

Redesigning the Indian Military Jeep

Industrial Design Project II

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Guide

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The Industrial Design Project II titled

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Guide

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Chapter 1

Introduction

Introduction to the project

1.1 Abstract

The Mahindra Jeep has been used by the Indian Military for more than 30 years now. It has become the image of the Indian Military in civilian areas. This small vehicle is very versatile in its range of applications from front line reconnaissance to being a shuttle to transport soldiers from their army base camps to their homes in civilian areas.

Though the design has never seen a major change over the years, the Mahindra Jeep has found quite a following among soldiers and civilians alike. The Mahindra Jeep with requisite modifications has found a place among mud-terrain and off-road driving enthusiasts too. It is also used in rural areas for short distance transportation and doubles-up as a light-goods delivery van. But over the years there has been a certain decline in the ownership of this vehicle amongst the new generation.

The project was taken up as a sincere attempt to redesign the Mahindra Jeep, since it is a product which has outlived its design life but is still accepted by the Military as well as civilians alike, so that a certain affinity could be created with the younger and more ambitious generation and the niche market created over the years could be taken to the next level.

The Figs. 1.1 and 1.2 on the left show the first version of the Jeep which Mahindra built under license from Willys, USA. in India in 1949.

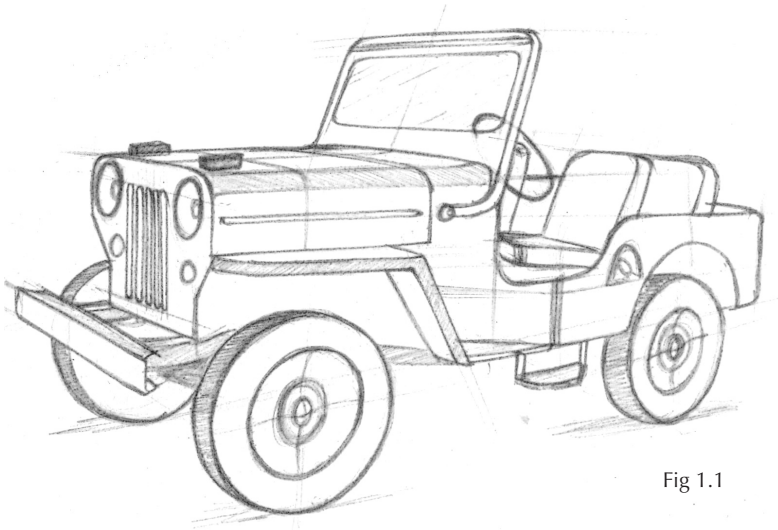


Fig 1.1

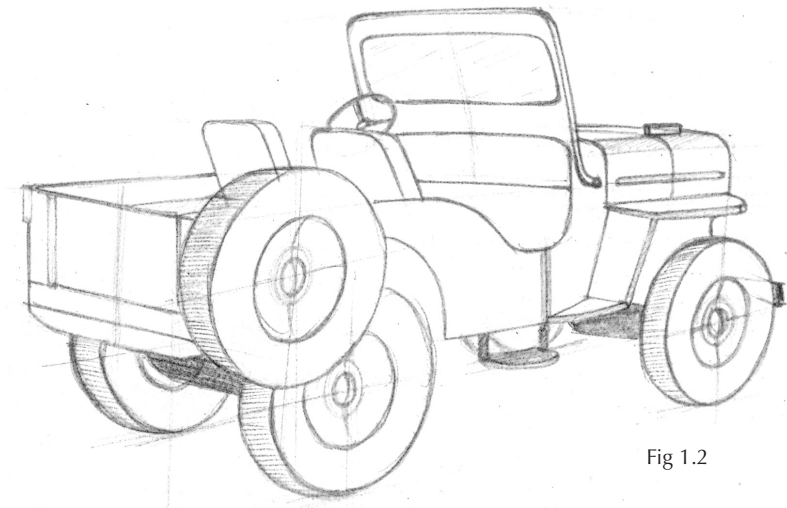


Fig 1.2

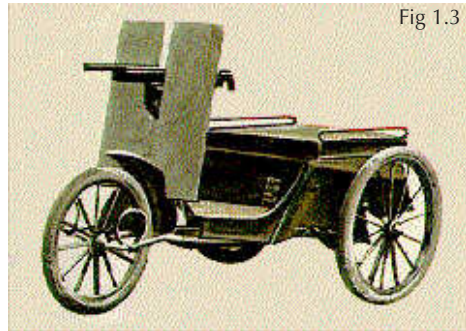


Fig 1.3

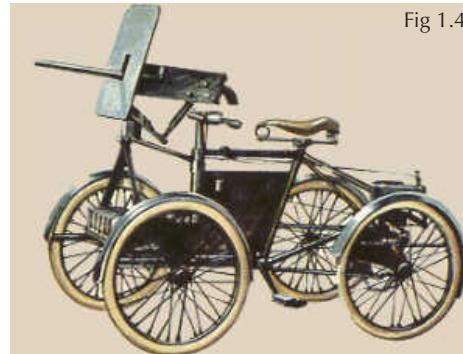


Fig 1.4

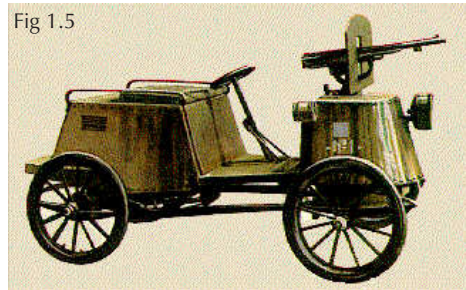


Fig 1.5

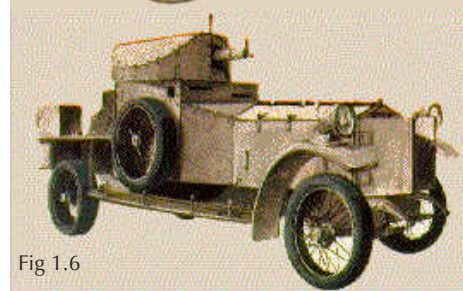


Fig 1.6

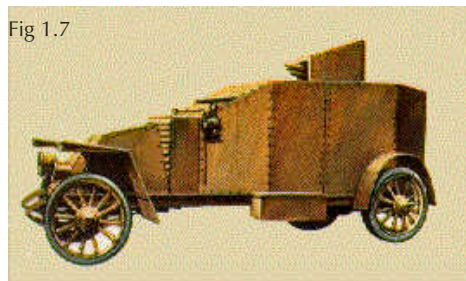


Fig 1.7



Fig 1.8

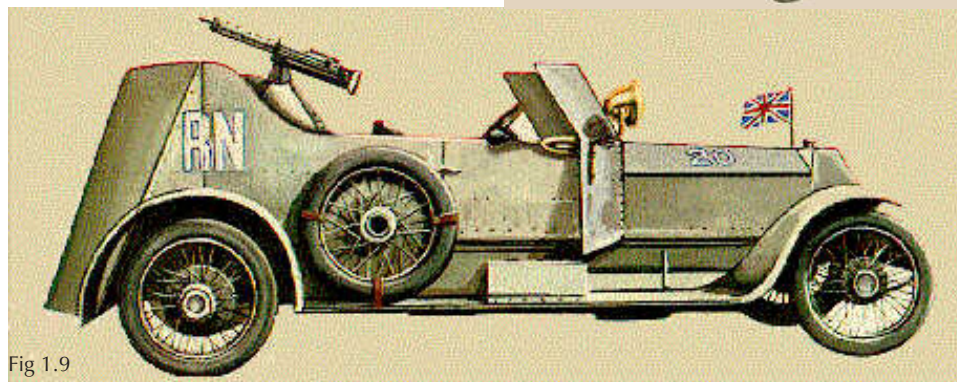


Fig 1.9

1.2 Introduction

The first Military vehicles date back to the year 1896, when regular production vehicles were simply fitted with a firearm and some makeshift shielding. These vehicles were commonly known as 'Automitrailleuse' or simply put 'military use'.

Till the year 1913, quality of vehicles improved and so did the shielding improve. Onwards from 1913, with coachbuilders coming of age, their proficiency was used for making armor protected military or police vehicles.

Very soon today's big names like Rolls-Royce, Peugeot, Renault and Lancia brought out vehicles, which could be used for police and riot control.

The Figs. 1.3 to 1.13 show all the military vehicles developed and used from the year 1896 till 1940



Fig 1.10

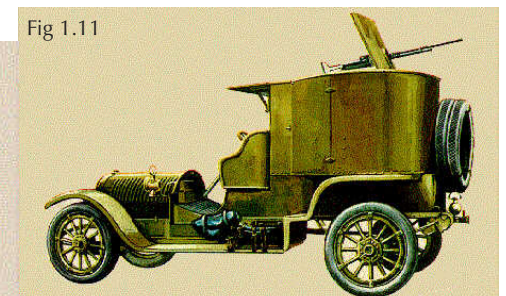


Fig 1.11

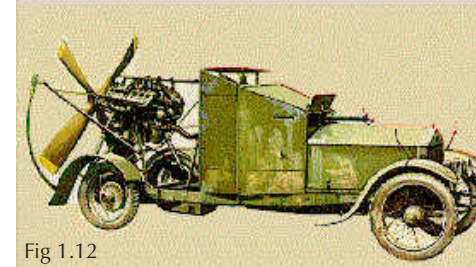


Fig 1.12

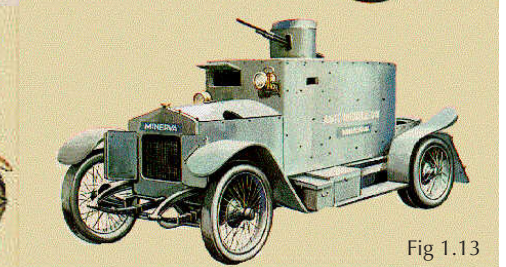


Fig 1.13

1.3 Introduction of the Jeep

In around early-1940 the Army identified a requirement for a Light Reconnaissance Vehicle, a small weapons carrier and personnel transport that would replace automobiles and motorcycles with sidecars.

Among the characteristics the new vehicles were to have:

- Weight not to exceed 1300 pounds
- Carry 600 pounds of payload in cross country operations
- Wheelbase not to exceed 75 to 80 inches
- Height not to exceed 40 inches
- Ground clearance of 6.25 inches at minimum
- Mount for a .30 cal. machine gun
- Approach angle 45° and departure angle 40°
- Rectangular body and folding windshield
- Seating for 3 soldiers
- 4x4 drive with two speed transfer case, geared for up to 50 mph on-road and down to 3 mph off-road.

Bantam Company was the first to respond with a Bantam Reconnaissance Car or the BRC-60 in Mid-1940. They also improved on their original design by finally giving the army the BRC-60 mark 2.



Fig 1.14



Fig 1.15

The Fig 1.14 on the left shows the Bantam Reconnaissance Car or the BRC-60.

The Fig 1.15 on the left shows the team that developed the second version or Mark2 vehicle.



Fig 1.16

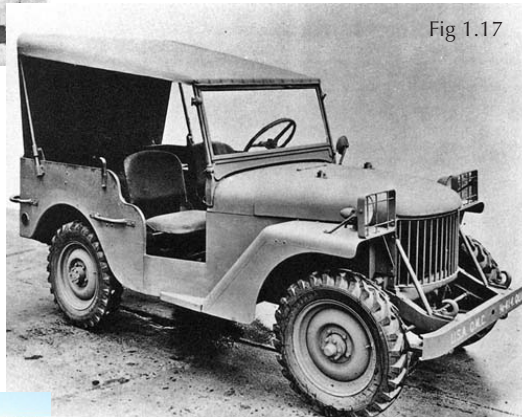


Fig 1.17



Fig 1.18



Fig 1.19

1.4 Development of the Jeep

Ford Motor Co. followed with their Pygmy introduced later in the same year, alongside the Willys Quad.

Ford came up with an improved version of its vehicle and called it the Ford GP. The army considered adopting the Ford GP with a few features of Willys Quad and so the new vehicle which came into the army was finally named as Ford GPW, where the 'W' stands for Willys.

The name 'Jeep' has its own derivations.

- Some say that this name came as a derivative of GP (or general purpose)
- Others say it got associated from 'Eugene the Jeep' a character from the comic strip Popeye famous in 1936. Eugene had this speciality wherein he could go anywhere without being noticed. This was a characteristic associated with the vehicle and so the name.
- People from the Military say that 'Jeep' is military slang for a new recruit.
- But the most noticeable are the publications of Red Hausmann who wrote a front page article with a photograph with a title 'Jeep Creeps Up Capitol Steps'. Most say that this was the main reason of the vehicle being named the Jeep.

The Fig.1.16 shows the Ford Pygmy during one of its tests

The Fig.1.17 shows the Willys Quad

The Fig.1.18 and Fig.1.19 show the Ford GPW.

1.5 Further versions of the Jeep

After a few years of supplying jeeps to the army, Ford and Willys brought out civilian versions of their Jeep, so as to fund their further military development.

The next version they came out with was called the M151-series. This successfully replaced the GPW version.

The major characteristic was moving the spare wheel from its side mounting position to the new mounting position behind the vehicle. The main reason for doing this was to reduce the width of the vehicle and prevent civilians being caught unawares by a side mounted protruding spare wheel. It also defined the width of the vehicle and no further driver-related precautions needed to be taken.

The new vehicle was also better looking and there were definite influences in the body design which prompted a more civilian outlook to the vehicle, more rounded fenders, better visibility and the new rear tail gate mounted spare-wheel.

The Fig.1.20 and 1.21 show the M151-series features, notice the rear mounted spare wheel.



Fig 1.20

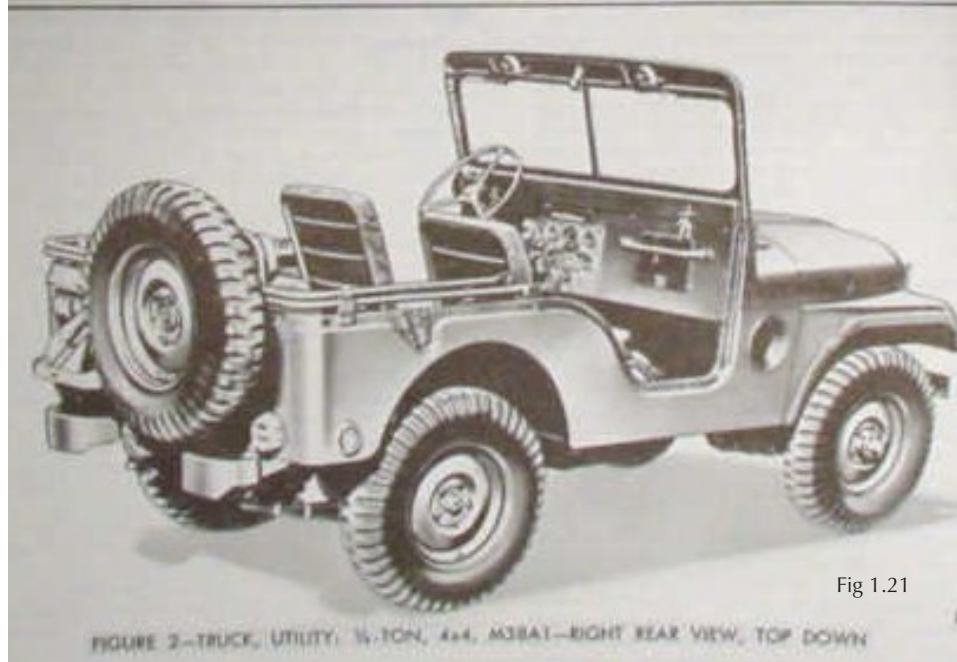


Fig 1.21

The Fig.1.22 shows the M151-series with modifications as available to the Military.



Fig 1.22



Fig 1.23



Fig 1.24



Fig 1.25

1.6 Last version of Military Jeep

The M-151. vehicle was later on replaced by the M-151 A2. This was a new vehicle, true to army regulations and was not designed with a civilian version in mind.

This vehicle was designed as per the 1940 regulations adapting them to the scenario existing in very late 1980s. The vehicle was very low-slung and was built in such a way that it could adapt to be used to deploy light and medium artillery on the frontline, during any critical situation.

