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VIBRATION ANALYSIS USING COMPOSITE MATERIAL

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ABSTRACT

The present project pattern in composite is for the advancement of aluminum metal grid composite with matrix. It is a direct result of Properties like light weight, minimal effort, bio-biodegradability, low natural effect and straightforwardness to fabricate. It gets important to consider the vibration conduct of composite notwithstanding mechanical quality and synthetic properties for viable usage in genuine applications as they exposed to numerous sorts of stacking condition and various kinds of vibration with various arrangements. In present work an aluminum composite bar is made with unidirectional direction for estimation of transverse vibration with various end arrangements results got from explanatory technique and modular examination in ANSYS are analyzed. The mechanical properties are considered by performing tensile, flexural and impact test on the beam according to ASTM standards.In this study, free vibration of circular cross-sectioned aluminium matrix composites beams is investigated numerical and experimental under four different boundary conditions: Clamped-Clamped (C-C), Clamped-Free (C-F), Clamped-Simply Supported (C-SS) and Simply Supported-Simply Supported (SS-SS). Experimental solution is carried out using vibration testing machine and numerical solution is done ANSYS software. Then, solutions including the effects of the geometric characteristics, and boundary conditions are obtained and discussed for the natural frequencies of the first three modes. To confirm the reliability of the vibration analysis carried out in the present paper as well, all the experimental results are checked with the corresponding numerical results obtained from the finite-element-method (FEM) based software called ANSYS.

KEYWORDS

Composite beam and Vibration.

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INTRODUCTION

Composite have been utilized in designing structures in the course of the most recent six decades or somewhere in the vicinity. They could be found in an assortment of utilizations as in make wings and fuselage, satellites, helicopter sharp edges, wind turbines, pontoons and vessels, cylinders and tanks, robot arms, brake pedals and springs and so forth.

Light weight metal Aluminum composites can possibly be utilized as swaps for steel and cast irons segments, particularly when network materials aluminum. Their points of interest over conventional materials are generally perceived and these are high solidarity to weight proportion, and their properties which can be custom fitted as indicated by need other focal points incorporate high firmness, high weakness and erosion obstruction, great rubbing qualities, and simplicity of creation. Consequently, endeavors are being made to improve existing composites.

Aluminum composites are pulling in the specialist on account of properties like light weight, low natural effect, biodegradability and non-rough attributes. Truth be told, certain downsides like helpless dampness opposition, lower strength, hydrophilic nature, lower life cycle and helpless imperviousness to fire properties make the obstruction being used of aluminum composite. Anyway these days increments of mechanical properties of aluminum composite makes them accessible for certain modern applications. In the light of mechanical and conservative properties, there are distinctive sort of regular accessible from various species and diverse source. With the advancement of improved innovation mechanical properties of this composite material are begun improving.

COMPOSITE MATERIALS

Composites are viewed as blend of materials (or metals) of various arrangement. The materials hold their personalities in the mechanical work, i.e., they don't break up totally into one another. These materials can genuinely be confirmed and uncover an interface between each other. The various types of composites used: MMCs, PMCs and CMCs but nowadays the use of metal-matrix, ceramic-matrix plays a significant job whereas SiC is the best used matrix for fabrication.

Theoretical Analysis

For theoretical examination, considering the pillar as persistent and free undamped framework. Since the bar is made of composite material, so information with respect to the physical properties of grid material and sap like thickness, youngs modulus and poisson ratio proportion of individual material and by weightage or volume division of network material utilized for making the composite are to be theoretically determined and in this manner the common recurrence for separate END condition by theoretical examination. For analyzing natural frequency, requires properties like young's modulus, density and poisons ratio of beam can be calculated by equations (1), (2) and (3). By results of equations (1), (2) and (3), frequency is theoretically obtained by equation (4).

Theoretical Analysis

Young's modulus (E_c)

In case of axial loading,

$$E_c = (E_m \times V_m) + (E_f \times V_f)$$

For transverse loading,

$$1/E_c = V_f/E_f$$

Poison's ratio (μ_c)

$$\mu_c = \frac{\varepsilon_t}{\varepsilon_l}$$

Density (ρ_c)

$1/\rho_c$

$$\rho_c = \rho_f V_f + \rho_m V_m$$

Natural frequency *(f)*

$$w = \beta^2 \sqrt{\frac{EI}{\rho A}}$$

$$w = 2\pi f$$

Where, W and V are weightage fraction and volume fraction respectively. There is numerous conceivable sort of beam bar setup. Following Table No.1 shows the administering condition for some of various beam arrangement. Fulfilling condition of Natural Frequency we get various estimations of Satisfying equation of Natural Frequency we get different values of β for known

FINITE ELEMENT MODELING

ANSYS 15.0 is used for analysis purpose. Model analysis module is used for the model analysis. Beam is modelled in ANSYS and various end conditions are configured and analysis done to find out natural frequencies of different beam with different end conditions. Figure No.1(a), (b), (c) shows visual interpretation of different mode of vibration and Table No.2 shows the results of ANSYS analysis.

RESULTS AND DISCUSSION

Table No.2 shows the comparison of natural frequency obtained by different method namely, analytical and ANSYS.

From Table No.2, it is clear that cantilever beam configuration have minimum natural frequency for same mode compared to other end configuration, while natural frequencies are maximum for clamped-clamped condition followed by clamped-supported and supported-supported configuration.

