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Damping wave propagation in periodic composite panels

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Highlights

- Composite
 - Vibration
 - Band gap
 - Periodic plate
-

1. Introduction

Composite structures have been introduced in the transportation industry to reduce vehicle mass and energy consumption. Composites have low internal damping which leads to higher levels of vibration and induced noise. To reduce the vibrations amplitude and thus the acoustic discomfort, damping elements placed in specific locations of the structure [1-2] are sometimes used. The integration of these elements to optimize the structure is often complex, costly, and may cause a delay in product delivery. In order to avoid curative treatments, another solution is to incorporate anti-vibration function at the design stage of the composite material. In this paper, the anti-vibration function is obtained by the introduction of periodic effect. The use of periodicity allows to stop wave propagation in a given frequency range [3-4], called band gap. The vibro-acoustic properties of the structure are thus improved.

2. Modeling a periodic cell:

The study focuses on periodic composite plates of glass/epoxy by defining elementary cells, very smaller than the dimensions of the plate to assume that the test structure is infinite. To obtain the dispersion curves of an infinite periodic structure, we need to determinate the frequency associated to each wave vector which propagate through the elementary cell: Bloch-Floquet periodicity conditions are applied on the boundaries. Finite elements models are performed using Comsol Multiphysics ®4.4 software to test different configurations of square elementary cell. The results show that to obtain a band gap, the elementary cell should have an important glass fiber concentration in its center. The dispersion curves obtained for the studied configurations (Fig. 1) show the appearance of partial band gap for only certain directions of propagation.

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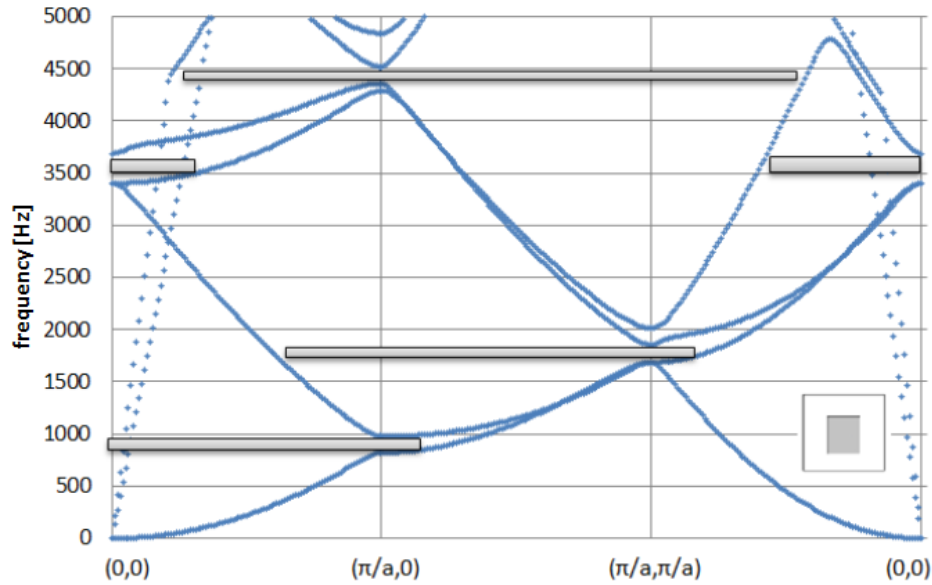


Fig. 1. Dispersion curves for a periodic composite plate of glass/epoxy.

3. Conclusions and Perspectives:

In this article, we showed that a local increase in the number of fiberglass layers arranged periodically leads to a partial band gap: for given frequencies it exists yet one direction for which the waves can propagate. However, the efficiency has to be improved. Thus, a parametric optimization study will be done to determine the dimensions and material properties required to obtain band gaps through all directions. This numerical study will be validated by vibration tests on periodic composite structures, whose local dynamic properties (stiffness, damping) have been determined in advance by an inverse method inspired from the Force Analysis Technique (FAT, also known by the French acronym RIFF) [5].

References

1. M. Assarar, A. El Mahi, J-M. Berthelot, "Damping Analysis of Sandwich Composite Materials", *Journal of Composite Materials - J COMPOS MATER*, vol. 43, no. 13, pp. 1461-1485 (2009).
2. S. Assaf, "Finite element vibration analysis of damped composite sandwich beams", *International Journal of Acoustics and Vibration*, Vol. 16, n°4, pp. 163-172 (2011).
3. L. Brillouin, "Wave propagation in periodic structures", McGraw-Hill Book Company, New York (1946).
4. C. Claeys, K. Vergote, P. Sas, W. Desmet, "On the potential of tuned resonators to obtain low-frequency vibrational stop bands in periodic panels", *Journal of Sound and Vibration* 332, pp. 1418–1436 (2013).
5. F. Ablitzer, C. Pézera, J-M. Génevaux, J. Bégué, "Identification of stiffness and damping properties of plates by using the local equation of motion", *Journal of Sound and Vibration* (2014).