Well this version did not stay for long in the army and was soon replaced by the HMMWV (High Mobility Motorized Wheeled Vehicle).

The HMMWV, or the 'humvee' as it soon began to be known as, became very popular due to its versatility and the number of modifications that it could support.

The Fig. 1.23 to 1.25 show the M-151 A2 in a live warfare situation.



Fig 1.26



Fig 1.27

The Fig.1.26 and 1.27 show the HMMWV in un-armored and the armored condition.

Chapter 2

What happened in India?



The Fig.2.1 shows the Land Rover Series One



The Fig.2.2 shows the Jona or the Nissan Patrol60

2.1 Indian scenario

The Indian army was using the Land Rover Series One; these were brought in by the British when they invaded India. The other vehicle being used by the Indian Army was the Jona.

The Jona was built in India under license from Nissan in 1960, it was a 4x4 configuration and the model introduced was the Patrol60. The vehicle was used by the Indian Army till 1990 until it was scrapped and the transition was made to the Mahindra Jeeps.

The Mahindra Jeeps were introduced in the year 1949. These were the vehicles which came as CKD (completely knocked down) kits and were assembled in Mahindra's manufacturing facility.

Slowly Mahindra started making the frame structure and the other parts started being indigenously manufactured. There were also civilian versions of these Jeeps known as the CJ (civilian jeep) which were sold so as to help fund their Army program.

Finally Mahindra brought out its first vehicle based on the Willys Jeep M151 in the year 1985, known as the MM-400DP. This further evolved to the MM-540DI which is still made for the Army.



Fig 2.3



Fig 2.4

The Fig.2.3 and 2.4 shows the Mahindra jeeps used in the Indian Air Force for transportation from the Air Terminal to the Pilots quarters.



Fig 2.5



Fig 2.6

The Fig 2.5 and 2.6 shows the Mahindra jeep used by the high-rank officials as their personal means of transport.



The Fig.2.7 shows the MM-540 soft top version

The Fig.2.8 shows the CJ500 soft top version



The Fig.2.9 shows the MM540XDP Legend.

2.2 Current Indian Scenario

Since 1985 the MM-400DP has been undergoing a lot of changes. The civilian version was later developed with a fibreglass hardtop. Subtle changes to the bodywork and they have managed to keep the product in the market.

Its been around 20 years since and there has not been any new component added to the exterior body styling. An introduction of new materials and a betterment of manufacturing processes has given the vehicle a better touch and feel factor but in essence the design has not progressed. Problems like pre-mature rusting and excessive body rattling has also been reduced.

The CJ series has progressed to being called the 'Major' with a few plastic parts added and certainly better fit and finish. Not much otherwise has changed over the years.

The MM series progressed from the MM400DP to the MM540DP and the MM540XDP for the army. The XDP version had a lot of mechanical upgrades and the company soon launched a civilian version of the XDP.

Very recently the company has launched yet another version of the MM-540XDP series calling it the 'Legend'. This comes with a lot of add-ons, fender extensions and lots of chrome inserts. The delving into the parts bin of other vehicles made by the same company is quite evident to cut costs.



The Fig. 2.10 shows the Mahindra Axe.



The Fig. 2.11 shows the Tata LSV

2.3 Army replacements planned

The army is also aware that a change in its image is required and so has started looking for options to replace the existing Mahindra Jeep. Mahindra is readying a new vehicle called the Axe as an FAV (Fast Attack Vehicle). It is primarily a six-seater vehicle with payload space too.

The other vehicle being made is by Tata Motors and is known as the Tata LSV (Light Specialist Vehicle). This is the replacement Tata plans to develop to get the Army contract. Other vehicles are also being prepared by the Ordnance Factory.

With Tata Motors now owning Land Rover, the Indian Army might also stand a chance to be benefitted by the hugely successful Land Rover Defender. But then looking closely, these vehicles are much longer, wider and heavier than the small and agile jeep.



The Fig. 2.12 shows the Land Rover Defender.

Chapter 3

Understanding Requirements

3.1 Design brief

Objective:

To redesign the identity of the Indian Military Jeep.

Unique Selling Proposition:

The Indian Military in each of its sub-disciplines the Army, the Navy and the Air Force is getting better and better everyday acquiring the latest technology. The last few years have seen betterment in equipment and gear carried by the soldiers too. The specialist vehicles have also been re-looked at and more powerful and better designed vehicles have made their way into the Indian Military.

The jeep has always been associated with the Indian Military and a new and fresh vehicle is required, with better aesthetics and design features, as per current trends, so as to make it desirable to the new generation of soldiers.

Core benefits:

The new vehicle will be an evolution of the existing vehicle, evolving on all of the design features found in the previous vehicle. The vehicle will grow on the design positives of the old vehicle as well as introduce newer safety features as required by the current road-safety scenario.

The styling will also look at making the vehicle portray itself as being able to bear all the physical abuse the user would like to impose upon the vehicle.

Broad specifications:

- Wheel base/track: 2275 mm/1400 mm
- Tyre: P240/70 R16 Radial Tubeless
- Ground clearance: 230 mm
- Transmission: 6-speed Dual clutch, fully Automatic Direct Shift Gearbox.
- Engine: 2.2L CRDe, all Aluminum block, 4-cylinder inline, Diesel.
- Turbo: Single Variable Turbine Geometry Garret Turbocharger, 2.4psi.
- Power: 120Bhp@4000rpm
- Torque: 285Nm@1800rpm
- Seating Capacity: 4 adults
- Drive: All wheel drive, 60/40 split to Rear, Low-range shift-on-the-fly.
- Suspension: All wheel Independent Suspension.
- Artillery: Light Artillery Mounting provision.

User profile:**Primary user:**

The primary user would be the army soldier or the off-road enthusiast.

Secondary user:

The secondary user is the maintenance crew, the passengers.

Product environment:

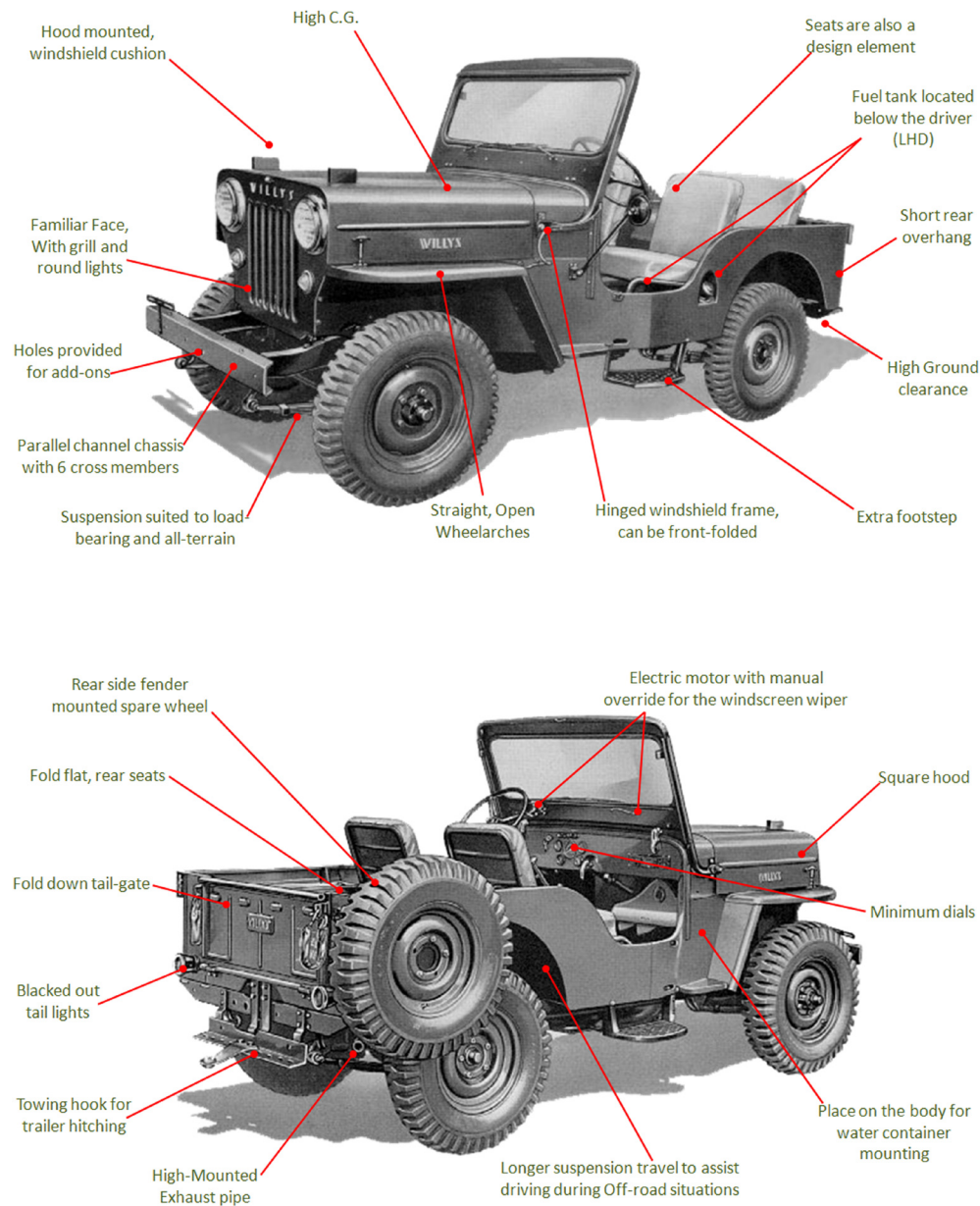
The Military Jeep in India is used for the following:

- Primary Reconnaissance – patrolling the Line of Control or areas around military base camps, mainly during night.
- Tank-Hunting – spotting enemy battle-tanks camouflaged and hidden in the battlefield.
- Support Vehicle for another Heavier Specialist Vehicle - carrying Live Shells for the weapon.
- Mobile Communication Centre for a Heavier/Fixed Installation and ground troops.
- To aid any kind of Material Handling inside or outside the Military Base.
- As a runabout for the Military Officials.
- Transport soldiers from their homes in civilian areas to their Military Base Camps and vice-versa.

Project limitations:

The project does not deal with the design process for the interiors of the vehicle. A few details of the interiors which would affect exterior styling are mentioned. Basic seating idea, which directly affects ingress and egress of rear seat passengers will be proposed.

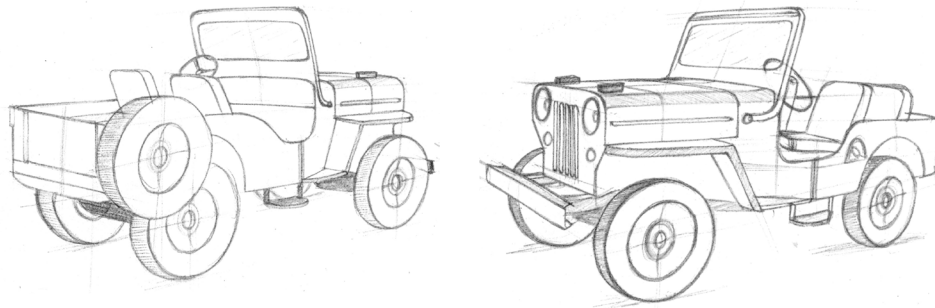
The Fig.3.1 shows the features of the WWII Jeep



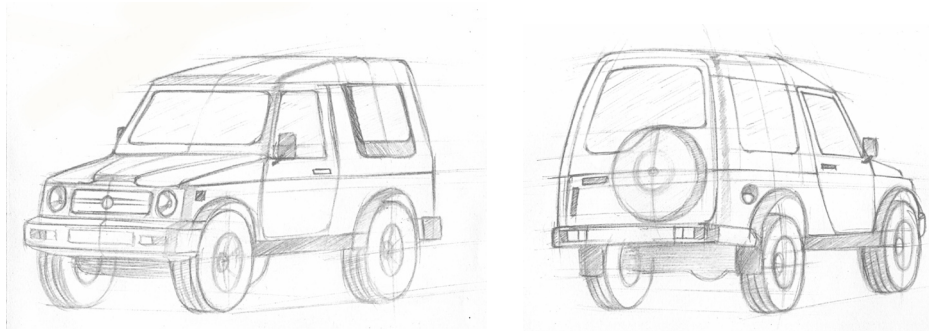
3.2 Features that define the jeep

Looking into the design of the jeep a list of characteristic features were observed which defined a jeep. These features distinguished the jeep from other vehicles which were substitutes made by other manufacturers.

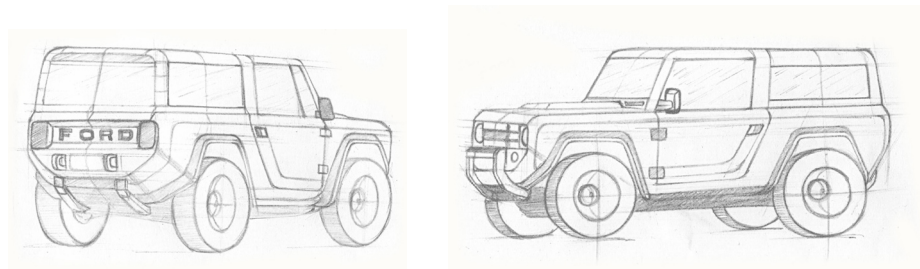
- The front grill with vertical slats is one of the features, though the original jeep has seven, changing the number really doesn't dissolve the identity of the vehicle.
- The round headlamps alongwith the grill define the face of the vehicle and thus the identity of the vehicle.
- The squared front fenders give a very strong look to the vehicle.
- The typical profile which defines the ingress/egress opening for the vehicle or the driver passenger door opening when seen from the side profile.
- The drop down windscreen design.
- The spare wheel mounting on the rear door.
- The soft fabric roof.
- The short wheel base.
- The go-anywhere and do-anything looks.
- Place on the body for mounting of water cans, and fuel tanks.
- The new regulations require a roll-over bar as compulsory equipment.
- The hydraulically assisted power-steering allows for a smaller steering wheel diameter.
- The jeep is also characterized by raw bumpers and a high ground clearance as compared to other vehicles.



The Fig.3.2 shows the original Willys Jeeps built under license by Mahindra.



The Fig.3.3 shows the Maruti Suzuki Gypsy King.



The Fig.3.4 shows the Ford Bronco Concept

3.3 Learning from the existing

To begin the process, a few vehicles which define the jeep over the years or have been built by manufacturers as a substitute were looked at. These were studied to understand the approach taken by the design.

Later on these vehicles were traced and sketched out to study their lines and the proportions which defined them to be 'jeep alternatives' by other manufacturers. The vehicles studied under this category were the original Willys Jeep made by Mahindra, the Maruti Gypsy which has now been replaced by the Gypsy King and the concept vehicle by Ford, the Bronco. The revised lines found in the new Ford Bronco Concept launched in the year 2000 were studied.

The Willys Jeep was a vehicle which displayed a lot of sharp corners and also a very typical of its time, ruler-straight design. The technology existent at that time, combined along with the manufacturing simplicity, was responsible for the derivation of the shape. Ever since then, with a substantial improvement in the manufacturing processes, materials, engineering and suspension technology, the design elements of the jeep have been constantly changing.

The latest Maruti Gypsy King and the Ford Bronco Concept are examples cited here. The squared out fenders are now replaced by proper wraparound wheel-arches and sufficient wheel wells. More rounded contours and soft-looking forms have crept into the exterior body language of the vehicle.

The three figures on the left of the page explain the design evolution process from the WWII Jeep to the redesigned Ford Bronco Concept.



The Fig.3.5 shows the Rolls Royce Silver Ghost Boat Tail



The Fig.3.6 shows the Ford Model T.

The first Jeep designed was purely a reflection of the styling language followed in 1940. The passenger cabin was perfectly rectangular. The engine hood was squared and featured two protruding fenders. This style was very similar to the style trends found in cars back then. Studying the design of the jeep further, the engine hood was then 'joined' to the passenger cabin via tapering side fenders. This was exactly the styling prevalent in those years.

