Experimental and Numerical study on the effects of frame shapes and stacking sequence of composite plates subjected to high-velocity Impact

H. R. Raissi*, G. H. Liaghat†, H. Raissi†

* Deparment of Mechanical Engineering
Tarbiat Modares University, Tehran, Iran
Tarbiat Modares University, Jalal Ale Ahmad Highway, P.O.Box: 14115-111, Tehran, Iran
Author e-mail: raissi_hr@yahoo.com, web page: http://www.modares.ac.ir

† Department of Mechanical Engineering
Power & Water University of Technology, Tehran, Iran
Author e-mail: mechanic_hr@yahoo.com, web page: http://www.pwut.ac.ir

Abstract
The behaviour of different E-glass/epoxy plates has been experimentally and numerically (with the computer code LS-DYNA, three-dimensional (3D) transient deformations) studied under impact of steel spherical projectile(2.71gr, 8.7 mm diameter) at high velocity(280 m/s).Composite plates have sections with geometrical figures in the form of equilateral triangle, square, hexagon and circle. The result were obtained using gas gun machine and presented for two different cross-ply laminates ([[0,0,90,90,90], A type, [0,0,0,0,90], B type) and transverse isotropic laminate ([0,36,72,-72,-36,0,36,72,-72,-36], C type) and semi transverse isotropic laminate ([0,72,-36,36,-72], D type). During the experiments seen the highest energy absorption related to the square shape of type A, which is 99.8 percent has had to absorb the energy. Lowest energy absorption related to the triangular type D, which is 58.4 percent has had to absorb the energy. Ultimately be based on the geometry of the environment geometry and fiber length in each diagram in the amount of strain and strain rate considered effective. On the other hand the presence of several layers with identical orientation (type A, B) the effects of geometry on the strain rate decreases, and the degradation rate is reduced, in contrast with the presence of layers of different orientation (type C, D) the effects of geometry on the strain rate increases, and the rate of delamination also increases. Most area destroyed input and output related to the layer of lay-up D is the reason for this difference 72 ° each layer to layer other and create a large-scale delamination, which is geometric shapes-square and a circle with the effects of marginal in their from its surrounding environment are contributing to this more turns. Diversity in the area of failure input, output and middle, and the amount of output speed projectile, shows interaction geometry and structure is on a lay-up.

Keywords: Finite element analysis (LS-DYNA), Impact behavior, Ballistic test, Lay-ups of composite plate, Frame shapes