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DESIGN AND ANALYSIS OF REACTOR PRESSURE VESSEL USING COMPOSITE MATERIAL AT DIFFERENT POSITIONS

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ABSTRACT

The Reactor pressure vessels are commonly used for hold gases or liquids at a pressure substantially different from the ambient pressure and temperature in nuclear power plant and gas plants. They are widely used in various industries such as petrochemical, oil and gas, chemical, and food processing industries, and chemical laboratory applications. At present the outer shells of the pressure vessels are commonly made of metals like carbon steels and aluminium alloys. The payload performance, speed, operating range depends upon the weight. The lower the weight is give the better performance, one way is reducing the weight, and it is by reducing the weight of the shell structure. The composite materials improve the performance of the vessel and offers a significant amount of material savings. The stacking sequence is very crucial to the strength of the composite material. This Project involves various objective functions such as stiffness, buckling load and Weight at each level of optimization. In this present work composite pressure vessels are made of carbon fiber reinforced aluminum matrix composite. Usually composite pressure vessels are designed for minimum mass under strength constraints. A graphical analysis is presented to find optimum fiber orientation for given layer thicknesses. In the present work, an analytical model is developed for the Prediction of the minimum buckling load with/ without stiffener composite shell placed at continuous angle ply laminas of (0^0, 15^0, 90^0) for investigation. Design involves parameters such as maximum safe operating pressure and temperature, safety factor, corrosion allowance and minimum design temperature. Comparisons are made with the finite element model done by 3-D finite element analysis is built using ANSYS-15.0 version software into consideration, for static and buckling analysis on the pressure vessel.

Keywords: Reactor pressure vessel, catia Ansys, carbon fiber reinforced aluminum matrix composite . and Stainless Steel compositematerial.

1 INTRODUCTION

Pressure vessels are important because many liquids and gases must be stored under high pressure. Special emphasis is placed upon the strength of the vessel to prevent explosions as a result of rupture. Codes for the safety of such vessels have been developed that specify the design of the container for specified conditions. Most pressure vessels are required to carry only low pressures and thus are constructed of tubes and sheets rolled to form cylinders. Some pressure vessels must carry high pressures, however, and the thickness of the vessel walls must increase in order to provide adequate strength. Interest in studying of the shell arises from the fifties of twentieth century. The assemblies, containing thin shells, find wide use in the modern engineering, especially in ships, aircraft and spacecraft industry. The shell vibrations and buckling modes are analyzed by means of numerical methods, to clarify qualitatively the critical loads and different buck ling modes.

In today‟s aerospace and aircraft industries, structural efficiency is the main concern. Due to their high specific strength and light weight, fibre reinforced composites find a wide range of applications. Light weight compression load carrying structures form part of all aircraft, and space vehicle fuel tanks, air cylinders are some of the many applications.

In the present work, design analysis of fiber reinforced multi layered composite shell, with optimum fiber orientations; minimum mass under strength constraints for a cylinder with or without stiffeners under axial loading for static and buckling analysis on the pressure vessel has been studied. Cylindrical shells (see Fig.1.) such as thin-walled laminated composite unstiffened vessels like deep submarine exploration housings and autonomous under water vehicles are subjected to any combination of in plane, Out of plane and shear loads due to the high external hydrostatic pressure during their application. Due to the geometry of these structures, buckling is one of the most important failure criteria. Buckling failure mode of a stiffened cylindrical shell can further be subdivided into global buckling, local skin buckling and stiffener crippling. Global buckling is collapse of the whole structure, i.e. collapse of the stiffeners and the shell as one unit. Local skin buckling and the stiffener scrippling on the other hand are localized failure modes involving local failure of only the skin in the first case and the stiffeners in these cond case.

