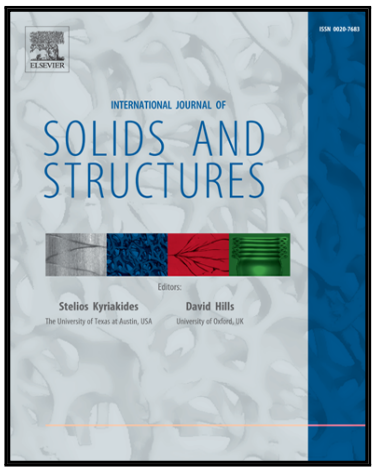

A numerical study of steel and hybrid armor plates under ballistic impacts

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A numerical study of steel and hybrid armor plates under ballistic impacts

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Abstract:

High strength steels such as Weldox 700E and para-aramid composites such as Kevlar 129/epoxy plates are commonly used materials for ballistic protections. In this study, the nonlinear finite element (FE) models of Weldox 700E and Kevlar 129/epoxy plates were created and validated against experimental data. A parametric study was conducted using numerical models to investigate the ballistic performance of monolithic steel plates, multi-layer steel plates, and hybrid plates made of steel and Kevlar layers, under impact conditions specified by the NATO Level I or EN1063 BR5 standards. In this parametric study, numerical simulations were performed on 30 different configurations of steel and hybrid plates subjected to impacts of .223 bullets at 900 m/s. The effects of layer thickness of monolithic and layer configuration of multilayer steel and hybrid plates were investigated in detail. The results showed that layer configuration could significantly affect the ballistic performance of layered steel and hybrid plates. A layered steel plate had superior ballistic protection to that of a corresponding monolithic steel plate. It was also found that the hybrid steel/Kevlar plate configurations resulted in a 26% weight reduction compared to the monolithic steel plates while providing better ballistic protection.

Keywords: Finite element; Armor plates; Ballistic; Impact; Ballistic limit; Kevlar

1. Introduction

Hardened steel plates, despite their heavy weights, are predominantly used for ballistic protection under rifle bullet threats. Although commercial monolithic steel plates could be manufactured to a large thickness, they may not meet the design needs of certain thickness and