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Dynamic Response of Rectangular Sandwich Tubes with Metal Foam Core Under Blast Loading

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ABSTRACT

In this paper, the dynamic response of clamped rectangular sandwich tubes with metal foam core under transverse blast loading is studied by analytical analysis and FE simulation. It is assumed that the local denting occurs before the overall bending, and the local denting leads to the reduction of the fully plastic bending moment of cross-section. First, based on the modified solution for the maximum deflection of the solid beam under transverse blast loading, a semiempirical analytical solution for the dynamic response of rectangular hollow metal tube is given subjected to transverse blast loading considering local denting effect and combined axial force and bending moment. Then, based on the analytical solution for the dynamic response of the clamped metal tube, a semi-empirical analytical solution for the dynamic response of clamped rectangular sandwich tubes with metal foam core subjected to transverse blast loading is obtained. The upper and lower bounds of the analytical solution are given by the inner square and outer square of the yield surface. The numerical calculation for the dynamic response of clamped rectangular sandwich tubes is carried out. It can be seen that numerical results locate between the upper and lower bounds of the analytical results for the dynamic response of clamped rectangular metal tubes and sandwich tubes. Next, using the least square method, an analytical method to predict the maximum deflection of sandwich tubes is given under no experimental or numerical data conditions based on the existing data. The present analytical method can be used to predict the dynamic response of clamped rectangular sandwich tubes with metal foam core under transverse blast loading. Also, the comparison of energy absorption between rectangular sandwich tube with metal foam core and rectangular hollow tube for the same mass is conducted. It is shown that the rectangular sandwich tube is better than the rectangular hollow tube in terms of energy absorption in large deflection.

KEYWORDS

Rectangular sandwich tube; metal foam; blast loading; dynamic response

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