International Journal For Technological Research In Engineering
Volume 4, Issue 6, February-2017 *ISSN (Online): 2347 - 4718*

NUMERICAL MODAL AND IMPACT ANALYSIS OF AEROSPACE COMPONENT

Girish Kadam E[1], Dr. Maruthi B H[2], Dr. Channakeshavalu K[3]
M.Tech scholar[1], Department of Mechanical Engineering, EWIT Bangalore, India
Professorr[2,3], Department of Mechanical Engineering, EWIT, Bangalore, India

Abstract: The performance of an optical system requires stringent control of dimensional stability, geometrical positioning, pointing accuracies, and optical surface deformations of the mirror assembly against load transfer effects. The loads that influence the mirror performance may be manufacturing process of the mirror and mount, assembly and interface loads, static pre-loads, dynamic launch loads, gravity release effects, in orbit thermal and other environmental loads. The Need for stringent and robust structure to hold the lens is calling too many research and innovations. This paper gives the detail of one such analysis which gives the insight of lens holding structure or lens mount. How it behaves for different loading conditions. Softwares like MSC Patran and MSC Nastran are used for the analyses. Static (1'g' along Y), Modal and Dynamic (Frequency response and Random) analysis are performed on the structure to study its behavior for various loads. Optimization is carried out in the initial stage to reduce the weight without compromising the stiffness of the structure. Stress and displacements for static analysis, Natural frequencies and Mode shape for Modal analysis; Stress and Amplification for frequency response analysis, Stress response for random analysis are observed and reported.
Keywords: Aerospace Component, Free Free Modal Analysis, Dynamic Analysis, Optimization.

I. INTRODUCTION

The AEROSPACE COMPONENT is one of the protection methods, which used to avoid the low speed accidents. It is placed in front or rear aerospace component body or other vehicles. Automobile AEROSPACE COMPONENTs are designed to observe the energy during front and rear impact of aerospace component such way that we can select best materials and geometry it should possess the above two requirements with minimum price. AEROSPACE COMPONENTs are not able to avoid fractures at high speed it applicable only minimum speed Ranges (300-500 km/s). It is able prevents injury to passengers at low speed as well as design to protect the hood, fuel tank, exhaust and cooling system, trunk, grille ,headlamps etc. in low speed. The low speed front impact usually deforms the front AEROSPACE COMPONENT, which absorb most energy when vehicle struck from front end. Since the impact speed of striking vehicle is very low, virtually no energy transferred to the passengers of struck vehicle. At high speed front impact of aerospace component may cause injury to passengers and damages to vehicle. The front impact are conducted by taking 100 % overlap (100 % of width of widest part of the vehicle is considered).The AEROSPACE COMPONENT standards are provided by National highway traffic safety administration (NHTSA) that produces AEROSPACE COMPONENT standard to light passenger automobile vehicles. The AEROSPACE COMPONENT standards are applicable to performance requirement of passenger vehicles at low speed rear and front accidents.

Literature related to exhaust muffler is as follows: Pradeep Kumar Uddandapu, He had analysis on, Plastic and composite materials used for aerospace component AEROSPACE COMPONENT, for impact analysis with different speeds by using analysis software. He studied the construction, materials hired for aerospace component AEROSPACE COMPONENT; study includes effective variables like material, construction, geometry and impact situations, for improving effectiveness of AEROSPACE COMPONENT in energy absorption. Author aerospace component tried out simulation and modelling through Solid works, impact analysis done at the rate of 13.3m/s (48km/h). AalenJohn and Nidhi M.B, both are conducted experiment and Analysis on low passenger Locomotive AEROSPACE COMPONENT. The model was created using modelling software. Impact and static Analysis done through ABQUS 6.10, the same model modal analysis under dynamic loading is done through ANSYS workbench. The different types of materials are used for these analyses like Aluminium B390, Chromium coated mild steel and aerospace components. Emil Evina et.al, She and her teammates are studied, Evaluation of deflection properties of steel sheet for aerospace component body parts. Steel available at different composition hence all steels have different deformation properties. Deformation or other properties we can't guess by directly seeing physical property of steel hence to use experimental results to study the properties of materials. Mechanical properties of steel is depending on hardening mechanism. If work hardening is more, the strain rate is increased and all molecules are single layered hence material become harder. Work hardening and strain hardening steel showed result that is more significant and it has single phase, micro alloyed and drawing quality. During the accidents shock or kinetic energy is produced in ordered absorb energy hydraulic or Pneumatic shock absorber is provided but this shock absorber works only one direction hence it is not capable to absorb to all energy. Alternative solution is discovered that shock absorber replaced by steel sheets.

