



DESIGN OF A QUICK ATTACK VEHICLE FOR SUPPRESSION OF FOREST FIRE

DESIGN PROJECT II : AMAN NIM - 196390010 - MOBILITY & VEHICLE DESIGN

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Motivation

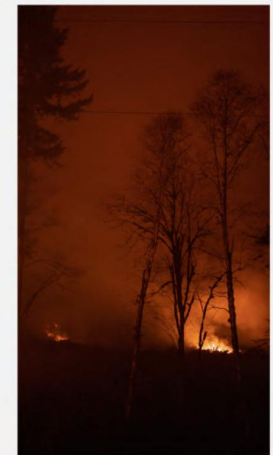
As forest fire cases rises in india upto 125% in the last two years and it has become a major problem not only in India but also in the world. And in India we are still using old technology and vehicles that are not meant for such type of issues thus fighting forest fire becomes an challenge.

Background Research

Introduction :

Forest fire in India

In India, wildfires have raged on in the past few years as well, causing extensive damage. In February 2018, it took five days and the mobilisation of huge resources including Indian Air Force choppers to douse the fire at Bandipur Tiger Reserve in Karnataka. An estimated 4,800 hectares of forests were lost in the incident. The very next month, in March 2018, a group of trekkers got caught in a fatal wildfire at Theni, Tamil Nadu. The state went on to impose a ban on trekking in forests between February 15 to April 15, considered as fire season. According to the India State of Forest Report 2019, over 30,000 incidents of forest fires were reported in India in 2019. Additionally, more than 36% of Indian forest cover (657,000 sq km area) is prone to frequent forest fires and of this, 10% are highly prone, according to a Forest Survey of India (FSI) report on fire prone forest areas. Around 21% of the total forest cover is highly to extremely fire prone, adds the latest forest survey. The dry deciduous forests, which receive low rainfall, face 5-6 dry months and have nutrient poor soil, such as those in tropical and subtropical latitude, are more vulnerable to fire compared to others. These areas are in Odisha, Chhattisgarh, Madhya Pradesh and in the southern states. Chir pine forests in hilly states are equally prone.

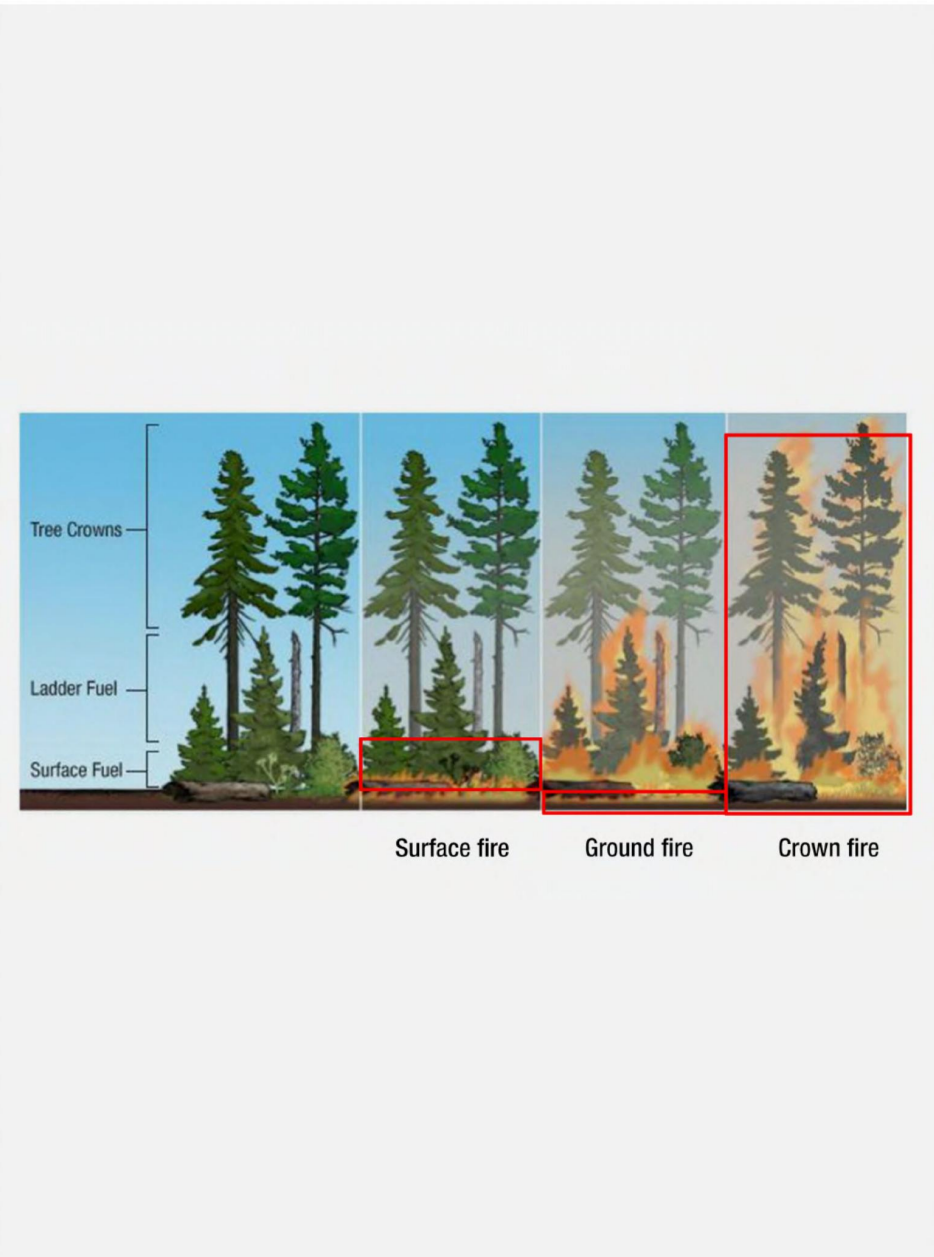


Types of forest fire

Surface Fire - A forest fire may burn primarily as a surface fire, spreading along the ground as the surface litter (senescent leaves and twigs and dry grasses etc) on the forest floor and is engulfed by the spreading flames.

Ground Fire - These fires are fires in the sub surface organic fuels, such as duff layers under forest stands, Arctic tundra or taiga, and organic soils of swamps or bogs. There is no clear distinction between underground and ground fires. The smoldering underground fires sometime changes into Ground fire. This fire burns root and other material on or beneath the surface i.e. burns the herbaceous growth on forest floor together with the layer of organic matter in various stages of decay. They are more damaging than surface fires, as they can destroy vegetation completely. Ground fires burn underneath the surface by smoldering combustion and are more often ignited by surface fires.

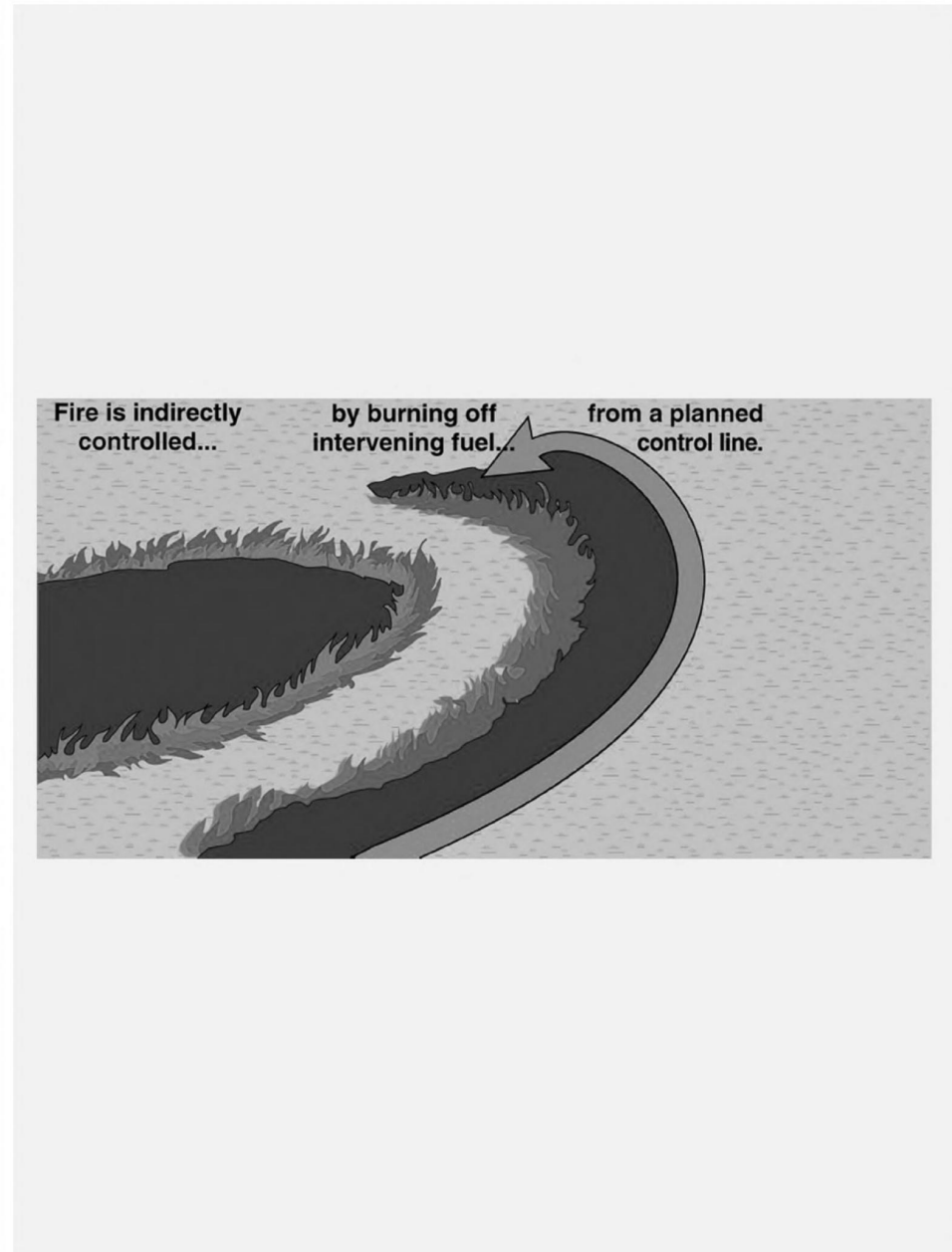
Crown Fire - A crown fire is one in which the crown of trees and shrubs burn, often sustained by a surface fire. A crown fire is particularly very dangerous in a coniferous forest because resinous material given off burning logs burn furiously. On hill slopes, if the fire starts downhill, it spreads up fast as heated air adjacent to a slope tends to flow up the slope spreading flames along with it. If the fire starts uphill, there is less likelihood of it spreading downwards.



How forest fire approach in India

Indirect attack

Often, preparatory suppression tactics are used a distance away from the oncoming fire. This is called an indirect attack. Indirect attack can include the use of firelines, backburning and wetting unburned fuels. It can also include the creation of control lines, which are boundaries that contain no combustible material. Control lines can be constructed by physically removing combustible material with tools and equipment, or portions may be naturally occurring. Lines may also be created by backfiring—that is, creating small, low-intensity fires using driptorches or flares. The resulting fires are extinguished by firefighters or, ideally, directed in such a way that they meet the main fire front, at which point both fires run out of flammable material and are thus extinguished. Additionally, the use of long-term retardants may be used. Such compounds reduce the flammability of materials by either blocking the fire physically or by initiating a chemical reaction that stops the fire.



Direct attack

The Incident Commander determines an anchor point, generally located near the origin of the wildland fire or another point such as a road, stream, or trail where firefighters can begin to safely the fire. The Incident Commander designates an escape route and a safety zone where firefighters can go if fire conditions worsen, making it too dangerous to continue working. The safety zone is an area the fire has already completely burned, or an area that will not burn, like rocks or dirt. Lookouts may be posted to protect firefighters from unexpected fire behaviour, and weather reports are communicated to crews so that there are no surprises with wind shifts or other weather factors. While firefighters work up the sides or flanks of the fire from the anchor point, a variety of other activities can be occurring at the same time.



Method used

Control line

One of the most important components of wildfire suppression, control lines are simply the boundaries natural or manmade that firefighters employ to control how and where a fire spreads. A rocky ridge or river can serve as a natural control line, or firefighters can establish a manmade one by, for example, clearing out an extended line of brush. Within this overarching definition, a fire line is when the barrier is scraped down "to mineral soil," a scratch line is a preliminary line built in a hurry, and a wet line is when the area has had flame retardant or water applied. And when you hear on the news that a fire is "X percent contained," this is generally what they're talking about that some percentage of the fire's perimeter has a control/fire line. Sadly, because fires can sometimes jump the barrier, this means even a 100 percent contained fire can start up again.



Burning out

When establishing control lines, digging a small ditch and pulling up some plants isn't always enough. To create a sturdy, fuel-free barrier, firefighters may use small torches to burn the brush just inside a control line. A burnout is one of several ways to bolster a control line and further prevent a blaze from escaping the established boundaries.



Mop-Up

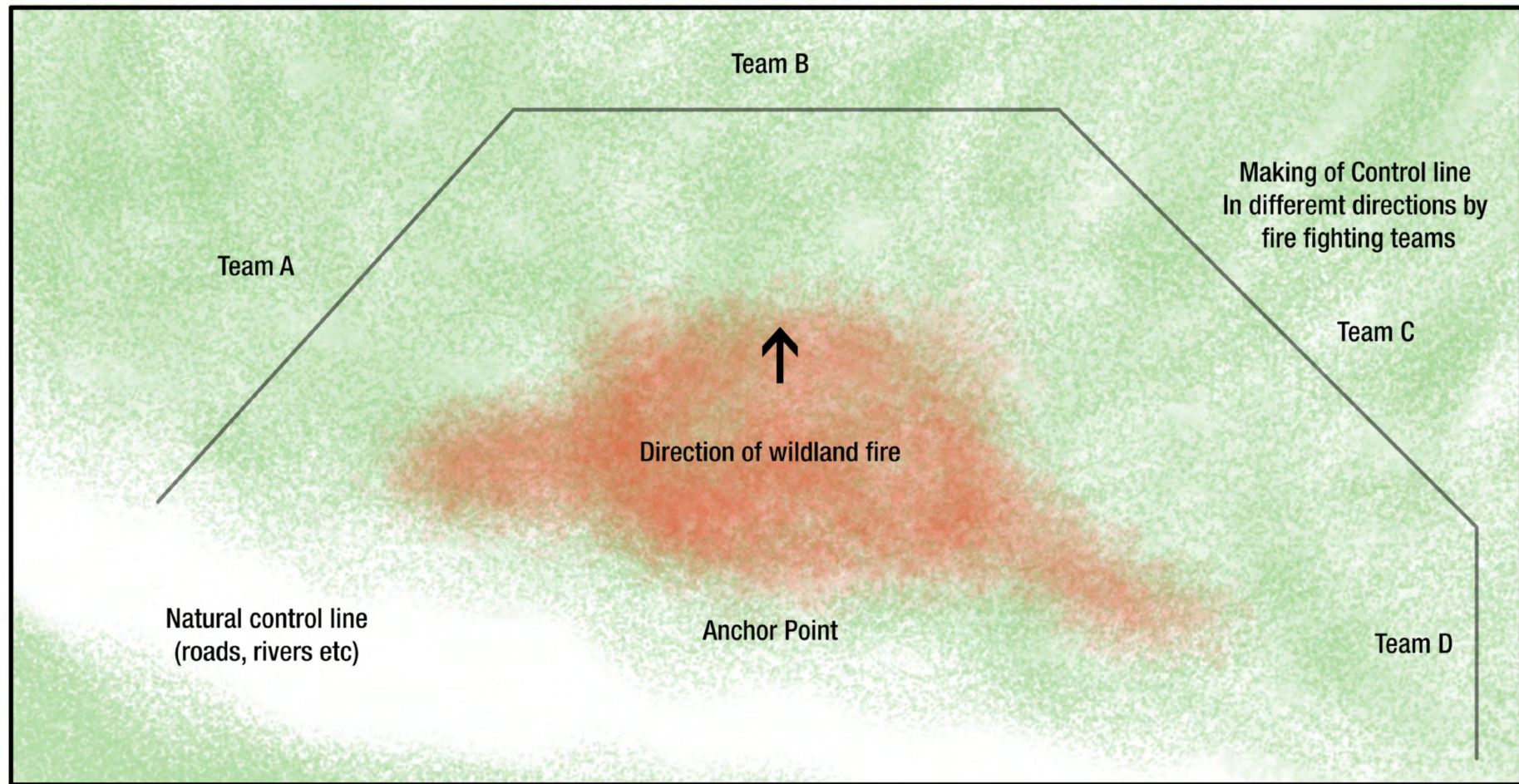
It's called mop-up when firefighters go back and clean up along a completed control line. Mop-up consists of dousing any embers and spot fires that have made their way across control lines. It also involves protecting still-vulnerable fuels using a burnout (if they're permanently situated) or by simply moving them.

