# Mechanical Behavior of Sandwich Structures: Numerical Simulation

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December 10, 2019

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**Abstract.** The main objective of our study is to determine the frequencies and the deformations proper by the finite element method, using the code implemented in ANSYS software, this numerical investigation by the finite element method was carried out for two types of Sandwich materials such as aluminum and mild steel, with boundary conditions: embedding, free, free, free (ELLL) in order to determine the modal parameters of composite plates such as frequencies as well as clean deformations. The results obtained show that the increase of the rigidities of the materials and increases with the increase of the rank of the mode and consequently the increase of the eigenfrequencies. For this purpose the comparison of the characteristics of the sandwiches are carried out on the first modes of vibration which are the most important..

**Key words:** sandwich materials, ANSYS, finite element method, eigenfrequencies, deformity.

## I. INTRODUCTION

In practice, structures made of sandwich materials (aluminum, mild steel ......... ..) are subjected to mechanical loading that produce the overall behavior of the flexural structures, which are determined by the overall stiffness of the sandwich materials, the latter depending essentially These characteristics are exerted by localized loads exerted on different parts of the structures, inducing a local behavior of the sandwich materials which strongly depend on the mechanical properties of the material core.

The local behavior of sandwich structures can be evaluated from static punching tests, while 3-point bending tests can be used to analyze the influence of local behavior and global bending behavior as a function of the distance between them. support.

## II. Geometry of the problem

Rectangular sandwich plates having the dimensions 82 mm × 52 mm × 5 mm, the thickness of which is 0.8 mm are used (FIG. 1).

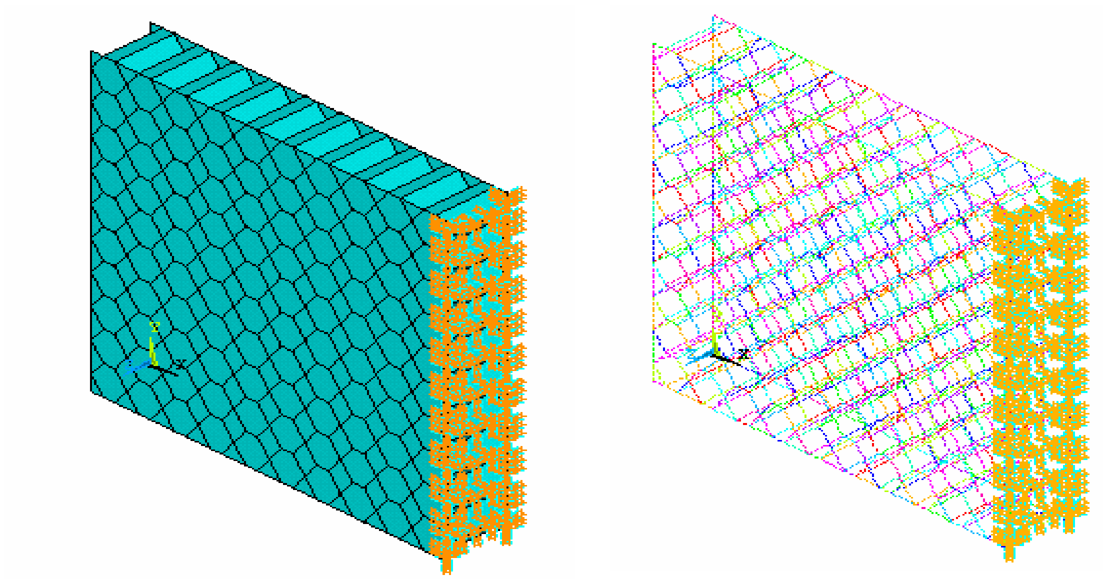

Fig 1 The geometry of the ELLL plate

## III.Results And Discussions

We are interested in choosing to present deformations of the different mode in 2D, in order to identify the nodes and the vibration bellies of each mode and to be able to compare the results numerically by ANSYS.

The characteristics of sandwich materials such as aluminum and mild steel are shown in the following table:

| | Aluminium | Acier doux |
|---|---|---|
| Module Young | 70 GPa | 206 GPa |
| Module Poisson | 0.3 | 0.29 |
| Mass density | 2700 $Kg/m^3$ | 7800 $Kg/m^3$ |

