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Email : ijitce.editor@gmail.com or editor@ijitce.com

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DESIGN AND LINEAR LAYER ANALYSIS OF PRESSURE VESSEL BY USING COMPOSITE MATERIALS

Ishrath Nousheen

Abstract

This study analyses the strength of a pressure vessel that was built with weld effectivity in mind and then tested using the ANSYS finite element analysis program. When a company targets the design characteristics of a pressure vessel according to the intended weld successfully, mathematical correlations are likely to be included. We will be using CATIA for our modeling. The pressure vessel will undergo structural and thermal study in ANSYS for several materials.The thermal analysis was used in this research to find out how the heat was distributed and how much heat was transferred per unit area at various materials such as e-glass, carbon fiber, and steel.It is necessary to do static and linear layer analyses in order to ascertain the strain, deformation, and stress at various stacking levels, including 3, 6, 9, and 12.

INTRODUCTION TO PRESSURE VESSELS

If there is a difference in pressure between the inside and outside of a container, we call it a pressure vessel. A pressure vessel must be designed and manufactured to be leak-proof since any damage to one might result in serious bodily harm or property damage. Pressure vessels may have the form of a sphere, a cylindrical tube, or a cone. Although it is more difficult to manufacture, a spherical pressure vessel is stronger than other shapes. A pressure vessel's material has to be both robust and ductile. Its impact hardness is 27J and its elongation is at least 14%. Despite their superior strength, metallic pressure vessels are not favoured in the aerospace or oil and gas sectors because of their corrosive qualities and high weight-to-strength ratio. Pressure vessels with a low mass are required by these sectors. an acceptable substitute for metal pressure vessels because of its lack of corrosion and low weight-to-strength ratio

PARAMETERS OF DESIGN:

Stable strain vessel design comprises,

(a) Thickness design for vessels

(b) Thickness design for dish ends.

(c) Determining the Test Strain for Hydrostatics

(d) Bursting pressure calculation

Assistant professor, Department of Computer Science and engineering, Nawab Shah Alam Khan College of Engineering and Technology, Hyderabad, 500059

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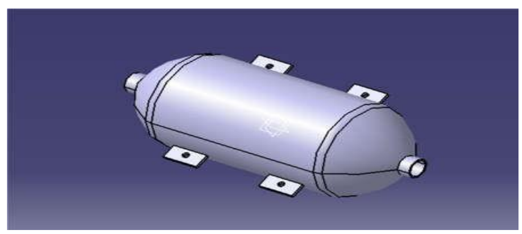
Survey of Literature

Anisotropic laminated cylindrical shells buckling and postbuckling in thermal conditions were investigated by Zhi-Min Li et al. [2015] when subjected to axial compression and combined external pressure. An analysis of buckling and postbuckling is given for a thin cylindrical shell of finite length that is anisotropically laminated and subjected to axial compression and coupled external pressure loading according to the boundary layer theory. The numerical examples show the postbuckling behavior of anisotropic laminated cylindrical shells that are either perfect or imperfect, with regard to geometric and material qualities as well as load-proportional factors, in various temperature environments. The created analytical model is a flexible and reliable instrument for investigating composite structures' buckling and postbuckling behaviors.Pressure vessels for seawater reverse osmosis desalination facilities were studied by A.M. Kamal et al. [2016] using analytical and finite element modeling. ATo improve the PV design parameters, an analytical solution and finite element modeling (FEM) were used to simulate the pressure vessel (PV), which houses the membrane components of seawater reverse osmosis (SWRO) desalination. There has been a comparison of two PV material types: fiber reinforced composites and stainless steel. Stainless steel PVs are designed using the Von-Mises yield criteria, whereas composite PVs are designed using the Tsai-Wu failure criterion. In this study, carbon/epoxy and eglass/epoxy composites are examined. Hybrid composite materials are also used for the layers that run the length of the vessel. Composite PVs are less heavy than their stainless steel counterparts, according to the research. While hybrid composite PVs are more cost-effective in the long run, carbon/epoxy PVs provide the best weight reductions.

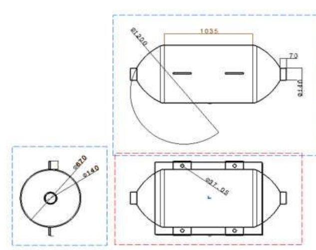
A CASE STUDY IN AUTOCAD

New technologies have emerged and several inventions have been patented throughout the history of our industrial civilization. Perhaps the only development that has had an effectproduction is the digital computer, which is more rapid and revolutionary than any before technology. The drawing office is seeing a rise in the use of desktops for the design and finishing of engineering accessories. The use of computers and image-editing software to facilitate or enhance product design at every stage, from initial ideation to final documentation, is known as computer-aided design (CAD). The most common use of computer-aided design (CAD) is in the creation of interactive computer portraits. In the fields of mechanical design and geometric product modeling, computer-aided design systems are powerful tools.