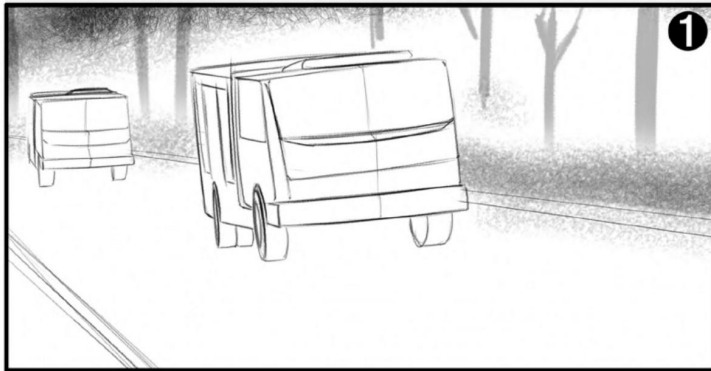


Current Scenario for forest fire

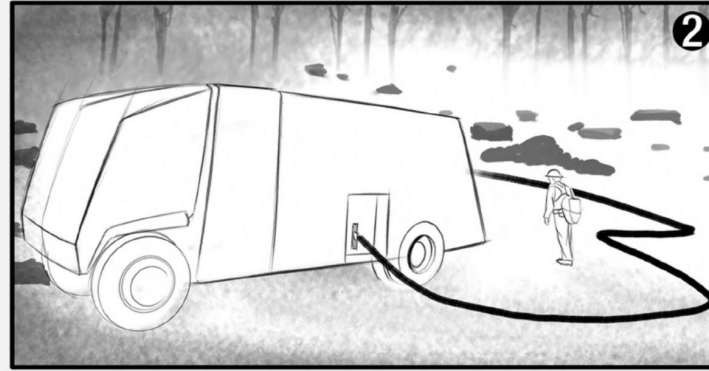
Plan of action

Firstly a plan of action is made by the incident commander based on the data and images he got during the detection of fire. MODIS and SNPP-VIIRS satellite has been used for detection. The plane of action will be consist of in which direction the forest fire is moving and finding of natural barrier to set a anchor point of fire. Based on fire moving direction control line are being made to make a barrier by which fire cannot passed through it.





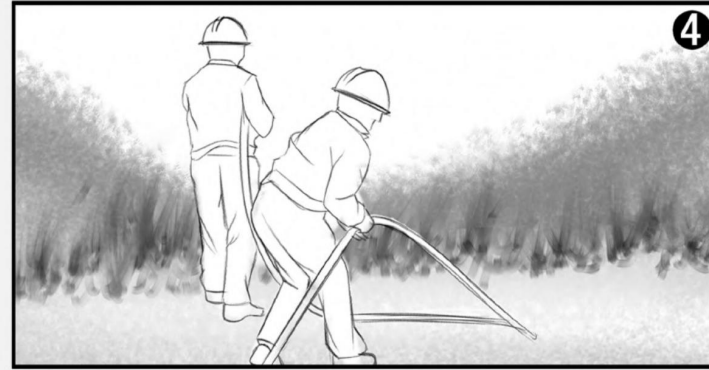
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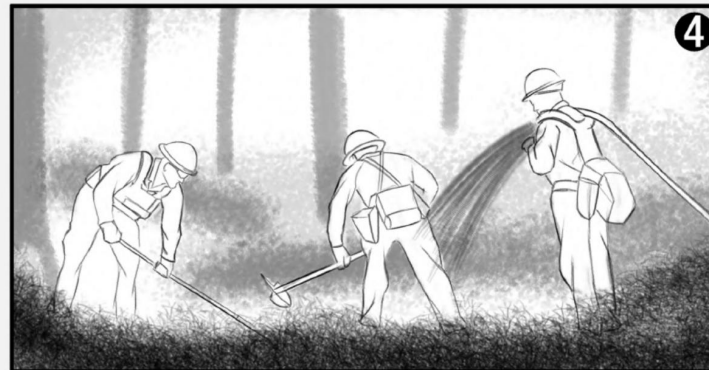
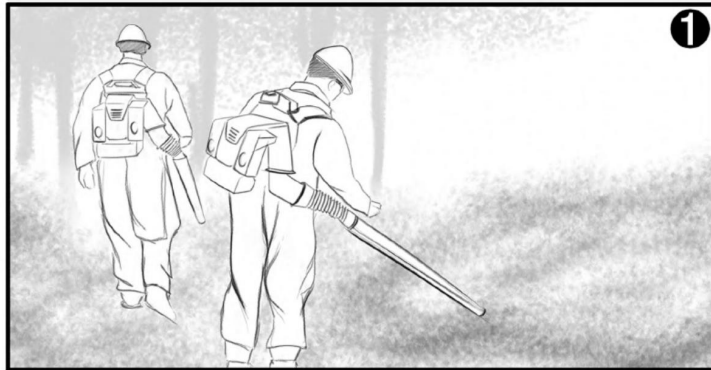
Initial approach to forest fire

Scene 1 : Reaching to the site with by taking mini water tender and water bowsers.

Scene 2 : Parking the truck far from the fire site because of off road capabilities size of the trucks.

Scene 3 : Walking to the fire site by taking heavy equipments such as 60m long hoses and also the no of nozzles for effective operations and also some other required equipments.

Scene 4 & 5 : Fighting the crown fire at anchor point of fire.



Method used for suppression of fire

Scene 1 : Removing the surface dry bushes from surface to make control line with the help of blower.

Scene 2 : Making of control line by again removing the dried bushes from the surface with the help of shovels. A lot of people are involved for making of control line a kilometer long takes upto 100 people to make the control line.

Scene 3 : Back burning method is being used to suffocate the main fire by starting up a small fire in oposite the directio n of maving fire.

Scene 4 : Mop up method has been used in the last for clean up of small fire that can become again a major fire.

Product study

Mini water truck (Mist truck)

This vehicles meant to reach the fire site at intial stage this vehicles have the tendency to go anywhere with the help of 4x4 configuration this vehi-cles usually have a water tank of 500 liters and a foam tank of 50 liters with all the pumping units and they also carry a set a light equipments also. Small Fire Tender does quick transportation of Fire Fighter to an inci-dental scene, providing water with which to fight a fire and carrying equipment needed by the Fire Fighter. It plays a critical role in situations, where Medium and Large Fire Trucks are difficult to mobilize due to narrow passage. High pressure water mist system require only approxi-mately 10% of the water needed for conventional Fire system. This means less damage, lower repair or restoration costs and shorter down-times or interruptions to operations.



Fire truck (Water tender)

Water Tender Type 'A' & 'B'TM are specifically designed for Fire Fighting on 16 tonner chassis, also effective with rugged suspension and high wheel clearance in mountain dirt road condition. The Fire Tender are generally equipped with Fire Station equipment including required no. of B.A. Sets, Fibre glass blankets, electric insulated gloves, Extension Ladder and other critical accessories effective in Class 'A'TM Fire.

Key Points:

- Negligible maintenance
- Free of environment pollution
- Runs on CNG
- Faster action



Water bowser

Water Bouser is the ideal solution where there is shortage in Fire Fighting Water with no hydrant systems. Whether in desert regions, vast oil refineries or difficult terrain, its tank bring enough water to the scene. Small and medium fire tenders quickly reached the fire destination and in case of failure, Water Bouser alone can also perform the extinguishing task. The bouser also has a demountable pump, which allows the vehicle to be used for quick attack purposes. The vehicle can be filled from any hydrant or other water supply, or open water using the on board pump.

Key Points:

Durable construction
Act as a reservoir



Multipurpose tender

Multipurpose Fire Tender are meant to be used in the Industries having complex production process where there are chances for different types of Fire break (Electrical short circuit, Diesel / Petrochemical Fire etc. Multipurpose Fire Tender equipped with powerful pump system in combination with long quantity of Water and foam as well as additional systems like DCP and CO2 system. These trucks two seater fire fighter carrying a wide range of heavy rescue equipment to rescue people from fires in roads, rails, airplane accidents etc. Its Hi-Ab crane has a winch and its rescue equipment includes airbags, still saw, windscreen cutters etc.

Key Points:

Versatile
compact



DCP Truck

Dry Chemical Powder Fire Tender are designed to fight fires without the use of Water and Foam. Mostly these are used in Electrical Fires and the situations where use of Water can have a negative impact on Fire. DCP Fire Trucks are designed to fight fires without the use of water or foam. It is used in situation where water would have a negative impact on fire or substance. Dry Chemical Powder (DCP) system which is an excellent vessel that can discharge a total of 250 kg of DCP through a 30 m hose at 2.5 kg/sec using dry nitrogen as the propellant. Its storage compartments encompass a wide variety of rescue equipment like breathing apparatus and cutting equipments. Each vessel is fitted with battery gas cylinders and also has additional cylinders in spare capacity in case of emergencies.

Key Points:

- Only used in electrical fire
- Compact
- Can carry more equipments



Foam tender

Foam Tender / trucks stand ready day and night, to protect people, the environment and property in the challenging environment of chemical industry, as they need Fire Fighting Vehicle equipped with powerful pump system in combination with foam proportionating system. Foam Tenders carries upto 2800 liters of Flouro protein foam liquid and foam making equipment. It is used for fighting fires that involve flammable liquids . These foam tenders prevent liquid spills from igniting. This vehicle carries high expansion foam for dealing with fires in restricted access areas, such as basements, ship holds etc.

Key Points:

- Light weight construction
- Compact
- More area for equipments



Foam nurser

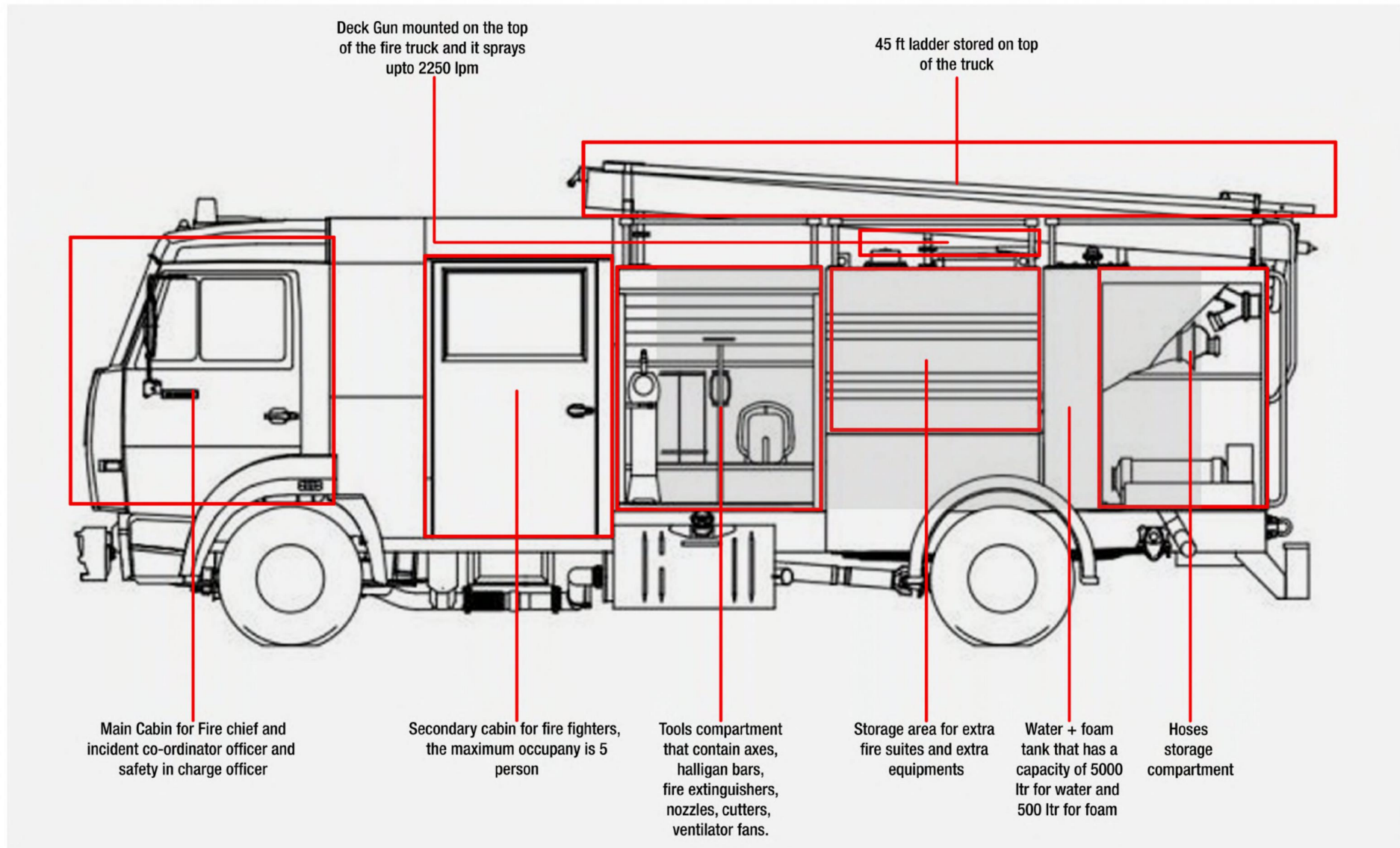
These trucks act as a storage tankers for a foam trucks that are fighting in the front line of the fire incidents and this trucks are also equiped with a ultra high pressure pump for fill in and fill out purpose of the other foam trucks. Foam Tenders carries upto 20000 liters of Flouro protein foam liquid and foam making equipment. It is used for fighting fires that involve flammable liquids . These foam tenders prevent liquid spills from igniting. This vehicle carries high expansion foam for dealing with fires in restricted access areas, such as basements, ship holds etc.