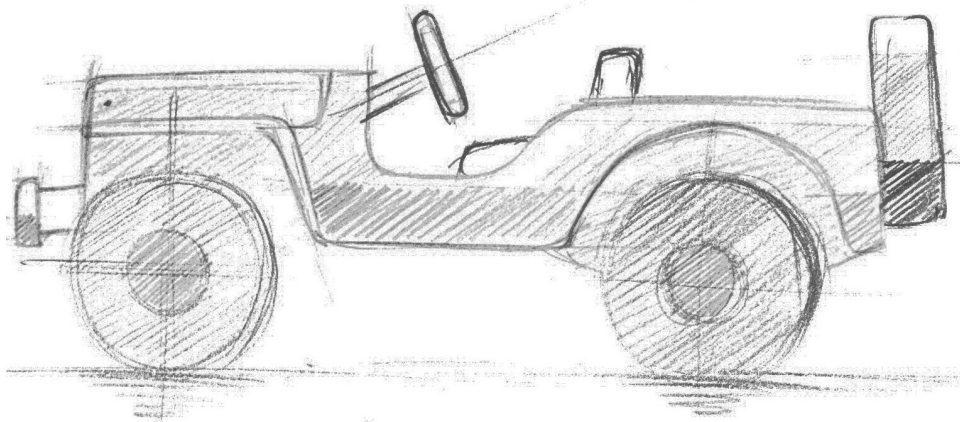
The similar kind of styling clues can be also found on the Rolls Royce Silver Ghost as well as the Rolls Royce Silver Ghost Boat Tail and right from the Ford Model T, this styling was very prevalent. With the advent of better technology and independent suspension, the mounting requirements needed a newer more wider engine bay. The fenders started being minimized and finally got incorporated into the engine-hood.

This sort of design further evolved into the segment more popularly known as the small SUV.

The design elements of the jeep distinguish it from other vehicles. But a lot can be incorporated in the new design from the new vehicles and also cars. The gradual fusion of the passenger cabin with the front engine hood and the rear boot is a feature to be studied in cars.

Moreover, continuity of lines is the style which defines every vehicle today. The introduction of this style in the jeep will not only make it look modern but also keep the design simplistic, which the jeep design is recognized for.

Understanding requirements - Frontline jeep



The Fig.3.7 shows the Frontline jeep



The Fig.3.8 shows the Frontline jeeps returning from a tank-hunting operation.

The Army requires jeeps in two body configurations, the Frontline jeeps and the Passenger jeeps.

The Frontline jeeps are required by the Army for Frontline activities and therefore include minimum bodywork and are preferred to be as low-slung as possible.

So these vehicles are devoid of the fabric roof, the front windshield, the roll-over bar, doors, and in some cases even rear seats, front seat cushioning is also kept to a bare minimum.

Their headlights and tail-lights are blacked out and there are no footsteps for boarding or alighting. The vehicle may have a front bumper mounted winch and/or a rear mounted tow hook too.

The seating configuration is generally a four seater and the two passengers sitting in the rear section, behind the driver and co-driver, sit facing each other. This is important so that all four directions can be scanned easily.

Due to the absence of the rear seats the Frontline Jeeps are also used for transporting goods inside base camps.

Passenger jeep

The Passenger Jeeps are required by the Military for peacetime operations or for civilian area visits.

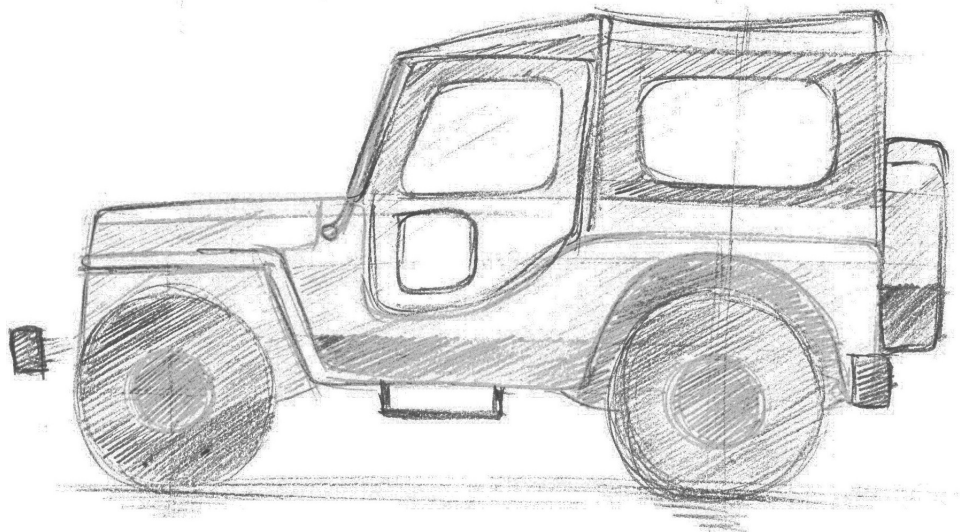
These vehicles are used with or without the fabric roof depending on the kind of activity involved.

These Jeeps are generally used as a transport shuttle for Military Officers and soldiers alike. When meant for Military Officials the fabric roof is attached, but, when meant for off duty soldiers, the roof may or may not be attached.

These vehicles have a single-rear bench seat facing forwards. This seat is adequate for two medium sized adults to sit comfortably.

Additional footsteps for boarding or alighting from the vehicle are provided. The front winch and the rear tow hook might or might not be present.

The vehicle might have soft fabric doors or might be found with sheet metal doors or might not have any doors at all.



The Fig.3.9 shows the Passenger jeep

Chapter 4

Design Process

4.1 Image board



fig. 4.1 Land Rover Defender



fig. 4.2 Land Rover Defender Army version



fig. 4.3 Ford GPW



fig. 4.4 Jeep Rubicon and Jeep Wrangler



fig. 4.5 Hummer H3 Alpha SUT



fig. 4.6 Jeep Rubicon



fig. 4.7 Ford Bronco Concept



fig. 4.8 Mercedes Benz G-wagon



fig. 4.9 Hummer H3 Alpha SUT



fig. 4.10 Jeep Rubicon off-road version



fig. 4.11 Jeepster Concept



fig. 4.12 Jeep JT



fig. 4.13 Maruti Gypsy King



fig. 4.14 Mahindra Major



fig. 4.15 Jeep Rubicon



fig. 4.16 Mercedes Benz G55 AMG



fig. 4.17 Ford GPW



fig. 4.18 Mercedes Benz G-wagon



fig. 4.19 Hummer H4



fig. 4.20 Ford Expedition 2010



fig. 4.21 Local Motors PanTerra Concept



fig. 4.22 Jeep Hurricane



fig. 4.23 Mercedes G-sport



fig. 4.24 Ford Bronco Concept

The Image Board mainly consists of the SUV and Jeep like vehicles. These were ideally collected with a view of seeing the evolution of the vehicle since it was first launched as in Fig. 4.3 to what it has come to be in the present.

The images also contain a few of the shapes that the jeep might take in the future, like the ones shown in Fig. 4.11 or the 4.21.

A few modern day SUVs also feature in this as Fig. 4.16 and 4.20

fig. 4.25

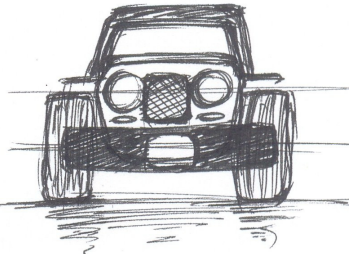


fig. 4.26

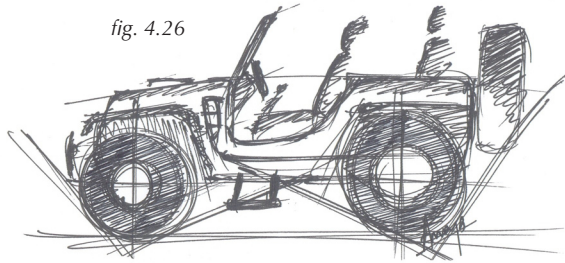


fig. 4.27

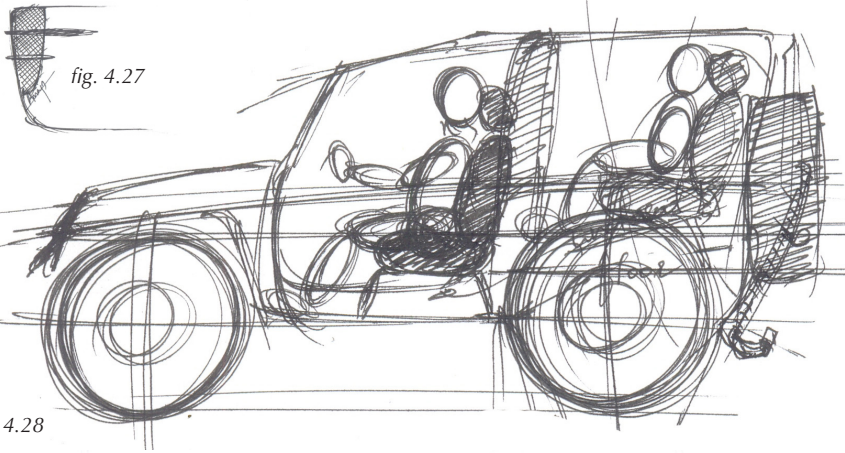


fig. 4.28

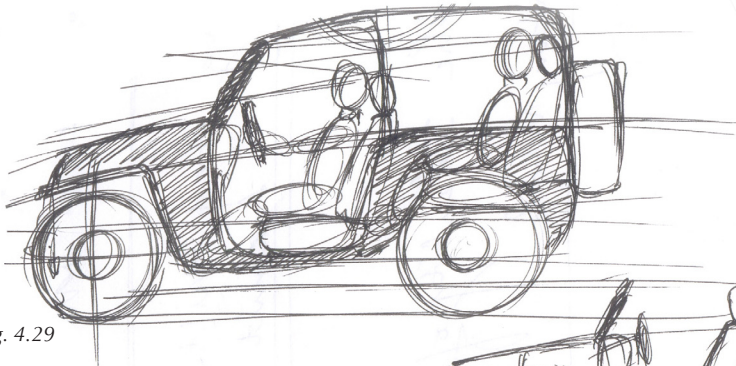


fig. 4.29

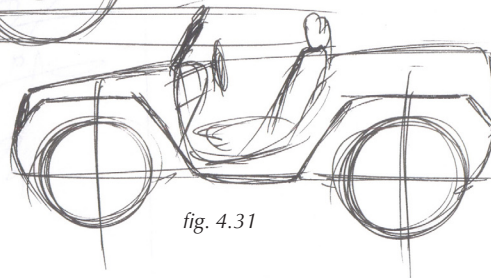


fig. 4.31

fig. 4.30

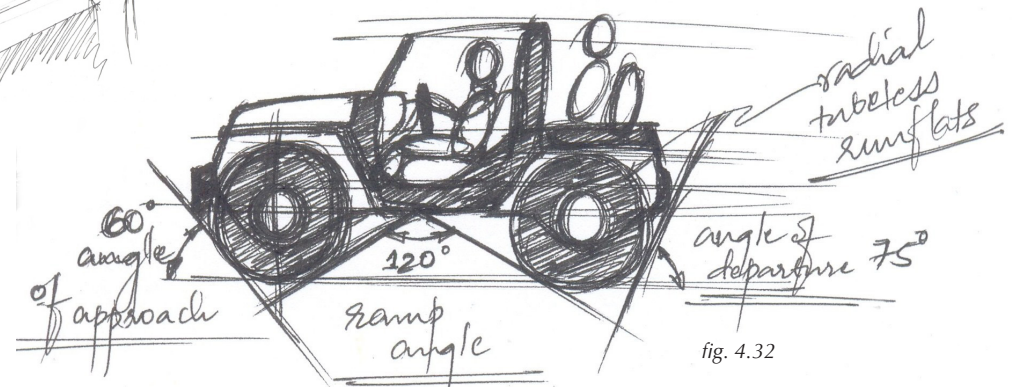
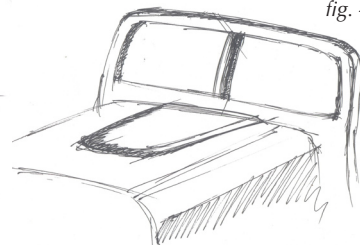


fig. 4.32

4.2 Initial sketching

Initial doodling was done to see how the styling could be evolved. A mention was given to see which elements were to be changed and which elements needed to be added according to the new road-safety regulations.

The seating layout was also to be looked at and how passenger occupancy requirements would affect the exterior design elements was to be worked upon. The first sketches were to look at a few features of the vehicle which would affect the exterior styling of the vehicle.

Especially the idea of having a protruding moulded instrument panel meant pushing the heat shield further back. This decision decreased the length of the bonnet increased the door width, so more ingress/egress area was available.

The advent of power-assisted steering decreased the steering wheel diameter further allowing the steering wheel to be much lower.

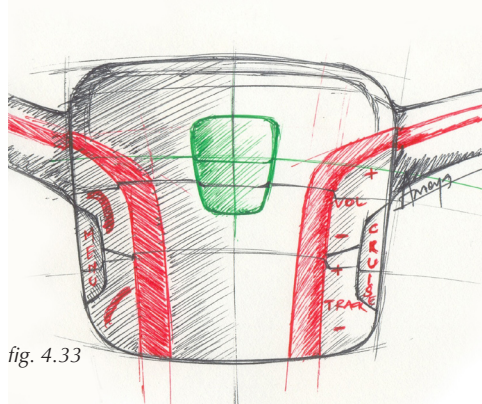


fig. 4.33

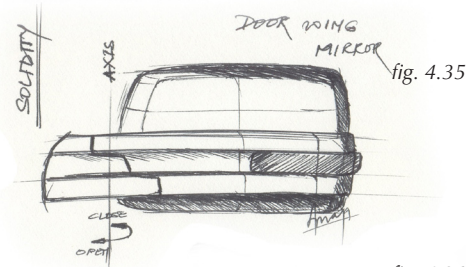


fig. 4.35

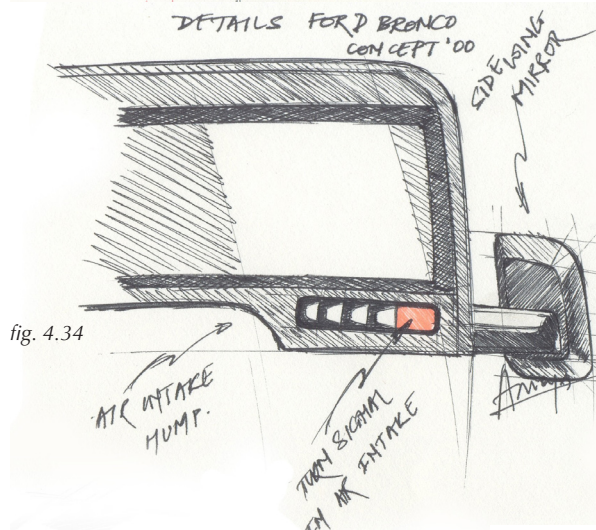


fig. 4.34

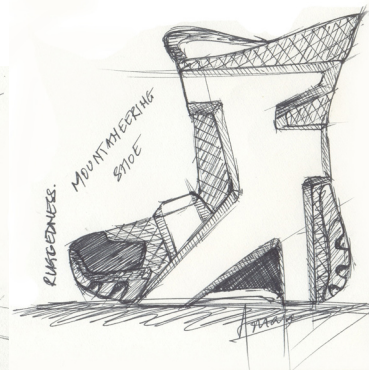


fig. 4.37

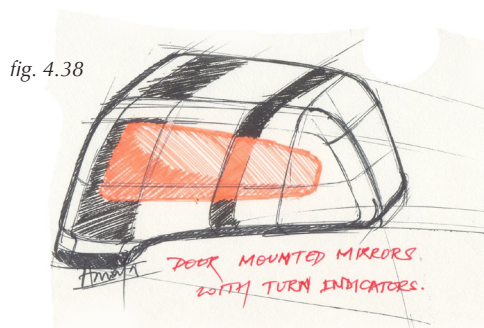
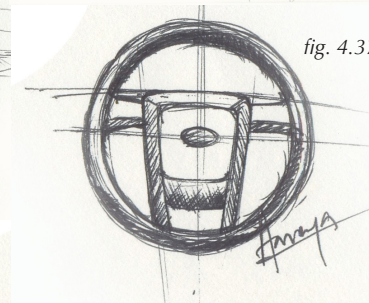


fig. 4.38

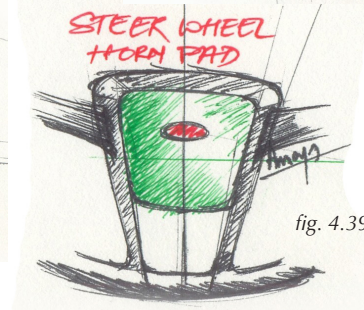


fig. 4.39

4.3 Understanding Attributes

From the image board a set of attributes were conceived. These attributes were to capture the essence of the military jeep. Agility, alertness, camouflage, solidity, robustness, ruggedness and toughness were derived. With these in mind, a few other vehicles were studied and their styling features were looked into. Their elements were studied and looked into to see how their design approached these attributes.

