EXPERIMENTAL DESIGN AND STATIC, DYNAMIC AND THERMAL ANALYSIS OF BUFOR GUN'S MAZEEL BRAKE

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ABSTRACT

This project is focused on the design and analysis of forming tools for the Bofors gun Mazeel brake component. The idea of this project is to evaluate and analyse the forming process before actually developing the tools that could help to avoid expansive mistakes.to see the effect of MUZZLE deformation on the forming of sheet metals, strains, and spring back of the component and avoid the spring back by providing sufficient clearance and to find the best material of the bofors gun.

While converting a raw material to a finished product it is essential to have an accurate design of the product and also data required for manufacturing after completion of analysis.

The main objective of this project is the design and analysis of a Bofors gun Mazeel brake component based on the specifications given and with some design considerations. The modelling of the Bofors gun Mazeel brake is to be done in SOLIDWORKS. The stress and strain values induced on the various parts of the press tool will be evaluated using analysis software ANSYS 19.3.

1. INTRODUCTION

The Bofors forty-millimetre gun, typically cited merely because the antiaircraft, [is associate degree anti-aircraft auto cannon designed within the Thirties by the Swedish producer AB Bofors. It absolutely was one in all the foremost widespread medium-weight anti-aircraft systems throughout warfare II, employed by most of the western Allies furthermore as some captured systems being employed by the Axis powers. A tiny low variety of those weapons stay in commission to the current day, and saw action as late because the gulf War.

In the post-war era, the initial style wasn't appropriate for action against jet-powered craft, thus Bofors introduced a brand new model of considerably additional power, the forty metric linear unit L/70. In spite of sharing nearly nothing with the initial style apart from the calibre and therefore the distinctive round shape flash hider, this weapon is additionally wide known merely as "the Bofors". Though not as common because the original L/60 model, the L/70 remains in commission, particularly as a multi-purpose weapon for light weight armoured vehicles, as on the CV 90.

In the BAE systems Bofors is a part from March 2005

Fig 1. British Bofors 40 mm L/60 on Mk VII, Priddy's Hard, Gosport, United Kingdom

1.1 Weapon Systems

1.1.1 Dhanush

Fig 2. Dhanush

Dhanush could be a 155x45 Calibre autochthones gun developed by OFB. Dhanush as associate degree artillery system has verified to be one in every of the most effective amongst its category. a forty five Calibre towed gun system capable of targeting at long ranges incorporating autonomous egg laying options and having one in every of the foremost subtle suites of electronic and computing systems within the world. . The weapon has most vary larger than eight to ten Kms compared to the prevailing in-service 155mm x thirty-nine Cal Bofors Guns with higher accuracy. It wills hearth every type of ammunition on the market with Indian Army.

1.1.2 130mm Up-Gunning

Fig 3. 130mm up gunning

130mm Gun is of Russian origin and was the most keep of the Indian Army for long. Indian Army needs to upgrade these Guns to 155/45 Cal, that will increase its vary from twenty seven click to thirty eight click.

OFB has completed the upgradation and prepared the prototypes. Internal firing trials of OFB guns conducted at PFFR from eleventh to twenty first Jan, 2016 satisfactorily. This is often AN autochthonic effort created by OFB.

1.1.3 155mm x 52 cal Towed Gun System

Fig 4 155mm x 52 Cal Towed Gun System

Indian Army features a demand of 155mm x fifty two Cal Towed Gun Systems, that RFP was floated. OFB, as a proactive approach, initiated action for developing 155mm x fifty two Cal Towed Gun Systems through in-house R&D efforts. As a neighbourhood of this effort, 155X52 Cal Towed.

Gun developed in-house by OFB has been proof dismissed with success in August 2015. This another time proves in-house capability accessible with OFB to design/develop Artillery guns.

1.1.4 105mm vehicle mounted gun system

Fig 5. 105mm vehicle mounted gun system

In fashionable warfare the time of response and surprise component area unit are necessary to win any battle. Associate pretentious weapons mounted on a vehicle provide it with shoot-and- belt along capability to cut back latency and add the surprise component.

Considering the on top of demand, OFB has developed a Vehicle mounted 105mm gun system. Demonstration humour trial has been conducted at Artillery College, Deolali to gauge stability, accuracy, consistency and quality.

It is a very native effort with 100% sub-assemblies/components made indigenously.

1.1.5 KAVACH Chaff Launcher

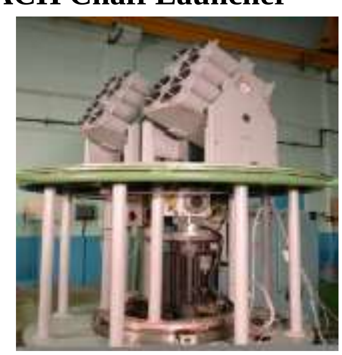


Fig 6. KAVACH Chaff Launcher

Kavach could be a military service decoy system to distract radar-guided missiles from their targets and act as a system for protection. The Kavach decoy system releases chaff created of silver coated optical fibre. The chaff forms a muddle that remains suspended within the air in order that the incoming missile confuses the chaff because the actual target and gets barred onto the chaff rather than the particular target.

