ISSN No: 2348-4845
International Journal & Magazine of Engineering, Technology, Management and Research
A Peer Reviewed Open Access International Journal

Design And Analysis Of Aerospace Component

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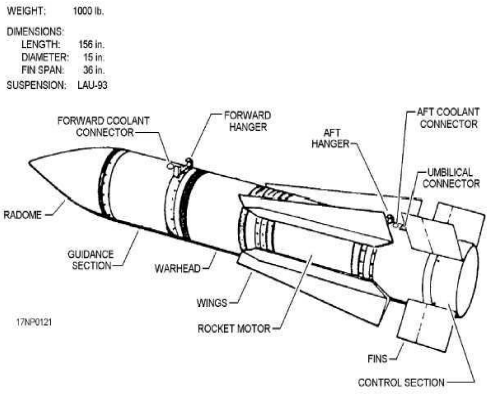
Abstract:

This paper presents a finite element model of a missile control component under different conditions like different missile weights, different materials etc. To check its capacity to work under different working conditions. Structural analysis of component was done for finding stress distributions and high stress locations on component under different materials separately and after finite element analysis by comparing the S2 glass used component and aluminum used component under different weights of missiles, the best suitable material was find out with the help of graphs after analyzing stress values, deformation ranges, strain values. The best material fulfils all requirements like light weight ,high strength, high reliability etc. Compared to other material. The main objective of using these materials is both materials are lightweight, high strength, high reliability and mostly uses in aviation field.

1.INTRODUCTION

Present project deals with aerospace missiles components functioning under different static and dynamic conditions especially specially designed missiles for advanced applications. For these missiles mainly have less weights and proper designed geometrical constructions. This project deals with a component which is very important for releasing the missiles target named radome guided by the control system and this component is called control system component Control system component is used to fix the target radome with warhead (missile body)with constant Stability, and when missile released, then to release the target to a specific location this control system component automatically disconnect or loosens its connection with the target radome and when happ ening this, control system component undergoes very high pressures and high temperatures and changing of displacement of component and strains. So, the design of component plays main role for working of missile and component has to sustain all these features.



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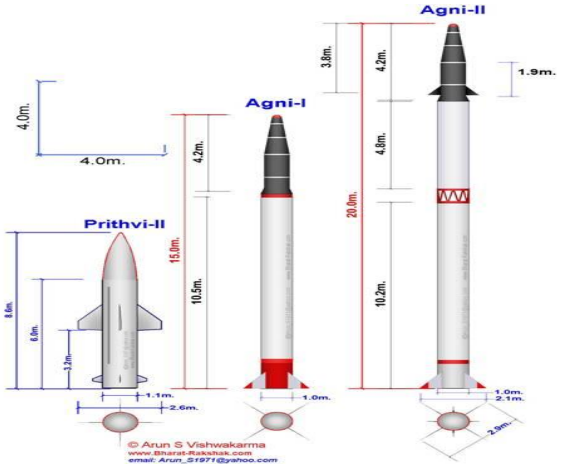
Present project has taken the missile with different weights i.e., 12kgs, 13kgs, 14.2kgs and analyzed the components working and its various properties under different weights. The main reason to take the missile with these specific weights is these weighted missiles are very less in weight. Control system component has to undergo very high pressures and high temperatures and other important characteristics which is directly effects the missiles working.



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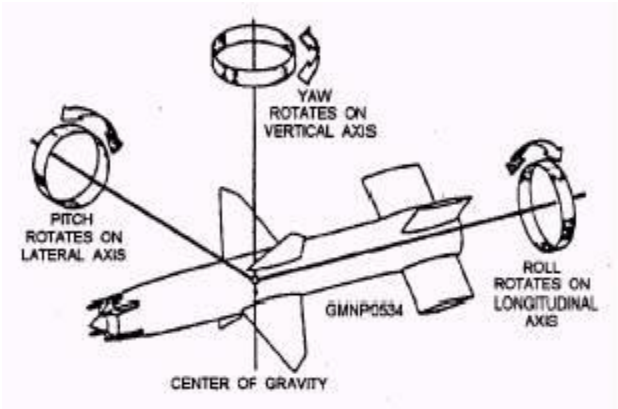

Rotary Moments of a Missile: Pitch, Roll, and Yaw

So the material used for manufacturing the control system component is very important for proper working of component, because the various materials have various properties and according to these properties the component capacity and its suitability for missile has analyzed. Aluminum material is mai nly used in aerospace industry because of its special characteristics like light weight structure, high strength to weight ratio etc. So the present project have used two different materials that are aluminum and S2 glass and analyzed its properties separately for missiles of different weights.

