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Vibrational Analysis of Drilling Machine Bed

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Abstract— *Generation of vibrations is natural process while working on a machine, and this is affect the machine tool life and structure. In this present work the composite materials have been used to minimize the chatter vibrations on a slotted table radial drilling machine as a substitute for the bed of work piece. A layer of Glass fiber epoxy and Glass fiber polyester plate are used for the work piece to conduct the experiments. The stack of composites plate and a mild steel plate of similar dimension is fixed to the slotted table. A digital phosphorus storage oscilloscope of Tektronix 1000 series is used to record time period, frequency and RMS amplitude of vibration signal which are generate during drilling operation. Experiments is also conducted without any composite material below the mild steel specimen. Observation concluding that the amplitude of vibrations decreases with increase upto optimum number of layer of composites, these optimum number of layers is also determine in the present work. Analysis of damping is also perform with help of energy balance approach for composite material.*
Keywords— Composite, Glass fiber epoxy, Glass fiber polyester, Drilling, Material damping, Vibration and Chatter

I. INTRODUCTION

Vibrations are generally occurs due to unbalance force generating on the machine structure or component during operations. This result shorter life of machine structure. At present work consider a radial drill machine which have also chatter and vibrations during the operations. The main objective of the work is to minimize the vibrational amplitude on the drilling machine bed with help of composites. Material damping ratio for machine tool value is .0031, which is found by the energy balance technique. Passive damping technique has wide applications in different areas and machine components.

II. LITERATURE REVIEW

Almost 2000 damping materials result conducted by Lazan, B.J.[1]. Rahman et al. [2] made a review on non conventional material structure over the last reaserch work. Composites are also used for CNC milling machine massive slides for machining moulds by Suh et al. [3]. Improvement can be done by viscoelastic layer using applied damping treatment Haranath et al. [4]. composite materials generally exhibit higher damping than structural metallic materials and survey on damping capacity of fiber rainforced composites by Bert [5] and Nashif et al.[6]. Research on damping in fiber-reinforced composite materials have done by Chandra et al. [7]. Viscoelasticity is a discription of behavior of material damping of composites assumed by Gibson et al.[8] and Sun et al.[9]. Prediction of material damping of laminated composites analyzed by Morison [10] and Kinra[11] conducted a study of influence of ply-angle on damping and modulus of elasticity of a metal-matrix composite. Mechanical properties of fiber-reinforced composite materials and structures accurately characterize by Gibson et al [12]. Effects of transverse shear deformation on the modal loss factors and the natural frequencies of composite laminated plates by using the finite element method studied by Koo KN et al. [13]. Damped free vibrations of composite shells assumes a uniform distribution of the transverse shear across the thickness analyzed by Singh s. p et al. [14]. An application of composite concrete bed for CNC machine tool in order to satisfy the requirements like high stiffness and high damping has been experimentally conducted proposed by Ding Jiangmin et.al [15]. Krishna Mohana Rao. G et. al. [16] conducted an Experimental Analysis of Passive Damping Technique on Conventional Radial Drilling Machine Tool Bed using Composite Materials and gave some useful results. Sharad Kumar Shukla et. al. [17] analyzed the vibration on radial drilling machine using piezoelectric sensor. Nisarg M. Trivedi and J.R Mevada. [18] et.al have worked on improvement of surface finish by vibration control using composite materials in milling machine.

III. EXPERIMENTAL SETUP

Fig. 1 Composite Layers

Fig. 2 Experimental Setup

As shown in Fig. 1, the specimens of 210 x 210 x 5 size are prepared for Glass Fiber Epoxy and Glass Fiber Polyester. Size of the mild steel plate is taken as 210 x 210 x 5 mm. Drilling operation is carried out using a 10mm drill bit to a depth of 3mm with while increasing the number of composite plates from one to four. A contact type magnetic base vibration pickup connected to a digital phosphor storage oscilloscope of Tektronix 1000 series is used to pick up amplitude, time period, RMS amplitude and frequency. Finally Mild steel plate alone is machined with no layer under it. Fig. 2 shows the experimental set up.