Key Points:

- Heavy construction
- Carrying capacity is high
- Used for bigger industry



Anatomy of Type 2 fire truck

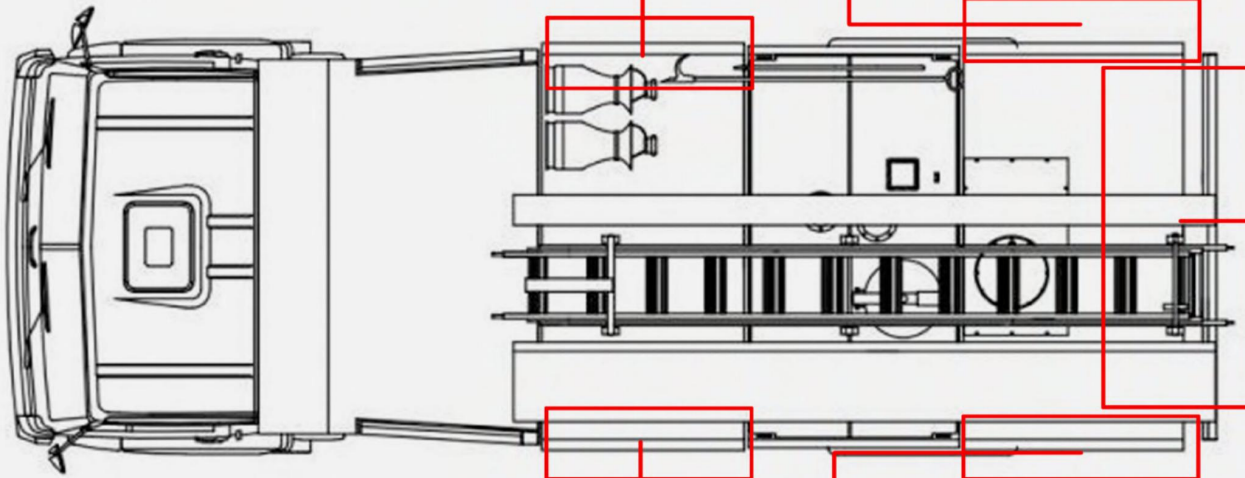




Storage area for extra fire suite and road indicators



DCP set up with it's own pump and the hoses



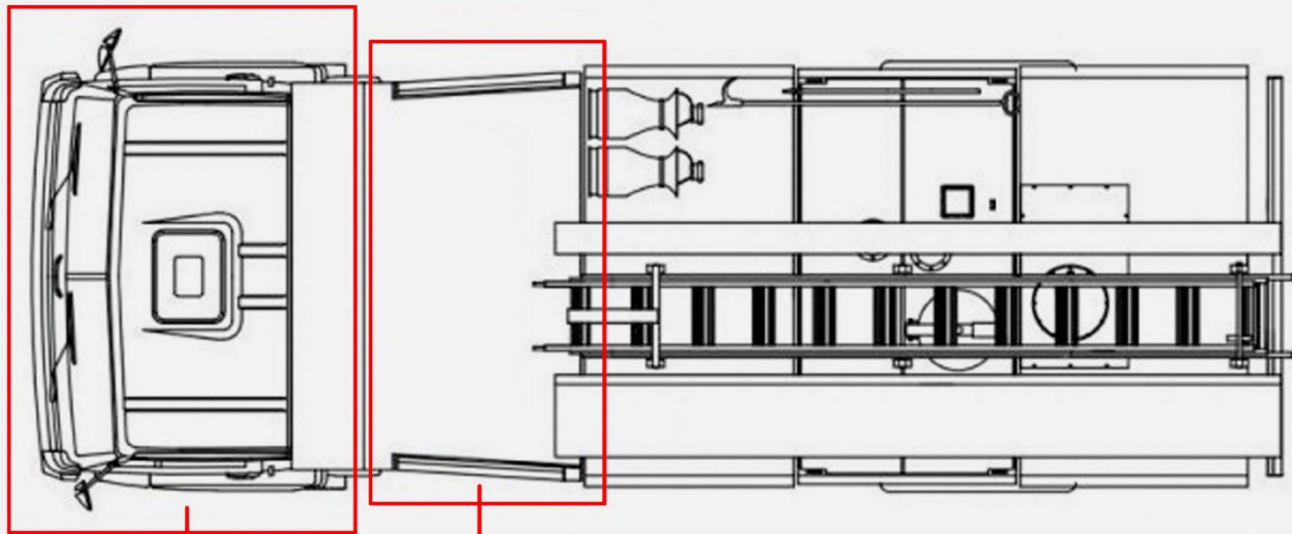
Water and foam two stage pump powered by diesel engine through PA coupling



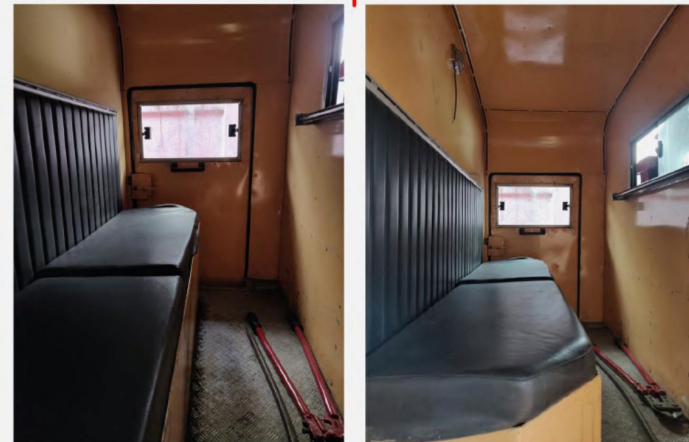
Miscellaneous equipment storage area with a small compartment for fire extinguisher



Storage area for hoses and different nozzle with coupling for hose attachments



Not too many changes were done in the cabin there is an addition of an of an electronic controller on the front dashboard just above the ac vents area. And there was also a storage box on the back of the driver seat .



An secondary cabin was added to the fire truck just after thecab of truck to accomodate extra fire fighters in the back a total of four people can seat in the back and there was also underseat storage area to store equipments.



Understanding Type 3 Wildland Fire Engine

A wildland fire engine is one that is specifically designed to assist in fighting wildfires by transporting firefighters to the scene and providing them with access to water and other equipment. Wildland engines are specially designed for the technique of pump-and-roll. This is a tactic where the vehicle drives with the pump engaged while a firefighter uses a hose to spray water on the fire.



Left front compartment

- . Chainsaw
- . Chainsaw Repair Kit
- . Spark Plug Wrench
- . Spark Plug
- . Bar Oil
- . Floto Pump Tool Kit
- . Wheel Chock
- . Barricade Tape
- . Duct Tape
- . Small Sledge Hammer
- . Rubber Mallet
- . Plug And Dike
- . Marking Paint (2)



Hose storage area back of the truck

- . Double jacket
- . Forestry hose
- . Turbo jet fog nozzle
- . Nozzles
- . Adapters



Left rear compartment

- . Double Jacket Hose
- . Chainsaw Chaps
- . McLeod
- . Pulaski
- . RoundPoint Shovel
- . Halligan
- . Sledge Hammer



Right rear compartment

- . SlimQJim Kit
- . Flare Container
- . Spare O2 Cylinder
- . Co2 Ex2nguisher
- . Cooler
- . MCI Kit
- . Trauma Bag
- . Pediatric Bag
- . Electronic Suc2on Unit



Inside cab

- . SCBA (4)
- . SCBA Mask
- . Head sets (4)
- . Driver Headset
- . Litebox Hand Lights (3)
- . Drop Rope with Bag
- . Web Gear
- . Mobile Data Computer
- . King Radio
- . Chest Radio Holder
- . Cyalume Light S2cks (6)
- . Medco Key Set
- . Fuel Key



Right front compartment

- . Airway Bag
- . ALS Monitor
- . ALS Drug Box
- . Jump Bag
- . CQCollar Bag
- . Cardboard Splint Set
- . Infec2on Control Kits (4)
- . OB Kits
- . Sterile Water (6)



Back Compartment

- . Salvage Cover
- . Debris Carrier
- . U2lity Rope
- . Hearing Protector
- . Rescue Rope Bag



Top compartment

- . Driptorch
- . Driptorch Fuel Can
- . Mixed Gas Fuel Can
- . Funnel

User Study

For user study, interviews has been done at National Academy of Fire and Safety Indore and later for observational study and understanding the different vehicles used for fire fighting in India, a visit to main Fire Brigade Station Indore has been done.

User's interviews key highlights

Mr. Subhash Gupta

Safety In Charge
Mhow Cantonment Fire department
Involved in khandwa forest fire of 2017

"Local people helps to suppress fire on daily wages, for khandwa fire around 400 local people help during this forest fire operation. They helps in suppression of fire by making of control line and suppression of small fire by use of green leaf bush to put down the fire. Transportation of local people to first line was another challenge as if they go by foot fire will destroy much more area before they reach."

Mr. S R Verma

Firefighter
Involved in khandwa forest fire of 2017

"Difficulty to reach to a fire spot (ground zero) as the vehicles are quite heavy and terrain is also uneven and no. of firefighters that can get into a vehicle is maximum upto to 5 as other seating areas are occupied by equipment that are used in the first line of action. For example :- mahindra bolero were used during khandwa forest fire as vehicle to reach to the site and vehicle was modified for forest rangers so what they have done is they have remove the back side seat to store the equipment for their daily work and during forest fire this back seat has been used for fire fighting equipments."

Mr. Aakash Chouhan

Incident Commander
Mhow Cantonment Fire department

"It took me and my team around 3 hours with a vehicle and a walking distance of around 2.5 km to reach to the fire site as first we have to equip ourself first before reaching to the site and driving through vehicle for a long time through rough area has already tired us somehow".

Mr. Sudhesh Bhamar

Fire Engineer
Involved in 2015 jabalpur forest fire

"A need of new tools or equipment to make control line much more faster and using much less man power .A hand operated tractor has been used to make a control line with a plow attached to it in the front as control line width vary from 6 to 14 ft depends on type of fire."

Mr. Santosh K Dubey

Station Incharge
Indore Fire Brigade

"Use of compact multipurpose fire tender has become quite effective in urban environment as these vehicles can do multiple works and are able to suppress different type of fire. And in Indore we are shifting more towards light fire fighting vehicles as its easy to go through traffic with these kind of vehicles have low cost of runing".

Problem Identified

.Reaching to the forest site on time is the biggest problem as these vehicles are build for urban environmentand dosen't have much off road capabilities as required.

.Quickly deployment of the teams to the incident site takes a lot of time as these trucks are not build to carry too many people at a time.

.It's difficult for people to carry heavy equipments by hands as sometimes it's difficult to take trucks at the main site because of uneven terrain.

.Contineous filling of water is one of the biggest problem as these vehicles operate in a remote locations.

.Making of control lines with conventional tools takes much more time and making it for a long kms long stretches is also not effective.

.Evacuation of injured people from site is quite challenging as these people work in a team of 5 to 7 peoples if anyone get injured a minimum of 2 people are required to take him to the medical vehicles.

.There is also a difficulty to store more equipments as much part of vehicles are occupied by water and foam tanks.

Key Insights

- . There is need of a vehicle that can transport fire fighters to different fire site as quickly as possible through difficult terrain.
- . There is a need of a new vehicle configuration in which minimum fire fighters can suppress fire at fire line of action.
- . There is a need to reduce no. of peoples that are being working during making of control lines and mop up method.
- . A need for a compact and much more effective suppression system for forest fire.

Design Brief

The objective is to design a new class of forest fire fighting vehicle which is capable of direct and indirect attack. The vehicle should effectively and efficiently increase the approaches done for fire fighting without involvement of lot of people.

The vehicle must function primarily as an attack vehicle while providing unparalleled vehicle and crew safety and survivability in forest fire and also maintain superior off road capabilities for quick reaching to attack site and vehicle should also pose appropriate fire suppression technology for the purpose of initial response in front line of action.

Main Function :

1. Fire fighter safety and survivability.
2. Quickly reaching to first line of action.
3. Capable of direct and indirect attack.
4. Capable for mountaneous and uneven terrain.

Exterior Specifications

User Research

Observational Study

Online Research

Overall length :

The vehicle used in current scenario are **Tata 407 and Tata 207** for its compact and sizes but main problem associated with this vehicles is lack of area for suspension system. so the overall length taken is a sub 5 meter truck. **And the truck taken for reference is Tata LPTA 715 for its off road capabilities and compact size.**

Overall length = 5400 mm

Wheel Base

The main problem of current trucks is the rear overhang. The overhang is quite extended that it decreases the driving capability in uneven terrain. So the wheelbase taken is considered based on the overhang lengths in rear and front of the vehicle.

Wheel base = 3620 mm

Width

The vehicles that are mostly used are pickup trucks and small water tenders so a considerable width of the **Tata LPTA 715 has been selected so that vehicle can operate easily in uneven terrain.**

Width = 2400 mm

Height & Ground clearance

The vehicle height has been considered based on the common water tender height that can easily accommodate the overall of package. And also that can help in a greater ground clearance for drivable in uneven terrain.

Height = 2540 mm

Ground clearance = 550 mm

Angle of approach & departure

During observation study the vehicle used for forest fire in India are build for urban environment so they have really low angle of departure. So a really high angle of approach and departure has been taken for drivability in uneven terrain.

Angle of approach = 50 degree

Angle of departure = 65 degree

Tank Size

Most common truck used are Tata 407 and 207 that has water tank capacity of 2000 liters and 500 liters which is quite low and need a lot of refilling again and again.

Water tank size = 5200 liters

Foam tank size = 1000 liters

Technical Specifications

Engine :

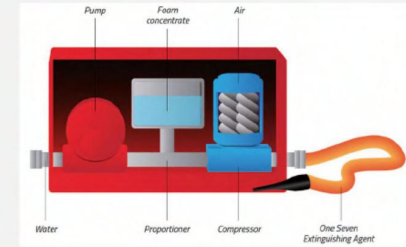
Tata Cummins 6BT turbocharged diesel engine. It's one of the best engine developed by Tata for its light utility military vehicle LPTA 713 TC that has been used roughest terrain in India.

Inline 6 cylinder engine producing 205 -300 bhp providing a peak torque of 700 Nm.



Foam Concentrate :

One Seven foam concentrate will be used as a fire retardant. The one seven concentrate increases the fighting time by converting one molecule of water into seven foam molecules the means it can easily convert 1000 liters of water into 7000 liters of fire retardant.



Transmission & Drive :

5 speed manual transmission will different drive will be used in the purpose build vehicle.

All wheel drive configuration will be used for better maneuverability and handling of vehicle in mountaneous and uneven terrain.



