

Redesign Of INFANTARY COMBAT VEHICLE



Project Guide

Prof K. Munshi

DC

Mr. Mukesh Bhopalkar



Abhishek Prasad

07613803

ID 07-09



The Project Objective:

The Project aims at redesigning the current BMP-2 ICV used by the Indian Army and to achieve a perfect balance between aesthetics, function, usability and safety of the crew.

What is an ICV?

- Armed support vehicle for main battle tanks.
- Secure areas captured in battlefield
- Provides cover fire for infantry
- Commutation for infantry

Expected additional future role

- Urban warfare



INFANTARY COMBAT VEHICLE : Main Parts

Armour and countermeasures

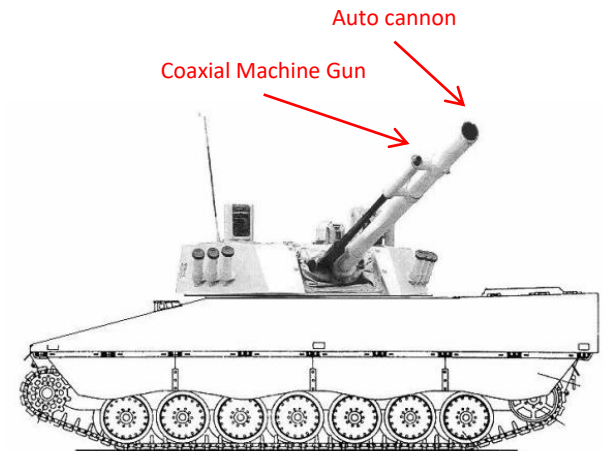
- ICVs have thinner and less complex armour than tanks to ensure easy mobility
- Proof against heavy machine guns, artillery fragments, and small arms
- Anti-tank duties in emergencies or in support of tank units
- Carry riflemen and their weapons into the battlefield
- The vehicle to be tailored for particular missions
- The most common counter measures are smoke grenade dischargers, help IFVs to avoid a hits from ATGMs by allowing the IFV to hide behind a smoke screen.

Main armament

- The primary weapon on most ICVs is an Autocannon, usually of a calibre between 20 and 40mm
- Fire several types of munitions, including high explosive, incendiary, and kinetic penetrator rounds
- Germany's Puma (IFV) can fire Air Burst Munition (ABM) Carry

Coaxial Machine guns

- On all IFVs, a coaxial machine gun is mounted on the turret along with the main armament
 - Most common calibre is 7.62mm
- Some ICVs mount more than one machine guns



Missile

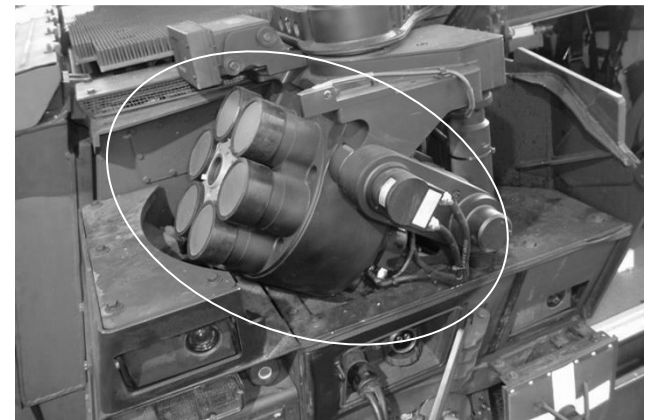
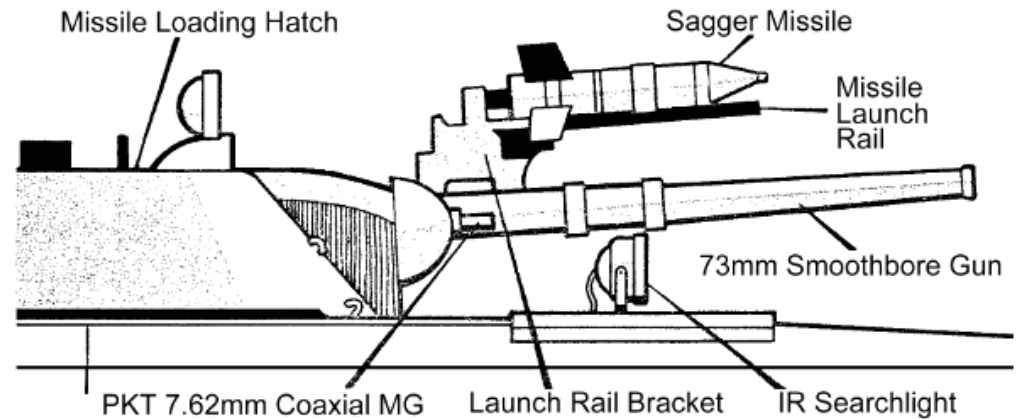
Some IFVs are equipped with anti-tank guided missiles

These missiles are mostly medium range (2000-4000 m)

Surface-to-air missiles or a combination of the two (2T Stalker)

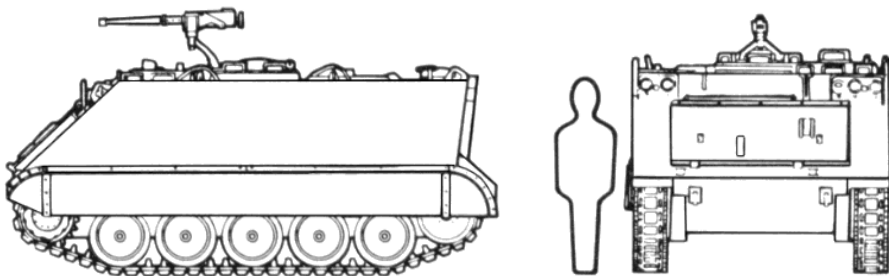
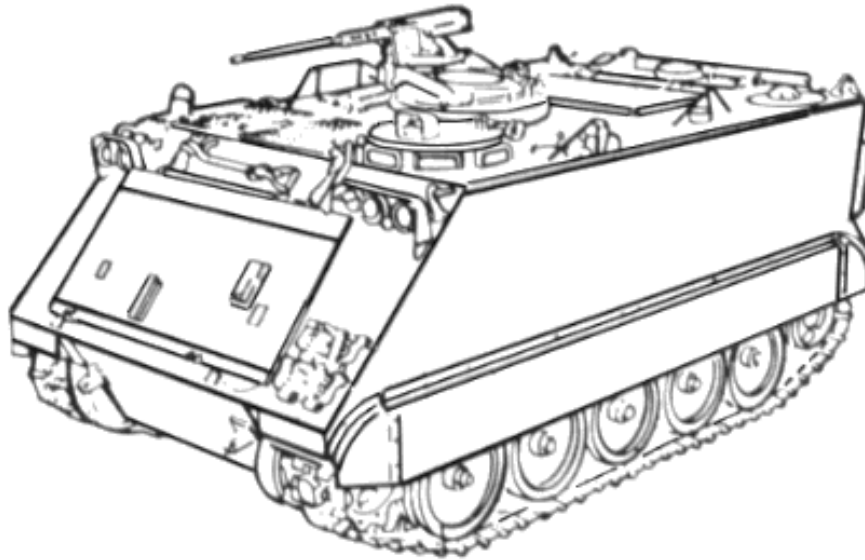
Grenade launchers

Some new vehicles, such as the Puma, come equipped with 30, 40 or 76 mm grenade launchers. All IFVs also have smoke grenade dischargers for concealment.



Data Collection & Research

M113



-M113 is an armoured personnel carrier family of vehicles

-Fully tracked vehicle

-Can handle limited amphibious operation in lakes and streams

-Extended cross-country travel over rough terrain

-High speed operation on improved roads

-Most widely used armoured fighting vehicles

-Designed as a transport to protect against artillery fragments

BMP-1



Western powers were surprised when the Soviet Union paraded the first purpose-designed IFV, the BMP-1, in 1967. The BMP possessed a very low profile and was armed with both a 73mm smoothbore gun and an AT-3 Sagger ATGM. Its steeply-sloped front armour offered partial protection against NATO's standard .50 calibre machine gun in a 60 degree frontal arc, while its smoothbore gun and ATGM were a threat to NATO APCs and even MBTs. It was not quite the breakthrough some would make it out to be, as in practice its performance was similar to the heavily-armed APCs which NATO countries had already begun to develop.

World Scenario : ICVs



German Marder-I



German Marder-II



German Puma



Canadian LAV III



British Warrior



American M2 Bradley



M1126 Stryker



Spanish Pizarro



Italian Dardo



Indian Abhay



South African Ratel



Swedish Combat Vehicle 90



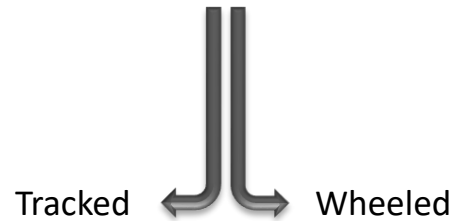
French AMX-10P



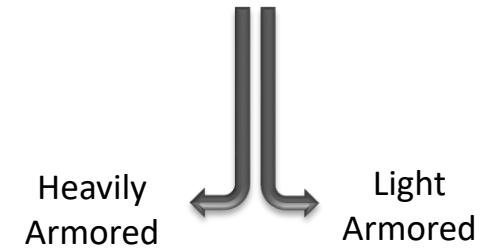
Dutch YPR-765 AIFV

Types of ICV

ICV (Based on Mobility)

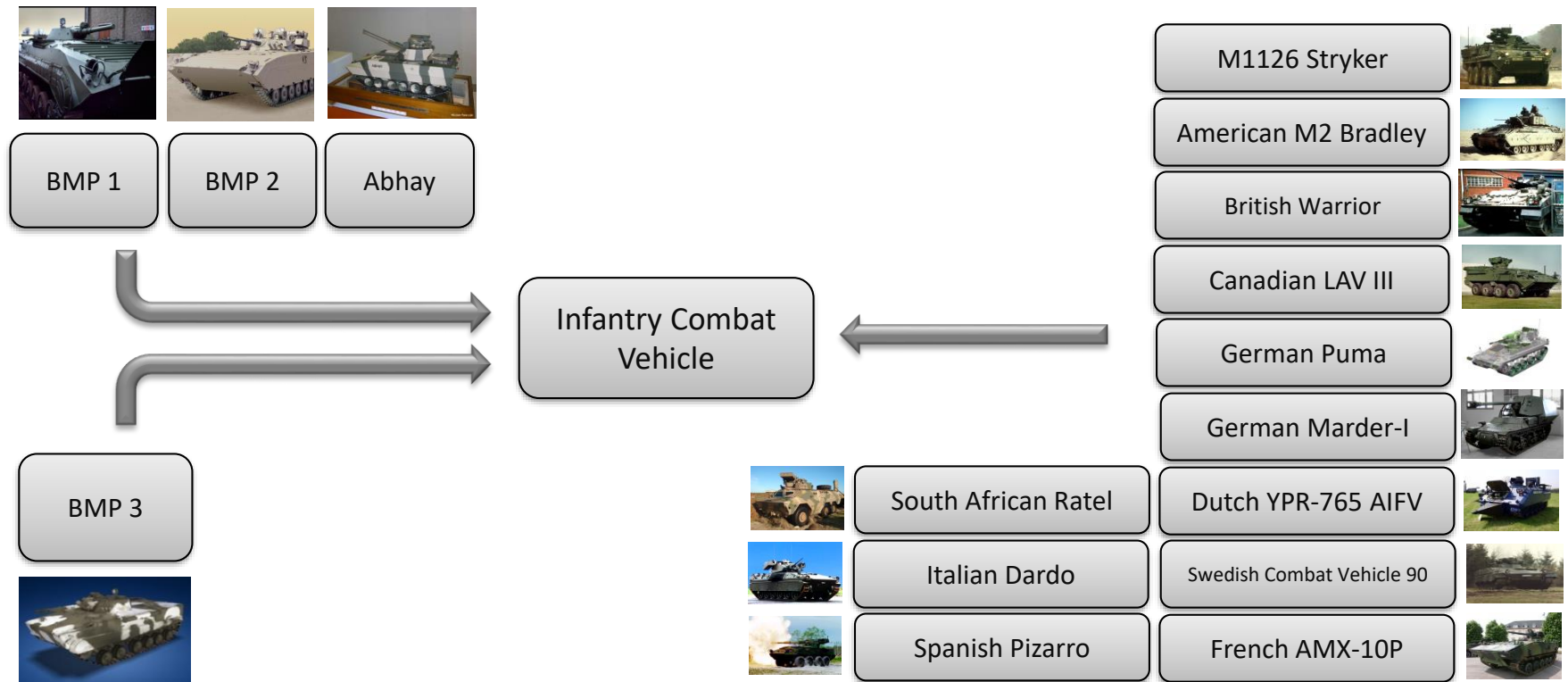


ICV (Based on Armor)

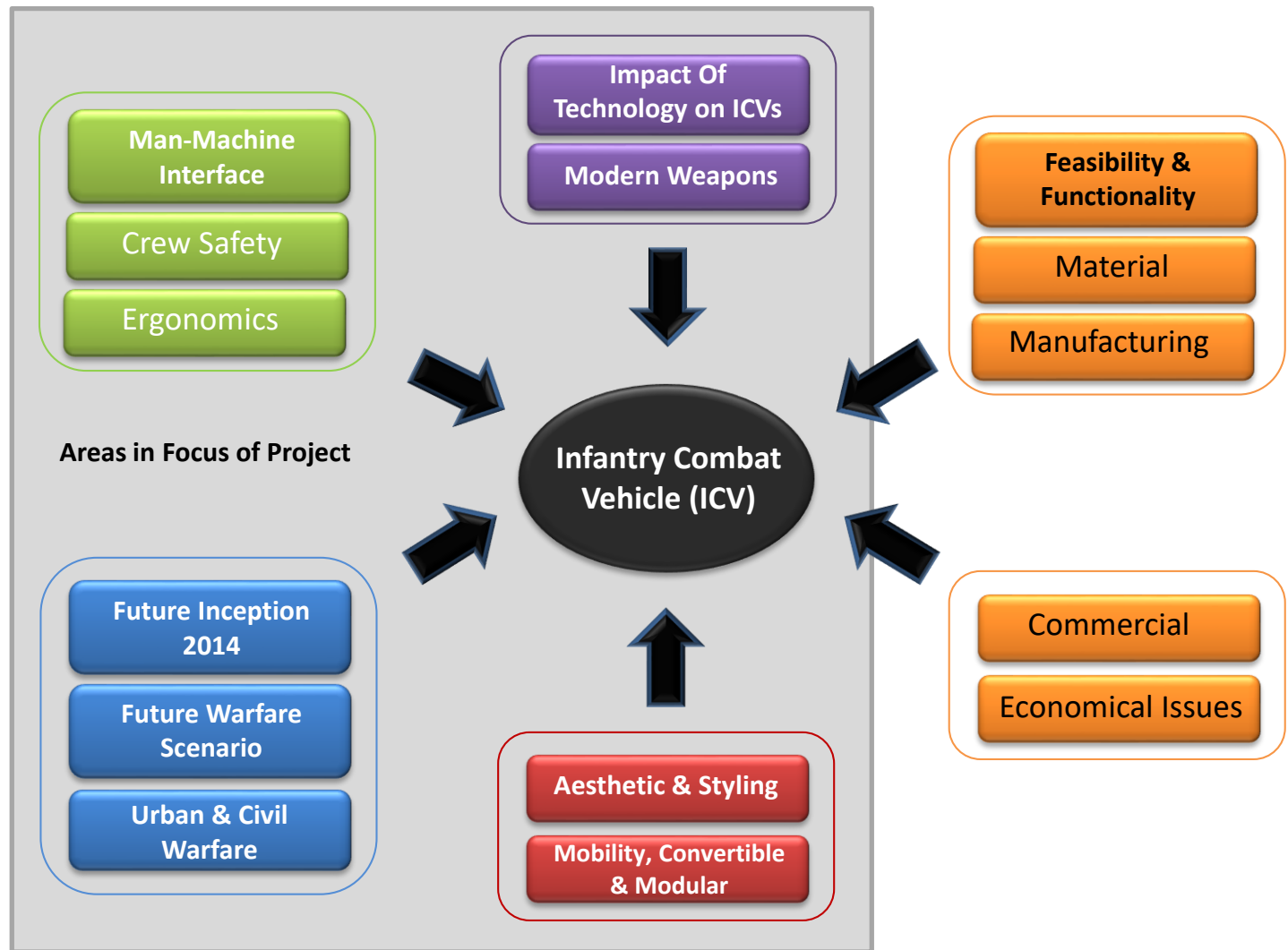


Where India stands????

On one hand India is there with age old fleet of BMP-2 & recently developed Abhay and ready to accept a bit advanced BMP-3, on the other hand, other superpowers in the world are standing with their advanced and high tech ICVs.



Various Aspects Of ICVs



BMP 2 used in Indian Military

- Sequel to BMP-1.
- Vulnerable to .50 calibre machine gun fire in the sides and rear.
- 7 crew members
- Enhanced armor.
- The commander sits with the gunner in an enlarged turret.
- BMP-1 has a capability to make its own smoke screen by injecting vaporized diesel fuel.



Technology Matrix

Fire Power

Primary Weapon

Secondary Weapon

ATGMs

Countermeasures

Protection

Armor

Add - On

Passive

Active

Crew Safety System

NBC

Mobility

Chassis

Power pack +
Transmission

Suspension

Steering

Propulsion

Wheels / Tracks

Command & Control

BMS

Comm. & NAV

Electro Optics &
Sensors

Fire Control System

Stabilization

Misc

Ammo Handling

Vetronics

Climate Control

APU

Fire Suppression

Current Generation ICVs & Their Specialties :

Puma Germany



- Heavily Armoured
- Highest Power-to-Weight ratio
- Combat weight 31.5 tons

VBCI France



- Best Armor to weight Ratio(claimed)
- Modular Armor

Current Generation ICVs & Their Specialties :

Puma Germany



- Heavily Armoured
- Highest Power-to-Weight ratio
- Combat weight 31.5 tons

VBCI France



- Best Armor to weight Ratio(claimed)
- Modular Armor

Stryker USA



- Light-weight(<20 tons)
- Armed with 12.7 cal gun

CV90 Sweden



- Armed with 40mm L70 cannon

Patria AMV Finland



- High export success
- Modular Construction
- Modular Armor
- Amphibious

BTR-90 Russia



- 0 turning radius possible
- Side-opening Doors
- Amphibious

Piranha Switzerland



- Most produced modern ICV series
- Amphibious

Dardo Italy



- Aluminum alloy armor

Bionix II Singapore



- Compact dimensions
- Amphibious
- Variant with Grenade Launcher

BMP-3 Russia



- Most heavily armed ICV
- Lightly armored
- Amphibious

ASCOD Spain / Austria



- Co-operation between Spain & Austria
- Next version to be armed with BMP-3 turret

ICVs at Glance

Sr.	Program	Country	Mobility	Crew	Weight	Power to Weight Ratio	Armament Calibre (mm)	
							Primary	Secondary
1	Puma	Germany	T	3+6	31000	34.09	30	5.56
2	VBCI	France	W	2+9	26000	20.81	25	7.62
3	Stryker	USA	W	3+8	19000	21.88	12.7	7.62
4	CV90	Sweden	T	3+7	25000	23.69	40	7.62
5	AMV-Hitfist(Patria)	Finland	W	3+8	24000	22.65	30	7.62
6	BTR-90	Russia	W	3+7	20920	23.62	30	7.62
7	Piranaha IV	EU	W	2+8	25000	21.48	30	7.62
8	Dardo	Italy	T	3+8	23000	22.28	25	2 x 7.62
9	Bionix 2	Singapore	T	2+9	21500	22.16	30	7.62
10	BMP-3(upgraded)	Russia	T	3+7	18900	34.31	100	30+3x7.62
11	Ascod/Pizzaro/Ulan	Spain	T	3+8	25200	23.49	30	7.62

ICV Protection

Sr.	Program	Std. Armor protection (against cal.mm)	Upg. Armor protection (against cal.mm)	weight std. (tons)	weight Up - Armored. (tons)
1	Puma	30 (Frontal + Arc + flank) +14.5 (all-round)	30+(all-round)	31.5	41.3
2	VBCI	30(Frontal) est. 14.5(all-round)	N/A	26	N/A
3	Stryker	14.5 (all-round)	add on reactive armor	19	23
4	CV90	14.5 (all-round)	30(Frontal-Arc) +30(sides)	24	28
5	AMV-Patria	14.5+(allround)est.	30mm	16	26
6	BTR-90	12.7 (all-round)	N/A	21	N/A
7	Piranaha IV	14.5 (all-round)	add on reactive armor	N/A	25
8	Dardo	N/A	Steel plates	23	N/A
9	Bionix 2	N/A	N/A	23	N/A
10	BMP-3 U	30(frontal) +7.62(all-round)	12.7(all-round)+ERA	18.9	22.9
11	ASCOD	14.5(Frontal) +7.62(all-round)	30(Frontal-Arc) +14.5(all-round)	25.2	28.5

Wheel v/s Track- A Comparison

Sr. No.	Criteria	Tracked	Wheeled
1	Cross-Country Mobility	✓	
2	Traction on Slopes	✓	
3	Road Speed	70 km/h top speed	100 km/h top speed ✓
4	Operating and Service Costs		✓
5	High GVW, Volume and Payload	✓	
6	Gap and Obstacle Crossing	✓	
7	Fuel Economy		✓
8	Reliability		✓
9	Low Silhouette	✓	
10	Maneuverability / Turning Radius	✓	

New Technologies in ICVs

- Hybrid drive (Sweden)
- Active Suspension
- Modular Construction
- Modular Armor
- Continuous rubber band tracks



Modular Armor

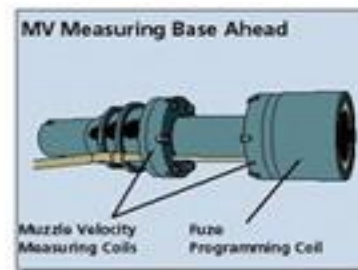
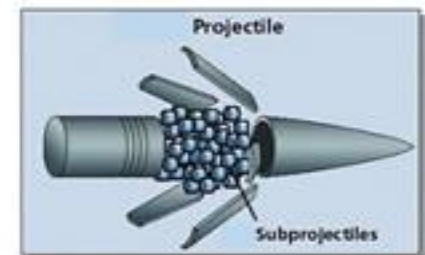
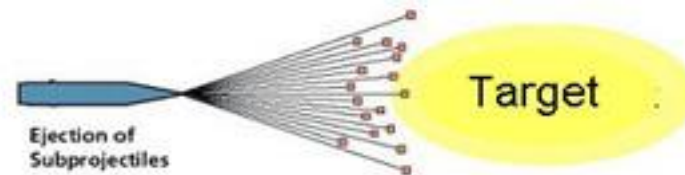
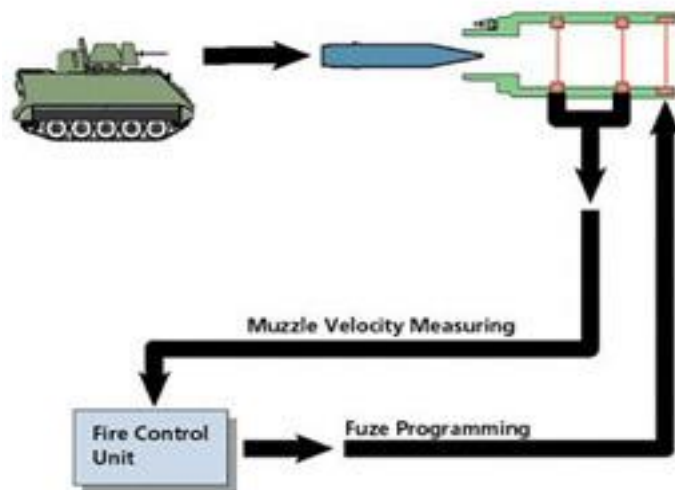


Modular Construction



Hybrid Drive

- Electric Reactive Armor (Lockheed Martin)
- 40mm Case Telescoped Weapon System (BAE+Nexter)
- Air Burst Munition (ABM)



Deficiencies in ICVs

- Difficult to fire when vehicle on move
- Lightly armoured roof
- Simultaneous Multiple Target Engagement not possible.
- US experience of wars in 1991 and 2003 showed lack of proper IFF –(Identification Friend or Foe) Systems.
- Heavy steel armour.
- Vulnerable to mines and RPGs.

