Fea Simulation for Vibration Control of Shaft System by Magnetic Piezoelectric Control Mount

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Abstract: ***Advanced materials such as carbon fibber, ceramics, composites, and so are increasingly used in modern industry. They make the structure lighter and more rigid. In this work a magnetically mounted adaptive vibration control method is employed. Piezoelectric element. The piezoelectric element is incorporated into a permanent magnet, referred to herein as a control mount. They are attached to the surface of the steel shaft by their magnetic attraction. It is a damping method for control. Vibration generated in the system. Instead of the epoxy being attached to the piezoelectric control base, a magnet is effectively used. For vibration control base. It is effective in 90-99% frequency damping. It reduces amplitude and distortion by 60% effective.***

Keywords: finite element analysis, control device, shaft system, vibration reduction and so on

1. Introduction

Rotating machinery is often used in mechanical systems, including mechanical tools, industrial turbo machinery. And aircraft gas turbine engines. Vibration caused by mass unbalance is a common problem in rotating machinery. If the main inertia axis of the rotor does not coincide with its geometry axis, an imbalance occurs higher speed. Resulting in greater centrifugal imbalance forces and the current trend of rotating the device to higher power. Density significantly results in higher operating speeds. Therefore, vibration control is essential to improve the machine surface. Longer bearing, spindle and tool life in high-speed machining; and reduced quantity. Unscheduled outages in space truss interferometers [1]. The shaft is the most important power transmission element. The drive shaft transfers torque from one position to another. During power transmission, the bearings are torsionally deformed. Due to the transmitted torque and bending from lateral loads (gears, pulleys, rotors, sprockets, etc.). The vibration in the system has great influence on the system performance. It is therefore necessary to control the vibration. Use different techniques. But in this paper, the use of magnetic piezoelectric control bracket. Traditional method Passive vibration control includes the attachment of viscoelastic materials and mechanical vibration absorbers [2]. Piezoelectric materials having the ability to convert mechanical energy into electrical energy and vice versa often used in active and passive vibration control applications. When the piezoelectric material strain, the charge and the energy dissipated when a current flows through the external grid or shunt.

2. Problem Statement

In order to avoid the failure caused by heat and vibration, the control system of the axis of the system. Rotating at 700 rpm with a length of 200 mm, supported by two bearings attached at both left and right ends there of The shaft is subjected to a hammer load of 220 N in the centre, as shown in the following block diagram.

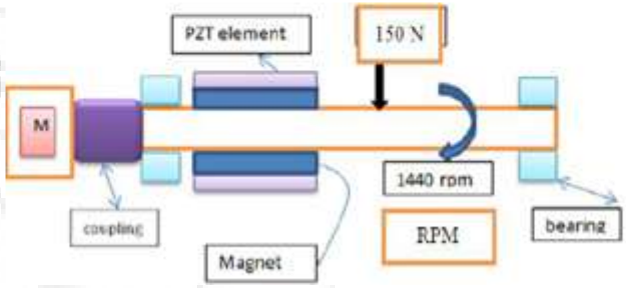


Figure 1: Problem Statement

In this work the system is analysed with and without control mounts by Finite Element Analysis (FEA) technique

2.1 Finite element analysis

FEA works on finite element method techniques, which are obtained by a numerical analysis technique Similar to solve a variety of engineering problems. Because of its diversity and flexibility as an analysis Tools, which have received much attention in engineering schools and industries. In a growing number of engineering solutions today, we find it necessary to obtain an approximate solution to the problem, rather than completely closing the solution.

2.2 The steps used in the analysis:

The FEA works with the help of the following steps, depending on the technique of the finite element method.