Turret Gun :

Rosenbauer RM60 roof turret will be used as a main supression system for fire fighting. The gun will we electronically controlled by incident commander through a joy stick. The RM60 has a maximum throw range of 80 meters for foam concentrate. It has been selected for its compact size, throw range and overall usability of the turrent gun.



Suspension :

An heavy duty independent double wish-bone type suspension will be used for better handling and also for the increase in suspension travel of the vehicle.

Rear and front both will have the double wishbone suspension system.



Tyres specification & essential features :

Tyre = 425/75R20 will be used for better maneuverability and increasing the overall ground clearance of vehicle.

Central tyre inflation system and run on flat tyre will be used for better climbing and offroad capabilities.



Power take off unit :

Power and roll PTO unit will be used to power the main compressor and pump unit for high pressure discharge of fire retardant.



An Auxiliary water tank, supplies water to the temperature controlled high pressure spray down system that allows the vehicle to stay fully operational and also act as a safety feature for in wild fire.



Frame & Body type :

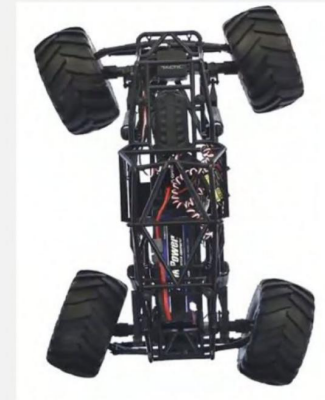
A ladder frame will be used as the super structure of the vehicle for better strength and better payload capabilities.

A body on frame configuration will be used so that the vehicle can be easily made up in any modern production line.



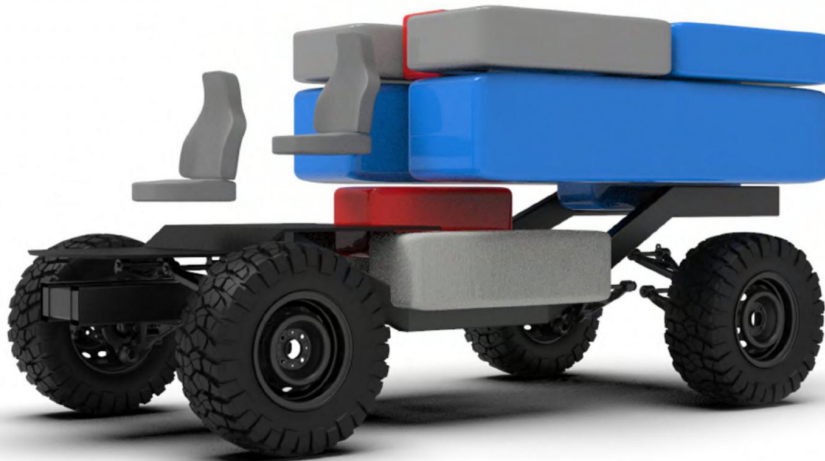
Steering Mechanism :

Four wheel steering will be used better maneuverability and handling of the vehicle for mountaneous area. The rear steering link will be lockable for different activity.

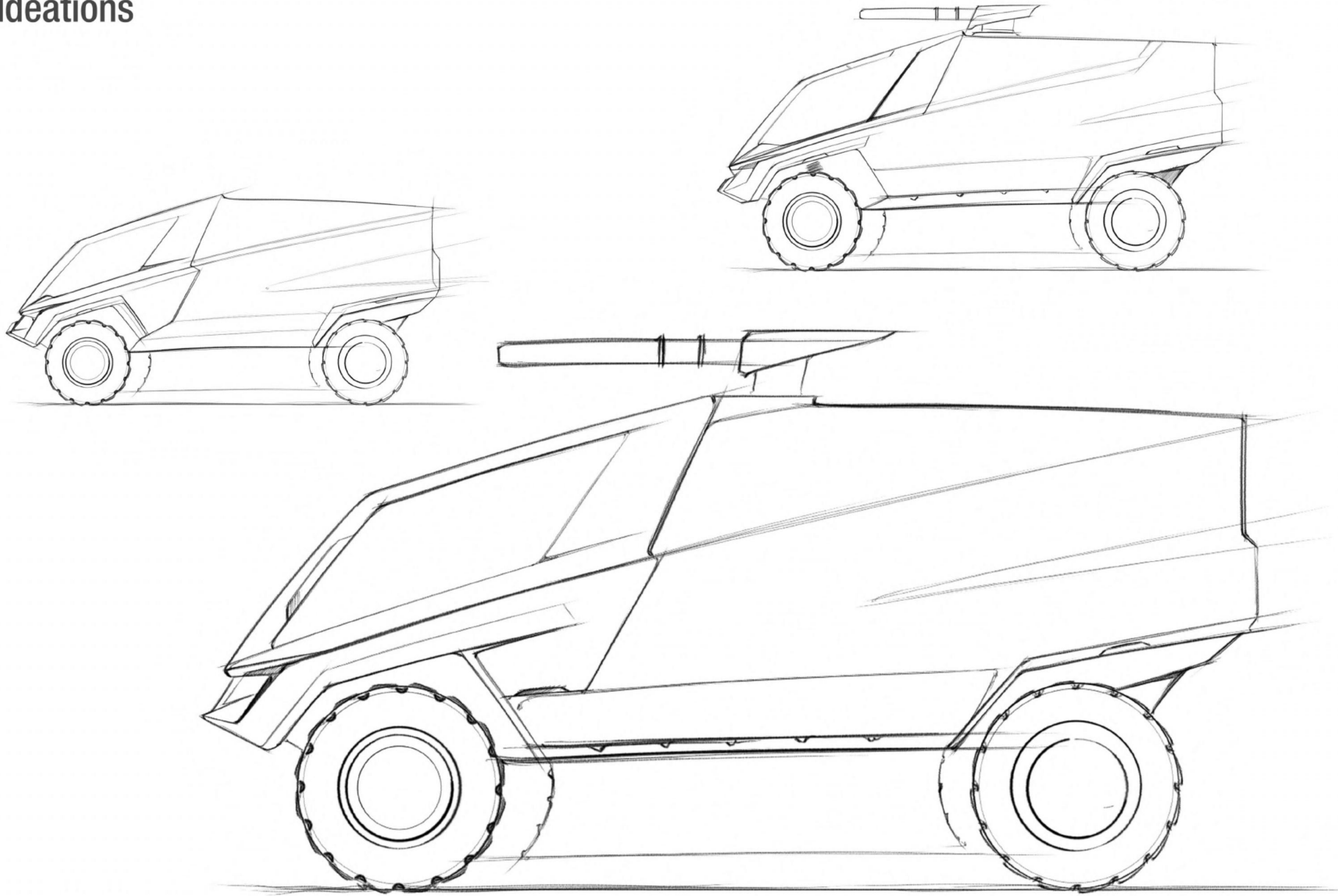


Concept 1 Schematic Package

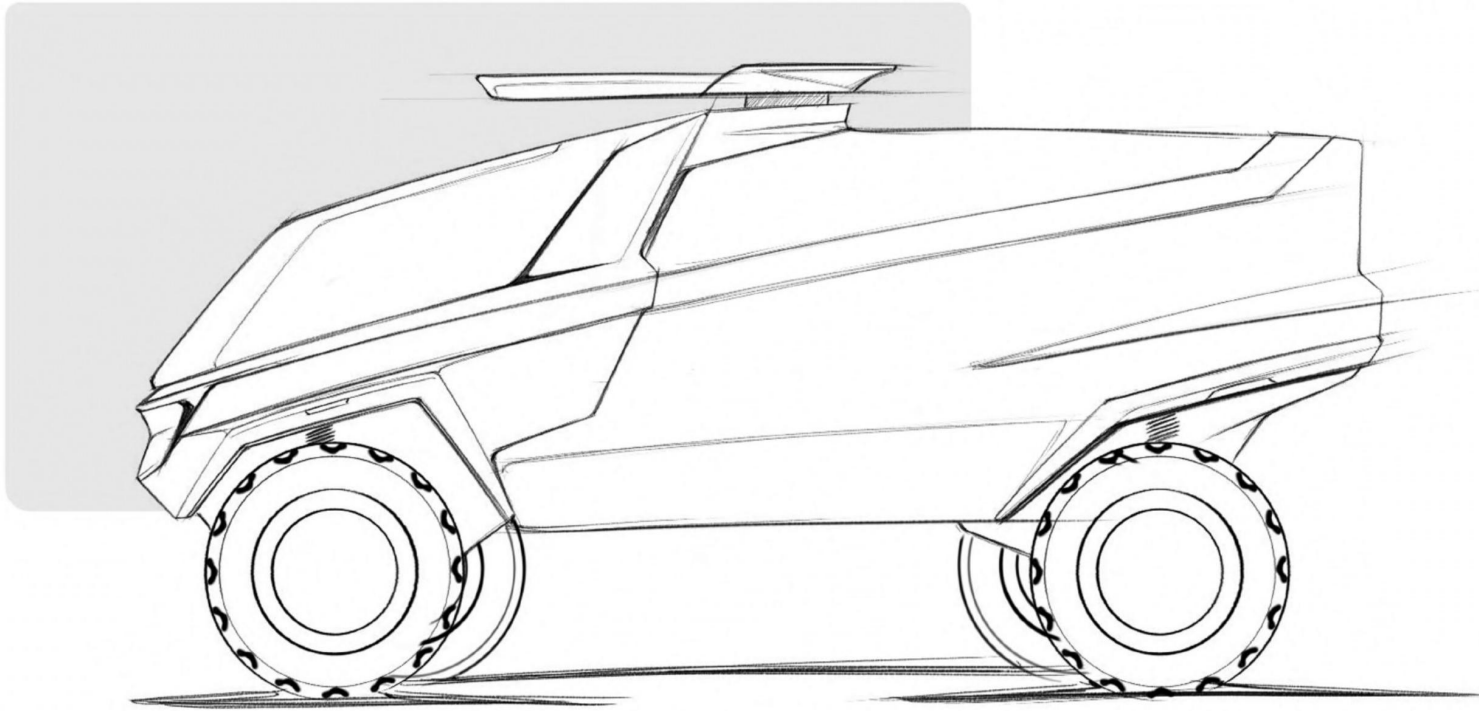
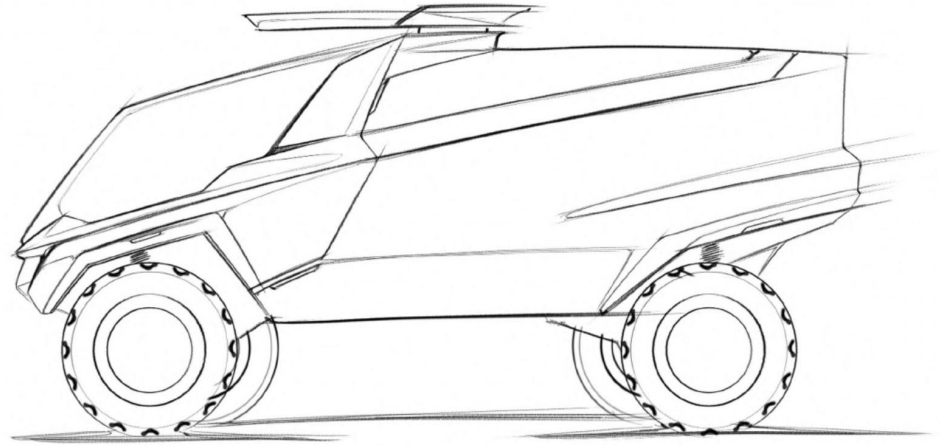
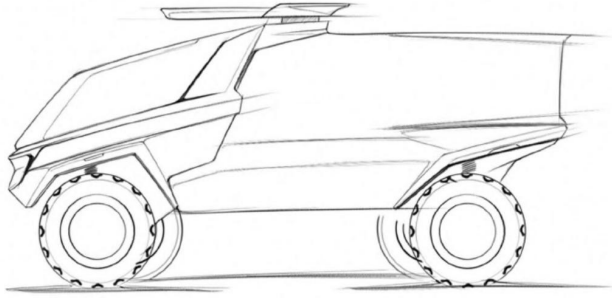
This package has a tandem seating arrangement which gives a more attacking condition for the incident commander as well as the fire engineer.



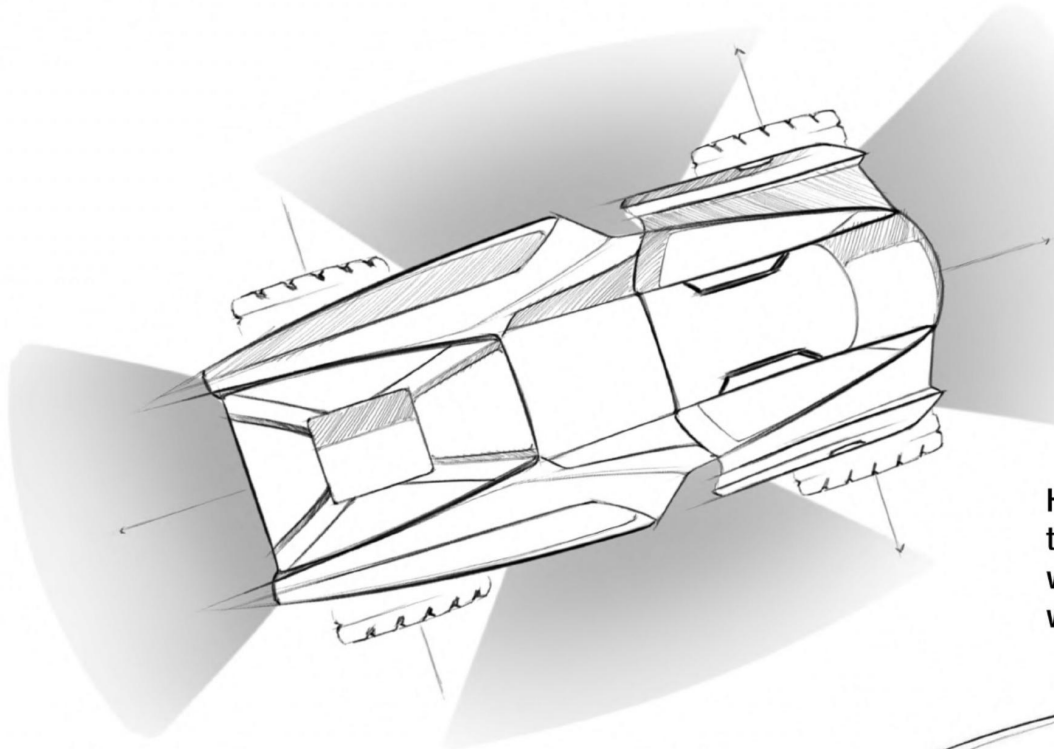
Ideations



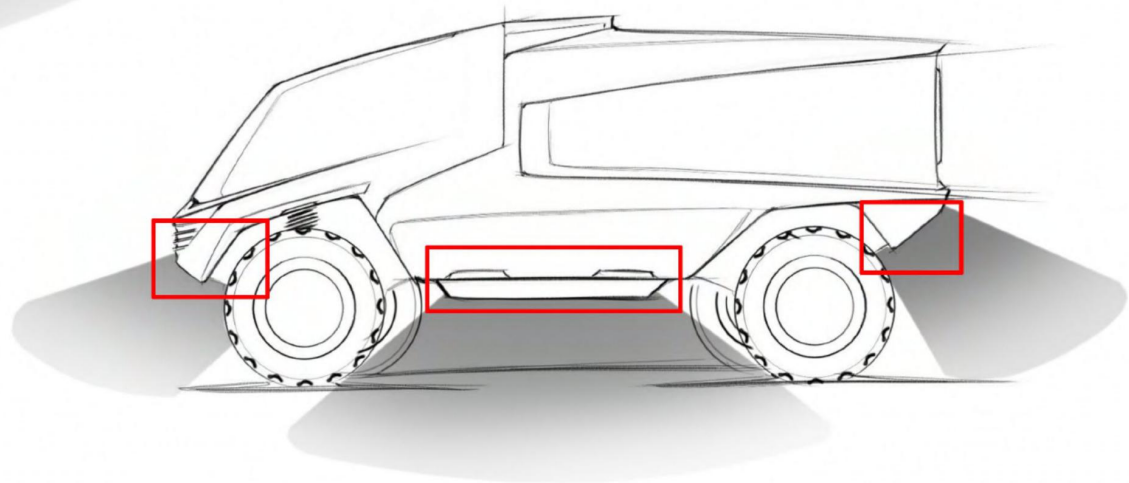
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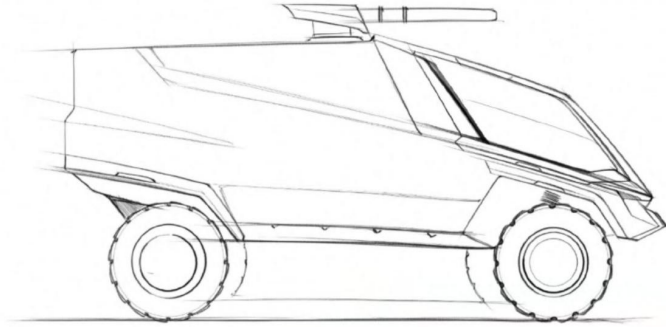
Ideations