1.1.6 Naval Gun CRN-91

Fig 7. Naval gun CRN-91

The shut vary Naval-91 (CRN-91) may be a armed service version of the 30mm automatic gun put in on the Sarath ICV. The Gun has been developed by OF Medak in association with DGONA/Indian Navy. CRN-91 designed to be mounted on ships, and is created of special material suited to marine atmosphere.

The CRN-91 naval weaponry is gyro stabilised and is directed by electro-optic readying system (EOFCS) for day and night use. It can even be remotely operated. Because of its low its operational price, it's most suited to vessels primarily designed for period patrolling and policing, significantly for anti-insurgency, anti-smuggling, anti-pirate and maritime police work of exclusive economic zones (EEZ). It's been put in on several tiny warships. The autochthones CRN ninety one Gun with EOFCS provides them the requisite military posture to undertake their basic role of patrolling effectively.

2. Literature Review

Design optimization of Muzzle Brake for precision rifle M. Sherif same, Ossama R. Abdelsalam*, and Mohamed H. Muzzle brakes (MBs) have an excellent result on reducing the recoil force of weapons throughout firing. During this paper, optimum MB potency, MB force and recoil force for (12.7 metric linear unit x ninety-nine mm) precision rifle are studied. The target is to get the optimum space of aspect openings, inclination angle and range of chambers for the MB so as to extend the MB potency and MB force and thereby to decrease their coil force of the weapon. Associate in nursing analytical model for conniving MB potency, MB force and weapon recoil force for MBs of 2, 3 and 4 chambers has been established. This Model is then utilised together with style of experiment and response surface methodology applied mathematics techniques to develop a swish response perform which may be with efficiency employed in improvement formulation. Finally, multi objectives generic algorithmic rule improvement methodology has been used to seek out the optimum MB style parameters.

Performance Analysis and Design Optimization of Two-Baffle Muzzle Brake of one hundred fifty five metric linear unit Artillery Gun, Anubhav Tiwari one, Vighnesh Pawar one, Muzzle brake may be a device fitted at the muzzle finish of the tube to scale back the recoil energy by discharge some quantity of propellant gases sideways because the shot is discharged. the main focus of the study may be a two-baffle muzzle brake that has its immense application in most of the one hundred fifty-five metric linear unit bored barrel of advanced artillery guns of this generation. the target of the study is to research then optimize this style of two-baffle muzzle brake developed for one hundred fifty-five metric linear unit barrel of advanced towed artillery gun system. The performance characteristics of muzzle brake is measured in terms of its potency, instantaneous sound pressure levels (SPL) generated within the crew zone, mechanical strength and sturdiness, considering the limitation on its weight that imposes instability at the muzzle finish and more effects the accuracy of the impact of shot on the target. The autochthonic machine ways and tools developed and valid in-house are used for the analysis and style optimisation cycles. the height pressure and also the velocity of the shot earned for intense firing condition is450 MPa and 890 m/s, severally. The accomplishment of the study may be a three-baffle muzzle brake style efficiently 2 hundredth larger than current two-baffle muzzle brake, and alternative performance characteristics remained unrevised.

Computer motor-assisted style and analysis of a tunable muzzle brake Ekansh Chaturvedi*, Ravi K. Dwivedi, This analysis work deals with the planning of a tunable muzzle brake [10] for a rifle divided in5.56 a forty five international organisation ammunition. It proposes to resolve the matter of handling variations from shooter to shooter by incorporating the feature of tunability. Beside this, it conjointly solves the matter of demand of optimum recoil briefly recoil weapons. This innovation offers this style a grip over it's already existing counterparts within the market. the merchandise is meant victimization the interior ballistics calculations and also the investigations been performed victimization solid works flow simulation tool and ANSYS static structural to visualize the parameters like speed distribution, pressure growth, and muzzle brake force on the series of ports and comparison of the thus found results with those devised by the authors of the documents mentioned in references. This assures the market ability of the merchandise for satisfactory performance, once brought among its already existing counterpart, although with a small edge over them thanks to tunability. The results thus found shall be ended satisfactory concerning the performance of muzzle brake.

3. Problem Statement

The main objective of this project is to style forming press tool to manufacture a district with needed dimensional accuracy systematically over amount of your time to satisfy production needs by adopting the forming operation of a mazeel brake Bofors gun by mistreatment the high hardened steel to scale back the assembly time and price of producing of a part in single press tend. The most purpose of this press tool is to bend the high thickness (25mm) part in a very hot bending tool.

