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MODELLING AND FINITE ELEMENT ANALYSIS OF COMPOSITE PRESSURE VESSEL

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ABSTRACT
Pressure vessel chambers have wide capacities in warm and thermal energy stations, cycle and substance enterprises, in house and sea profundities, and liquid stockpile strategies in ventures. Spot on plan follow is admissible strain for weld power communicated as weld proficiency. Proficiency is illustrated as the proportion of longitudinal (pivotal) power of a welded joint to the longitudinal power of line or tank shell.
In this proposal, the strain vessel is planned by the weld productivity and dissected for its solidarity using limited component examination application ANSYS. Numerical relationships will most likely be respected for the plan of tension vessel whose plan boundaries are designated through an association as per the ideal weld productivity. Displaying will be refined in CATIA. Investigation will be done in ANSYS on the strain vessel with various composite materials. In this task, static investigation is to decide the pressure, misshapening and strain. Exhaustioninvestigation is to decide the life, harm and wellbeingvariable of the tension vessel utilizing EN 32 Steel, Carbon fiber and E-glass fiber materials.Heat examination is to decide the temperature dissemination and hotness move rate per unit space of the tension vessel utilizing EN 32 Steel, Carbon fiber and E-glass fiber materials. Straight layer investigation is to decide the pressure, misshapening and resist various layers stacking like 3, 6, 9 and 12 layers.

INTRODUCTION TO PRESSURE VESSELS
A pressure vessel is defined as a container with a pressure differential between inside and outside. Damage of a pressure vessel has a potential to cause extensive physical injury and property damage so leak-proof design and manufacturing is important . Shape of pressure vessel may be spherical, cylindrical or cone shape. Spherical pressure vessel has more strength than other shape but its manufacturing is very complicated . Material used for
tough. Its elongation is not less than 14% and its impact toughness is not less than 27J. Metallic pressure vessels are having more strength but due to their high weight to strength ratio and corrosive properties they are least preferred in aerospace aswell as oil and gas industries. These industries are in need of pressure vessels which will have low weight to strength ratio without affecting the strength. Fiber reinforcement plastic composite material is best suitable alternative for metallic pressure vessel due toits low weight to strength ratio and non-corrosiveproperty

DESIGN PAREMETERS:
The design of stable strain vessel entails,
(a) Design of Vessel thickness
(b) Design of Dished ends thickness.
(c) Calculation of Hydrostatic experiment strain
(d) Calculation of Bursting pressure

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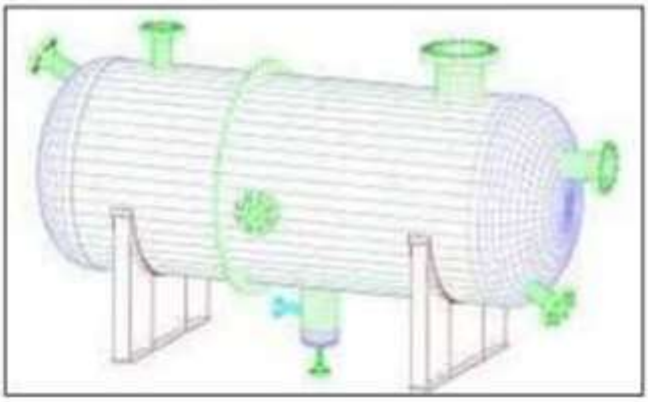

LITERATURE SURVEY

Zhi-Min Li et al. [2015] studied buckling and postbuckling of anisotropic laminated cylindrical shells under combined external pressure and axial compression in thermal environments. The buckling and postbuckling analysis for an anisotropiclaminated thin cylindrical shell of finite length subjected to combined loading of external pressure and axial compression using the boundary layer theory is presented. Postbuckling response of perfect and imperfect, anisotropic laminated cylindrical
shells with respect to the material and geometric properties and load-proportional parameters under different sets of thermal environmental conditions arenumerically illustrated. The analytical model developed can be used as a versatile and accurate tool to study the buckling and postbuckling behaviour of composite structures.
A.M. Kamal et al. [2016] investigated analytical and finite element modelling of pressure vessels for seawater reverse osmosis desalination plants. A pressure vessel (PV) which contains the membrane elements of seawater reverse osmosis (SWRO) desalination has been modelled using analytical solution and finite element modelling (FEM) to optimize the PV design parameters. Two types of PV materials have been compared namely; stainless steel and fiber reinforced composite materials. Von-Mises yield criterion and Tsai-Wu failure criterion are used for the design of stainless steel and composite PVs respectively. Eglass/epoxy and carbon/epoxy composite materials are considered in this work. In addition, hybrid composite materials are introduced for layers through the vessel thickness. The results have shown that the composite PVs have lighter weight than the stainless steel PVs. The carbon/epoxyPVs introduce the optimum weight savings but interms of the total PVs cost, the hybrid composite PVscan be used.