Fig 1.1 :Rector Pressure Vessel

In the present work, an analytical model is developed for prediction of optimum fiber orientations for given layer thicknesses, and mainly minimum buckling load for with or without stiffener composite shell under multilayered continuous angle-ply loading condition is investigated. The model developed is more general in the sense that any configuration of stiffeners, on either one side or both sides of the shell can be modeled accurately. Stiffened shells having either symmetrical or unsymmetrical shell laminates can also be modeled with equal ease using this model. Grid stiffened cylindrical shells are the shells having a certain kind of stiffening structures either on inner, outer or both sides of the shell and significantly increases the load resistance without much increase in weight. To further reduce the weight, both the shell and the stiffeners are made using fiber reinforced polymers. The promising future of stiffened composite cylinder has in turn led to an extensive research work in this area. For the sake of analysis, shell elements (shell 91 & solid 46) were used and analysis was carried out with the aid of the commercial package, ANSYS-15.0. Due to the expensive nature of composite cylinder test specimens, experimentation could not be performed.

Introduction to Thin Composite Shells

The shell whose wall thickness is small compared to the radius of curvature and the corresponding radius of twist is known as thin shell. Plate and shell structures are used in a light weight load bearing structural parts for various modern aerospace, offshore, nuclear, automotive, and civil engineering structures. These shells are subjected to compressive loads. In the case of air crafts, they are subjected to fluctuating flight loads, which also produce compressive components. These compressive loads cause buckling of the shell structure. The analysis of composite shell structures requires consideration of a variety of failure modes. Often analysis programs cannot predict all failure modes using a single analysis model, and consequently structural designers must use a variety of analysis tools. It is also common that for a given failure mode, it is difficult to obtain the same result using different programs. There is no need to argue that composite shells are important in modern technology.

Composite Materials

Composites are considered to be combinations of materials differing in composition or formon a macro scale. The constituents retain their identities in the composite i.e. they do notdissolve or otherwise merge completely into each other although they act in the idea of a composite material is not a new or recent one concert. In nature, one can find out many composite materials, for example wood is a fibrous natural composite (cellulose fibrous in lign in matrix). Bone is yet another example of natural composites. Our ancestors invented composite by mixing straw and clay to make bricks. Straw is fiber reinforcement and clay is the matrix. The first glass fiber reinforced polymer was developed in 1940. The origin of distinct discipline of composite materials started in 1960"s.Extensive research has been doneoncompositematerialsince1965.One difference between laminated composites and traditional engineering materials is that a composite"s response to loads is direction dependent. Monolithic metals and their alloys can"t always meet the demands of today"s advanced technologies. The composite materials exhibit high specific strength and high specific modulus resulting in substantial reduction of weight of the components, thus improves efficiency, and results in energy savings. One of the main advantages of composite materials is the flexibility involved in getting the desired strength and stiffness in the direction required. Carbon fibers are very common in high-modulus and high-strength applications. It is well known that the measured strength of most materials is much smaller than their theoretical strength because of presence of imperfections or inherent flaws in the materials. Flaws in the form of cracks that lies perpendicular to the direction of load are particularly detrimental to the strength. It is found that non polymeric materials have higher strength along their lengths because of small cross sectional fibers, the flaws are minimized.

In case of polymeric materials, orientation of the molecular structure is responsible for high strength and stiffness. Fibers because of their small-sectional dimensions are not directly usable in engineering applications. They are embedded in matrix materials to form fibrous composites. The matrix serves to bind the fibers together; transfer loads to the fibers and protects them against environmental attack and damage due to handling. The shell is multi-layered fibrous composite shell. Each layer or lamina is a single-layer composite and thus orientation is varied according to design. Each layer is vary thin (thickness 0.4 mm to 0.7mm) and cannot be directly used. Several identical or different layers are bonded together to form a multi-layered composite shell.

Each layer may be differing from another layer in (a)Relative volumes of the constituent‟s materials (b) Form of the reinforcement. (c) Orientation of fibers with respect to common reference axes. Thus the directional properties of the individual layers may be quite different from each other.

