International Research Journal of Engineering and Technology (IRJET) e-ISSN: 2395-0056
Volume: 06 Issue: 11 | Nov 2019 www.irjet.net p-ISSN: 2395-0072

Implementation of Stealth Tech on Tank

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Abstract - *This paper discusses the analysis of Development of weapon. How the world of Stealth changed from the Late 80's to early 90's. And it proves that the Low observable Characteristic Vehicle, ship and Aircraft are the best option to Dominate the Enemy. Hence some research papers were reviewed. The fundamental aspects of the stealth were discussed especially Radar signature. The new model of the tank is proposed so the special task force can complete their mission more precisely.*

***Key Words*: Radar, Low Observable Characteristic, Radar cross section (RCS), Radar Absorbent material (RAM)**

1. INTRODUCTION

The word war exists from the birth of mankind. In every era the people want to dominate the enemy. But by keeping profile or signature low. I.e. To hide from the eye of enemy. After development of Radar system everything gets changed. The nothing can hide from the Electronic spectrum. So that the New technology comes into Existence called Stealth technology. It's also called as Low observable technology. Stealth is not the new concept for the today's warfare. It covers a range of techniques such as aircraft, ships, submarines, missiles etc. Stealth technology is developed to reduce the probability of object to visible on the screen of Radar, Infrared and other detection Method's Display.

1.1 History

1.1.1 Aircrafts

The first attempt to construct the Stealth craft is a German Horten HO-299 built before WWIII. In today's era we use the theory of Russian physicist Petr Ufimtsev known as the "Physical theory of diffraction". He concludes that the radar return is related to the edge configuration of object not size. After 1975 the two Aircrafts were constructed as hopeless diamond and Lockheed, sadly both of them were lost during the test. But they established the concept of a stealth fighter aircraft by their successive fly.

Fig-1: Lockheed F-117 Nighthawk (Wikipedia.org)

The Lockheed F-117 Nighthawk is first aircraft of this series. The first fight was taking place in 1981. This craft built under the code name of "Have blue". After the achievement of the "have blue". U. S Give contract to construct the F-117A. The Initial operational capabilities were achieved in 1983.These all projects are in done secretly until it publicises in late 1988.

Just after the decision of development of F-117A. The U.S. Decided to develop the Bomber.

Likewise, the Northrop B-2 Spirit was Comes in existence. A subsonic Four Engine Stealth bomber, in which 20 are still Operational. In Supersonic series the LO principle was applied to Rockwell B1, resulting to the B1-B supersonic strategic bomber.

1.1.2 Ships

The sea shadow was the first in series. It publicizes in April 9 1999. It built for the secret CIA project in 1970 and mothballs for the years. This is carried out for the recovery of the Soviet Union sub that sank off on coast of Hawaii. Gosimir Explorer and HMB-1 are the two ships that were used. The Gosimir is a ship capable of deep-sea mining. HMB-1 is submerged in Gosimir Explorer.

The sea shadow was reactivated in May 1999 by the navy nearly for 5 Years. Only for the research in future ship engineering concepts and serve as a host vessel for companies to demonstrate advance naval technologies. These are currently in san Francisco Bay.

Fig-2: Sea Shadow (Navysite.de)

2. Literature Review

The paper published by the Author Sharad Kumar with topic "Stealth Technology: Fight against Radar". His paper is showed that During WWII Radar and surface to air missiles posed a threat to aircraft. At that time the stealth technology is developed. His paper concludes that the radar and stealth become the leading area to research.

The second paper published by G.A. Rao as "Integrated Review of Stealth Technology and its Role in Airpower". His paper provides us the basics idea about the range of radar and how it works. He concludes that the nation requires the new tech in stealth and the stealth tech is essential for the new era.

3. Detection Methods

1) RCS: Aircraft, Missiles, ships, land Vehicles.
2) Infrared signatures:
3) Acoustic signature:
4) Visible signature:
5) Laser Cross section:
6) Magnetic signature:

3.1 Radar signatures

Radar (Radio Detecting and Ranging) is used to detect the objects as well as it can track and identify they object distance. It uses electromagnetic waves to detect the objects. It transmits the Electromagnetic waves towards the object and receive the reflected waves from the object and identify it. More precisely we observe the Echoes that returned from the object. Below is figure of simple radar.