Deficiencies in BMP-2

- Troop seating
- Fuel tanks



Seats



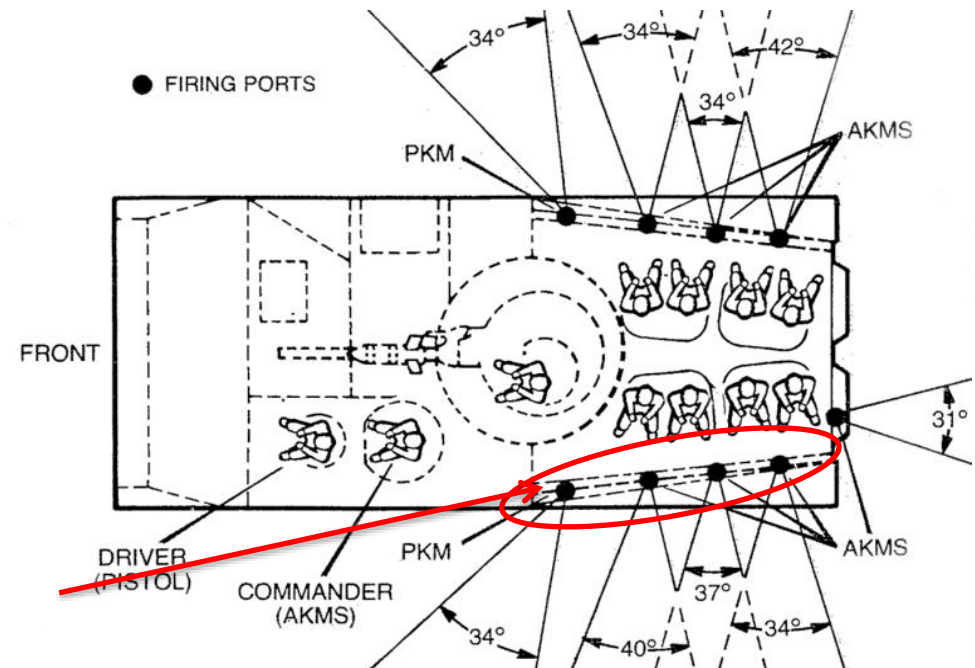
Fuel tank



- Light armoured
- Cannon reloading is slow
- Paint quality
- Control panels
- Firing ports



Firing Ports



- Russian Instructions
- Cabin Ambience
- Emergency exit
- Seat harness
- Heating of crew compartment
- No cushioning for jerks
- Grenade Launcher

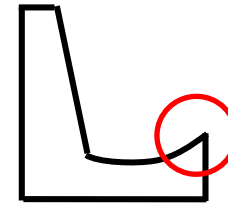


Grenade Launcher on Turret



No Harness & Cushioning on the Seats

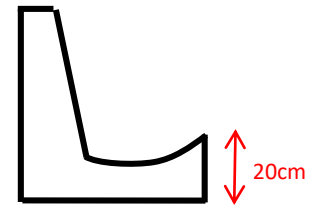
- Crew Seat
- Crew Seating height



Crew Seat



Crew Seat



Crew Seat

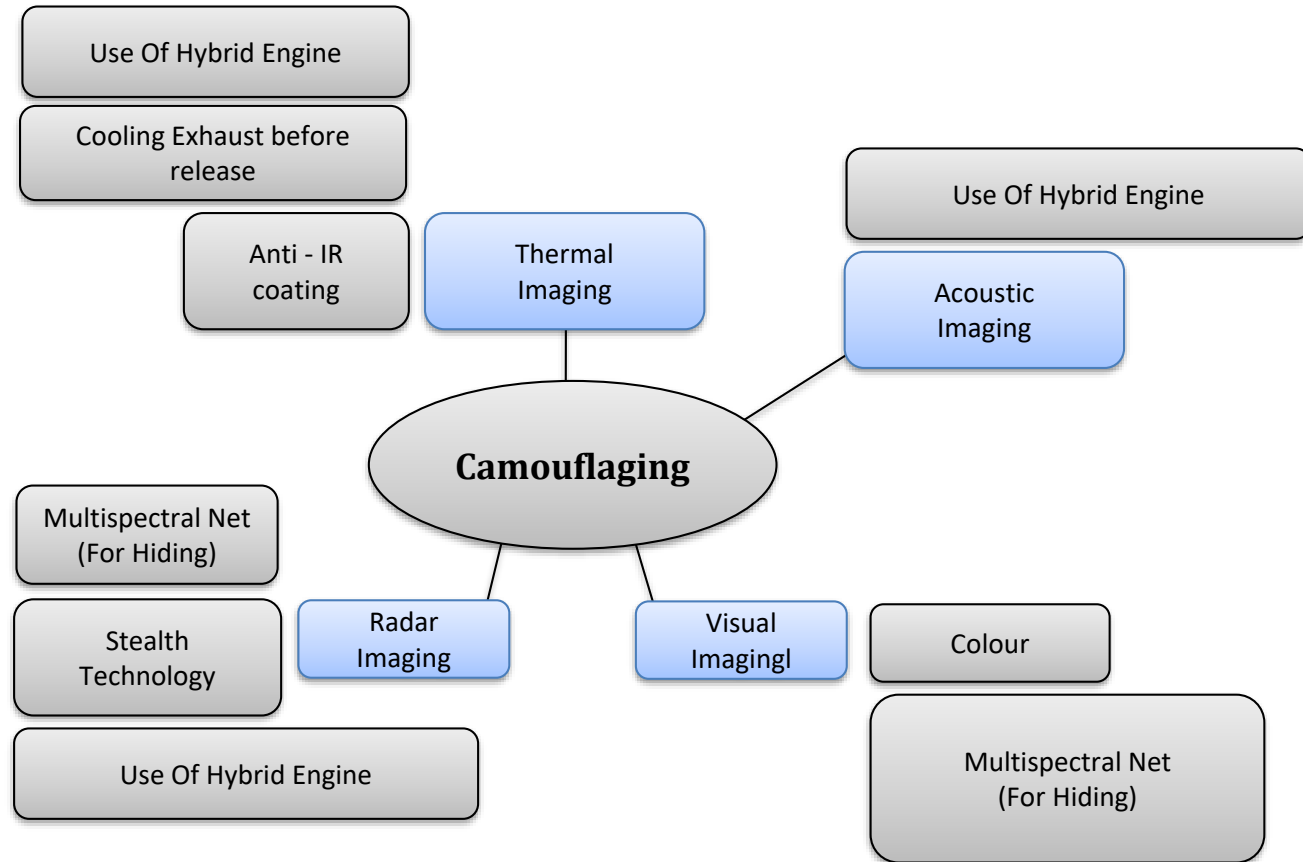
Good feature of BMP-2

In comparison to the other ICVs which has side exhausts, BMP-2 has upper Exhaust Vents. This is a good feature. During battle, bullets & artillery fragments penetrates the side vents that leads to explosion.

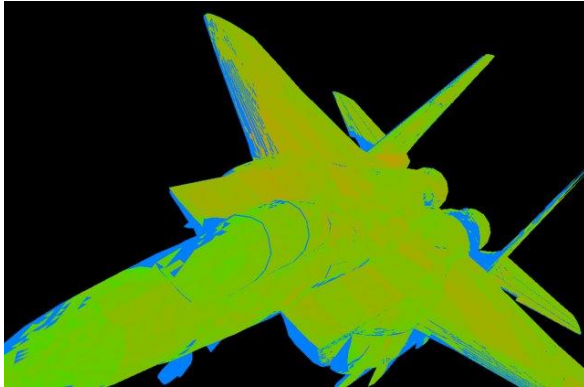


Upper Exhausts

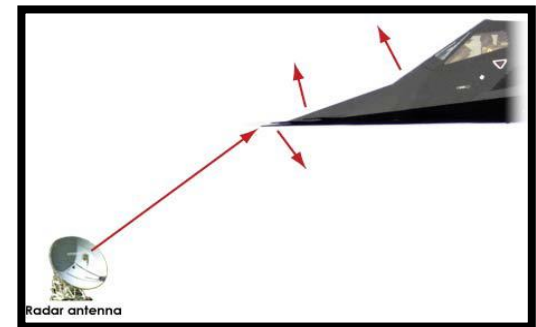
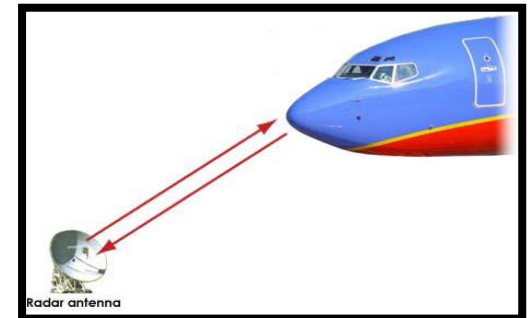
Camouflaging : Mapping



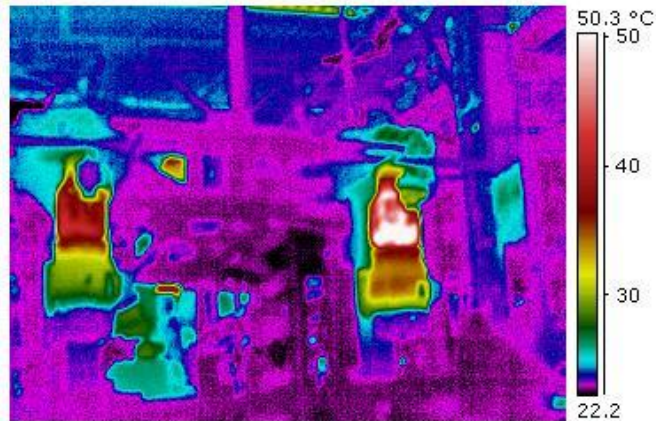
Radar Signature



- Radar Signature of an object depends on the amount of radio energy sent by the radar it deflects back to the radar
- Certain cross-sections & wedge like shapes reflect very low amount of radio energy back to the radar
- Reflections cant be completely removed
- Surface treatment to absorb radar energy
- Combined result : ICVs can have a signature as small as a small animals
- Stealth Technology can be used to eliminate the RADAR signature.



Thermal Signature



- Heat energy emitted is a potential source for ICVs being the target of Fighter Crafts using Infrared & heat seeking missiles
- Surface coatings are available that reduce thermal signature and camouflage against surroundings.
- Match thermal signature with that of the environment is one of the remedy.
- Running the ICVs on battery power during war (Hybrid Drives).

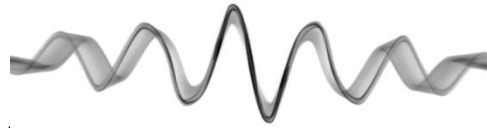
Figure:

1 – ICV without Anti-Thermal Coating

2 – ICV with Anti-Thermal Coating



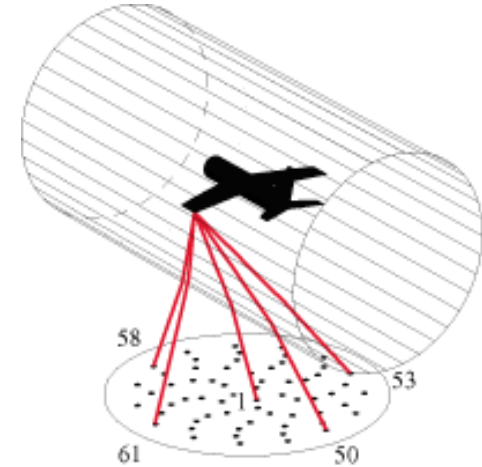
Acoustic Signature



Sound from ICVs can also be lethal for them and can destroy other camouflaging protections.

Many fighter planes deploy, the acoustic imaging system, consists of three major components the ultrasonic sensor, sensor controller, and personal computer. The ultrasonic captures the sound wave input while the personal computer displays the image output on a computer screen. The personal computer use MATLAB to process the signals provided by the ultrasonic sensor. It enables to image any vehicle running on the ground.

So, dampening of the Acoustic source is also of great concern.



Visual Signature

External Body Painting of ICVs is also of much importance and is the primary level of protection. Choose of good quality color paint keeping in mind the Climate & Terrains , in which the ICVs are to be used can provide a better and economical Protection level.

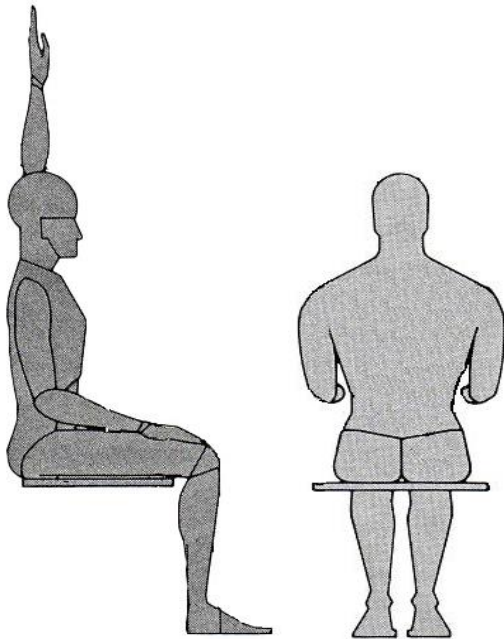


Project Brief

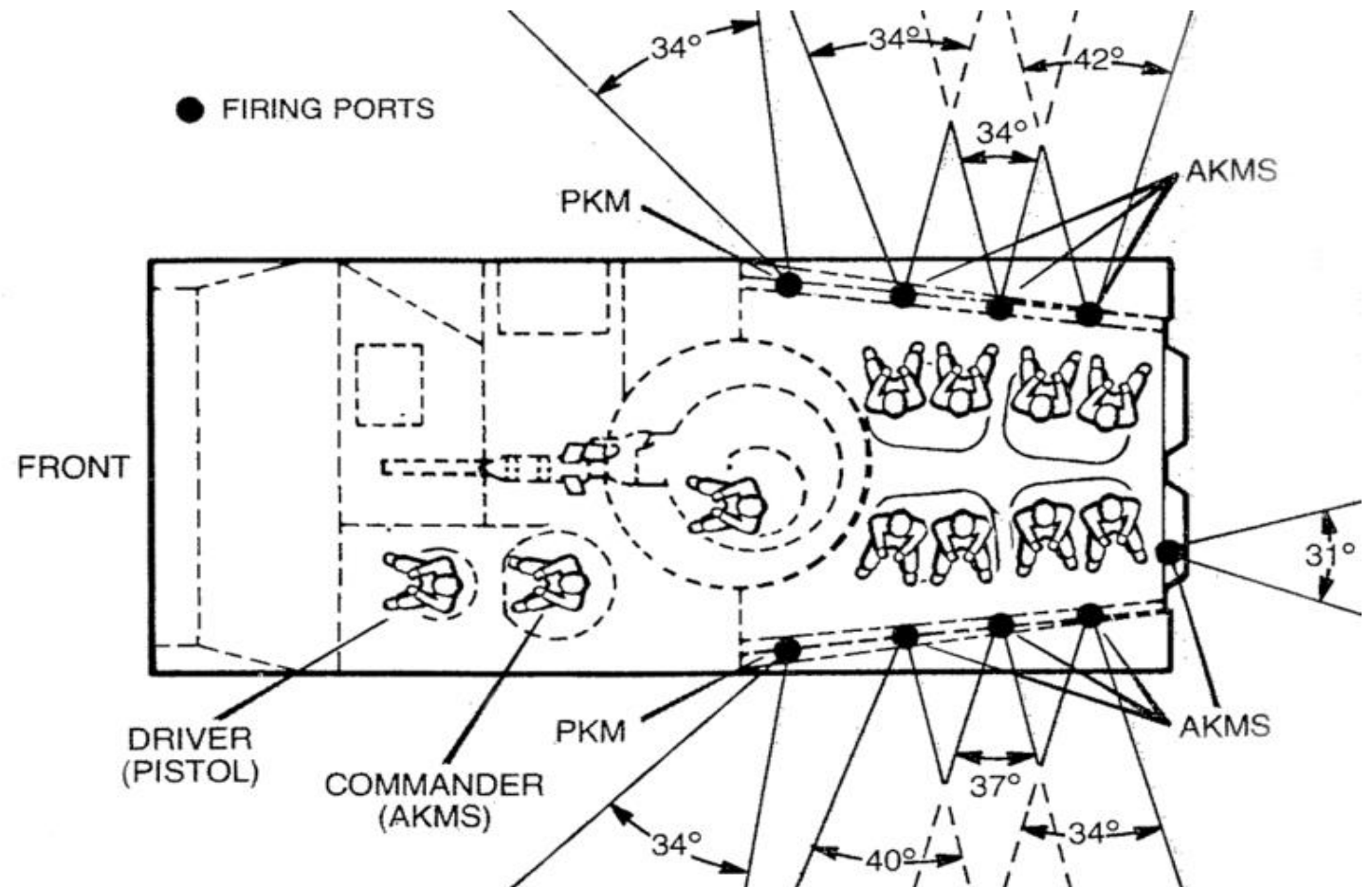
After understanding the insights from the data collection concerning the history of ICVs and the current Indian and International scenario it is clear that what user desires to see is an ICV in terms of usability, simplicity of operation, comfort and performance. Concerning the above issues the following brief is written for the project:

“The goal of the project is to achieve a perfect balance between the bookends of appearance, function and safety of the crew members as well as the vehicle and targets to develop an ICV to enhance its service to the user in terms of functionality and user convenience with regards to war-fare ergonomics.”