Elements like the rear view mirror, its mounting, the front nose grill, the door handles, tail cluster were a few of the elements whose lines were scrutinized. Some products of a non-automobile origin were also observed to see how they had approached the design.

The solidity in the door wing mirror was due to the proportions of the mounting element and the depression running through the body towards the turn signal. The ruggedness in the mountaineering shoe was seen due to the rounded linear engravings found at the front as well as the rear of the shoe. Moreover the strengthening element of the shoe which was embossed had a chamfer running on all edges. This gave it a more muscular and strong look.

The features like the steering wheel were studied and a few of those were looked at as inspirations for strong and rugged features along with a certain simplicity that was also observed in the design. The door wing mirror of a Mercedes C-class was also looked at to study a simple rugged design along with the elegance of continuity of lines and surfaces.

Concepts were once sketched over so as to follow the lines and to separate the defining form lines. The defining form lines helped in identifying the major edges which give the required character to the design.

fig. 4.40

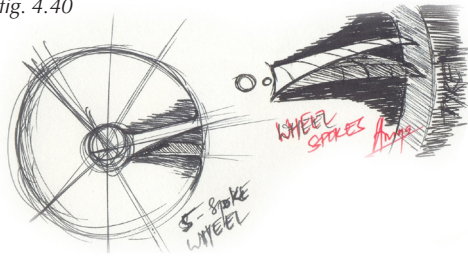


fig. 4.41

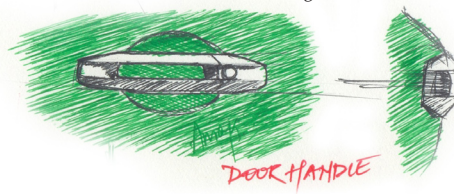


fig. 4.42

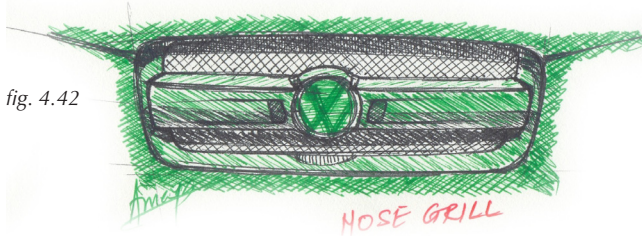


fig. 4.43

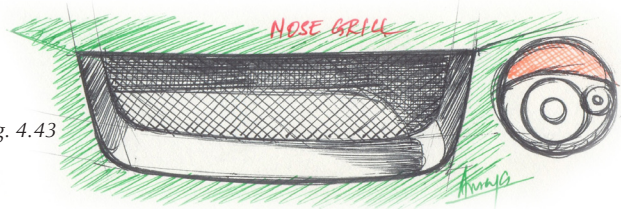
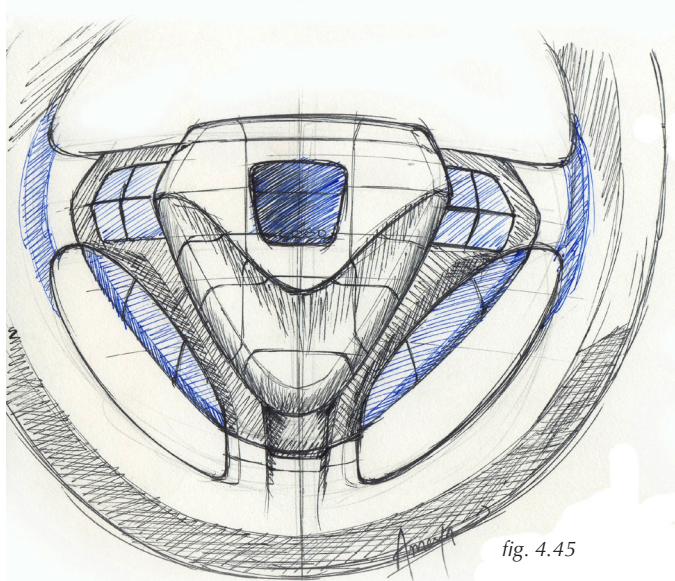
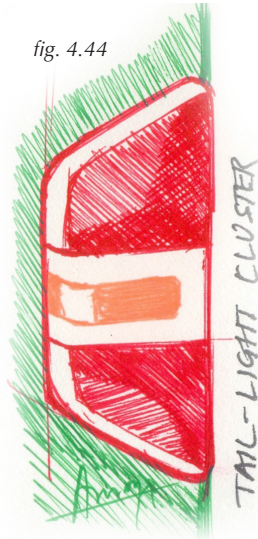


fig. 4.44



Further, many more elements were looked at to understand the finer aspects of the design language followed in the modern cars. The elements like door handles, nose grill and even tail light clusters helped in understanding the directions taken by modern car design.

The five-pair spoke alloy wheel of the Audi A4, as seen in Fig. 4.40, gives us an idea of how camouflaging is used. The inner spoke of the twin spoke, is not visible directly, and so it gives the vehicle a precise and bespoke look, even though it is internally tough to resist loading.

The door handle, shown in Fig. 4.41 depicts how a very solid looking handle can be designed with ample recesses and proportions to suit the vehicle. Similarly the Fig. 4.42 and Fig 4.43 depict the nose grill in two typical shapes. The rounded grill with a central cross-member, typical of a Volkswagen (Fig. 4.42) and the smiling grill typical of a Cadillac (Fig.4.43). These address the same element in different ways, while the Volkswagen keeps it subtle and stately, the Cadillac takes it into being sporty and more in-your-face type looks.

The rear light cluster, as depicted in Fig. 4.44, helps explore the various combinations and patterns found in tail-light clusters, though this is not a desirable feature in a Military Jeep. The steering wheel of Honda cars as shown in Fig. 4.45, depicts a certain allure along with all its surfaces and contours. The steering is not only strong and sturdy looking but also multi-functional and very technically advanced.

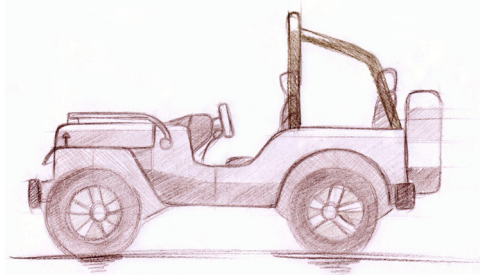


fig. 4.46

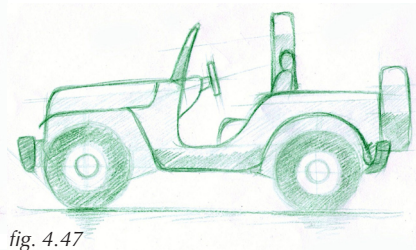


fig. 4.47

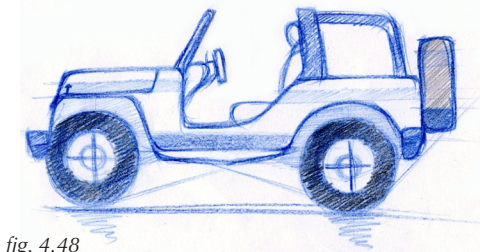


fig. 4.48

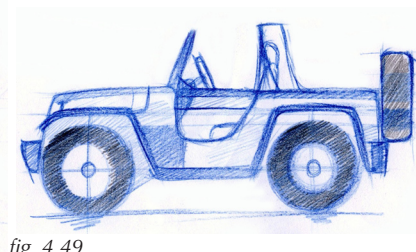


fig. 4.49

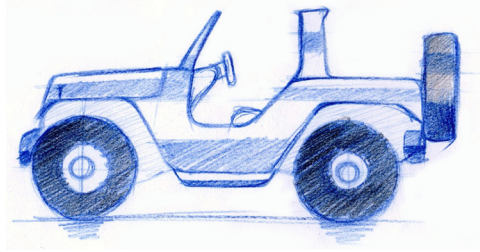


fig. 4.50

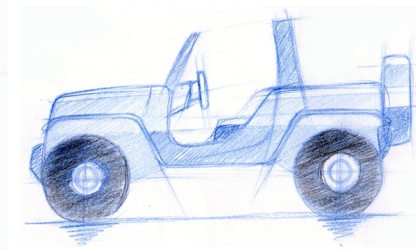


fig. 4.51

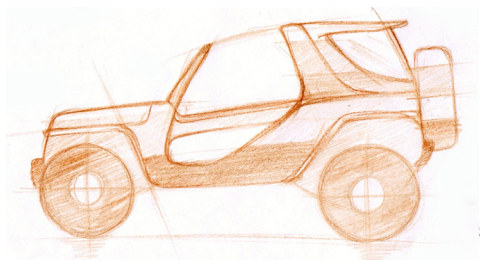


fig. 4.52

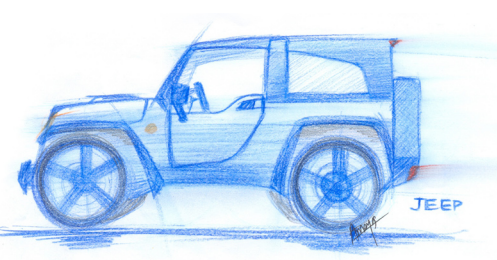


fig. 4.53

4.4 Exploring the shape evolution

The shape of the original jeep has hardly changed for more than 30 years. But these years have seen a large evolution in the shapes and forms as far as cars and other vehicles have been concerned. Car styling has transitioned from being sharp and boxy to smooth curves with flowing lines and soft edges. The same approach was taken with the jeep, though it was more gradual.

Firstly the technology derived changes were introduced and later on purely formal evolution was undertaken. The most noticeable of the formal changes introduced were the rearward-inclined front grill of the vehicle and the forward-tapered engine hood. This gave the vehicle a dynamic and ready-to-go stance alongwith enhanced front visibility.

Due to the introduction of the steering-shaft mounted instrument panel the heat shield could be moved further back and this liberated a lot of cabin space. This resulted in a forward mounted windscreen, which could be sloped back considerably to enhance the sporty character of the vehicle.

Car styling has always followed a trend towards vehicle-design inspired from the wedge, as it is a dynamic as well as an aerodynamic form. This concept was introduced to the styling of the jeep. A previously non-existing shoulder-line was added and that brought a lot of continuity to the design of the vehicle.

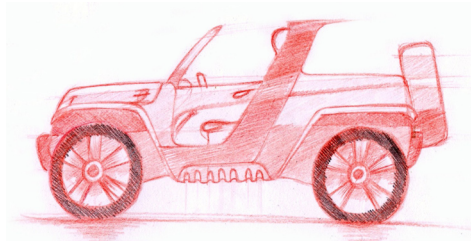


fig. 4.54

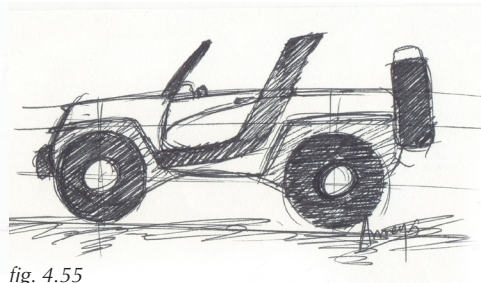


fig. 4.55

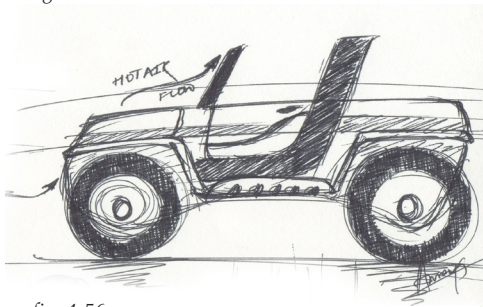


fig. 4.56

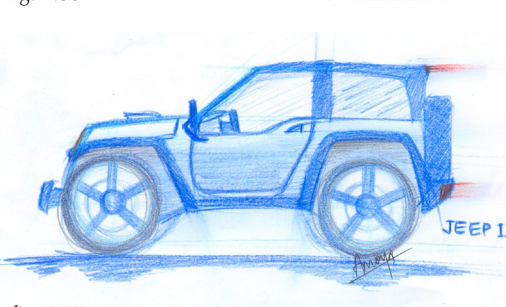


fig. 4.57

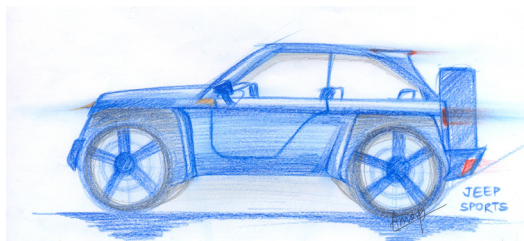


fig. 4.58

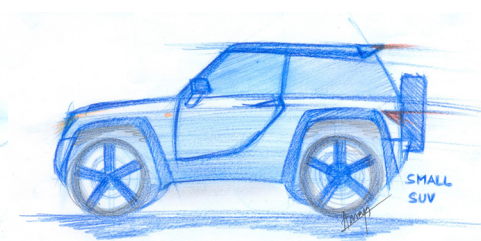


fig. 4.59

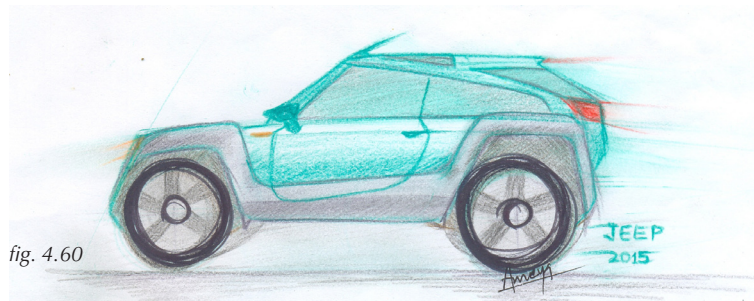


fig. 4.60

An elongated wheelbase meant that the driver could sit much lower and similarly the rear seat passenger was lowered down into the body. This resulted in lowering the centre-of-gravity of the vehicle and allowed the roof to be lowered.

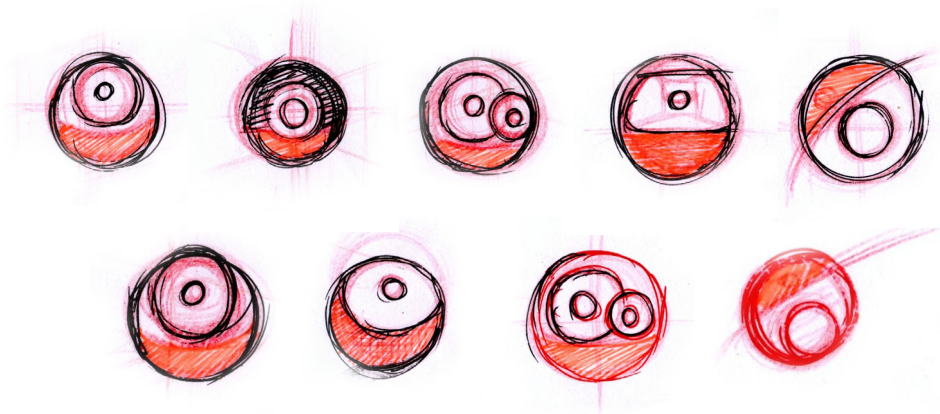
A lot of effort was put into seeing that the side profile which was found on the original jeep was replicated in the new design. The transition was tough and involved making it more of a useful element than just pure styling. Eventually it was achieved while establishing a continuity between the waistline and the shoulder line of the vehicle. The kink is part of the door as on the original vehicle and now houses the door handle.

