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Vibration Analysis And Optimization Of Housing For Ecu In Automobile Using Fea

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Abstract

Electronic Control Unit housings are subjected to various harmonic vibration loads generated by engine at various RPM levels. Encounter of resonant frequencies of housing in specified frequency range can cause damage to PCB enclosed within housing. Vertical vibration/excitation levels are dominant which cause bending moments in PCB and housing. Basic design of housing will be done using CATIA. Finite Element Analysis shall be used to design and optimum housing which will sustain harmonic loads coming from engine vibrations. Modal & Harmonic analysis will be used to investigate mode shape and response of enclosure at specified frequency ranges. Modal analysis result using FEA will be compared with modified model of ecu.

***Keywords**:- ECU, FEA, MODAL& HARMONIC ANALYSIS, CATIA,PCB*

1 .INTRODUCTION

The electronic control unit (ECU) used in today's cars and trucks is used to control the engine and other components' functions. An ECU is a computer with internal pre -programmed and programmable computer chips that is not much different from a home computer or laptop. The vehicle's engine computer ECU is used to operate the engine by using input sensors and output components to control all engine functions.The ECU needs inputs from vehicle sensors like the crankshaft sensor and camshaft sensors to compute the information using a program that has been stored in the ECU on a programmable memory chip. The ECU program will use the inputted sensor information to compute the needed output like the amount of fuel injected and when to spark the coil in order to start the engine.There are different ECUs used for different systems on the vehicle. The different ECUs used can be for the transmission, trac tion control or ABS, AC, body functions and lighting control, engine, air bags, or any other system a vehicle may have. Some vehicles may incorporate more than one ECU into a single unit called a power train control module (PCM). These units can be an advantage by having more modules in one location but may be a disadvantage by adding longer wires to reach the component it operates.

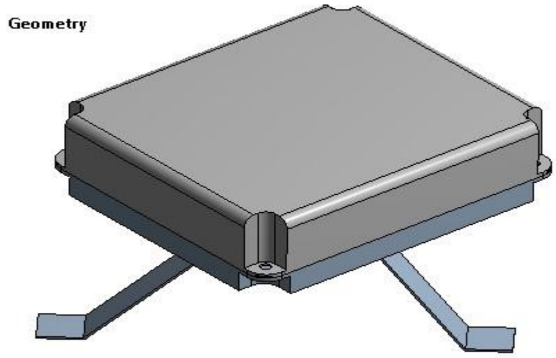

Fig. CATIA model of ECU without stiffeners

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2. ANALYSIS

The finite element method (FEM), is a numerical method for solving problems of engineering and mathematical physics. Typical problem areas of interest include structural analysis, heat transfer, fluid flow, mass transport, and electromagnetic potential. The analytical solution of these problems generally require the solution to boundary value problems for partial differential equations. The finite element method formulation of the problem results in a system of . FEM then uses variation methods from the calculus of variations to approximate a solution by minimizing an associated error function.

Properties of Outline Row 3: Aluminum Alloy

	A	B	C
1	Property	Value	Unit
2	Material Field Variables	Table	
3	Density	2770	kg m^-3
4	Isotropic Secant Coefficient of Thermal Expansion		
5	Coefficient of Thermal Expansion	2.3E-05	C^-1
6	Isotropic Elasticity		
7	Derive from	Young's Modulu...	
8	Young's Modulus	7.1E+10	Pa
9	Poisson's Ratio	0.33	
10	Bulk Modulus	6.9608E+10	Pa
11	Shear Modulus	2.6692E+10	Pa

Fig. Material properties

MESH:- ANSYS Meshing is a general-purpose, intelligent, automated high-performance product. It produces the most appropriate mesh for accurate, efficient Multiphysics solutions. A mesh well suited for a specific analysis can be generated with a single mouse click for all parts in a model. Full controls over the options used to generate the mesh are available for the expert user who wants to fine-tune it. The power of parallel processing is automatically used to reduce the time you have to wait for mesh generation. ANSYS Meshing chooses the most appropriate options based on the analysis type and the geometry of the model. Especially convenient is the ability of ANSYS Meshing to automatically take advantage of the available cores in the computer to use parallel processing and thus significantly reduce the time to create a mesh. Parallel meshing is available without any additional cost or license requirements.