Ergonomic Analysis & Layout



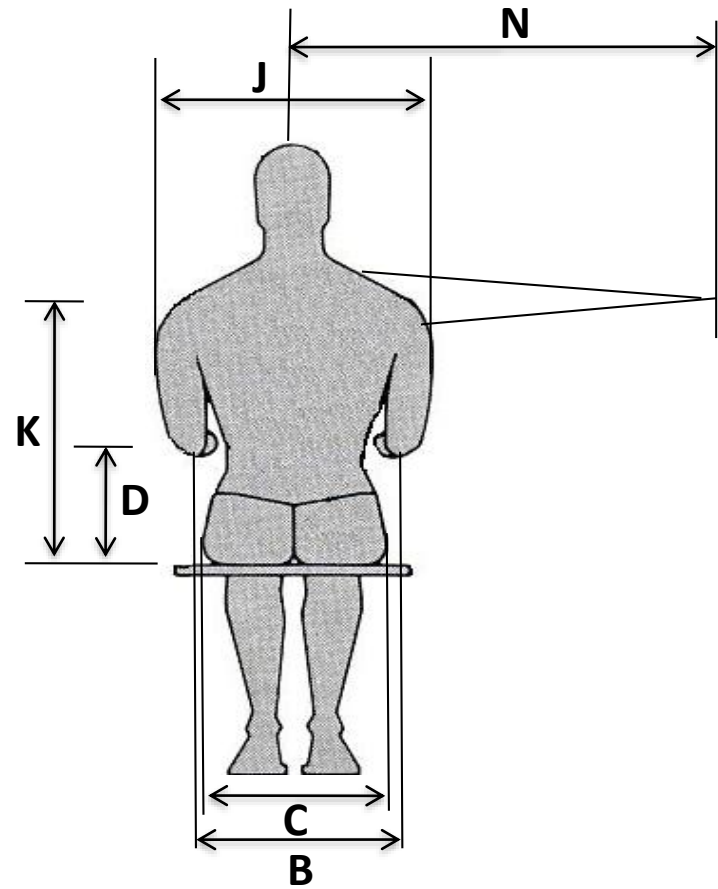
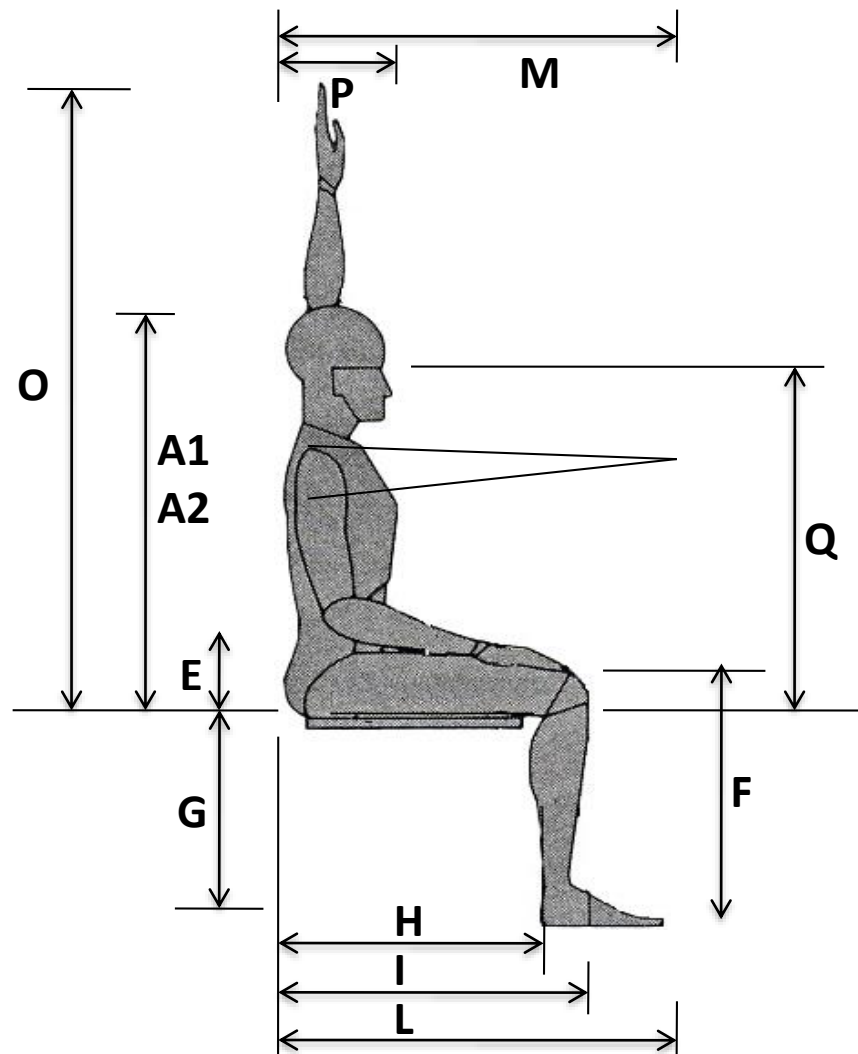
BMP 1



Abbreviations used throughout the Ergonomic Analysis

A1	Sitting Height (Erect)
A2	Sitting Height (Normal)
B	Elbow-to-Elbow Breadth
C	Hip Breadth
D	Elbow Rest Height
E	Thigh Clearance
F	Knee Height
G	Popliteal Height
H	Buttock Popliteal Length

I	Buttock Knee Length
J	Shoulder Breadth
K	Mid-Shoulder Height Sitting
L	Buttock-Toe Length
M	Thumb Tip Reach
N	Side Arm Reach
O	Vertical Reach Height Sitting
P	Maximum Body Depth
Q	Eye Height Fitting



Ergonomic Data

01 Stature

Age		18 - 24	25 - 34	35 - 44
5th		163.3	163.6	163.1
50th		174.2	175.3	174.2
80th		180.1	181.4	179.6
95th		185.7	187.5	184.2

02

	J (Shoulder Breadth)	M (Thumb Tip Reach)
5th	44.2	82.3
95th	52.6	97.3

03 Vertical Reach Height Sitting

Age		18 - 24	25 - 34	35 - 44
5th		84.6 / 81.0	82.6 / 81.5	85.6 / 81.3
50th		91.2 / 86.9	91.7 / 87.4	91.4 / 87.1
80th		95.8 / 89.9	94.7 / 90.4	95.8 / 90.2
95th		97.3 / 93.2	97.5 / 93.5	96.5 / 93.2

04 Knee Height

Age		18 - 24	25 - 34	35 - 44
5th		49.3	50.3	49.3
50th		54.6	54.9	54.6
80th		57.2	57.7	57.2
95th		59.4	61.0	59.4

All the dimensions are in cm

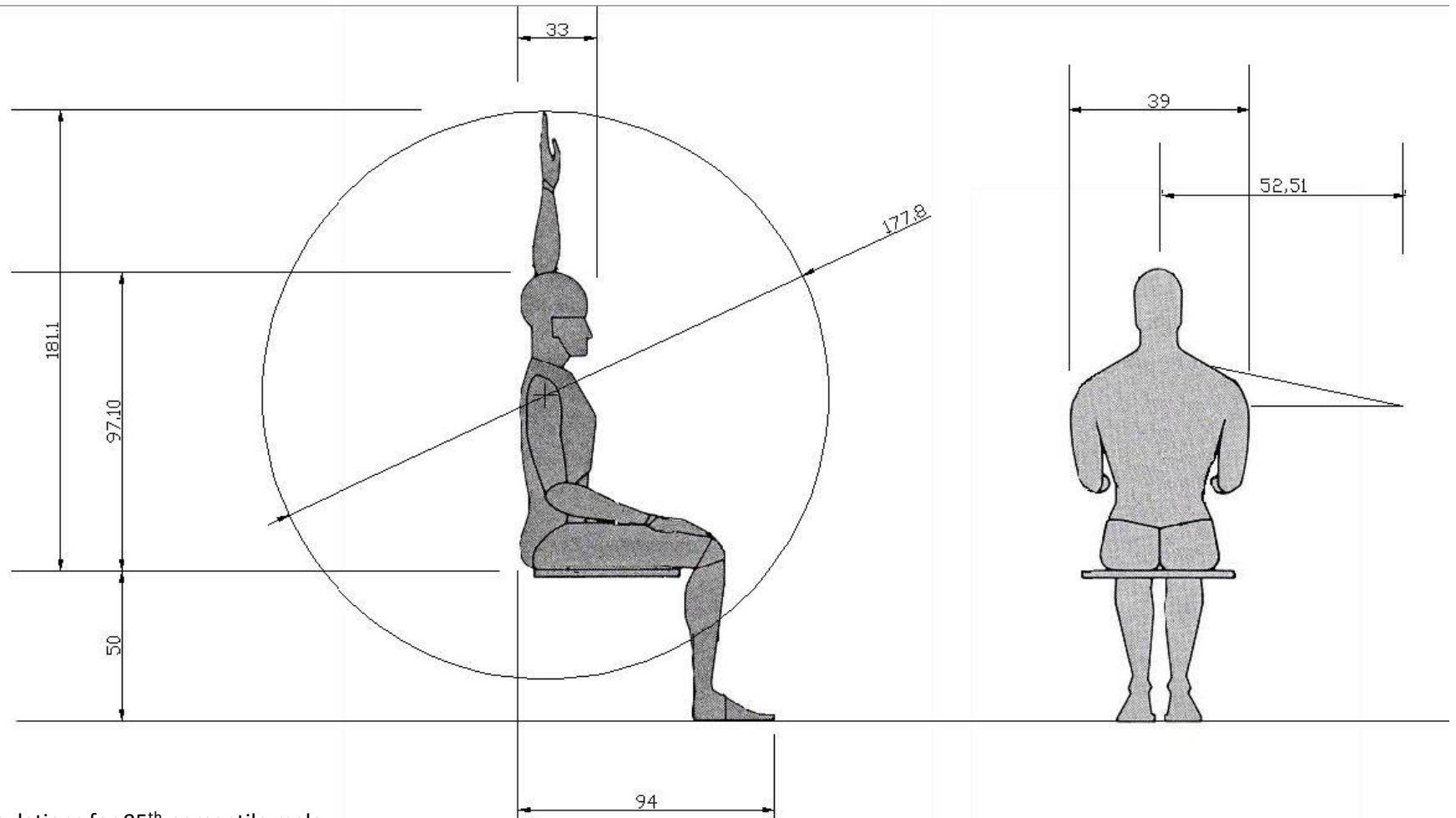
05

		18 - 24	25 - 34	35 – 44
5 th	G	40.6	40.6	39.6
	B	33.3	34.8	35.8
	C	30.5	31.0	31.5
50 th	G	44.5	44.5	43.9
	B	39.1	41.4	42.4
	C	34.3	35.6	35.8
80 th	G	47.0	47.2	46.2
	B	43.7	45.2	46.5
	C	37.1	37.8	38.1
95 th	G	49.8	50.0	48.5
	B	49.3	50.0	50.8
	C	40.1	40.6	40.4

Calculations For 95th Percentile

	18 - 24	25 - 34	35 - 44	Avg.
A1	97.3	97.5	96.5	97.10
A2	93.2	93.5	93.2	93.30
B	49.3	50.0	50.8	50.03
G	49.8	50.0	48.5	49.43
J				52.60
L				94.00
M				88.90
N				86.40
O				131.10
P				33.00
H	54.9	55.6	55.4	55.3

All the dimensions are in cm



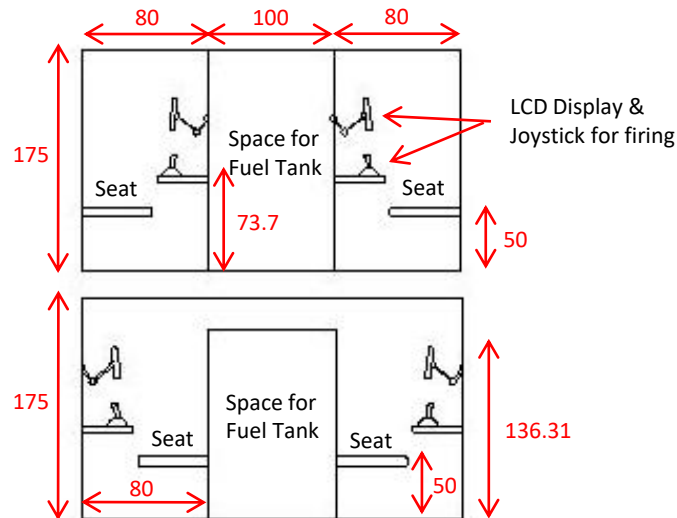
Calculations for 95th percentile male
All the dimensions are in cm

Various Layout Plans

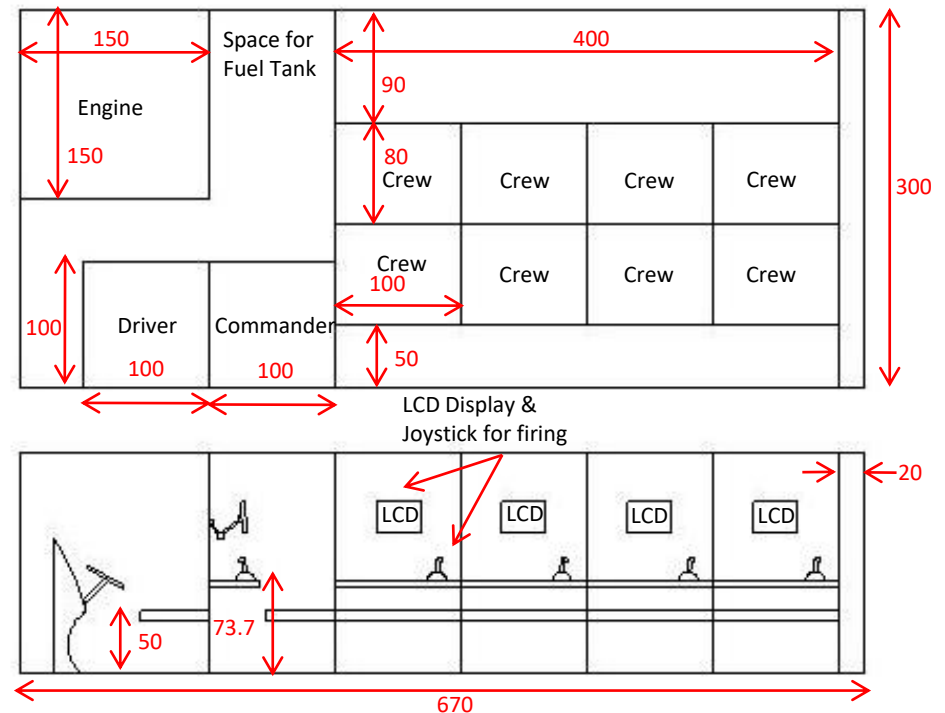
Layout 1

Designing of the layout started all with new approach of giving all the infantrymen to have Automatic Machine Guns so that they can fire through joysticks. The major advantage was that Infantrymen will be saved from the exposed firing ports in the conventional ICVs. The dimensions of this layout is given in the diagram. The dimensions used for the designing was directly taken from the ergonomic Analysis, there was no optimization. Here two seating arrangements have been shown for the Crew men. One back to back and another back facing the wall.

The biggest disadvantage was, plenty of space it was taking for the additional joysticks and LCD Panel. Later going through the technical details, it was found that the efficiency of the even 2 infantrymen firing through the joysticks is equivalent to all the Infantrymen firing in the conventional ICVs. So, for the better utilization of the space, layout had to be changed.

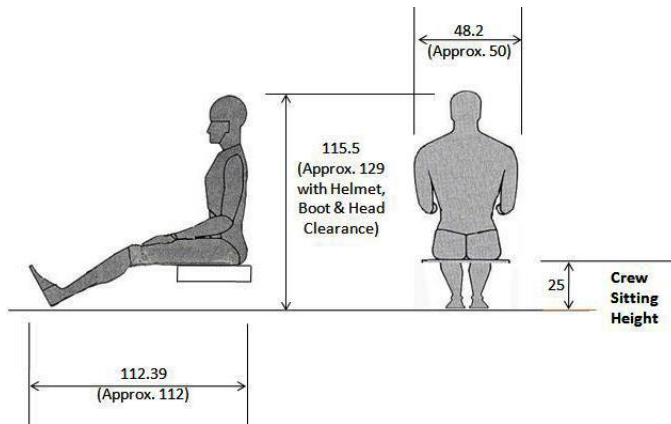


Calculations for 95th percentile male : All the dimensions are in cm

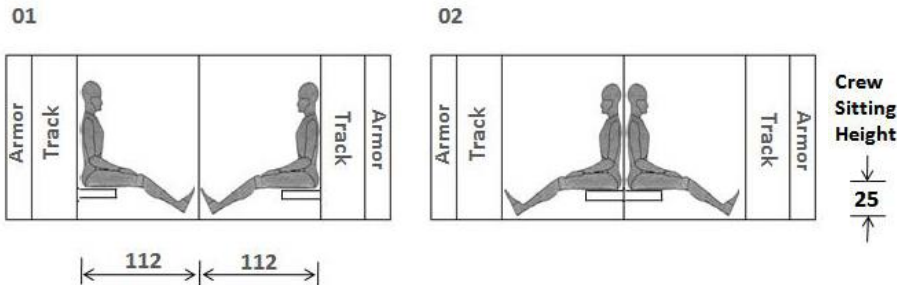


Layout 2

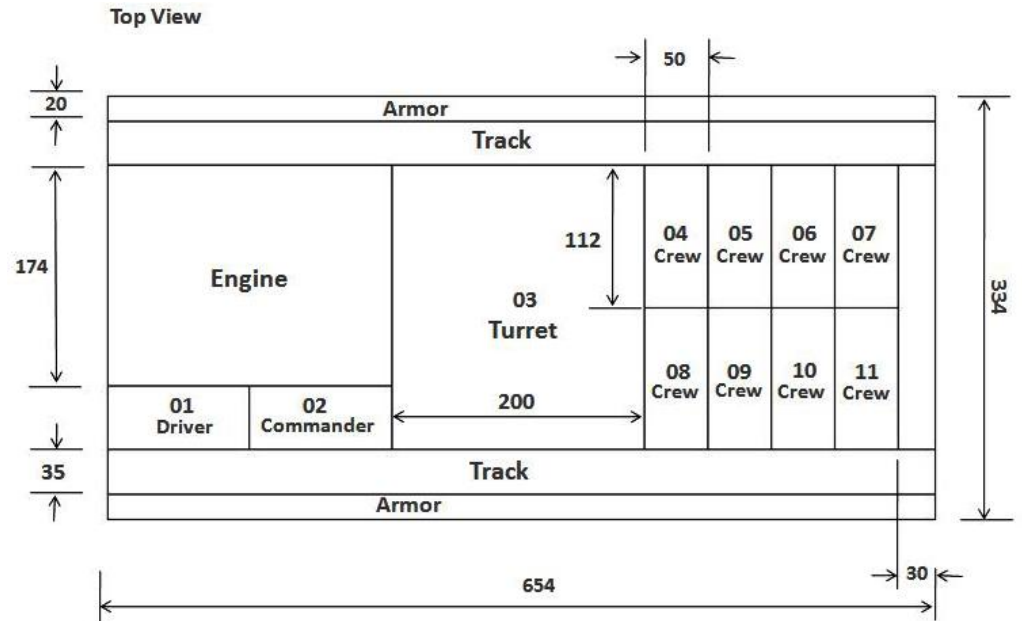
Stage2 comes up with the better utilization of the space , decrease in the vehicle length, Track & Layouts were also considered in the layout and a bit detailed dimensions of the major parts.



Back View

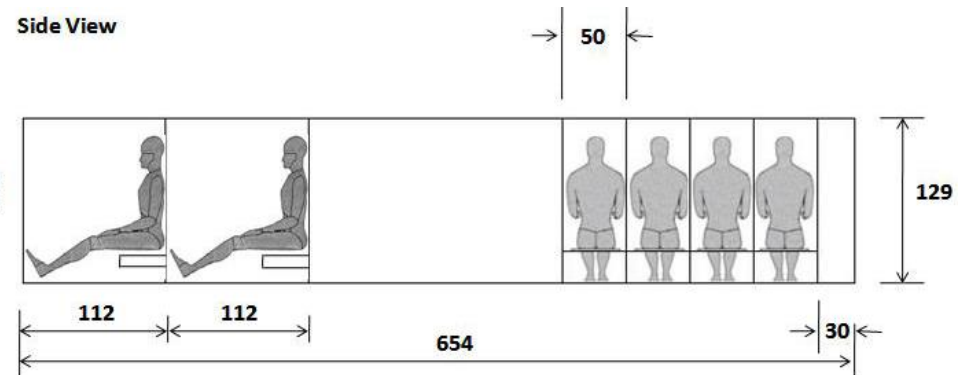


Calculations for 95th percentile male : All the dimensions are in cm

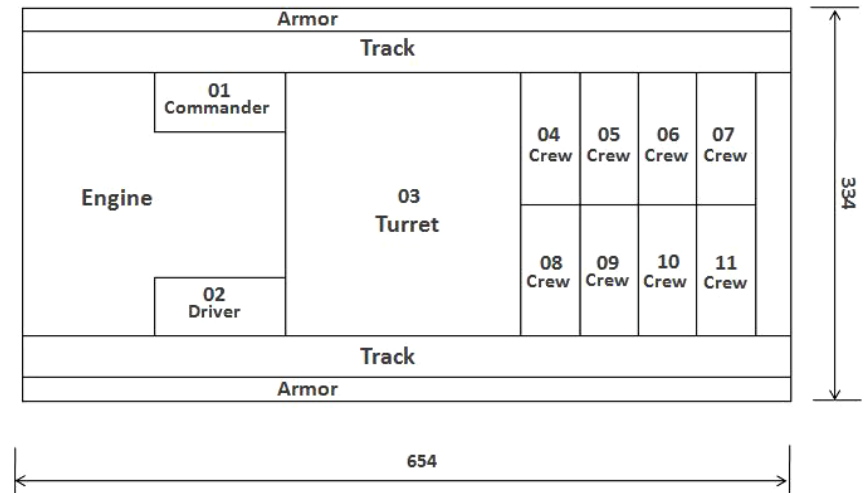
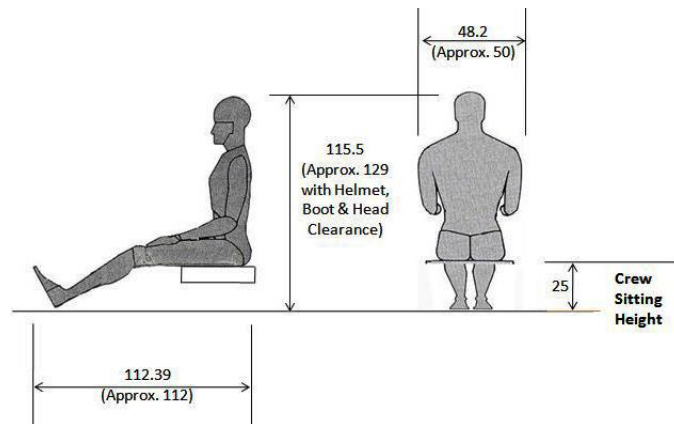


