Design And Evaluation of Natural Frequencies of Frameusing FEM

Chakradhar V[1], Maruthi Prasad P[2]
[1, 2] Dept of Mechanical Engg
[1, 2] JNTU

Abstract- *Every physical object has its own frequency of vibration. If the natural frequencies of two bodiesare matched, then they vibrate vigorously leading to structural and mechanical damage of equipment, generally this phenomenon is termed as "Resonance". In this study a sheet metal frame member is designed in CAD software and further FEM analysis is carried out using Solid Works software to find out the first resonating frequency.*

Keywords- Frequency Analysis, Solid Works, Solid Works Simulation, Structural Analysis, FEM

I. INTRODUCTION

The term frequency is generally defined as a reciprocal of time period measured in Hz. In mechanical terminology the term frequency is associated with vibration. [1]Vibration is concerned with the oscillating motion of elastic bodies and the force associated with them. The breakdown of machinery and structures are due to matching up of frequencies. Mathematically frequency(f) of vibration is a function of stiffness of material (K in N/m) and mass (m in Kg).

$$f = (K/m)^{1/2} \ (0.5/\pi) \text{----(1)}$$

While designing, based on the application and usability of product, the productdesign should be ensured that its frequency of vibration doesn't match with the frequency of other products it is surrounded by. For example:[2]Earths natural frequency is 7 Hz, typical diesel engines have a frequencies upto 18 Hz, so the frame units and assemblies that are assembled next to this engine should have a minimum of 23 Hz frequency else there is a greater scope for resonance and the entire systems may fail. To change the frequency of products[3]Dynamic vibration absorber (DVA), also known as tuned mass damper (TMD), has been proven to be a useful device. In this paper frequencies of 3D object (frame) is evaluated by FEM concepts using CAE tools.

II. MODELLING

The Modelling of frame is done in user friendly CAD software Solid Works. In this current research a frame of 300 mm x 480 mm X 180 mm is considered and is shown in Fig.1a.The frame material is considered as aluminium 6061 alloy, a thickness of 2mm is considered for frame material.

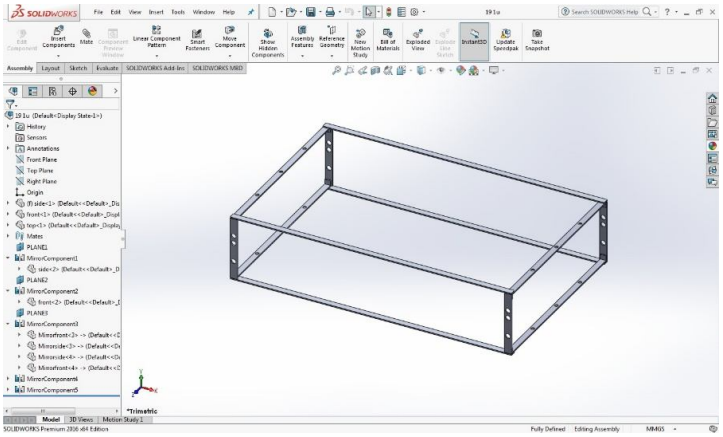

Fig.1a- CAD Model of Frame

III. SIMULATION-FEM ANALYSIS

After successful modelling of frame in solid works , the cad model is exported into the simulation domain of solid works to find out the first resonating frequency of the frame.The following steps are followed in FEM analysis:

Solid Works initial settings and methodology:

- Select frequency in the simulation as shown in Fig 2a.
- Check for the CAD geometry, assign Aluminium 6061 as material to all the frame components in the Simulation.
- Now from Fixtures advisor, select the fixed geometry icon , select the inside face of the six holes provided in the model (Those holes are provided in model so that the frame is fixed in usage by using fasteners)
- The fixtures defining is detailed in fig.2b andfig.2c
- Now using Solid work default mesh parameters discretization/meshing of model is done and is shown in Fig 2d.

