# Accepted Manuscript


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PII: S1359-8368(17)32024-3

DOI: 10.1016/j.compositesb.2018.01.030

Reference: JCOMB 5521

To appear in: *Composites Part B*

Received Date: 14 June 2017

Revised Date: 13 November 2017

Accepted Date: 31 January 2018

Please cite this article as: Alonso L, Navarro C, García-Castillo SK, Analytical models for the perforation of thick and thin thickness woven-laminates subjected to high-velocity impact, *Composites Part B* (2018), doi: 10.1016/j.compositesb.2018.01.030.

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**Analytical models for the perforation of thick and thin thickness woven-laminates subjected to high-velocity impact**

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**Abstract**

This paper deals with the problem of high-velocity impact of a low-mass projectile on woven composite plates. A nondimensional formulation of two analytical models has been developed (one for thin laminates and the other for thick ones). Both analytical models are based on energy conservation and have been applied for the ballistic impact on E-glass woven fibres/polyester composite plates. The results of the models (mainly the ballistic limits) have been compared with experimental results. The value of the ratio target thickness/projectile diameter determining whether the laminate behaves as thick or thin has been established.

**Keywords**

A. Laminate, B. Impact behaviour, C. Analytical modelling.

**NOMENCLATURE**

$A$ = empirical parameter

$B$ = yarn width

$b$ = stress-wave transmission factor

$C_{Vl}$ = velocity of the longitudinal elastic waves

$C_{Vt}$ = velocity of the transverse elastic waves

$C_{Vxl}$ = velocity of the compressive waves through-thickness direction

$E$ = in-plane Young modulus of the laminate plate

$E_0$ = initial kinetic energy of the projectile

$E_A$ = energy absorbed by all the energy-absorption mechanisms at any elapsed time-for thin laminate

$E_B$ = energy absorbed by all the energy-absorption mechanisms at any elapsed time for thick laminate

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