IV. RESULTS

Table 1 Experimental Frequency and Amplitude data for Glass fiber polyester

S. No	Depth of cut (mm)	Number of layers	Signal Amplitude (mV)	Time Period (µs)	Frequency (KHz)	RMS Amplitude (mV)
1	3	1	51.1	807.5	1.431	12.2
2	3	2	32.2	495.1	1.81	6.23
3	3	3	22.1	978.7	1.09	5.99
4	3	4	44.5	329	2.432	9.3

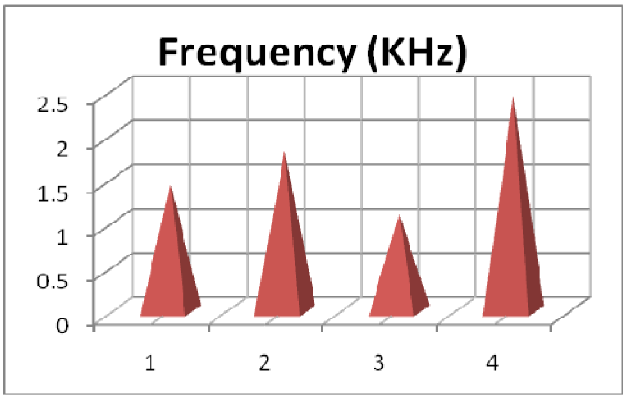

Fig. 3 Frequency versus Number of layers for Glass fiber polyester

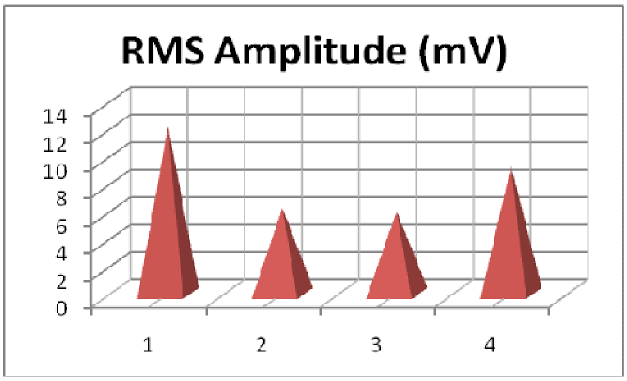

Fig. 4 RMS Amplitude versus Number of layers for Glass fiber polyester

Table 2 Experimental Frequency and Amplitude data for Glass fiber epoxy

S. No	Depth of cut (mm)	Number of layers	Signal Amplitude (mV)	Time Period (µs)	Frequency (KHz)	RMS Amplitude (mV)
1	3	1	32.4	867.8	1.28	6.04
2	3	2	27.9	446.9	1.45	5.13
3	3	3	51.1	538.2	1.76	9.06
4	3	4	57.4	541.6	1.56	13.02

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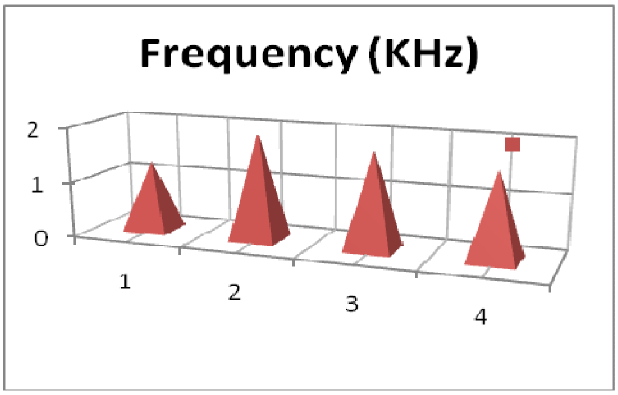