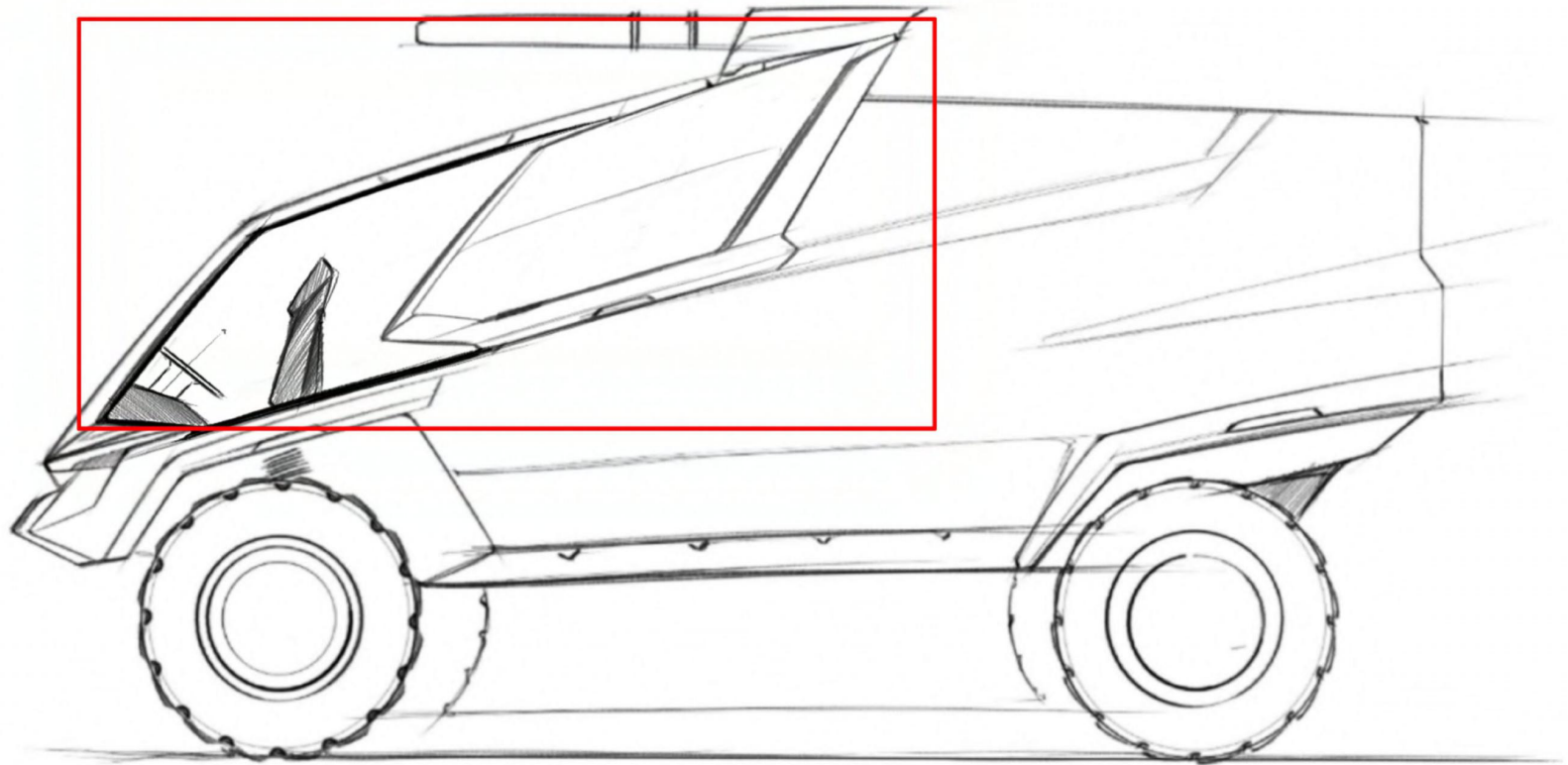
High pressure waterspray down function that increases the surviability of vehicle when stuck in forest fire. The system spray water in all direction of the vehicle.



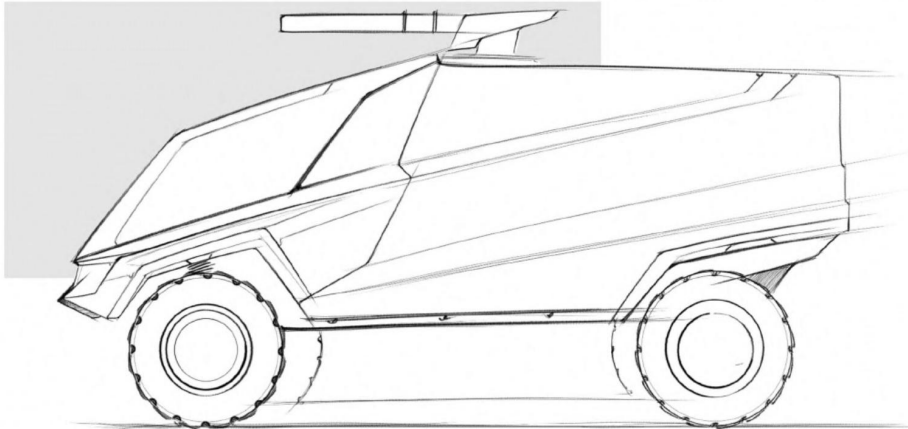
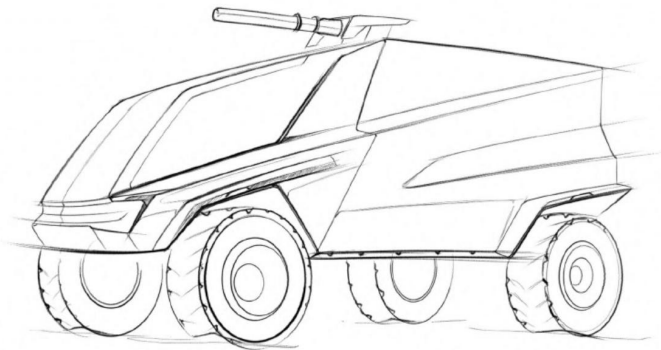
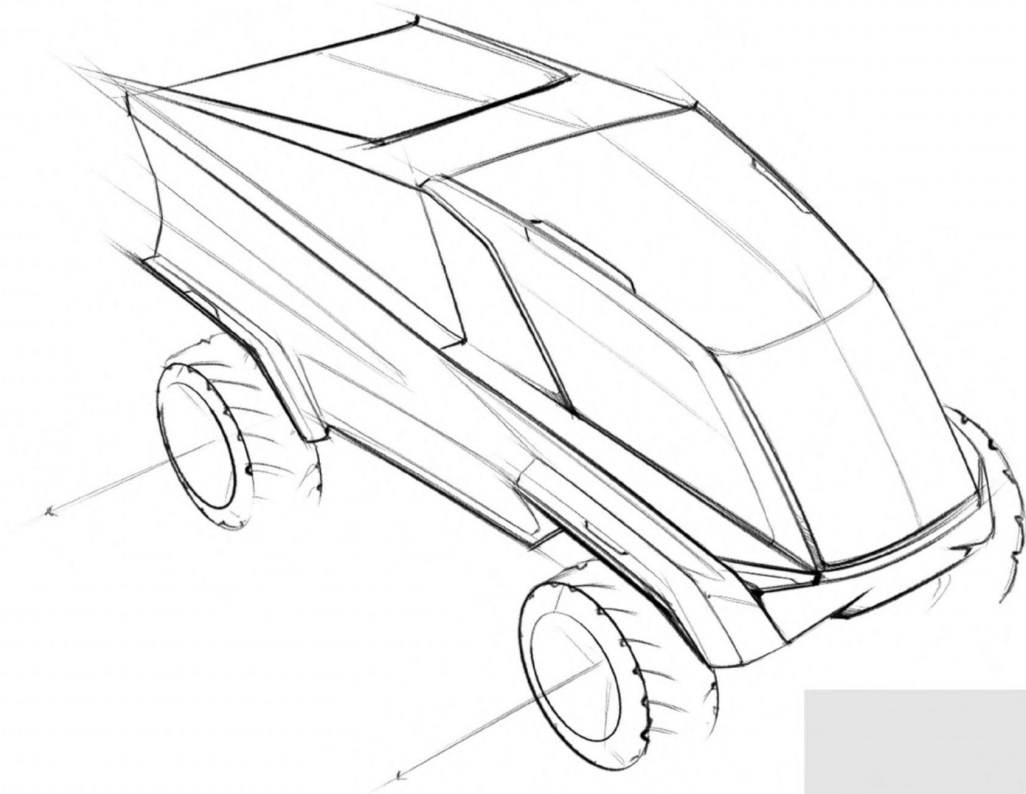
Ideations



Single sliding door for easily ingress and egress in the vehicle.



Ideations

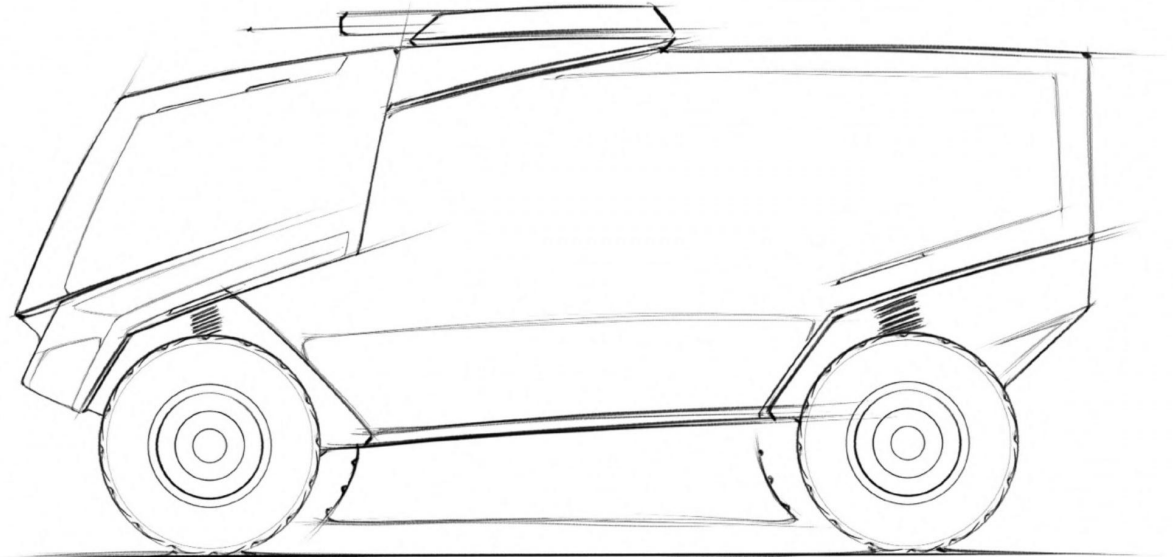
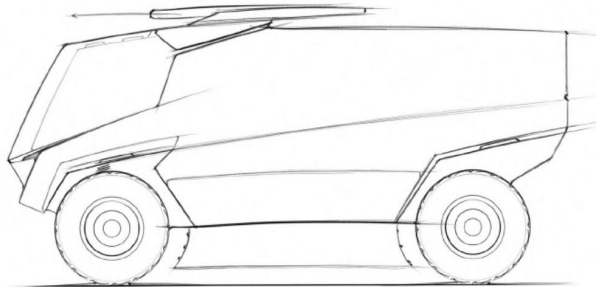
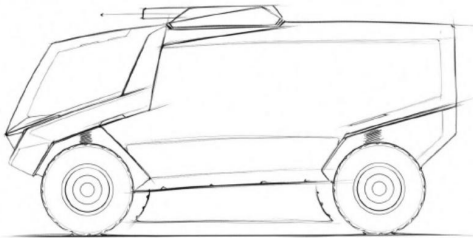
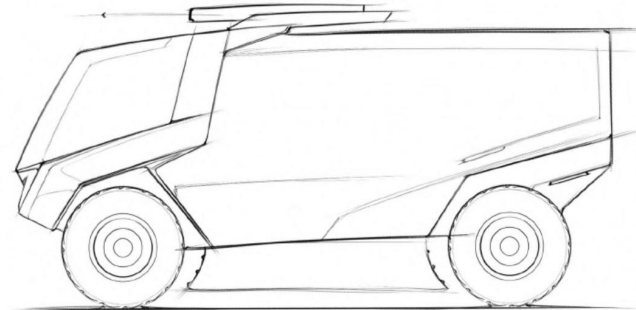
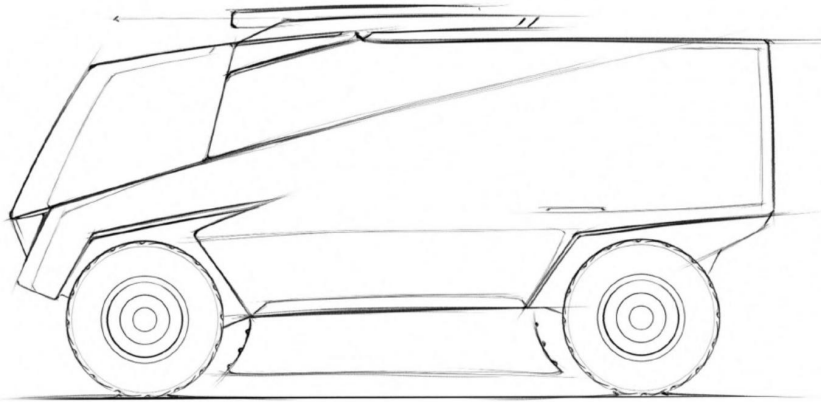