Objectives

To Design and drafting the press tool at intervals the out there press limits

To calculate the desired forming force and pad force

To static structural analysis of press tool main parts

SOLID WORKS software system for modelling of tool

Static structural analysis software system for applying hundreds on punch and die for to envision either the tool are going to be withstanding on the applied hundreds or not.

Specification

Sr.No	Specification	Value
Press Data		
1	Model No.	HS-630-2120X1800
2	Serial No.	H-1005
3	Force Capacity(max)	630 tonnes
4	Stroke (mm)	750
5	Day light (mm)	1000
6	Working pressure kg/cm^2	310
7	Bed area LRXFB (mm)	2120X1800
8	Ram rea LRXFB (mm)	2120X1800
9	Power kw	90X3.7X2.3
Cushion Data		
10	Cushion Force KN	2500
11	Cushion Stroke (mm)	350

The basic conception concerned during this technique to achieve the target of the systematic and proper tool style, a well-planned approach has been used and also the methodology consists of the subsequent.

Force Calculation

The bending load could also be calculated from the information of fabric properties and also the die characteristics as shown below:

$$F_b = \frac{KLs\,t^2}{W}$$

F_b=bending force

K=0.33 for wiping bending die

Span W= r_d+r_p+c

r_d=die radius 15mm

r_p=punch radius 99mm

c=die clearance 25mm

For left edge

L=431.88

W=99+25+15

=139mm

Left edge bending force

$$= \frac{0.33x91x431.88x25^2}{139}$$

= 58315.45

=58 ton

Same as right side

$$= \frac{0.33x91x431.88x25^2}{139}$$

= 58315.45

=58 ton

Total forming force

$F_B=F_{B1}+F_{B2}$

=58315.45+58315.45

= 116630.9

Pad force (for ejection purpose)

$F_P=0.5\times F_B$

= 0.5×116630.9

= 58315.45

Total force required

$FN = F_B+F_P$

= 116630.9+58315.45

=174946.35

=175 Ton

Pressing capacity = F_N+1.5

= 175×1.5

=262.5 ton

$$\frac{E}{R} = \frac{M}{I} = \frac{\sigma\, b}{Y}$$

Where

E – Young's modulus (N/mm^2)

R – Radius of curvature (mm^2)

σ_b – bending stress (N/mm^2)

y – Neutral axis location (mm)

m – Moment (N.mm)

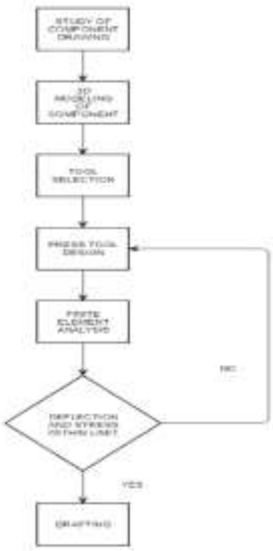
I -2nd moment of inertia (mm^4)

Cost Estimation for Final Design:

Raw Material Cost

Material	Component	Raw Material size (mm)	Raw Material Volume (mm^3)	Material desity (kg/mm^3)	Raw Material Mass (kg)	Price/Kg (Rs.)	Quantity	Cost (Rs.)
T-90	Punch	500 x 350 x 206	36050000	7.73E-06	278.6665	90	1	25079.99
	die	650x 480 x 254	76440000		590.8812		1	53179.31
EN-36	Guide Bush	Ø90x 140	635850	7.85E-06	4.9914225	80	3	1197.941
	Guide Pillar	Ø60 x 430	1215180		9.539163		3	2289.399
C-45	Pusher	Ø40x 535	671960	7.85E-06	5.274886	70	2	738.484
	Stopper	Ø20 x 50	15700		0.123245		1	8.62715
	Locator	180x71 x20	255600		2.00646		1	140.4522
M.S	Top Plate	890x 690 x 60	36846000	7.85E-06	289.2411	60	1	17354.47
	Bottom Plate	890 x 690 x 70	42987000		337.44795		1	20246.88
TOTAL								**120236**

Design Methodology



4. Solid works

4.1 Introduction to Solid Works

SOLIDWORKS

Solid Works could be a solid modelling package (CAD) and computer-aided engineering(CAE) Trojan horse that runs on Microsoft Windows. Solid Works is printed by Dassault System.

Over three,246,750 product designers and engineers worldwide, representing 240,010 organizations, use SOLID WORKS to bring their styles to life–from the good gadgets to innovations that deliver a stronger tomorrow.