II. OBJECTIVES OF THE WORK

- To collect data related to project.

- Do the experimental modal analysis of AEROSPACE COMPONENT and find out Natural frequency, mode shapes and damping ratio.
- Create AEROSPACE COMPONENT model by using modelling software.
- Then it is imported Altair hyper mesh and mesh the model, Solve through using optistructs solver.
- Then validate the Experimental results with numerical results.
- Natural frequency of AEROSPACE COMPONENT increased by adding the stiffener to AEROSPACE COMPONENT.
- To conduct impact test for front AEROSPACE COMPONENT taking 100 % overlap.
- The AEROSPACE COMPONENT model is imported to ANSYS LS-DYNA workbench, to determine the deformations and acceleration with respect to time.

III. METHODOLOGY

MODELING

The modeling of the exhaust was done using CATIA V5. The fig.1 shows the Catia V5 model of aerospace component.

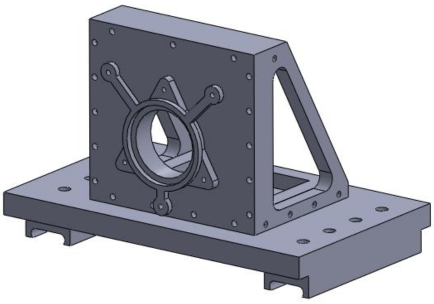

Fig 1 CATIA model of aerospace component

Finite Element Method

The Finite Element Method (FEM) is a numerical technique used to determine the approximated solution for a partial differential equations (PDE) on a defined domain (W). The complex problems can be solved easily. In this method of analysis, a complex regions is discretized into simple geometric shapes called elements. Finite Elements of exhaust muffler is meshed by using linear first-order (3-or-4-noded) shell element at part mid surface and meshing is done using Altair HYPERWORKS pre processor. Mesh model consists of 36532 elements and 50810 nodes.

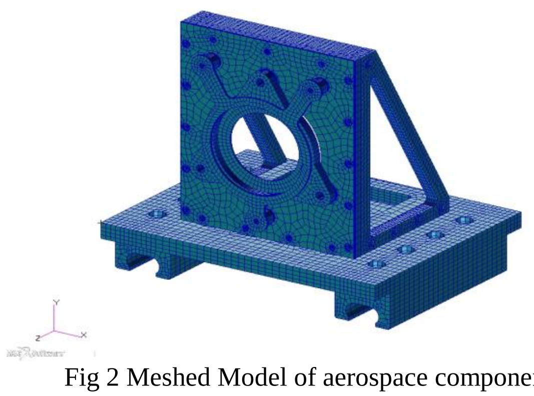

Fig 2 Meshed Model of aerospace component

Material Selection
Material Used- STEEL
ALUMINIUM

Table 1. Material Properties of Steel

PROPERTIES	VALUE		
YOUNG's MODULUS[E]	2.1E5N/mm^2		
POISSON's RATIO	.3		
DENSITY [RHO]	7.9E-09Tonne/mm^3		
MASS[M]	2.69E-3 Tonne		

Table 2. Material Properties of Aluminium

PROPERTIES	VALUE
YOUNG's MODULUS[E]	6.5E4N/mm^2
POISSON's RATIO	.3
DENSITY [RHO]	7.9E-09Tonne/mm^3
MASS[M]	1.393E-3Tonne

Boundary Conditions

Free Free Analysis

The material properties of the material are updated to the software, no constrains and no loads. The muffler is analyzed freely to obtain the results.