3D model OF pressure VESSEL



2D MODEL OF PRESSURE VESSEL



INTRODUCTION TO FINITE ELEMENT METHOD

Finite detail procedure (FEM) is also known as as Finite detail evaluation (FEA). Finite aspect procedure is a common analysis manner for resolving and substituting complex issues with the aid of less complicated ones, acquiring approximate solutions Finite detail method being a flexible tool is utilized in

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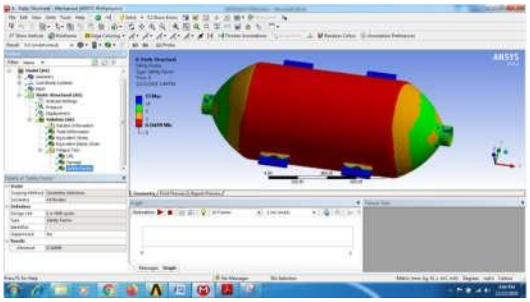
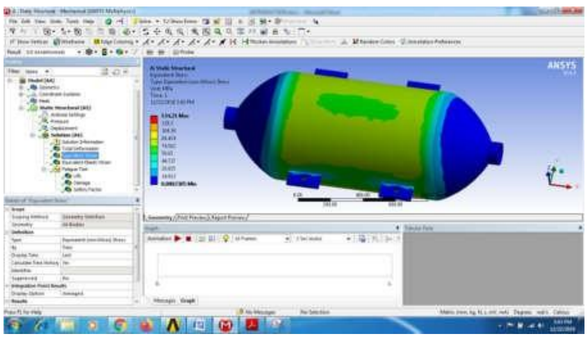
quite a lot of industries to remedy several

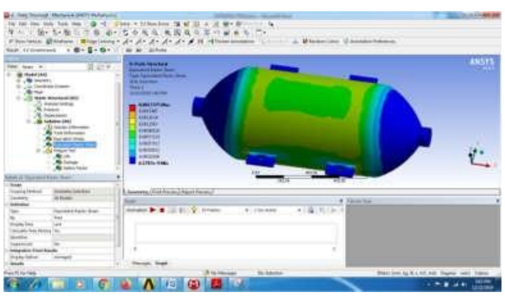


functional engineering problems. In finite element method it's possible to generate the relative results.

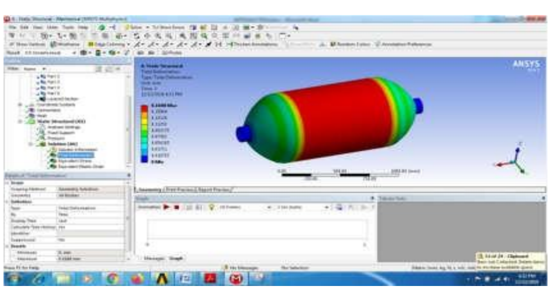
EQUIVALENT STRESS



EQUVALENT STRAIN



FATIUGE ANALYSIS OF PRESSURE VESSELLIFE



Layer	Material	Thickness (mm)	Angle (°
(+Z)			
3	EN 32 STEEL	5	90
2	CARBON FIBER	5	0
1	E GLASS FIBER	5	-90

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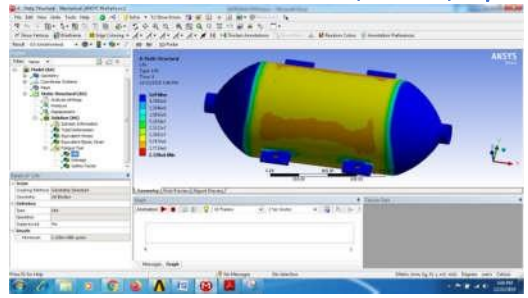


