OpenAccessPub

Research Article

Journal of Biomaterials

Freely Available Online

The application of different orientation of orthotropic composite beam

Elaakili Abdellatif[1,*], El Bekkaye merrimi[1]

[1] Mohammed V university in Rabat,Morocco

Corresponding author: Elaakili Abdellatif , Mohammed V university in Rabat,Morocco

Keywords: orthotropic composite beam,application,lay up.

Received: Sep 03, 2023

Accepted: Jan 19, 2023

Published: Mar 30, 2023

Academic Editor:

Raul Isea , Fundación Instituto de Estudios Avanzados -IDEA

Abstract

In the present document, the dynamic analysis of isotropic materials applied to the laminated composite beam has been studied to improve the simplification of the homogenization process of heterogeneous composite materials.[1,2].

This study is based on the conventional stratified theory of Von Karman's formulation and the kinetic energy of Euler Bernoulli developed through displacement relationships.

The model used in this study to explain the problem of non-linear geometry in the free vibration applied of laminated beam is based on the Hamilton's principle for solving the motion equation anddetermining the frequency of the reaction of the rolled beam.

The numerical of the symmetric an asymmetric material gives a good idea of the behaviour of the orthotropic materials, and to minimize the problem of many areas used these materials such as: dental medicine, aeronautical, aerospace, because they have a good strength, high rigidity.[2,3]

The comparison between the different lay up may give greater importance to this study and open the search to simplify the problem of non linear geometry and give a good result about the older other published.

For instance the application of medicine,the researcher has to decode the compatibility of the human body with new materials,and to minimize the problem of deterioration,The comparison with different lay up give more interesting by the mechanical engineering and the researcher's to give the solution of no linear problem and optimize

the composite material's to adaptation with problem study.[4]

Introduction

The laminated composite material became important in many field such as: mechanical, electronic, aerospace, aeronautic, dental medicine, medicine, nanotechnology. [5,6]

They have good properties physics and mechanic can be give more interesting for researcher's and ingenieur's of different area.

for example the used of composite beam in nanotechnology to concentrate of this properties for search in the development of laminated composite material's in biology and medicine.

Further more, the application of orthotropic composite beam is increasing in different area because they have more advantages as : aeronautic used the material's because they have a good soupless,high rigidity.

Therefore this study is based on the application of orthotropic laminated composite material's in different area and offered the occasion the analyze the procedure of homogenization for composite beam .

The model used in this paper based in the theory of Von Karman for the strain displacement relationships and the equation of Euler Bernoulli which developed the equation of total energy.[7].

Classical Theory of laminated composite material

This study is based on theory of geometry nonlinear in different area and the problem became very important in many field because ,more the users of composite material's .such us the aeronautic and aerospace search

