



Enhancement In Surface Finish For Boring Operation By Minimizing Vibration.

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Abstract: Many of the small -scale industries are facing problems of vibration while doing boring operation on lathe. Boring tool is used to enlarge the drilled hole. Vibratory motion between tool and work piece can lead to reduce performance. Vibration in boring operation causes tool damage, improper surface finish and other effects.

There are few important things to note while performing boring operation as it is noisier and vibration will cause due to this operation. During an internal turning operation, the cutting tool and the boring bar are subjected to cutting forces due to the relative motion between the tool and work piece in the cutting speed direction and in the feed direction. Therefore, a variable cutting force during boring operations causes the tool to deflect and leave behind a wavy surface. When the cutting edge encounters this wavy surface in the next revolution, the relative phasing can lead to increased force and deflection through regenerative chatter and creates vibration to reduce these vibrations different dampers used of different material is used to reduce vibrations.

Index Terms - Boring operation. Vibration, Ra values, dampers used of different materials.

Introduction

Vibration which causes while performing boring operation is the main cause and it should be limit ones it get come into surface finish and quality matters of product. It is important to limit vibrations of the machine tool structure as their presence results in poor surface finish, cutting-edge damage, and irritating noise. The causes and control of free and forced vibrations are generally well understood and the sources of vibration can be removed or avoided during operation of the machine. Chatter vibrations are less easily controlled, and metal removal rates are frequently limited because the operator must stop the machine to change the cutting conditions, which often means reducing the depth of cut or feed rate. The causes of machine tool chatter are generally well understood, and the vibrations occur because of the basic interaction between the cutting process and the machine tool structure in industry where metal cutting operations such as turning, milling, boring and grinding take place, and degrading vibrations are a common problem. In internal turning operations vibration is a pronounced problem, as long and slender boring bars are usually required to perform the internal machining of work pieces. Tool vibration in internal turning frequently has a degrading influence on surface quality, tool life and production efficiency, whilst also resulting in severe environmental issues such as high noise levels. For boring bars that have L/D ratio of $< 5:1$, then relatively stable cutting conditions with controllable vibration influences can be tolerated. However, if L/D ratios utilized are larger than this limiting value, then potentially disastrous vibration tendencies could occur, leading to a variety of unwanted machining and work piece characteristics, these include: • Limited tool life – caused by forced and self-excited vibrations, restricting both cutting efficiency and tool life, • Unacceptable machined surface texture – vibrations in the form of work piece surface chatter, can be the cause for component rejection, • Substandard machined

roundness – vibration/chatter affects creating high frequency. There are few important objects to set while finding co relationship between surface finish, vibration.

Objectives

The proposed work is to see the feasibility of passive damping technique in boring bar and develop a damper which can minimize the effects of vibration.

1. To measure the vibrations occurred during boring operation
2. To Design Damper for boring tool
3. Measure the vibrations occurred using boring tool with dampers.
4. Check the Ra values of work pieces in cases 1 and 3.

Design Parameters

1. L/D ratio of boring tool is the main cause of vibration occurred in boring operation.
2. Select the proper L/D ratio as per need for boring operation.
3. To Design passive vibration damper for minimising the effect of boring operation
4. Find out correlation between Ra values for with and without damper for boring operation.

Dimensional Analysis

Parameters affecting response of a damped single degree of freedom system under harmonic excitation are selected based on its equation of motion. Equation of motion of a single degree of freedom system under harmonic excitation is given by,

$$x = f(m, k, C, F_0, \omega)$$

$$f_1(x, m, k, C, F_0, \omega)$$

These variables may be completely described by fundamental dimensions of M – L – T systems. Hence the number of fundamental quantities, $m = 3$. Therefore, there are $(n - m) = 3$ independent dimensionless π -terms, say π_1, π_2, π_3 and π_4 . $f_2(\pi_1, \pi_2, \pi_3) = c_1$ (4.10) In order to form these π -terms, one has to choose 3 repeating variables, since in this case $m = 3$. As stated earlier, these variables should be such that they, among them, contain all the three fundamental dimensions and they themselves do not form a dimensionless parameter. Hence x (L), m (M) and k (MT^{-2})

Materials for dampers

- I Viscoelastic polymers,
- II Viscous fluids,
- III Magnetic and
- IV Passive piezoelectric.