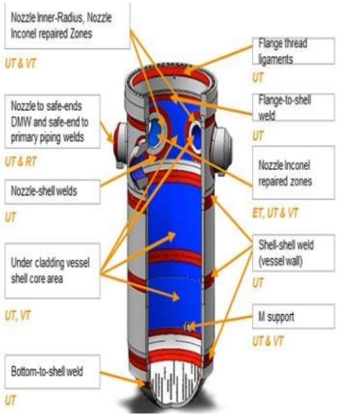

Fig. **1.2.Step so f reactor pressure vessel**

One of the most common methods to manufacture matrix composites is called the hot pressing method. Glass fibers in continuous tow are passed through slurry consisting of powdered matrix material, Solvent such as alcohol, and an organic binder as shown in fig 1.2.The to is then wound on a drum and dried to form Prepregtapes. The pre pregtapes can now be stacked to make a required laminate; heating at about 932°F (500°C) burns out the binder. Hot pressing at high temperatures of about 1832°F (1000°C) and pressures of 7 to14Mpa Design analysis of any composite structural element would require a complete knowledge of properties of individual layers. Each layer is a continuous angle-ply composite laminate consists of parallel fibers embedded in a matrix. Several unidirectional layers can bestacked in a specified sequence of orientation to fabricate a laminate that will meet design strength and stiffness requirements. Each layer of a unidirectional composite may be referred to as simple a layer ply or lamina. One of the most important factors for determining the properties of composites is relative proportions of the matrix and reinforced materials. There lative proportionate can be given as the weight fractions or by one of the experimental methods after fabrication. The volume fractions are exclusively used in the theoretical analysis of composite materials. Most man made composite materials made from two materials, these are a reinforced material called fiber and a base material called matrix. For example in concrete columns the concrete is base material which is called matrix and the iron rods come under fibers for reinforcement. Their existing three types of composites.

Fibrous Composites: It consists of fibers of one material in a matrix material of another material.

Particulate Composites: These are composed of particles of one material in a matrix of another material.

Laminate Composites: These are made of layers in which fibers and matrix are made of different materials, including the composites. The purpose of matrix is to transfer loads and protect them against environmental attack and damage due to handling. Based upon the properties required, the matrix and fiber materials are selected.

Fiber Fibers are principal constituents in fiber reinforced composite material. Theyoccupy the large volume fraction in a composite laminate and share major portion of load acting on a composite.

Glass is the most common fiber used in polymer matrix composites. Its advantage including its high strength, low cost, high chemical resistance and good insulating properties.

Carbon fibers are very common in high-modulus and high-strength applications. The advantages of carbon fibers include high specific strength and modulus, low coefficient of thermal expansion and high fatigue strength.

Aramid fiber is an aromatic organic compound made of carbon, hydrogen, oxygen and nitrogen. Its advantages are low density, high tensile strength, low cost and high impact resistance.

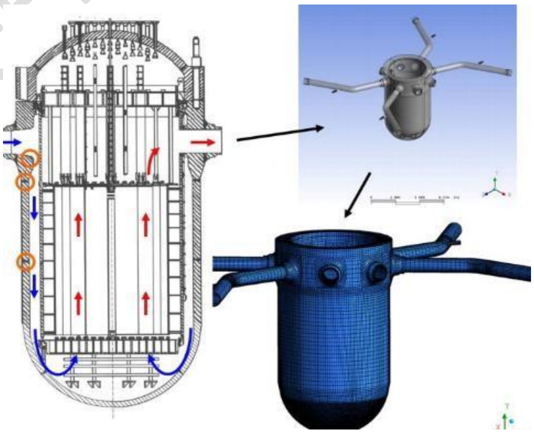

Fig1.3.Reactor Pressuring

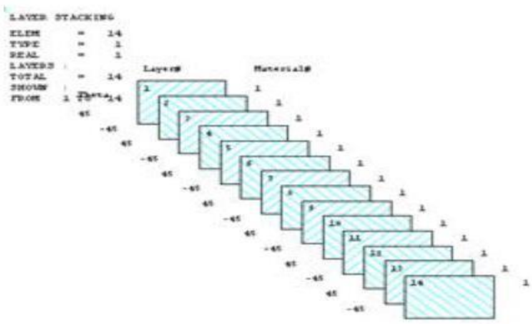

Fig1.4. Layer Stakin

In Filament winding as shown in fig1.5, fibers are impregnated with a resin by drawing them through an in-line resin bath, Depending on the desired

Vol 13, Issue 01, Jan /2022
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properties of the product; winding patterns such as hoop, helical can be developed. The product is then cured with or with out heat & pressure. Each ply is pressed to remove any entrapped air & wrinkles; the lay-up is sealed at the edges to form a vacuum seal.