The spare wheel is still rear mounted and is on the same side as the driver. The extra space on the body is used for fuel-can mounting and the containers for drinking-water for frontline jeeps.

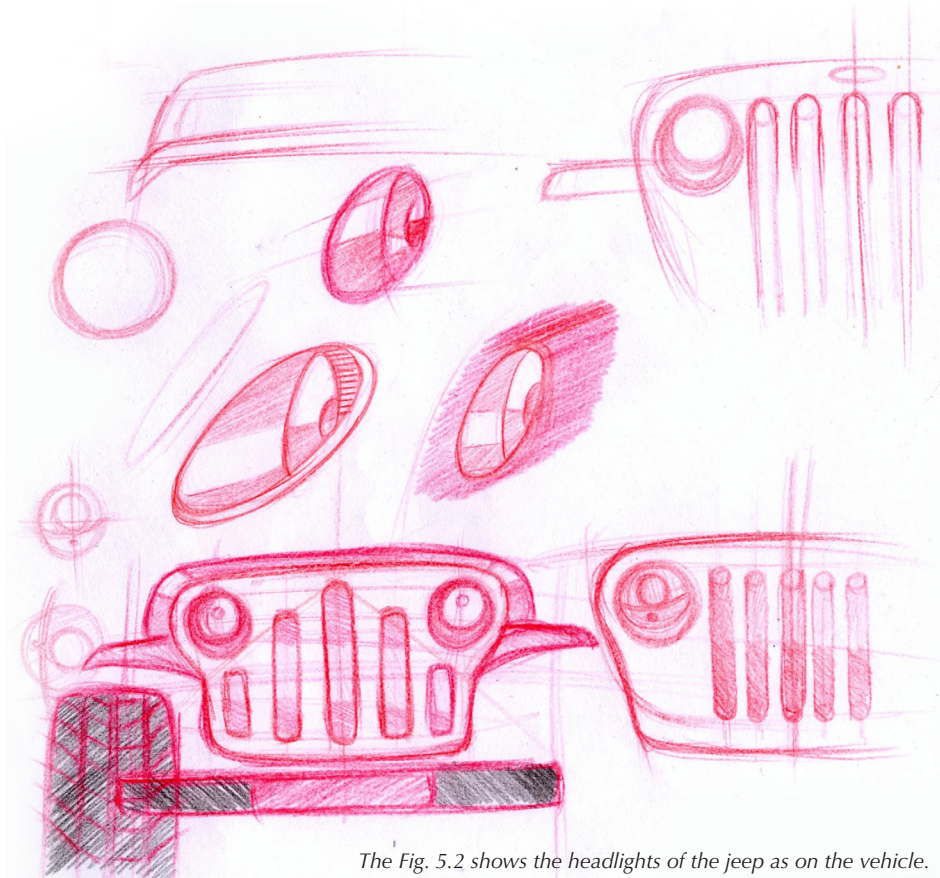
The design evolution of the jeep was stopped two to three stages short of the final futuristic vehicle derived, with purely automobile styling. The idea was to still retain a jeep like profile, with pronounced changes, disguised by a subtle deviation in the final form.

Chapter 5

Product detailing



The Fig. 5.1 shows the different types of headlight cluster designs.



The Fig. 5.2 shows the headlights of the jeep as on the vehicle.

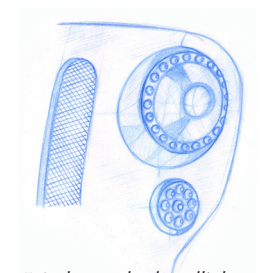
5.1 Headlight cluster

The headlights used by the original jeep were round in shape and thus played a huge part in defining the face of the vehicle, but these headlights were just about enough to illuminate a few metres before the vehicle.

With the advent of new technology and Polycarbonate clear lens headlights, light clusters have become very popular. Powerful lights can be incorporated in small spaces and supported by Xenon illumination with powerful yet tiny servo-motors, the road-lighting technology for cars has developed to make driving at night fatigue free.

This though has opened up a huge field for designers. Light clusters can be designed with various configurations and different specifications. The lights are the same as eyes to a human face, so the light cluster helps define the attribute to a vehicle. Various sketches were made to explore attributes like aggressive, frowning, strong, vigilant. A few configurations were tried out with respect to the vehicle as seen in Fig. 5.1 and 5.2.

A new regulation followed by the European union is to adapt day-time running lights and a version supporting LEDs to minimize power consumption during daytime driving was looked into.



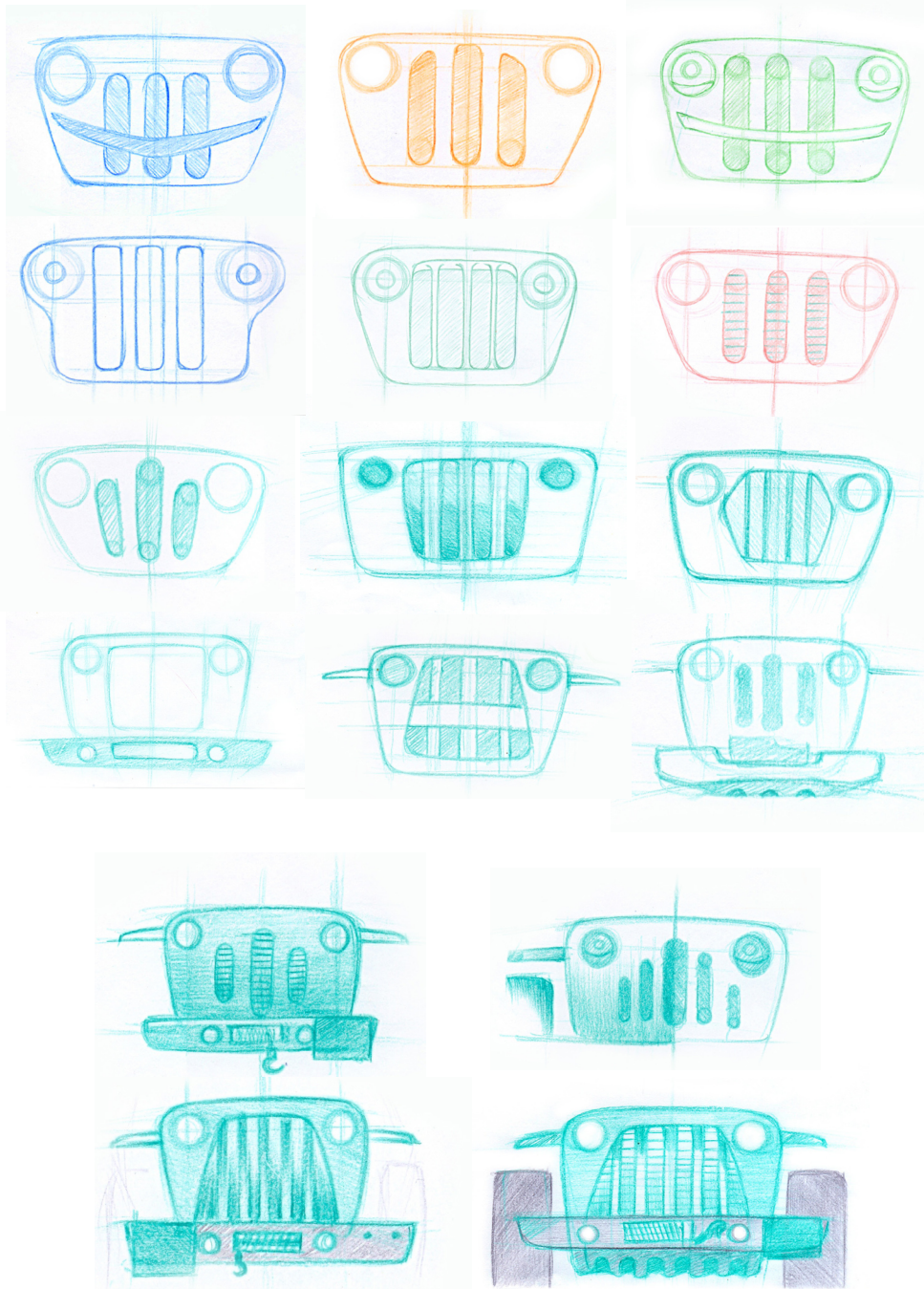
The Fig. 5.3 shows the headlight cluster with the Day-time running LED lights and LEDs for indicators.

5.2 Front Grill

Alongwith the characteristics like the headlights the elements of the front kidney grill define the face of the jeep. This face is primarily characterized by vertical slats which define the slots for the intake of air for cooling the engine and radiator.

The original jeep has seven vertical slats of similar width equally distributed between the two round lights at the extremes. The front grill was designed to exude a simplicity as well as give a solidity to the vehicle. Since the army man is a fierce person for the enemy alongwith being kind and helpful to fellow citizens, an certain essence of both these was tried to be captured in this ideation process.

Moreover the other elements like the front fender/wheelarches and the bumper were drawn to see if the entire complete package achieved the results as required. The extreme side mounted registration plate further added to the entire composition of elements which gave the vehicle a very retro-look.



The Fig.5.4 shows the ideation sketches for the front grill of the new vehicle.

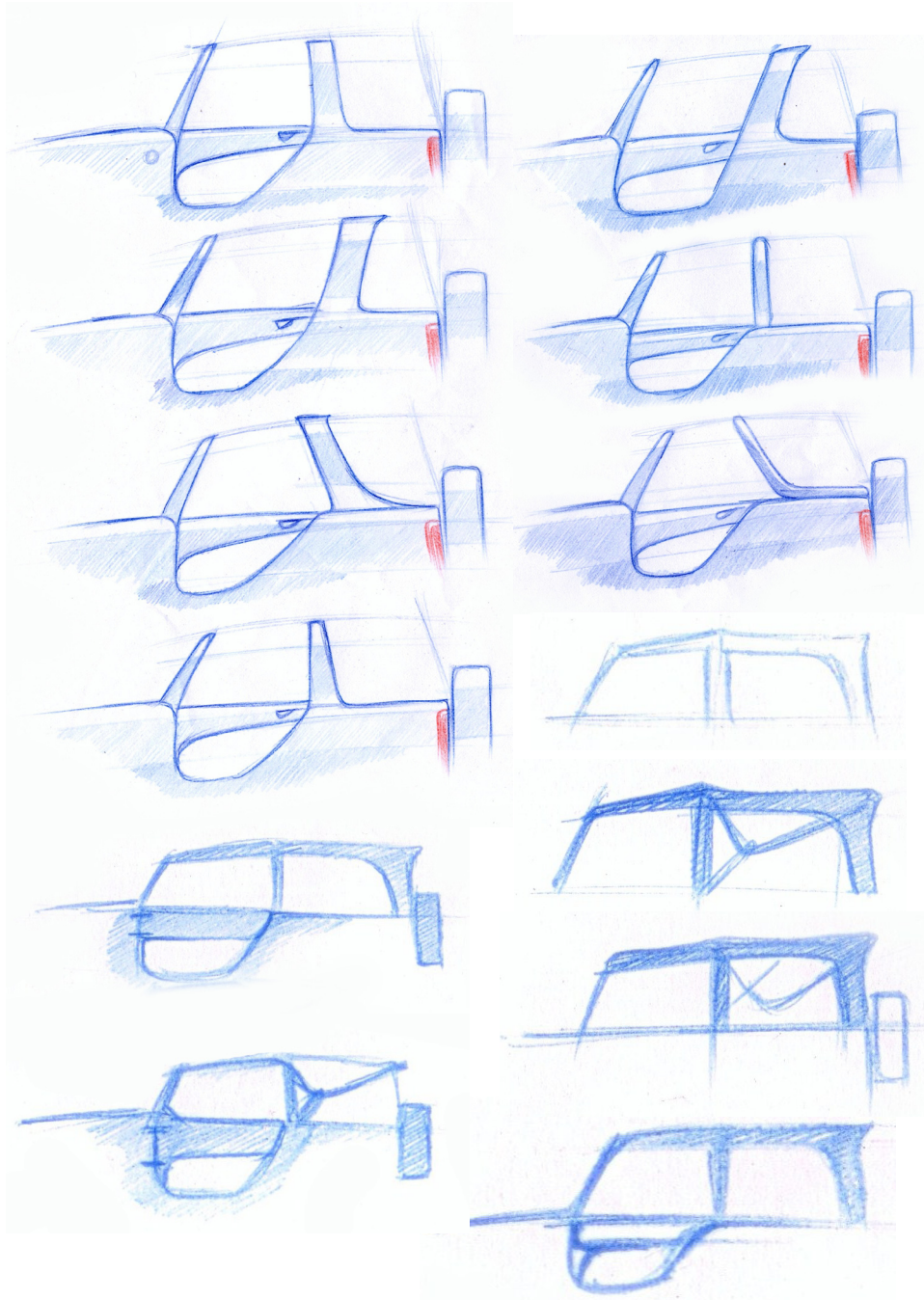
5.3 Rollover Guard and Canvas Roof

The original jeep was not designed to have a rollover protection. Due to this there were fatal casualties which occurred whenever a jeep toppled over. The absence of the roof in certain situations also made the jeep fatal for its occupants.

According to the new road safety rules the occupants have to be protected by a rollover guard, so in the redesigned vehicle this has to be added. Since the jeep is mostly used without the canvas roof, the rollover guard becomes part of the exposed frame of the vehicle.

Some iterations of the rollover guard with respect to the windscreen of the vehicle were looked at. Vertical, parallel to windscreen rake, positive and negative angles were explored. The position of the rollover guard also defines the security of the rear passenger and so its position with respect to rear seat occupants was a concern.

The rollover guard defines the roof contours of the jeep when covered with a canvas roof. So some iterations were made of the canvas roof stretched over the rollover guard. The tautness and the slackness of the stretched canvas roof was taken into consideration.



The Fig.5.5 shows the various designs for the rollover guard and the stretched canvas roof.

5.4 Front and Rear bumpers

The front and rear bumpers found on the original jeep were simple extensions at both ends of the chassis of the vehicle. Moreover only the front bumper of the vehicle was protruding outside the vehicle. The rear bumper was overshadowed by the protruding rear mounted spare wheel.

For the new vehicle the front and rear bumpers need to be as low enough to pass pedestrian safety rules as well as strike a balance with not ruining the ground clearance or the angle of approach or angle of departure of the vehicle.

In the new vehicle the front bumper needed to be able to house the turn indicators or extra fog lamps and the registration plate. For off-road applications there is a requirement of a tow-winch, which needs to be either incorporated into the front bumper or externally mounted on it. Moreover an incorporated tow-winch, is placed centrally and so the registration plate gets pushed to the either extreme end of the bumper.

In the new vehicle the rear bumper has to be extended to make contact at the rear end before any other part of the vehicle. Further more to improve rear visibility the rear mounted spare wheel needs to sit further lower and so a recess has to be provided in the rear bumper. If required the rear bumper also needs to incorporate the stoplights, the turn-indicators and the reverse assist lights.



