Investigating the Effect of Delamination Size and Shape on Laminated FRP Composites Under Vibration Loading

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INTRODUCTION This study is based on the determining the effect of delamination size and shape on the natural frequency of laminated composite. To solve this problem Layer wise theory is used in Structural Mechanics Module.

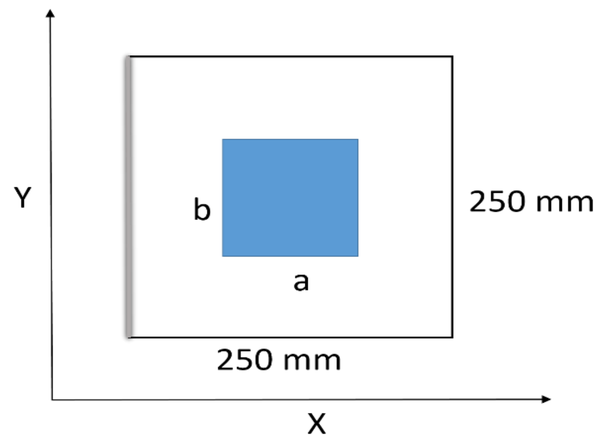

Figure 1. Layout of the delamination in graphite epoxy laminate composite

COMPUTATIONAL METHODS: A finite element model is developed in COMSOL Multiphysics® using Composite Materials Module with layered material technology. Orthotropic material properties is defined for graphite-Epoxy laminate in Layered Material node. 2-D triangular mesh elements and Eigen frequency study used to perform simulation.

Table no. 1 Properties of Graphite-Epoxy(FRP)

Elastic properties	**Graphite-Epoxy**
Ex (GPa)	181.00
Ey = Ez (GPa)	10.30
Gxy = Gxz (GPa)	7.17
Gyz (GPa)	4.00
mxy = mxz	0.28
myz	0.30

RESULTS: Figure 2 represents variation of natural frequency with increase in square delamination size for increasing modes.

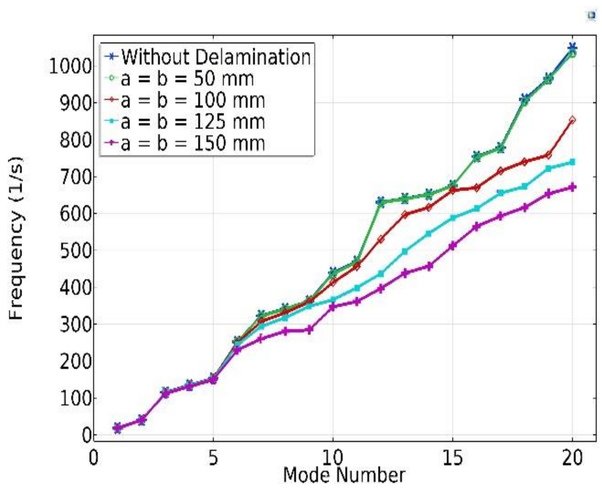

Figure 2 variation of natural frequency with respect to mode no. of different square size delamination

Figure 3 represents variation of natural frequency with different shapes of same delamination area for increasing modes.

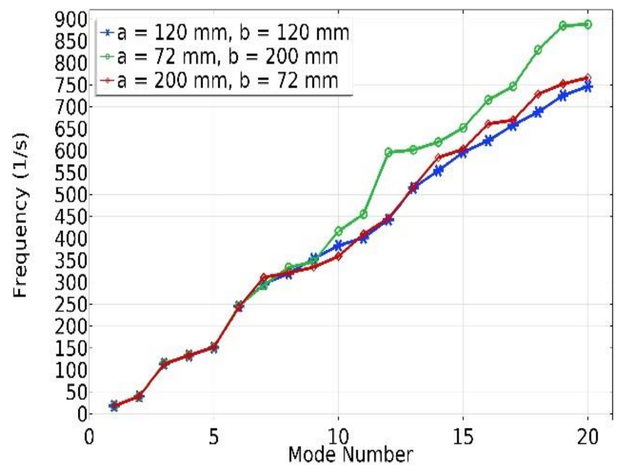

Figure 3. variation of natural frequency with respect to mode no. of different delamination shapes

Figure 4 shows the mode shapes of square delaminated laminate of different size at 10th mode .

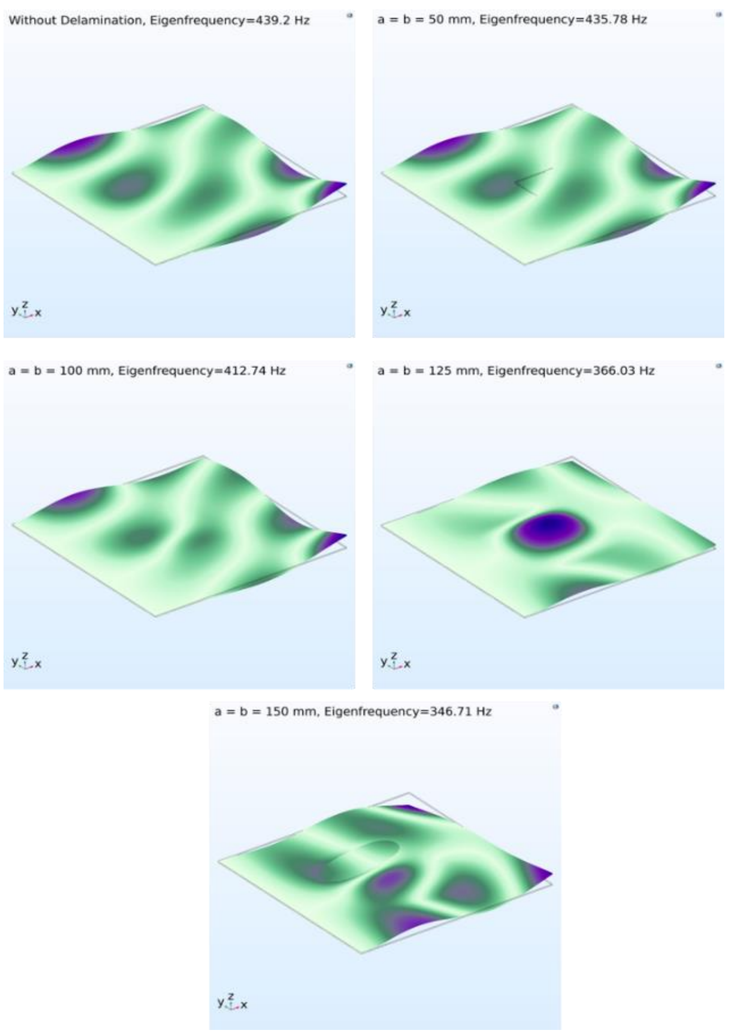

Figure 4. The mode shape of laminate at 10th mode for square delamination of different size.

CONCLUSIONS: In the present study, it can be concluded that as the size of the delamination increases the natural frequency of the laminate decreases. This study also concludes that the shape also has great impact on the natural frequency of the laminate.

REFERENCES:
1. R. M. Gadelrab, The effect of delamination on the natural frequencies of a laminated composite beam, *Journal of Sound and Vibration, 197, 283-292 (1996)*
2. E. J. Barbero and J. N. Reddy, Modeling of delamination in composite laminates using a layer-wise plate theory, *International Journal of Solids and Structures,*28, 373-388, (1991)