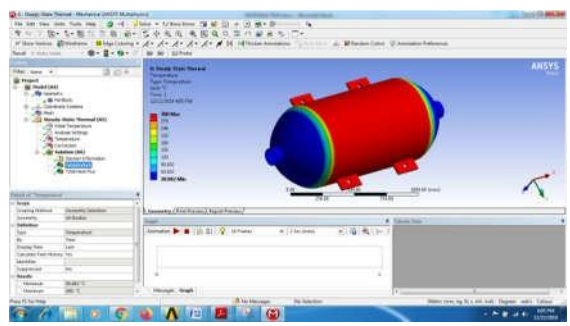
DAMAGESAFTEY FACTOR

THERMAL ANALYSIS OF PRESSUREVESSEL

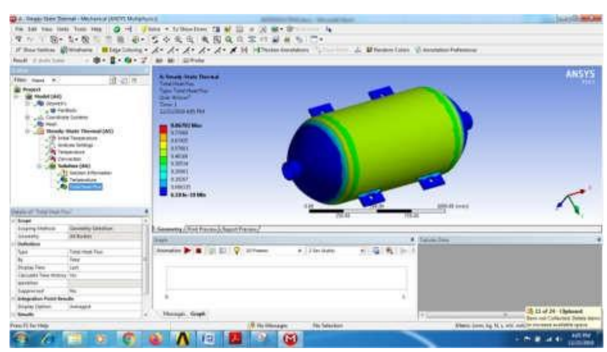
MATERIAL- E-GLASS

FIBER TEMPERATURE

DISTRIBUTION



HEAT FLUX



LINEAR LAYER ANALYSIS OF PRESSUREVESSEL

TOTAL DEFORMATION

EQUIVALENT STRESS

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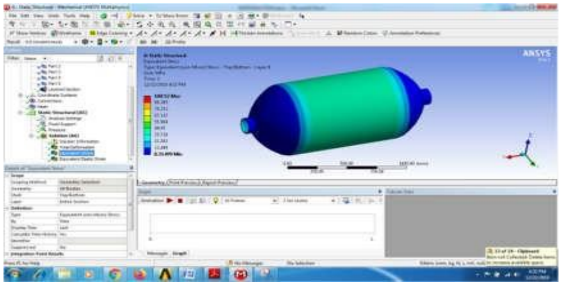

RESULTS AND DISCUSSION Static analysis results table

Material	Deformation (mm)	Stress (N/mm^2)	Strain
EN 32 steel	0.23452	166.73	0.00083952
Carbon fiber	0.57623	139.64	0.0020695
E glass fiber	0.49539	134.21	0.0017375

Fatigue analysis results

Material	Life	Damage	Safety factor
N 32 steel	$1.67e^6$	1323.9	0.13442
arbon ber	$2.52e^6$	834.72	0.16051
glass ber	$2.77e^6$	752.99	0.16699

Thermal analysis results

Material	Temperature distribution(°C)		Heat flux(w/m^2)
	Min	Max	
EN 32 steel	29.886	300	0.51658
Carbon fiber	30.00	300	0.5958
E glass fiber	30.002	300	0.86702

Linear layer analysis results

Layer stacking	Deformation(mm)	Stress (N/mm^2)	Strain
3 layers	0.1688	100.52	0.00049313
6 layers	0.14806	88.568	0.00043465
9layers	0.14047	84.069	0.00041268
12 layers	1.3439	80.576	0.0003955

In summary,

The pressure vessel will undergo ANSYS structural, linear layer, thermal, and fatigue analyses with varying material and stacking configurations.When comparing E-glass fiber to EN 32 steel and carbon fiber, the static analysis shows that the stress values are lower at E-glass fiber.Life of the pressure vessel at the E-glass fiber is shown in fatigue study.Evidence from thermal analyses shows that E glass dissipates more heat than carbon and steel.Stress values are lower in the 12-layer stacking pressure vessel model compared to the traditional model, according to the findings of the linear layer analysis.As a result, the pressure vessel and layer stacking model benefit from using E glass fiber material.

REFERENCES

[1] Alexis A. Krikanov,"Composite pressure vessels with higher stiffness" Composite Structures 48 (2000) Published by Elsevier Science Ltd.

[2] A.M. Kamal et al," Analytical and finite element modeling of pressure vessels for seawater reverse osmosis desalination plants" Desalination 397 (2016) 126–139 2016 Elsevier B.V.

[3] "Analysis of Liquid Petroleum Gas Cylinder using Twice Elastic Slope Criteria to Calculate the Burst Pressure of Cylinder", International Journal of Engineering Research & Technology, Vol. 4 Issue 01, January-2015, pp. 561-568.

[4] Aziz Onder et al, "Burst failure load of composite pressure vessels" Composite Structures 89 (2009) 159–166 Published by Elsevier Ltd.