Dassault System SOLIDWORKS house offers complete 3D software system tools that permit you produce, simulate, publish, and manage your knowledge. SOLIDWORKS product square measure simple to find out and use and work along to assist you style product higher, faster, and a lot of cost-effectively. The SOLIDWORKS specialize in ease-of-use permits a lot of engineers, designers and alternative technology professionals than ever before to take advantage of 3D in transportation their styles to life. It is headquartered at Waltham, Massachusetts, USA.

The latest version of Solid works was discharged on nineteenth Gregorian calendar month, 2016 as Solid works 2017.

4.10 Design of BG Components

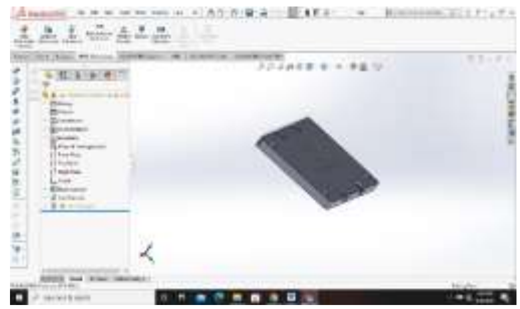


Fig 4.1 bottom pale

With the help of part we will do the bottom, with the help of sketch and futures options.

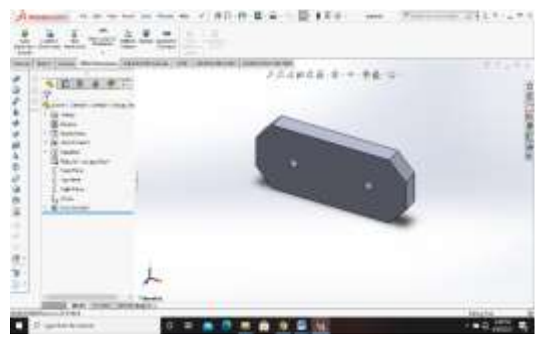


Fig.4.2 pusher

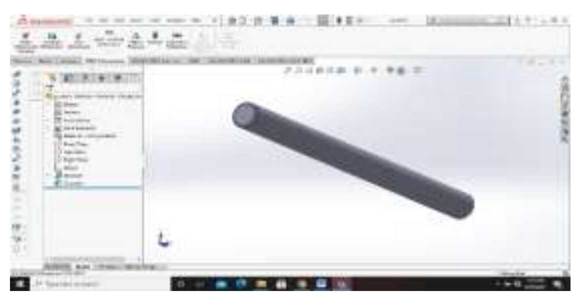


Fig. 4.3 pulley

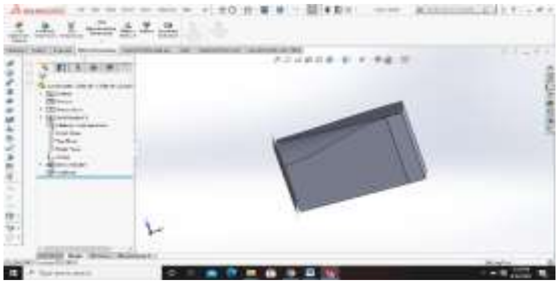


Fig. 4.4 bottom plate inside the body

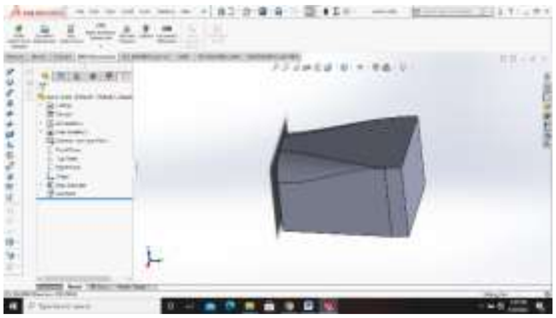


Fig.4.5 pusher block

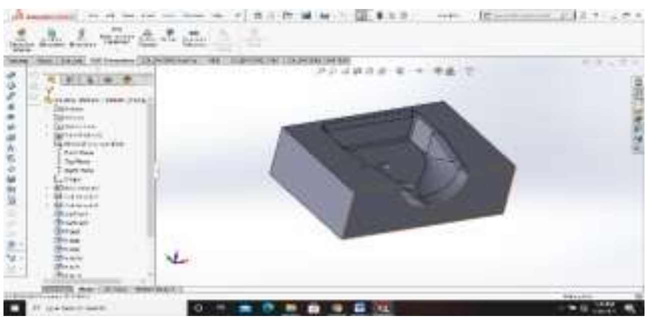


Fig 4.6 die plates

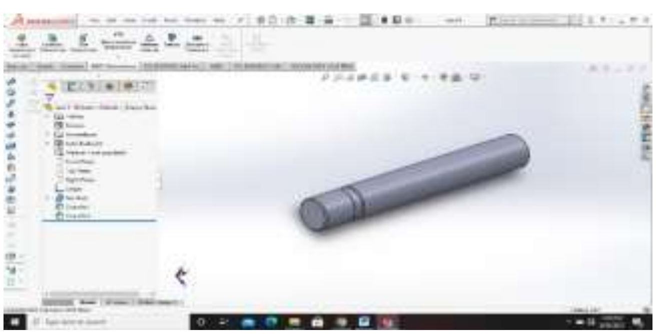


Fig.4.9 bush

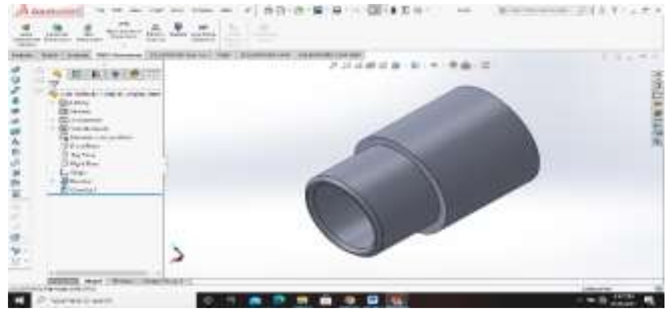


Fig 4.10 hollow bush

Fig.4.11 bottom blaster

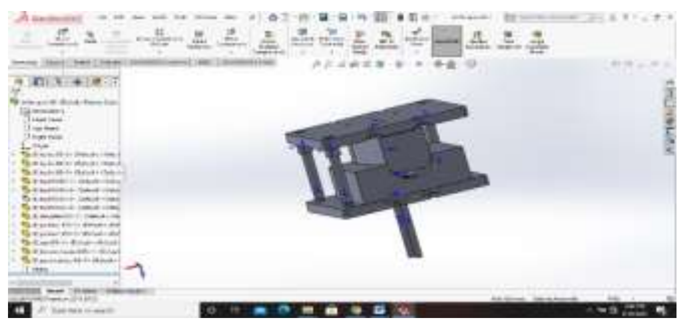