All the dimensions are in cm

Side View

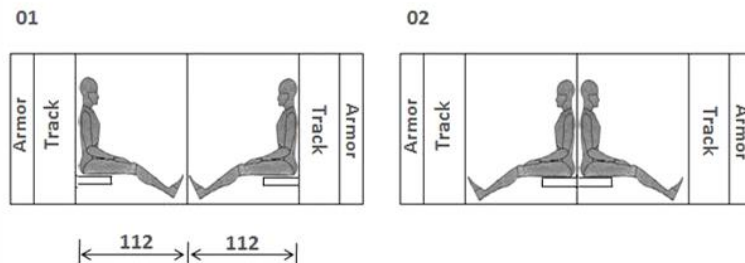


Layout 3

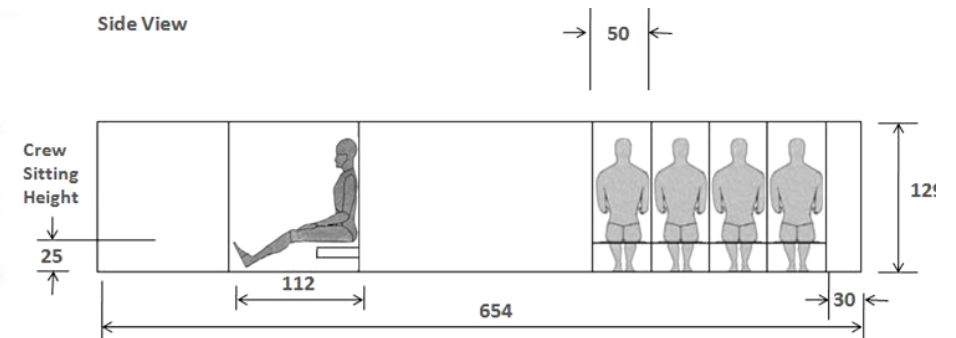


All the dimensions are in cm

Back View

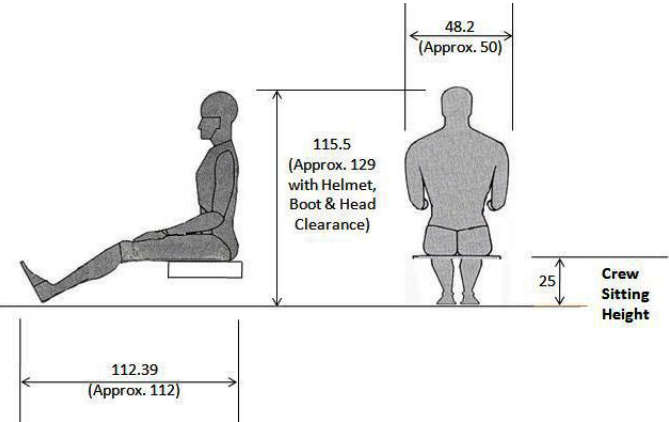


Side View

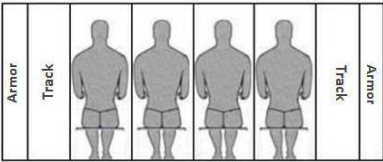


Calculations for 95th percentile male
All the dimensions are in cm

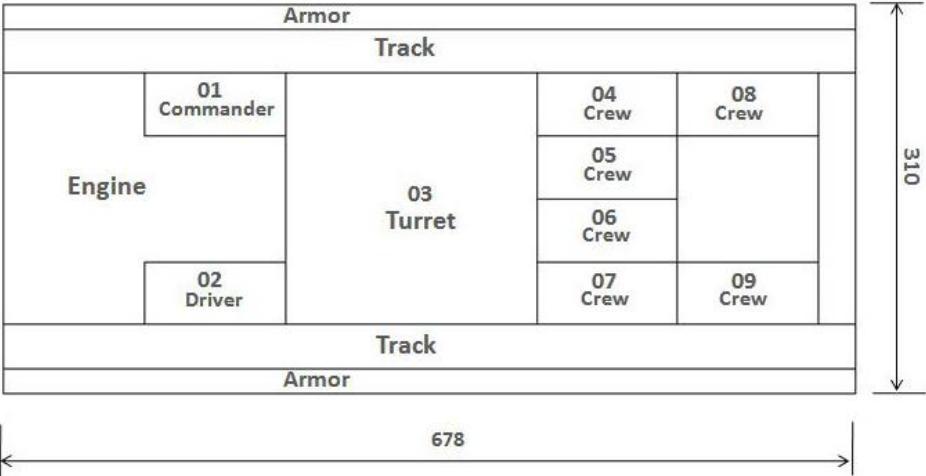
Layout 4



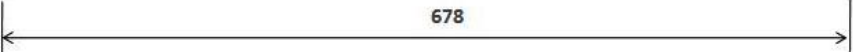
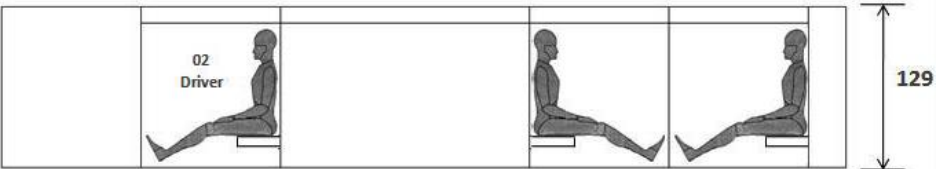
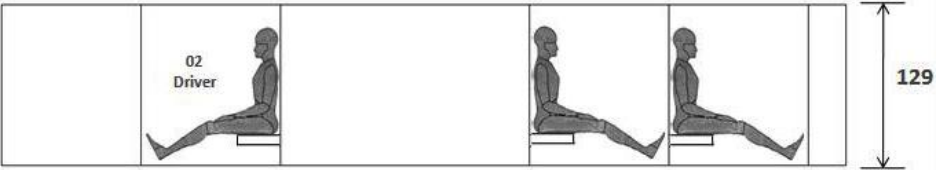
Back View



Calculations for 95th percentile male
All the dimensions are in cm

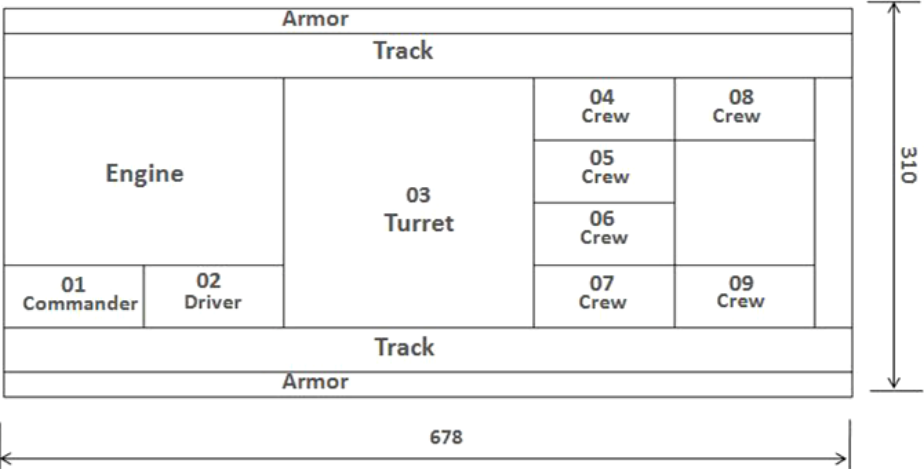
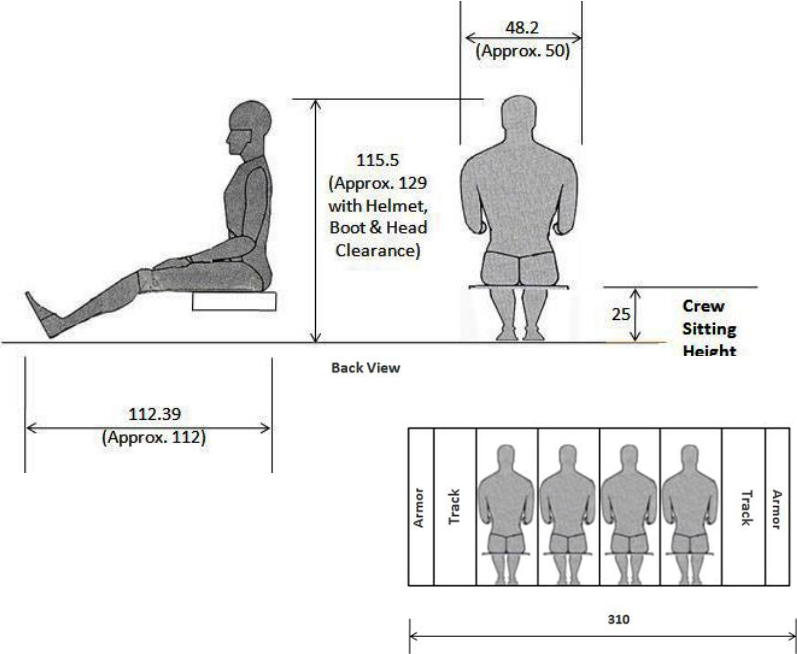


Side View

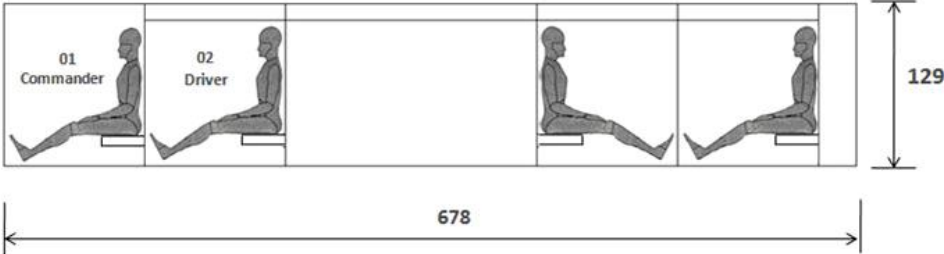


Layout 5

The biggest disadvantage of 2,3,4 & 5 was the Gunner for the turret was never taken into consideration. 4 & 5 had reduced the number of crewmen which was not good. And crew sitting height was decreased to 25cms, which was not comfortable. The Hollow space in the front part of Vehicle was also not considered, which helps in the Amphibious working of the Vehicle. Even the Turret Dimensions were not considered for the height decision.

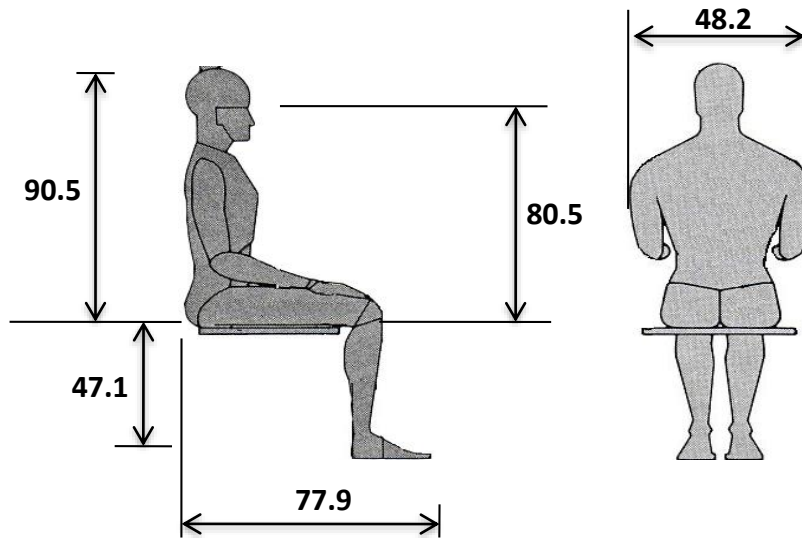


Side View



Calculations for 95th percentile male
All the dimensions are in cm

Final Layout Concept



$$\begin{aligned}\text{Seat Height} &= \text{Popliteal Height} + \text{Boot} \\ &= 47.1 + 3 \\ &= 50.1 = 50 \text{ (approx.)}\end{aligned}$$

$$\begin{aligned}\text{Space width for one Soldier} &= \text{Shoulder Width} + \text{Clearance} \\ &= 48.2 = 50 \text{ (approx.)}\end{aligned}$$

$$\begin{aligned}\text{Crew Compartment Height} &= \text{Seat Height} + \text{Sitting Height} \\ &\quad + (\text{Helmet or Turban}) + \text{Clearance} \\ &= 50 + 90.5 + 3 + 10 \\ &= 153.5 = 155 \text{ (approx.)}\end{aligned}$$

$$\text{Buttock-Toe Length} = 77.9 = 80 \text{ (approx.)}$$

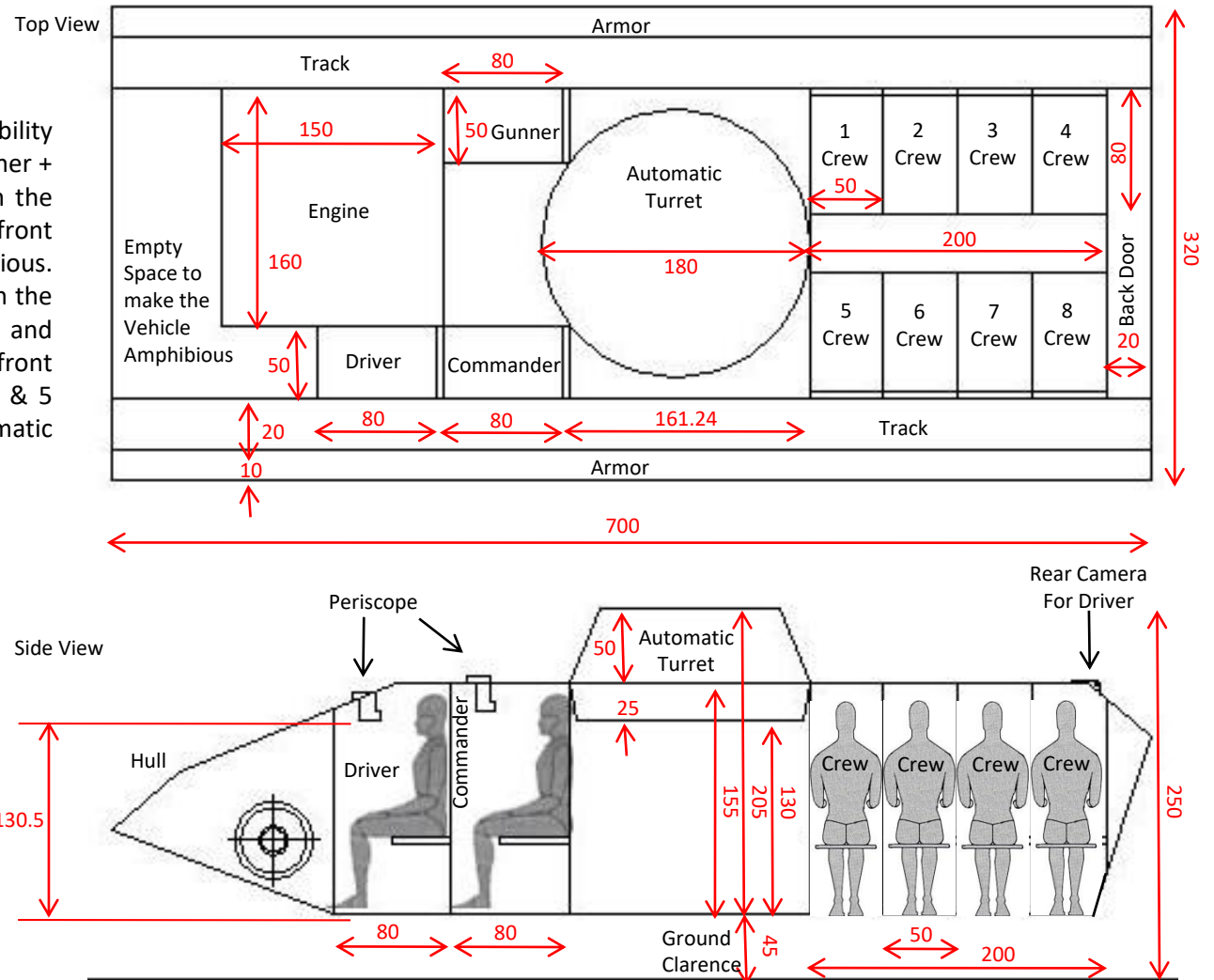
$$\text{Seat \& Back Cushioning} = 5$$

Rest of the Dimensional Data are given throughout the final layout Of the ICV.

Calculations for 95th percentile male
All the dimensions are in cm

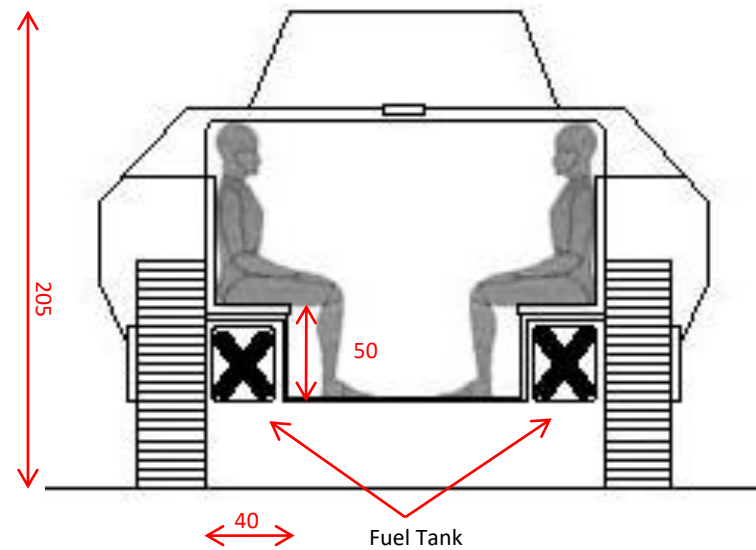
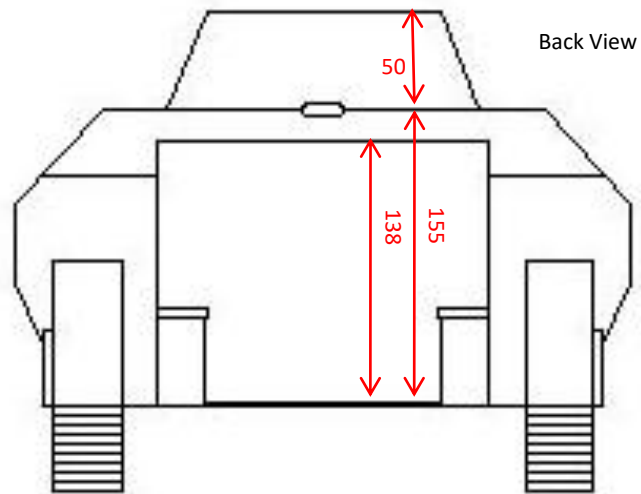
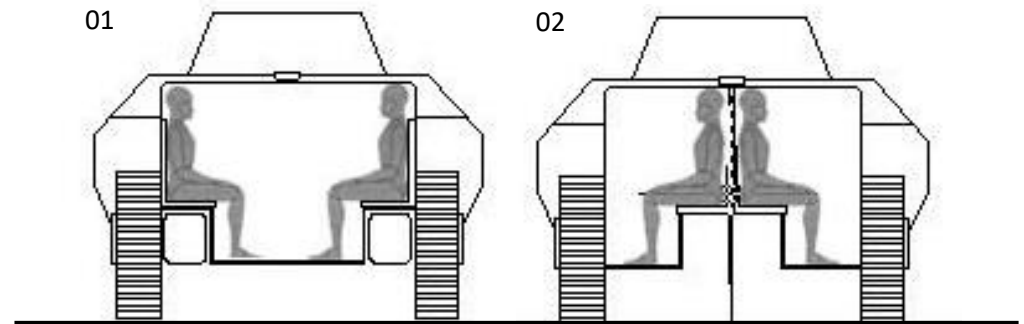
Final Concept

The final lay started with considering capability of 11 people (Driver + Commander + Gunner + 8 Crew). All the dimensions are given in the layout figure. There is empty space in the front part of the vehicle to have it Amphibious. There is two rows of Infantrymen sitting in the rear part of the vehicle. Driver and Commander are in the left side in the front while Gunner is in the right side. Crew 1 & 5 will be the persons who will be firing Automatic Machine Guns.



Calculations for 95th percentile male
All the dimensions are in cm

The crew sitting can be of two types as shown in the figure. Both are good and optimized to its best. But the need to break the fuel tank into two banks lead to take decision in favor of the first.



All the dimensions are in cm

Rig Testing & Changes Post-Rig Testing



After the Ergonomic Calculation and Layout designing, Rig was made of the crew compartment to get the real feel of the space. There were several important points which has to be taken into account and are explained here.

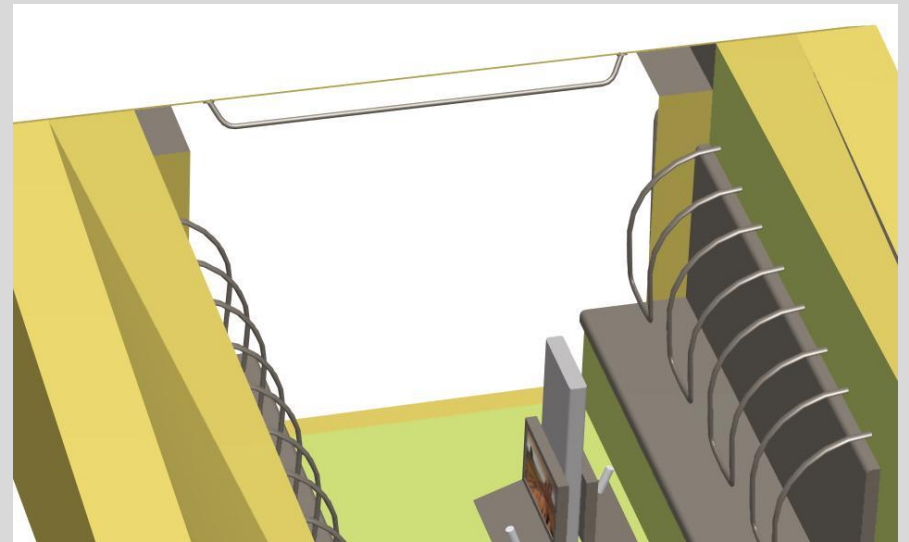
There were several Changes Post-Rig Testing. Rig Testing was done with few of the people of different heights to ensure that there is proper utilization of available space within Ergonomic Boundaries.