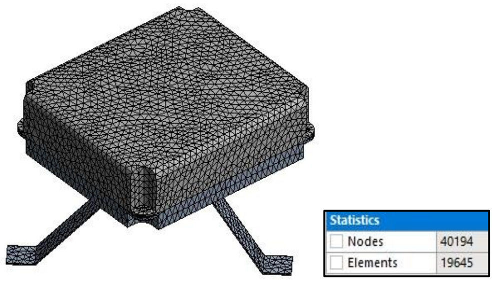

Fig. Meshing of ECU without stiffener

BOUNDARY CONDITION:- A boundary condition for the model is the setting of a known value for a displacement or an associated load. For a particular node you can set either the load or the displacement but not both.The main types of loading available in FEA include force, pressure and temperature. These can be applied to points, surfaces, edges, nodes and elements or remotely offset from a feature. The way that the model is constrained can significantly affect the results and requires special consideration.

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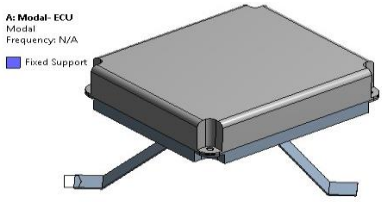

Fig. Boundary condition of ECU without stiffeners

MODAL ANALYSIS:- Modal analysis is the study of the dynamic properties of systems in the frequency domain. Examples would include measuring the vibration of a car's body when it is attached to a shaker, or the noise pattern in a room when excited by a loudspeaker.