Fig. 5 Frequency versus Number of layers for Glass fiber epoxy

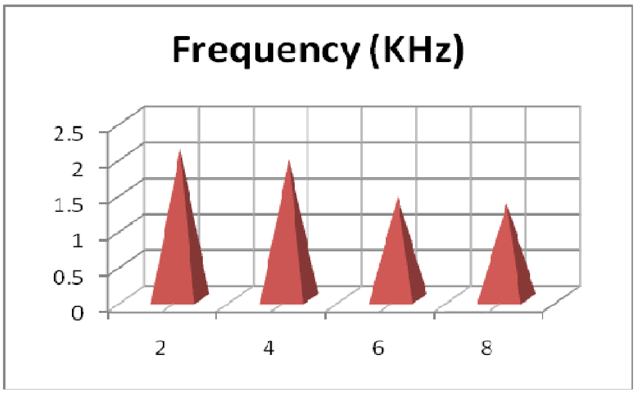

Fig.7 Frequency versus Number of layers for sandwich Plates

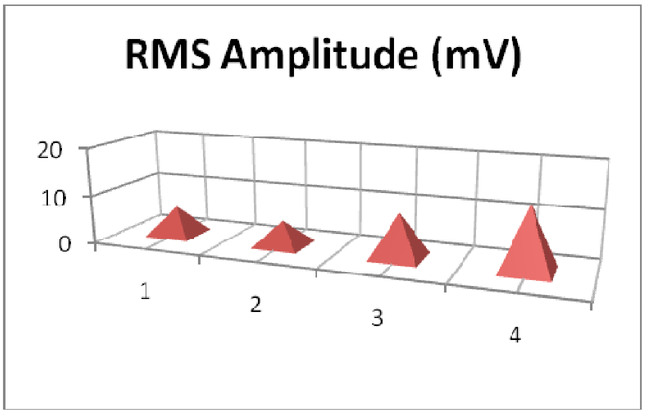

Fig. 6 RMS Amplitude versus Number of layers for Glass fiber epoxy

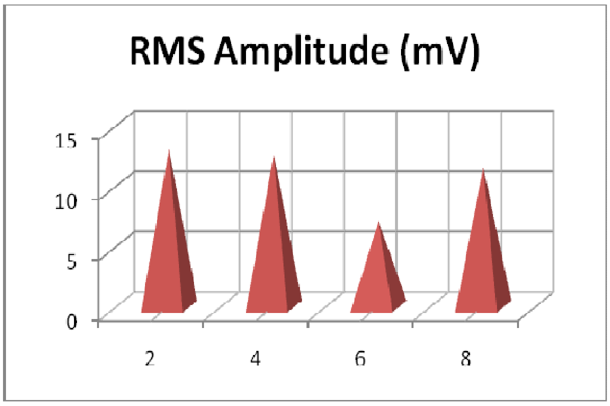

Fig. 8 RMS Amplitude Number of layers for sandwich Plates

Table 3 Experimental data for the sandwich plates of Glass fiber epoxy and polyester

S.No	Depth of cut (mm)	Number of layers	Signal Amplitude (mV)	Time Period(µs)	Frequency (KHz)	RMS Amplitude (mV)
1	3	2	56.8	427.3	2.10	13.1
2	3	4	55.9	507.8	1.95	12.6
3	3	6	31.02	682.7	1.43	7.05
4	3	8	48.3	712.1	1.34	11.5

Table 4 Experimental data for the Mild steel plate

S.No	Depth of cut (mm)	Number of layers	Signal Amplitude (mV)	Time Period(µs)	Freqency (KHz)	RMS Amplitude (mV)
1	3	1	59.1	598.3	1.618	14.7

Table 5 Optimum no. of plates and Height of machine tool bed

Type of composite	**Optimum no. of plates**	**Height of the machine bed**
Glass fiber polyester	Three	15 mm
Glass fiber epoxy	Two	10 mm
Sandwich plates	Six	30 mm

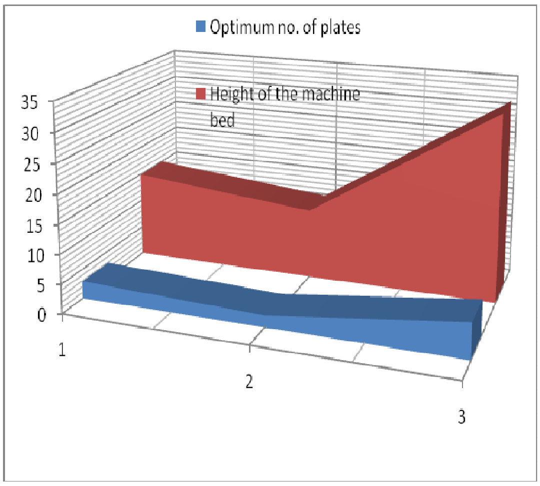

Fig. 9 Optimum no. of plates and Height of machine tool bed

V. CONCLUSION

A composite material provides the wide variety of applications in Mechanical Engineering field. In this research work we have performed various theoretical calculations and practical experiments and found out that the results are well in favour of the previous calculations performed by many researchers in relation with the properties of materials. The results obtained are approximately equal to the results found previously by many researchers. In practical session we have found out the optimum no of layers of composites become different if the thickness of sheets joined face to face adjacently is reduced which leads to decrement in machine tool bed height. These results also lead to save the material of composites. As we know that the composited are very costly thus, this reduces material cost. The final vibration in the machine tool bed is also less as compared to previous researched models. The Root mean Square Amplitude is also less in comparison which makes this model very effective as well as cost efficient comparative to previous researched Models. This research also opens wide range of tricks to implement for further research work.

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