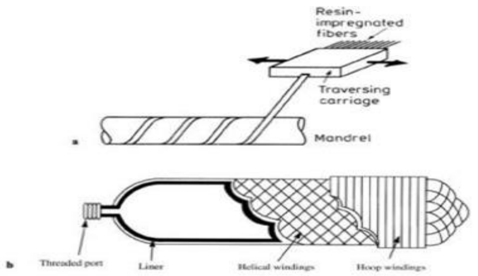
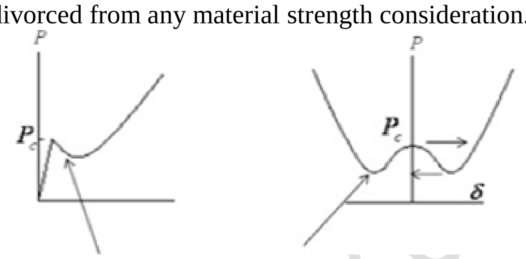


Fig1.5. Filament wound Pressure Vessel

BUCKLINGANALYSIS

Buckling may be defined as the failure of structure under axial compressive load. The load at which the shell structure becomes unstable under Compressive loads and buckles is known as buckling load. A structure may fail to support its load when a connecting snaps, or it bends until it isuseless, or amember in tension either pulls apart or a cracks forms that divides it, or a member in compression crushes and crumbles, or finally, if a member in compression buckles, that is moves laterally and shortens under a load it can no longer support.
Of all of these modes of failure, buckling is probably the most and most catastrophic. The ratio of critical stress to the working stress is known as buckling factor. There are three basic types of buckling of thin shells corresponding to the three types of membrane stresses, axial and circumferential normal stress and shear stresses on axial and circumferential surfaces. To cause buckling the axial and circumferential stresses must be compressive. When a structure(usually subjected to compression) undergoes visible large displacements transverse to the load then it is said to buckle. Buckling may be demonstrated by pressing the opposite‟s edges of a flat sheet of cardboard towards one another. For small loads the process is elastic since buckling displacement disappears when the load is removed. Local buckling of plates or shells is indicated by the growth of bulges, waves or ripples, and is commonly encountered in the component plates of thin structural members. Buckling proceeds in manner which may be either: Stable - In which case displacement increases in a controlled fashion as loads are increased, i.e. the structure‟s ability to sustain loads is maintained. Unstable- In which de formations increase instantaneously, the load carrying capacity nose-dives and the structure coll apsescata strophically. Neutral equilibrium is also a theoretical possibility during buckling – this is characterized by deformation increase without change in load.Buckling and bending are similarin that they both involve bending moments. In bendingthese moments are substantially independent of the resulting deflections, whereas in buckling the moments and deflections are mutually inter-dependent - so moments, deflections and stresses are not proportional to loads. If buckling deflections become too large then the structure fails this is a geometric consideration, completely divorced from any material strength consideration.



Unstable post-buckling path
(snap)Fig.1.6.Bucklingcurve

Since the displacement are uncontrolled in most practical systems, shells behave in a snap-buckling mode i.e. as an increasing load reaches the bifurcation point, the cylinder must under go an instantaneous increase in deflection(“snap”)to the point in order to accommodate the increasing load. A subsequent decrease in load is accommodated by a corresponding decrease in buckling deflection until the point is reached where upon the structure again snaps instantaneously – this time back to the point on the primary path as shown in figure. Clearly this behaviour makes it imperative in design to apply large safety factors to the theoretical buckling loads of compressed cylinders.