1) Pre-processing geometry creation, material property selection and model meshing.
2) Solution - deal with boundary conditions and solve it.
3) Post processing - Get results.
4) Analytical methods used Modal analysis and Harmonic analysis

2.3 Modal analysis

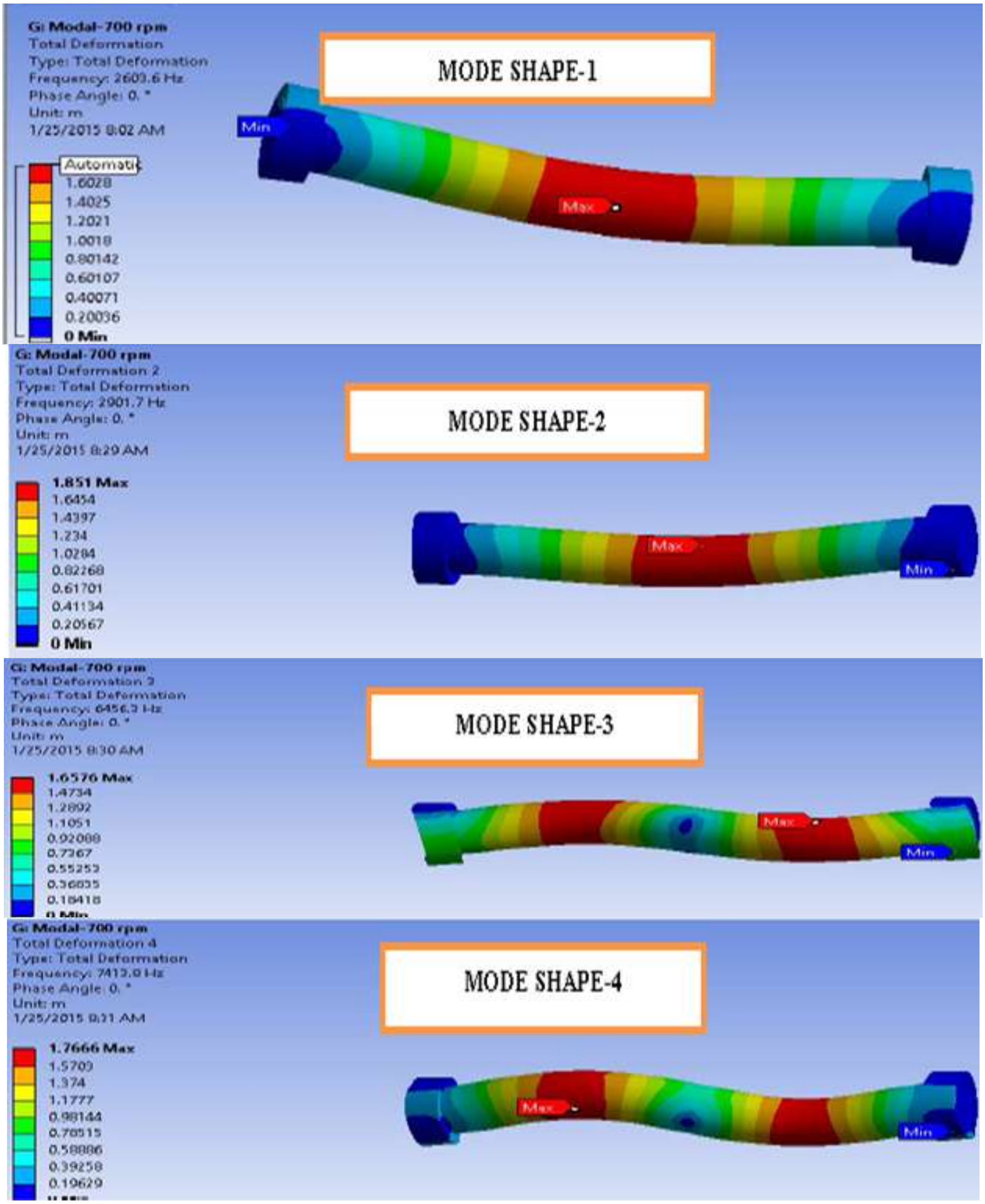
It is used to determine the vibration characteristics, that is, the natural frequency and modal shape of the structure or machine Component. These two parameters are important in the design of the structure under load condition.