Fig 4.12 design of BG component

5. Introduction to FEA

5.1 Introduction

Finite component Analysis (FEA) was initial developed in 1943 by R. Courant, WHO used the Ritz methodology of numerical analysis and decrease of variation calculus to get approximate solutions to vibration systems. Shortly thenceforth, a paper printed in 1956 by M. J. Turner, R. W. Clough, H. C. Martin, and L. J. Topp established a broader definition of numerical analysis. The paper targeted on the "stiffness and deflection of complicated structures".

By the first 70's, FEA was restricted to costly mainframe computers usually in hand by the astronautics, automotive, defence, and nuclear industries. Since the fast decline within the value of computers and also the fantastic increase in computing power, FEA has been developed to an implausible exactitude. Gift day supercomputers are currently ready to turn out correct results for every kind of parameters.

MATERIAL PROPERTIES

TITANIUM ALLOY

Table 5.1 titanium alloy

CARBON FIBER:

Table 5.2 Carbon Fiber

NICKEL ALLOY:

Table 5.3 nickel alloy

SILICON CARBIDE

Table 5.4 silicon carbide

Static structural and steady state thermal analysis

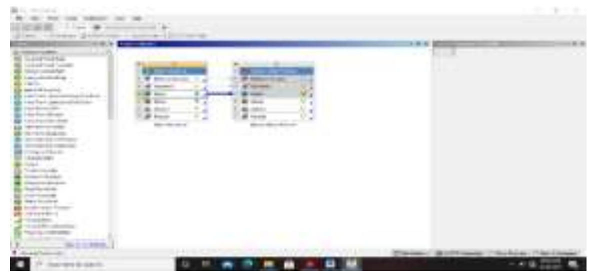


FIG: -5.5 Structural and thermal analysis

Fig:- 5.6 meshed file Fig5.7: - Fixed support, forces (boundary conditions)

