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Comparative Parametric Analysis on the Dynamic Response of Fibre Composite Beams with Debonding

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Abstract : Fiber Reinforced Polymer (FRP) composites enjoy an array of applications ranging from aerospace, marine and military to automobile, recreational and civil industry due to their outstanding properties. A structural glass fiber reinforced polymer (GFRP) composite sandwich panel made from E-glass fiber skin and a modified phenolic core has been manufactured in Australia for civil engineering applications. One of the major mechanisms of damage in FRP composites is skin-core debonding. The presence of debonding is of great concern not only because it severely affects the strength but also it modifies the dynamic characteristics of the structure, including natural frequency and vibration modes. This paper deals with the investigation of the dynamic characteristics of a GFRP beam with single and multiple debonding by finite element based numerical simulations and analyses using the STRAND7 finite element (FE) software package. Three-dimensional computer models have been developed and numerical simulations were done to assess the dynamic behavior. The FE model developed has been validated with published experimental, analytical and numerical results for fully bonded as well as debonded beams. A comparative analysis is carried out based on a comprehensive parametric investigation. It is observed that the reduction in natural frequency is more affected by single debonding than the equally sized multiple debonding regions located symmetrically to the single debonding position. Thus it is revealed that a large single debonding area leads to more damage in terms of natural frequency reduction than isolated small debonding zones of equivalent area, appearing in the GFRP beam. Furthermore, the extents of natural frequency shifts seem mode-dependent and do not seem to have a monotonous trend of increasing with the mode numbers.

Keywords : debonding, dynamic response, finite element modelling, novel FRP beams
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