2.4 Harmonic analysis

It is used to determine the frequency response and phase response sinusoidal curves with external loads. Through the use of this system. The frequency is calculated to avoid resonance. The given system is analyzed for different rpm conditions.

A) Analysis without control installation
In this shaft, the shaft rotates at 700 rpm and is subjected to a 150N load supported by two bearings. Shaft material for SS- 202.

1. Modal analysis: In this analysis method, the natural frequency and modal shape are calculated. It has a high frequency. Mode Shapes Shows the maximum deformation in the axis.



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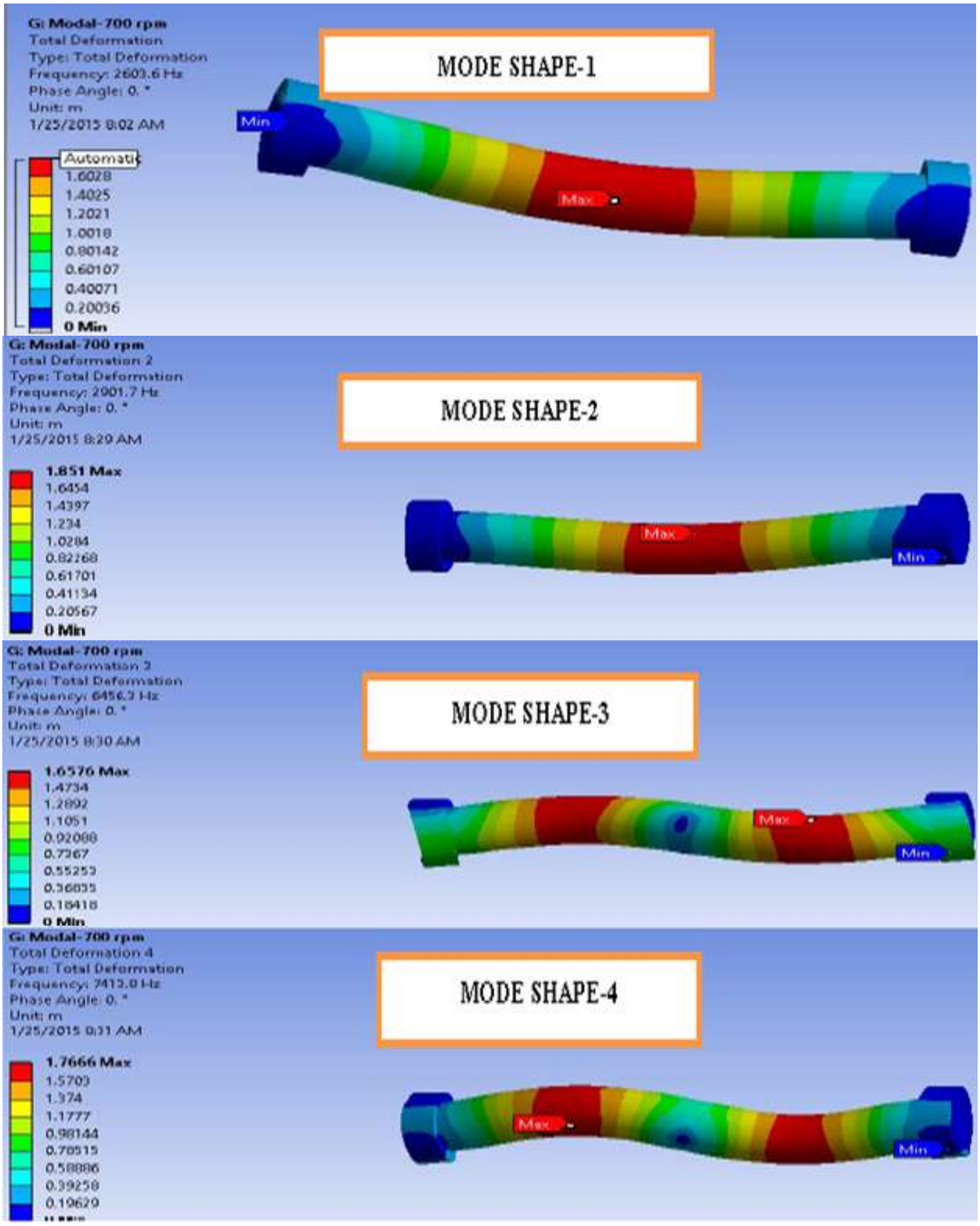

