OPTIMIZATION OF LATHE BED TO REDUCE VIBRATION

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Abstract

In this competitive market it has to be maximized the production with the help of machine tools. for increasing the production of machine tools by increasing spindle speeds have caused vibration in machine tools. The two main functional requirements of machine tool bed for machine tools to run at high speed are high structural stiffness and high damping, which cannot be satisfied simultaneously if conventional metallic materials such as cast iron are employed. Hence there is a need to replace cast iron with alternate materials to reduce the vibration of bed.

The objective of this study is to improve the natural frequency and damping capability of machine tool bed using a material Epoxy-Glass. So in this study, a machine tool bed made of Epoxy-Glass is designed. Modal analyses were conducted numerically and experimentally to determine the modal frequencies, damping ratio.

Keywords*-Epoxy-Glass, Vibration, Natural Frequency, lathe bed, damping ratio*

I. INTRODUCTION

The lathe is a machine tool used principally for shaping articles of metal (and sometimes wood or other materials) by causing the work piece to be held and rotated by the lathe while a tool bit is advanced into the work causing the cutting action. The basic lathe that was designed to cut cylindrical metal stock has been developed further to produce screw threads. tapered work. drilled holes. knurled surfaces, and crankshafts. The typical lathe provides a variety of rotating speeds and a means to manually and automatically move the cutting tool into the work piece. Machinists and maintenance shop personnel must be thoroughly familiar with the lathe and its operations to accomplish the repair and fabrication of needed parts.

Machine tools play an important role in manufacturing industry. The productivity, accuracy and efficiency of machine tools have increased considerably in the past few decades, with improvement of the material content. So it increases the possibility of operational and mechanical property material. It should be decrease the negative effect such as vibration at minimum level. The main important property of machine tool are high static stiffness for bending and torsion, good dynamic characteristic, good dimensional stability and low co-efficient of expansion. Materials used in manufacturing machine tools, especially when viewed in terms of their mechanical characteristics, have a great importance in comparison to other construction.

materials and this will continue in the future. According to few property like chemical resistance, damping and stiffness the conventional metallic material cast iron cannot be used. for manufacturing machine tool Cast iron, a traditional material is used. But its inherent disadvantages include high cost, poor torsional rigidity due to thin walls; difficulty in producing the finished product etc. to reduce this disadvantages have to led research for new metallic material either supplement or completely replaced cast iron material. Many materials have been found to have the ability to replace the conventional cast iron such as mild steel, granite, ceramics, concrete, ferro-cement, polymers, epoxy granite and composites. there is two most important functional requirement for a machine tool are stiffness and damping to improve static and dynamic characteristic.

Several researches have been done to find a suitable replacement to cast iron and researchers also suggested replacement for cast iron. In this study an epoxy-glass is used to replace the conventional cast iron bed as the best way to obtain both high stiffness and damping. The bed made of cast iron has inherent disadvantages such as low stiffness, pollution causing foundry materials and difficulty in producing the finished product. The Epoxy-Glass bed showed improved static and dynamic performances when compared with cast iron.

II. EXPERIMENTAL MODAL ANALYSIS

2.1 EXPERIMENTAL SET UP

Material no.	Name of the material	Cross section
1	Cast iron	250*250*8
2	Epoxy-glass	250*250*8

Table 1. SPECIMEN DETAIL

Fig. 1. EPOXY-GLASS

Fig. 2. Cast Iron

The experimental modal tests are used to determine the modal frequencies of the Epoxy-Glass cross section. This will help to identify if the natural frequency which in turn will help to control vibration. The setup is shown in Fig. 3. The results are shown in Fig. 4. The test procedure is similar to that conducted on cast iron cross section.

Fig. 3. Experimental set up for Epoxy-Glass plate

Fig 4. Experimental Set up for cast iron plate

2.2 MATERIAL PROPERTY FOR CST IRON

DENSITY	7200 kg/m3
POISSON RATIO	0.3
YOUNG MODULUS	2.1 e+11Pa

2.3 MATERIAL PROPERTY FOR EPOXY-GLASS

DENSITY	1915 kg/m3
POISSON RATIO	0.245
YOUNG MODULUS	4.9e+10 Pa

2.4 EXPERIMENTAL RESULT

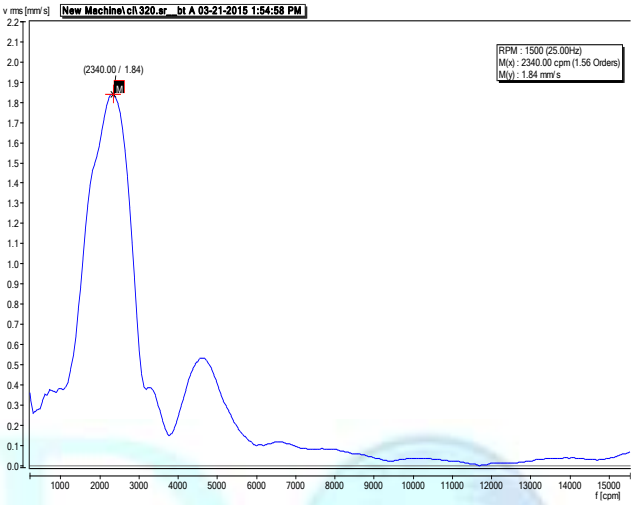

Fig. 5. **RESPONSE OF CAST IRON**

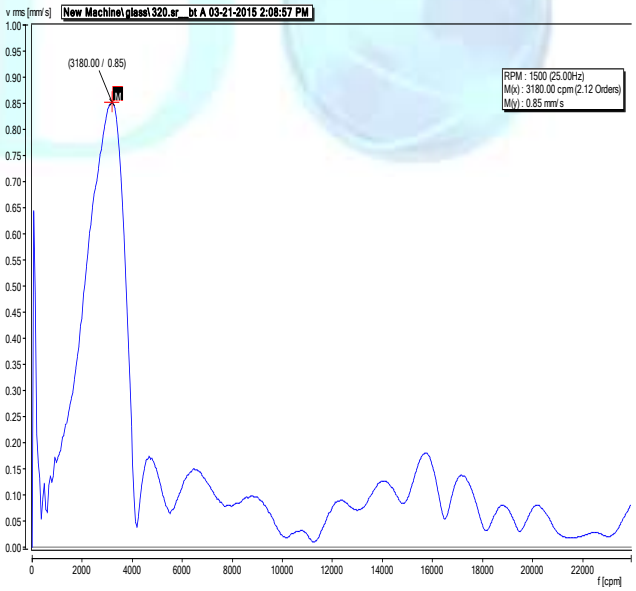

Fig. 6. **RESPONSE OF EPOXY GLASS**

2.5 COMPARISION OF NATURAL FREQUENCY

MODE	CAST IRON	EPOXY GLASS
1	972.44	1244.2
2	1074.1	1379.6
3	1465.1	1883.8
4	2267.3	2909.4
5	2604.5	3332.5
6	2755.4	3534.4

Also damping ratio is calculated with the help of half power band with method.

$$\xi = (f_2-f_1)/f_n$$

where ξ = damping ratio

f_2-f_1 = half power bandwidth

f_n = corresponding natural frequency

From the method damping ratio is calculated for cast iron is 0.20 and for epoxy-glass is 0.25.

III. RESULT AND CONCLUSION

The comparison of experimental modal tests prove that natural frequencies of EPOXY-GLASS bed is higher limiting the probability of resonance. The damping ratio of the EPOXY-GLASS bed was also greater than cast iron.

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