Problem while alighting the vehicle : Soldiers with all %tile needed something to hold while alighting.

For this problem holding while alighting the ICV was solved by providing a Alighting Rod placed just above the door on the inside.





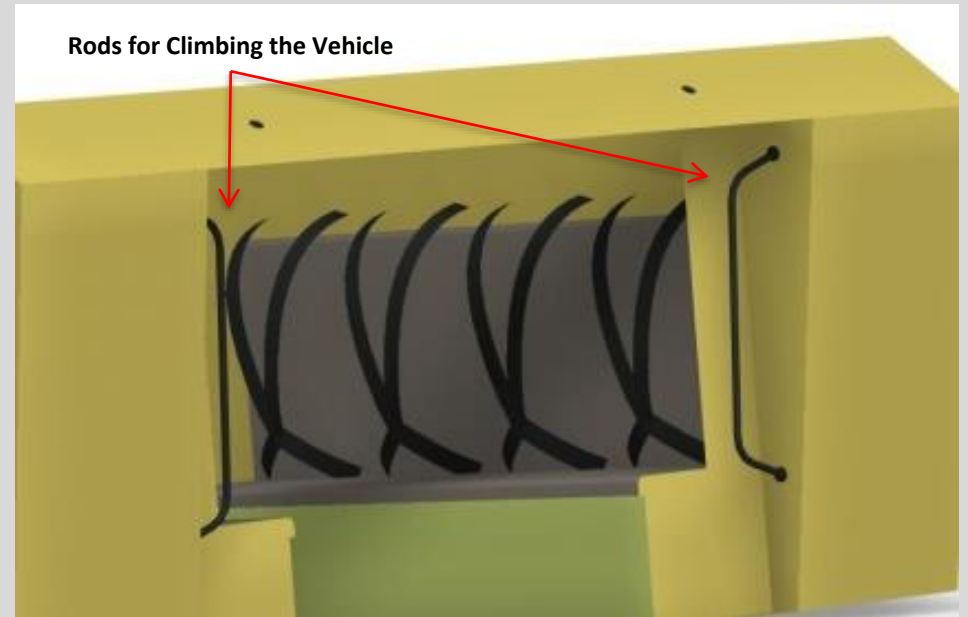
As the whole calculation was done for the soldier with 95th %tile, so the soldier of 50th %tile was facing problem while sitting as his feet was in air. So, seat height is needed to be decreased.

For this case of sitting problem, seat height was decreased from 50cms to **40cms**. Again testing was done with people of all heights, due to presence of extra space in front of seat, height was comfortable for people with all types of heights.



Soldier with smaller height needed some support or handle while climbing the vehicle.

This Problem for the need of having a hold by a soldier of small stature was solved by providing Climbing Hold Rod given on the both sides of the door on the back side.

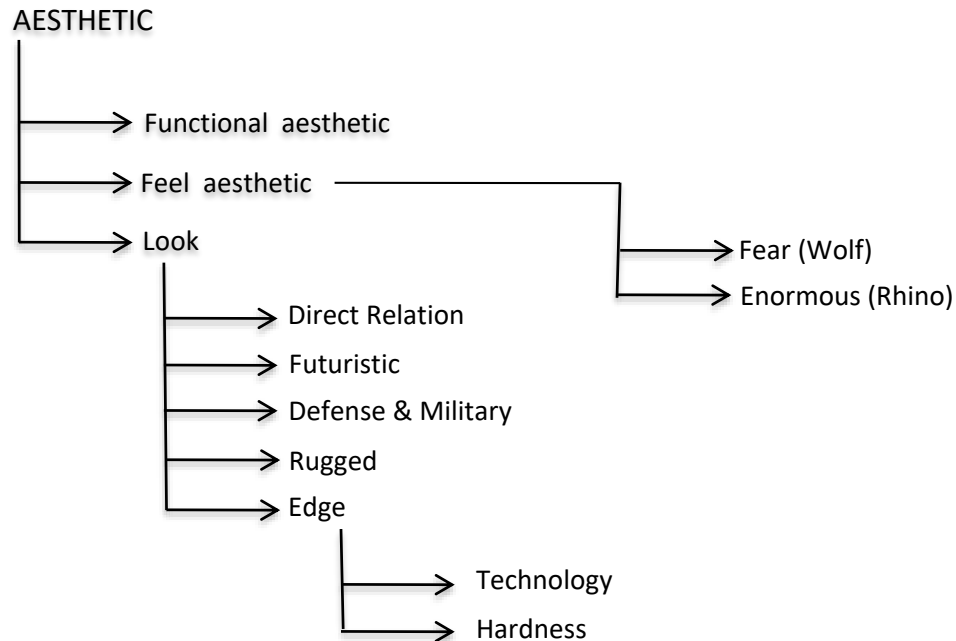


Aesthetic & Styling



AESTHETIC

Aesthetic in case of Army is needed for Moral. The Feeling of having a Good fighting Weapon keeps the moral of the Soldier high and of enemy low. Visual Plays a Drastic Effect on the mind. So, Aesthetic & Styling in case of Army Product is also justified.



MOOD BOARD



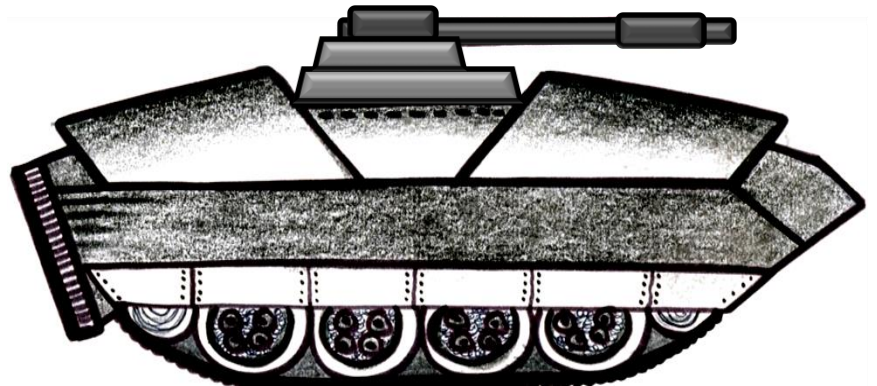
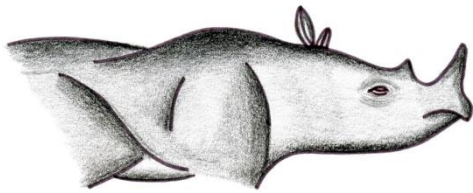
Elements of Mood Board

The words that comes out of my mood board to describes my Design are

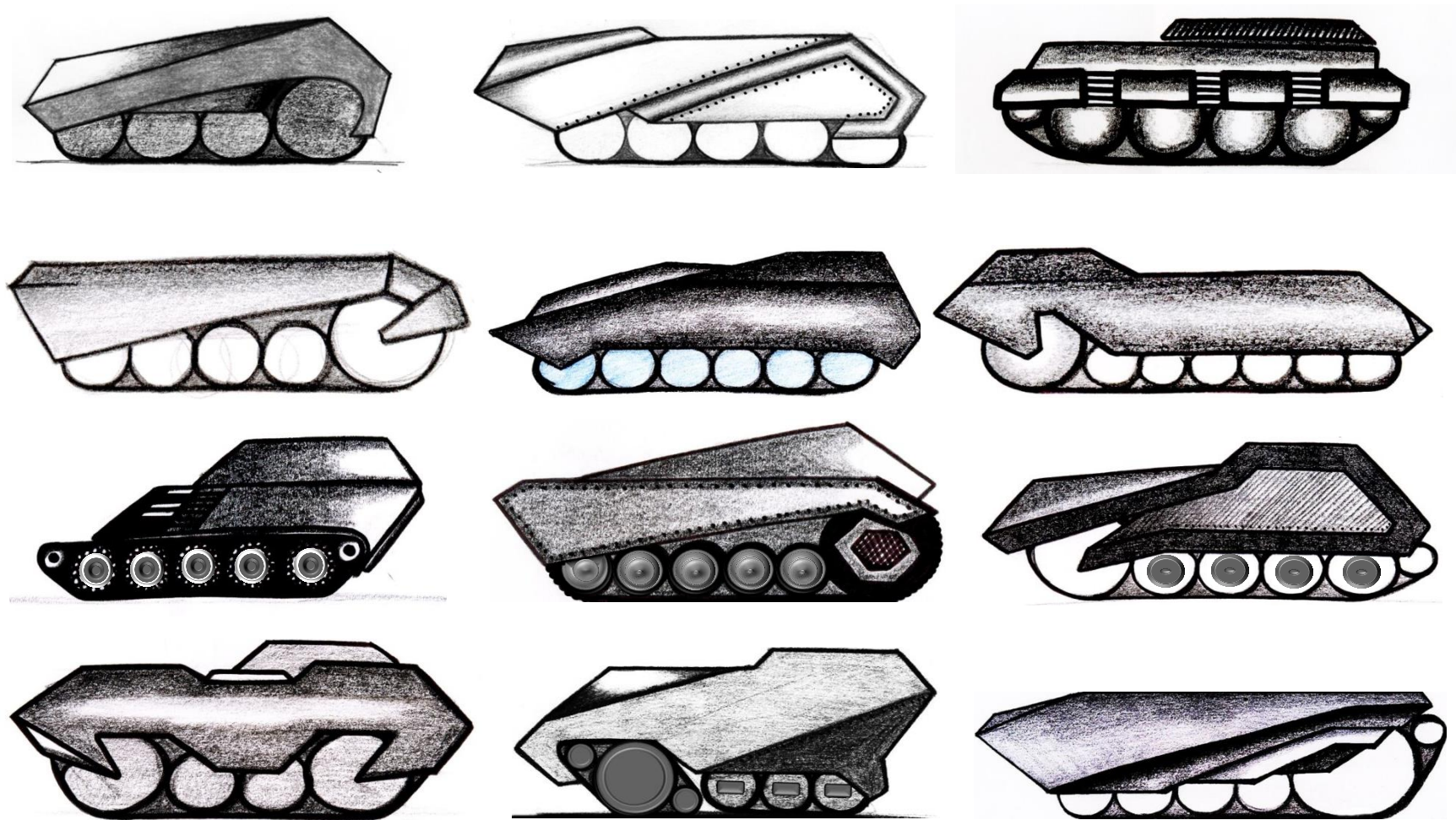
- **Aggressive**
- **Dynamic**
- **Ferocious**
- **Futuristic**
- **Powerful**
- **Rugged**
- **Protective**
- **Enormous**

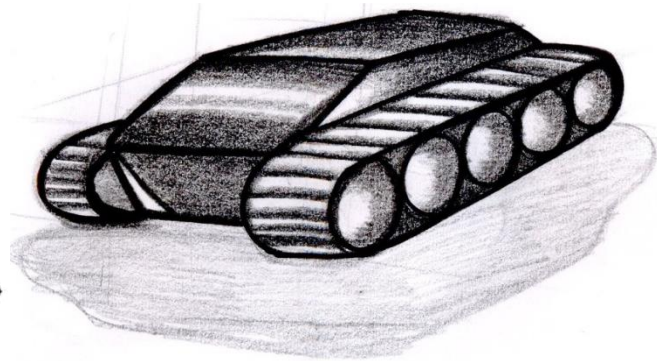
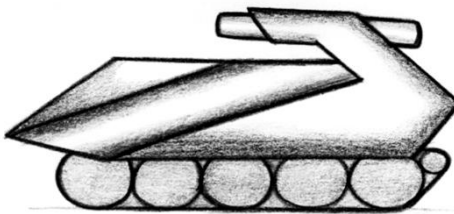
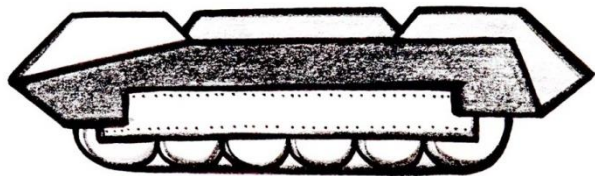
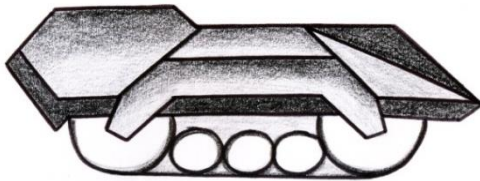
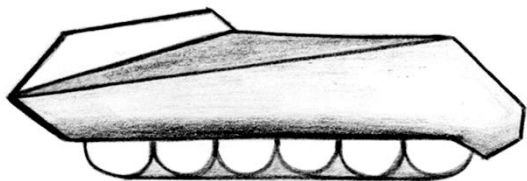
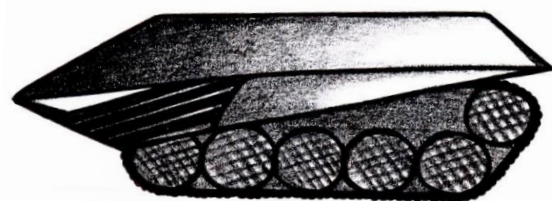
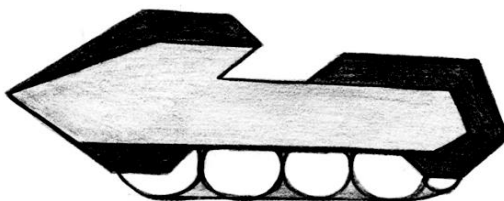
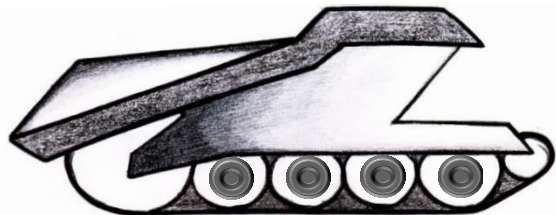
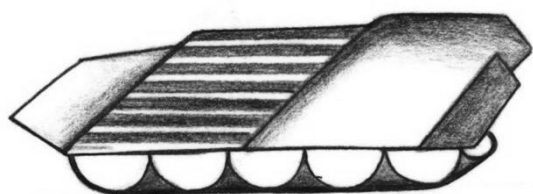
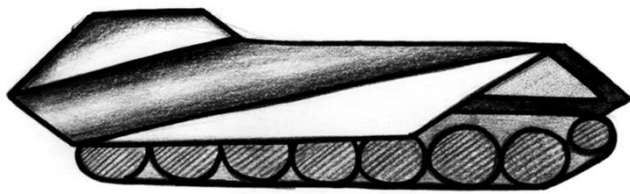
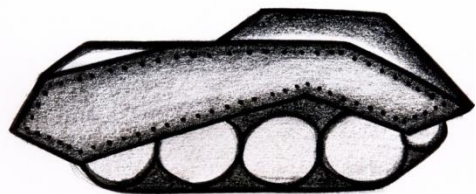
Concept Sketching & Ideas

Rhino



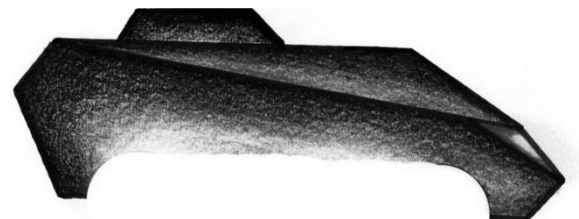
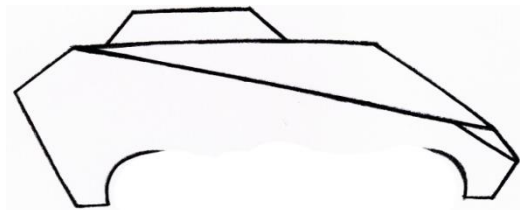
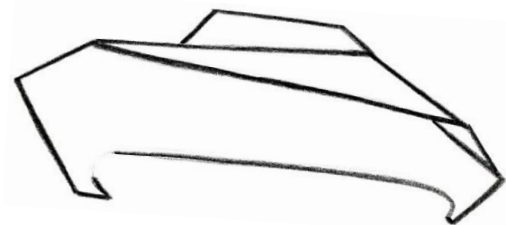
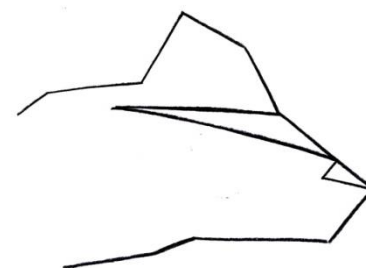
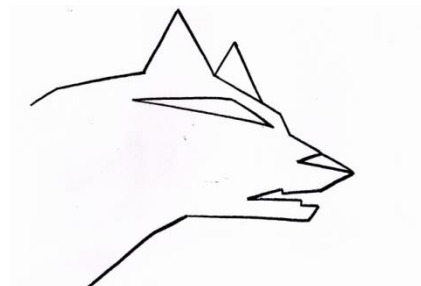
Other Concept Sketching



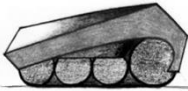
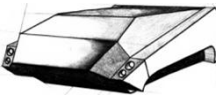


Fear (Wolf) : IMAGE BOARD





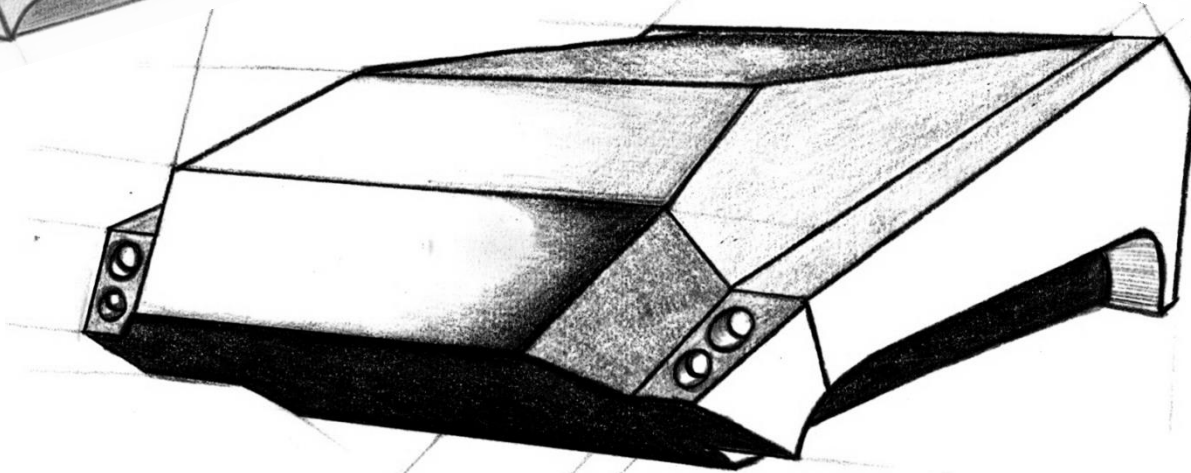
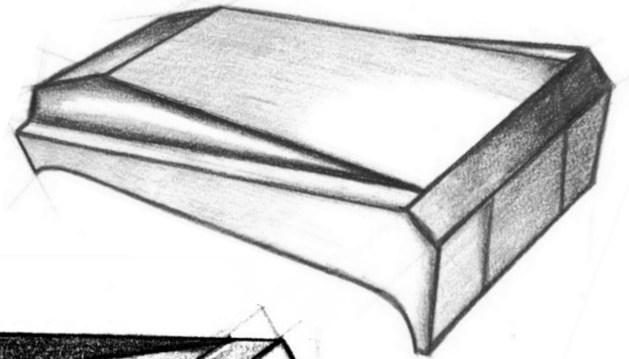
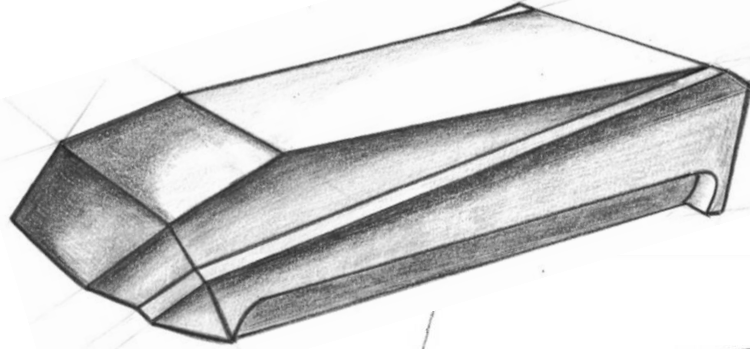
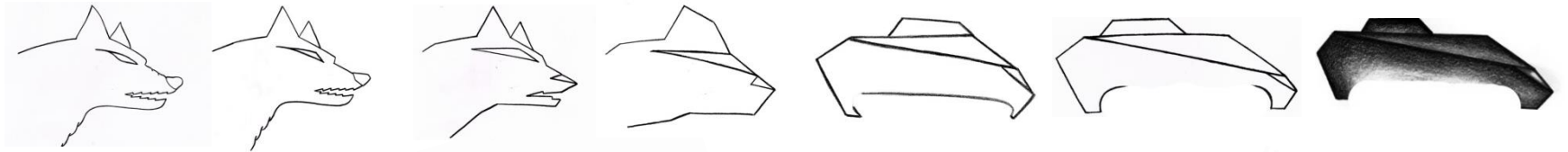
Selection of Final Concept

		1	2	3	4	5	6	7
								
Aggressive		4	4	6	7	6	8	5
Dynamic		4	4	5	7	6	9	5
Ferocious		4	4	6	8	5	8	6
Futuristic		2	5	4	8	7	9	5
Powerful		7	6	5	8	6	8	6
Rugged		8	5	3	6	6	6	7
Protective		6	4	4	7	6	7	5
Enormous		7	5	3	8	6	8	5
Total		42	37	36	59	48	63	44