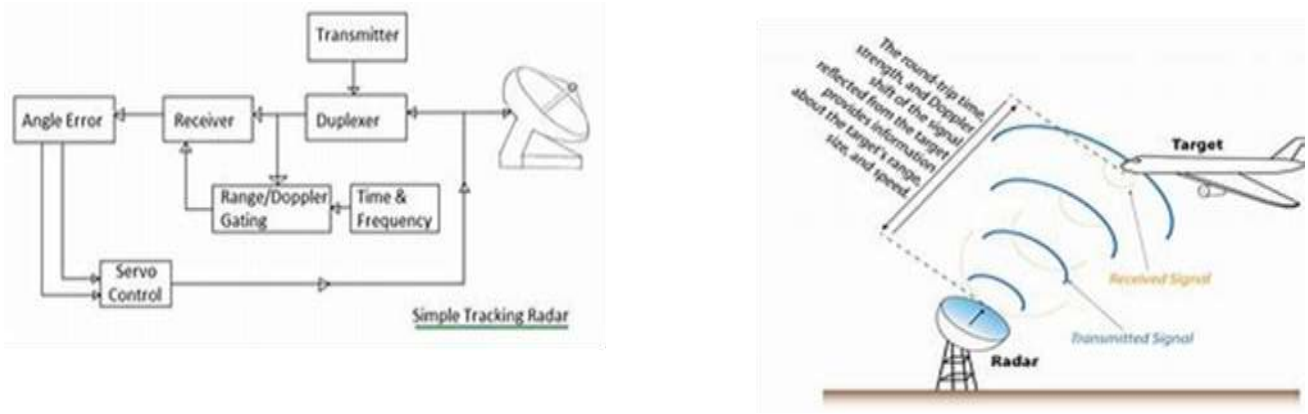


Fig-3: Simple Radar tracking

Following are frequency Range used.

1. Low frequency range (0.1-1.0 GHz): - Used for surveillance and detection.
2. Medium frequency range: - Used for SAM Launchers.
3. High frequency range: - Used for radar onboard aircraft.

3.2 Radar Cross section (RCS)

it's the imaginary area which is perfectly reflect and reflect the same amount of the Energy back to the Receiver. That reflected by the target. The Dictionary of IEEE Defines that RCS measure the strength of a target to reflect the wave.

$$\sigma = \lim_{r\to\infty} 4\pi r^2 \frac{|E_s|^2}{|E_i|^2}$$

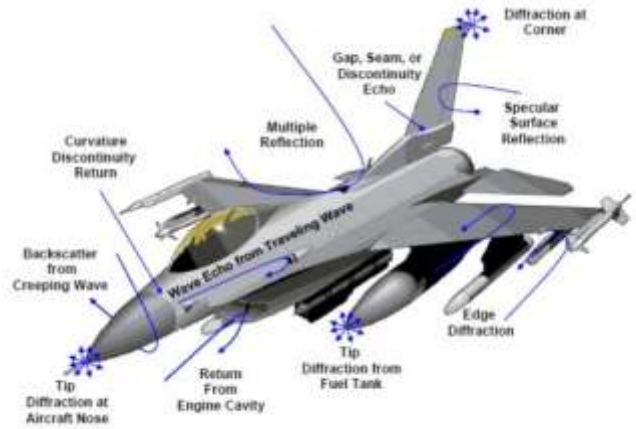


Fig-4: The main surface for radar scattering.

Where Es = Power per unit solid angle scattered.

Ei = Power per unit area of a plane wave incident. (Direction is specified).

3.3 RCS Computation

It is the function of size, shape and ratio of the target dimension to the wavelength of the impinging radar wave. The RCS have three regions depending on lambda(λ) an alpha(α):

1 Rayleigh Region (λ>>α): -
In this σ is varies with λ and λ is proportional to the reciprocal of 4 power of wavelength and square of the body volume.
2 Resonant Region (λ ≈ α): –
Rapid changes in σ are likely to occur in this region (due to interactions between various scattering mechanisms). In the case of a sphere, a creeping wave travels around the sphere and back towards the receiver, where it interferes constructively or destructively with the specular backscatter.
3 Optical Region (λ<< α): –
Here σ varies smoothly with the wavelength and tends to some definite value (most of the radar operate in this region). In this region, RCS is highly sensitive to the size, shape and material properties of the target.

