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MINIMIZATION OF BORING TOOL VIBRATION USING COMPOSITE MATERIAL

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ABSTRACT :- Boring is a commonly used operation to enlarge the existing holes of machine structures. When boring tool is slender and long, it is subjected to excessive static deflections or self-excited chatter vibrations which are detrimental to the accuracy and surface finish of the hole. It also causes accelerated wear and chipping of the tool. Internal turning frequently requires a long and slender boring tool in order to machine inside a cavity, and vibrations generally become highly correlated with one of the fundamental bending modes of the boring tool. There are several ways to eliminate vibrations, but most effective and reliable ones required the thorough understanding of dynamic characteristics of the tooling system. Furthermore, the interface between the boring tool and the clamping house has a significant influence on the dynamic properties of the clamped boring tool. This report focuses on the behavior of a boring tool that arises under different overhang lengths which are commonly used in the manufacturing industry.

Keywords— Boring tool, carbon fiber, vibration

I. INTRODUCTION

In a boring operation, the boring tool is subjected to dynamic excitation, due to the material deformation process during a cutting operation. This will introduce a time-varying deflection of the boring tool. If the frequency of the excitation coincides with one of the natural frequencies of the boring tool, a condition of resonance is encountered. Under such circumstances the vibrations are at a maximum, thus the calculation of the natural frequencies is of major importance in the study of vibrations. Bending vibration is major type of vibration in the boring tool caused by the forces from the cutting process.

The force that is applied to the cutting tool during a cutting operation comes from the chip deformation process. Most practical structural systems exhibit internal stiffness and the capacity to support transverse shear.

II. PROBLEM STATEMENT

During deep boring process, usually when l/d (overhang length/boring tool diameter) ratio is higher, the excessive vibrations are induced at tip of boring tool which hampers the surface finish consequently quality of the products. Moreover it reduces life of cutting tool. Hence, vibration of boring tool is reduced by means of applying carbon fiber composite layers as a passive damper with different orientations of fiber.

III. OBJECTIVES

1. To develop a new technique to reduction of vibration in boring operation.
2. To study the analytic behavior of boring tool under different cutting conditions.
3. To analyses the effect of carbon fiber lapping with different angle of layer and optimize vibration.
4. To analyses the vibration response of laminated tool by experimental result.

IV. SCOPE

In this study, a finite element analysis of boring tool with and without the damper, with different layer configuration will be carried out. The experimental set-up will be designed to study the effect of various cutting parameters on the boring tool. It is proposed that the configurations of the polymer based composite should be selected such that it gives maximum damping effect. The results obtained by finite element analysis will be validated with experimental analysis.

V. METHODOLOGY

The stiffness and damping of the boring tool should be increased in order to reduce the vibration. In this project, to achieve the maximum damping effect, the boring tool is laminated with carbon fibre with different fibre orientations. Four different boring tools were laminated with carbon fibre with 0 orientations. To assess the effect of carbon fibre on the acceleration amplitude, experimentation is carried out with different cutting parameters. Load Cases

Load Case Without Lamination	Frequency (Hz)	Tangential Load Ft (N)	Radial Load Fr (N)	Equivalent Force Fe (N)
1	1113.28	15.3603	4.7310	16.0724
2	1020.51	26.7439	8.2371	27.9837
3	839.84	25.98542	8.0035	27.1900
4	795.9	14.9247	4.5968	15.6165
5	613.73	26.1595	8.0571	15.7211
6	664.06	15.0246	4.6276	27.3721

Load Case with Lamination	Frequency (Hz)	Tangential Load Ft (N)	Radial Load Fr (N)	Equivalent Force Fe (N)
7	927.73	15.3603	4.7310	16.0724
8	1000.98	26.7439	8.237149488	27.9837
9	781.25	25.9854	8.003512367	27.1900
10	771.48	14.9247	4.5968	15.6165
11	600.59	26.1595	8.0571	15.7211
12	644.53	15.0246	4.6276	27.3721

