World Academy of Science, Engineering and Technology
International Journal of Aerospace and Mechanical Engineering
Vol:10, No:06, 2016

Modal Analysis of Functionally Graded Materials Plates Using Finite Element Method

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Abstract : Modal analysis of an FGM plate composed of Al2O3 ceramic phase and 304 stainless steel metal phases was performed in this paper by ABAQUS software with the assumption that the behavior of material is elastic and mechanical properties (Young's modulus and density) are variable in the thickness direction of the plate. Therefore, a sub-program was written in FORTRAN programming language and was linked with ABAQUS software. For modal analysis, a finite element analysis was carried out similar to the model of other researchers and the accuracy of results was evaluated after comparing the results. Comparison of natural frequencies and mode shapes reflected the compatibility of results and optimal performance of the program written in FORTRAN as well as high accuracy of finite element model used in this research. After validation of the results, it was evaluated the effect of material (n parameter) on the natural frequency. In this regard, finite element analysis was carried out for different values of n and in simply supported mode. About the effect of n parameter that indicates the effect of material on the natural frequency, it was observed that the natural frequency decreased as n increased; because by increasing n, the share of ceramic phase on FGM plate has decreased and the share of steel phase has increased and this led to reducing stiffness of FGM plate and thereby reduce in the natural frequency. That is because the Young's modulus of Al2O3 ceramic is equal to 380 GPa and Young's modulus of SUS304 steel is 207 GPa.

Keywords : FGM plates, modal analysis, natural frequency, finite element method
Conference Title : ICMAME 2016 : International Conference on Mechanical, Aeronautical and Manufacturing Engineering
Conference Location : Venice, Italy
Conference Dates : June 13-14, 2016