3.4 Radar detection Range

The range of Detection is depending on the Frequency which is using. If the frequency of operation is Low then the Height of antenna is impractical. If the Radar is using for the Tracking the object then Radar require the good accuracy and necessary resolution so that it track the object precisely. So, the aircraft guns and Guided missiles use the high frequency radar. The Range of radar is given by the below equation.

Its detection range varied to the fourth root of the target 's RCS.

$$R_{max} = \left[\frac{P_R \cdot G_R^{\,2} \cdot \lambda^2 \cdot \sigma}{(4\pi)^3 \cdot (S/N)_{min}} \right]^{1/4}$$

4. RCS Reduction

To Reduce the RCS of aircrafts, Several Techniques used simultaneously. Depending upon the cost, Type of mission the techniques were selected.

Below are some techniques.

4.1 Shaping

The RCS is reduced by reduction in scattering of incident wave in the same direction. This can be done by the appropriate shaping of the object. There are two different methods to shape the air craft.

1) By making the surface geometry smooth blend and compact.

EX: - B-2 Bomber.

2) By faceted Configuration using flat surfaces which reflects minimum wave back to the receiver.

EX: - Lockheed F-117A.

There are some precautions during adapting this technique.

1. Minimizing the Size of the object.
2. Making the cockpit less visible (transparency) by applying the coating of thin conducting layer.
3. Avoiding the Flat surface which are likely to be normal.
4. Highly swept leading with rounded wing tip.
5. Dislocating the Engine in Upper side of body and Buried it in intake and exhausts.
6. Taking S shaped curve for the intake lips.

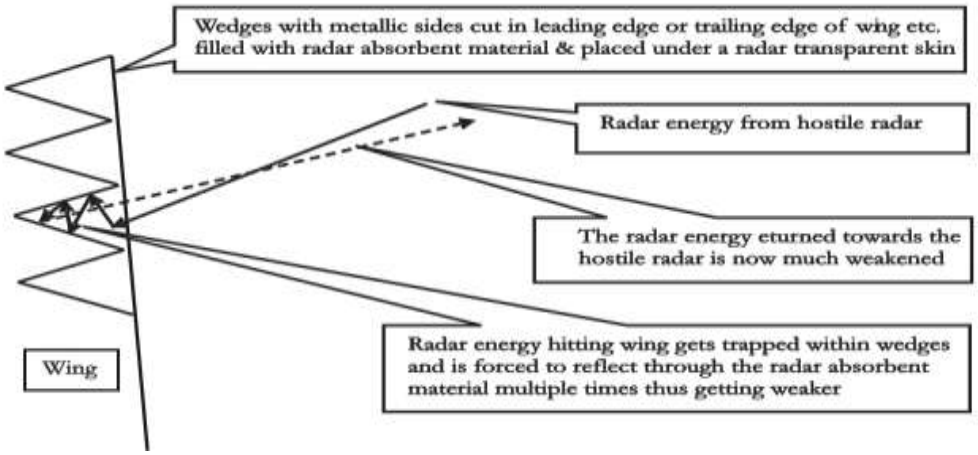


Fig-5: Substructure Designed to Attenuate Incident Radar Energy.