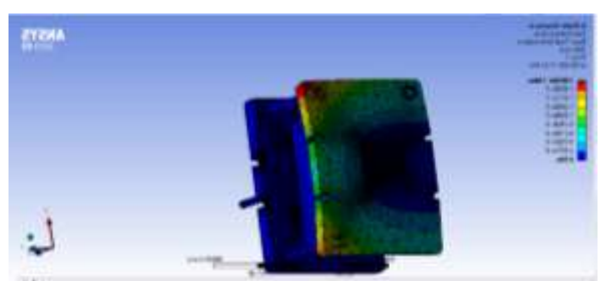


Fig5.8: -Total deformation for Titanium alloy

Fig 5.9 : -Equivalent Strain for Titanium Alloy

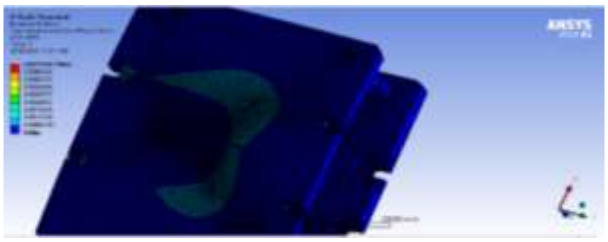


Fig 5.11: - Equivalent(von-mises) stress

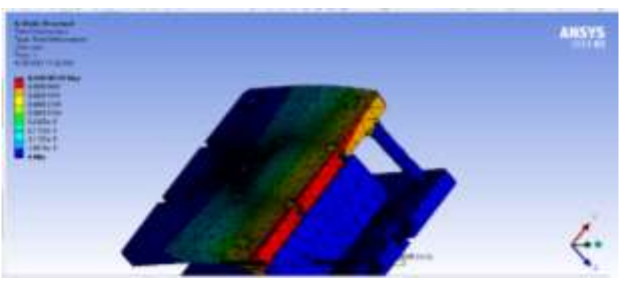


Fig 5.12: - Total deformation of carbon fiber

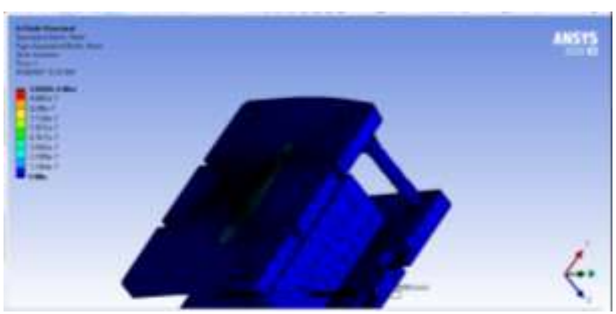


Fig 5.13 : - Equivalent strain for Carbon fiber

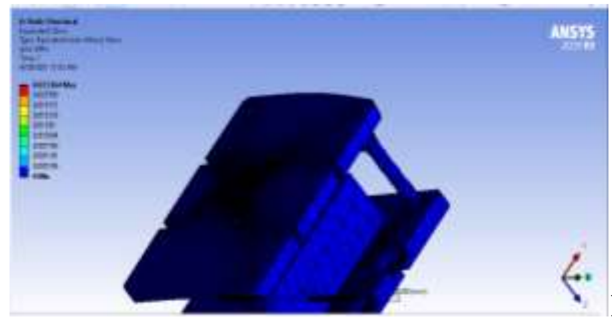


Fig 5.14 : - Equivalent (von-mises)Stress for Carbon fiber

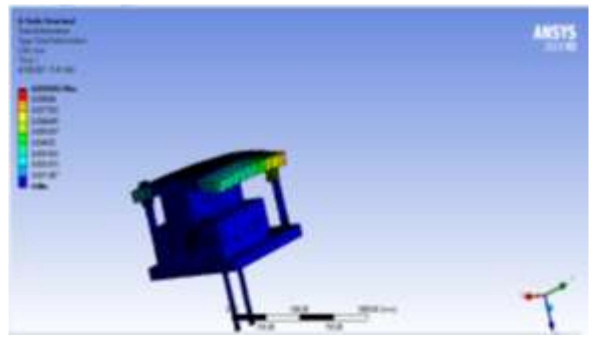


Fig5.15: -Total deformation of Nickel alloy

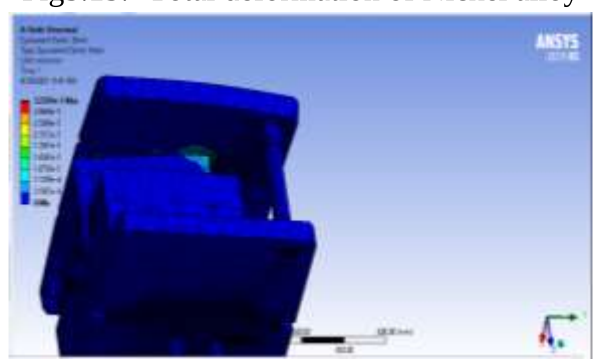


Fig 5.16: - Equivalent strain for Nickel alloy

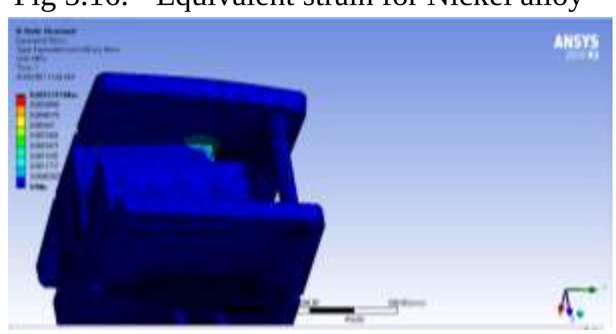


Fig 5.17: -Equivalent (von-mises) stress

