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Thin-Walled Composite Girders Subjected To Pulse Loading

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Summary

The paper deals with static and dynamic buckling of thin-walled C-shape girders subjected to compression or/and bending pulse loading with different pulse shape. The rectangular, trapezoidal and triangular shape of pulse have been considered. The employed pulse duration is comparable with period of natural vibration.

The unidirectional fibre composite material was modelled as orthotropic one. The material properties was designed using theory of mixture. The dynamic behaviour of such structures subjected to bending or/and compression have been under analysis. To investigate the local dynamic buckling only one segment of girders was taken into consideration.

For finding the critical pulse amplitude leading to dynamic stability loss the Budiansky-Hutchinson, Ari-Guru criteria and the criterion proposed by the author have been employed.

The problem is investigated using two different method. The first one was finite element method and the second one was proposed asymptotic analytical-numerical method. In order to obtain the equations of plate, the non-linear theory of orthotropic thin-walled plates has been modified in such a way that it additionally accounts for all components of inertia forces. The differential equations of motion have been obtained from Hamilton's Principle, taking into account Lagrange's description, full Green's strain tensor for thin plates and Kirchhoff's stress tensor.

The influence of pulse shape and time of its duration, geometrical imperfection, material properties (fibre volume fraction value) on dynamic behaviour was checked. The critical dynamic load factor (defined as a ratio of pulse loading amplitude to static buckling load) corresponding to dynamic buckling have been estimated using three mentioned above criteria - the obtained results were compared.