Both materials are using very frequently in aviation field because of its special advantages. Aluminum material proved itself as a major contribution in the development of space engineering. The first aircraft made by Wright brothers in 1903,the parts of the engine were made by aluminum.

Rocket science was developing its technology and advances and design developments have been improving and main concentration is streamlining the body of missiles or aero planes because how much less weight the missile has that much easy to reduce the costs and easy to control and easy to take off. For this purpose the material which has considerable less weight, high durability, high strength is using in space research that is aluminum. After discovering the aluminum uses in astrionics many researchers have been conducted to solve task of aluminum reinforcement.

After several researches an aircraft alloy called duralumin has been find out which is a strong alloy which contains major constituent of aluminum and other materials used in alloy are magnesium, copper, manganese. Before discovering this strong alloy so many challenges are there in front of military missiles especially low climbing capacity and did not meet with requirements of military aviation. But duralumin met all requirements with high strength, forgebility,less weight, high reliability. This aluminum material shows direct impact on world wars. Because several countries uses this aluminum used missiles for showing their potential in the world wars.

Countries like USA and USSR are used advanced ultra-strong aluminum alloys in their missile technology which directly shows their domination in world wars compared to other countries. India also implementing so many researches for developing advanced missiles. Aluminum material also does not reduce its strength in high temperatures which plays so much of advantage in missile technology.

In this project, we are using control system component which undergoes high stresses when working conditions. So we are using special grade of aluminum called A24345.This grade of aluminum especially uses in highly stressed components of all types in aircraft. Control system component undergoes high stresses in missiles when working. So we are using this A24345 type of material for manufacturing of component.

Most of the parts of space technology are made by aluminum like engine parts etc., major composition is made by aluminum. Other material which is used in this project is S2 glass (glass fiber material) which is a composite material which is currently showing its strength in aerospace applications.

This composite material serves major purpose and showing special advantages compared to aluminum which are high tensile strength, high compressive

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strength, withstand high temperatures etc. Composite materials are mainly used in missiles components because of its very less weight compared to aluminum.

S2 glass is a lower cost version of Sglass.For taking account in to cost consideration, advanced develop ents have been taken for new version called S2 glass is used in this project. Many types of glass fibers are available say E glass etc., but S2 glass has high tensile and compressive strengths compared to all glass fibers.

Present aerospace science has developing by using composite materials in their applications. By using these materials missile technology meeting all requirements and special design features needed by component are possible only by using composite materials.

This glass fibre S2 glass is using mainly because of its lightweight, high reliability and using in fire retardant materials and it has showing excellent corrosion resistance property which is very special feature of application mainly uses in planetary science. So many materials does not resist corrosion properly but by using S2 glass composite material this limitation can be avoided. This S2 glass is used specially in highly loaded parts which undergoes high stresses, high pressures etc.,The used missile in this project is guided missile which is necessary for military applications to destroy the enemy's submarines etc., which are moved continuously. For these special applications, normal missiles are not used because missile can hit the target at a particular fixed position.

But at wars or special protection situations happened, the enemies submarines or rockets moves towards the continues speeds. Then it is only possible to destroy the enemies target by guided missiles. The guided missiles motion of path was controlled by control system which is provided in the missiles body. The guided missile automatically moves with respect to the target and distance between them was analyzed itself time to time and releases its target radome in fraction of seconds time when ready to hit the target when exactly estimated itself.

The guided missiles can be classified in to several types based on their performance. For example according to range they are classified based on their travelling distance requirement. According to their method of launching they are classified by air to air, air to surface, surface to air, surface to surface missiles. Mostly air to surface missile is mostly used.

