International Journal of Science and Research (IJSR)
ISSN: 2319-7064
SJIF (2019): 7.583

Design and Analysis of Spherical Dome

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Abstract: ***The Work "Design and analysis of spherical dome" involves the Designing of the dome in the Catia V5 and the analysis is being done using Ansys 18.1. The analysis is done under two different condition once the pressure is applied from inside and in second the pressure is applied from the outside and the total deformation is being studied. This dome is made up of material 15CDV6 is an aerospace alloy basically used in motor casing for the rocket. This project is to analyze the dome under different pressure conditions and to see the stress and buckling on the dome.***

Keywords: Spherical dome, 15CDV6, Design & analysis

1. Introduction

Domes are the architectural element they are semi-circle and can be both solid or hollow depends upon the area of use. Domes have no corners and no angles and they have enormous amount of space with minimum materials as they do not require any support. Domes are one of the strongest and stiffest structures existing despite of their thickness. Domes can be mad from concrete, mud, glass, snow, steel The fabrication and the design of the dome can be sometimes being very complex. The construction of the domes started in Rome first they use dome for making Church and Historical monuments. Domes are also used for making structure under-water for the purpose of entertainment.

2. Material Used

15CDV6

15CDV6 is a chromium-molybdenum-vanadium heat treatable steel with high strength after heat treatment. The alloy is easily welded and heat treatable, and does not require localized heat treatment after welding. Having high Yield strength & Ultimate strength it is widely used in aerospace industry and for making rocket motor casing.

Mechanical properties for 15CDV6

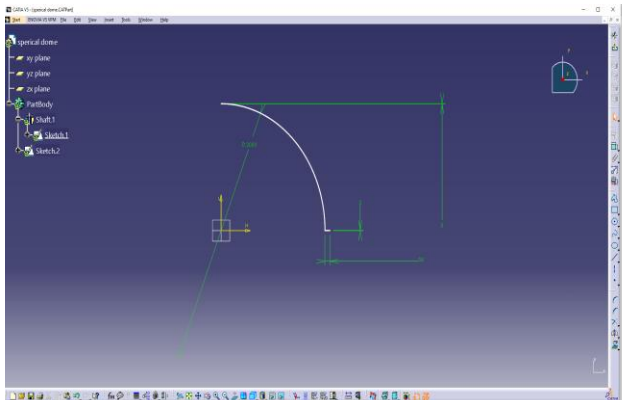
Property	Value	Unit
Density	7850	Kg^-3
Young's modulus	2.06E+05	MPa
Poisson's Ratio	0.3	
Bull Modulus	1.7167E+11	Pa
Shear Modulus	7.923E+10	Pa
Tensile Yield Strength	930	MPa
Tensile Ultimate Strength	1080	MPa

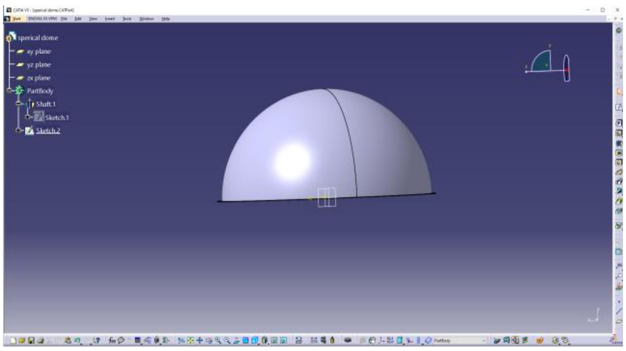
3. Dimension

Diameter of the dome is – 2 m.
Thickness – 3mm.
Base – 50mm.

Modelling of the dome

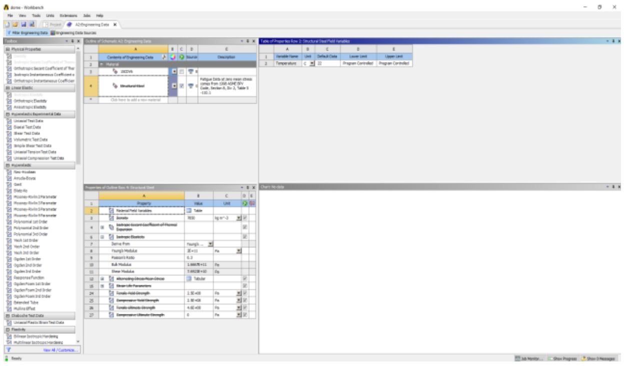
Designing of the dome using Catia V5 according to the given dimensions in part design. After designing in part pad the 2D design to make it 3D solid. Save the design in IGS format for the analysis in Ansys.





