# Modal Analysis For Composite Sandwich Plates Of Honeycomb Core

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***Abstract*— The purpose of this work is to realize a vibratory study on panel's sandwiches established by the honeycomb core and aluminum skins, used in the conception of the aerospace structures; all the analyses are based on conditions in the embedded free limits (E-L-L-L). The aim is to compare the natural frequencies of the two plates with those obtained from the two simulation models. Two methods are used in modeling, 3D drawing of the sandwich structures and calculating an equivalent structure using the homogenization method based on representative elementary volume (REV) using ANSYS software. The modal resolution of these two configura-tions is performed by the finite element method. The comparison of numerical results shows excellent agreement.**

***Keywords*— sandwich plate, homogenization, FRF's , modal analysis, finite element method.***

## I. Introduction

The use of sandwich structures continues to increase rapidly for applications ranging from satellites, aircraft, ships, automobiles, rail cars, wind energy systems, and bridge construction. These panels are made of skins and core. The core is usually made of a more flexible material than the skins, but the entire panel is characterized by a large force and low total weight. The honeycomb sandwich structures have been extensively used in manufacturing aeronautical structures due to their high specific bending stiffness of light and charges in a distributed resistance in addition to their good capacity for energy absorption [1].

Several studies exist in the literature aim to seek more appropriate methods for the determination of the dynamic behavior of composite materials using the beam type specimen plate. The study of flexural vibration of such structures is mainly based on research of frequencies and mode shapes, Ćetkovićet Vuksanovic [2] used LayerWise theory for analyzing the free vibration of composite laminated plates and sandwiches. Vibration control of such structures is necessary because it is often a major problem in determining the dynamic characteristics under different conditions reinforcement and configuration.

The first attempt to obtain an expression of the natural frequencies and loss factor of beam sandwich material was performed by Kerwin [3]. He considered simple sup-ported sandwich beams, whose elastic skins were much stiffer than the soul. Thus, the core was assumed not to be deformed in the transverse shear and bending stiffness of the sandwich beam was that of the basic structure. Ditaranto [4] extended the work of Kerwin to treat free vibrations sandwich beams with arbitrary boundary conditions. Then, while keeping the assumptions Kerwin, another model was developed by Meifeng and Wenbin [5] to study the forced vibration for various boundary conditions. Using the finite element method, the modal analysis of a sandwich beam honeycomb was carried out by Boudjemai et al [6].. In this paper, we present a numerical model of sandwich plate core honeycomb by the finite element method and by the method of homogenization.

## II. Numerical modeling

### A. *Structure real discretized by finite elements*

The sandwich plate honeycomb cores are simulated by the computer code ANSYS structures, the model takes into account 377 cells. The numerical resolution of these plates is performed by the finite element method with SHELL63 elements with 4 nodes and 6 degrees of freedom per node. The chosen network allows to make computing heavy while maintaining good accuracy results. Excessive refinement does not give better results.

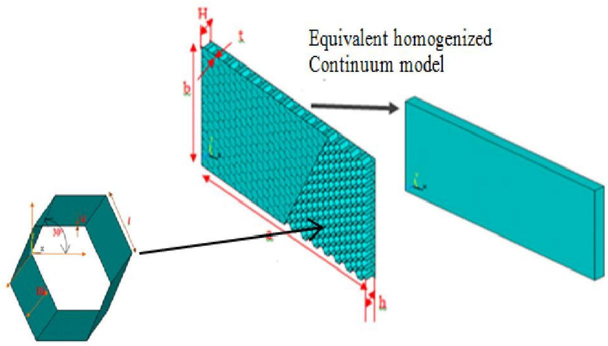


Fig.1 Equivalent parameters of a honeycomb sandwich plate.