1)MODAL ANALYSIS OF ECU WITHOUT STIFFENERS

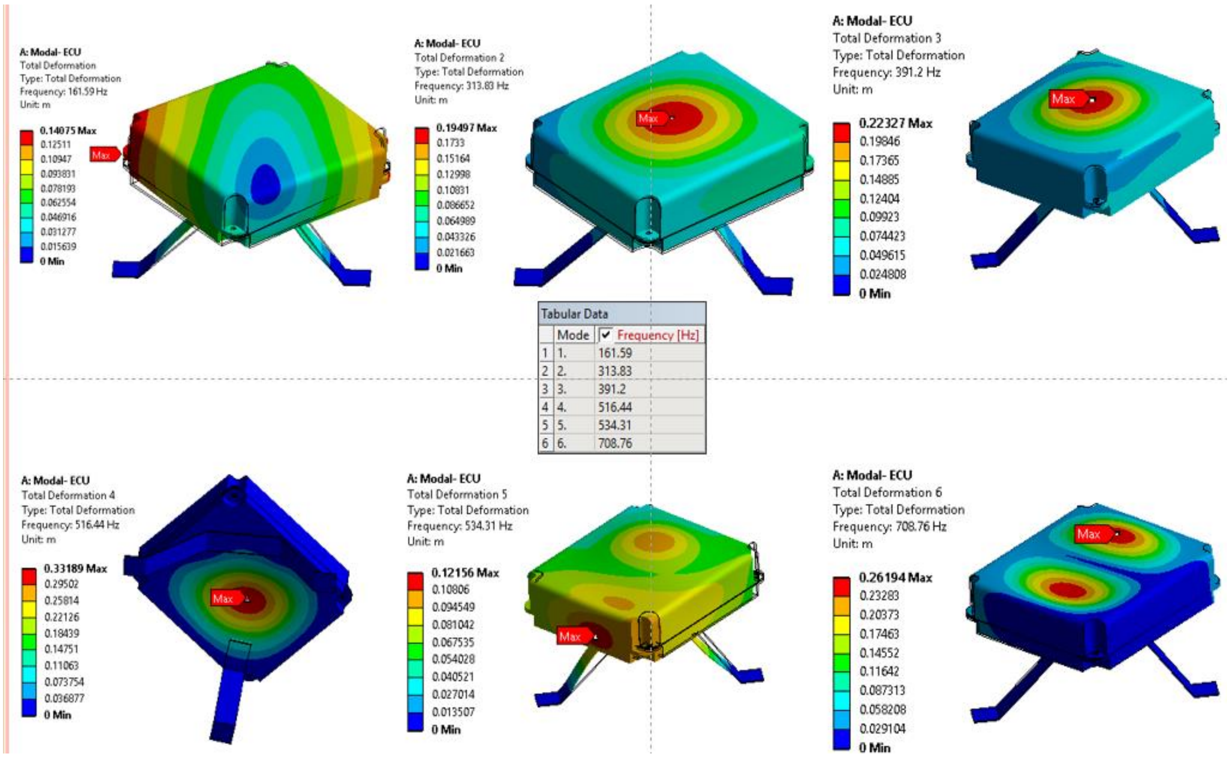

Fig Modal analysis of ecu without stiffeners

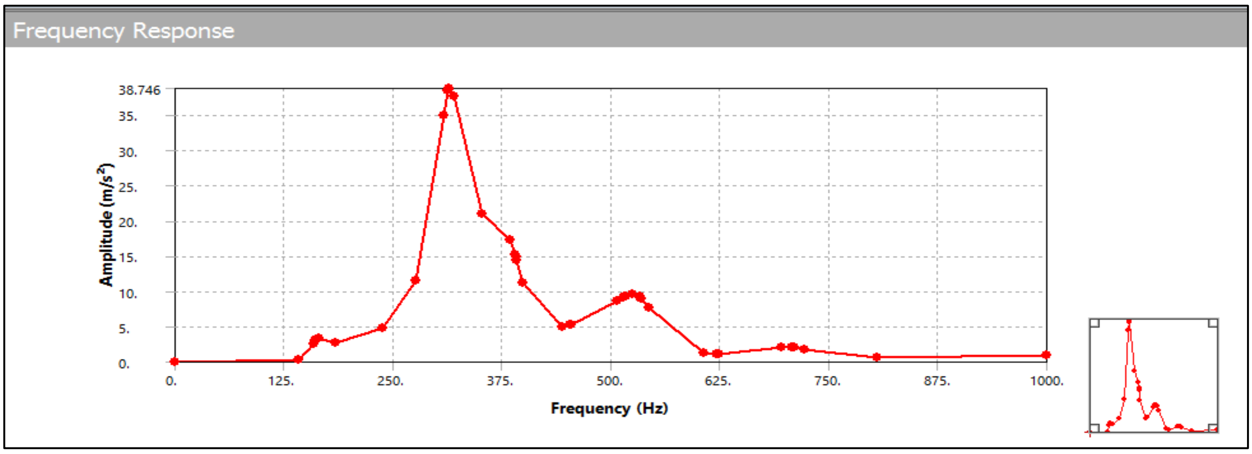

Fig Harmonic Response curve of ecu without stiffeners

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2)MODAL ANALYSIS OF ECU AFTER ADDITION OF STIFFENERS

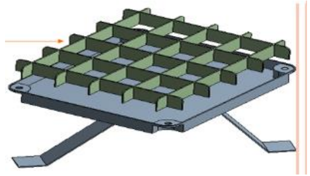
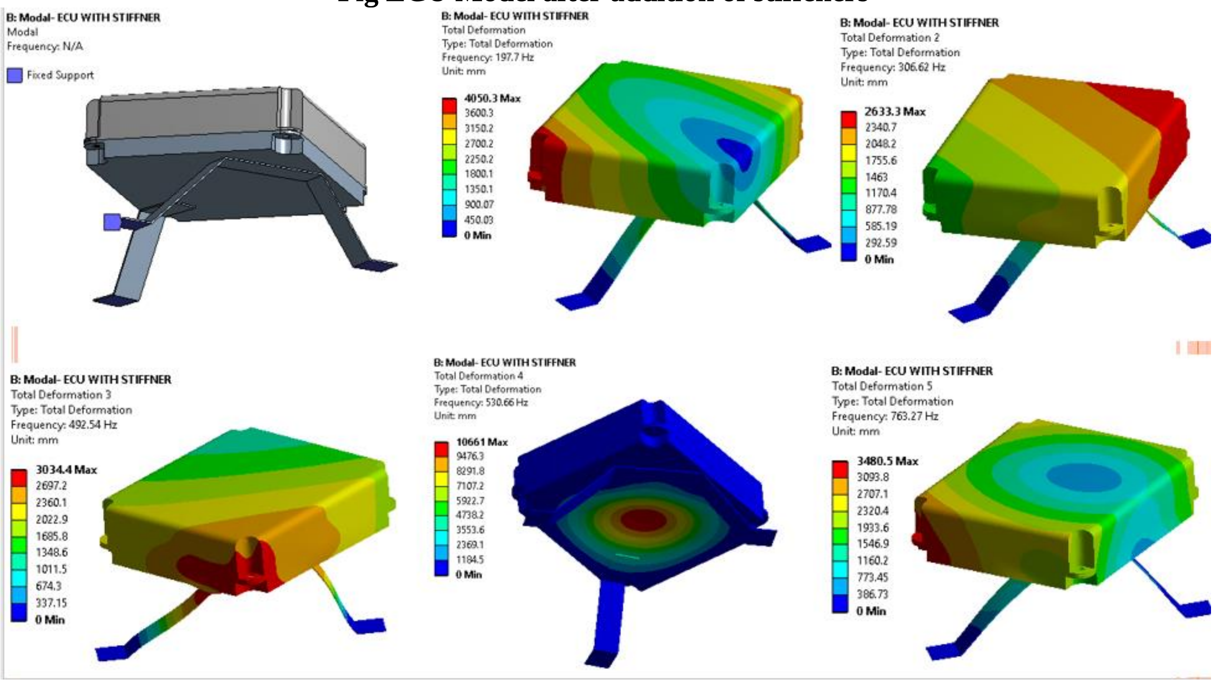