The Fig.5.6 show the exploration of the shape for the front and rear bumper

fig. 5.7

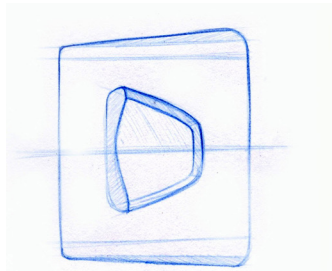


fig. 5.8

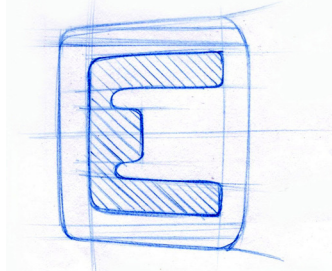


fig. 5.9

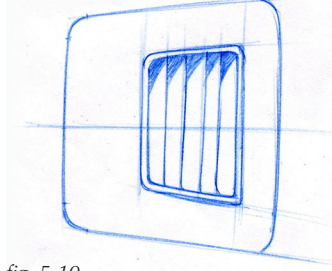


fig. 5.10

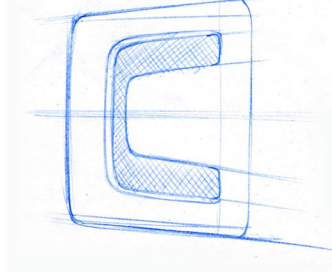


fig. 5.11

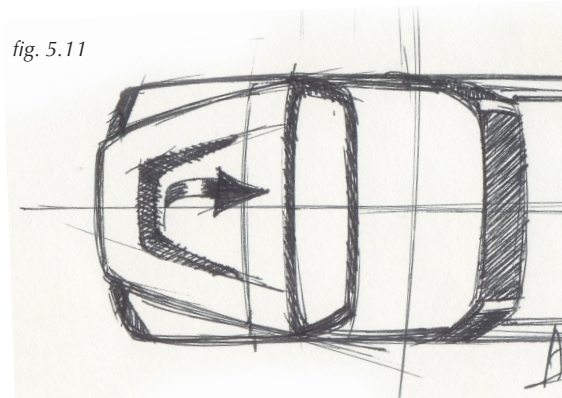


fig. 5.12

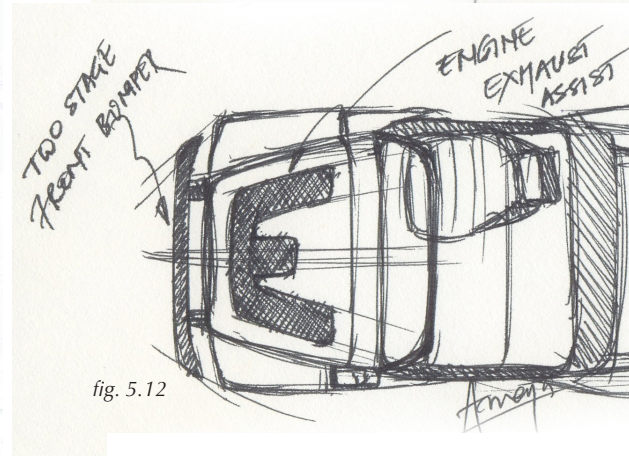
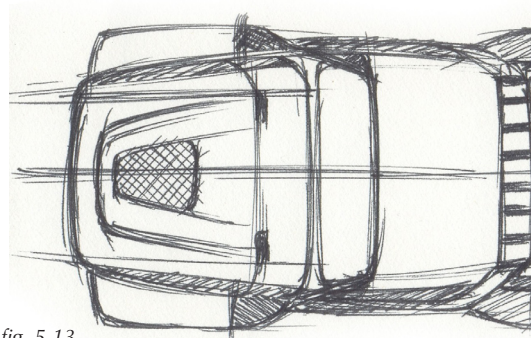


fig. 5.13



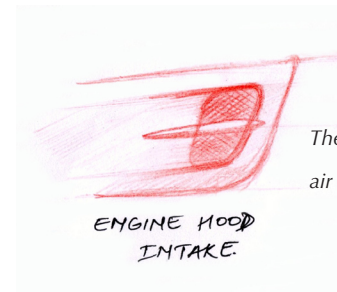
5.5 Engine Hood

The squared out engine hood is a characteristic element which defines every jeep. The first jeeps contained a single crease through the centre of the hood and one each through the sides. These creases not only gave the hood rigidity but were also visual elements expressing the solidity of the vehicle.

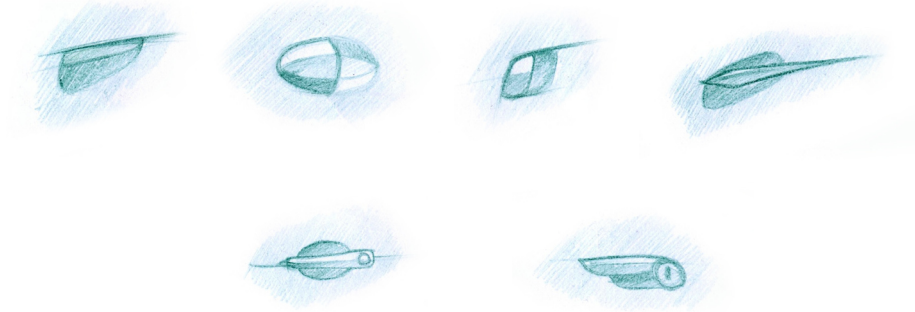
With a new and more powerful engine, intake air as well as exhaust air becomes a priority. Moreover with the trend being towards more flowing surfaces and smooth moving forms, the hood design is seen to be tapering so as to fuse with the body, where the passenger cabin begins as shown in Fig. 5.11.

The top surface of the hood may have provision for an intake to feed the intercooler. This surface may otherwise have an exhaust to allow the channeling of hot air out from the engine. These have been ideated in all the sketches shown on the left side.

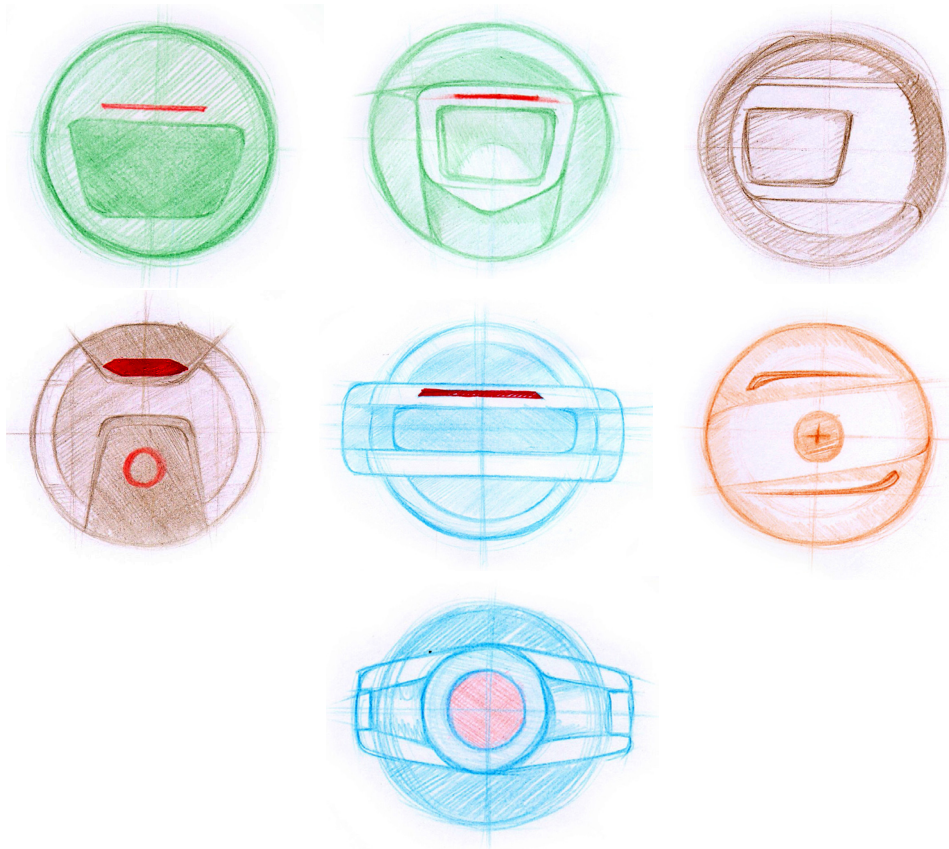
A pair of creases on the surface of the hood try to follow the lines from the front grill towards the wiper mounting recess area towards the windscreen. The creases on the side of the hood have been avoided, since the new engine hoods found in cars are reinforced from the inside.



The Fig.5.14 shows the idea for a side mounted engine hood air intake opening.



The Fig.5.15 shows the various ideas for the door handles of the vehicle.



The Fig.5.16 show the various ideas for the 5th wheel cover.

5.6 Door Handles & 5th Wheel Cover

The original jeep was not designed with doors. Further for quite a few years even the civilian version of the vehicle never came with sheetmetal doors.

With occupant safety being a primary criteria, sheetmetal doors have been added. Door handles were ideated to see the various types commonly available, as shown in Fig.5.15. These were to be designed to be strong which would stand the test of time with relative ease.

Another feature specifically designed for the civilian version would be the 5th wheel cover or the spare wheel cover. The spare wheel has no place to carry the manufacturers logo and that is a cause for concern for quite a many. Also since a high mounted third brake-light has been made compulsory in all vehicles and since the soft canvas roof has no provision for such, this spare wheel cover will have provisions for one. These are shown in Fig. 5.16.

The spare wheel also makes a provision to display the logo of the manufacturer as well as the registration plate if required. Moreover the spare wheel cover adds a few design elements to the rear end view of the vehicle.

Chapter 6

Initial Concept

6.1 Initial Concept Sketches



fig. 6.1

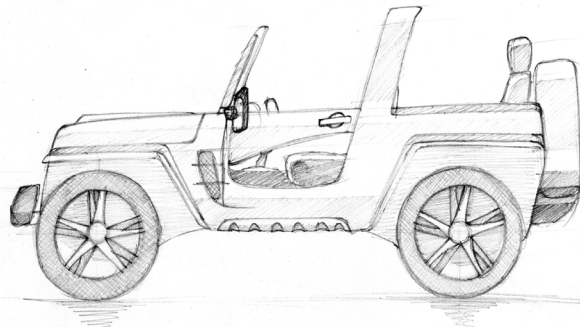


fig. 6.2

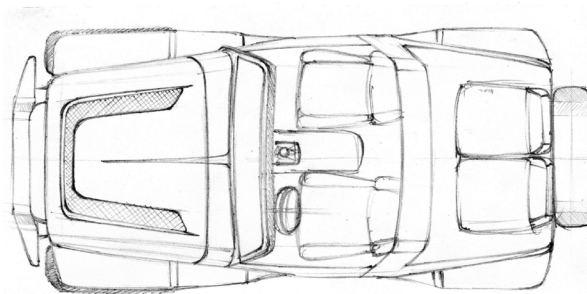


fig. 6.3

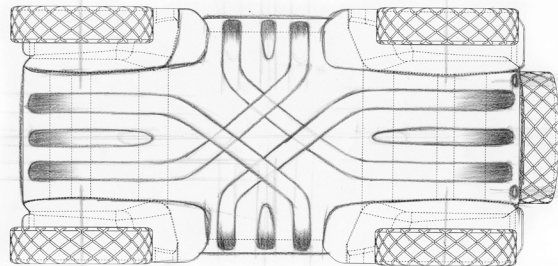


fig. 6.4

After all the detailing was done, the elements which appealed the most were put together and a final concept was proposed. The final concept vehicle had a lot of improvements and refinements coming from the initial idea.

Noticeable is the wedge-shaped design, the rollover bar and the prominent shoulder line, as seen in Fig. 6.2. The squared front fender is also extended to the rear wheel-arch and following the shoulder the rear wheel-arch is raised. This also allows for more travel of the rear suspension. The engine hood exhaust contours were prominently made visible. The windscreen was preferred to being a curved one as compared to the flat windscreen previously found, depicted in Fig. 6.3.

The rear view mirrors are larger and their mountings have been firmly attached to the body of the vehicle, as seen in Fig. 6.1. This gives a feeling of solidity to the entire vehicle. The moulded underbody has been added to assist in sound-damping and also renders a sense of ruggedness to the vehicle as depicted in Fig. 6.4.

Alloy wheels have been added to reduce the weight at the ends, and add a certain attitude to the vehicle. The passenger cabin section is tapering towards the rear of the vehicle. The door handle selected is large and chunky. The vehicle featured a partial door, which exhibited the typical jeep profile.

The vehicle has also tapered from both the sides to give it a very narrow look and also lower the centre of gravity of the vehicle.