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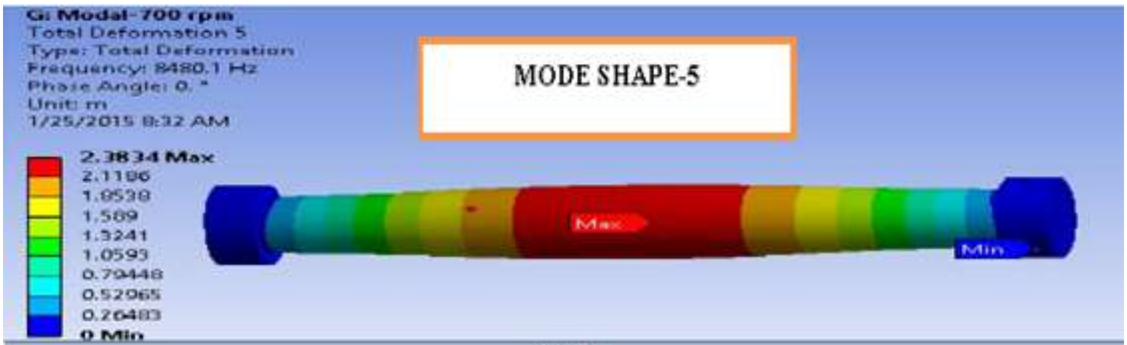


Results					
Minimum	0. m				
Maximum	1.8032 m	1.851 m	1.6576 m	1.7666 m	2.3834 m
Minimum Occurs On	Part 2				
Maximum Occurs On	Part 1				
Information					
Reported Frequency	2603.6 Hz	2901.7 Hz	6456.3 Hz	7413.8 Hz	8480.1 Hz

Figure 1: Mode shapes and frequency result by FEA without control mount

2) Harmonic response analysis: The figure shows the harmonic response of the 150 N load. It produces significant. As the vibration frequency is high.