Concept 2 Schematic Package

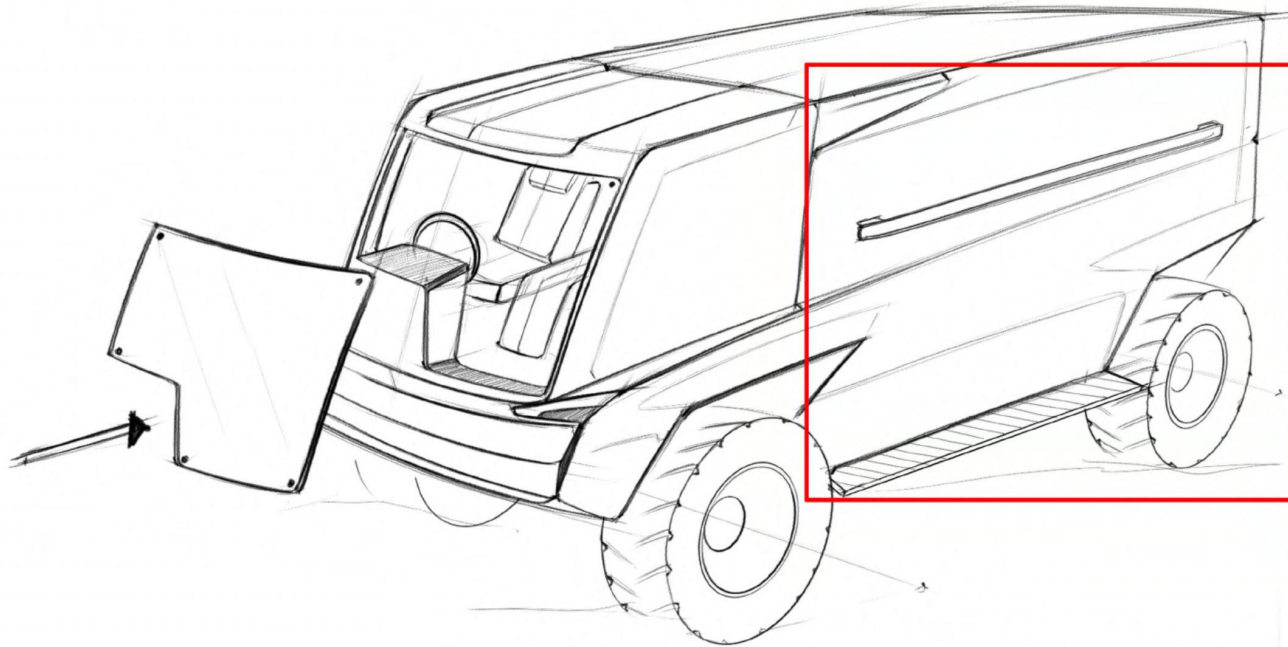
This package has a single cab seating arrangement giving a more area in back of the vehicle making more room for the suppression system.



Ideations

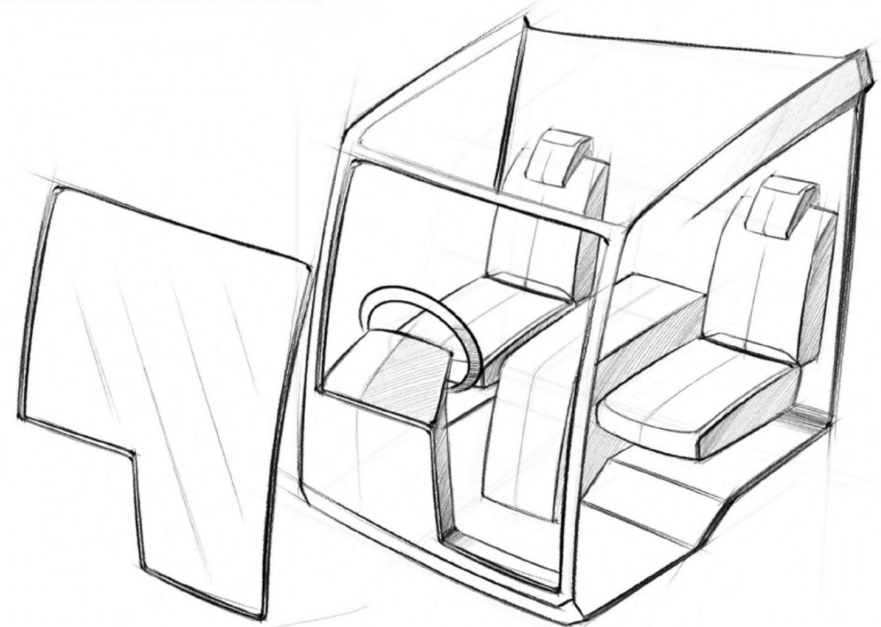


Ideations

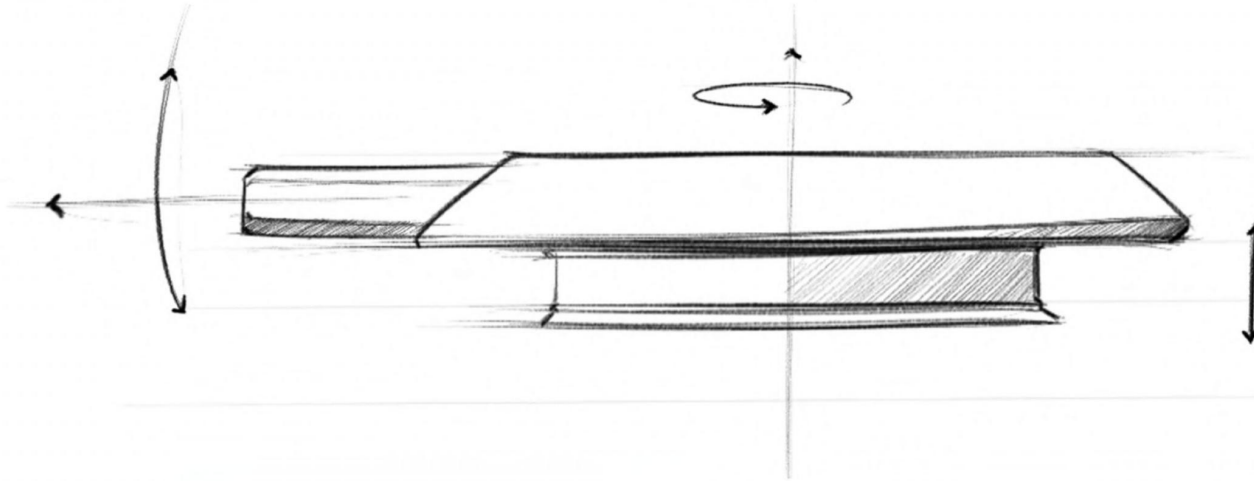


Side grab rail so that people can easily climb in case of emergency.

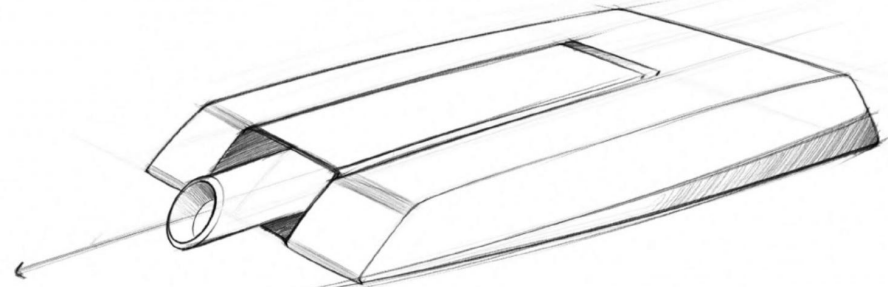
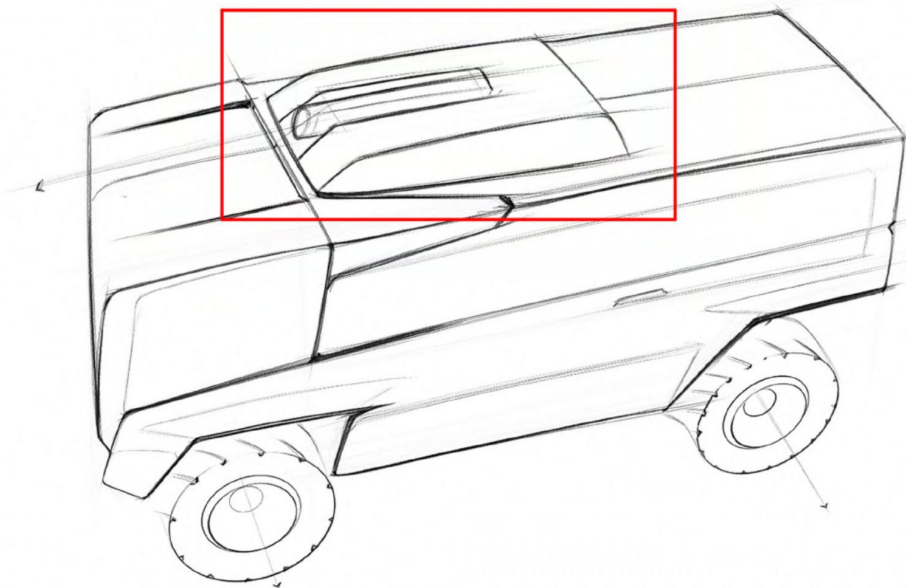
Emergency removal front windshield that act as an emergency exit when vehicle is stuck in forest.



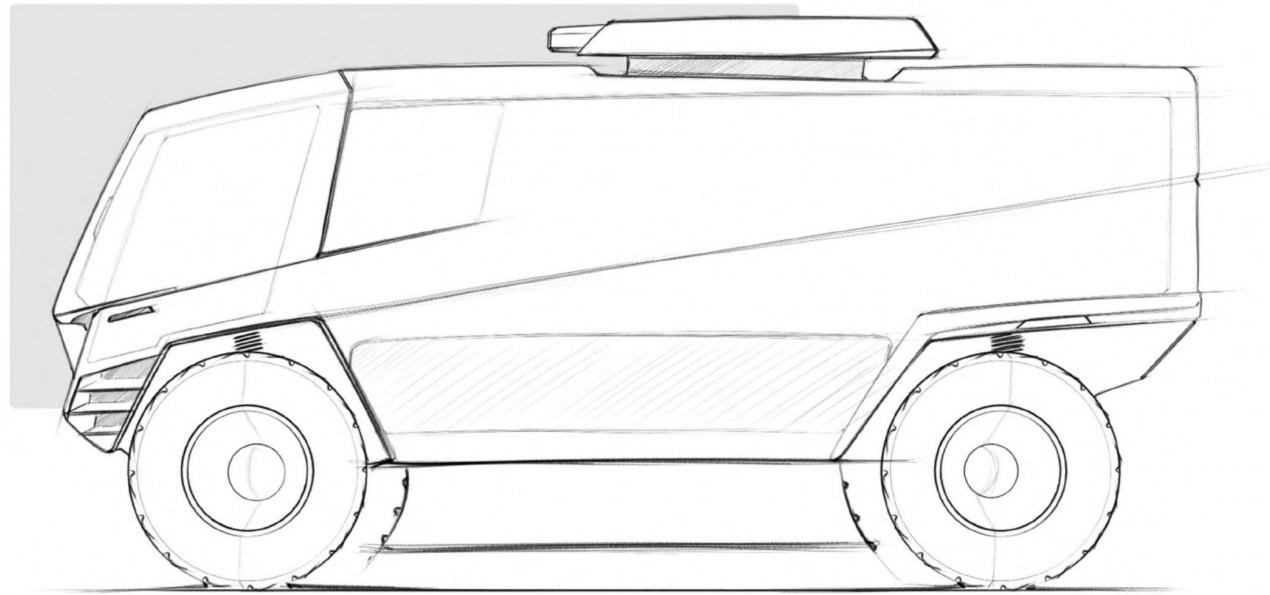
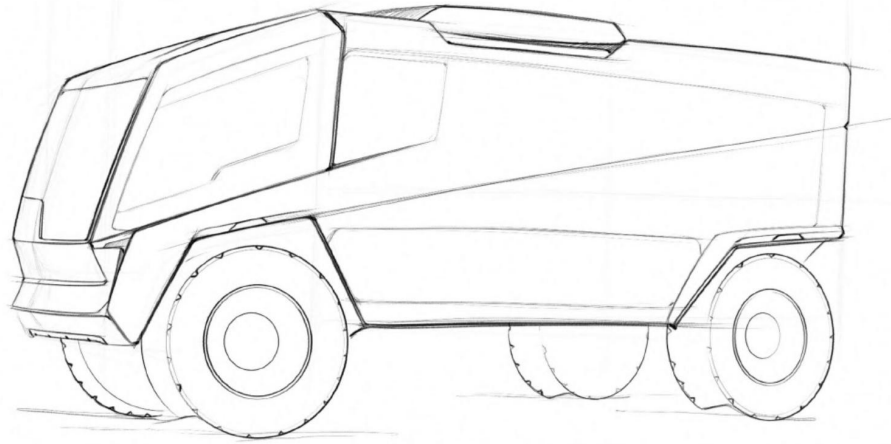
Ideations



Rosenbauer RM 60 turret water cannon for suppression of fire without getting out of the vehicle. The turret is safe under a cover with an inside honeycomb structure to withstand any type of shock impact. The turret can be rotated at an angle of 270 degree and head has movement of around 90 degree.