EA RESULT

Load Case 1

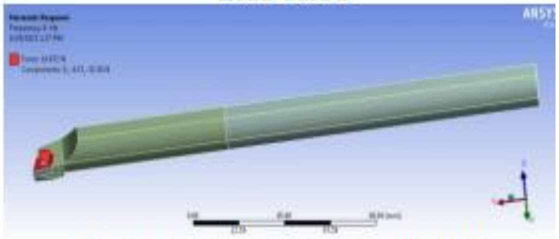

Fig 1 Load applied as per condition 1

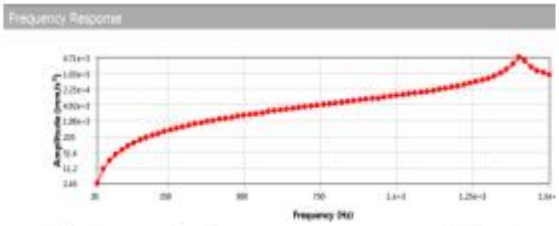

Fig. 2 Amplitude response as per condition 1

Load Case 2

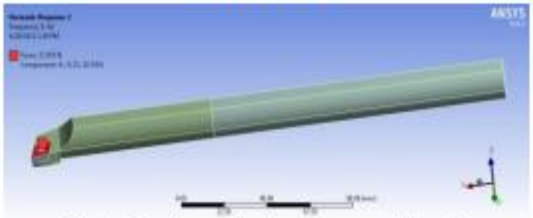

Fig 3 Load applied as per condition 2

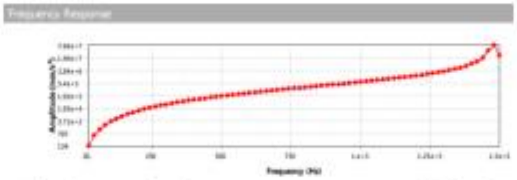

Fig. 4 Amplitude response as per condition 2

Load Case 3

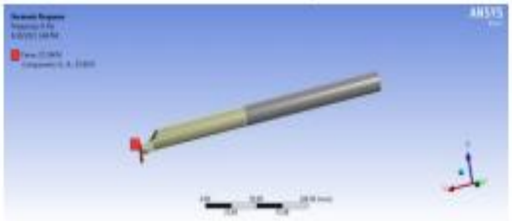

Fig 5 Load applied as per condition 3

F

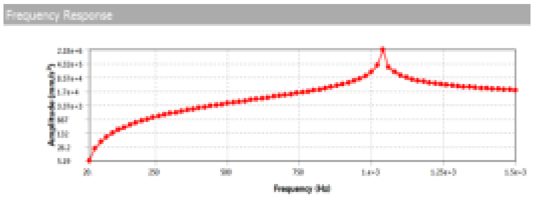

Fig. 6 Amplitude response as per condition 3

Load Case 4

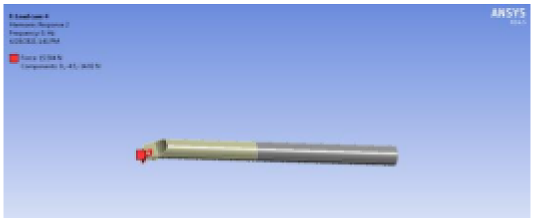

Fig 7 Load applied as per condition 4

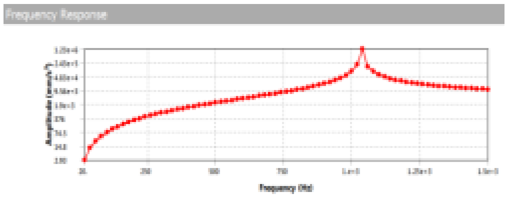

Fig. 8 Amplitude response as per condition 4

Load Case 5

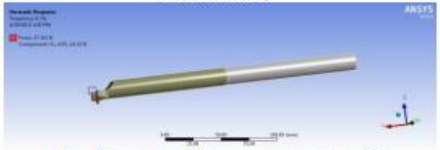

Fig 9 Load applied as per condition 5

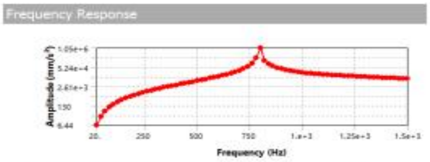

Fig. 10 Amplitude response as per condition 5

