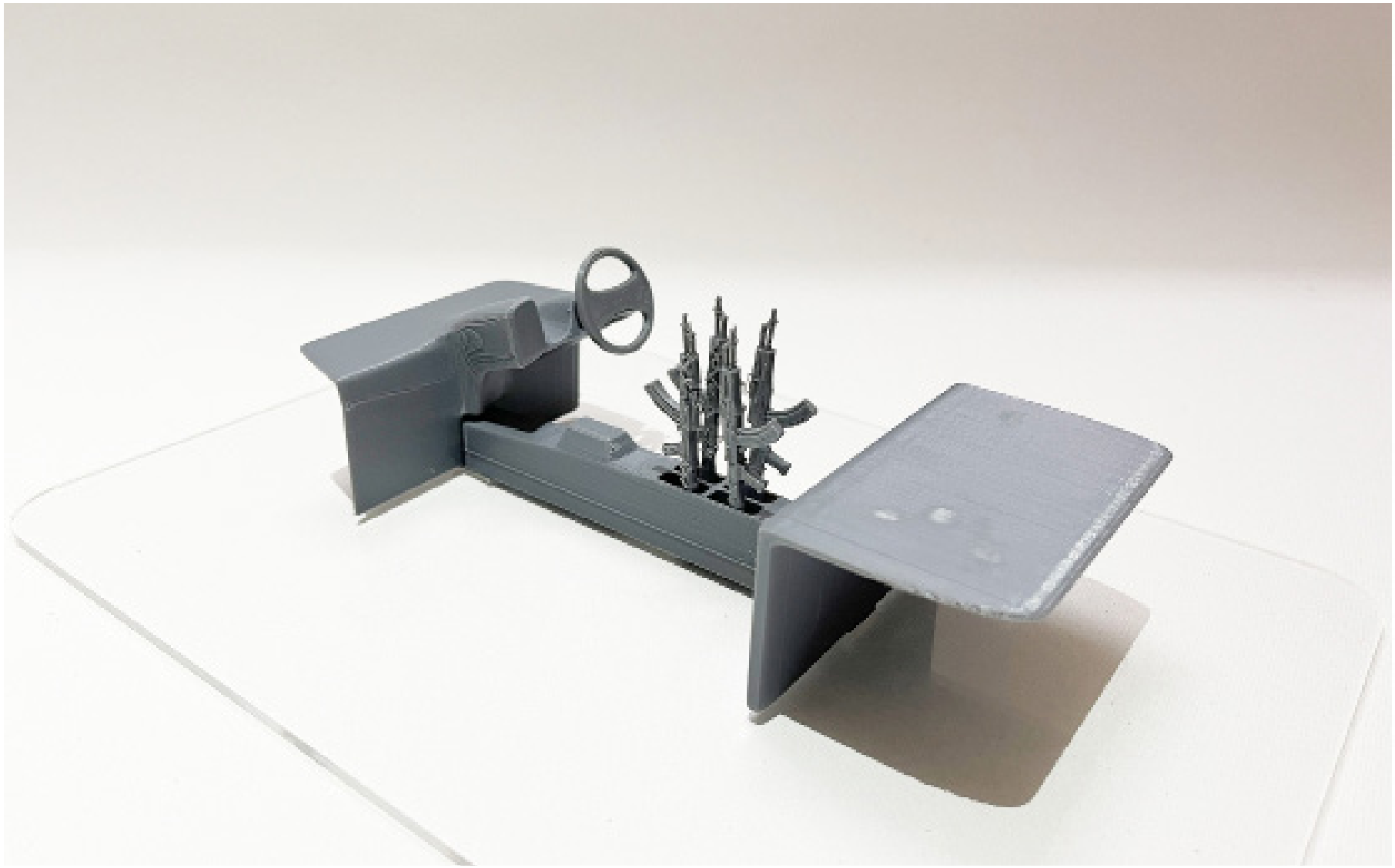








15. SCALE MODEL 1:15



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