Fixed Free Analysis

The assumption is that there is no bending moment at the free end.

IV. RESULTS AND DISCUSSION

Analysis is done using MSC NASTRAN and the results obtained from FEM are compared.

A. CASE 1

Steel Material

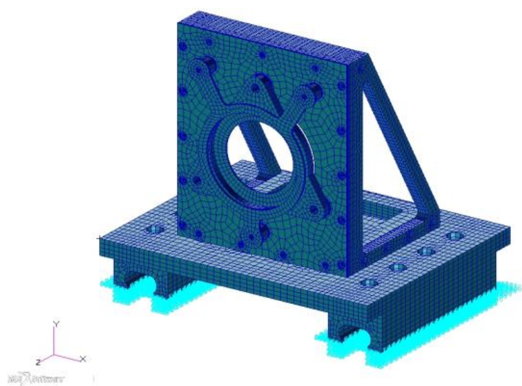

Fig 3. Meshed Model for steel component

FEM Results

Numerical Results

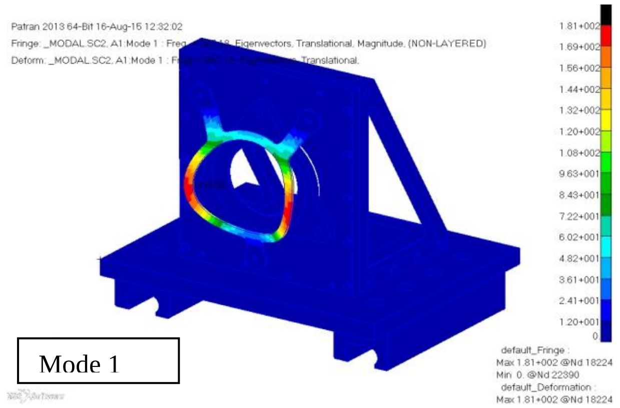

Fig 4 Mode 1 obtained from FEM method

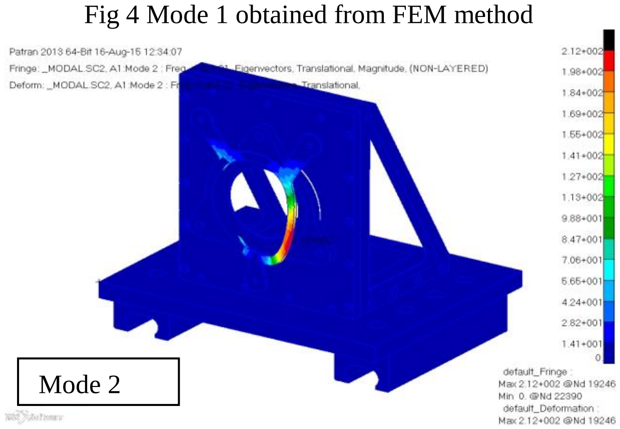

Fig 5 Mode 2 obtained from FEM method

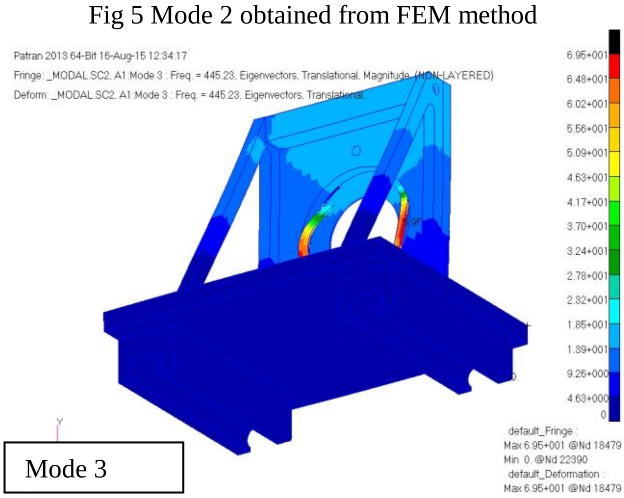

Fig 6. Mode 3 obtained from FEM method

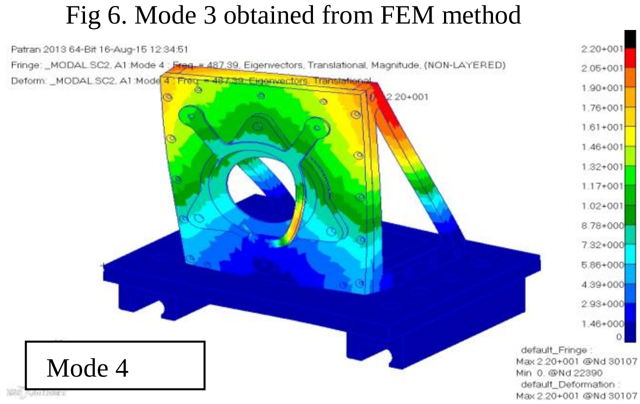

Fig 7. Mode 4 obtained from FEM method

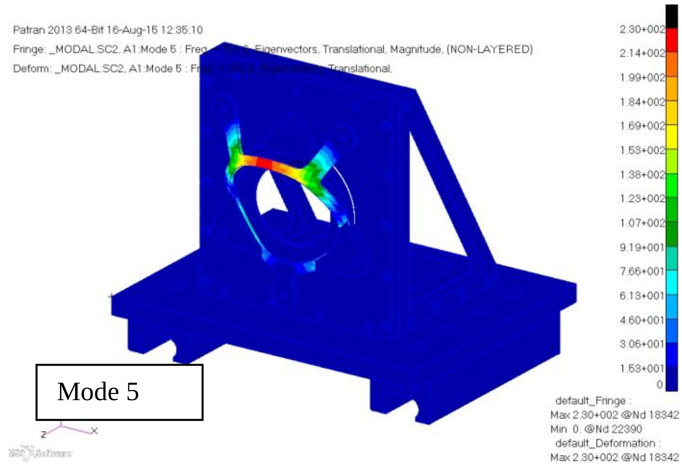

Fig 8. Mode 5 obtained from FEM method

Static Results

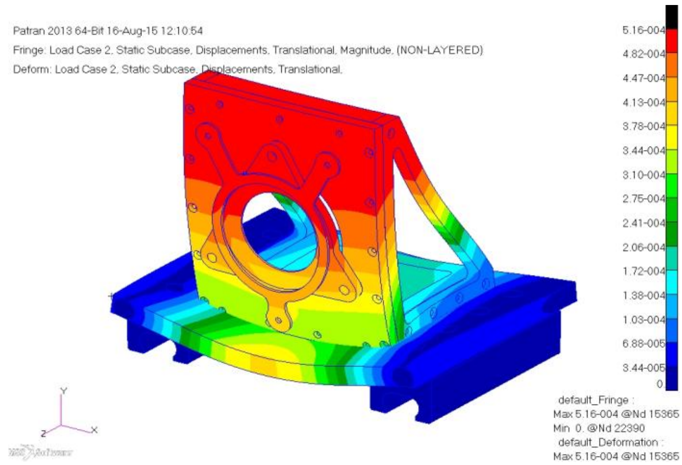

Fig 9. Mode of displacement for steel component

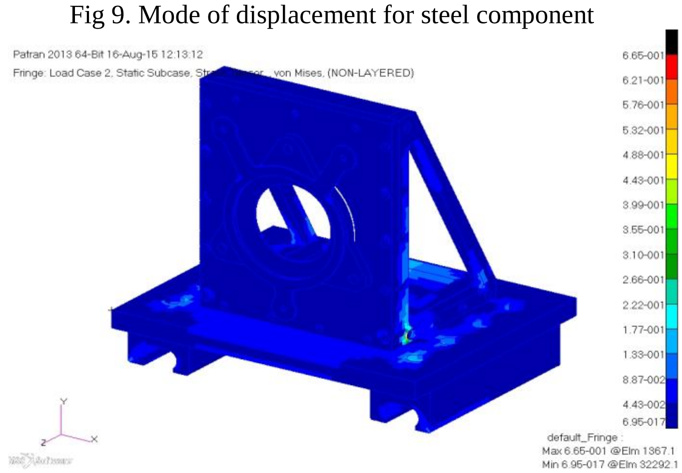

Fig 10. Mode of stress for steel component

Table 2. Comparison of results using FEM

MODE NUMBER	FEM (Hz)
1	387.18
2	401.21
3	445.23

4	487.39
5	731.6

B. CASE 2
Aluminium Material