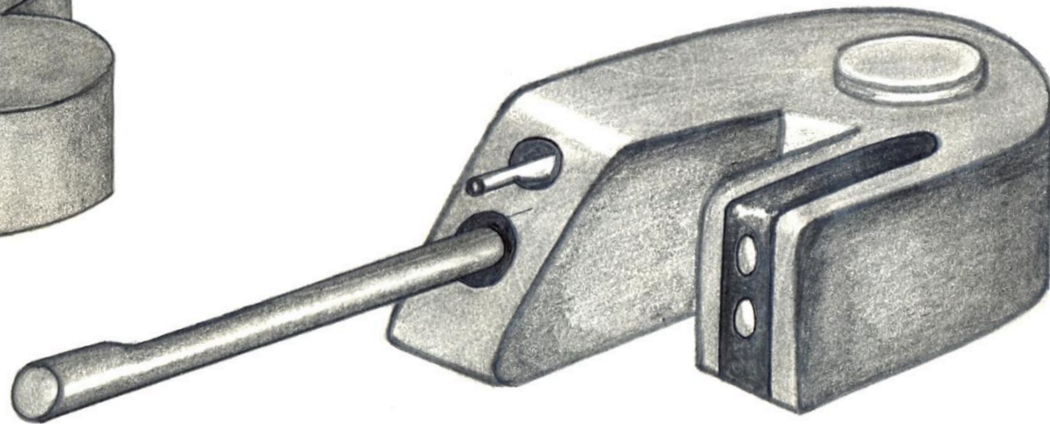
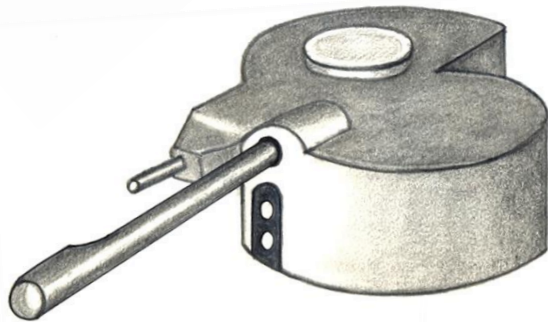
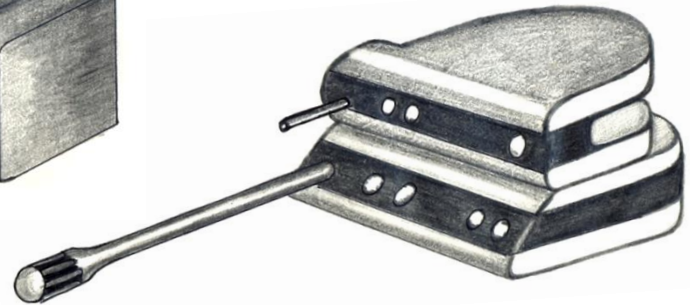
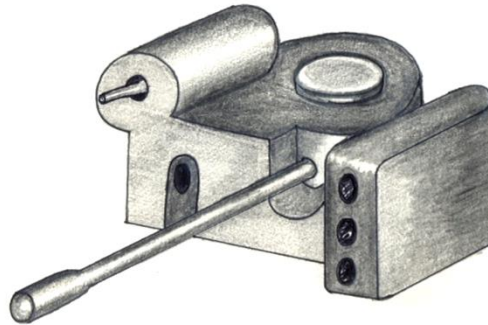
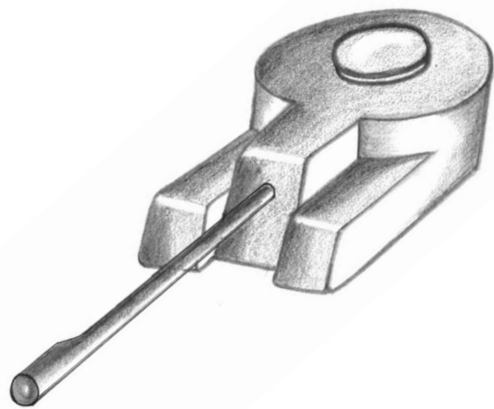
Exploration & Mock-up Models (Wolf)



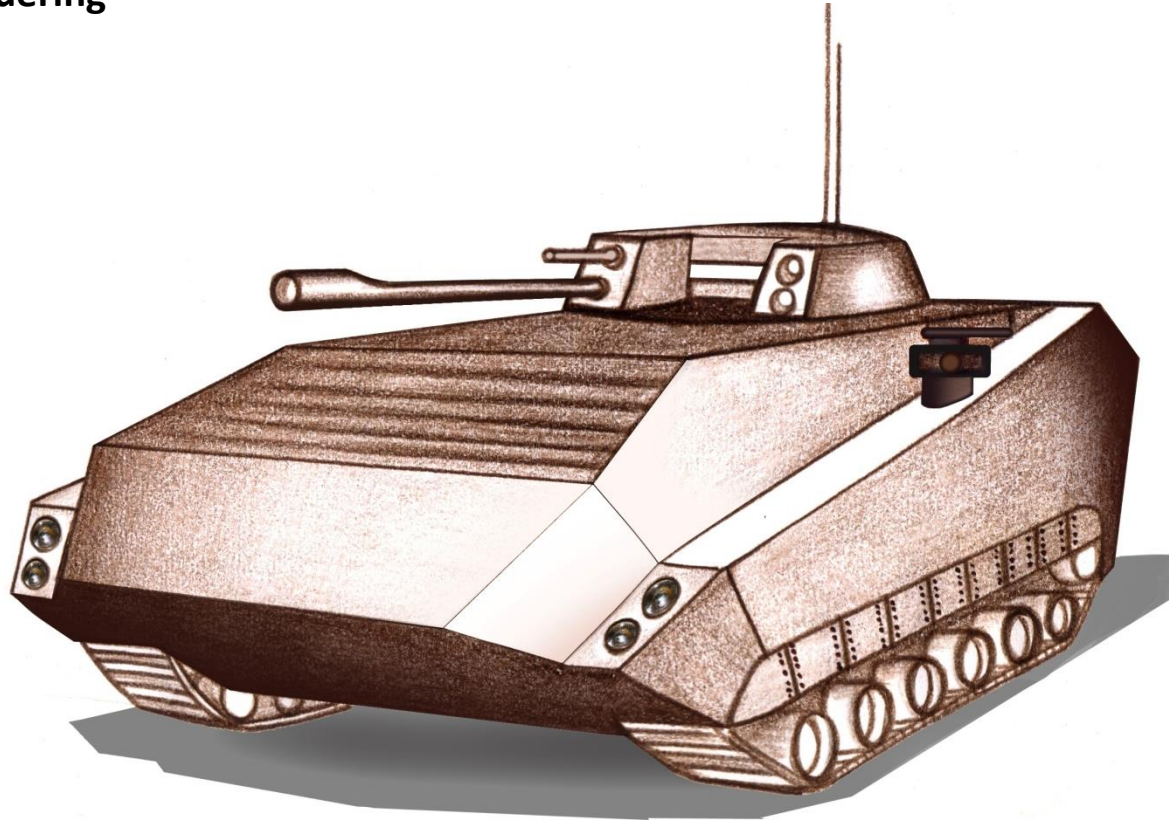
Final Concept Development

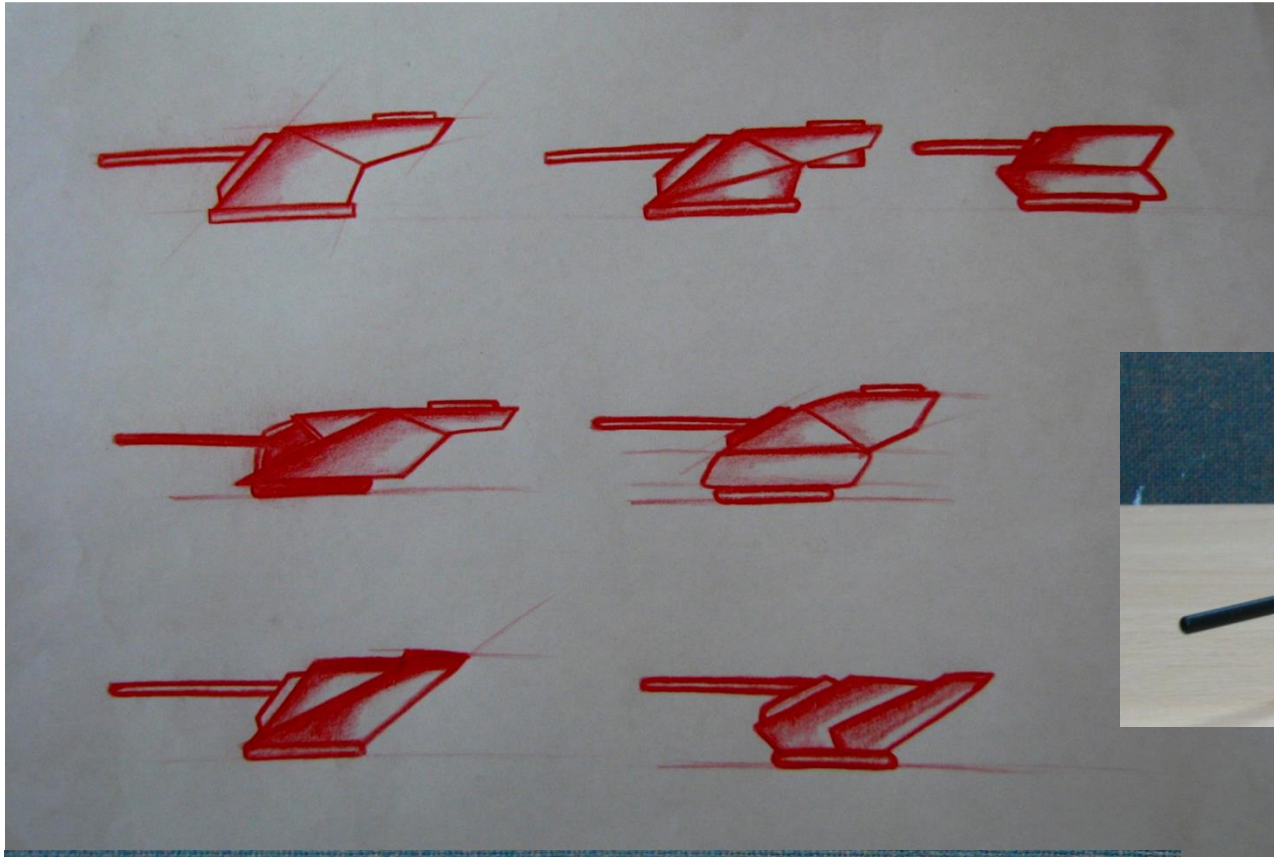


Designing of the Turret



Final ICV Rendering





New Features to the Design

1) Fuel Tank Placement & Crew Safety :

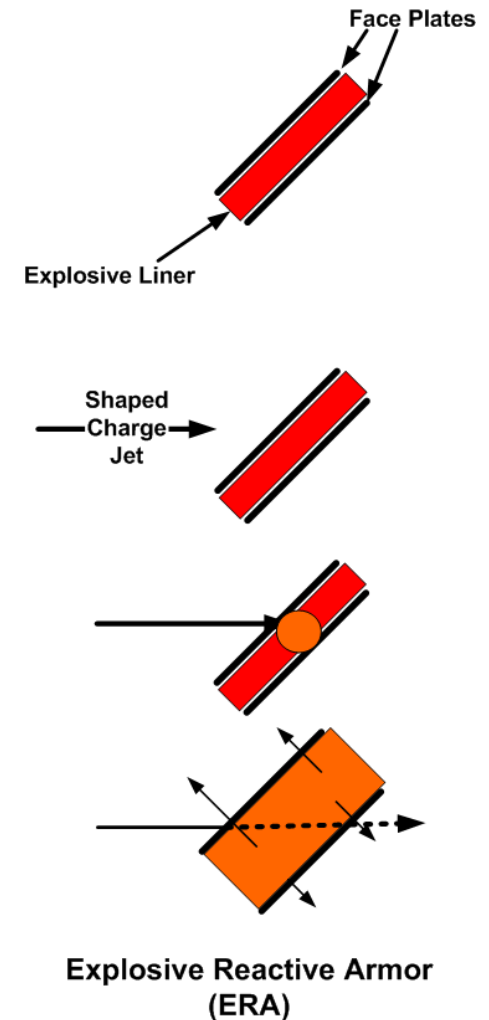
Unlike the other conventional ICVs in which the Fuel Tank is either inside the vehicle or in the door, the new design has two banks of Fuel Tanks., both fuel tanks are outside the Hull of the vehicle.

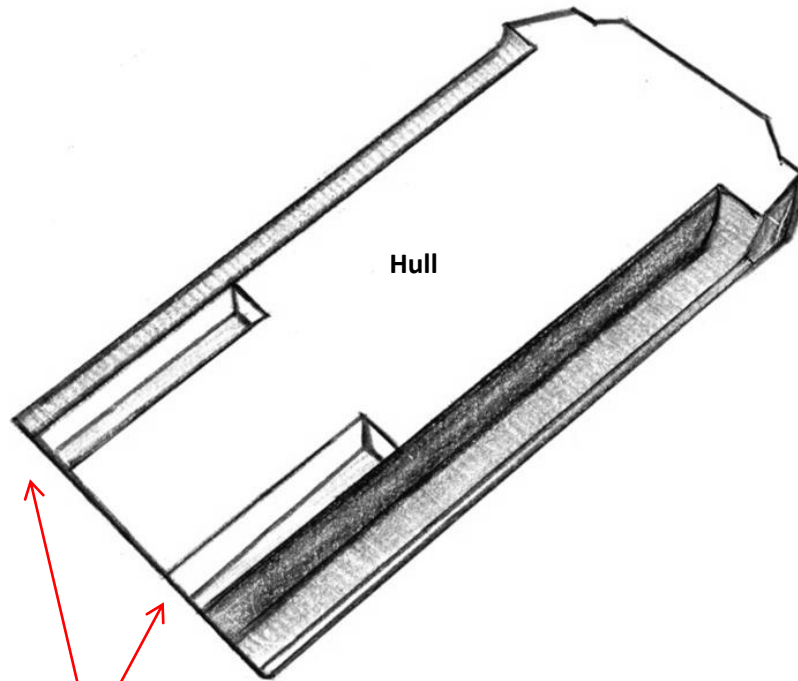
Now there is a layer of Plastic Explosive in between the Fuel Tank and the surface of the Hull. Now in case of any missile hit or mine explosion, these Plastic explosive will detonate on time and detach the Fuel Tank from the body of the vehicle. This is the same case as that of Reactive Armor.

In case of Reactive Armor, there is a layer of explosive in between the surface of the vehicle and the Protective Armor. Now, when a missile hits the Armor, this layer of explosive detonates and the Protective Armor along with the Missile flies away from the vehicle, thus minimizing the damage.

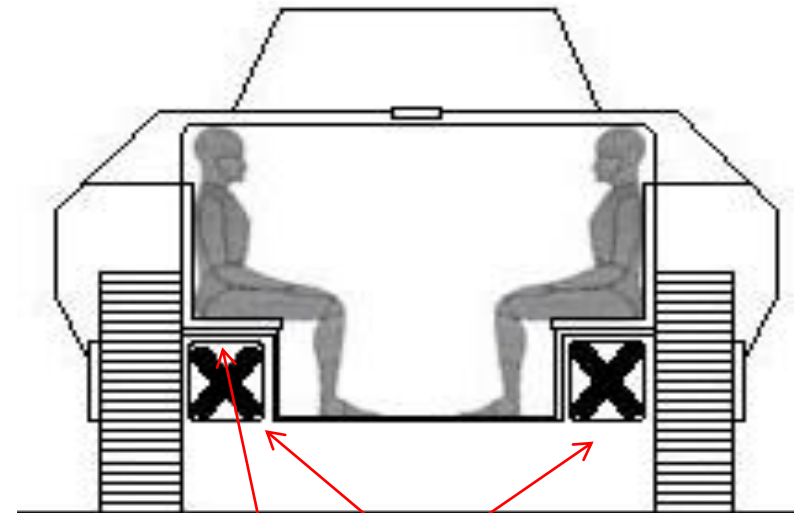
In the present design, there are two banks of Fuel, in case of explosion its not necessary that both will explode. Even if one is intact, vehicle will work and can be used unlike the conventional ICVs. In addition to these two banks of fuel, one more can be there just below the turret if needed.

As both the Fuel Tanks are outside the Hull, Crew is always safe from explosion of the Fuel Tanks.





Place for Fuel Tanks



Fuel Tank

A layer of Explosive in
between Fuel Tank &
Body of the Vehicle

Unmanned Turret :

Installation of Unmanned Turret to reduce weight. Even as the unmanned turret is small in size in comparison to the old one that BMP-2 uses. So, Vehicle size can be reduced and 60% space below the Unmanned Turret can be used for other new important Installation.

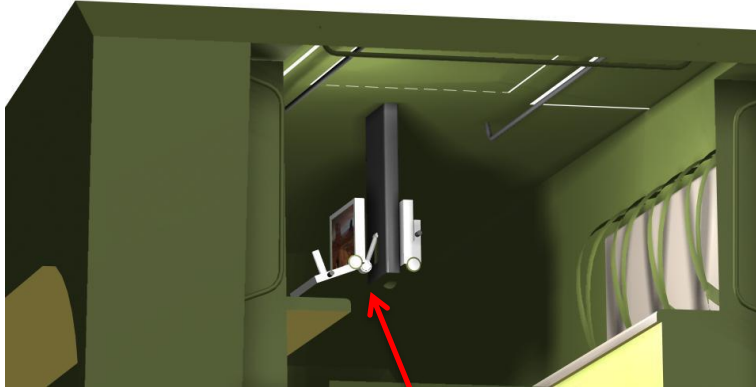


Use Of Automatic Machine Guns :

Use of Automatic Machine Guns by the Crew leads to better firing on move. Another important point is that the efficiency of two automatic Guns are equivalent to all the Crew Members firing in the conventional ICVs, so there is no need to provide Automatic Guns to everyone. Further as we are using Automatic Guns which can be fired remotely from inside, so there is no need of firing port. Crew is safe from bullets & Artillery fragments in the Battlefield coming through these ports.

The placement of the Control Panel for these guns and its opening is explained through the figure.

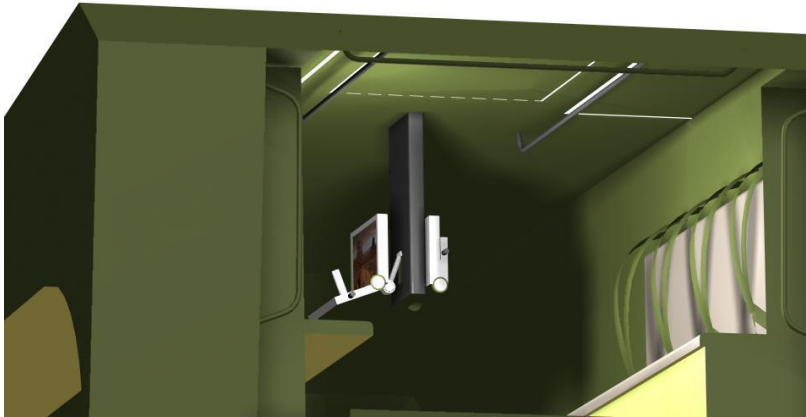
Stage 1



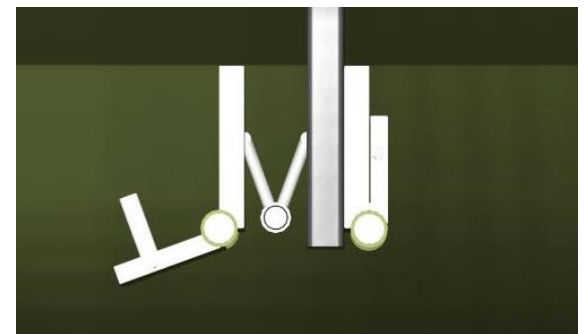
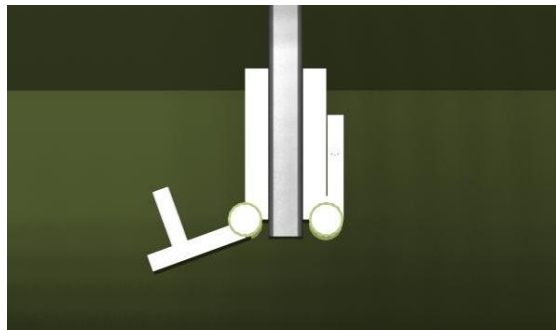
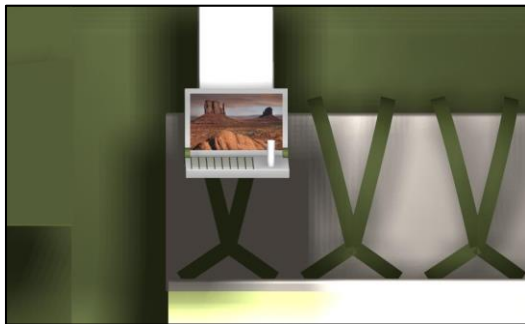
Automatic Machine Guns Firing Control Panel inside the Vehicle, used by the 4th person on the both sides of the sitting.

Automatic Machine Guns outside the ICV.