Load case 6

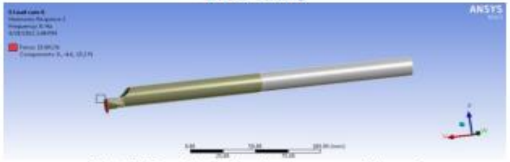

Fig 11 Load applied as per condition 6

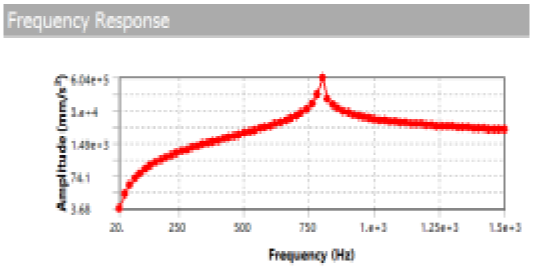

Fig. 12 Amplitude response as per condition 6

Load case 7

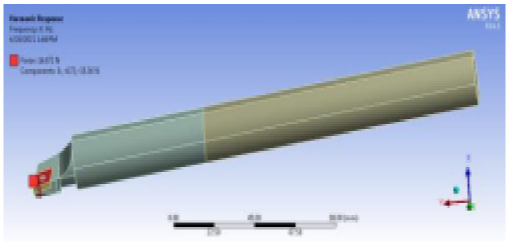

Fig 13 Load applied as per condition 7

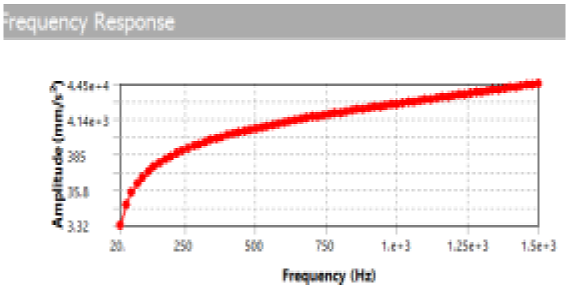

Fig. 14 Amplitude response as per condition 7

Load Case 8

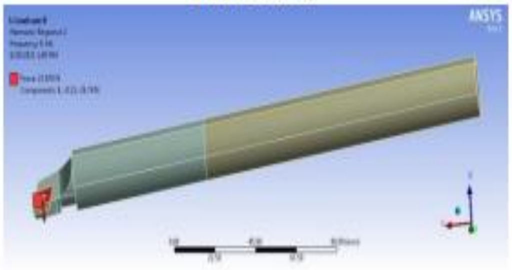

Fig 15 Load applied as per condition 8

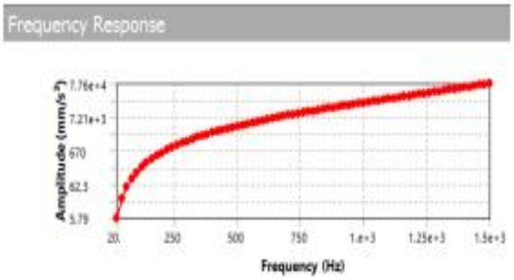

Fig. 16 Amplitude response as per condition 8

Load Case 9

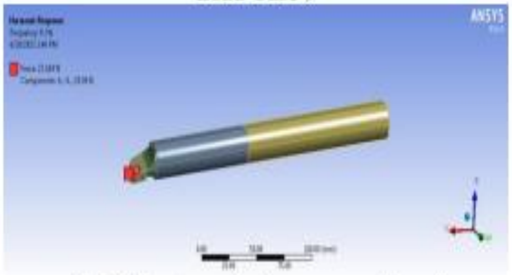

Fig 17 Load applied as per condition 9

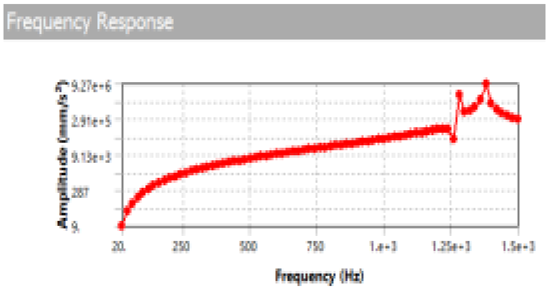

Fig. 18 Amplitude response as per condition 9

Load Case 10

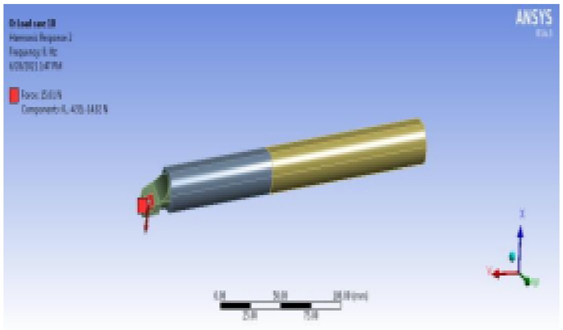

Fig 19 Load applied as per condition 10

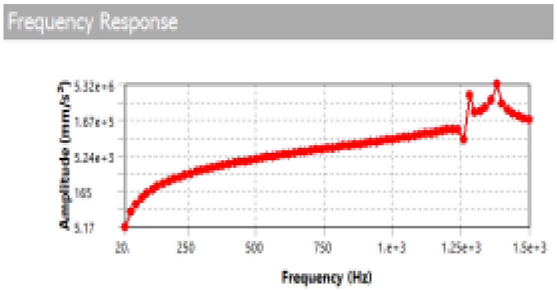

