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# SOME STUDIES ON COMPOSITE STIFFENED SKEWED HYPARS UNDER FREE VIBRATION

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***Abstract:*** *The skewed hypar shells are architecturally beautiful, easy to cast and are often preferred as roofing units. In the present study the literature on composite stiffened panel is studied and it is found that the free vibrations of composite stiffened hypar shell panels have not been studied in details. A finite element is developed combining a composite eight noded shell element with a three noded composite beam element. The code is validated by solving benchmark problems and fundamental frequencies are obtained for different combinations of laminations, boundary conditions and stiffener arrangements (both number and depth). Results are analysed thoroughly and the paper ends with a number of conclusions of design significance.*

***Keywords:*** *Stiffened Hypar Shell, Free Vibration, Finite Element.*

## INTRODUCTION

Among the common civil engineering shell forms, which are used as roofing units, the skewed hypars have a special position because these architecturally pleasant forms may be cast and fabricated conveniently being doubly ruled surfaces. The hypar shells may be stiffened to have enhanced rigidity when subjected to point loads or provided with cutouts for some service requirements. A comprehensive idea about their static and free vibration characteristics is essential for a designer for successfully applying these forms. Nowadays researchers are emphasising more on laminated composite shells realising the strength and stiffness potentials of this advanced material. The initial studies about vibrations of stiffened shell panels where about stiffened cylindrical shells reported from time to time by Bardell and Mead (1989), Mecito g̃ lu and Dökmeci (1991), Olson (1991), Sinha and Mukhopadhyay (1994), Jiang and Olson (1994) who used different methods like collocation, finite strip and finite element. Sinha and Mukhopadhyay (1995) echoed this fact in their review paper. As the