Damage and wave propagation characteristics in thin GFRP panels subjected to impact by steel balls at relatively low velocities

Amr A. Nassr, Tomomi Yagi, Takashi Maruyama, Gen Hayashi

Abstract:

An experimental investigation was conducted to determine the damage and wave propagation characteristics in Glass Fibre Reinforced Polymer (GFRP) panels subjected to impact by steel balls at relatively low-velocities up to 91 ms⁻¹. While maintaining the same impact energy level, the influence of ball mass on panel response was studied. The effects of composite lay-up sequence and successive impacts were also investigated. The wave propagation characteristics, including wave types, wave velocities, wave attenuations, and strain rates, were extracted from dynamic strain records measured at various locations on the panels. The results showed that, for the same level of impact energy, the small ball mass produced larger deformation and delamination than the large ball mass. Additionally, the resistance to impact was influenced by the composite lay-up sequence of similar fibre weight fraction. Test panels subjected to successive impacts showed an increase in cumulative delamination areas, whereas the tests indicated that successive impacts had a little effect on the perforation limit of the test panels. The impact velocity showed a pronounced influence on the measured peak strains and strain rates. The flexural wave was the predominant wave system, propagating at different velocities in different directions. In proximity to the impact site, both flexural wave and indentation predominated over the transient response. In addition to the flexural wave, impact induced low amplitude tensile longitudinal waves of high velocity.

Keywords:

FlexureImpactStrain rateWaveWoven fabric

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