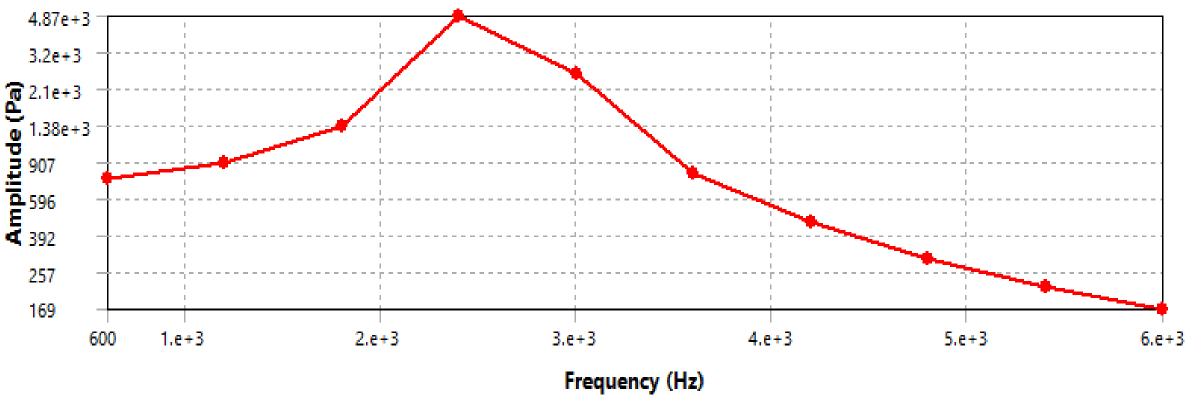
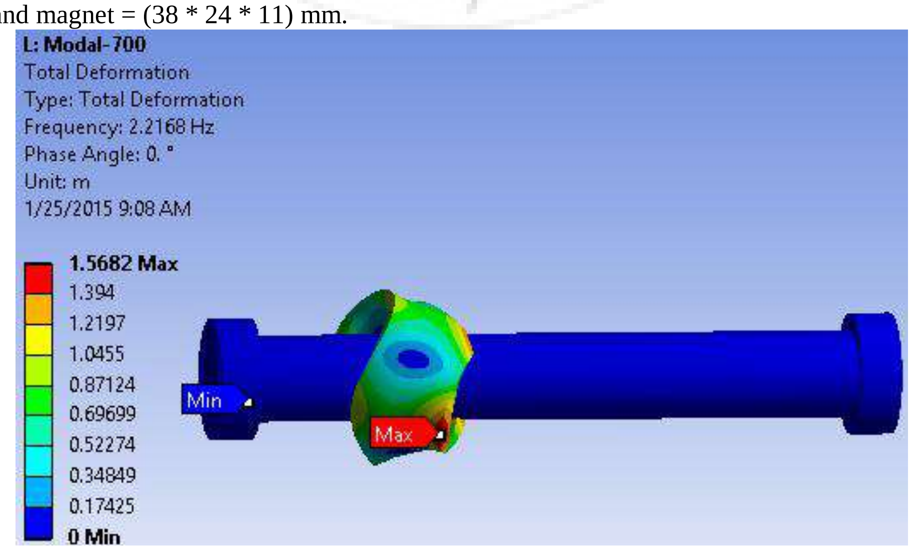
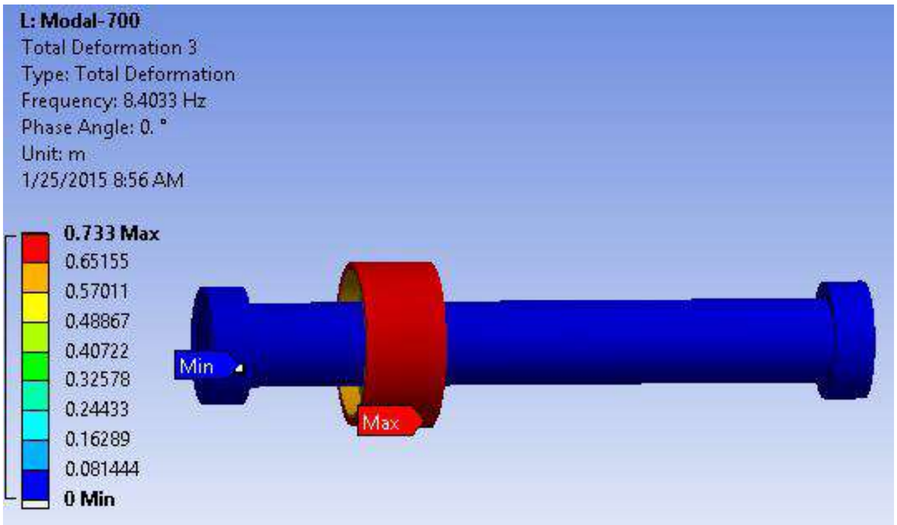


Figure 2: Frequency at harmonic response with load by FEA without control mounts

B] Analysis with Control Installation: Geometry was created in Pro-E 5.0 and then imported in ANSYS. Magnetic Piezoelectric control blocks for vibration control have become very effective and successful Dimensions, PZT = (44 * 38 * 24) mm and magnet = (38 * 24 * 11) mm.



