

Structural Design and Analysis of Multifunctional Combat Vehicle for Army Personnel

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Abstract:- Each country is adopting state-of-the-art technology for its border security. Such technologies help to secure the sovereignty of the country, therefore, it is necessary to study the latest technologies in the field of security. In the same way that countries are developing in the field of defense, the factors that pose a threat to the country are also evolving. The defense system needs to be upgraded to protect the country from such anti-social elements. Indian Defense Establishments have faced a number of terrorist attacks in last few years, be it the attack on Indian Central Reserve Police Force (CRPF) unit at Pulwama in 2019 or the terrorist attack on Pathankot Airbase in 2016. Considering all these phenomena, this dissertation presents the structural design of multi-functional combat vehicle equipped with an advance weapon system. This combat vehicle is designed to protect Army personnel from terrorist attacks as well as to respond more effectively to such attacks. The name of this vehicle 'Ajastra' is inspired by its huge size and the ability to withstand enormous stress.

Keywords:- Armored Vehicle, Military Weapon, Ladder Frame Chassis, Structural Design, Missile Launcher.

I. INTRODUCTION

In the past few years, terrorists have been attacking Army Vehicles. In all this, many Army personnel have been martyred. 2019 Pulwama attack is the well-known example of how Indian Army vehicles have been attacked. Innovation ideas need to emerge in order to be safe from the human and economic damage caused by such attacks, as well as to respond to these attacks in the same way or more destructively, and that is why Ajastra, a combat vehicle is being presented. The name Ajastra indicates the size and capability of this combat vehicle.

Ajastra, a multifunctional armored vehicle has been designed keeping in mind the potential dangers to Army vehicles travelling through Naxalite or Terrorist areas. Ajastra is designed in such way that it can carry out deadly attacks in addition to the protection of Army personnel. This combat vehicle can carry at least 8 Army personnel in case of emergency. The vehicle is equipped with a Missile Launcher with Grenade Launcher and a Heavy Machine Gun for the most lethal attack. This combat vehicle has been designed with reference to light tanks in the service of the Indian Army. Although Ajastra is designed on the lines of tanks, it has the capability of heavy off-roading. This combat vehicle is

powered by a 750 Nm Torque and 250 Kw Horse-Power Diesel Engine. The naturally aspirated diesel engine of Ajastra has been designed keeping in view of payload capacity and off-roading capacity of vehicle. This walking weapon is equipped with the latest technologies such as Integrated Fire Protection System, Microprocessor based Sensors, Surveillance Cameras, Land Navigation System and many more.

II. DESIGN OF VEHICLE

A. Structural Design:

• Body Frame:

The body frame of Ajastra has been designed accordingly Self-Supporting Integral Pattern (Grid Frame) and (70 mm x 70 mm) square pipe of 6061 aluminium alloy is appropriate for the body frame of Ajastra. The body frame of this combat vehicle is designed according to Integral Member Welding method to withstand maximum stress. Metal Inert Gas Welding (MIG) technique is suitable for manufacturing of this body Frame.

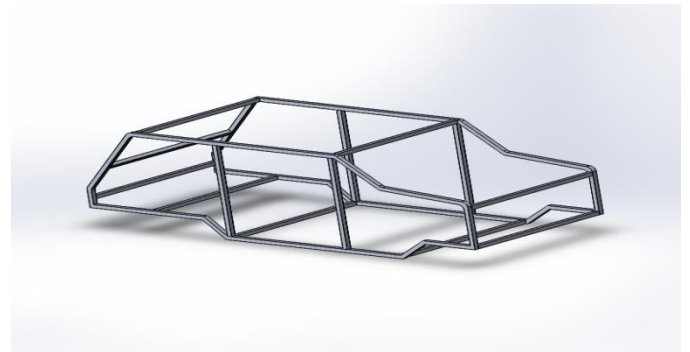


Fig. 1: Design of Body Frame created on Solid Works 2017.

• Chassis:

The chassis of Ajastra has been designed accordingly Ladder Frame Pattern and AISI 4130 alloy steel is perfect for this. (225 mm x 80 mm) channel is suitable for the long member of chassis and (220 mm x 40 mm) square pipe is appropriate for the cross members of chassis according to the design of Ajastra. Due to the material of this size, the load carrying capacity of this combat vehicle is becoming more than required. Metal Inert Gas Welding (MIG) technique is suitable for manufacturing of this chassis.