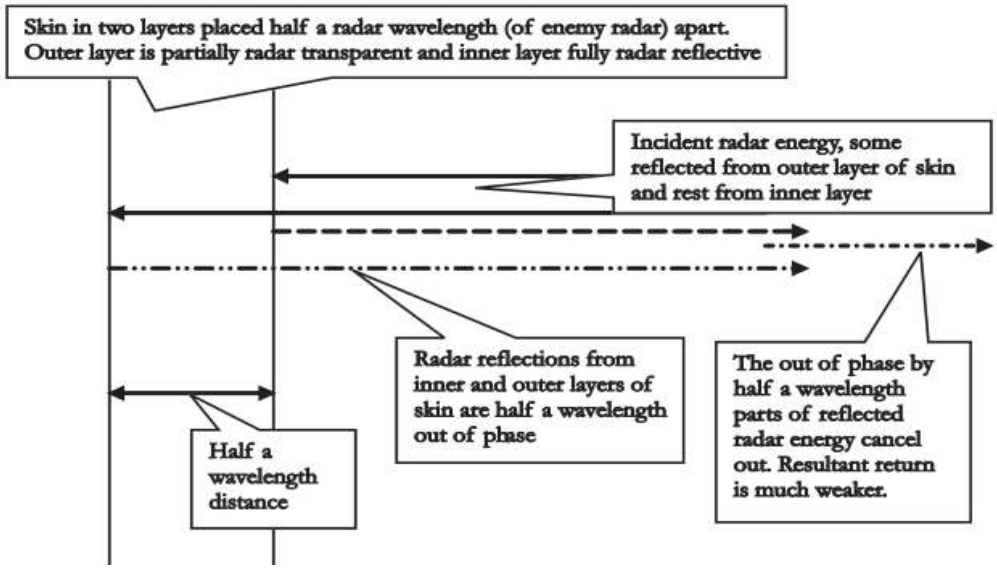


Fig-6: Active Radar Energy Cancellation

5. Radar Ablative Paints

Simply these are paints which contain iron balls hence the common name is "Iron ball paint". When the Radar energy incident on the material then the magnetic field generate in the particles and These particles converts the radar energy into the heat energy. Thus, the strength of radar decreases. As in the paint there are the meta particles the weight of paint is high. These paints contribute in the high radar reflectivity and reduce the RCS to some extent.

5.1Radar Absorbent material (RAM)

RAMs have free electrons in their structure. When the Beam of Radar energy incidents on the surface of object having the RAMs coating then the free electron tends to oscillate in the frequency of the incident beam. Due to friction and inertia of the electron the radar energy converted into the heat energy and hence the reflected wave has weak strength. There are many composites like RCC (Renforced carbon carbon) has high strength and have radar absorbent property.

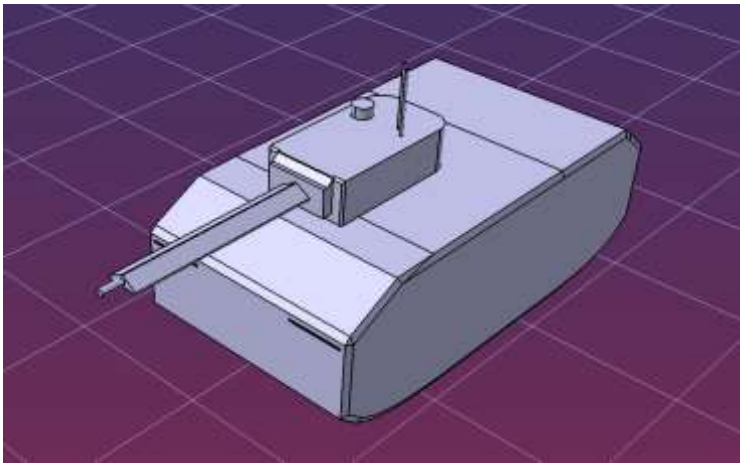
Tables-1: Valves of RCS (m2)

Sr. No	Typical target Type/aircraft	RCS(m2)
1	A typical car	100
2	B-52	100
3	B-1(A\B)	10
4	F-15 "Eagle"	25
5	Cabin cruiser	10
6	Average man	1
7	Insect	0.001
8	F-22 "Raptor"	0.0001

Figure show modern air craft reduce to great extent but not exactly zero. So, the detection of these aircraft and object lower to extent but not can be eliminated.

6. Results

(Model Proposed (tank))



Model-1: Concept Model for Project (Required modification)

After the study of the modern technology we come with this idea to Made the mode of stealth Tank. In this tank we used the many techniques like shaping and RAM the model is totally based on the shape of the tank. We avoided all the flat surfaces and increased the chamfers on the surface. As it is not possibly eliminating the model on the radar, we have to apply the coating of Iron ball contained paint. We can also construct the tank totally with the Carbon contained material.

7. Conclusion

Stealth technology is need of today's world. All the weaponized vehicle of the military must have to designed with this technology so that the signature of vehicle must be hide from the eye of the Enemy. It is not so that the stealth vehicles are the Invincible, they can be detected on the short distance. But it is very difficult to engaged by a fire control radar or a missile radar seeker. Due to implementation of stealth techniques cost of the vehicle is very high. The collusion is that we don't need more fighters with LO principle we need few of them to do extremely sensitive operation. In any how the LO threat is very sensitive, which should be deal very appropriately. Finally, that the modern warfare is changing very significantly so we have to change with the era and we have to modify our older version of the fighters to new one.

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