2.DESIGN

The control system component has designed with PROE software. This PROE package is useful in dealing with solid modeling applications. roe is a 3 dimensional CAD programme which has special features and has special design modes like other CAD CAM CAE programs like catiav5,unigraphics etc. PROE is an advanced tool of cad cam programs and uses in analyzing the interactions of components easily while designing and estimate the interactions changes, technically efficient designing with complex modificat ions can be done in designing mode only.

After designing of component, if any changes have to done it is difficult to change entire designing component. With advanced tools of cad cam programmes we can accurately estimate and design the components according to the requirements. Design steps involved in process has separate modes and each mode has its own characteristics to complete its design stages and they include tolera nces, dimensions etc., and each mode depends on other modes axiomatically, if one change takes place at a design step it will show impact on other modes also. So entire design process has to analyzed properly. The cad cam tools consists separate design files to create various designs separately.In part mode, part files are created and parts are created according to requirements and any changes can done like geometric shapes of parts like cuts,blends,rounds of shapes of part etc.,

In assembly mode interaction of parts has to be joined together and checking the components design properly to meet demands of requirements of components. After components design complete drawing mode estimation is done with complete information of component that how to manufacture the component with special

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indications including surface roughness etc.,challenges and requirements are changing time to time and different components have to design without reducing its working range and product differentiation has to carefully done according to needs. The advantage of caecum tools is when a design change is done on a particular part and assigned the parts then it will automatically shows impact on the entire assembly of component and it can be studied for correctness of drawing and this is possible with the caecum tools.

3. ANALYSIS

After designing the component, finite element analysis is to be carried out and this method is very important for those involved in engineering design. This finite element method used to solve several problems in these areas of structural analysis, thermal analysis, buckling analysis etc., The analysis software program me was first developed by swason analysis systems Inc. And in this present project the control system component was analyzed and type of analysis done was structural analysis by using finite element method.

The organization of any programme was done by two levels. At beginning level used for programme controls such as copying binary files etc., and at processor level the entire analysis is carried out to obtain the results to check whether the component has designed properly or not. At processor level the analysis is carried in three different levels. Each processor stage has its separate characteristics for doing analysis.

Pre processor:

In this stage, initially element type was assigned which belongs to component and geometry definitions was given and using material whether aluminium or S2 glass material properties was given (young's modulus, poissons ratio, density etc.,)Type of analysis was to given whether structural analysis or thermal analysis or buckling analysis etc., in this project structural analysis of component was done.

Mesh generation is carried in pre-processor stage and before meshing ,type of meshing is to select whether free mesh or mapped mesh both are having different method of meshing characteristics. Free mesh having no restrictions in terms of element shapes and has no specified pattern applied to it.But mapped mesh having specified restrictions in terms of their element shapes and mapped area mesh have quadrilateral or only triangular elements and mapped volume mesh have hexahedron elements.

Solution processor:

In this stage, the main analysis is carried out that is applying the loads and obtaining the solutions and in this solution processor the entire using data definitions has to given that are type of solution whether static, modal or transient etc., and defining loads whether point loads or surface loads etc., are the basic using data definitions necessary in solution processor.

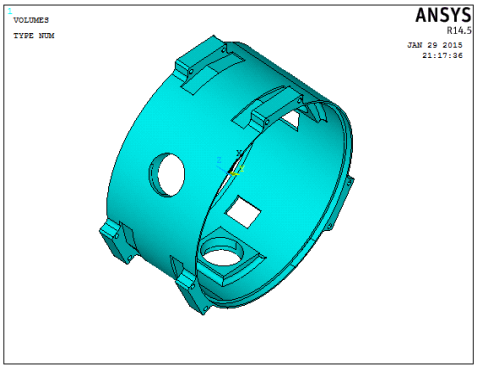
Post processor:

In the general post processor, already obtained solution in solution processor is analysed with help of graphs and comparing with other parameters to view results.In the present project, the component was analysed with help of graphs by comparing with two different materials in different missile weights and after comparing stress values and strain values and deformation ranges of component the best suitable method of process is selected.