1) Modal analysis: In this analysis method, the natural frequencies and modal shapes are calculated. It has less Frequency and deformation. The mode shape shows that the zero deformation in the axis is absorbed Control the base.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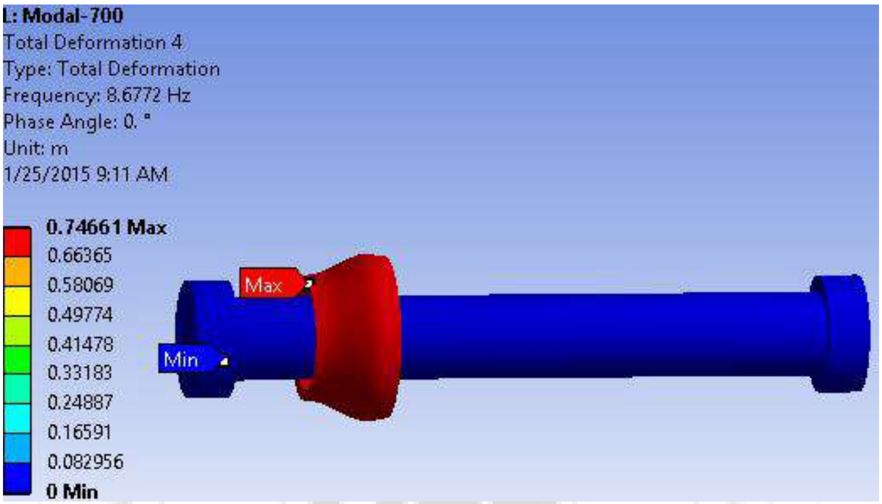
Total Deformation 3
Type: Total Deformation
Frequency: 8.4033 Hz
Phase Angle: 0. °
Unit: m
1/25/2015 8:56 AM
0.733 Max
0.65155
0.57011
0.48867
0.40722
0.32578
0.24433
0.16289
0.081444
0 Min
Min
Max


L: Modal-700
Total Deformation 4
Type: Total Deformation
Frequency: 8.6772 Hz
Phase Angle: 0. °
Unit: m
1/25/2015 9:11 AM
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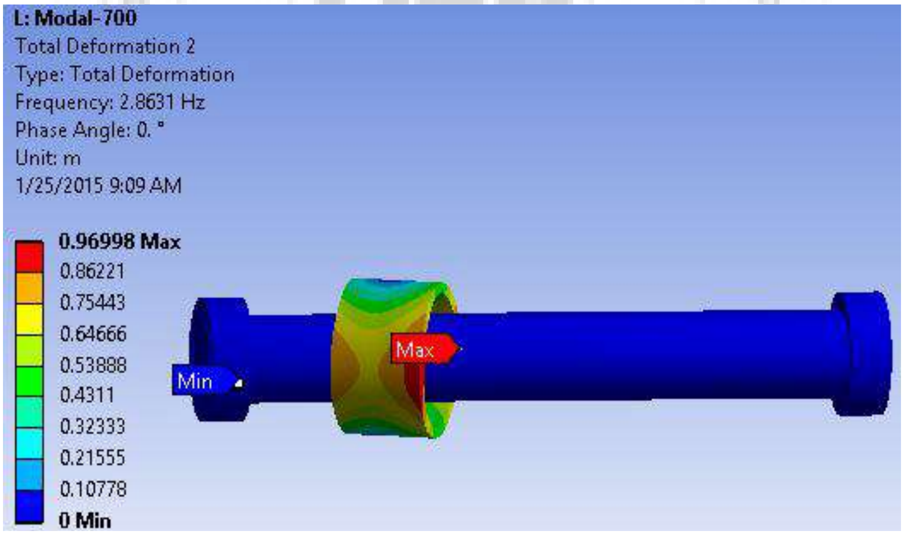
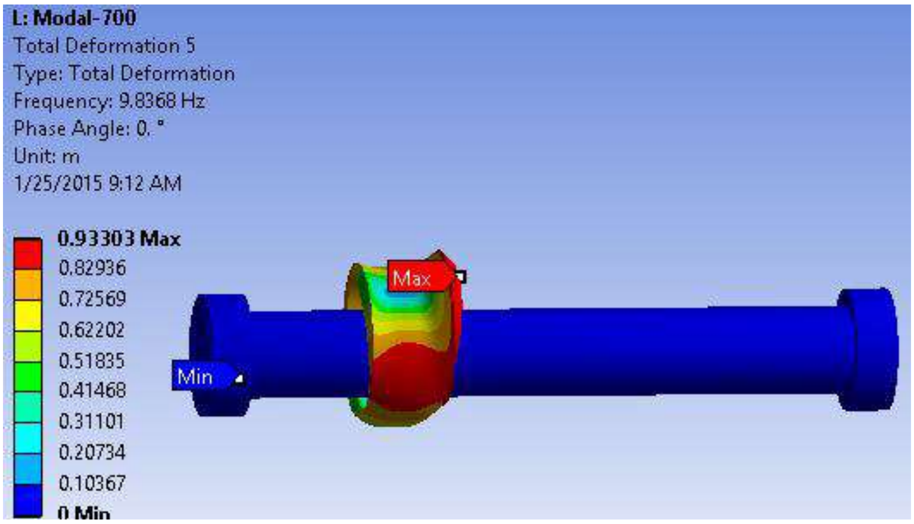
0.66365
0.58069
0.49774
0.41478
0.33183
0.24887
0.16591
0.082956
0 Min
Max
Min