All above materials are to be used for reduce vibration and enhance damping effect. passive damping treatments work by absorbing significant amounts of strain energy from the vibration modes of interest and dissipating this energy through mechanism. The principle of passive damping is to enhance the damping ability of the tool without actively compensating for the upcoming vibrations. A common way

to achieve passive damping is by using viscoelastic materials to dissipate the energy that causes vibration. Viscoelastic polymers provide high energy dissipation. Viscoelastic ally damped structures have been successfully applied in many engineering fields. Generally employing the VE polymer in three different ways; i as free-layer dampers (FLD), ii as constrained-layer dampers (CLD), iii in tuned viscoelastic dampers (TVD). FLDs are defined as those dampers composed by a single layer of damping material positioned on top of the base material by gluing or other bonding techniques. CLDs consist of a sandwich structure where the damping material is constrained between two layers of elastic material. TVDs consist of a mass residing on a damping layer bonded to the base material. Figure 5.1: (a) Free layer damper, FLD. (b) Constrained-layer damper, C) Tuned Viscoelastic damper

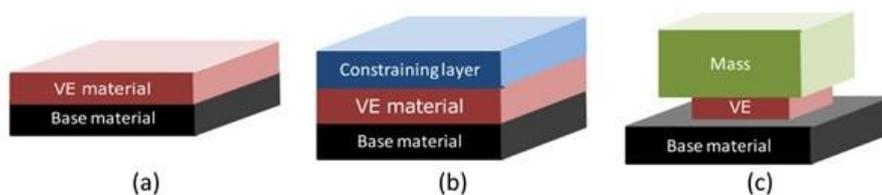
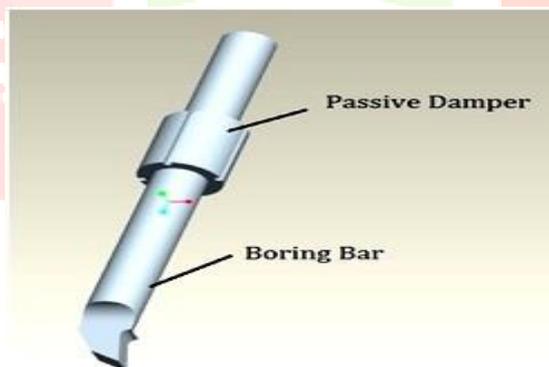


Fig 1-Viscoelastic material dampers for vibration reduction

Design for Customized boring bar (With different material damper)

Length of the damper depends upon the relationship between boring bar overhang and damper diameter. For experiment purpose the boring bar overhang is taken as 100 mm and 120 mm .I.D=0.016L and O.D=0.038L and slot dimensions-0.004.

Fig 2-Boring bar with damper



Experimental Setup

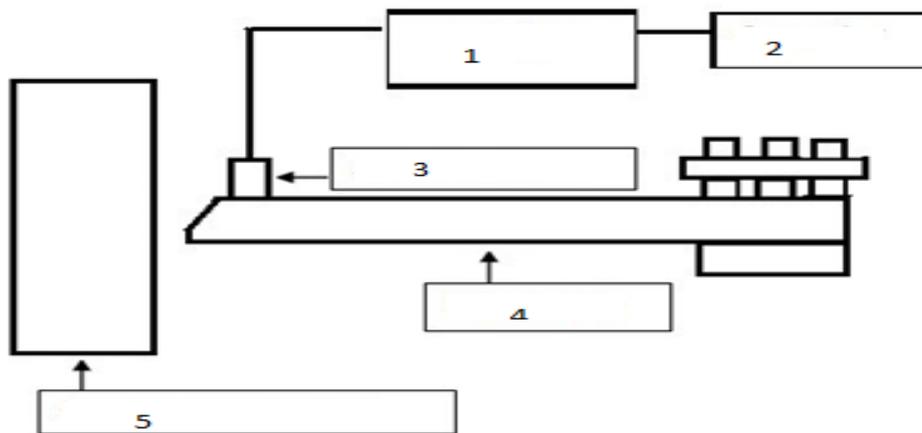


Fig 3-Experimental arrangement for vibration measurement for boring operation.