Fig. 20 Amplitude response as per condition 10

Load case 11

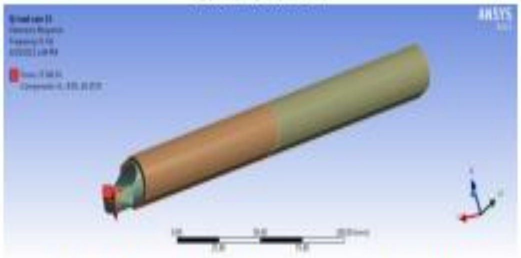

Fig 21 Load applied as per condition 11

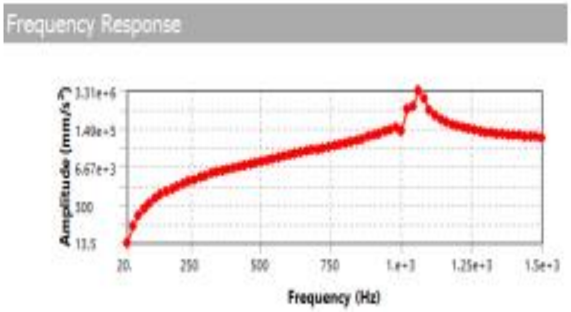

Fig. 22 Amplitude response as per condition 11

Load Case 12

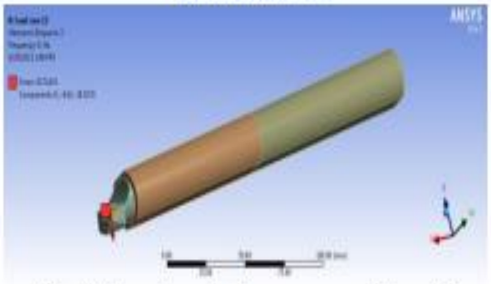

Fig 23 Load applied as per condition 12

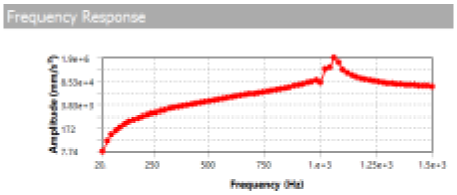

Fig. 24 Amplitude respose as per condition 12

VI. RESULTS

In order to study the effect of different fiber layer on the damping of the boring tool, 6 tools were prepared. First the pilot experiments were performed to investigate the performance of each boring tool. were taken by combining the overhang tool length (96, 112, and 128 millimetres) and cut depth (0.1 mm, 0.2 mm, 0.3 mm). The tool with lamination performs better than the other tools, according to the pilot testing.

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