Ideations

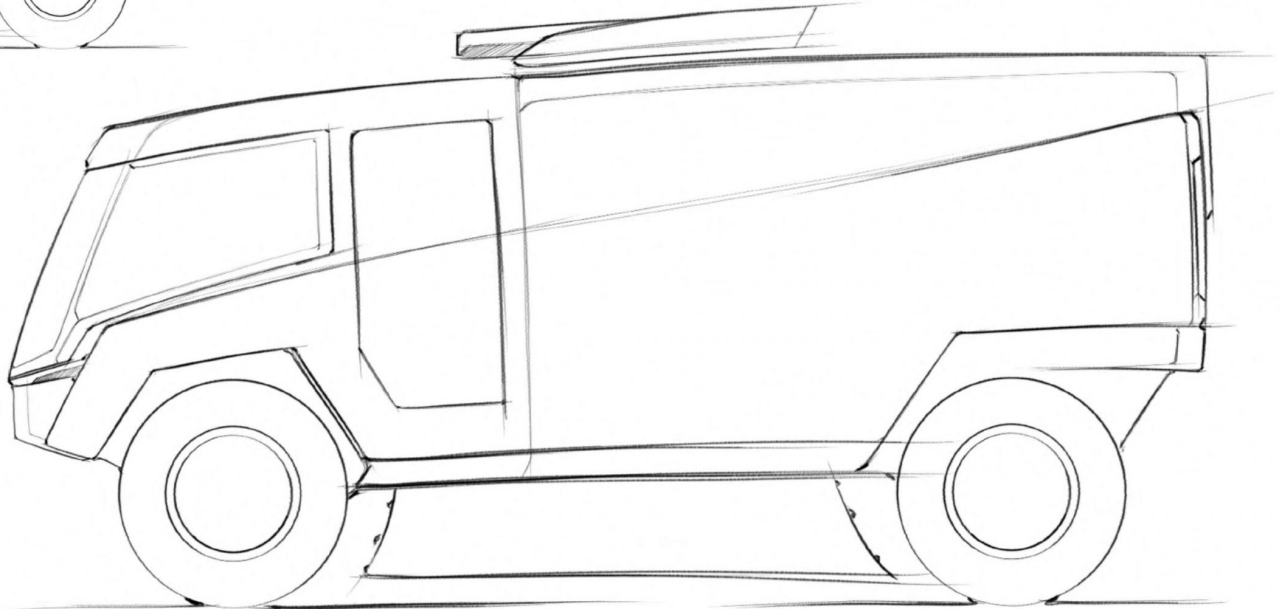
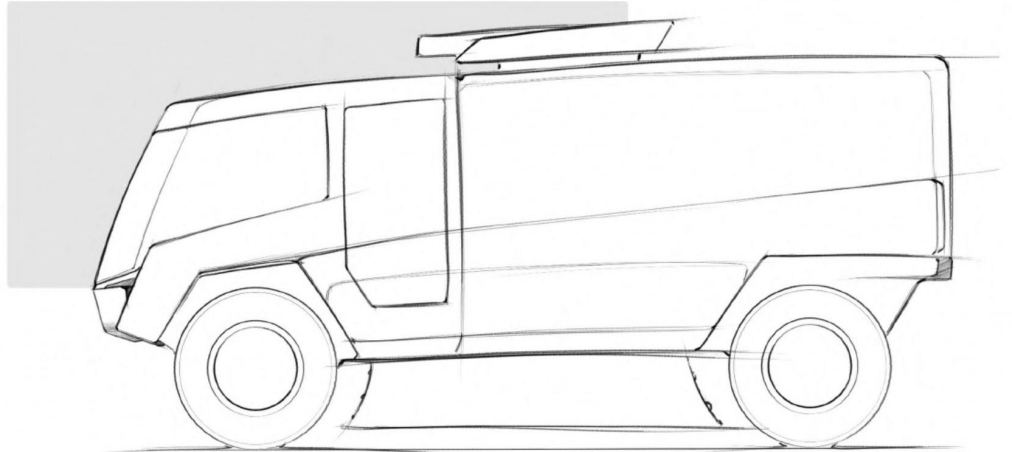
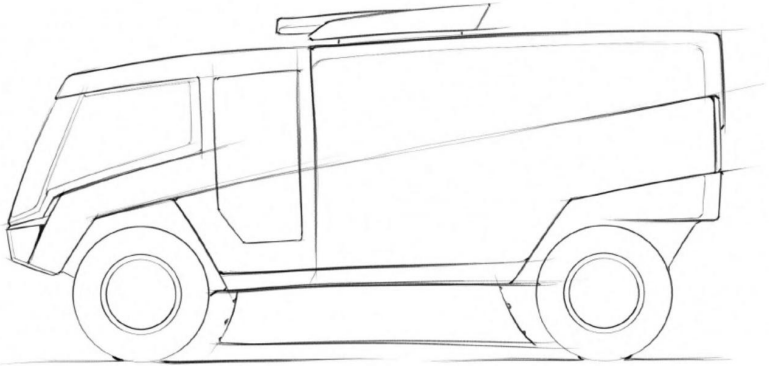


Concept 3 Schematic Package

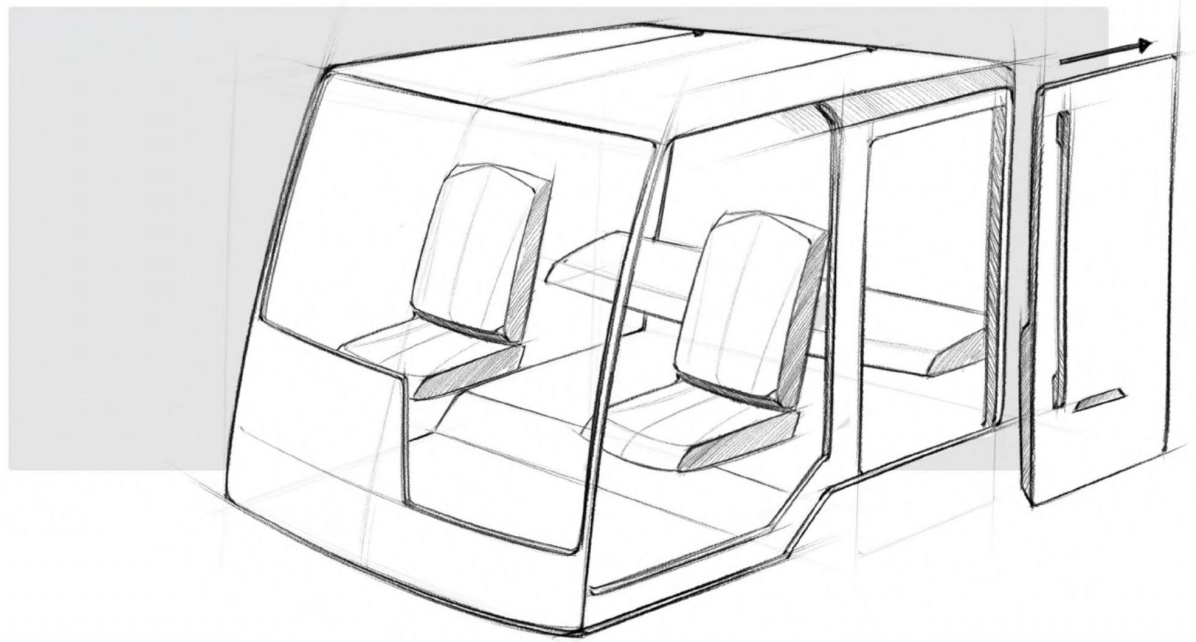
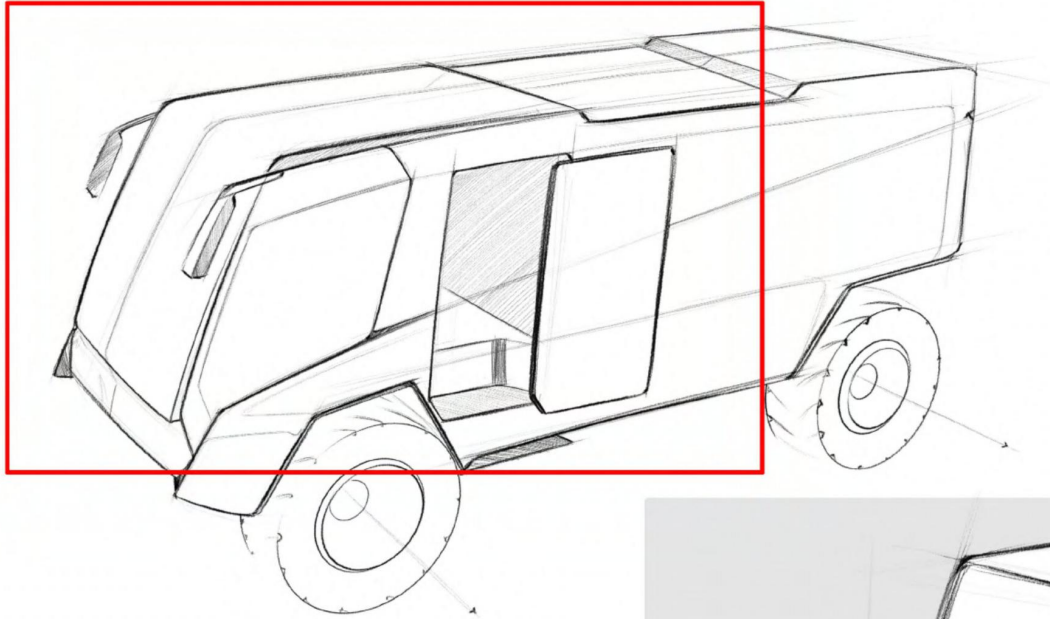
This package has a crew cab seating layout which gives more area for people that are in need during fire direct and indirect attack.



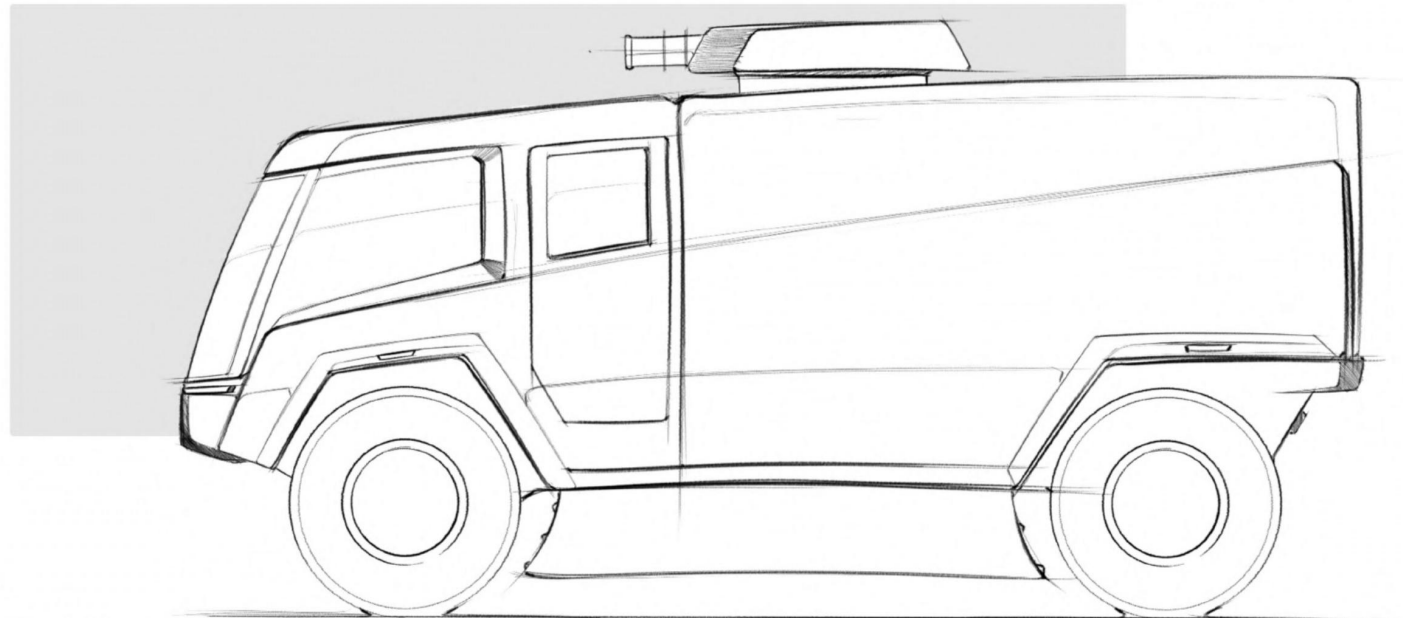
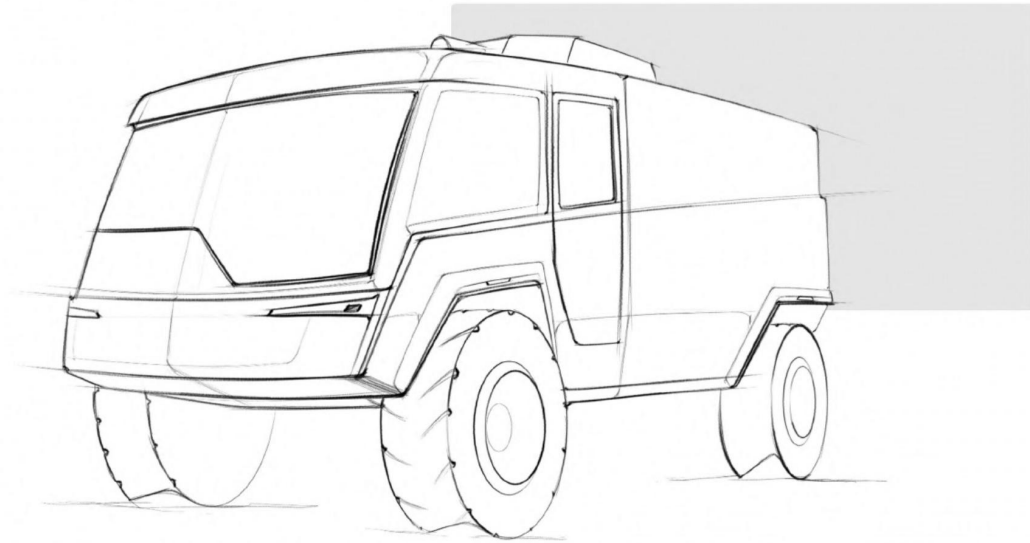
Ideations