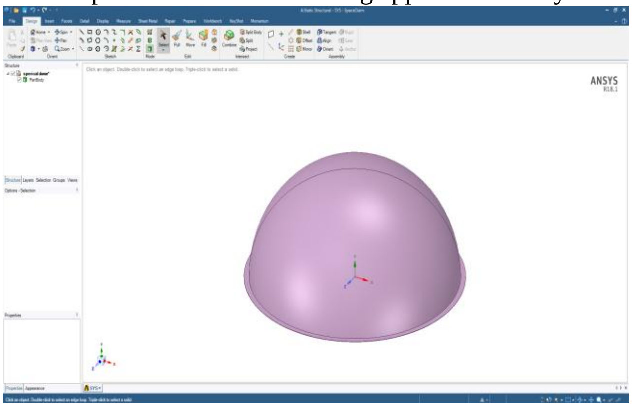
Analysis of Dome

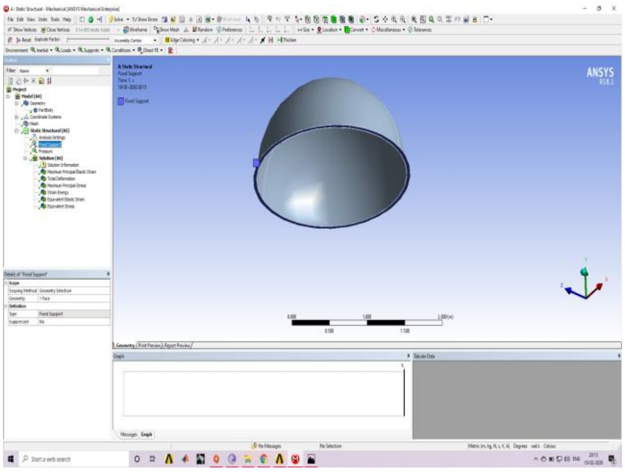
In Ansys select the static structure module and import the 3D geometry.
Now manually input the physical properties of the material 15CDV6.
Now fix the base of the dome and surface on which pressure will be applied.



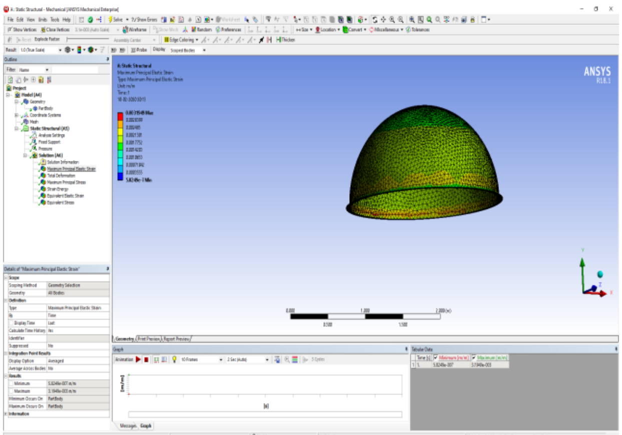
CASE -1

When a pressure of 30 bar is being applied internally.

