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Analysis For The Reinforcement Of Conventional Armour

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Abstract : *This paper documents the development of today's lightweight body armours including their designs, materials, analysis, National Institute of Justice ballistic and North Atlantic Treaty Organization fragment threat categories, and qualification testing requirements. Material characteristics are discussed for each of the multiple material dimensional scales, which include the molecular and fabric scales. Ballistic impact effects on multi-layered woven fabrics and sandwiched composites are presented as well as analysis models used to depict stress and transverse wave propagations, projectile blunting, and armour penetration.*

I. INTRODUCTION

Conventional Armour have historically delivered optimised ballistic performance against a range of battlefield threats, including both armour piercing and fragmentation threats. Aramid shear thickening composite along with Boron carbide and polyethylene composite offers better protection with decrease in weight. The relationship between its properties, specifically the properties Aramid shear thickening composite and boron carbide, polyethylene and ballistic performance of 7.62mm bullet is the subject of the current study. While the composition, processing and microstructure of boron carbide, polyethylene will determine its mechanical properties which then can be correlated to and will critically determine its penetration resistance which after research and testing will improve impact resistance and lead to analysis of reinforcement of armour.

II. HEADING'S

III. Detail study of bullet and armour materials

Detail study of 7.62*39mm caliber

The 7.62×39mm (aka 7.62Soviet) round is a rimless bottlenecked intermediate cartridge of Soviet origin that was designed during World War II. Due to the worldwide proliferation of RPD and RPK light machine guns and SKS and AK-47 pattern rifles, the cartridge is used by both militaries and civilians alike. 7.62×39mm ammunition is purportedly tested to function well in temperatures ranging from −50 to 50 °C (−58 to 122 °F) cementing its usefulness in cold polar or hot desert conditions

Materials taken for multilayered armour plate

Boron carbide

Boron carbide is one of the hardest materials known, ranking third behind diamond and cubic boron nitride. It is the hardest material produced in tonnage quantities. Boron carbide, in conjunction with other materials also finds use as ballistic armour (including body or personal armour) where the combination of high hardness, high elastic modulus, and low density give the material an exceptionally high specific stopping power to defeat high velocity projectiles.

Polyethylene

Polyethylene consists of nonpolar, saturated, high molecular weight hydrocarbons. Therefore, its chemical behavior is similar to paraffin. The individual macromolecules are not covalently linked. Because of their symmetric molecular structure, they tend to crystallize; overall polyethylene is partially crystalline. Higher crystallinity increases density and mechanical and chemical stability.

Aramid shear thickening fluid composite

Shear-thickening fluid (STF), which behaves like a solid when it encounters mechanical stress or shear. In other words, it moves like a liquid until an object strikes or agitates it forcefully. Then, it hardens in a few milliseconds. This is the opposite of a shear-thinning fluid, like paint, which becomes thinner when it is agitated or shaken. To make liquid body armor using shear-thickening fluid, researchers first dilute the fluid in ethanol. They saturate the Kevlar with the diluted fluid and place it in an oven to evaporate the ethanol. The STF then permeates the Kevlar, and the Kevlar strands hold the particle-filled fluid in place. When an object strikes or stabs the Kevlar, the fluid immediately hardens, making the Kevlar stronger. The hardening process happens in mere milliseconds, and the armor becomes flexible again afterward.