- Now run the Simulation and the results get automatically gets loaded in the results column of simulation tree.
- Now right click on results and choose the icon “list frequencies” there by the Solid works lists out the first five resonating frequencies. (listing five frequencies is default option and the analysis here run in default parameters)

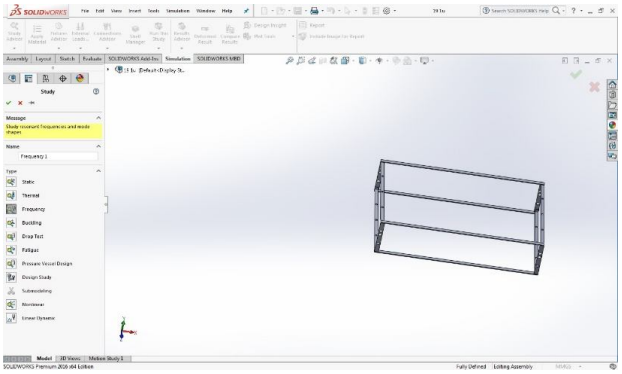

Fig.2a- Selecting Frequency Simulation

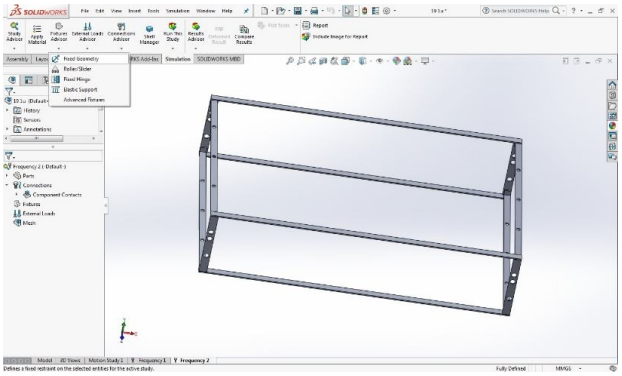

Fig.2b- Defining fixtures

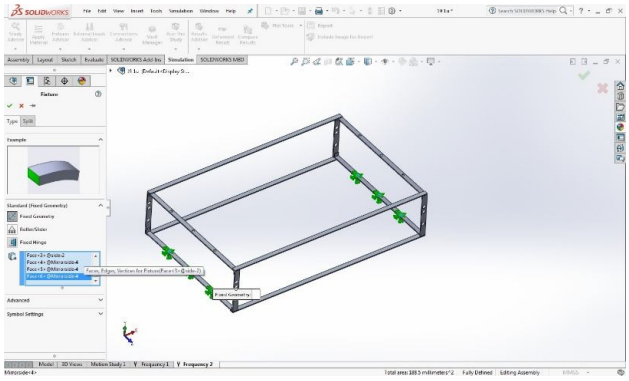

Fig.2c- Defining fixtures

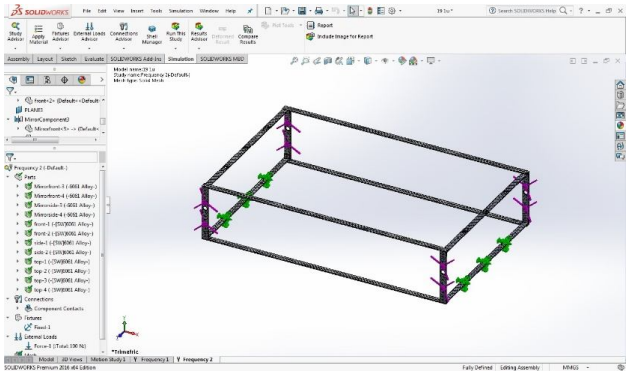

Fig 2 d : Meshing of frame

IV. CONCLUSION

- The frame modellingis done using solid works followed by frequency analysis.
- The first resonating frequency of frame is evaluated using frequency analysis and is found to be 26 Hz.

REFERENCES

[1] http://nptel.ac.in/courses/112103111
[2] https://en.wikipedia.org/wiki/Schumann_resonances
[3] New Design of Vibration Absorber for Periodic Excitation-Shyh-Chin Huang and Kao-An Lin
[4] https://en.wikipedia.org/wiki/Vibration