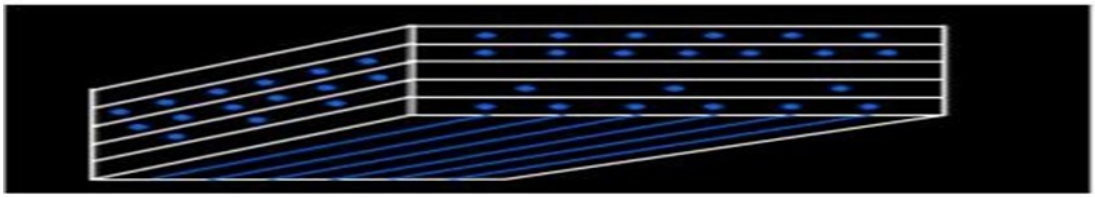

Figure 1. laminated composite beam

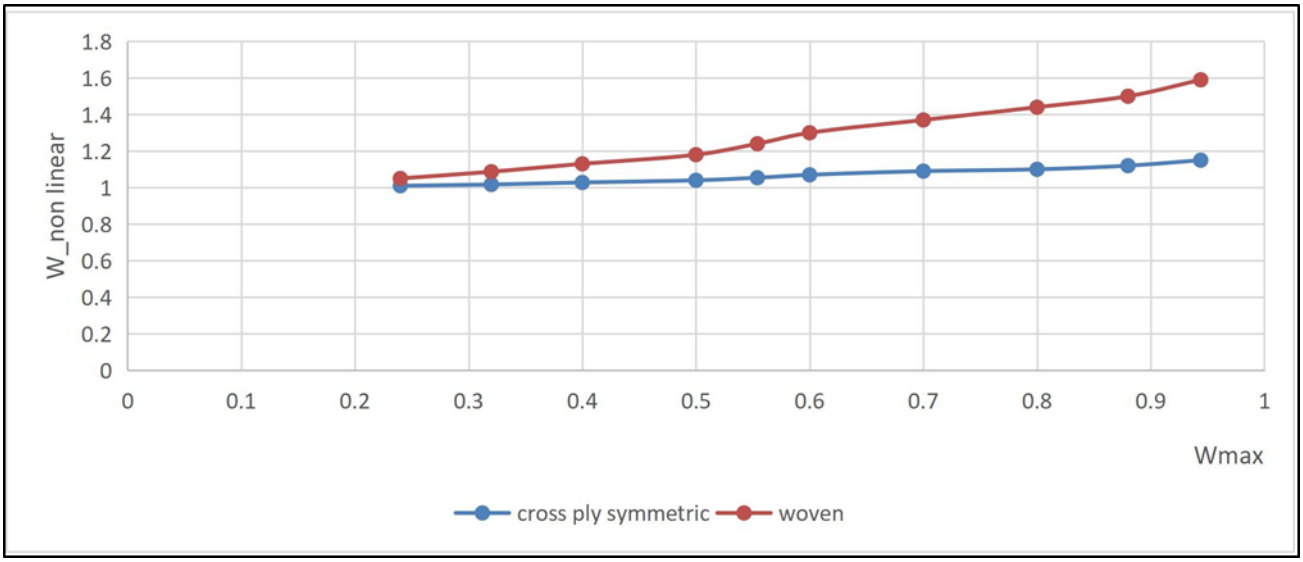

Figure 2. comparison of non-linear frequency between cross ply and woven

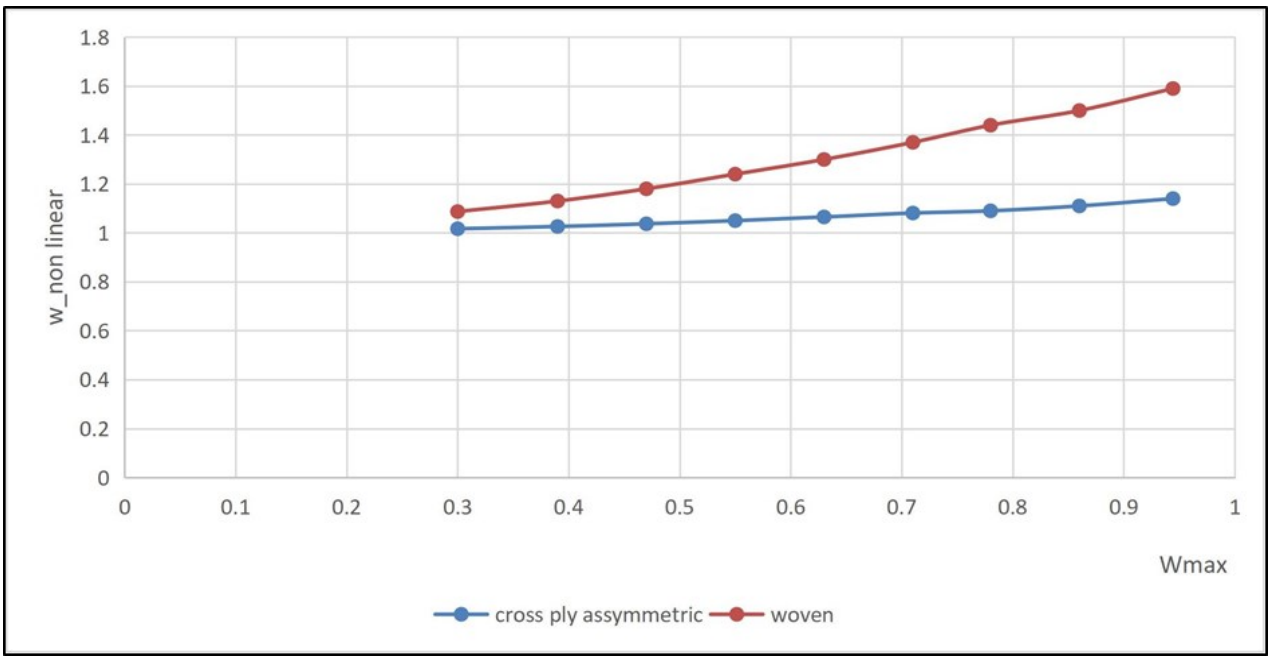

Figure 3. comparison the non-linear frequency between cross ply asymmetric and woven

