Design and Analysis of CNC Cabinet by using Glass Fibre Material

Pratik A. Jadhav[1], Krishna R. Kawade[2], Somnath S. Kadam[3]. Rushabh B. Bothe[4]
Prof-M.B.Valekar[5]

[1,2,3,4,5]*Department of Mechanical Engineering, GHRCEM, Pune, Maharashtra Internal Guide, Department of Mechanical Engineering, GHRCEM, Pune Maharashtra*

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Abstract-*In general, machine tool structures like lathe, CNC, broaching, and grinding machines, etc. are subjected to regular unwanted vibrations. These machine tool vibrations or chatter are deleterious to machining operations. It results in degraded quality on the machined parts, shorter tool life, and unpleasant noise, hence are to be necessarily damped out. The important characteristics of the machine tool structures for metal cutting are high damping and static stiffness which ensure manufacture of work pieces of the required geometries with acceptable surface finish at the required rate of production in the most economical way. The unwanted vibrations must be arrested in order to ensure higher accuracy along with productivity.*

In the present work, CNC machine cabinet are metallic materials which electrically react. Which is not good for the operator. And also the weight of the cabinet is too heavy and trouble to transport. And isolation is also not provide fully. So we can change the material for this and used the E-glass fibre, which help to resolve this problems.

KEYWORDS: glass fibre, catia V5R20, ansys, CNC Machine details.

1. INTRODUCTION

Glass fibres, also known commercially as 'fiberglass', are most extensively use reinforcements for polymer matrix composites due to their combination of low cost, high strength and relatively low density. Unlike carbon or Kevlar fibres glass fibres are isotropic thus avoiding loss of properties when loaded in the transverse direction. Fiberglass is produced by pulling molten glass through orifices at a temperature where the glass has just the right amount of viscosity. A schematic of one of two common glass manufacturing process. Glass fibre are among the most versatile industrial materials known today. They are readily produced from raw materials, which are available in virtually unlimited supply (Ref 1). All glass fibres described in this article are derived from compositions containing silica. They exhibit useful bulk properties such as hardness, transparency, resistance to chemical attack, stability, and inertness, as well as desirable fibre properties such as strength, flexibility, and stiffness (Ref 2). Glass fibres are used in the manufacture of structural composites, printed circuit board sand a wide range of special-purpose Products (Ref 3). Fibber Forming Processes. Glass melts are made by fusing (co-melting) silica with minerals, which contain the oxides needed to form a given composition. The molten mass is rapidly cooled to prevent crystallization and for med into glass fibres by a process also known as fibre inaction.

2. GLASS FIBRE TYPE

Glass fibres fall into two categories, low-cost general-purpose fibres and premium special-purpose fibres. Over 90% of all glass fibres are general-purpose products. These fibres are known by the designation E-glass and are subject to ASTM specifications (Ref 5). The remaining glass fibres are premium special-purpose products. Many, like E-glass, have letter designations implying special properties (Ref 6). Some have trade names, but not all are subject to ASTM specifications

3. COMPOSITE MATERIALS

Composite materials, often shortened to composites, are engineered or naturally occurring materials made from two or more constituent materials with significantly different physical or chemical properties which remain separate and distinct at the macroscopic or microscopic scale within the finished structure. The constituents are combined in such a way that they keep their individual physical phases and are neither soluble in each other nor form a new chemical compound. One constituent is called reinforcing phase which is embedded in another phase called matrix. The most visible applications is pavement in roadways in the form of either steel and aggregate reinforced Portland cement or asphalt concrete.

Mostly fibres are used as the reinforcing phase and are much stronger than the matrix and the matrix is used to hold the fibres intact. Examples of such composites are an aluminium's matrix embedded with boron fibres and an epoxy matrix embedded with glass or carbon fibres. The fibres may be long or short, directionally aligned or randomly orientated, or 'some sort of mixture, depending on the intended use of the material. Commonly used materials for the matrix are polymers, metals, ceramics, carbon and fibres are carbon (graphite) fibres, aramid fibres and boron fibres.

Fibber-reinforced composite materials are further classified into the following

A) Continuous fibre-reinforced

b) Discontinuous aligned fibre-reinforced

c) Discontinuous random-oriented fibre-reinforced.

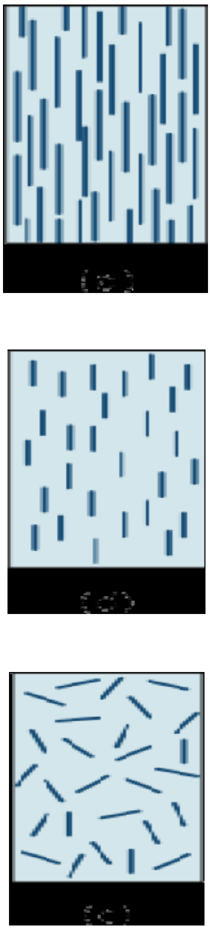

Fig 1.1 Types of fibre reinforced materials

4. DAMPING OVERVIEW

The three essential parameters that determine the dynamic responses of a structure and its sound transmission characteristics are mass, stiffness and damping. Mass and stiffness are associated with storage of energy. Damping results in the dissipation of energy by a vibration system. For a linear system, if the forcing frequency is the same as the natural frequency of the system, the response is very large and can easily cause dangerous consequences. In the frequency domain, the response near the natural frequency is "damping controlled". Higher damping can help to reduce the amplitude at resonance of structures. Increased damping also results in faster decay of free vibration, reduced dynamic stresses, lower structural response to sound, and increased sound transmission loss above the critical frequency. A lot of literature have been published on vibration damping. ASME published a collection of papers on structural damping in 1959 [6].