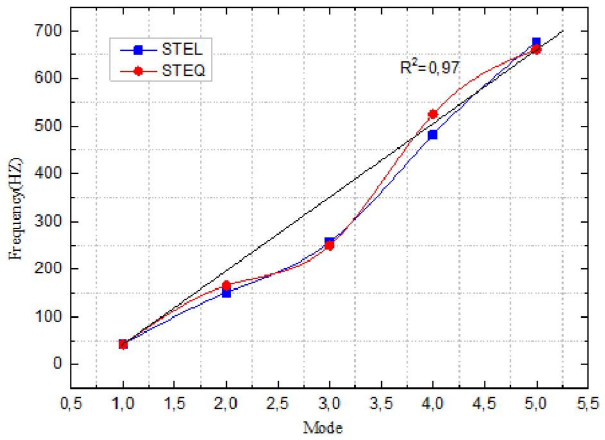


Fig.2 Comparison between FEA and equivalent methods for large frequency.

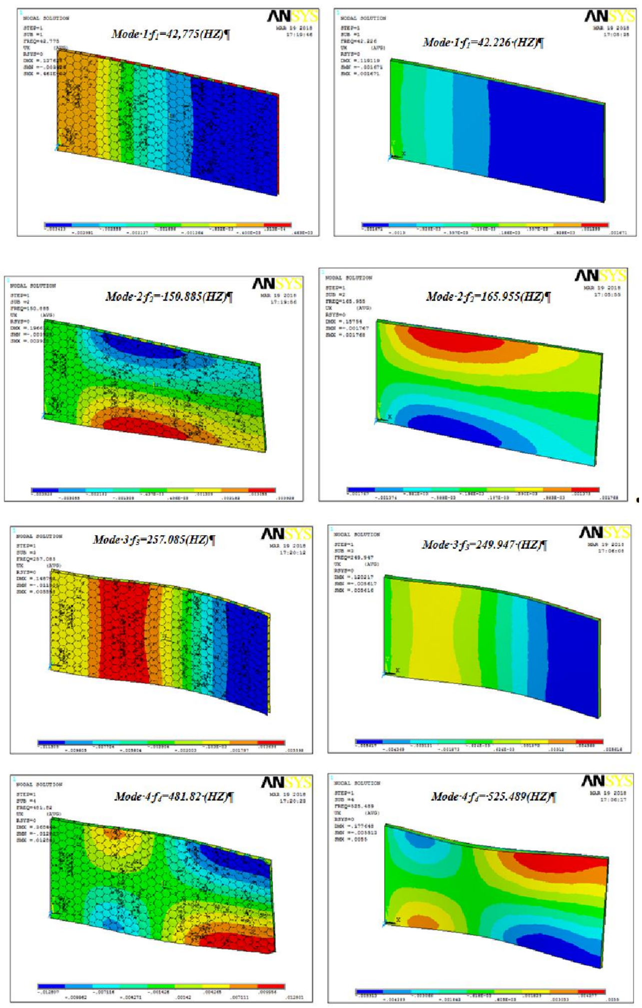


Fig.3 Presented three dimission for FEA and equivalent methods.

## III. Discussion of Results

This increase in volume causes air Rating Decrease rigidity of the plate and the par consequence natural frequencies fall which reaches to the fifth 155Hz mode.

The comparison of the results obtained by the two methods gives a numerical correlation R2 =0.97, which shows that the model of homogenization correctly represents the actual structure and saves a lot of computing time in numerical simulations for different plate geometries, see Figure 2 and 3. Comparing method's element by the homogenization method (equivalent structure) shows a very good concordance.

## IV. Conclusion

Two simulation models sandwich plates, core honeycomb have been developed in this work. The results of the homogenization model raised plaques calculated from mechanical properties by determining the natural frequencies of sandwich plates' core honeycomb cells with sizes 11. The results of the homogenization model, which allows a very significant gain in computation time, are in good agreement with those of the sandwich plate model solved by the finite element method. Based on the model of homogenization, we showed that different geometric dimensions necessary in the design of plates of honeycomb core sandwiches have a great influence on the natural frequencies of these plates. This study saves computing time, which can give a clear idea for the industrial design of this type of structures.

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