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International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-3, January 2020

Vibration Analysis on a Thin Walled Structure

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Abstract: ***A vibration analysis performed on thin walled open beam section. The influence of the vibration is studied for different thickness and different critical load conditions. A FEM model is applied to the thin wall sections like beams. For the different young's modulus, critical load and thickness of the flange the mode shapes are analyzed. The free vibrations of the channel unsymmetrical thin-walled beam of length 80, breadth of the flange is 37.81e-3, thickness of the flange, over all lengths of the flange at λ = (7.5, 10,12.5,15,17.5,20), for e= 10,20.3040,G= rigidity of modulus also been analyzed..***

Keywords: **vibration analysis, critical loads, structure, thin walled beams.**

I. INTRODUCTION TO THIN WALL BEAMS

An aircraft's structural elements consist primarily of thin plates which are stiffened by rib and stringer arrangements. Thin plates (thin sections/ thin walled structures) are buckled under relatively small compressive loads and so must be stiffened to prevent this.

To determine the thin plates buckling loads in isolation is relatively straightforward but when the stiffers are attached to the skin, then the problem becomes complex and the solutions relies on an empirical solution. The buckling of the thin plates is a phenomenon in which it may lead to instability and failure of the aircraft components; hence the buckling phenomenon on thin plate finite element analysis is analyzed by ANSYS software.

The different types of thin walled structures or thin sections are: T, C, L, I, Z section. These sections are used in the construction of an aircraft; they are used primarily in the construction of the fuselage.

II. FINITE ELEMENT METHOD

The FEA (Finite Element Analysis) is a numerical method for solving mathematical, engineering and physics problems. Used for complicated geometries, loadings, and material properties where analytical solutions is difficult to obtained.

Two methods of FEM are
1. Force method
2. Displacement method

Revised Manuscript Received on January 30, 2020.
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In the forced method, the set of equations are related to the displacement points.
•In the stiffness method, the set of equations are the equilibrium equations relating displacements of points.
•Rayleigh-Ritz is a displacement method working on energy principle where equations can be obtained in matrix form.

III. DESIGN SPECIFICATIONS

This journal uses double-blind review process, which means that both the reviewer (s) and author (s) identities concealed from the reviewers, and vice versa, throughout the review process. All submitted manuscripts are reviewed by three reviewer one from India and rest two from overseas. There should be proper comments of the reviewers for the purpose of acceptance/ rejection. There should be minimum 01 to 02 week time window for it.

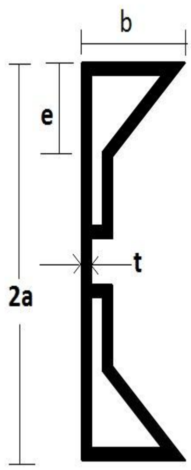


Fig. 1.C-SECTION

A.DIMENSIONS OF THE CROSS SECTIONS

Length of the beam=h
Height of the cross section H=2xa
Breadth f the cross section=b
Thickness of the cross section=t
Height of the flange section=e

Case1: λ and **Mcr** values for different thicknesses (t) at e=10

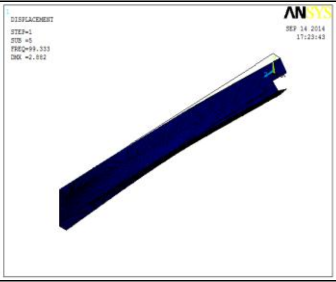
E= 10e-3				
λ = L/H)	t= 0.6	t=1.10	t=2.0	t= 3.14

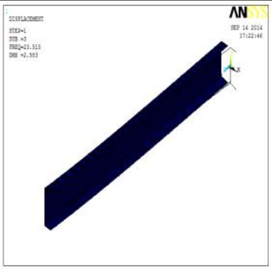
Case 2: λ and **Mcr** values for different thickneses at e=20

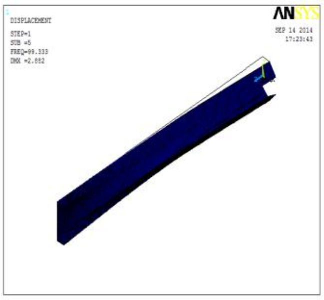
E= 20e-3				
λ=7.5	t= 0.6	t=1.10	t=2.0	t= 3.14

IV. RESULTS & DISCUSSION

CASE:1-Modes For e=10, thickness (t) =0.6, at λ=(7.5, 10,12.5,15,17.5,2)