Table 1 The characteristics of sandwich materials

| Aluminium | Acier doux |
|---|---|

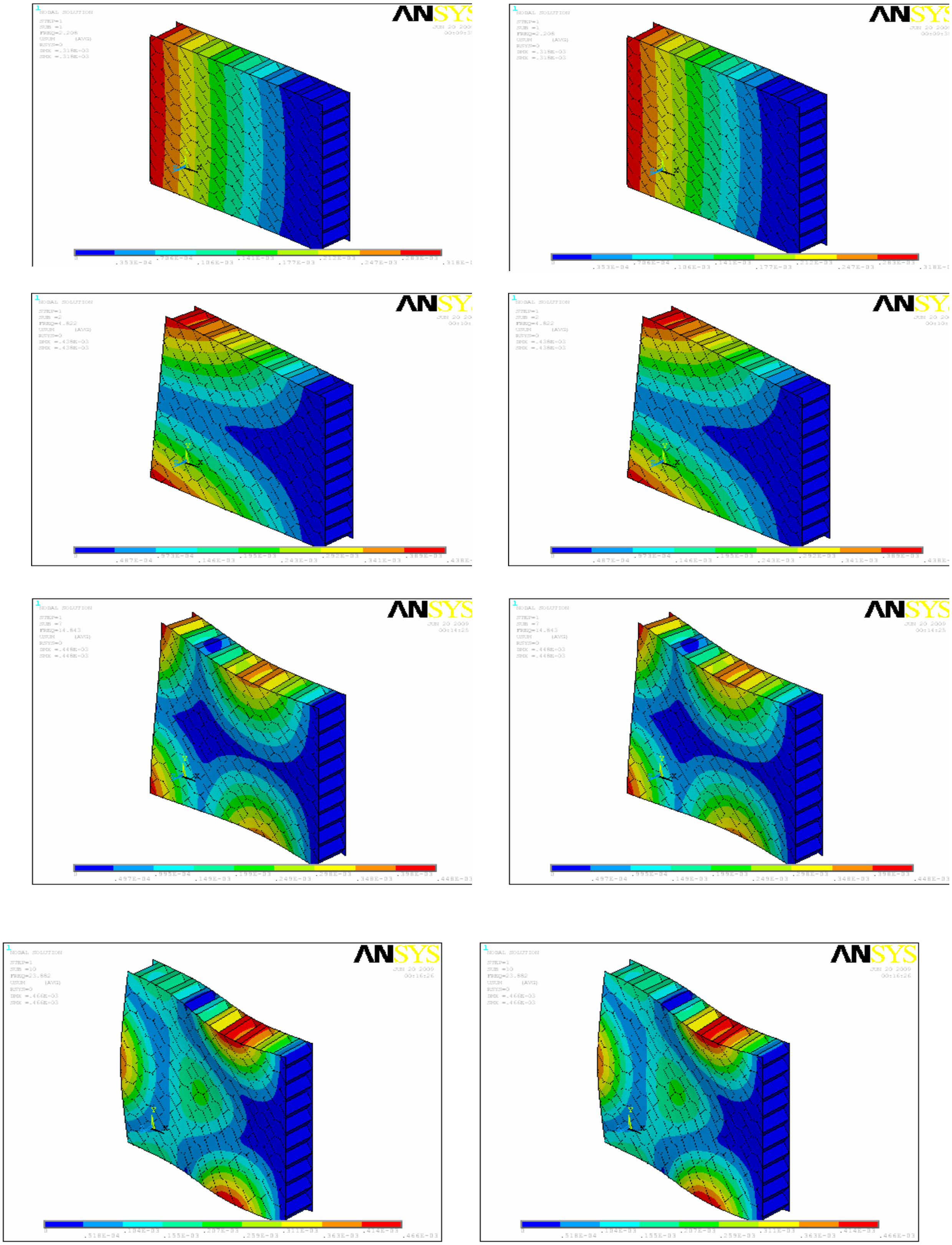

Fig 2 The bending modes of the plate in ELLL configuration

| | Mode | Fréquence | Aluminium (hz) | Acier doux (hz) |
|---|---|---|---|---|
| | Mode 1 | F1 | 2.3146 | 2.2084 |

| | | | | |
|---|---|---|---|---|
| ELLL | Mode 2 | F2 | 4.9087 | 4.8224 |
| | Mode 3 | F3 | 5.5806 | 5.4745 |
| | Mode 4 | F4 | 11.211 | 10.584 |
| | Mode 5 | F5 | 13.652 | 12.572 |
| | Mode 6 | F6 | 14.777 | 14.750 |
| | Mode 7 | F7 | 14.974 | 14.843 |
| | Mode 8 | F8 | 15.264 | 14.994 |
| | Mode 9 | F9 | 23.065 | 23.493 |
| | Mode 10 | F10 | 24 .230 | 23.882 |

Table 2: the eigenfrequencies of the sandwich materials used.

The comparison between the plates also shows the increase of angle orientations decreases the eigenfrequencies and consequently the rigidity is reduced in borderline cases (ELLL).

The absence of significant dispersion between the modal parameters between aluminum and steel gives us the choice to optimize the material of lightness (aluminum) compared to the heaviest (mild steel).

## IV.Conclusion

The main conclusions that can be drawn from this study are:

• The determination of the modal parameters is very important (eigenfrequencies) in the worry of avoiding the phenomena of resonances which disturbs the good functioning of the rotating machines.

• The increase in stiffness of materials and increases with the increase of the rank of the mode and consequently the increase of the eigenfrequencies.

• The boundary conditions strongly influence the vibratory behavior of composite laminates (eigenfrequencies).

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