Table 1. Comparison between cross ply symmetric and cross ply asymmetric and woven

W_{max}(cross ply symmetric)	$w_{nonlinear}$	W_{max}(cross ply asymmetric)	$w_{nonlinear}$	W_{max}(woven)	$w_{nonlinear}$
0,24	1,01	0,24	1,009	237	1,05
0,32	1,017	0,3	1,016	316	1,087
0,4	1,028	0,39	1,026	0,39	1,13
0,5	1,04	0,47	1,03	0,47	1,18
554	1,054	0,55	1,05	0,54	1,24
0,6	1,07	0,63	1,06	0,62	1,30
0,7	1,09	0,71	1,08	0,7	1,37
0,8	1,1	0,78	1,09	774	1,44
0,88	1,12	0,86	1,11	0,85	1,5
944	1,15	0,94	1,14	922	1,59

in properties to improve the rigidity and soupless of material for effect of temperature .

The part is based in the equation of laminated composite material's of case the orthotropic and isotropic material's written about the theory of Von - Karman for non linear strain -displacement relationships:

$$\varepsilon_x^a = \frac{\partial u^a}{\partial x} + \frac{1}{2}\left(\frac{\partial w^a}{\partial x}\right) \quad (1)$$

The Total elastic energy VT developed [3] by theory of Euler-Bernoulli applied in laminatedcomposited

$$V_T = \frac{1}{2}\left(\int_0^l \varepsilon_x^a N_x\, dx + \int_0^l M_y K_x dx\right) B_{11} \quad (2)$$

Where;

$$N_x = bA_{11}\varepsilon_x^a + bB_{11}K_x \quad (3)$$

And

$$M_y = bB_{11}\varepsilon_x^a + bD_{11}K_x \quad (4)$$

Total potential energy V_T developed in [2]

$$V_T = \frac{(ES)_{eff}}{2}\left(\int_0^l \left(\frac{\partial w^a}{\partial x}\right)^2 dx\right)^2 + \frac{(EI)_{eff}}{2}\int_0^l \left(\frac{\partial^2 w^a}{\partial x}\right)^2 dx \quad (5)$$

$$(ES)_{eff} = bA_{11} \quad (6)$$

$$EI)_{eff} = b\left(D_{11} + \frac{B_{11}^2}{A_{11}}\right) \quad (7)$$

Numerical Result

The study based in the calculation of non-linear frequency of orthotropic composite material's and the test realized about the orthotropic laminated composite beam ,they have the properties perfect: high rigidity, and good stiffness such us: ET=225 GPA , EL=210 GPA ; ρ = 2389Kg/m^3 ; h=0,01m

Acknowledgments

The work supported by Mohammed V university in Rabat

References

1. Li Jun, Hua Hongxing, Dynamic stiffness analysis of laminated composite beams usingtrigonometric shear deformation theory, Composite Structures, 89 (2009), 433–442. https://doi.org/10.1016/j.compstruct.2008.09.002
2. Berthelot JM. 2006. Damping analysis of orthotropic composites with interleaved viscoelasticlayers: Modeling. Journal of Composite Materials, 40(21): 1889-1909.
3. Berthelot J-M. 2007. Mechanical Behaviour of Composite Materials and Structures. Available on line at www.compomechasia.com.
4. Hodge, A.J.; Nettles, A.T.; and Jackson, J.R.: "Comparison of Open-Hole Compression Strength and Compression After Impact Strength on Carbon Fiber/Epoxy Laminates for theAres I Composite Interstage," NASA/TP—2011—216460,

Marshall Space Flight Center, Huntsville, Alabama, 2011.

5. Tomblin, J.S.; Ng, Y.C.; and Raju K.S.: "Material Qualification and Equivalency for PolymerMatrix Composite Material Systems," Final Contract Report DOT/FAA/AR-00/47, Office of Aviation Research, Washington D.C., 2001.
6. Gomes F. et al, Fatigue behaviour of an orthotropic steel bridge deck – benefits of an ultra high performance fibre reinforced concrete topping layer, p2097, Eurosteel 2011, Budapest.
7. Kolstein M.H., Fatigue classification of welded joints in orthotropic steel bridge decks, PhDThesis, TU Delft, 2007.