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Dynamic analysis of asymmetrically laminated composite frames

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Summary

Based on elastic wave theory, Pao[1] and his colleagues recently proposed a novel frequency domain matrix method, i.e. the Method of Reverberation-Ray Matrix (MRRM) for solving the transient response of truss-type structures. The theory has been shown accurately coincided with experimental data of a model truss for the early responses.

Fiber reinforced laminated composites have advantages such as high specific strength, high specific stiffness, corrosion resistance etc.. The dynamic as well as the static behavior of laminated composites is largely dependent upon fiber orientation and ply-stacking sequence. Due to inhomogeneity and anisotropy of the material, these structures are vulnerable to highly transient loading such as impact. The asymmetric laminate configuration could bring about axial-flexural coupling of the dynamic response.

The dynamic behaviors of laminated beams have been investigated by a number of researches with either analytical or numerical methods. Mahapatra and Gopalakrishnan[2] have investigated wave propagation of multiply connected asymmetrically laminated composite beams in term of spectral element method (SEM). However, there is little research in the literature dealing with the dynamic analysis of laminated composite trusses or frames. The present study extends the method of reverberation-ray matrix to the dynamic analysis of composite frames made up of asymmetric laminated beams. Firstly the velocity responses of a cantilever laminated beam are solved and compared with that of finite element method to validate the development of the theory and the computer code. Then, the strain responses of a 9-bar laminated frame subjected to a half cycle pulse force are analyzed and the equilibrium of forces and moments at a joint is checked, the effect of the coupling stiffness of laminated beam on the strain response is illustrated. The displacement and velocity responses of the 9-bar laminated frame are also examined.

References

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