MECHANICALPROPERTIESOFAMMCs

The aim of designing metal matrix composite materials is to combine the desirable attributesof metal and ceramics The addition of high strength, high modulus refractory particles to aductile metal matrix will produce a material whose mechanical properties are intermediate between the matrix alloy and the ceramic reinforcement Metals have a useful combination of properties such as high strength, ductility, and high temperature resistance, but sometimes some of them have a low stiffness value, whereas ceramics are normally stiff and strong.
The addition of high strength, high modulus refractory particles to a ductile metal matrix produce a material whose mechanical properties are intermediate between the matrix alloy and the ceramic reinforcement. Metals have a useful combination of properties such as high strength, ductility and high temperature resistance, but sometimes have low stiffness, whereas ceramics are stiff and strong, though brittle. Aluminium and silicon carbide, for example, have very different mechanical properties: Young's moduli of 70 and 400 GPa, coefficients of thermal expansion of 24 × 10−6and 4 × 10−6 /°C, and yield strengths of 35 and 600 MPa, respectively. By combining these

materials, e.g. A6061/SiC/17p (T6 condition), an MMC with a Young's modulus of 96.6 GPa and a yield strength of 510 MPa can be produced. By carefully controlling the relative amount and distribution of the ingredients of a composite as well as the processing conditions, these properties can be further improved. The correlation between tensile strength and indentation behavior in particle reinforced MMCs manufactured by powder metallurgy technique . The microstructure of SiC reinforced aluminium alloys produced by molten metal method. It was shown that stability of SiC in the variety of manufacturing processes available for melt was found to be dependent on the matrix alloy involved.

- Among discontinuous metal matrix composites, stir casting is generally accepted as a particularly promising route, currently practiced commercially. Its advantages lie in its simplicity, flexibility and applicability to large quantity production. It is also attractive because, in principle, it allows a conventional metal processing route to be used, and hence minimizes the final cost of the product. This liquid metallurgy technique is the most economical of all the Available routes for metal matrix composite production , and allows very large sized components to be fabricated.
- The cost of preparing composites material using a casting method is about one-third to half that of competitive methods, and for high volume production, it is projected that the cost will fall to one-tenth. In general, the solidification synthesis of metal matrix composites involves producing a melt of the selected matrix material followed by the introduction of are inforcement material into theme lt, obtaining a suitable dispersion.

2. LITERATURESURVEY

This chapter presents a survey of the investigations carried out on the analysis of cylindrical pressure vessel with to rispherical enddomes. This topic being a classical subject, quite a number of studies - analytical, experimental and numerical - have been reported in the literature. As it is difficult to cover the entire literature, a few notable ones on vessels with to rispherical heads under internal pressure are discussed here.

Materials have been pivot to the growth, prosperity, security and quality of life of human beings since the beginning of history. Without new materials and their efficient production, our world of modern devices, machines, automobiles, aircrafts and structural products could not exist. The increasing complexity of areas like construction, transport, environment, and energy demands products and industrial processes with improved quality, durability, functionality and structural properties of materials. This has inspired material engineers to come up with new materials at low cost to meet stringent and often c on flicting property requirements, which conventional materials such as monolithic metals and their alloys cannot satisfy. To meet today‟s requirements, composite materials have shown great promise. Composites are the materials, which are tailored by combining two or more materials to get properties that are not attainable in any of its constituents alone. These materials contain dispersed fibers, particles or whiskers embedded in a matrix, which may be metallic, polymer or ceramic material. Composites are made from constituents, which can be grouped as (a)matrix (continuous phase) and (b) reinforcements (either continuous or discontinuous) in the form of particles, flakes, whiskers and short fibers (Alman, 2001). These combinations of materials can result in a newly synthesized material having unique and tailored properties such as low density, exceptional strength and stiffness, fatigue and corrosion resistance, high thermal conductivity and low coefficient of thermal expansion (Srivatsan*et al*, 1995). Due to their light weight, composites are being extensively used in manufacturing components of ground, space and aerospace vehicles. Composite technology provides us with the ability to create new multi functional materials that can offer all the desirable characteristics required for a given application combined with low cost and near net-shape manufacturing processes, there by expanding the vision for new materials and applications. On the basis of nature of matrix materials, the composites may be classified as metal matrix composites (MMCs),ceramic metal composites (CMCs) and polymer matrix composites (PMCs) (Aggarwal andBroatman,1980).