6.2 Initial Concept Rendering

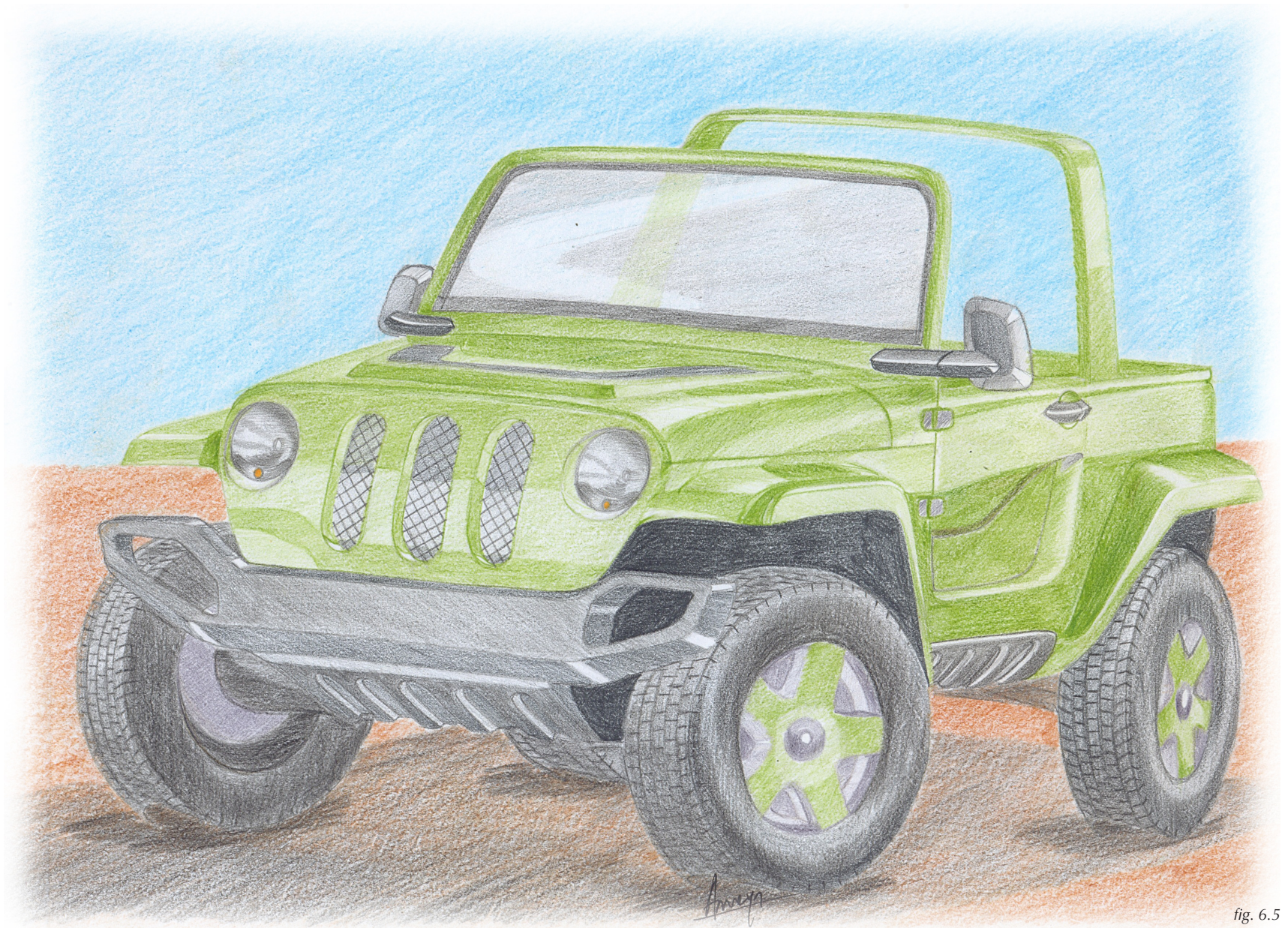


fig. 6.5

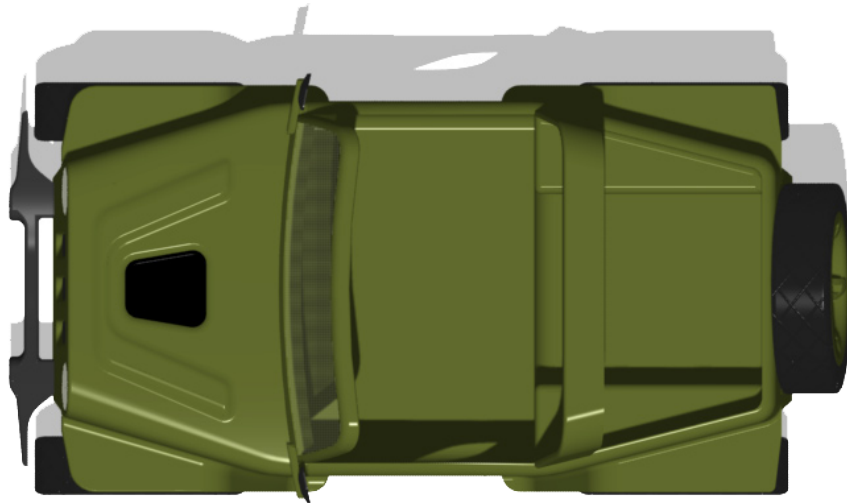


fig. 6.6

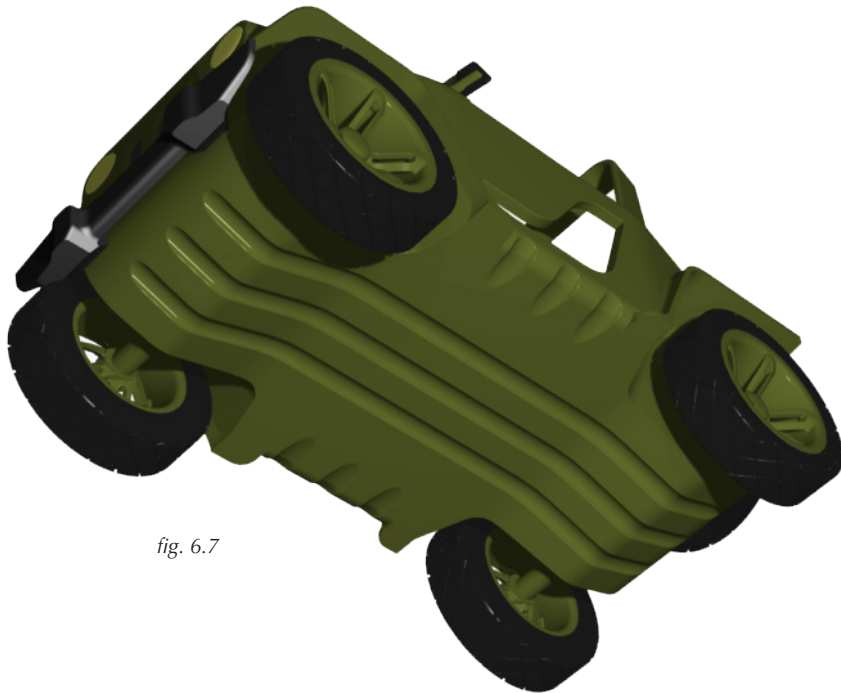


fig. 6.7

6.3 Rough CAD Model

From the final concept rendering, a very quick and rough CAD model was made to try and validate the design features of the vehicle. Though not exactly similar the CAD model did bring to the forefront some design problems, which were not prominent during the initial sketching stages.

The tapering rear section of the vehicle left absolutely no place for soldiers who preferred sitting facing each other, and also made the access door from the rear very narrow, as shown in Fig. 6.6. This needed to be addressed.

The underbody of the vehicle, as shown in Fig. 6.7, was to be given thought, so that the service-ability could be looked at. It was proposed to be built-up in two or three parts so that it could be removed easily.

The contours of the engine hood, as seen in Fig. 6.6, were to be worked out so that they would gel with the entire design language followed by the vehicle. The requirement of the contours was also in question.



fig. 6.8

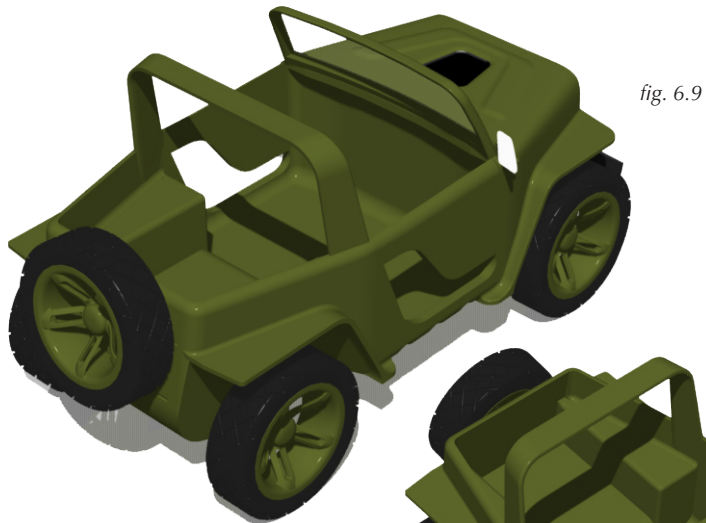


fig. 6.9

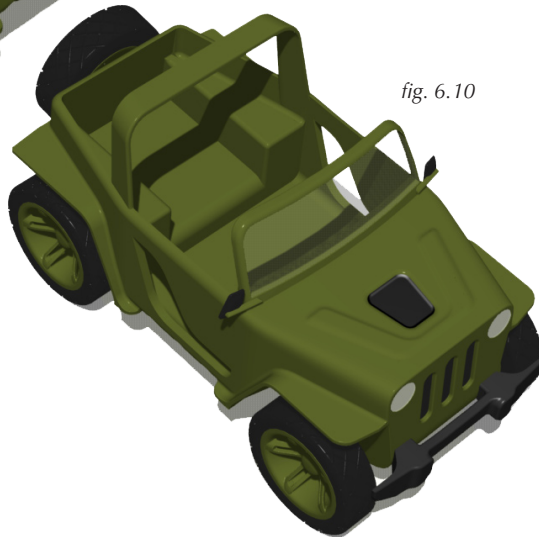


fig. 6.10

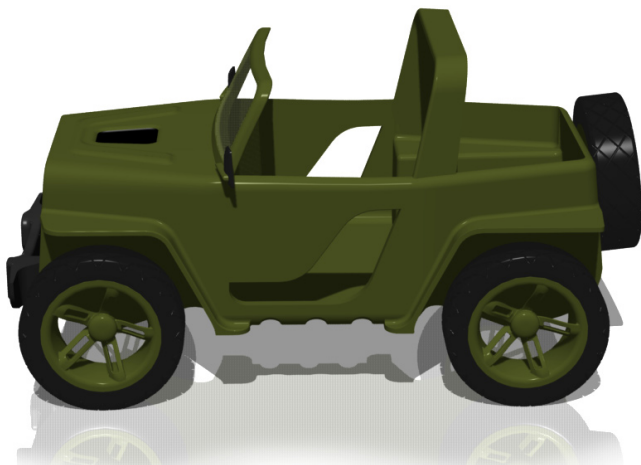


fig. 6.11

The front bumper design looked too bulky and also lacked character as seen in Fig. 6.10. A shift was to be made towards a simplistic design, which could be easier to manufacture and replace. Replacement as a criterion was seriously considered, because the front bumper is prone to maximum physical abuse.

The fenders made the vehicle look very symmetric when viewed from the side profile, as seen in Fig 6.11. This was not acceptable and needed to be addressed. A wedge-design was suggested and a gradually rising shoulder line could break the symmetry.

The proportions of the vehicle also did not appeal and so the vehicle was perceived as being higher than was intended in the design. Also very visible and looking disproportionate was the distance between the upright windscreen and the rollover bar, as seen in Fig. 6.11.

Further modifications in the vehicle involved justifying the stance of the vehicle with the canvas roof on it. The entire transition of surfaces was to be looked at, especially in the rear section of the vehicle.

The doors were to be looked at because they did not satisfy the requirement of safety. The styling was without any fundamental advantages to aid visibility or any similar terms. The doors had to be redesigned with safety and visibility in mind.

Chapter 7

Refinement

Refinement & Finalization

7.1 Concept refinement

The existing concept had a lot of issues troubling it. All of these were listed and looked into to improve them.

One of the primary issue was to get the placement of the spare wheel right. The idea was to place it to the right as seen from the rear of the vehicle. Exactly behind the driver, so that it does not obstruct visibility while backing up the vehicle, as seen in Fig. 7.4.

The bumper was the other criterion which was to be looked into. A simple yet rugged design was sought for. As for the rear, an extra fuel tank was added to the vehicle and the lights were incorporated into the rear bumper. This allowed the bumper assembly to be different for the different models (frontline, passenger and civilian versions)

The rearward taper was also reduced and roof setups with the rollover bar were looked into. The contours of the canvas roof were designed to imitate a more dynamic roof-line, as seen in Figs. 7.7, 7.8 and 7.9.

The door still remained in question and some thought was put in it to improve safety and keep the character. The overall lines of the vehicle were improved with continuity being a major criterion, as seen in Fig. 7.5 and 7.6.

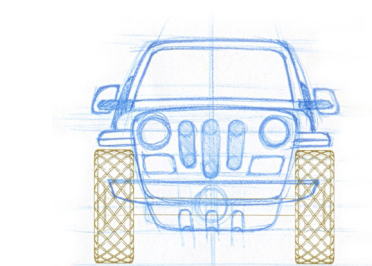


fig. 7.1

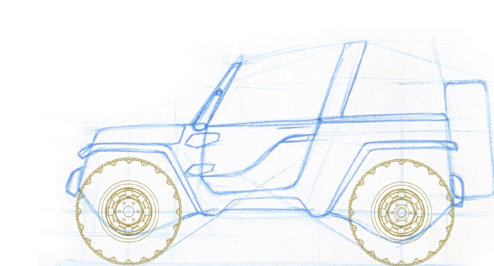


fig. 7.2

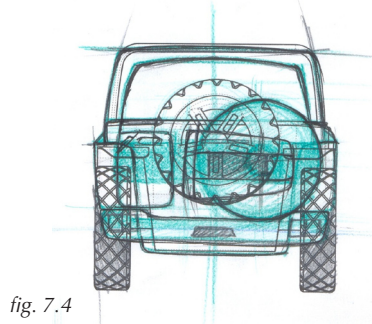


fig. 7.4

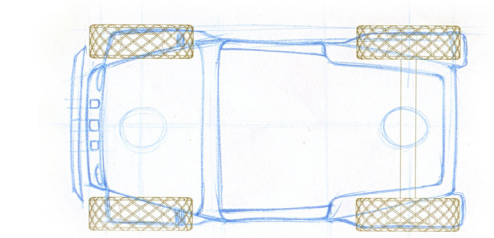


fig. 7.3

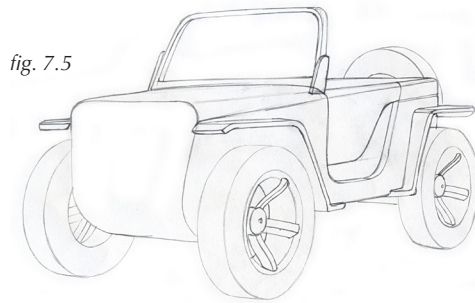


fig. 7.5

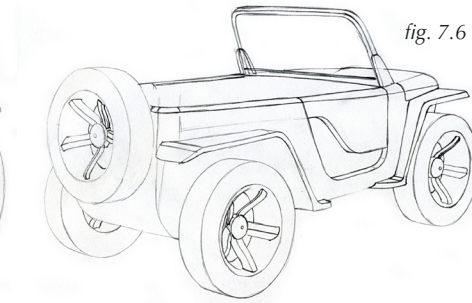


fig. 7.6



fig. 7.7

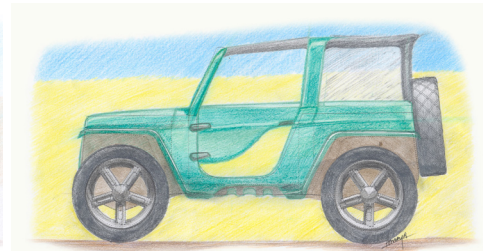


fig. 7.8

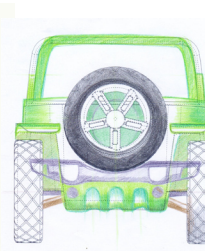


fig. 7.9

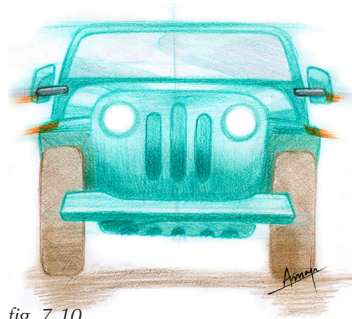


fig. 7.10

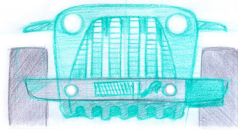


fig. 7.11

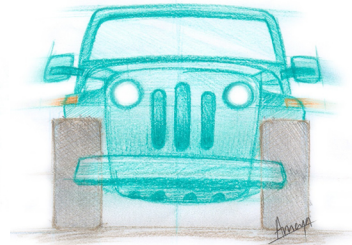


fig. 7.12

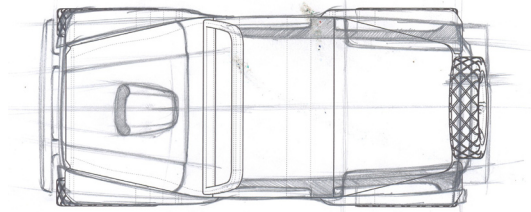


fig. 7.13

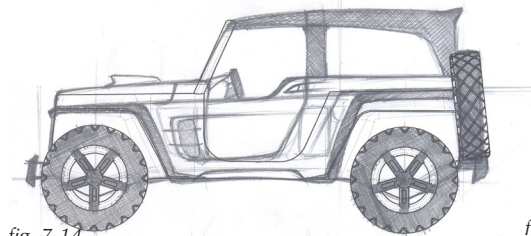


fig. 7.14

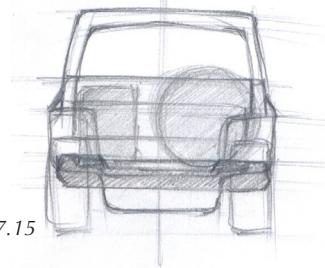


fig. 7.15

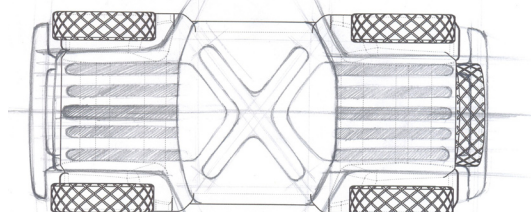


fig. 7.16

7.2 Concept finalization

The bumpers were finalized to be as simple as shown in the Fig. 7.11 in the centre. The registration plate mounting, as to which side, was not finalized. Turn signal repeaters were to be installed in the front fender and also the rear view mirrors.

The grill was made more aggressive and had a negative taper towards the bottom. The engine hood was made contoured with two sharp creases, forward meeting to denote a sense of dynamism, as shown in Fig. 7.13. A simple air intake for the intercooler was also installed in the centre of the engine hood. The rear section of the vehicle was tapered much lesser as compared to the CAD model, this liberated more passenger space.

The rear fenders were squared off too, to resemble the design language of the front. A soft pleasing look was achieved by giving a fillet radius at the edges. Excess space on the side fenders was explored for mounting of extra fuel tanks and water containers as shown in Fig. 7.14.

The door was designed so as to incorporate the jeep profile element into the shoulder-line of the vehicle. The wheelbase was decided so as to allow more legroom for the rear seat passenger and make him sit lower than earlier. The rear end of the vehicle was frozen upon and the position of the rear spare wheel along with an excess fuel tank was decided, as shown in Fig. 7.15. The rear bumper was recessed to allow the spare wheel to sit lower, so as to not compromise on rear vision.

The under body was split into three parts which could be easily removed with maintenance as a criteria, as shown in Fig. 7.16. The ribbing made the parts warp-free and also strong to resist loading.

7.3 Revised Final Concept sketches

The learnings from the revised sketches were fine-tuned and put into the final sketches, before rendering.

From Fig. 7.17 we see that the most prominent was the addition of the extra fuel and water containers on the sides of the vehicle. The rollover bar was featured to be prominently appearing from the curve in the side fuselage. The tapered front engine hood and the tapered front grill helped achieve a very sleek and dynamic look to the front of the vehicle. The air intake offset from the engine hood surface was also kept to a minimum to avoid being too loud.

The side profile line of the engine hood was inclined to be at an angle to add on to the dynamic looks of the vehicle. The front fender blended into the engine hood shut-line. The extension of this line further back matches with the door. The door follows the upward bound curve which eventually fuses into the shoulder line which starts from the engine hood of the vehicle and wraps around defining the rear section of the vehicle.