Lazan's book published in 1968 gave a very good review on damping research work, discussed different mechanisms and forms of damping, and studied damping at both the microscopic and macroscopic levels [7]. Lazan conducted comprehensive studies into the general nature of material damping and presented damping results data for almost 2000 materials and test conditions. Lazan's results show that the logarithmic decrement values increase with dynamic stress, i.e., with vibration amplitude, where material damping is the dominant mechanism. This book is also valuable as a handbook because it contains more than 50 pages of data on damping properties of various materials, including metals, alloys, polymers, composites, glass, stone, natural crystals, particle-type materials, and fluids. About 20 years later, Nashif, Jones and Henderson published another comprehensive book on vibration damping [8].

5. LITERATURE REVIEW

Bert [14] and Nashif et al.[15] had done survey on the damping capacity of fibre reinforced composites and found out that composite materials generally exhibit higher damping than structural metallic materials. Chandra et al. [16] has done research on damping in fibre-reinforced composite materials.

Composite damping mechanisms and methodology applicable to damping analysis is described and had presented damping studies involving macromechanical, micromechanical and Viscoelastic approaches. Gibson et al.[17] and Sun et al.[18,19] assumed viscoelasticity to describe the behaviour of material damping of composites. The concept of specific damping capacity (SDC) was adopted in the damped vibration analysis by Adams and his co workers [20-21], Morison [22] and Kinra et al [23].

The concept of damping in terms of strain energy was apparently first introduced by Ungar et.al [24] and was later applied to finite element analysis by Johnson et.al [25]. Gibson et.al [26**]** has developed a technique for measuring material damping in specimens under forced flexural vibration. Suarez et al [27] has used Random and Impulse Techniques for Measurement of Damping in Composite Materials. The random and impulse techniques utilize the frequency-domain transfer function of a material specimen under random and impulsive excitation. Gibson et al [28] used the modal vibration response measurements to characterize, quickly and accurately the mechanical properties of fiber-reinforced composite materials and structures.

Lin et al. [29] predicted SDC in composites under flexural vibration using finite element method based on modal strain energy (MSE) method considering only two interlinear stresses and neglecting transverse stress.

Koo KN et al. [30] studied the effects of transverse shear deformation on the modal loss factors as well as the natural frequencies of composite laminated plates by using the finite element method based on the shear deformable plate theory. SINGH S. P et al. [31] analysed damped free vibrations of composite shells using a first order shear deformation theory in which one assumes a uniform distribution of the transverse shear across the thickness, compensated with a correction factor.

6. METHODOLOGY

Methodology adopted:

CATIA

Is started as an in-house development in 1977 by French aircraft manufacturer AVIONS MARCEL DASSAULT, at that time customer of the CADAM software[1] to develop Dassault's Mirage fighter jet. It was later adopted by the aerospace, automotive, shipbuilding, and other industries. Initially named CATI (*conception assistée tridimensionnelle interactive* – French for *interactive aided three-dimensional design*), it was renamed CATIA in 1981 when Dassault created a subsidiary to develop and sell the software and signed a non-exclusive distribution agreement with IBM.[2] In 1984, the Boeing Company chose CATIA V2 as its main 3D CAD tool, becoming its largest customer.

In 1988, CATIA V3 was ported from mainframe computers to Unix.

In 1990, General Dynamics Electric Boat Corp chose CATIA as its main 3D CAD tool to design the U.S. Navy's Virginia class submarine. Also, Lockheed was selling its CADAM system worldwide through the channel of IBM since 1978. In 1992, CADAM was purchased from IBM, and the next year CATIA CADAM V4 was published.

In 1996, it was ported from one to four Unix operating systems, including IBM AIX, Silicon Graphics IRIX, Sun Microsystems SunOS, and Hewlett-Packard HP-UX.

In 1998, V5 was released and was an entirely rewritten version of CATIA with support for UNIX, Windows NT and Windows XP (since 2001).[3]

In the years prior to 2000, problems caused by incompatibility between versions of CATIA (Version 4 and Version 5) led to $6.1B in additional costs due to years of project delays in production of the Airbus A380.[4]

In 2008, Assault Systems released CATIA V6.[5] While the server can run on Microsoft Windows, Linux or AIX, client support for any operating system other than Microsoft Windows was dropped.[6]

In November 2010, Assault Systems launched CATIA V6R2011x, the latest release of its PLM2.0 platform, while continuing to support and improve its CATIA V5 software. In June 2011, Assault Systems launched V6 R2012.