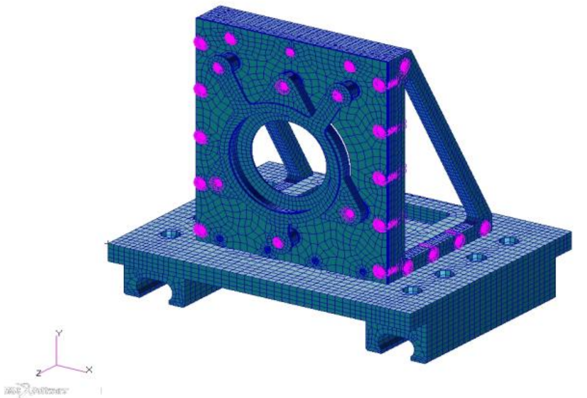

Fig 13. Shows the Aluminium plate added on the base of the component

FEM Results
Numerical Results

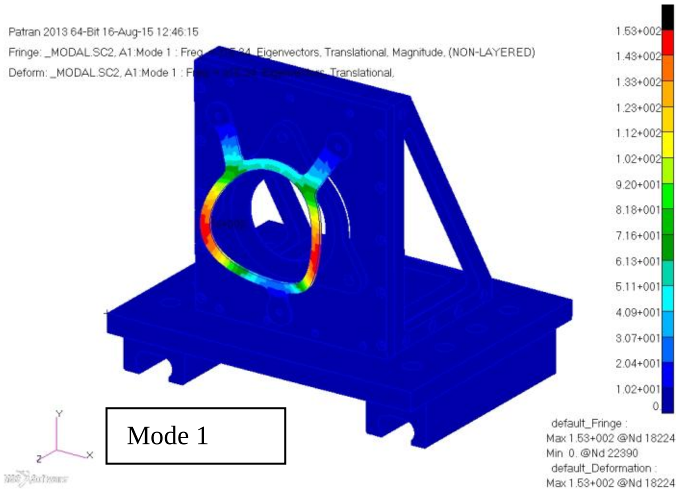

Fig 14. Mode 1 for Aluminium component

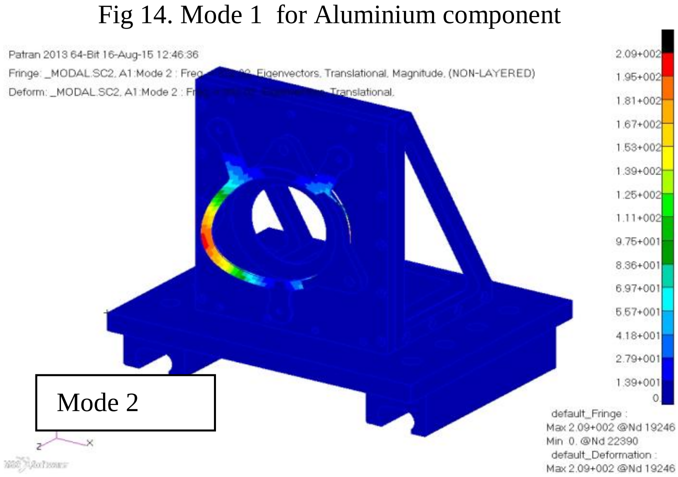

Fig 15. Mode 2 for Aluminium component

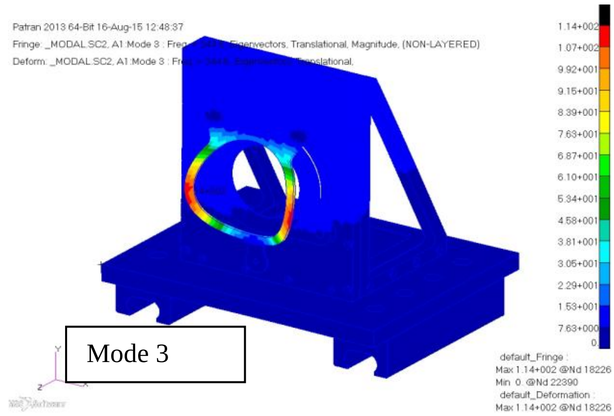

Fig 16. Mode 3 for Aluminium component

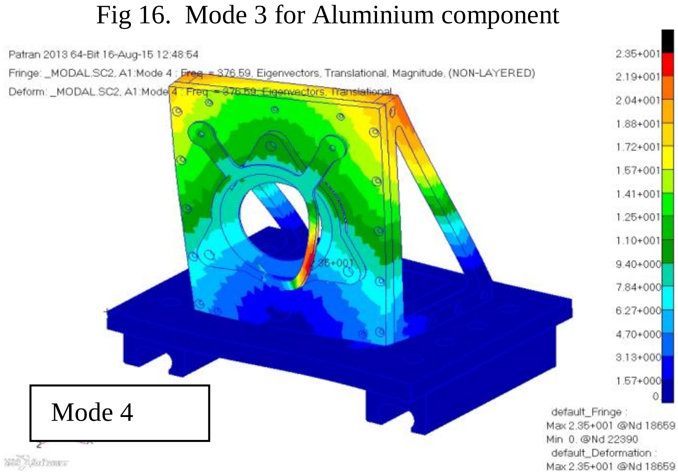

Fig 17. Mode 4 for Aluminium component

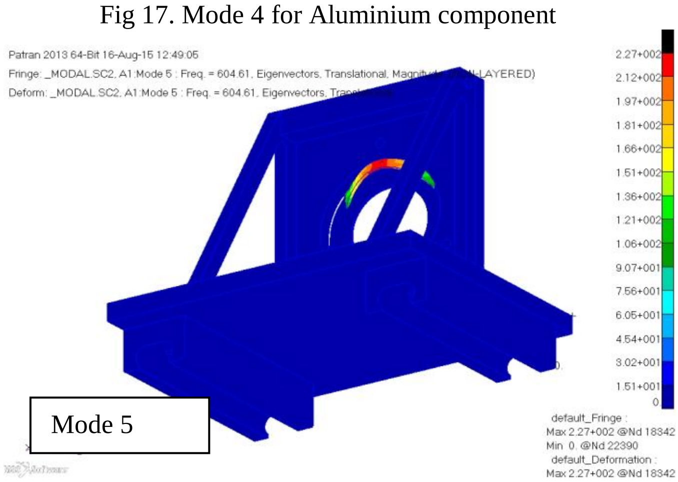

Fig 18. Mode 5 for Aluminium component

Static Results

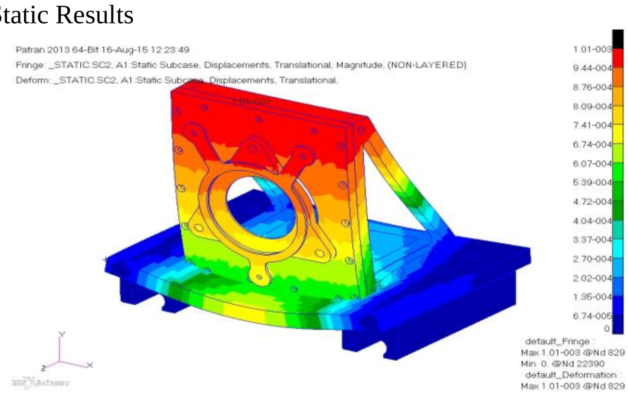

Fig 19. Mode of displacement for Aluminium component

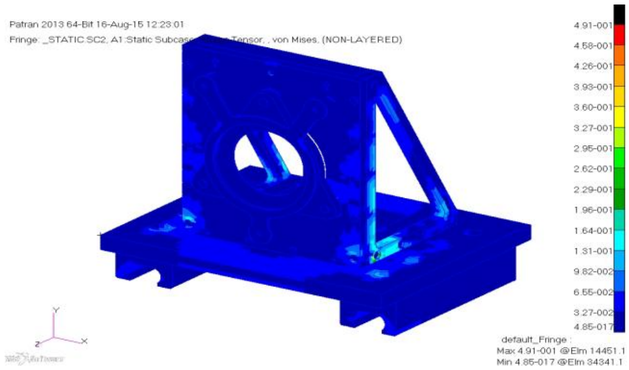
Fig 20. Mode of stress for Aluminium component

TABLE 3. Comparison of Results from FEM Method

MODE NUMBER	FEM (Hz)
Mode 1	315.34
Mode 2	332.02
Mode 3	344.60
Mode 4	376.59
Mode 5	604.61

V. CONCLUSION

With our experimental results, we can conclude that experimental and numerical results matched for some modes, but for few modes, it gives different natural frequency and mode shapes because in