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Single and repeated impact behaviors of bio-sandwich structures consisting of thermoplastic face sheets and different balsa core thicknesses

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Abstract

This paper aims to investigate the single and repeated impact behaviors of bio-sandwich structures consisting of E-glass fiber – reinforced thermoplastic face sheets and balsa cores. Low velocity impact tests were performed using a drop-weight impact machine under a hemispherical impactor. Preliminary single low velocity impact loadings were applied to the bio-sandwich composites with different core thicknesses (namely 15 and 25 mm) so as to obtain the energy limits which were ranged from fully elastic level (10 J) to perforation energy level (80 J). Impact behaviors and damage mechanisms which occurred at both face sheets and internal parts of the balsa core were elucidated through the energy profile diagrams and force – deformation (F-D) curves under low velocity single impact loadings. Besides, low velocity repeated impact tests of the bio-sandwich structures were performed with the same impact energy levels. Repetitive impact behaviors were also investigated with F-D curves at some specific repeated impact numbers. Impact failures which occurred in the upside and bottom of composite structures were detected with digital camera. According to the experimental findings, it was concluded that the total number of impact loads under impact energy level of 10 J until perforation were 38 for the sandwich structures with 15 mm balsa core thickness while it was 98 for the sandwich structures with 25 mm balsa core thickness. Based upon the test results, the number of impacts for perforation (N_r) under smaller impact energies without testing was easily predicted with the derived equation in the form of $E_i = aN_r^b$, where E_i represents the impact energy while a and b are the constants.

Keywords

A. Glass fibres; A. Thermoplastic resin; B. Impact behavior; C. Damage mechanics; D. Mechanical testing

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