World Academy of Science, Engineering and Technology
International Journal of Structural and Construction Engineering
Vol:16, No:02, 2022

Geometric Nonlinear Dynamic Analysis of Cylindrical Composite Sandwich Shells Subjected to Underwater Blast Load

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Abstract : The precise study of the impact of underwater explosions on structures is of great importance in the design and engineering calculations of floating structures, especially those used for military purposes, as well as power generation facilities such as offshore platforms that can become a target in case of war. Considering that ship and submarine structures are mostly curved surfaces, it is extremely important and interesting to examine the destructive effects of underwater explosions on curvilinear surfaces. In this study, geometric nonlinear dynamic analysis of cylindrical composite sandwich shells subjected to instantaneous pressure load is performed. The instantaneous pressure load is defined as an underwater explosion and the effects of the liquid medium are taken into account. There are equations in the literature for pressure due to underwater explosions, but these equations have been obtained for flat plates. For this reason, the instantaneous pressure load equations are arranged to be suitable for curvilinear structures before proceeding with the analyses. Fluid-solid interaction is defined by using Taylor's Plate Theory. The lower and upper layers of the cylindrical composite sandwich shell are modeled as composite laminate and the middle layer consists of soft core. The geometric nonlinear dynamic equations of the shell are obtained by Hamilton's principle, taken into account the von Kàrmàn theory of large displacements. Then, time dependent geometric nonlinear equations of motion are solved with the help of generalized differential quadrature method (GDQM) and dynamic behavior of cylindrical composite sandwich shells exposed to underwater explosion is investigated. An algorithm that can work parametrically for the solution has been developed within the scope of the study.

Keywords : cylindrical composite sandwich shells, generalized differential quadrature method, geometric nonlinear dynamic analysis, underwater explosion
Conference Title : ICIES 2022 : International Conference on Impact Engineering of Structures
Conference Location : London, United Kingdom
Conference Dates : February 15-16, 2022