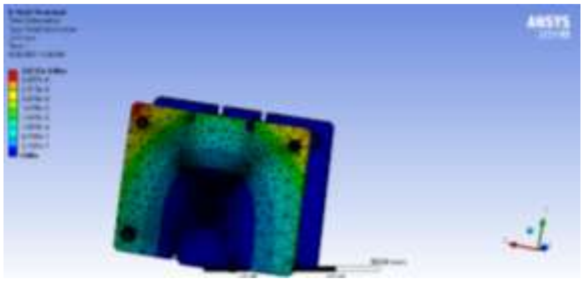


Fig 5.19: - Total deformation of Silicon carbide

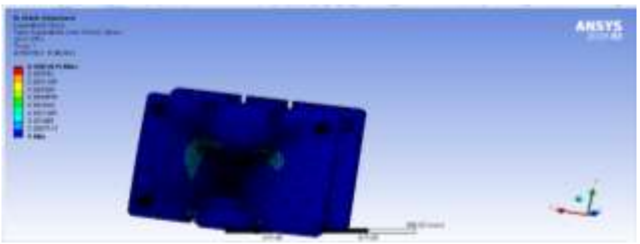


Fig 5.20:- Equivalent (von-mises) stress

THERMAL ANALYSIS :

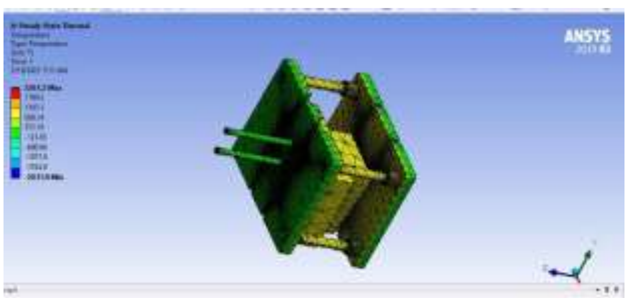


Fig 5.21 :-temperature

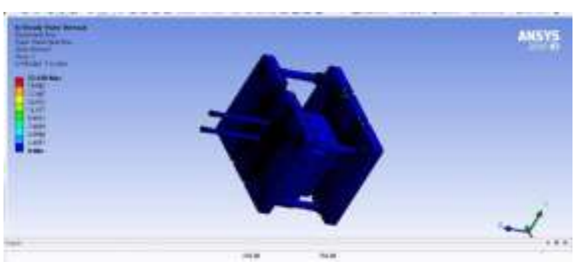


Fig 5.22: - Total heat flux of silicon carbide

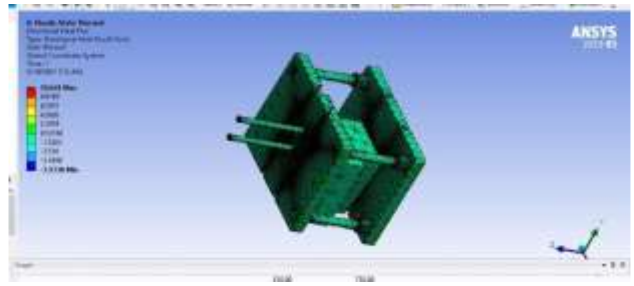


Fig 5.23: - Direction heat flux of silicon carbide

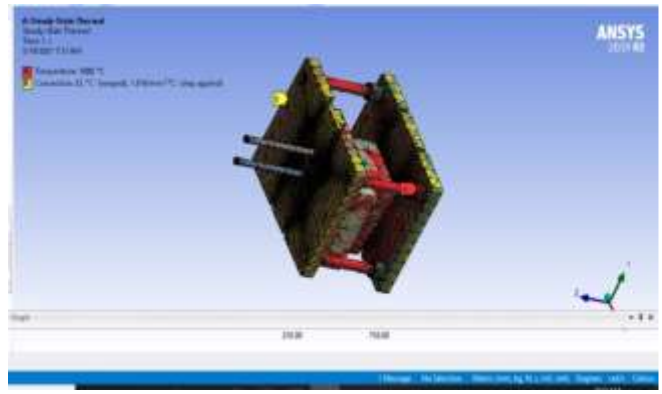


Fig **5.** 24: - Heat flow by convection

6. Results

TABLES

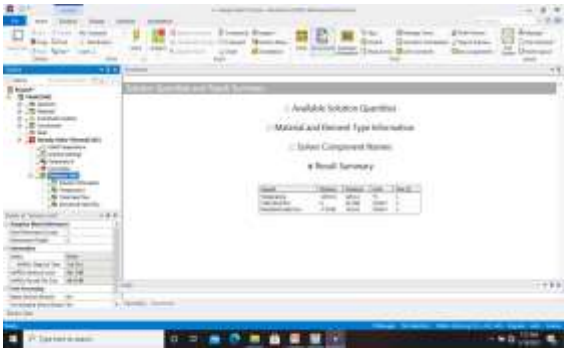
6.1 STATIC STRUCTURAL ANALYSIS

◉ Result Summary

Results	Minimum	Maximum	Units	Time (s)
Total Deformation	0.	1.8519e-004	mm	1.
Equivalent Elastic Strain	0.	1.0669e-006	mm/mm	1.
Equivalent Stress	0.	2.3364e-002	MPa	1.