Fig. 2: Design of Chassis created on Solid Works 2017.

B. Body Panels:

1.75-inch to 2.00-inch-thick MIL-12560 military grade steel plate is the right material to make Ajastra mile proof and bulletproof. To manufacture the body panels of this combat vehicle, rolling and forging techniques would be appropriate.

• **Engine Hood:**

1.75-inch-thick MIL-12560 Class 2 military grade steel plate is appropriate material for the Engine Hood. Rolling and Forging techniques would be appropriate to manufacture it. There is provision to fit the Headlights in the engine hood of Ajastra and for their protection; the Grill is design to fit.



Fig. 3: Design of Engine Hood created on Solid Works 2017.

• **Roof:**

2.00-inch-thick MIL-12560 Class 4 military grade steel plate is appropriate material for the Engine Hood. Rolling and Forging techniques would be appropriate to manufacture it. Since the weight of the missile launcher and other heavy weapons are being added on roof, its material has been designed with heavy thickness. A window cum exit door is designed on this roof, which can be used to operate the Roof Mounted Weapons as well as to get out of an emergency.

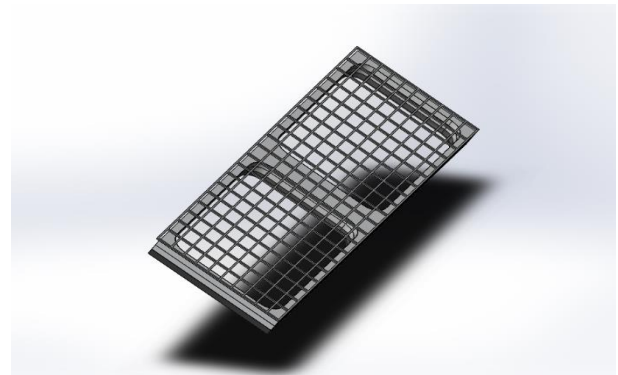


Fig. 4: Design of Roof created on SolidWorks 2017.

• **Windshield:**

5.00-inch-thick Bullet Resistant Fiberglass (UL 752 Class 5) is perfect material for the Windshield. The Bullet Resistance Fiberglass is fitted inside the frame of MIL-12560 Class 4 military grade steel plate. Windshield is design with metal net protection for extra security.

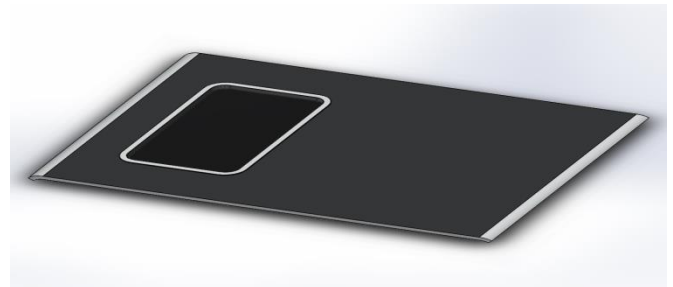


Fig. 5: Design of Windshield created on SolidWorks 2017.

• **Vehicle Dimensions**

Length	6700 mm
Width	2605 mm
Height	3115 mm
Wheelbase	4300 mm
Ground Clearance	435 mm
Approach Angle	42.8°
Departure Angle	38.5°
Ramp-over Angle	34.2°

Table 1 : Technical Data related to Vehicle Dimensions

C. Engine Design

• **Engine:**

The engine of Ajastra is design in such way that, this combat vehicle can operate in any terrain without difficulties. The engine is designed to meet the missile carrying capacity of vehicle. This 9000-cc engine is capable of generating 750 Nm of torque and 250 KW of power. Grey Cast Iron is one of the major material used in the manufacturing of this type of engines and its parts. To manufacture the various parts of the engine, casting technique would be appropriate.

