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Influence of Single and Multiple Skin-Core Debonding on Free Vibration Characteristics of Innovative GFRP Sandwich Panels

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Abstract : An Australian manufacturer has fabricated an innovative GFRP sandwich panel made from E-glass fiber skin and a modified phenolic core for structural applications. Debonding, which refers to separation of skin from the core material in composite sandwiches, is one of the most common types of damage in composites. The presence of debonding is of great concern because it not only severely affects the stiffness but also modifies the dynamic behaviour of the structure. Generally, it is seen that the majority of research carried out has been concerned about the delamination of laminated structures whereas skin-core debonding has received relatively minor attention. Furthermore, it is observed that research done on composite slabs having multiple skin-core debonding is very limited. To address this gap, a comprehensive research investigating dynamic behaviour of composite panels with single and multiple debonding is presented. The study uses finite-element modelling and analyses for investigating the influence of debonding on free vibration behaviour of single and multilayer composite sandwich panels. A broad parametric investigation has been carried out by varying debonding locations, debonding sizes and support conditions of the panels in view of both single and multiple debonding. Numerical models were developed with Strand7 finite element package by innovatively selecting the suitable elements to diligently represent their actual behavior. Three-dimensional finite element models were employed to simulate the physically real situation as close as possible, with the use of an experimentally and numerically validated finite element model. Comparative results and conclusions based on the analyses are presented. For similar extents and locations of debonding, the effect of debonding on natural frequencies appears greatly dependent on the end conditions of the panel, giving greater decrease in natural frequency when the panels are more restrained. Some modes are more sensitive to debonding and this sensitivity seems to be related to their vibration mode shapes. The fundamental mode seems generally the least sensitive mode to debonding with respect to the variation in free vibration characteristics. The results indicate the effectiveness of the developed three-dimensional finite element models in assessing debonding damage in composite sandwich panels

Keywords : debonding, free vibration behaviour, GFRP sandwich panels, three dimensional finite element modelling
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