TABLE 6.1 SILICON CARBIDE Structural analysis

6.2 Steady state thermal analysis :

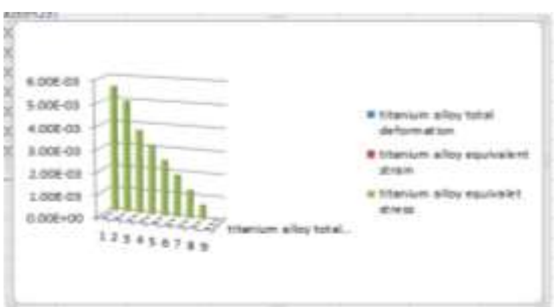


• Result Summary

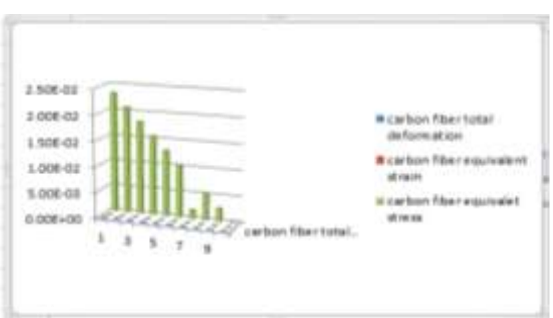
Results	Minimum	Maximum	Units	Time (s)
Temperature	-2011.9	2261.2	°C	1.
Total Heat Flux	0.	22.458	W/mm²	1.
Directional Heat Flux	-7.5736	10.641	W/mm²	1.

TABLE 6.2 SILICON CARBIDE thermal analysis

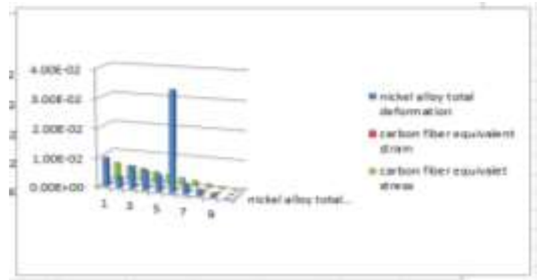
6.3 Graphs



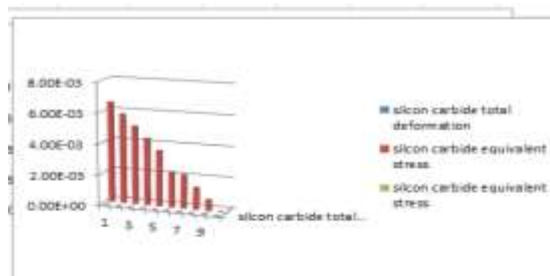
Graph 6.1 titanium alloy



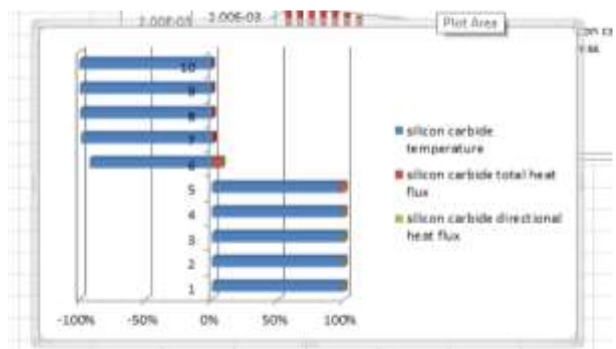
Graph 6.2 carbon fiber



Graph 6.3 nickel alloy



Graph6.4 silico carbide



Graph 6.5 silicon carbide temperature

CONCLUSION

- The design of BG component designed n solid works and static. Thermal analysis are done in ANSYS Workbench 2019 R3 version.
- When we compare the graphs ths silicon carbite is the best material so thermal analysis done in silicon carbide.
- This thesis involves the design of bofors guns mazeel brake; Forces required to operate the tool have been calculated using standard formulas

Future Scope

- Single compound tool which is able to perform each punching, Forming and non-cutting bend operation needed to supply the element.
- Automatic stock feed system.

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