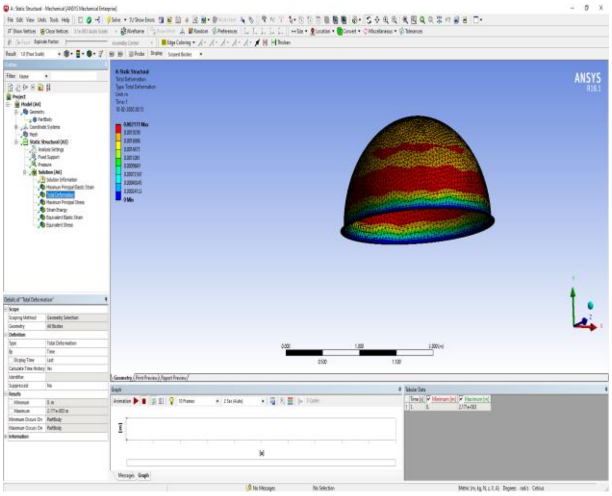




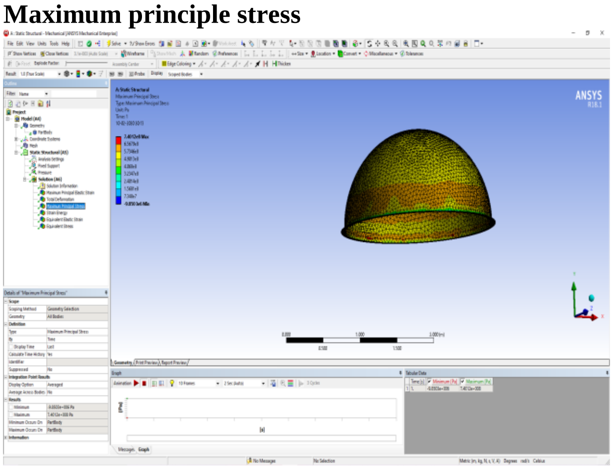
Maximum elastic strain



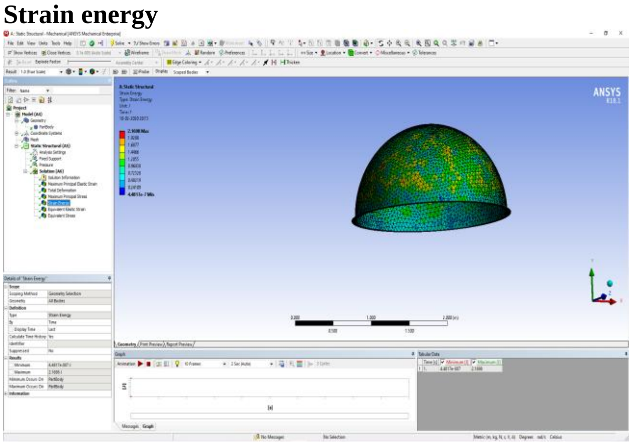
Total deformation



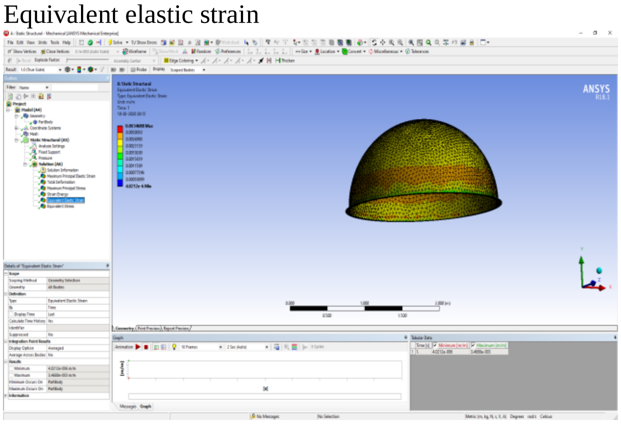
Maximum principle stress



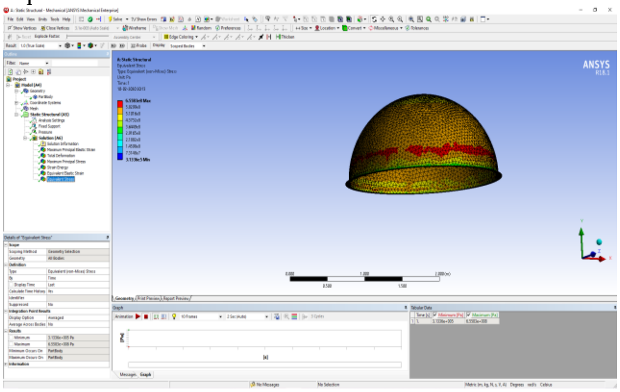
Strain energy



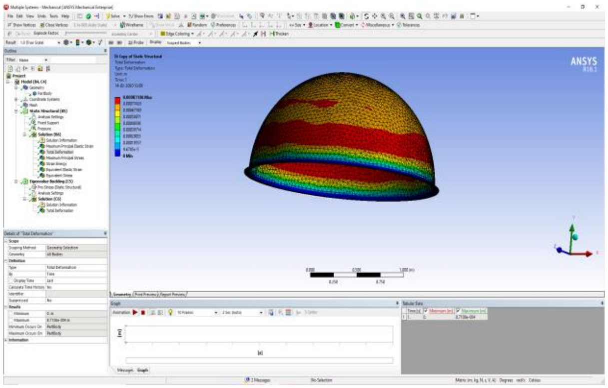
Equivalent elastic strain



Equivalent stress



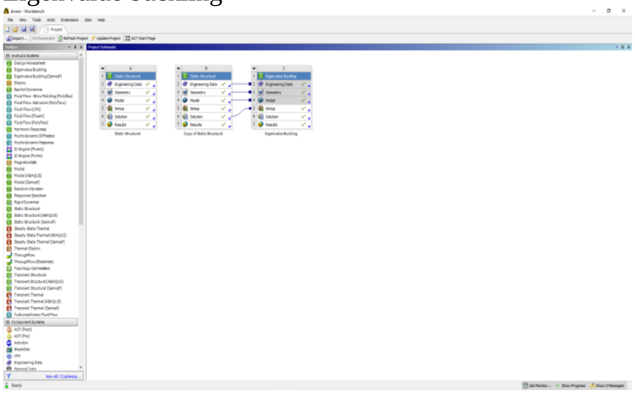
Total deformation



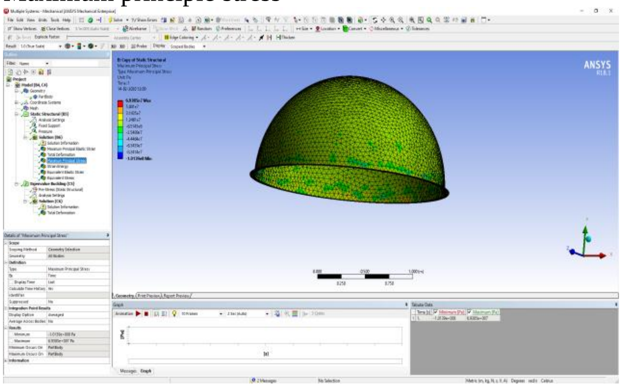
Case 2

Pressure of 12 bar is applied from outside

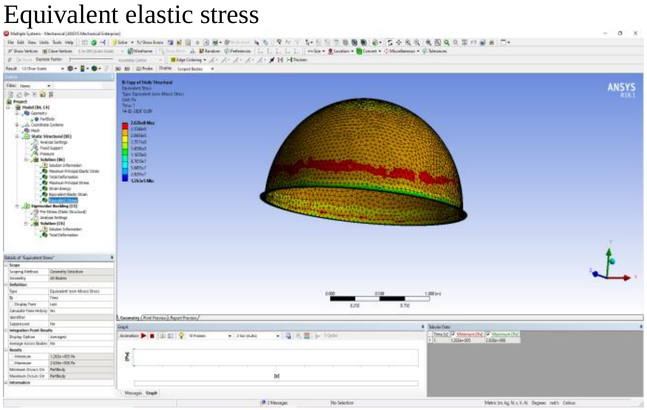
Eigenvalue buckling

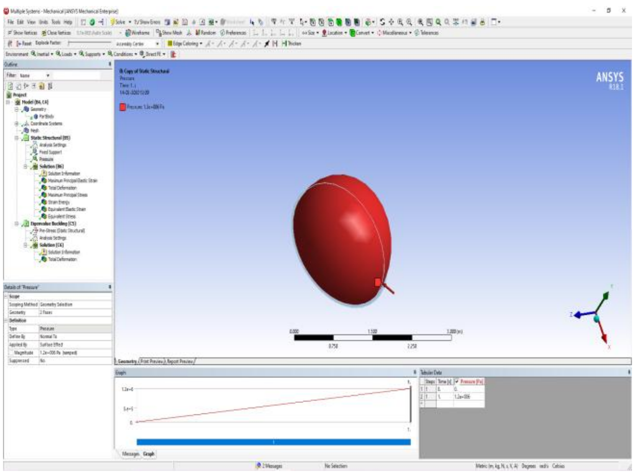


Maximum principle stress