4. ANALYSIS

Structural Analysis Of Missile At 12kgs
ALUMINIUM ALLOY MODEL 24345

Imported Model from Pro/Engineer



Element Type: Solid 20 node 186

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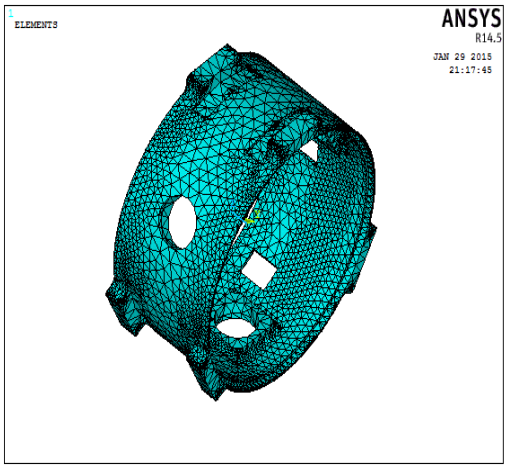
Material Properties:

Youngs Modulus (EX) : 70000N/mm^2

Poisson's Ratio (PRXY) : 0.33

Density : 0.0000028kg/mm^3

Meshed Model

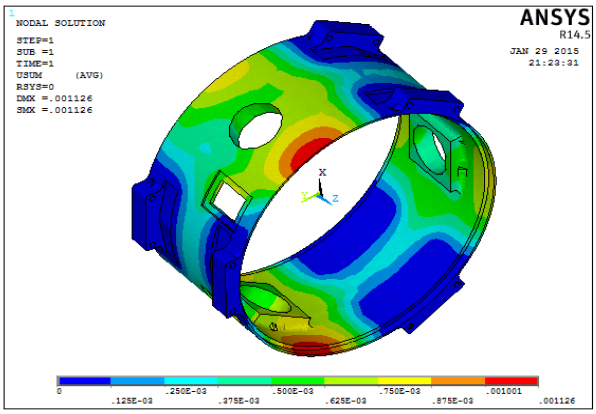


Loads

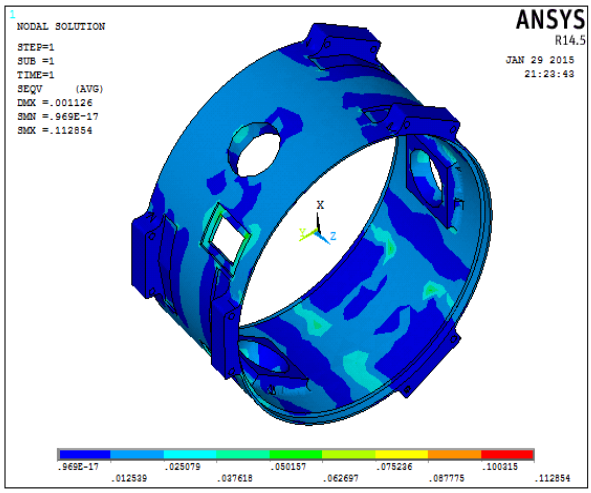
Pressure values –0.0096N/mm^2

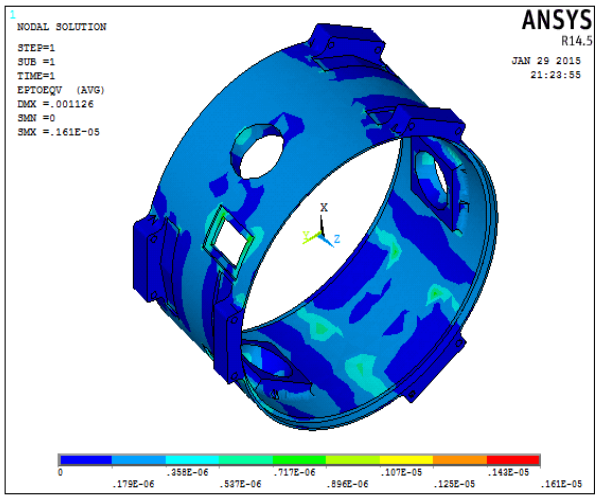
Solution

Solution – Solve – Current LS – ok



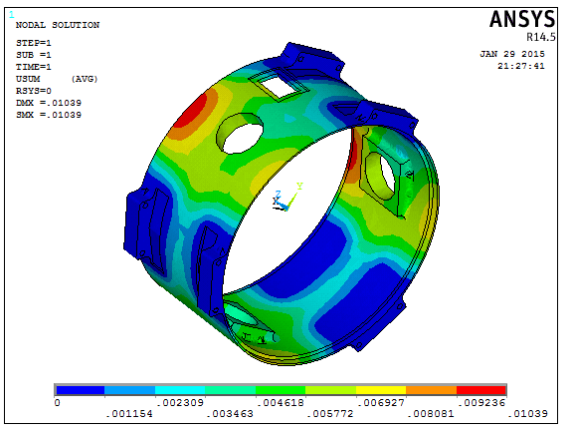