From the Fig. 7.18 we see that the squared front and rear fenders match each other and further enhance the wedge-inspired, forward crouching stance of the vehicle. The curved portion of the underbody is visible under the side-skirting. The canvas roof contoured to have a rear spoiler-like element further adds to the dynamic and sleek, but sporty stance of the vehicle.

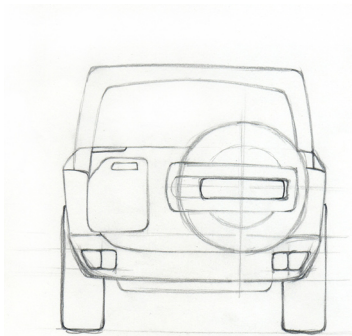


fig. 7.19

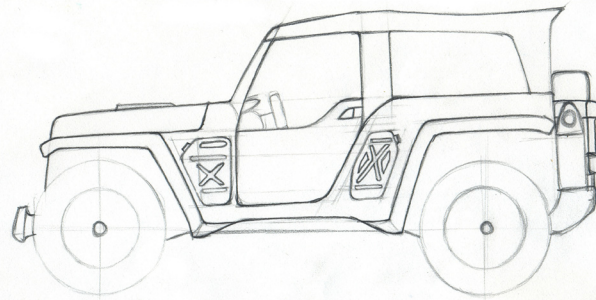


fig. 7.17

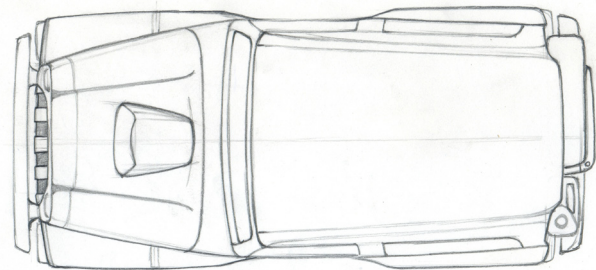


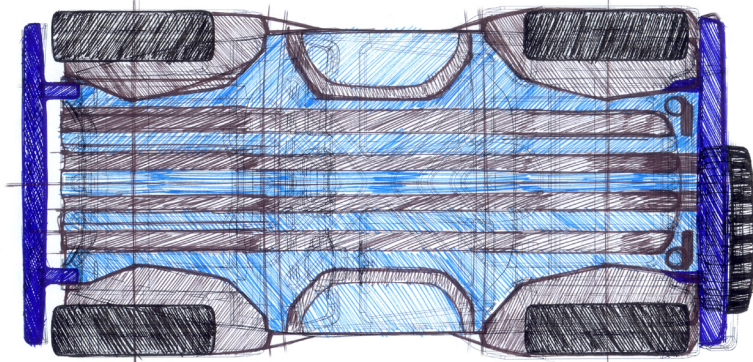
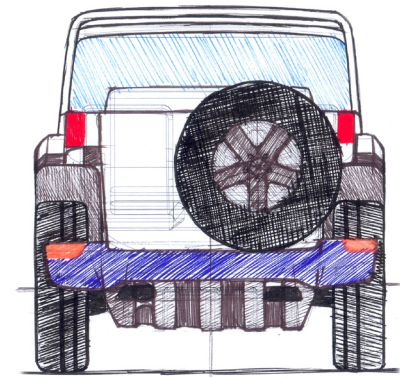
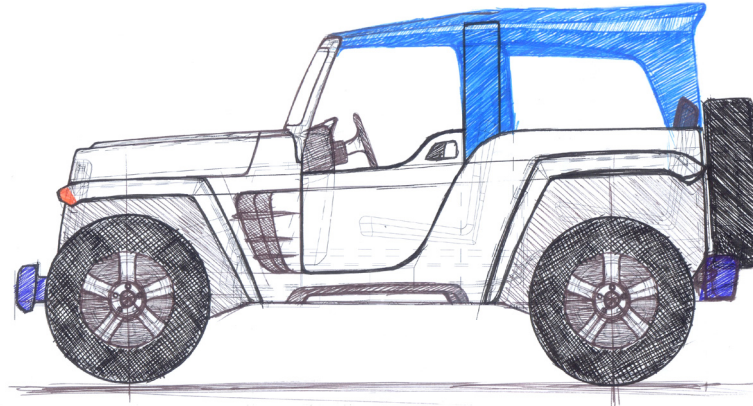
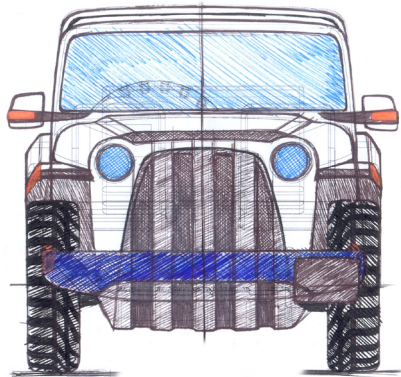
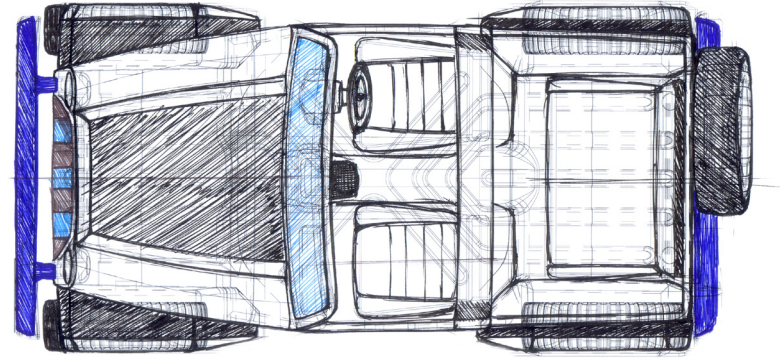
fig. 7.18

Chapter 8

CAD Model

CAD Modeling

8.1 Final Sketches



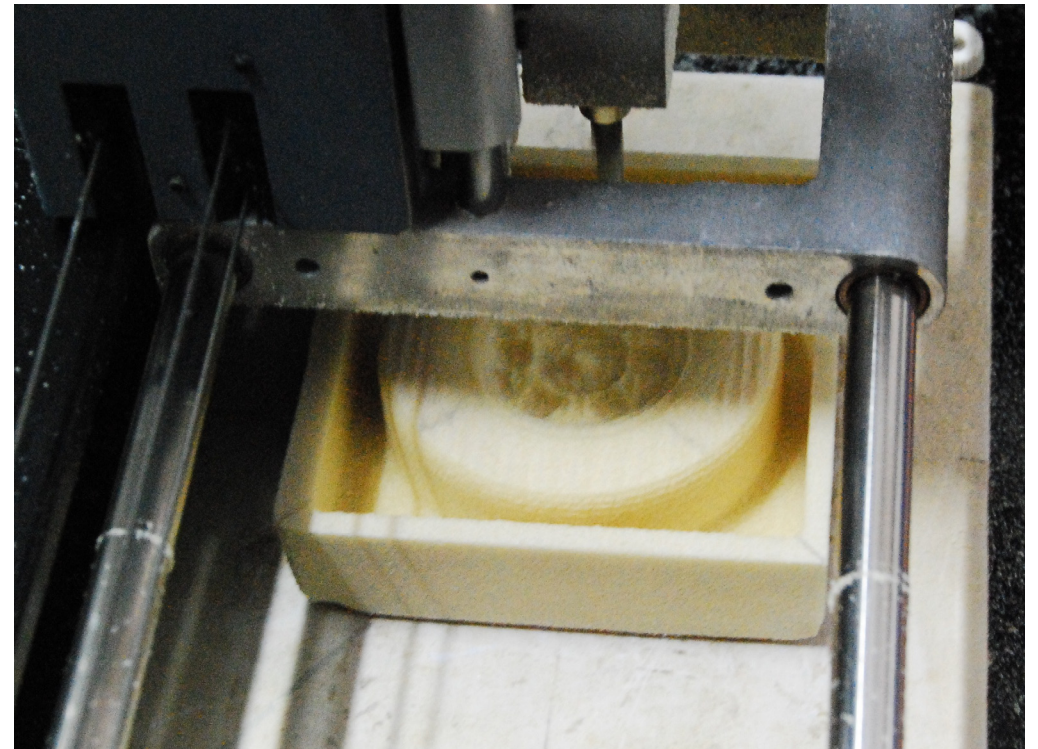
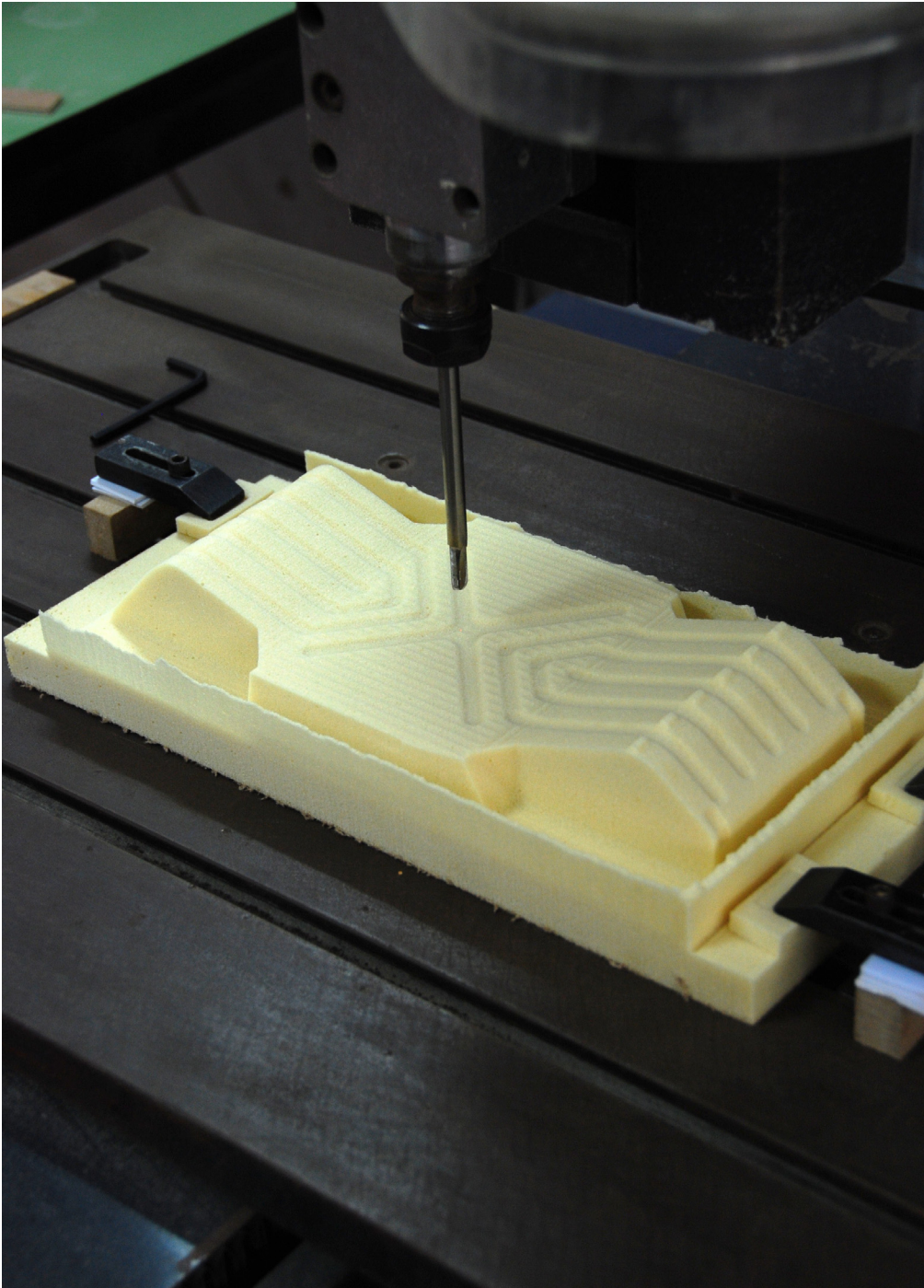
8.2 CAD Rendering

The CAD models were later developed for photorealistic renderings. The figures on this page give the details.

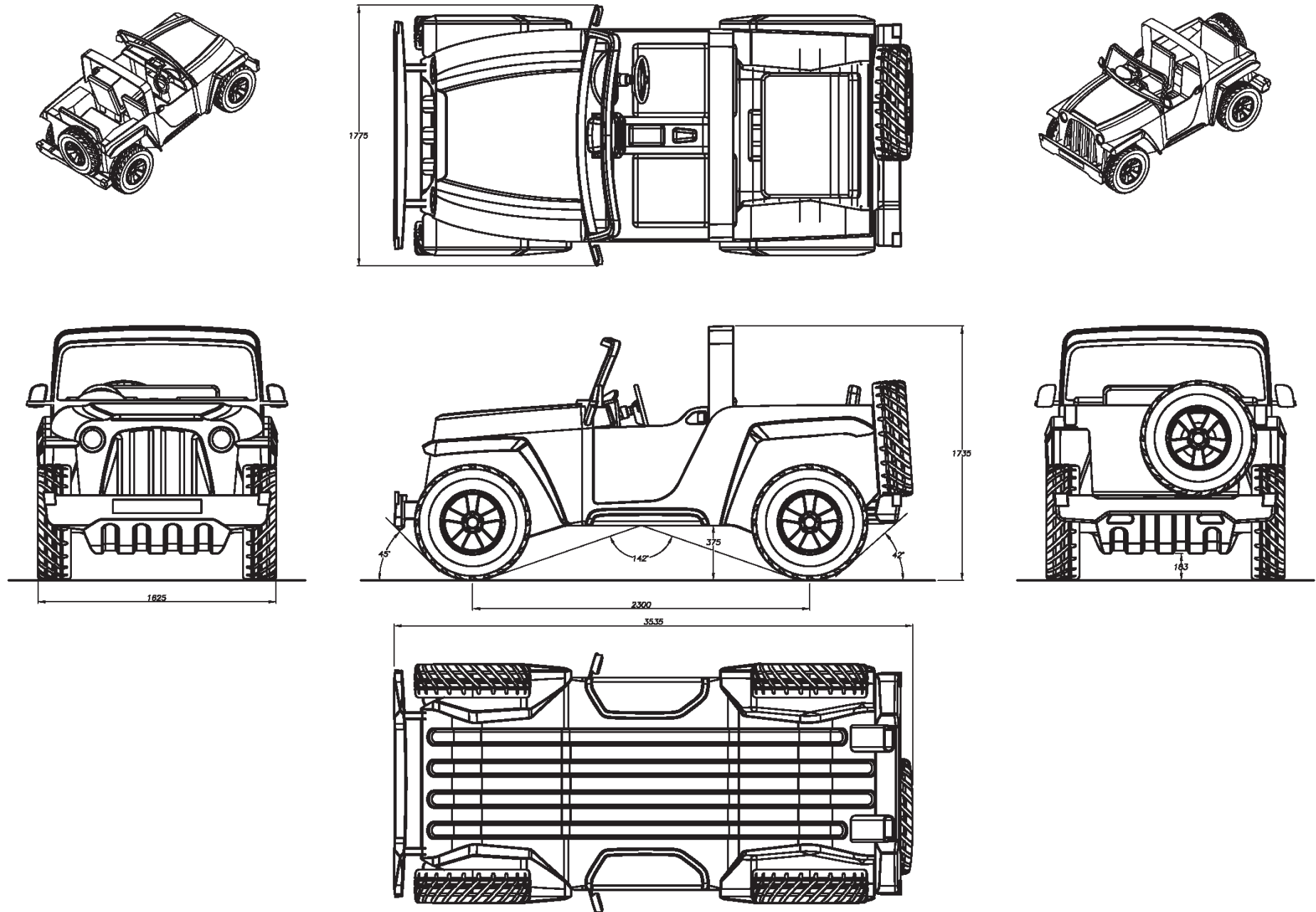


8.3 CNC Cutting

The CAD model was later converted to be cut on a Computer Numeric Control (CNC) Machine. The figures on this page give details of the same.



8.4 Dimensional Specifications



8.5 Final Product





References

References

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2. <http://carblueprints.narod.ru/jeep.htm>
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