IV. Figures And Tables

Fig :7.62*39mm caliber

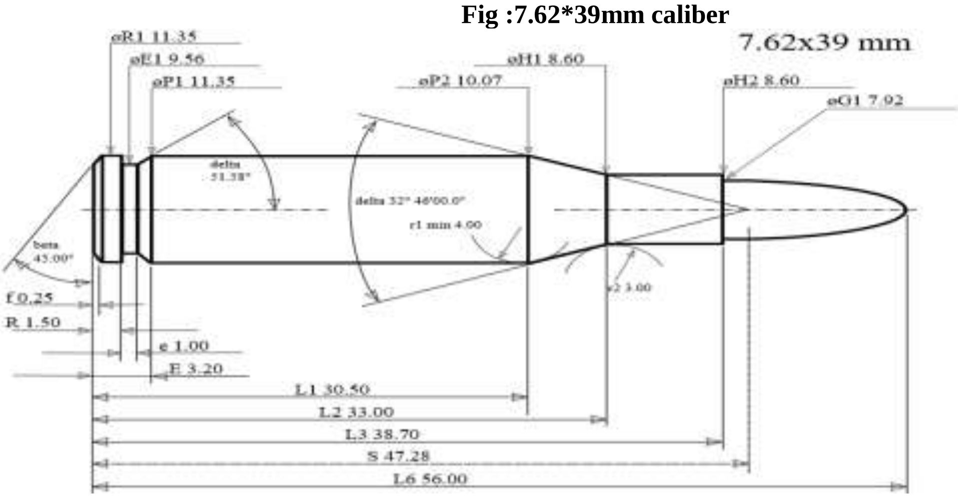


Table 1: Engineering properties of materials

DATA	POLYETHYLENE(HDPE)	BORON CARBIDE	COPPER-2	LEAD-2
YOUNG'S MODULUS (Gpa)	1.4	400	128	15
BULK MODULUS (Gpa)	3.14	250	140	45
POISSON'S RATIO	0.4	0.20	0.33	0.44
DENSITY (Kg/m3)	950	2500	8900	11350

Table 2: 7.62*39 mm caliber specification

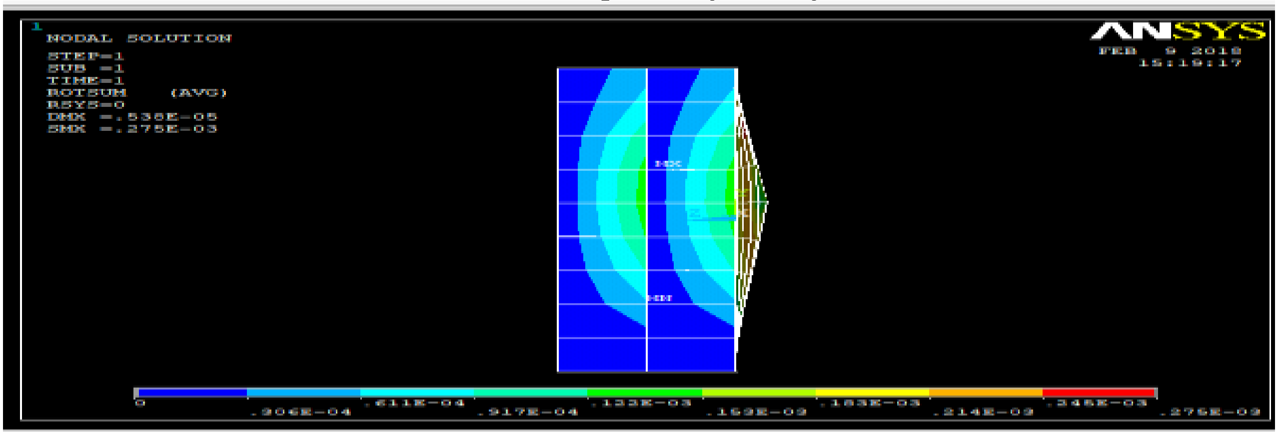
Muzzle velocity (m/s)	720
Diameter range (mm)	7.87 – 7.90
Overall length (mm)	26.5
Weight (gms)	Copper-2 jacket weight 33 gms