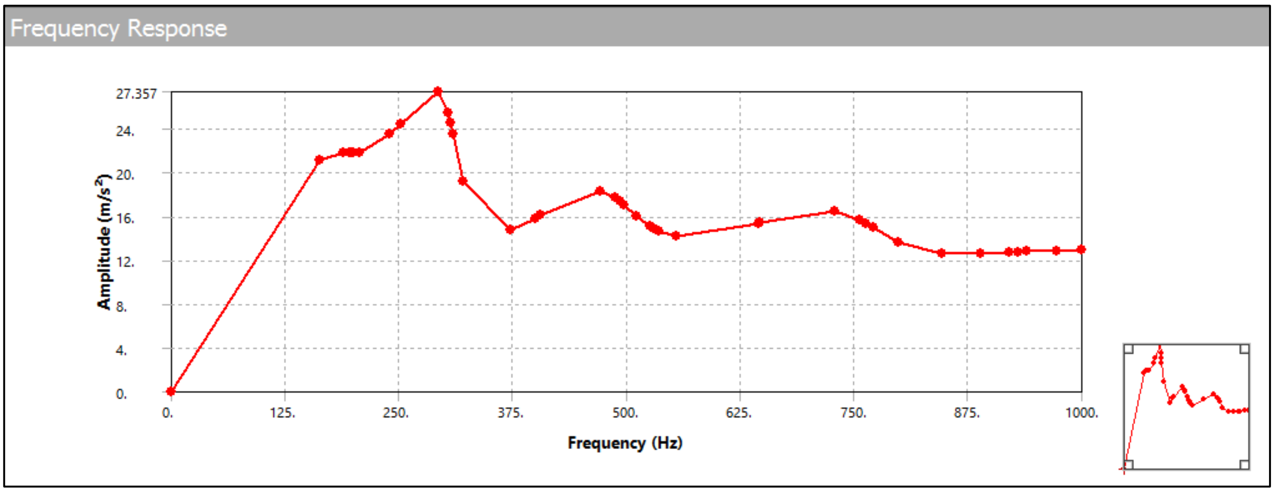
Fig ECU Model after addition of stiffeners



Tabular Data

	Mode	Frequency [Hz]
1	1.	197.7
2	2.	306.62
3	3.	492.54
4	4.	530.66
5	5.	763.27
6	6.	930.05

Fig Modal analysis of ecu after addition of stiffeners



3)COMPARISON OF MODAL ANALYSIS OF ECU WITH AND WITHOUT STIFFENERS

Tabular Data

	Mode	Frequency [Hz]
1	1.	161.59
2	2.	313.83
3	3.	391.2
4	4.	516.44
5	5.	534.31
6	6.	708.76

WITHOUT STIFFERERS

Tabular Data

	Mode	Frequency [Hz]
1	1.	197.7
2	2.	306.62
3	3.	492.54
4	4.	530.66
5	5.	763.27
6	6.	930.05

WITH STIFFERENS

3.CONCLUSION

IT IS OBSERVED FROM MODAL ANALYSIS RESULTS THAT ADDITION OF STIFFENER TO EXISTING ECU HAVE IMPROVED NATURAL FREQUENCY.

REFERENCES

1. Muti-objective topology optimization of an electric vehicle’s traction battery enclosure WANG Lu, CHEN Xiao-kai, ZHAO Qing-hai.
2. Design and Optimization of Sheet Metal Enclosure with the Help of Behaviour Modelling Niteen T. Kakade1, Pro.D.G.Gangwani.
3. Analysis of Enclosures and Anti Vibration Devices for Electronic Equipment for Space Applications G.S. Aglietti, and C. Schwingshack.
4. DESIGN OPTIMIZATION OF ARMY RADAR FRAME (ARF) FOR THERMAL AND STRUCTURAL CONDITIONSBikesh Kumar and Damodar Reddy.
5. Sensitivity analysis and optimization of sheet steel thickness for vibroacoustic behavior of enclosures Titouan Fourmaux, Morvan Ouisse, Scott Cogan, Emeline Sadoulet-Reboul.
6. INTERIOR SOUND AND VIBRATION CONTROL FOR AIR VEHICLE APPLICATIONS Li Cheng.
7. DESIGN AND OPTIMIZATION OF AN ANTENNA FRAME FOR THEMAL AND STRUCTURAL CONDITIONS Prudhvi Krishna Amburi and K Sreenivas.

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