In 2012, Assault Systems launched V6 2013x.

In 2014, Assault Systems launched 3DEXPERIENCE Platform R2014x [7] and CATIA on the Cloud, a cloud version of its software. [8][9]

7. ANALYSIS RESULTS

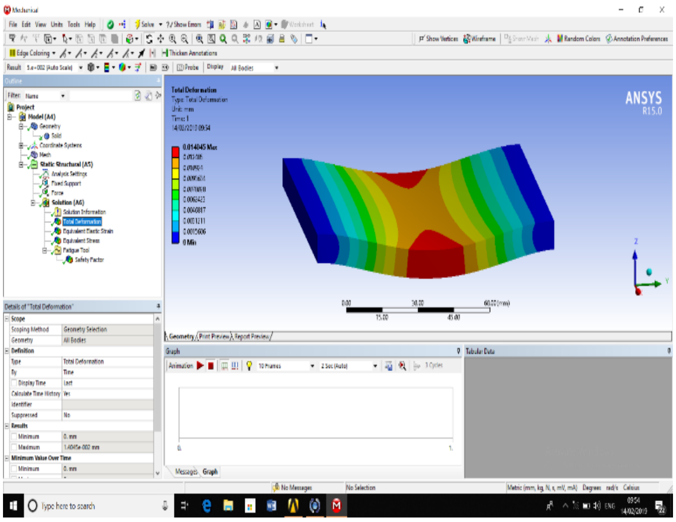

Fig 7.1; Total Deformation

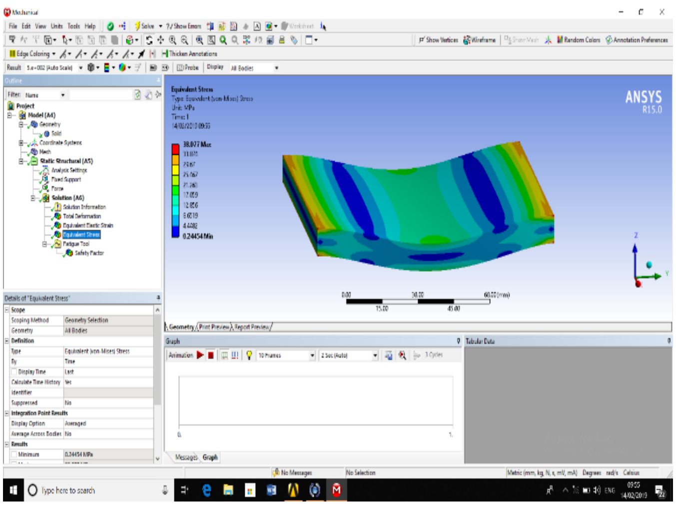

Fig 7.2; Equivalent Stress

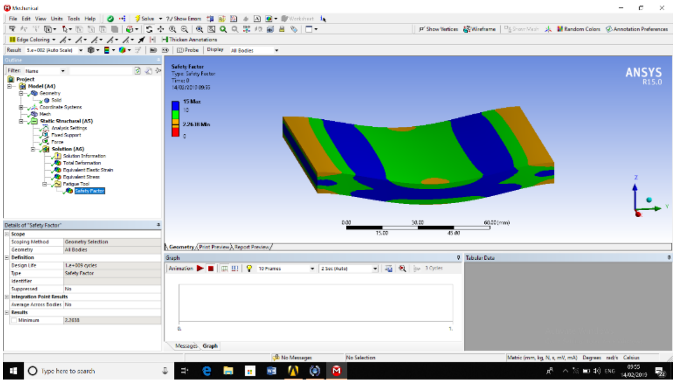

Fig 7.3; Safety Factor

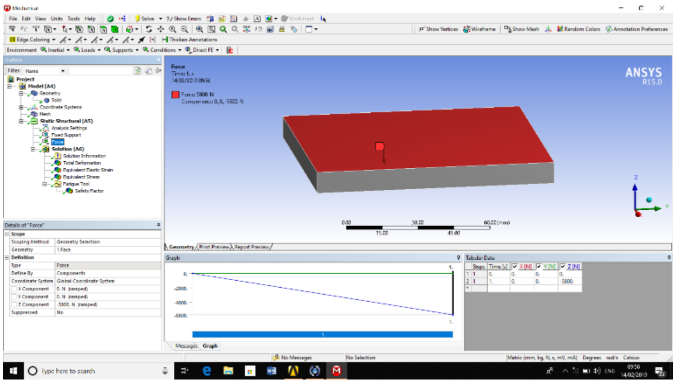

Fig 7.4; Force Analysis

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9. CONCLUSION

In this project we are successfully Design & Analysis the CNC machine cabinet for glass fibre material & reduce the weight of the system & also we develop the safe system from electricity accident.

10. REFERENCES

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