MODELING AND ANALYSIS

in the course of the historical past of our industrialsociety, many innovations have been patented and whole new technologies have advanced. Probably theone progress that has impacted
manufacturing more swiftly and drastically than any previous technological know-how is the digital pc. Desktops are getting used increasingly for both design and detailing of engineering accessories within the drawing office. Pc-aided design (CAD) is outlined as the application of computer systems and photographs software to support or increase the product design from conceptualization to documentation. CAD is most mainly associated with using an interactive computer portraits method, known as a CAD process. Pc-aided design systems are robust tools and within the mechanical design andgeometric modeling of products and add-ons.

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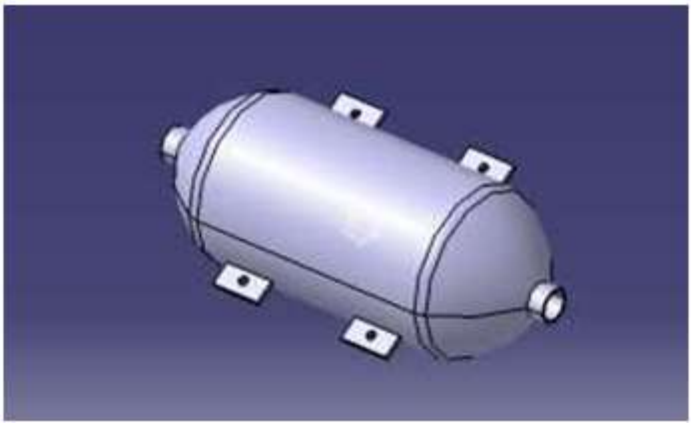
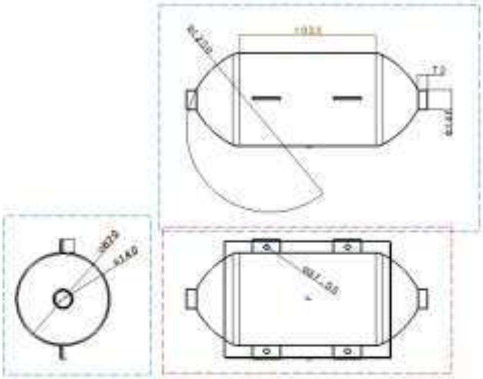
3D model OF pressure VESSEL



2D MODEL OF PRESSURE VESSEL



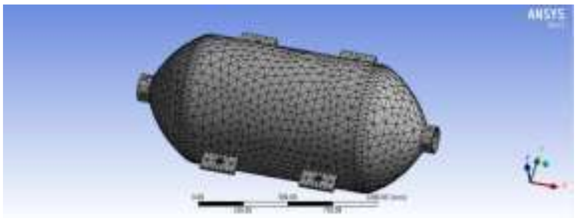
FINITE ELEMENT METHOD

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 quite a lot of industries to remedy several functional engineering problems. In finite element method it's possible to generate the relative results.

STATIC ANALYSIS OF PRESSURE VESSEL

Imported model

Meshed model



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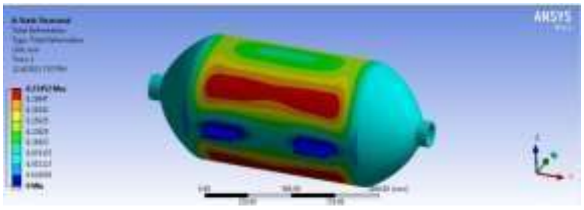
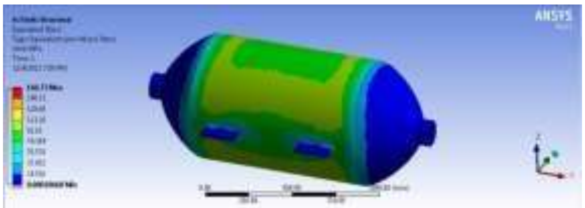
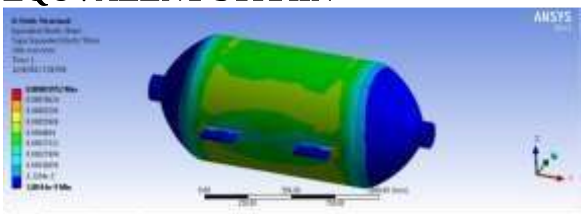
MATERIAL- E-GLASS FIBERTOTAL DEFORMATION