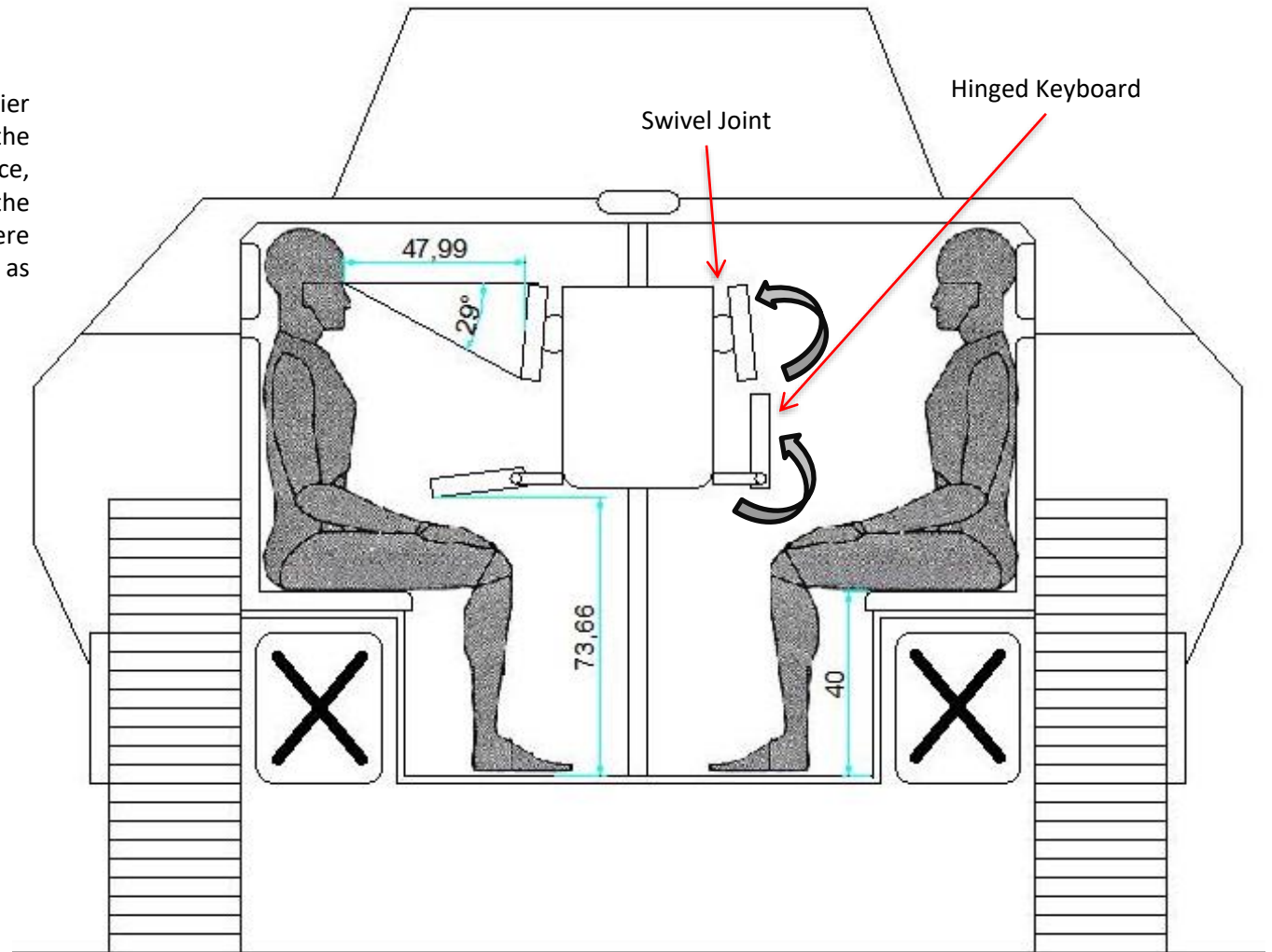


Disadvantage :
Vulnerable to the severe shocks under
which this vehicle goes. Screen and
Control Panel has to travel a long
distance to reach Infantrymen.



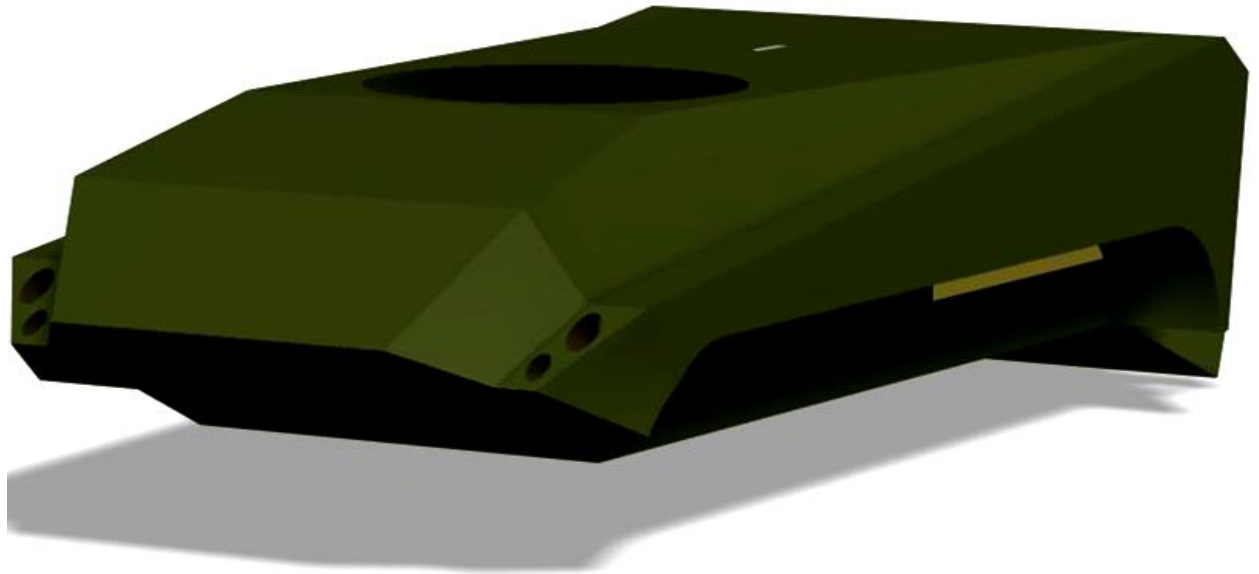
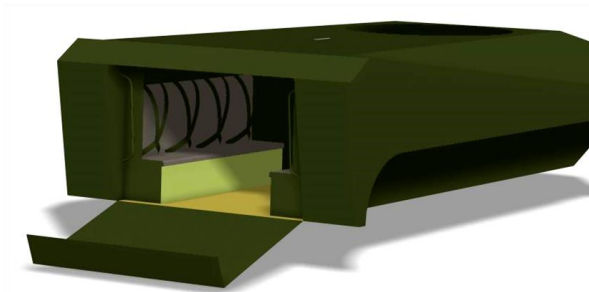
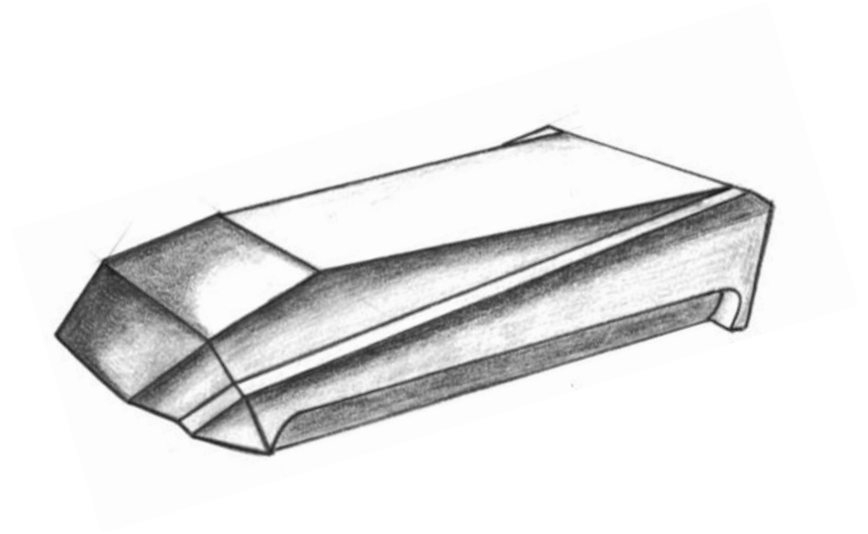
Final Refinement :

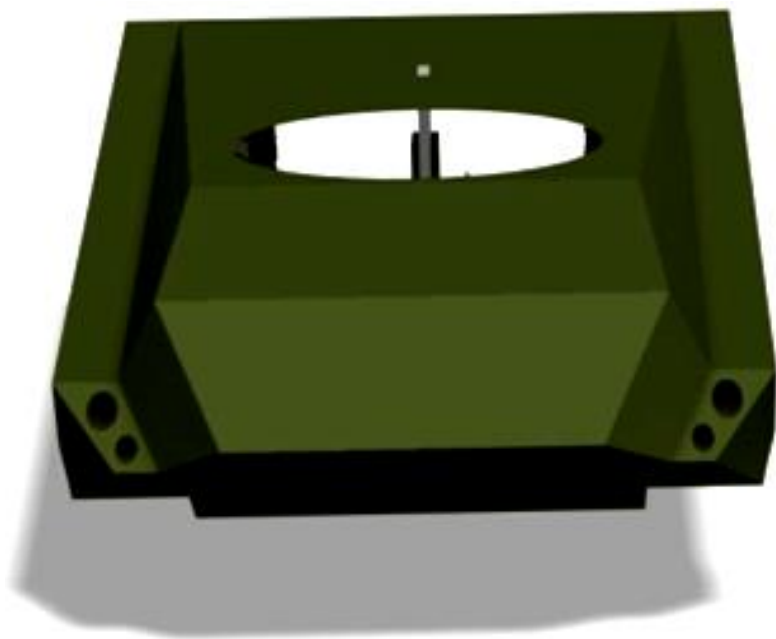
The hinges and arms in the earlier design made the display and the keyboard vulnerable to shocks . Hence, the arms were eliminated and the display and the keyboard were mounted on two separate hinges as shown in the figure.



Sloping Armor :

- Use of sloping armor with less thickness,
- will reduce the weight
 - increase in protection.





Instructions Inside the ICV :

All the instructions written inside the BMP-2 Vehicle were in Russian Language. Soldiers in the Army come from different Educational Background, so, in new design, all the instruction will be mostly in the form of Visual Symbols and written Instruction wherever needed to avoid the confusion arising out of Language. Some of the Graphic Instructions created and others are existing one.

New Icons



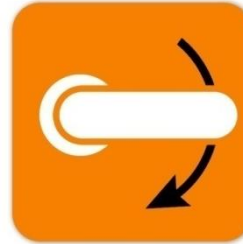
Seat Belt



Emergency Exit



Fuel Tank



Door Handle

Existing Icons



Repair



Control Panel



Explosive



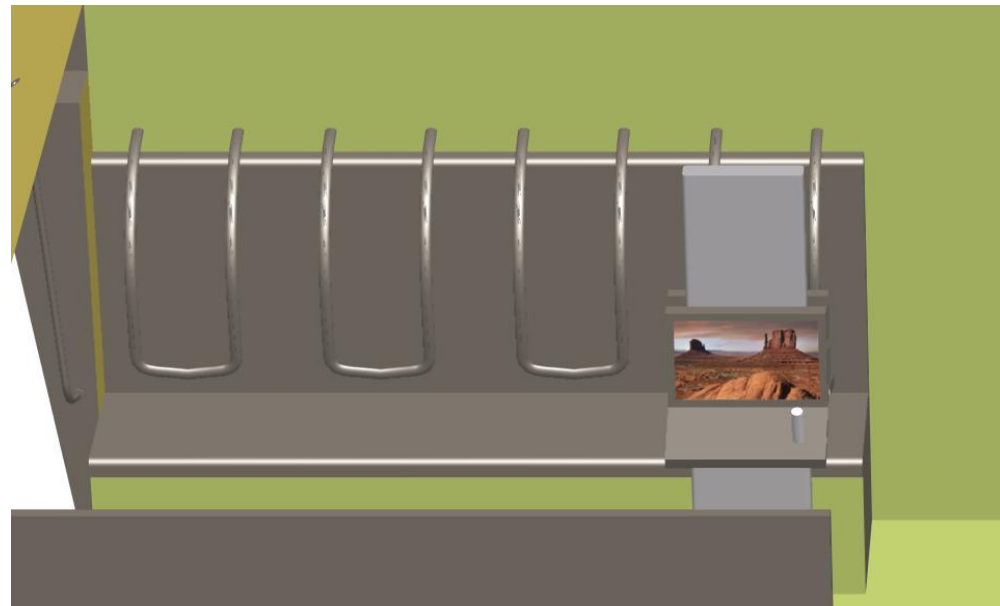
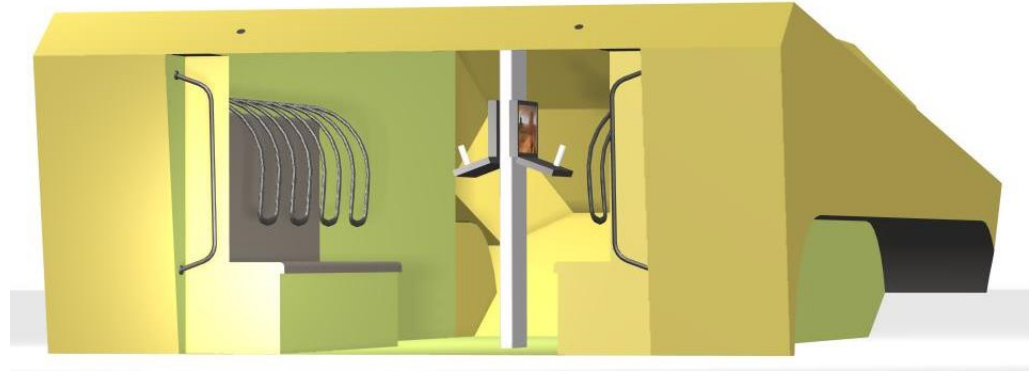
Flammable

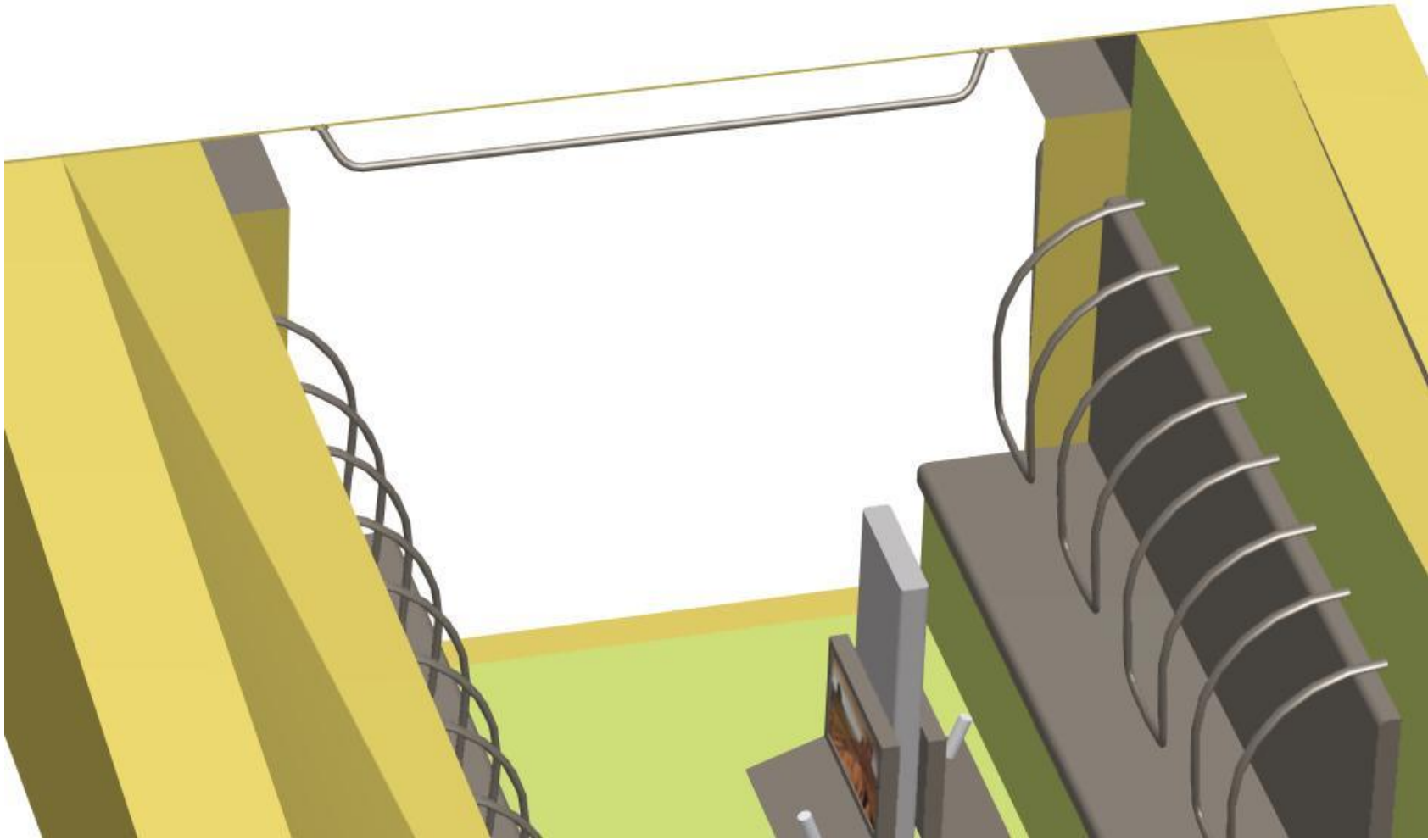
Harness :

Providing the Seat Belts (Harness) can led to better Firing Capability on move. Even to keep the Crew in place Harness is needed. Here there are two ideas.

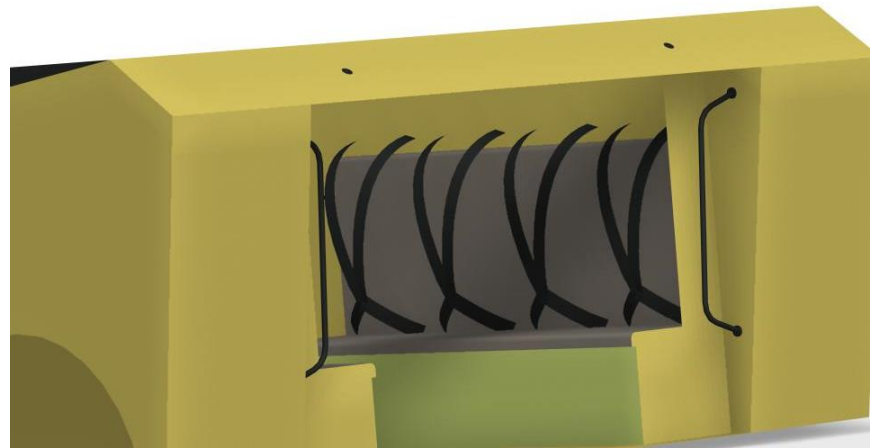
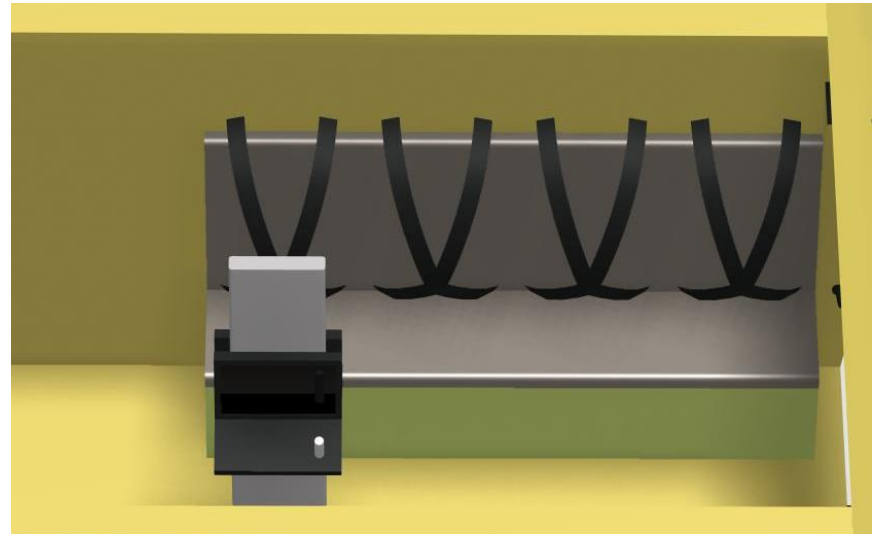
Idea 1) First Idea is as shown in the figure. Seats can have Harness just like used in Roller Costar but a bit redesigned.

In case of Emergency Evacuation through Top Hatch, these can work like a ladder as height is pretty big to climb.



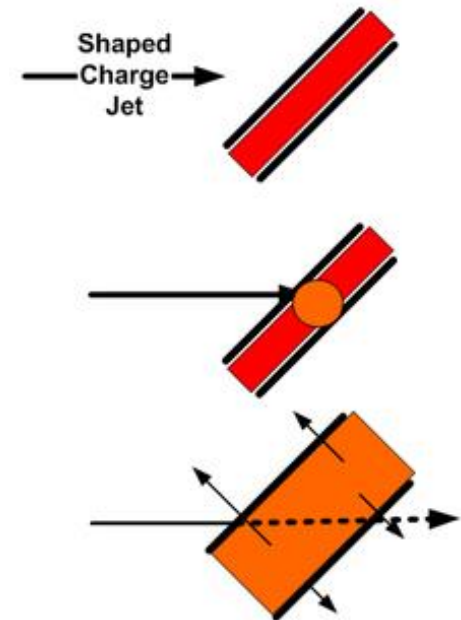
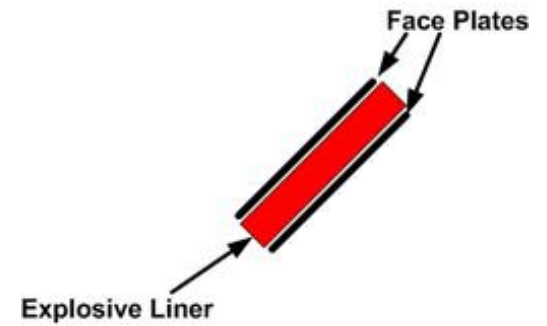


Idea 2) One of the Idea is to use 5 point Harness for holding the crew on its place. This is a bit more feasible for a less evacuation time. So, this is in the new design.