Von Mises Stress





SRUCTURAL ANALYSIS OF MISSILE AT 13KGS ALUMINIUM-ALLOY 24345

PRESSURE -0.00104N/MM^2



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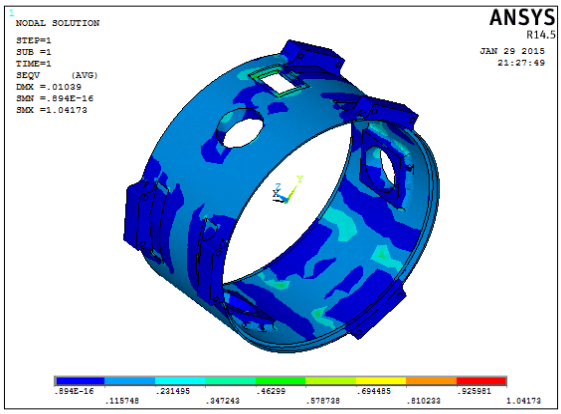
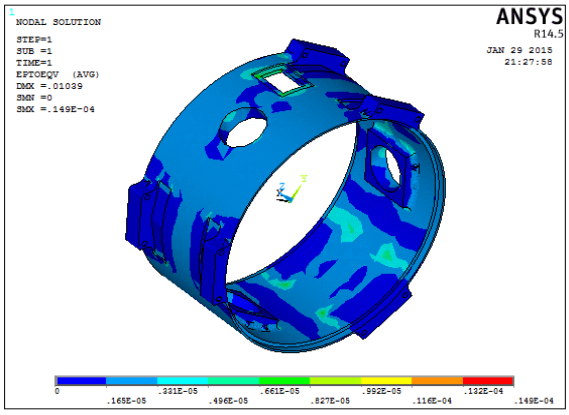
Von Mises Stress





STRUCTURAL ANALYSIS OF MISSILE AT 14.2KGS

ALUMINUM ALLOY 24345

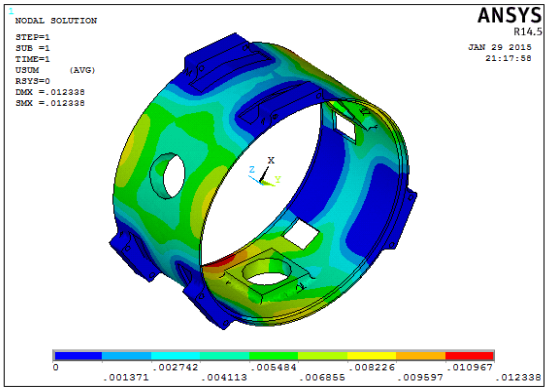
Pressurevalues-0.0114N/MM^2

Solution

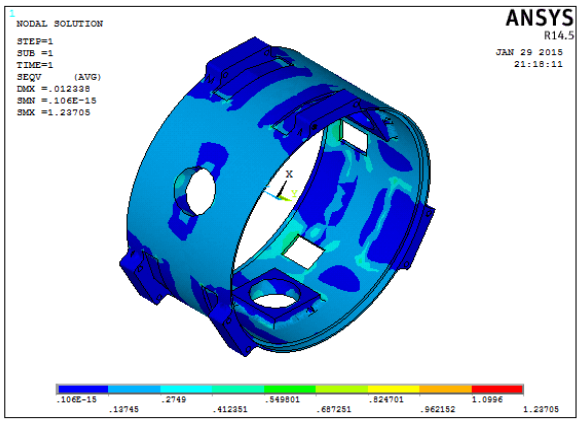
Solution – Solve – Current LS – ok

Post Processor

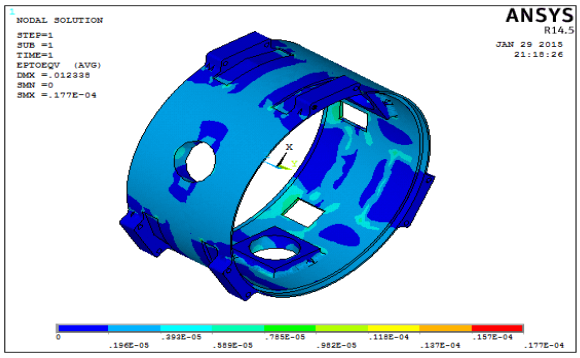
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress

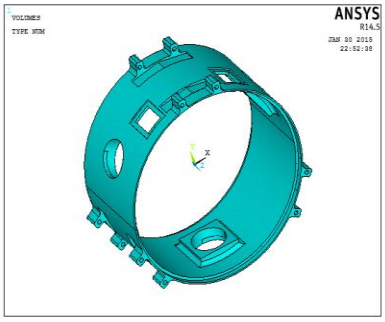


General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



STRUCTURAL ANALYSIS OF MISSILE AT 12KGS S2 GLASS MODIFY MODAL

Imported Model from Pro/Engineer



Element Type: Solid 20 node 186

Material Properties:

Youngs Modulus (EX) : 86900N/mm^2

Poissons Ratio (PRXY) : 0.23

Density : 0.00000246kg/mm^3

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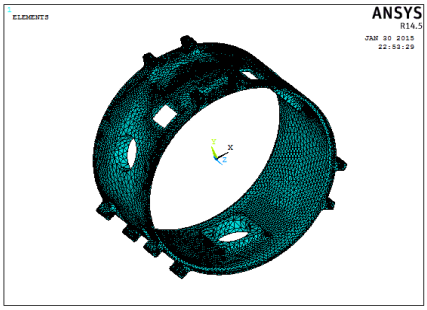
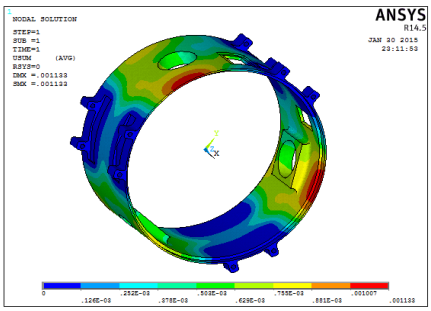
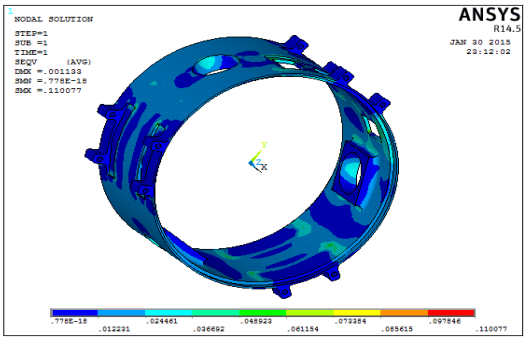


Loads
Pressure values –0.0096N/mm^2
Solution
Solution – Solve – Current LS – ok
Post Processor

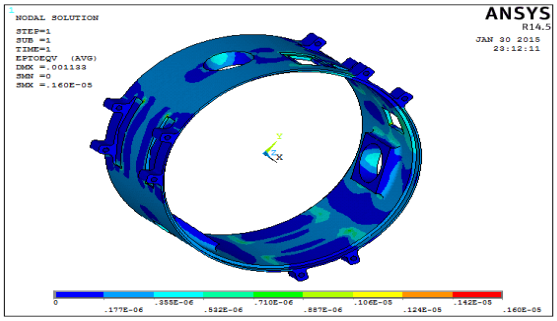
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress



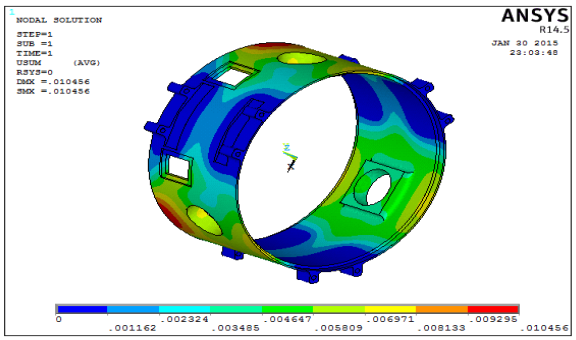
General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