L: Modal-700
Total Deformation 2
Type: Total Deformation
Frequency: 2.8631 Hz
Phase Angle: 0. °
Unit: m
1/25/2015 9:09 AM
0.96998 Max
0.86221
0.75443
0.64666
0.53888
0.4311
0.32333
0.21555
0.10778
0 Min
Max
Min



Results					
Minimum	0. m				
Maximum	1.5682 m	0.96998 m	0.733 m	0.74661 m	0.93303 m
Minimum Occurs On	Part 2				
Maximum Occurs On	Part 5				
Information					
Reported Frequency	2.2168 Hz	2.8631 Hz	8.4033 Hz	8.6772 Hz	9.8368 Hz

2) Harmonic Response Analysis: it shows damped frequency and low amplitude due to control mount when it is subjected to load.

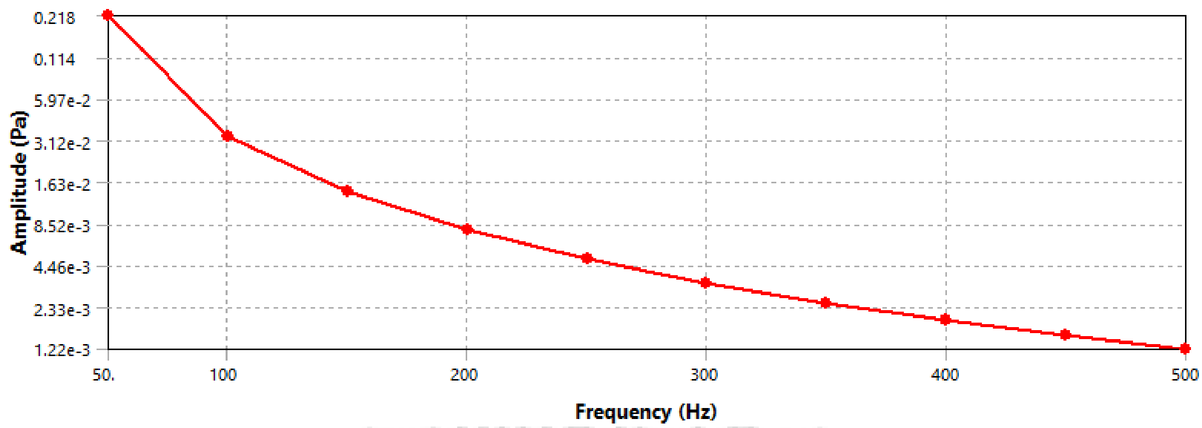


Figure 4: Frequency at harmonic response with load by FEA with control mounts

3. Conclusion

In this case, the control base has successfully attenuated the vibration. It is very good, highly economical shock absorber. There is no control to install the natural frequency is 2000-9000 Hz, while with the control installed it is very little 2-9 hertz. Therefore Control installation reduces efficiency by 99%. Due to control installation deformation is less than 60% efficiency. The range was also reduced due to 98% control installation. So the installation of magnetic piezoelectric control is very good. A shock absorber, a controller and an absorber.

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