1. FFT Analyser
2. Computer
3. Accelerometer
4. Boring Tool
5. Cylindrical work piece

Results

	Vibration Response (m/sec ²)		
	With Passive Damper		Without Passive Damper
1	7.9×10^{-4}	7.9×10^{-4}	4.1×10^{-3}
2	1.7×10^{-3}	1.7×10^{-3}	3.7×10^{-2}
3	2.4×10^{-3}	2.4×10^{-3}	4.4×10^{-2}
4	1.9×10^{-3}	1.8×10^{-3}	3.8×10^{-2}
5	9.3×10^{-4}	9.4×10^{-4}	5.6×10^{-3}

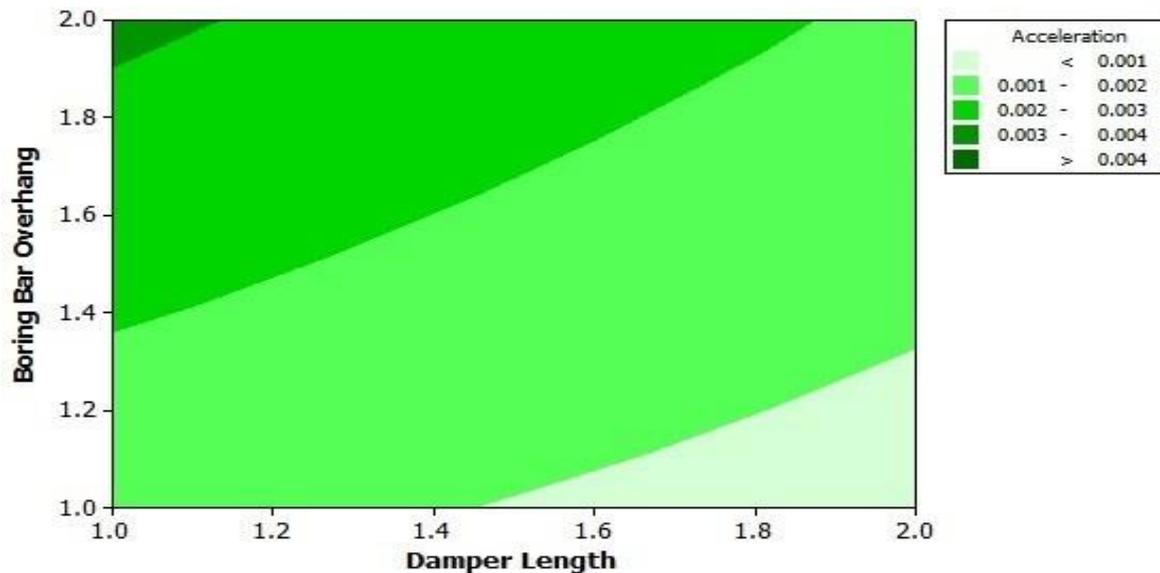


Fig 4-Corelation observed between damper length and boring bar overhang for different feed

Conclusion

- There is a definite need of damper in case of boring operation to minimize the end effects of vibration, e.g. poor surface finish, loss of dimensional accuracy etc.
- The PTFE dampers developed exhibits its effectiveness in minimizing the level of vibration during boring operation.
- The passive vibration damper as well enhances the surface finish of the machined component.
- Damper parameters e.g. length and material founds to be more effective than the machining parameters.

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