Use of Reactive Armours :

Reactive armour is a type of vehicle armour that reacts in some way to the impact of a weapon to reduce the damage done to the vehicle being protected. It is most effective in protecting against shaped charges and long rod penetrators.

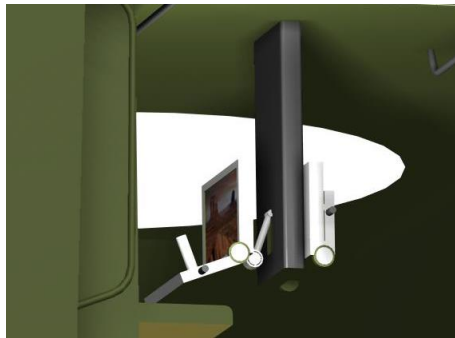


Explosive Reactive Armor
(ERA)

Control Panel:

Use of better control panel for the driver and the commander can be more reliable and secure. Day by day newer and newer technology is coming, use of these advances is needed. Use of better Control Panels for the firing of Automatic Machine Guns can lead to better result in Battle. Even Driver needs a better Control Panel for better and precise mobility.

Commander needs better control panel to take better decision based on the available data to construct the strategies for the battle.



Better Paint :

Use of better paint

- Can provide better **Visual camouflaging** as well as better **IR Camouflaging**.

- First level of protection and should be taken into account carefully.

- Intermat specialize in special-countermeasure **wide-spectrum anti-IR coating materials (400nm - 20000nm)** for concealment against thermal observation and deception of heat-seeking missiles. Intermat is widely known for being the only company promoting these state-of-the-art, anti-thermal coating materials that have been developed after many years of R&D.



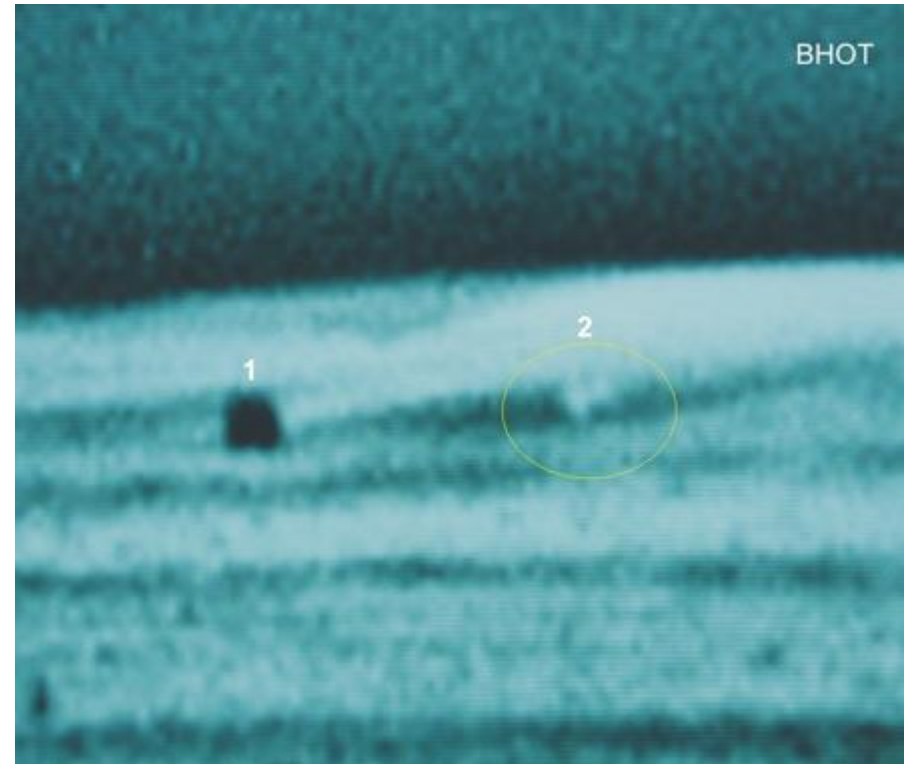
M113 painted with Intermat anti-thermal coatings



**Figure: 1 – ICV without Thermal Coating
2 – ICV with Thermal Coating**

BENEFITS OF INTERMAT ANTI-THERMAL CAMOUFLAGE

- ICV adapt to the IR environment of area
- Crewmen are protected from thermal threat
- Survivability in a complex and advanced military environment is significantly optimized
- ICV gains a sustainable advantage
- Targeting friendly assets is avoided
- Coating materials can be used as a permanent countermeasure during day or night, 365 days a year



Hummer images from a thermal viewer (8mu to 12mu) at 500m while manoeuvring. #1 is commonly painted. #2 is Intermat anti-IR painted.

Cooling of the Crew Compartment :

Heating of the BMP-2 Crew Compartment in Indian Climatic scenario is also of big concern. In case of Rajasthan like areas, due to Engine and out side heat. crew compartment temperature rises up to 58 Degree C. So, there r two ways of cooling

a) **Conventional Air-Conditioning**

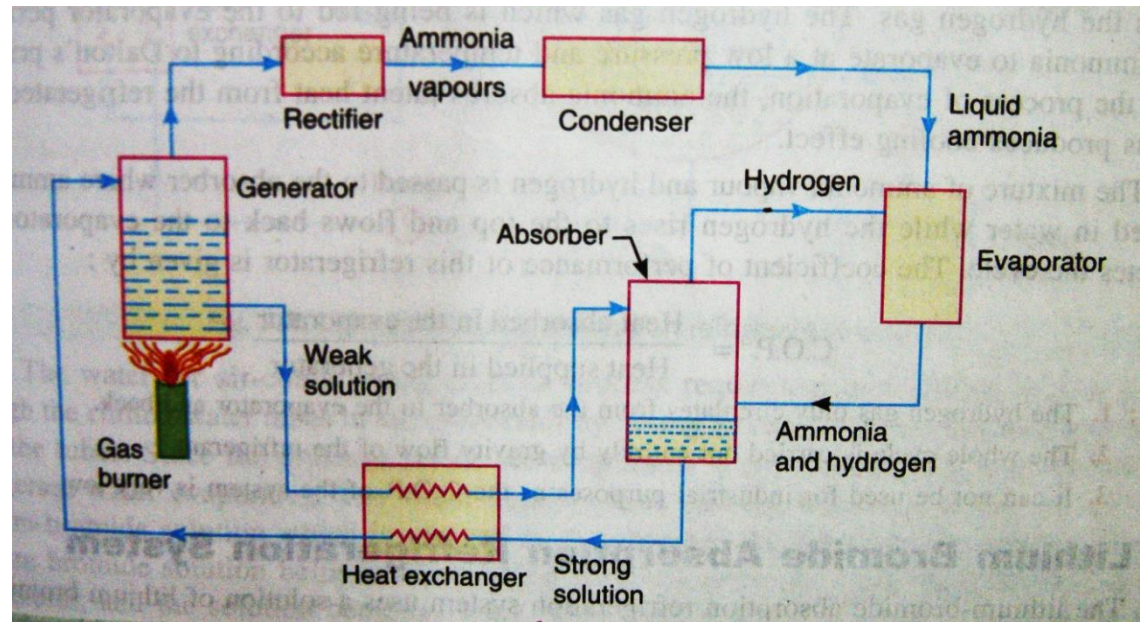
b) **Vapour Absorption based Air-Conditioning**

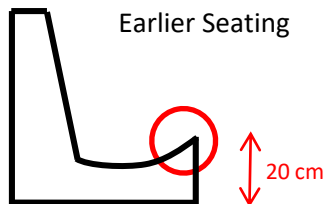
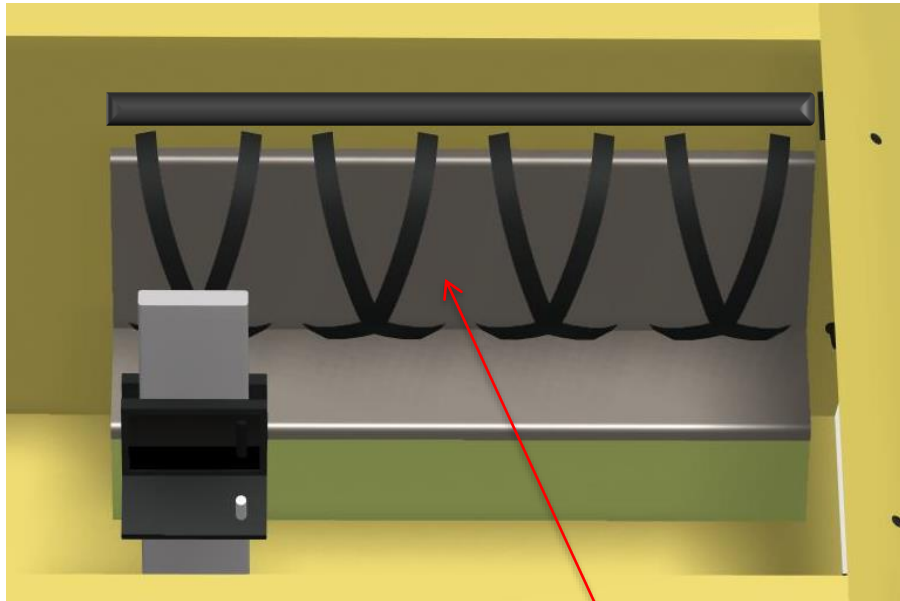
Advantages of this Cooling System –

a) In this system only single moving part (a small motor) is there, so less wear n tear.

b) As there is less noise, so there is no problem of Acoustic Signature.

c) As this System works on the heat of the Engine, so it also helps in the minimization of the Thermal Signature.

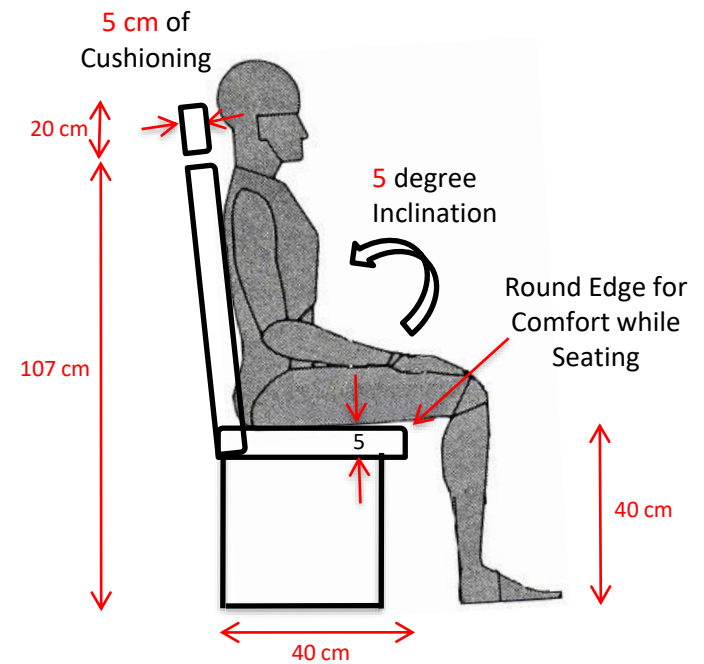




Harness

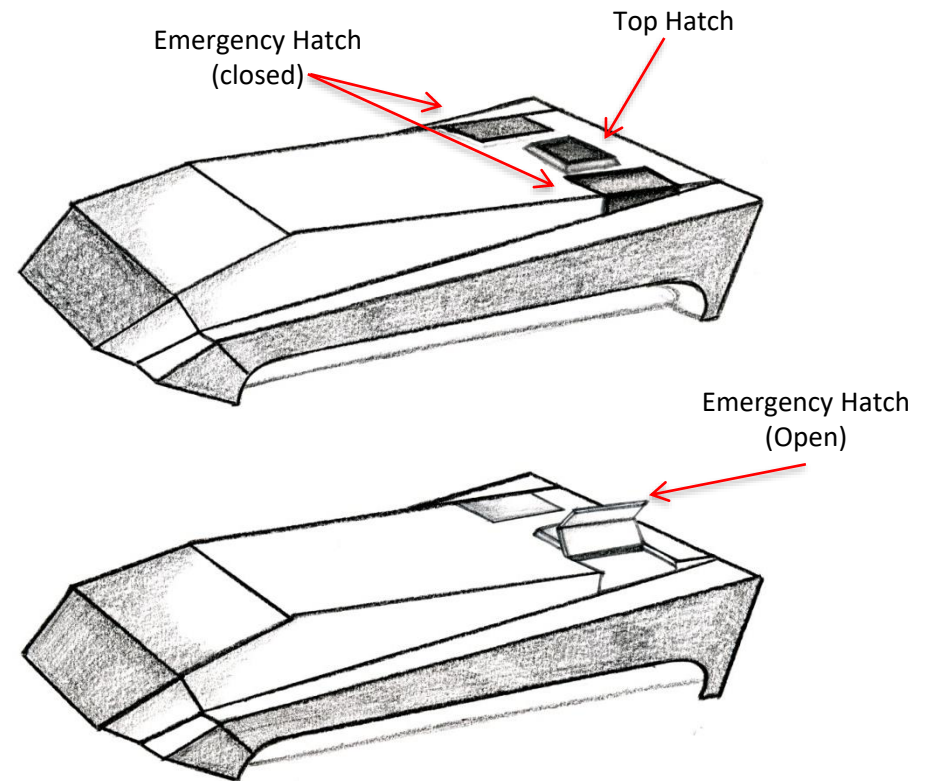
Crew Seating :

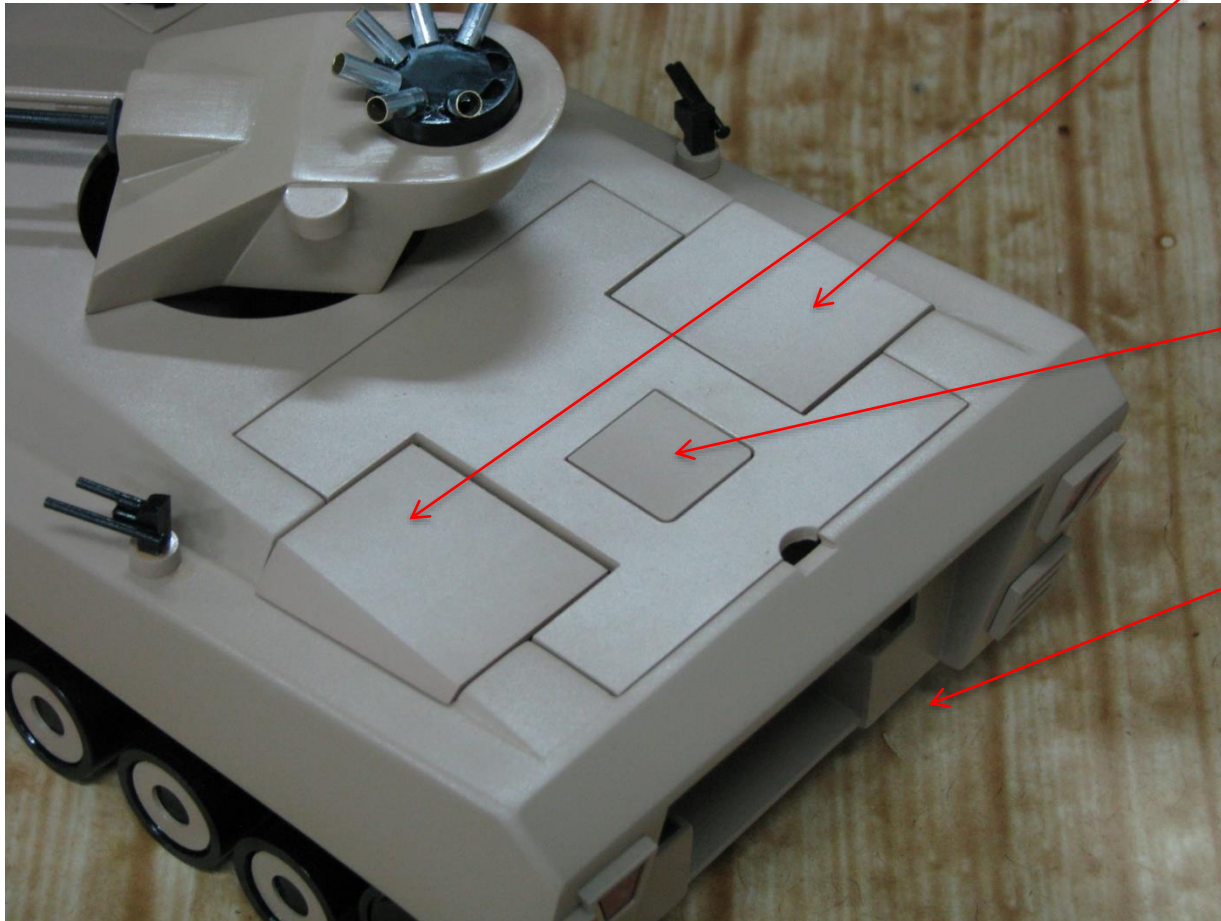
Crew seating has been analysed according to ergonomic analysis & Rig testing. The final dimensions are shown in the figure. Seats are provided with Harness so that Crewmen are on seat while on move.



Emergency Hatch :

Provision of Emergency can be really handy at the time of the Emergency Evacuation or Explosion. In the figure there is a Top Hatch along with Emergency Hatch on the both sides of the ICV.





Emergency Hatch

Top Hatch

Back Door

Grenade Launcher :

In conventional ICVs these Grenade Launchers or Smoke Guns are fixed to the turret or the body of the vehicle. So while sometime while firing these Grenades, Turret or the ICV has to be moved.

In the present diagram, Grenade Launchers are on the Top of the vehicle, when needed they can rotate on their axis to fire Grenades or Smoke Gun in any direction without moving the vehicle.

Grenade Launcher



Engine Exhaust on the Top :

The feature which is good in BMP-2 has been taken.

- First, this helps to reduce the Thermal signature of the vehicle.
- Secondly Top Exhaust are less vulnerable to the bullet and the artillery fragments causing breakdown of Engine.

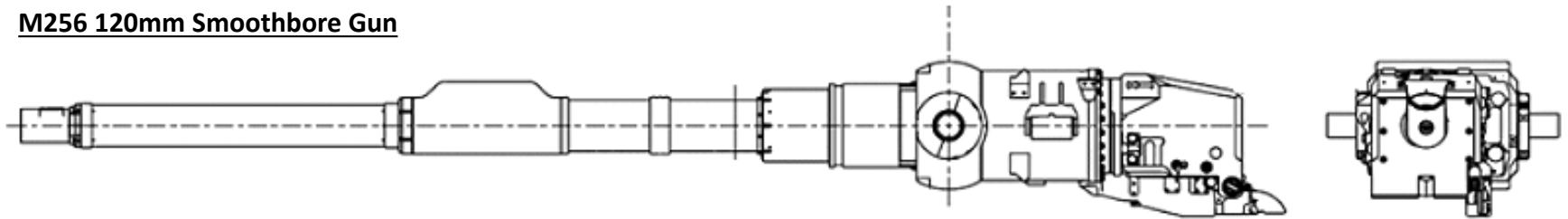
Top Exhaust



Armament : (Primary)

The new armaments for the new vehicle are -

M256 120mm Smoothbore Gun



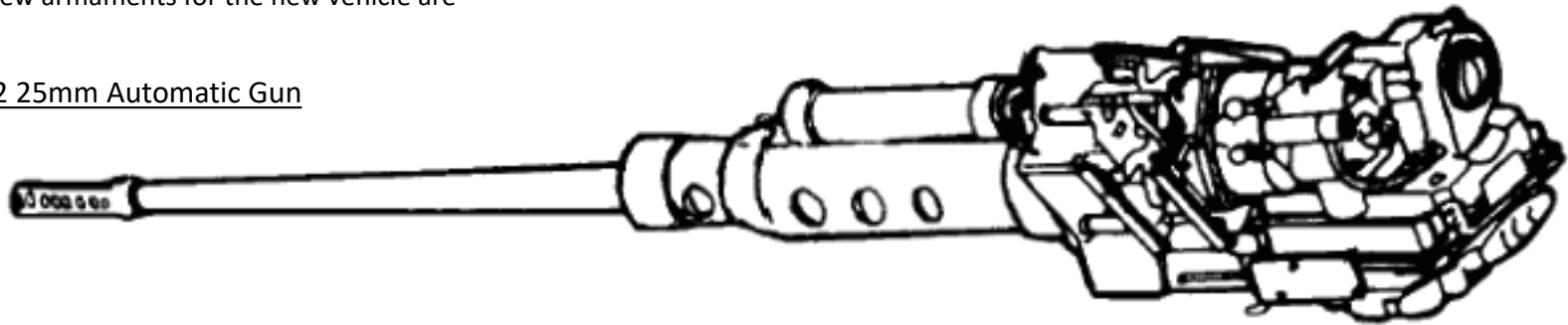
Alternative Designations	L44 (original German version)
Country of Origin	Germany
Weight	6,800 lb (3,084 kg)
Firing Impulse	7,000 lb-sec
Barrel Length	208.7 in (5,301 mm)
Breech Safe Service Life	4,500 rounds
Barrel Effective Full Charge (EFC) Life	1,500 rounds
Performance	
Maximum Effective Range	3,280 yd (3,000 m)



Armament : (Secondary)

The new armaments for the new vehicle are -

M242 25mm Automatic Gun



Alternative Designations

M242 25mm Machine Gun,
M242 Automatic Cannon, M242
Chain Gun, Bushmaster

Country of Origin

USA

Weight

242.5 lb (110 kg)

Dimensions (LxWxH)

9 x 1.06 x 1.22 ft (2.743 x 0.323
x 0.373 m)

Barrel Length

6.67 ft (2.032 m)



Learning :

This project has been challenging as well as a great learning experience. It has greatly enriched my knowledge regarding war scenario and the need for concern towards the usability and user convenience in defense systems. It has further underlined my belief in user driven design.

It has made me realize the importance of design as a process towards solving problems be it any field from life critical systems like an Infantry Combat Vehicle to everyday products

Thank You...