Table No.1: Governing equation for different beam configuration

S.No	Beam configuration	Frequency equation	Value of βl for		
			1^{st} natural frequency	2^{nd} natural frequency	3^{rd} natural frequency
1	Clamped-free	$\cosh(\beta l)\cos(\beta l)+1=0$	1.865104	4.684091	7.854557
2	Clamped-clamped	$\cosh(\beta l)\cos(\beta l)-1=0$	4.720041	7.843205	10.885608
3	Clamped -supported	$\tan(\beta l)-\tanh(\beta l)=0$	3.916602	7.067583	10.340176
4	Supported-supported	$\sin(\beta l)=$	π	2π	3π

ANSYS network analysis

Table No.2: ANSYS results of natural frequency at various modes

S.No	Beam	Mode no	Natural frequency (Hz)			
			End configuration			
			Cantilever	Clamped-Clamped	Clamped-Supported	Supported-supported
1	MMCs	1	18.522	118.76	81.732	51.73
		2	115.31	327.48	264.35	206.78
		3	323.6	640.49	550.05	456.33
2	PMCs	1	15.349	98.549	67.37	42.654
		2	95.71	270.48	217.56	171.14
		3	266.38	527.57	433.11	374.13
3	CMCs	1	14.677	95.019	64.867	41.217
		2	92.394	260.44	209.66	164.347
		3	256.57	508.32	436.34	370.032

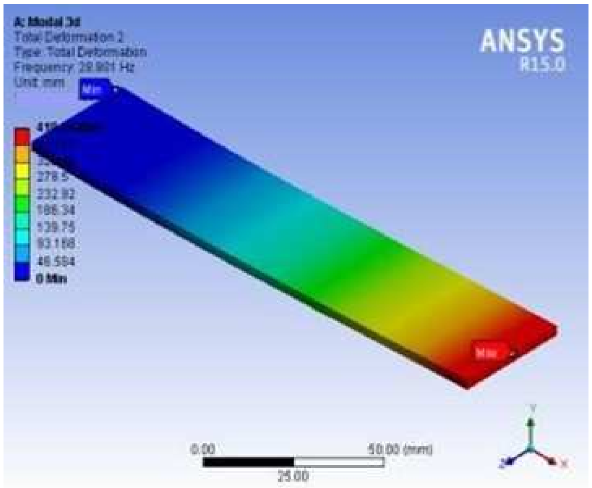

Figure No.1(a): Mode 1

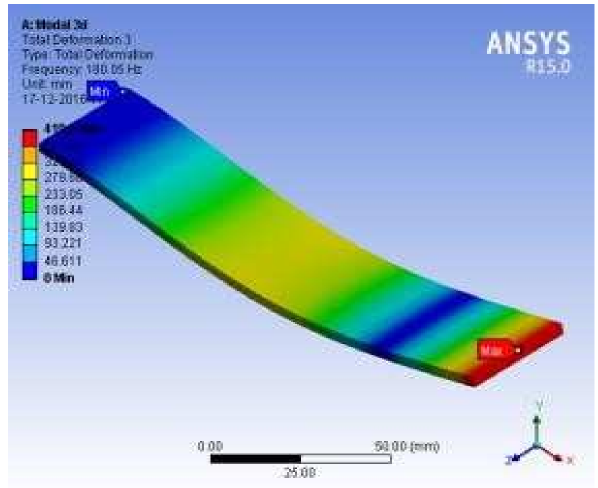

Figure No.1(b): Mode 2

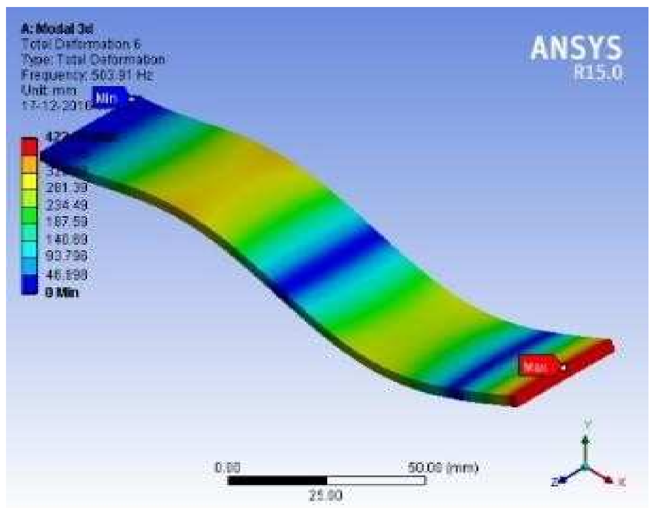

Figure No.1(c): Mode 3

Vibrating pattern of beam at different mode for Cantilever beam

CONCLUSION

Because of relative properties like light weight, minimal effort, great mechanical properties, low ecological effect, less vitality necessity, wellbeing in assembling and bio-degradability composites are currently become the significant region for research in composites to supplant the some modern application. So now it is important to examine the vibrational attributes of composite shaft with the investigation of mechanical properties. Here diagnostic demonstrating is introduced thinking about the transverse isotropy, which gives a thought regarding nature recurrence of composite bar. Scientific demonstrating is additionally done in ANSYS 15.0 to confirm the legitimacy of numerical displaying. Characteristic recurrence got by scientific demonstrating is upheld by ANSYS result. It additionally gives a thought regarding characteristic recurrence of beam. Results shows that composites have higher rigidity, modulus of flexibility higher effect quality and relative flexural quality which empower it to accessible for different applications. These composites are ideally utilized in family unit applications aviation structure application, fast turbine apparatus and in vehicle applications, for example, guard of vehicle, side board back board of entryway, rooftop and run board instead of glass fiber composite.

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CONFLICT OF INTEREST
We declare that we have no conflict of interest.

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