experimental analysis the model is partially fixed. Hence, we got the different natural frequency and mode shape. For free-free modal analysis we got lesser frequency compare to fixed-fixed modal analysis, because fixing of model, it will increase the stiffness thereby increases the natural frequency. By adding stiffener to AEROSPACE COMPONENT it will increase the natural frequency of system, because increase stiffness of model. Mild steel has lesser natural frequency compare to Aluminium. Natural frequency is function of both geometry and materials. The sharp corner geometries have lesser natural frequency compare to curved shape geometries. From experimental result we understand that natural frequency is local property and mode shapes are global property. From impact analysis results, we analyze that, the new AEROSPACE COMPONENT model has lesser deformation and accelerations compare to older model, hence it will able to avoid the damage of other aerospace component parts. The deformation of AEROSPACE COMPONENT model mainly depends on structure, if the structures have circular holes and rectangular pockets; it will decrease the deformation of AEROSPACE COMPONENT there by increasing the energy absorption capacity AEROSPACE COMPONENT.

FUTURE SCOPE OF WORK

Modal analysis is aerospace componentised in ordered to find out the natural frequency of system, thereby reducing resonance and impact analysis is aerospace componentised in ordered to determine the deformation and energy absorption of AEROSPACE COMPONENT, it able to increase the safety for passengers as well as vehicles. Further work is aerospace componentised out on modal analysis and impact analysis, where in modal analysis, to increase the natural frequency by adding different stiffeners and also by changing geometries based on applications and usage of parts. Similarly in impact analysis energy absorption capacity is increased by providing crumple zone to new model, thereby it may reduce deformation AEROSPACE COMPONENT

REFERANCES

[1] Pradeep Kumar Uddandapu [1], Impact Analysis on Aerospace component AEROSPACE COMPONENT by varying speeds using Materials ABS Plastic and Poly Ether Imide by Finite Element Analysis software Solid works, International Journal of Modern Engineering Research, Vol.3, Issue.1, Jan-Feb. 2013 pp-391-395

[2] Alenjohn NidhiM.B[2], Modellingand Analysis of Automotive AEROSPACE COMPONENT Used foraLow Passenger Vehicle, International Journal of Engineering Trendsand Technology, Volume 15 Number 7 – Sep 2014

[3] Yu. ZHU et.al [3],Frontal structure improvement on aerospace component basedon rear impact test, International Journal of Security and Its Applications, Vol.7, No.6 (2013), pp.147-154

[4] Qichui Jikuang Yang[4], Study of vehicle front structure crash worthinesson pole impact with different position, Fifth Conference on Measuring Technology and Mechatronics Automation, 2013

[5] Wenhao Mu, JIkuang Yang [5], Optimisation design of frontal AEROSPACE COMPONENT system for Pedestrian lower leg protection and low speed impact requirement.

[6] Q.H.Ma.et.al [6] Research on the Crash Safety of the Aerospace component AEROSPACE COMPONENT based on different standards, International Journal of Security and Its Applications, Vol.7, No.6 (2013), pp.147-154