Displaced volume	8992 cc
Stroke	130 mm
Bore	105 mm
Number of Cylinders	8
Compression ratio	14.3:1
Volumetric Efficiency	48.23%
Thermal Efficiency	40.93%
Lubrication System	Dry Sump Lubrication
Fuel Injection System	Common Rail Direct

Table 2 : Technical Data related to Engine Design

III. WEAPON STATION STRUCTURAL DESIGN

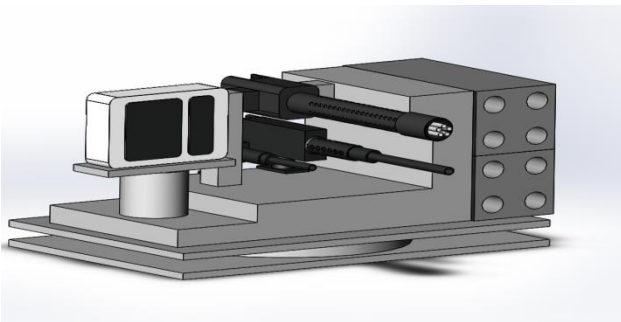


Fig. 6: Design of Weapon Station created on SolidWorks 2017.

IV. MISSILE LAUNCHER STRUCTURAL DESIGN

The Missile Launcher System of Ajastra is design for Anti-Tank Guided Missiles. The launch system of Ajastra consists of two pods mounted on the roof. Each pod houses four launcher tubes. The pods are loaded and unloaded into the launcher vehicle by Army personnel. The launch system can fire a salvo of eight rockets. The launcher structuretransverses 90° left or right from the centre line and can elevate up to 40°.

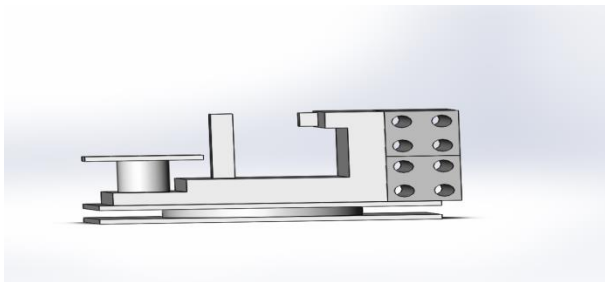


Fig. 6: Design of Missile Launcher created on Solid Works 2017.

V. FUTURE DEVELOPMENTS

A. Air Defence System:

Many countries have been using the drone system for surveillance for the past few years, but this system can also be used for espionage. According to studies so far, India’s Border Security Force has repeatedly shot down enemy state drones.

Ajastra can also be used for Air Defence if the compact-sized missiles are designed on the lines of the missiles currently in use for air defence. Drone Detection System can be added in this combat vehicle for air defence.

B. Ambulance:

Ajastra can perform the function of an Ambulance if the interior of this vehicle is modified. Due to the huge size of Ajastra, it can provide great space for the required facilities for ambulance. Immediate Treatment of wounded soldiers in case of emergency or war situation will be easily possible due to the mile proof and bulletproof capability of this vehicle. Ajastra could be used to provide Medical Services to Army soldiers operating in Terrorist or Naxalite areas.

C. Front Line Combat Vehicle:

Ajastra can used as a front line combat vehicle. The advanced weapon system of this combat vehicle is capable for the counter attack. This armoured vehicle also can carry combat equipment if the internal design of this vehicle is changed. Ajastra can used as armoured personnel carrier, to transport the infantry troops to the frontline.

VI. SUMMARY

Ajastra is an advance military vehicle that is equipped with modern weapons to attack and defense. This combat vehicle is suitable for Army, due to the various modern sensors and technologies. The multifunctional combat vehicle is designed to suit the different aspects of the Army. Ajastra can carry many responsibilities at the same time. Considering the safety of the Army Personnel, the body of this combat vehicle is designed with heavy armor plate, so this vehicle is mile proof and bulletproof. Ajastra is designed to easily withstand high-powered attacksas well as to respond those attacks with the most lethality. This armored vehicle is modeled on the basics of an Army Tank to withstand the stress generated during a counter-attack.

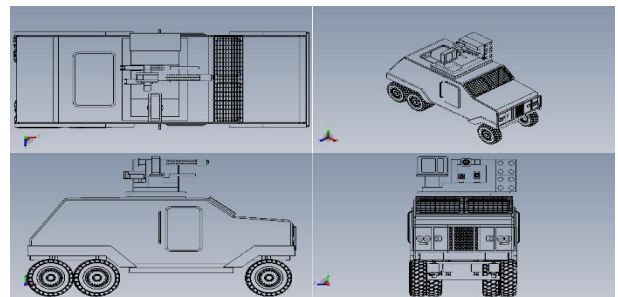


Fig. 7: Design of Ajastra created on SolidWorks 2017.

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