3. METHODOLOGY

The days are long gone when it was considered that the heavier the product better the quality. The light weight composite component makes more desirable to manufacturers, aswell as consumers and workers. Composite materials include outstanding Strength, excellent durability, High heat resistance and significant weight reduction. The present work clearly emphasizes on the usage of composite materials in the production of cylindrical pressure vessels. Weight calculations have been carried out by varying the materials like conventional and composite materials, tofindout the material that has minimum weight.
CarbonfiberCompositesareroughlyquarterweightofthestLength(height,„h‟)ofthecylinderL=1030mmDiameterofthecylinderd=670mm

Thickness of the shell t = 10 mmR -r=tr=R–t

r=335–10

r=325mm

Volume=Пr2h=ПX(335²-

Journal of Engineering Sciences
Vol 13, Issue 01, Jan /2022
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3252)X1030=21356546.86mm3=21.356546x 106mm6

=21.356546x10-3
Densityρ =mass/VolumeWeight=m.g =ρ.v.g
Densityofsteel
= 7.86gm/cm3=7.86x103m
=ρV=7.86x21.356x10-3=167.858kg

GlassEpoxy2.1x103x21.356x10-3= 44.847kg
CarbonEpoxy

1.55x103x21.356x10-3=33.10kg

AramidEpoxy

1.32x103x21.356x10-3=28.189k

MODELINGOFCYLINDRICALPRESSURE VESSEL

ThemodelingoftheCylindricalPressureVesselisdone inCatiaV5R20.

IntroductiontoCatiaV5 R20:

CATIA-V5 is the industry's de facto standard 3D mechanical design suit. It is the world's leading CAD/CAM /CAE software, gives a broad range of integrated solutions to cover all aspects of product design and manufacturing. Much of its success can be attributed to its technology which spurs its customer's to more quickly and consistently innovate a new robust, parametric, feature based model. Because that CATIAV5 is unmatched in this field, in all processes, in all countries, in all kind of companies along the supply chains.

Catia-v5 is also the perfect solution for the manufacturing enterprise, with associative applications, robust responsiveness and web connectivity that make it the ideal flexible engineering solution to accelerate innovations. Catia-v5 provides easy to use solution tailored to the needs of small medium sized enterprises as well as large industrial corporations in all industries, consumer goods, fabrications and assembly. Electrical and electronics goods, automotive, aerospace, shipbuilding and plant design. It is user friendly solid and surface modeling can be done easily.

The model is as shown in the figure3.1as shown below:

Fig 3.1Reactor pressure vessel Model

The drawing Specifications taken are as shown intheFigure3.2below:

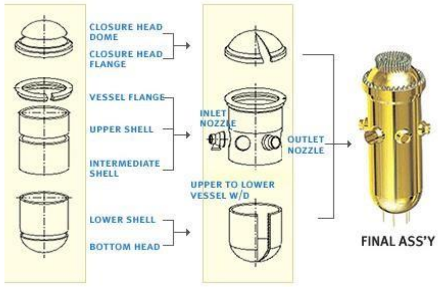

Fig.3.2. Drawing Specifications for the reactor Pressure Vessel.

Fig. 3.3 Drawing Specifications for the reactor pressure vessel.