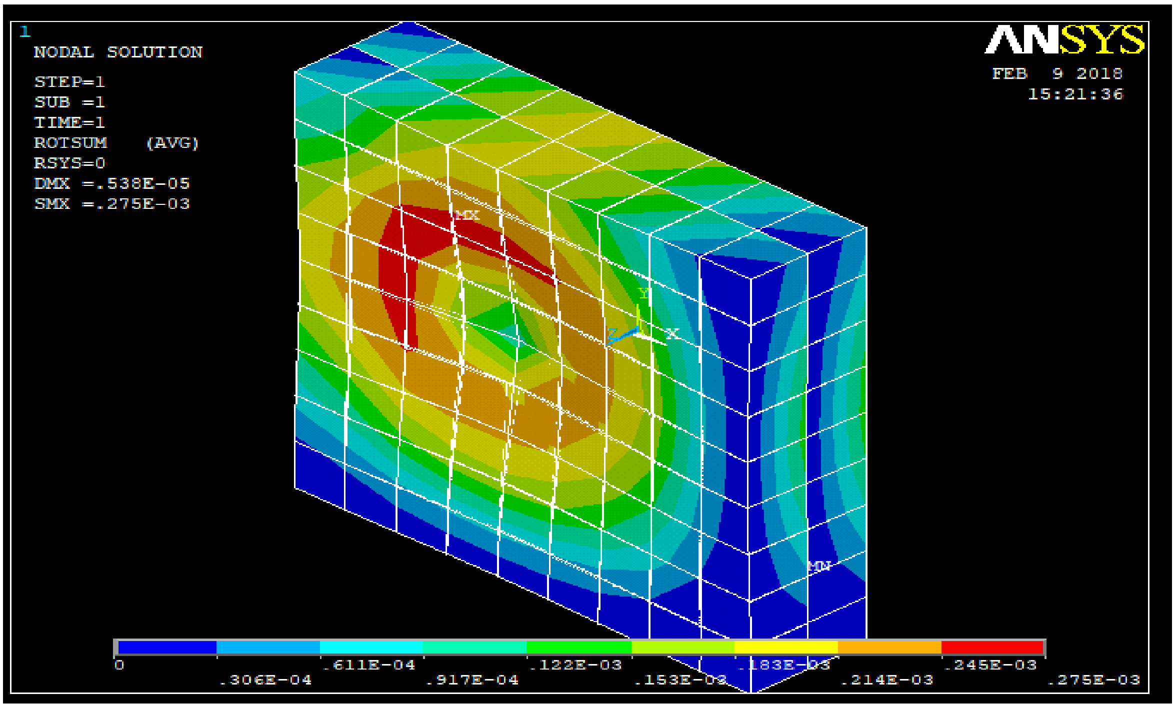
	Lead-2 core weight 107 gms
Impact force (N)	2000

Table 3: Properties of aramid shear thickening fluid composite

DATA	Kevlar 29	Kevlar 49
Young's modulus (GPa)	83 – 100	124
Density (g/m3)	1.44	1.44
Tensile strength (GPa)	2.27	2.27
Tensile elongation (%)	2.8	1.8
Fibre diameter (mm)	12	12
Fibre structure	Anisotropic	Anisotropic

V. Results And Apdl Analysis Ansys





POLYETHYLENE(HDPE)	BORON CARBIDE(B4C)
DIMENSIONS- Length * Breadth=200*150=30000 mm square	DIMENSIONS- Length * Breadth=200*150=30000 mm square

THICKNESS = 5 mm	THICKNESS= 5 mm
DENSITY = 950 Kg/cubic meter	DENSITY = 2500 Kg/cubic meter
Y = 1.40 Gpa	Y = 400 Gpa
K = 3.14 Gpa	K = 250 Gpa
u= 0.40	u= 0.20
FORCE= 2500 N	FORCE= 2500 N

DATA	THEROTICAL		APDL ANSYS
DISPLACEMENT	HDPE	B4C	
	14.15 mm	0.0566 mm	0.49 mm
STRESS	Sx=31.7 Mpa	Sx=72 Mpa	58.39 Mpa
	Sy=24.9 Mpa	Sy=49.3 Mpa	

VI. CONCLUSION

Multilayered armors have evolved into highly sophisticated protective devices delivering unprecedented protection levels against some of the harshest physical threats facing mankind. Continued effective protection of these communities requires further evolution of body armor; that is, the development of improved fiber materials, manufacturing processes, and relevant mechanics that outpace future increases in weapon effectiveness levels, Thus in our topic “Analysis for reinforcement of conventional armour”, we have discussed and analyzed the aramid shear thickening fluid composite, boron carbide and polyethylene’s physical, chemical and thermal properties and its penetration resistance at point blank range using 7.62*39mm bullet and found it effective to stop 7.62*39 mm bullet from a point blank range, Further investigation of the complex dynamics at each scale will increasingly incorporate the virtual environment through robust, physics-based, numerical modeling tools using, for example, explicit finite element analysis techniques coupled with theoretical and experimental validation testing.

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