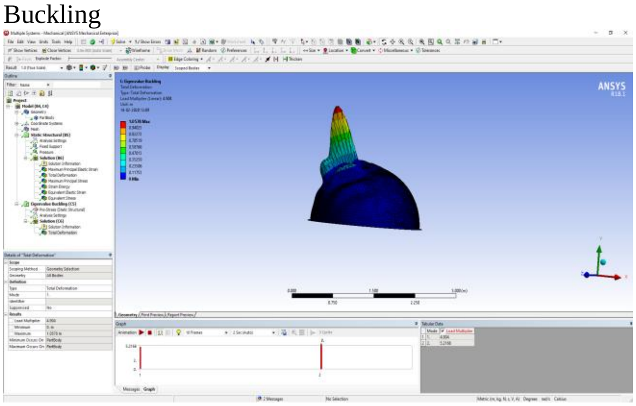


Equivalent elastic stress

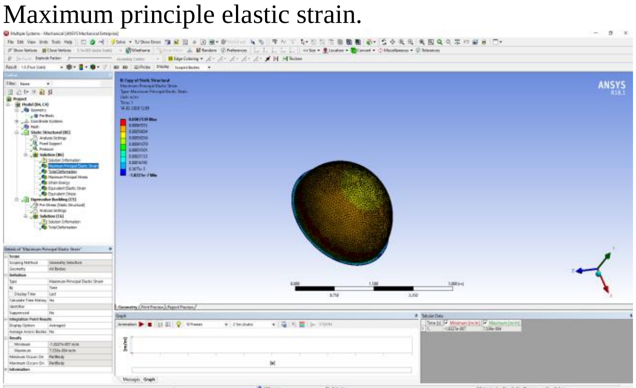




Buckling



Maximum principle elastic strain.



4. Results

Case-1

FOS = $\frac{930}{740.12}$ = 1.256

Total Deformation = 2.171 mm

Case-II

FOS = $\frac{930}{69.385}$ = 13.4034

Total Deformation = 0.87106 mm

5. Conclusion

Aerospace Grade materials like MDN 350,15CDV6 can be used in manufacturing vehicles in future. They can also be used in
Submarines because of their robust properties and high strength

References

[1] Aerospace Manufacturing Technology by NK Naik Kanchan Biswas GC Popli.
[2] en.wikipedia.org/wiki/Dome.
[3] smithmetal