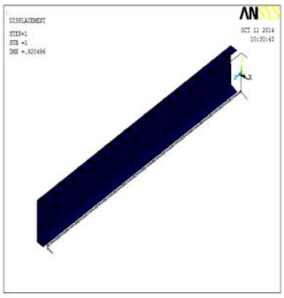


Table for modes and frequencies values for all λ values at e=10,t=0.6

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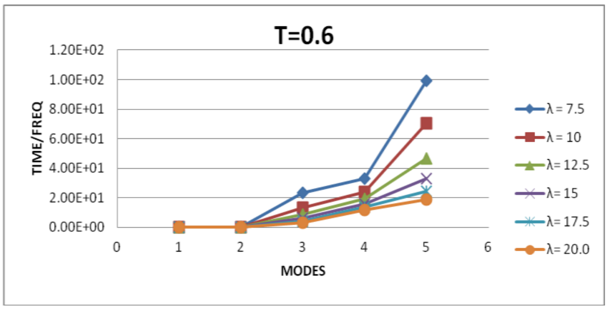
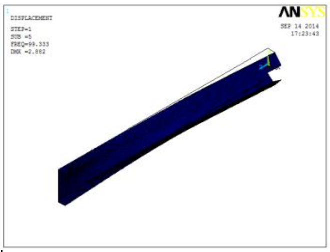
E= 10e-3, t=0.6						
	λ = 7.5	λ = 10	λ = 12.5	λ= 15	λ = 17.5	λ = 20
Mode= 1	Freq= 0.2839	0.2839	0.18589	0.32198	0.32198	0.2399
Mode= 2	0.42930	0.32198	0.32198	0.41567	0.35596	0.32198
Mode= 3	23.515	13.313	8.5391	5.9357	4.3631	3.3415
Mode= 4	33.222	24.112	19.210	15.953	13.552	11.685
Mode= 5	99.333	70.648	46.517	32.860	24.486	19.028

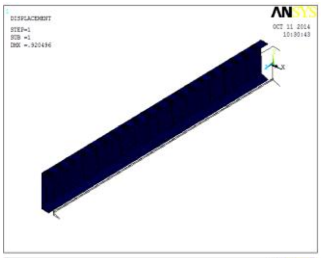


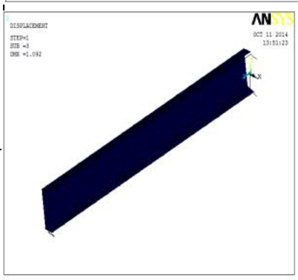
Graph for modes vs frequencies for all λ values at e=10, t=0.6

The free vibrations of the channel unsymmetrical thin-walled beam of length a= 80, b = breadth of the flange (37.81e-3), thickness of the flange at (t=0.6),) over all lengths of the flange at λ = (7.5, 10,12.5,15,17.5,20), for e= 10,G= rigidity of modulus (1),has been studied in this figure.

CASE:2-Modes for e=10, thickness(t)=1.10, λ=(7.5, 10,12.5,15,17.5,20)







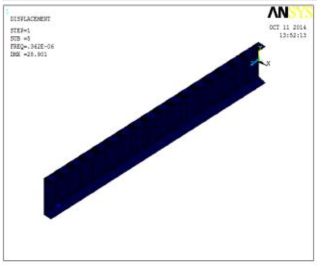
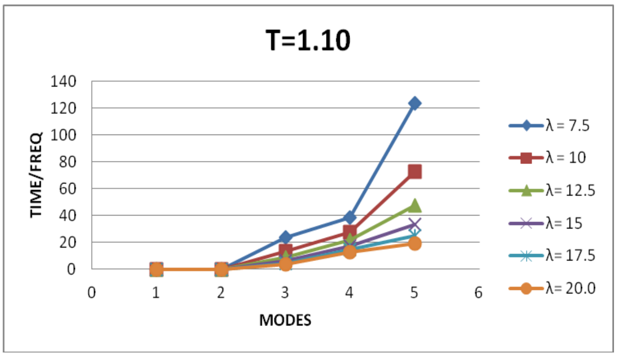


Table for modes and frequencies values for all λ values at e=10, t=1.10

E= 10e-3, t=1.10						
	λ = 7.5	λ = 10	λ = 12.5	λ = 15	λ = 17.5	λ = 20
Mode= 1	Freq = 0.000	0.18589	0	0.18589	0.18589	0.23999
Mode= 2	0.23999	0.28396	0.23999	0.18589	0.2399	0.32198
Mode= 3	23.615	13.33	8.5419	5.9351	4.3617	3.34
Mode= 4	38.434	27.678	21.55	17.499	14.61	12.433
Mode= 5	123.8	72.415	47.231	33.258	24.774	19.282



Graph for modes vs frequencies for all λ values at e=10, t=1.10

V.CONCLUSION

The free vibrations of the channel unsymmetrical thin-walled beam of length a= 80, b = breadth of the flange (37.81e-3), thickness of the flange at (t=0.6),) over all lengths of the flange at λ = (7.5, 10, 12.5, 15, 17.5, 20), for e= 10, G= rigidity of modulus (1),has been studied in case 1 The free vibrations of the channel unsymmetrical thin-walled beam of length a= 80, b = breadth of the flange (37.81e-3), thickness of the flange at (t=1.10.),) over all lengths of the flange at λ = (7.5, 10, 12.5, 15, 17.5, 20), for e= 10,G= rigidity of modulus (1),has been studied in case 2.

International Journal of Innovative Technology and Exploring Engineering (IJITEE)
ISSN: 2278-3075 (Online), Volume-9 Issue-3, January 2020

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