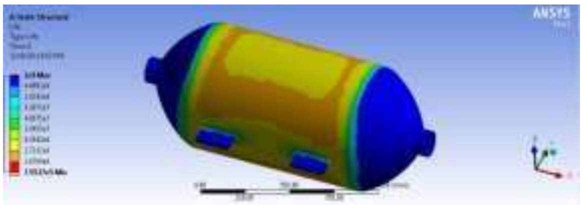
EQUIVALENT STRESS



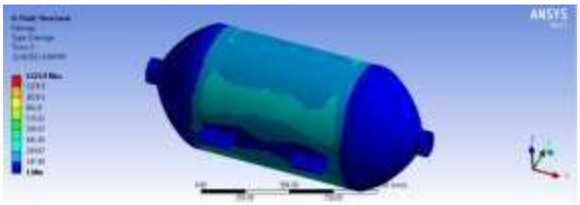
EQUVALENT STRAIN



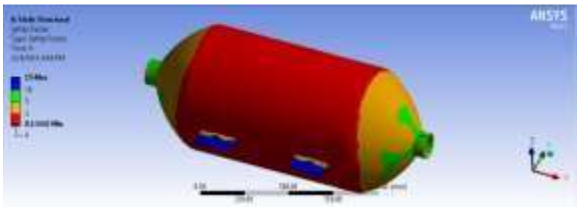
FATIUGE ANALYSIS OF PRESSURE VESSELLIFE



DAMAGE



SAFTEY FACTOR



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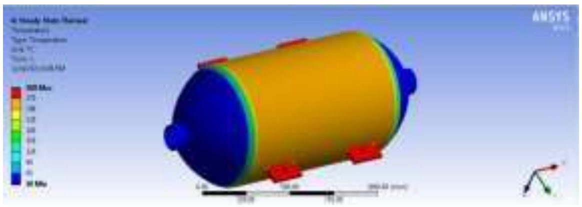
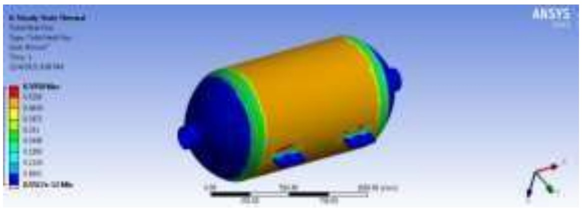
THERMAL ANALYSIS OF PRESSUREVESSEL
MATERIAL- E-GLASS FIBER TEMPERATURE DISTRIBUTION



HEAT FLUX



LINEAR LAYER ANALYSIS OF PRESSUREVESSEL
CASE: 1 3 LAYERS

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

TOTAL DEFORMATION

EQUIVALENT STRESS

RESULTS AND DISCUSSION
Static analysis results table

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

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Fatigue analysis results

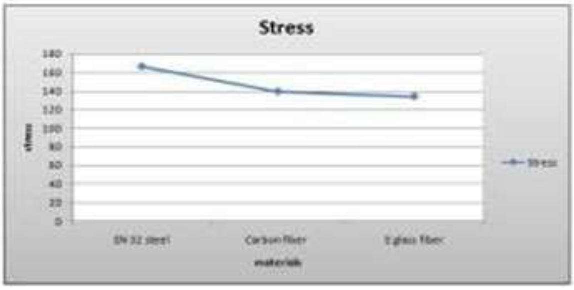
Material	Life	Damage	Safety factor
EN 32 steel	$1.67e^6$	1323.9	0.13442
Carbon fiber	$2.52e^6$	834.72	0.16051
E glass fiber	$2.77e^6$	752.99	0.16699

Thermal analysis results

Material	Temperature distribution(^oC)		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



Graph between Static analysis Stress and Materials Static analysis results were shown in Table 5.1 and Figure 5.1. In point of Stress minimization results, E- Glass fiber has major contribution followed by EN32 Steel and Carbon fiber. Deformation is low at EN32 Steel followed by E-Glass fiber and Carbon fiber.

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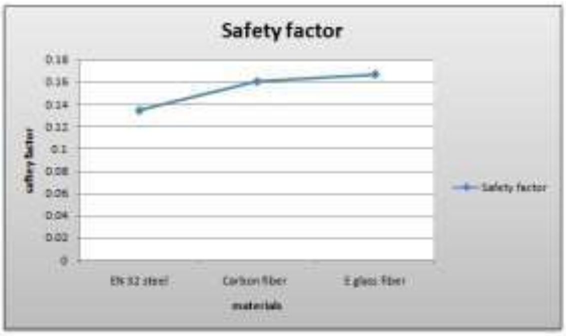

Figure : Graph between Fatigue analysis Safety factorand Materials
Safety factor is good at E-glass fiber material as seenin below figure

Figure : Graph between Linear layer analysis Stress
and Materials

So it can be concluded that the E-Glass fiber material is better material and 12 layers stacking is more efficient for pressure vessel

CONCLUSION

Structural, linear layer, thermal and fatigue analysis will be done in ANSYS on the pressure vessel with different materials and layer stacking.

By observing the static analysis the stress values are decreased at E-glass fiber when compared other two materials (EN 32 steel and carbon fiber).In fatigue analysis shows life of he pressure vessel at E-glass fiber.

By observing the thermal analysis results the heat dissipation is more for E glass material compare with steel and carbon materials.

By observing the linear layer analysis results, the stress values less at 12 layers stacking pressure vesselmodel when compared to conventional model.

So it can be concluded the E glass fiber material is better material for pressure vessel and layer stacking model.

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