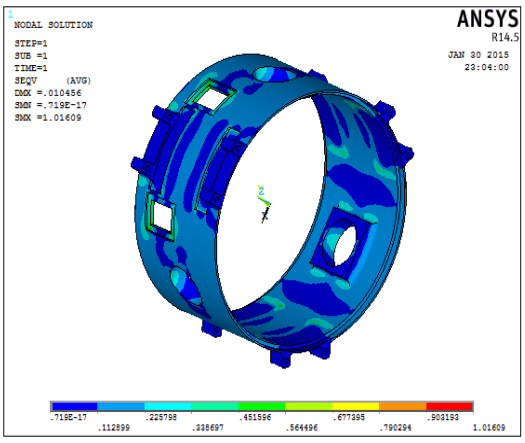
STRUCTURAL ANALYSIS OF MISSILE AT 13KGS

S2 GLASS

PRESSURE -0.00104N/MM^2
Solution
Solution – Solve – Current LS – ok
Post Processor
General Post Processor – Plot Results – Contour Plot - Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress



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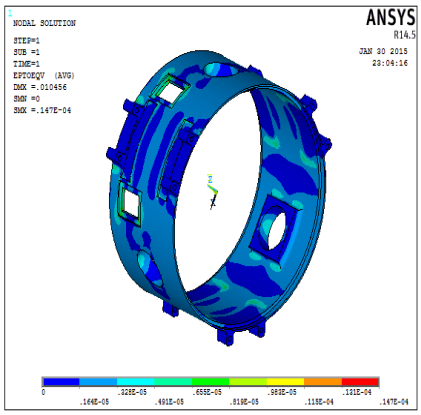
General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



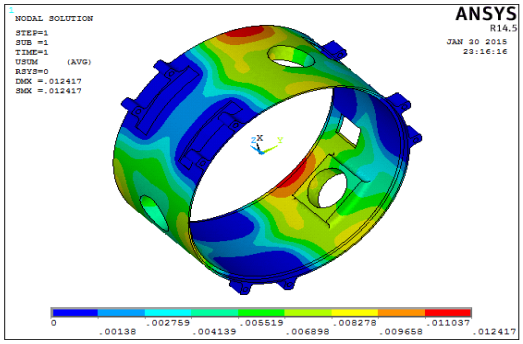
STRUCTURAL ANALYSIS OF MISSILE AT 14.2KGS S2 GLASS

Pressurevalues–0.0114N/MM^2

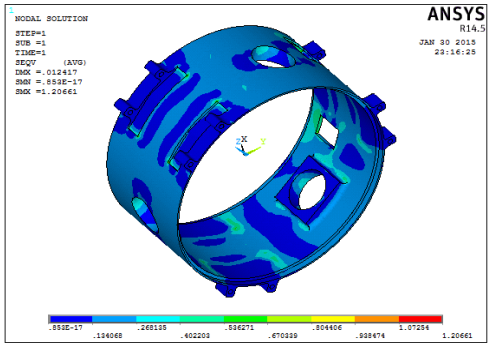
Solution

Solution – Solve – Current LS – ok

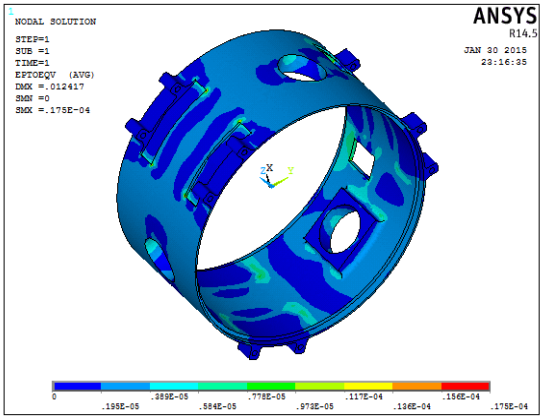
Post ProcessorGeneral Post Processor – Plot Results – Contour Plot – Nodal Solution – DOF Solution – Displacement Vector Sum



General Post Processor – Plot Results – Contour Plot – Nodal Solution – Stress – Von Mises Stress



