IMPACT OF KINETIC ENERGY PROJECTILES ON SINGLE AND LAYERED PLATES

By

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CERTIFICATE

This is to certify that the thesis entitled " IMPACT OF NETIC ENERGY PROJECTILES ON SINGLE AND LAYERED PLATES " by Mr. Madhu has been prepared under our supervision and has attained a standard required for a Ph.D. degree of the Institute. The thesis is a record of bonafied research work carried out by him and its contents have not been submitted to any other University or Institute for the award of any degree or diploma.

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ABSTRACT

The study of the phenomenon of impact of a projectile on single or layered plates has been of interest in military field and a number of industrial applications. This involves understanding of the mechanics of penetration, perforation and ricochet of the projectile. The ballistic performance of a given metal plate against kinetic energy projectile depends upon several parameters which include the mechanical and metallurgical properties of the material in the range of strain rates at which the materials are intended to be employed in real life situation. One of the ways to study the response of a plate is to find a proper correlation between the mechanical properties of its material, ballistic parameters and the immunity of the plate to impact. There are quite a few empirical and analytical solutions with regard to normal attack of projectiles on thin plates at subordnance and ordnance velocities. Very limited published literature however is available pertaining to normal and oblique impact of projectiles on intermediate and thick plates and on multi-layered targets, both adjacent and spaced. In a real life situation, it is the oblique impact which is more important, since most of the armour structures on battle tanks are designed to be inclined as also are the structural impacts of meteorites on skins of space vehicles and bird hits on aircraft turbine blades.

The present work is an experimental study of the response of different materials to impact of a hardcore armour piercing

projectile at ordnance velocity of about 820 ms^{-1}. The ballistic tests were conducted at a small arms range using a standard rifle. Square mild steel, aluminium and rolled homogeneous armour plates with the ratio of their thicknesses to the projectile diameter varying from 1.6 to 5.0, were tested for their performance to normal and oblique impact of armour piercing projectiles. The angle of obliquity of impact was varied from 0° (normal impact) till ricochet occured in plate of each thickness. Impact and residual velocites, crater dimensions, angles of exit of projectile after plate perforation and the angles of critical ricochet of the projectile were measured in these experiments. Relations, for obtaining the residual velocity, ballistic limit of the plate thickness for a given impact velocity and angle of impact obliquity, the velocity drop of projectile for a given plate thickness and the angles of critical ricochet of projectile are presented. Simulation studies using a finite difference hydrodynamic computer code were carried out to study the step-by-step sequence of penetration of cylindro-conical projectiles due to normal impact on mild steel and aluminium plates of different thicknesses. Histories of the residual velocity of the projectile, depth of penetration and plate deformations were monitored for every 5 μs time interval and are presented and discussed.

An attempt has also been made to study the response of multi-layered mild steel and aluminium plates, both adjacent and spaced, to normal impact of armour piercing projectiles at ordnance velocities of impact of about 820 ms^{-1}. Crater deformations observed in these plates were examined critically

and are presented and discussed. A comparison of the ballistic resistance of these target systems, both in contact and spaced with that of monolithic plates of the same thickness is presented.

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