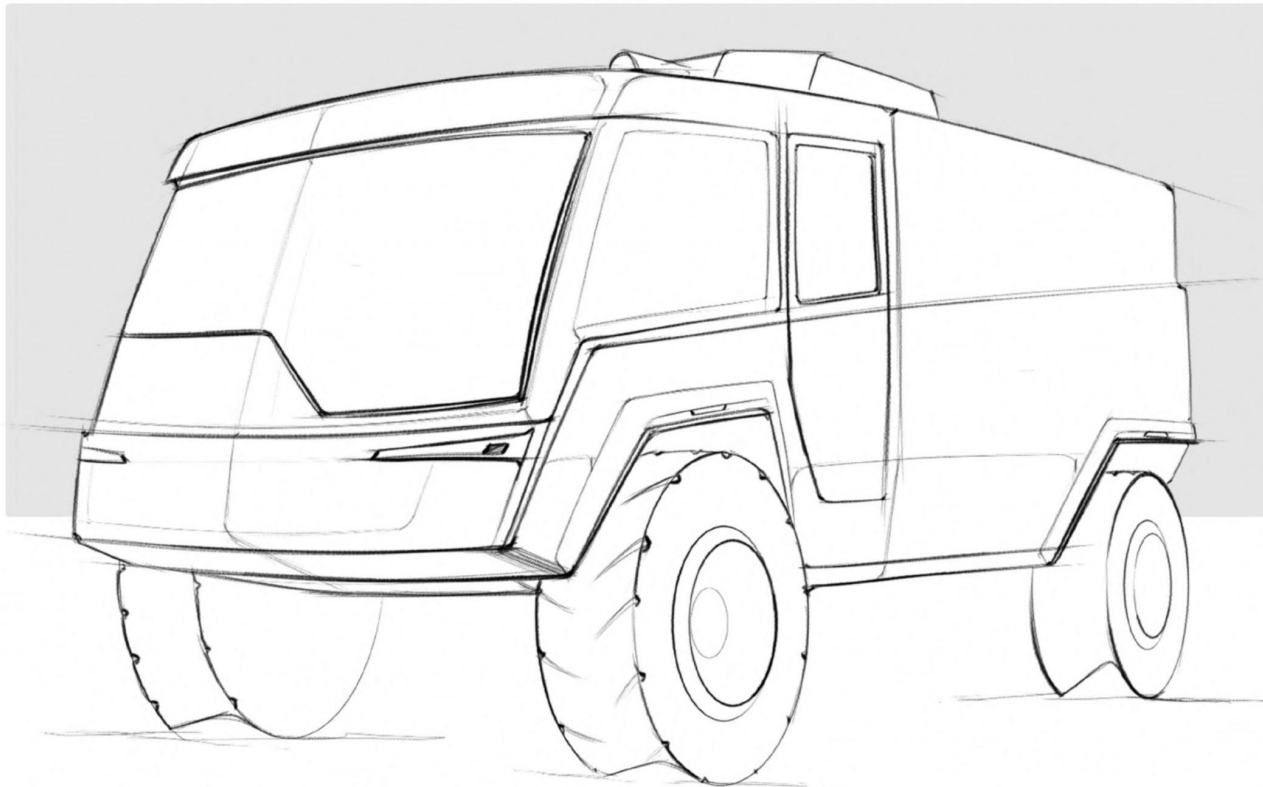
Ideations



Ideations

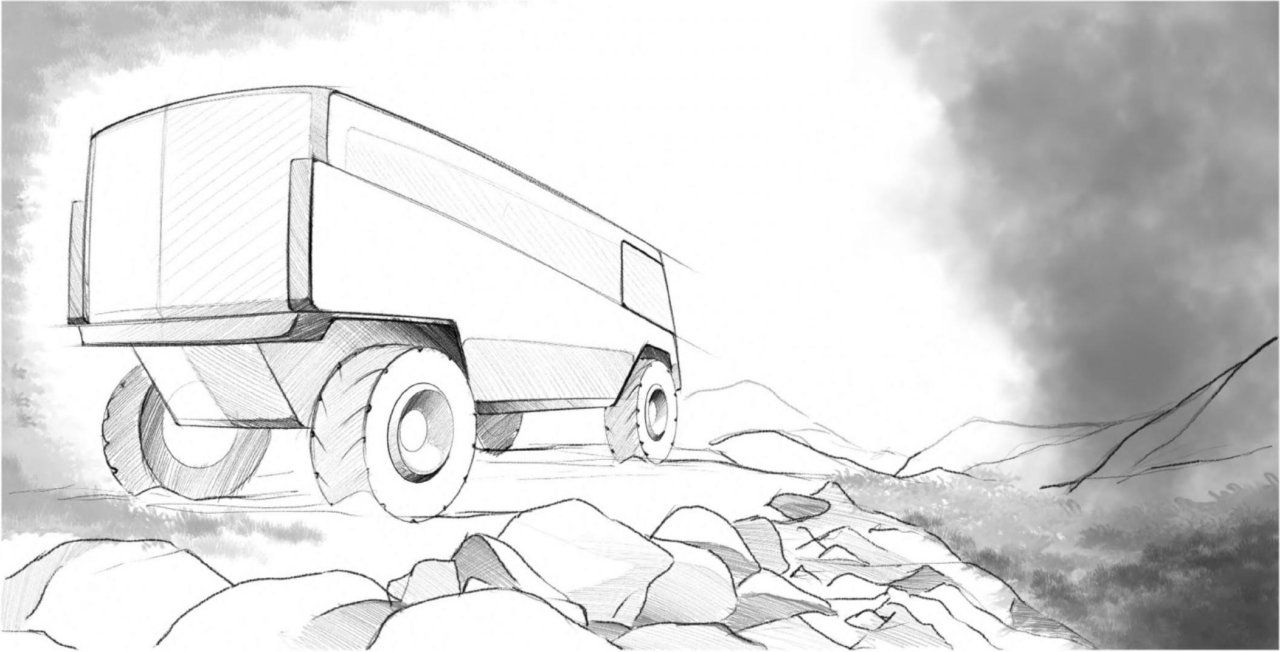


Final concept



Concept 3 has been selected as the final concept as it cover most of the key insights and it focuses more on higher supression capabilities as well as vehicle surviability in the intense conditions of forest fire.

Concept Visualization





Final concept 3d Model

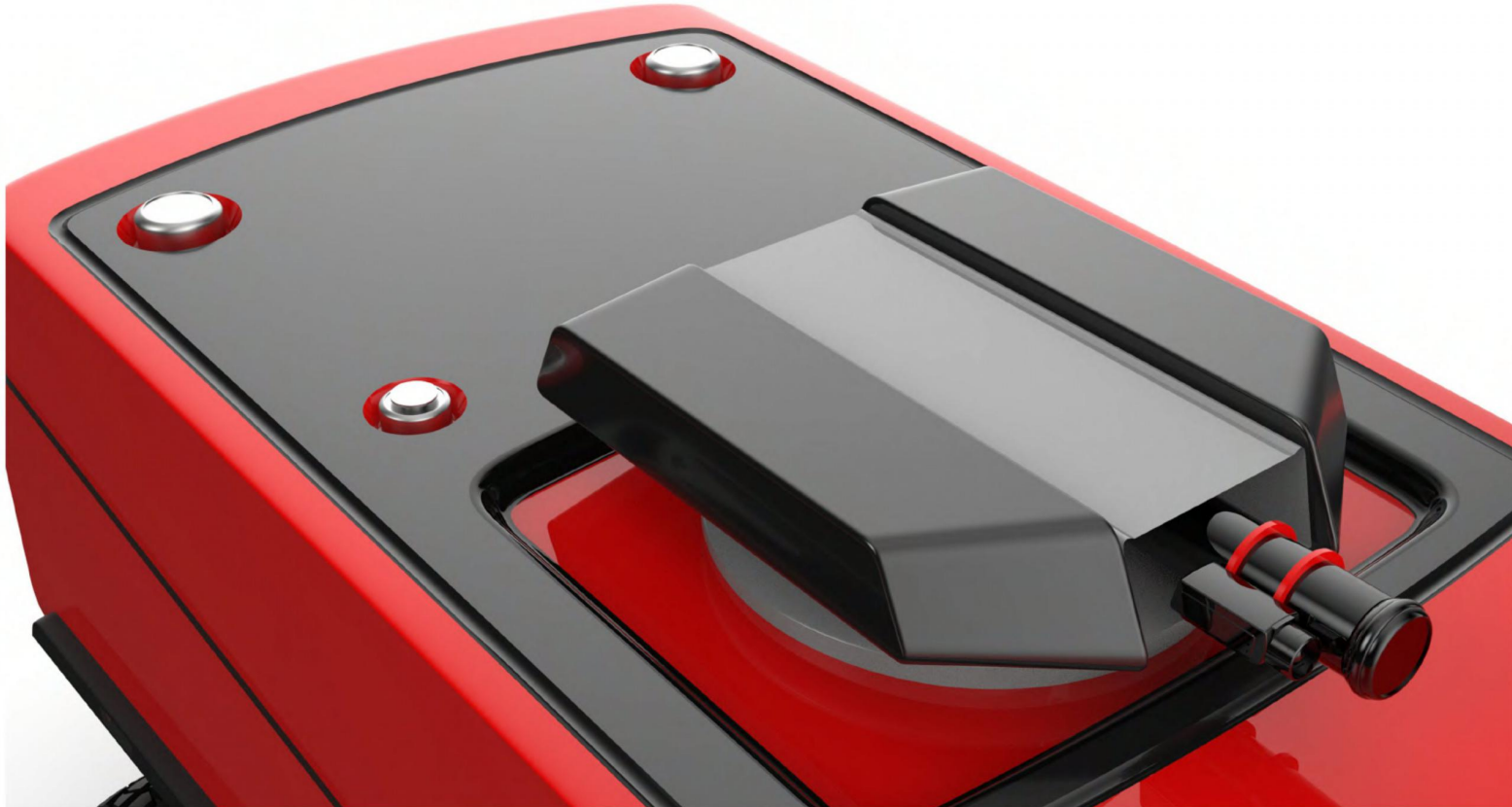








Main Turret



Rosenbauer RM 60 turret water cannon for suppression of fire without getting out of the vehicle. The turret is also equipped with thermal imaging camera. The turret is safe under a cover with an inside honeycomb structure to withstand any type of shock impact. The turret can be rotated at an angle of 270 degree and head has movement of around 90 degree.

Foldable front turret



Rosenbauer RM15 integrated turret in the front of the bumper act as a back up suppression system when the main turret is damaged badly. This turret is a foldable in the front bumper.





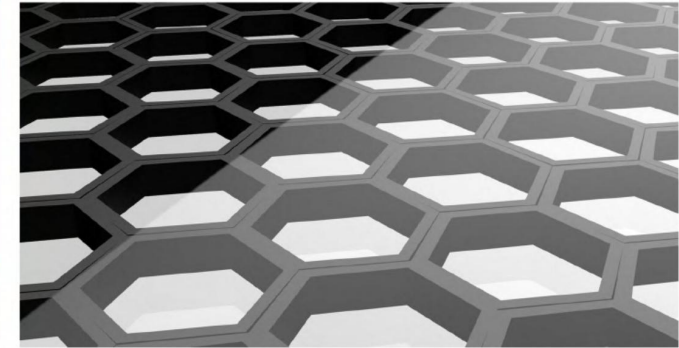
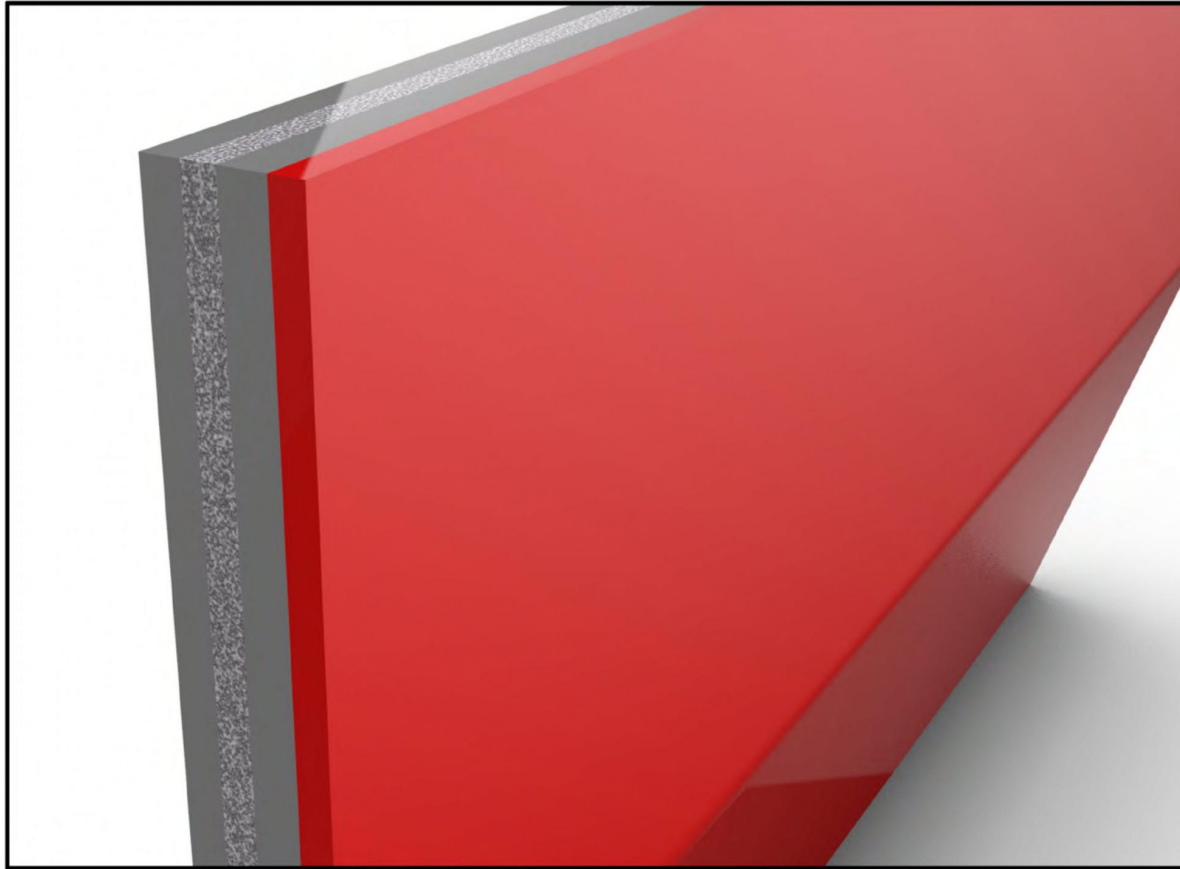
High pressure water spray down function for vehicle survivability when surrounded by fire and also an sand spray down function for tyre when it caught fire .



Emergency removable front windshield act as a exit gate when vehicle is stuck in the forest. Can be easily remove by pulling up an single handle.



Crew cab layout to accommodate a maximum of 4 people when in need and can be rescue. As the vehicle height is quite high so proper egress and ingress can be used because of the sliding door with grab rail on it .



The red outer most coating is the “Firo Sheild” coating .It is a coating that is done on metal surface that gives the same aesthetically function similar to normal paint. This coating can withstand constant fire for 2 hours at a temperature between 900 - 1400 c. It's 50% less expensive than the traditional fire resistant paint.

The gravel structure is the aerogel sheets that are being sandwiched between the the aluminum sheets.

The roof and turret casing or cover will have an honey-comb structure to withstand impact loads during direct and indirect attack.

Annexure

9/2/2020 NAFS Interview

NAFS Interview

Questionnaire
* Required

1. What are the activities that you do as part of your daily routine? *

2. How do the fire fighting teams get ready for forest fire season? *

3. What are the precautionary measures fire fighting teams do when they get information about forest fire incidents? *

4. How do you approach a forest fire ? *

5. And what are the critical things that you should keep in mind before reaching a site? *

6. What are the areas or terrain where forest fire is most difficult to suppress? *

7. At which state vehicles play an important role during forest fire? *

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9/2/2020 NAFS Interview

8. Are there any specific problems related to vehicles? *

9. What are the problems that are faced by firefighters during forest fire suppression? *

10. Does a firefighter work in a small shift during forest fire? *

11. Only fire fighters are being working or any other government authorities also involved in this kind of issue? *

12. Is there any different approach given to these people as these people are not trained for such types of issues? *

13. Are local people also involved in suppressing forest fires at small scale? *

14. If local village people are involved during fire suppression what equipment they have been provided and what method usually used by them? *

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15. How local villages are affected and what are the challenges faced during tackling those issues? *

16. At which state the fire cannot be further suppressed And what are the methods that are being used after that? *

17. Is there any story or incident that you want to share about forest fire? *

18. Are there any changes that you would like to do in current methods? *

19. What do you think about the technologies used in India for forest fire suppression and is there any suggestion that you would like to share? *

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