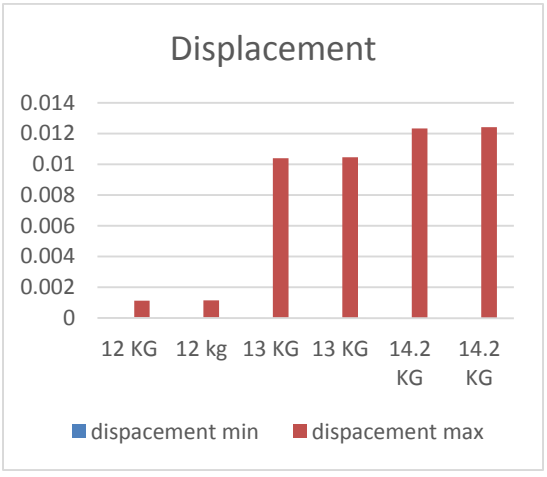
General Post Processor – Plot Results – Contour Plot – Nodal Solution – Strain – Total mechanical Strain



5.RESULTS & DISCUSSION

The data obtained from the Ansys are tabulated and compared below

si.no	material	load	displacement		von-mise stress		strain	
			min	max	min	max	min	max
1	A 24345	12 KG	0	0.001126	9.69E-18	0.112854	0	1.61E-06
2	S2 GLASS	12 kg	0	0.001133	7.78E-19	0.110077	0	1.60E-06
3	A 24345	13 KG	0	0.01039	8.94E-17	1.04173	0	1.49E-05
4	S2 GLASS	13 KG	0	0.010456	7.19E-18	1.01609	0	1.47E-05
5	A 24345	14.2 KG	0	0.012338	1.06E-16	1.23705	0	1.77E-05
6	S2 GLASS	14.2 KG	0	0.012417	8.53E-18	1.20661	0	1.75E-05



Graph1

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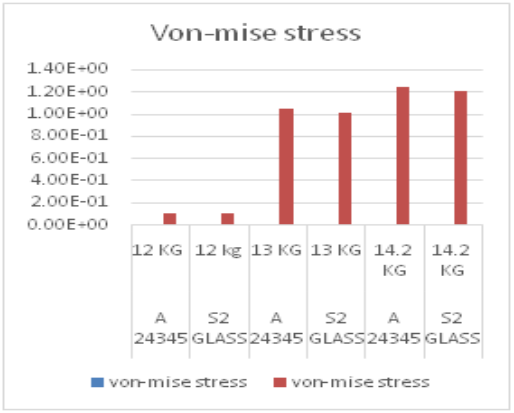
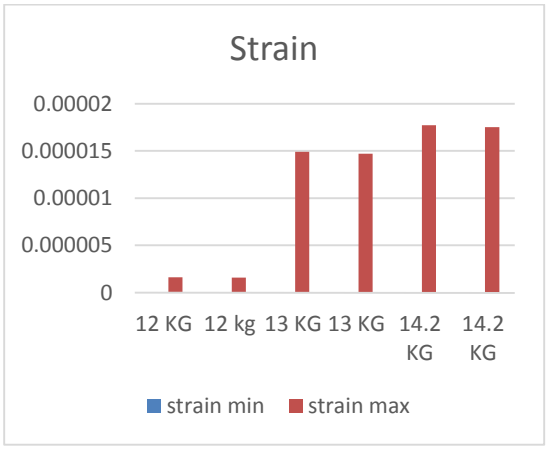


Graph2



Graph 3

All the figures are increasing with increase in load but when we compare the materials S2 GLASS is the best the first bar in the graph indicates A 24345 and the second bar indicates S2 GLASS.

6. CONCLUSION

In the present project, the Missile Controlcomponent has been studied for structuralbehaviour and optimised for safe structure.The Missile Control component wasstudied for 2 different cases:

- Static loads
- Dynamic loads

From the above analysis it is concludedthat the modified Missile Control componenthas stresses and deflections within the designlimits of the material used. The deflectionsand stresses obtained in the dynamicanalysis are also under the design limits ofthe material used.

I.e. S2 GLASS .Therefore it concluded that the ModifiedMissile Control component made up of S2 GLASS is safe under thestatic and dynamic loading conditions.

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