EFFECT OF SHEAR DEFORMATION ON THE FUNDAMENTAL FREQUENCIES OF COMPOSITE LAMINATES IN DIFFERENT THICKNESS

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Using of composite materials in the structures has increased dramatically in the past two decades because, it could be due to the unique advantages of these materials such as high strength to weight ratio and material properties change in desired directions mentioned. The composite materials commonly are composed from multiply laminate. To know the exact amount of natural frequencies is particular importance for investigating of behaviour of laminate. For analyzing the laminates, often has been used the classical theory that is not considered the shear deformations. In this paper, first several plates are modelled in ANSYS program and calculated the frequency and mode shapes and compared with the exact solution in literature. While these compressions have been shown the results of ANSYS have negligible error, therefore the laminates with different boundary conditions and different thickness are analyzed in ANSYS software and the result of Mindlin theory and classical theory are compared. The results show that decreasing the ratio of thickness to wide from 0.005 the results of fundamental frequency in Mindlin theory and classical theory are approximately same.

Table 1. Fundamental Frequencies of Laminate with Different Thickness

	ω^*	
(h/a)	Classical theory	Mindlin theory
0.5	15.830	5.492
0.25	17.907	9.115
0.2	18.215	10.820
0.1	18.652	15.156
0.05	18.767	17.583
0.01	18.804	18.547
0.005	18.809	18.792
0.001	18.810	18.805

According to the Table 1 it can be seen, firstly consider in the large thickness, the effect of shear deformation on the natural frequencies is considerable, So that the ratio of the thickness to width equal 0.5, fundamental frequency is decrease 4 time and secondly, the fundamental frequency variations in the classical theory of plates is very small although in the Mindlin theory these changes are very large. In Figure 1, the fundamental frequency of laminate is plotted against the thickness changes that the results can be seen well.

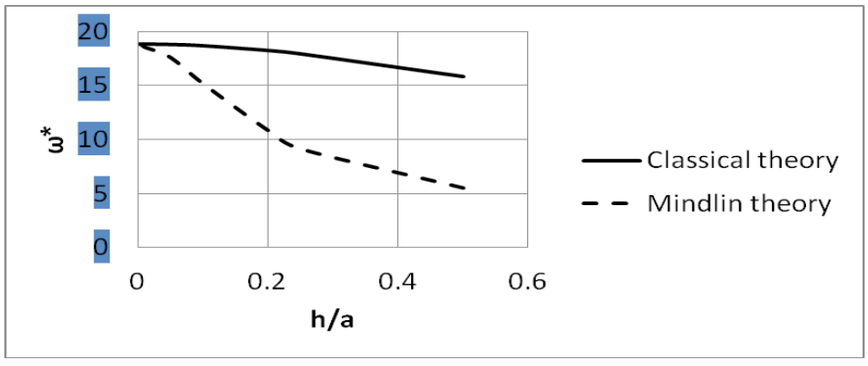

Figure 1. Fundamental Frequency of Composite Laminate with Different Thickness Ratio

Based on this Study, it is observed that the thick laminates; the shear deformation is considered effectively on the fundamental frequency and governs the frequency less than classical theory. As reducing the ratio of thickness the effect of the shear deformation on the frequency is reduced, when the ratio of thickness of laminate is less than 0.005, the results of Mindlin theory and the classical theory will be approximately same. Also the changes of the fundamental frequencies in the classical theory are very small but these changes in the Mindlin theory are considerable.

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