4. MODEL&MESHING

INTRODUCTIONTOFINITEELEMENTMETHOD

The finite element method is a numerical procedure for analyzing structures and continua. Usually problem addressed is too complicated to solve satisfactorily by classical analytical methods. The finite element procedure develops many simultaneous algebraic equations,which are generated and solved on a digital computer. The results obtainable are accurate enough for engineering purposes at reasonable cost. In addition itis an efficient design tool by which designers can perform parametric design studies by considering various design cases(different shapes, materials, loads , etc.,), analyze them and choose the optimum design .Hence the method has increasingly gained popularity among both researchers and practitioners.

GENERALDESCRIPTIONOFFINITEELEMENTANALYSIS

In the finite element method, the actual continuum or body of matter like solid, liquid or gas is represented as on assemblage of sub divisions called finite elements. These elements are considered to be interconnected at specified joints, which are called nodes or nodal points. The nodes usually lie on the element boundaries where adjacent elements are considered to be connected. Since the actual variation of the field variable(like dis placement, stress, temperature, pressure and velocity) inside the continuum is not known, we assume that the variation of field variable inside a finite element can be approximated by a simple function. These approximating functions (also called interpolation models) are defined in terms of values at the nodes. The new unknown will be the nodal values of the field variable. By solving the field equations, which are generally in the form of matrix equations, the nodal values of the field variable will be known. Once these are known, the approximating function defines the field variable through out the assemblage of elements.

ANALYSISOFCYLINDRICALPRESSUREVESSEL

The analysis of the cylindrical pressure vessel is done inAnsys15.0andtheanalysisreportsare as shown below. The geometry and the mesh model in Ansys are as shown in the Fig.3 and Fig.4 below respectively

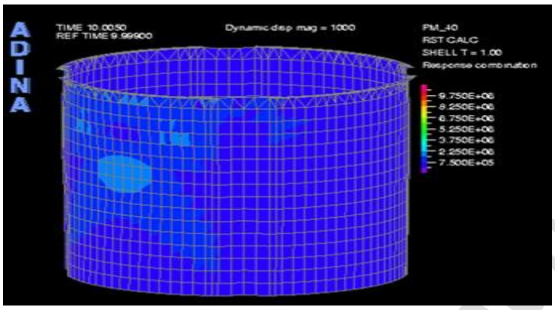

Fig.4.1Geometry of the pressure vessel

<u>MESHING</u>

The Modeled cylinder was imported to ANSYS for meshing; The solid model was settlement attributes, and established meshing controls, you can then turn the ANSYS program loose to generate the finite element mesh. By taking care to meet certain requirements, we can request a"mapped"mesh containing all quadrilaterals, all triangular, or all brick elements. Here the shell was meshed using quadrilateral elements. The mesh size usedis4mm for both shell and the stiffeners. The mesh size may be changed depending on the complexity of the problem. Also increases as the number of elements increases and it requires powered system to solve the problem. Mesh generation is one of the most critical aspects of engineering simulation.

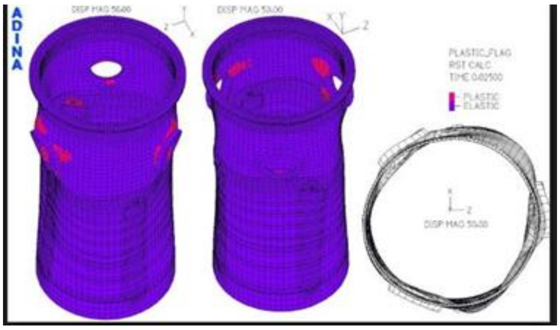

Fig.4.2Meshofthe reactor pressure vessel

5. **RESULTS**

The analysis of aluminium alloys cylindrical pressure vessel with the composite cylindrical pressure vessel is done. In addition we would like to change the orientation of composite cylindrical pressure vessel in such away that the thickness is 1mm with variants of 7layers,8^0layers,9 layers and 10 layers of composite allowed with anangle of 0,15 and 90.The results for the composite pressure vessel of 1mm with 7 layers and differentangles of orientation are as shown below:

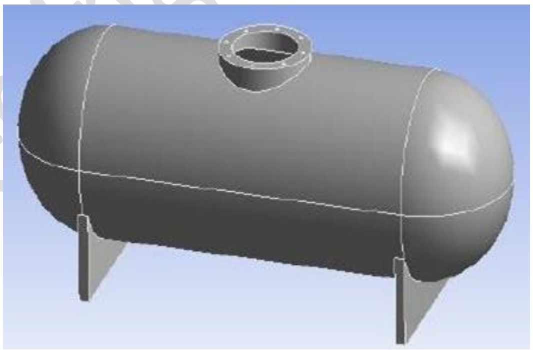

Figure5.1: Hemi spherical head vessel with two saddle support with15^0

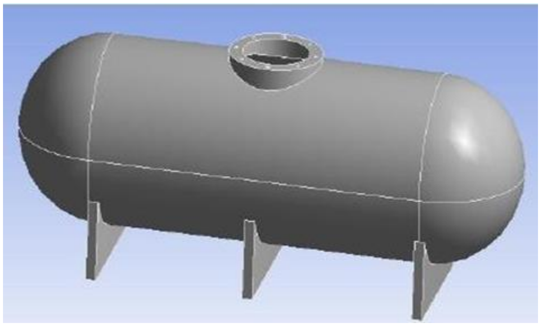

Figure5.2:Hemi spherical head vessel with three saddle support

Vol 13, Issue 01, Jan /2022
ISSN NO:0377-9254

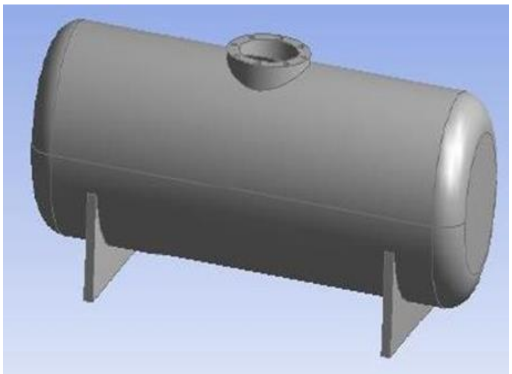

Figure 5.3 : Flat Circular Head with two saddle support
0^0Model of horizontal pressure vessel with saddle support:

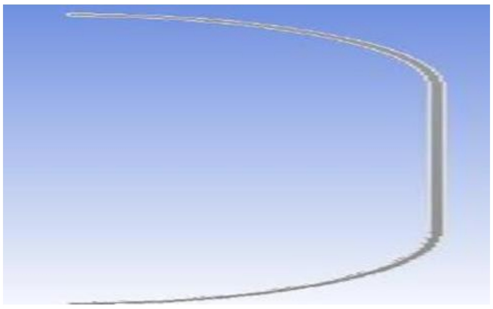

Figure5.4:Model of hemi spherical head15^0

Figure5.5:model of circular head0^0

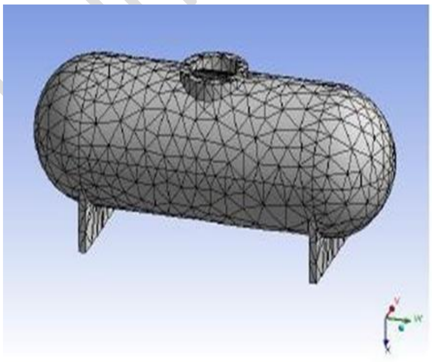

Figure5.6 :Hemisphericalhead vessel15^0

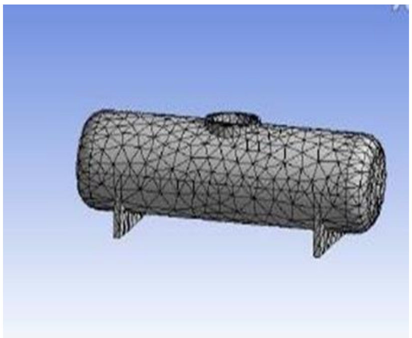

Figure5.7: Flat CircularHead0^0

The boundary condition for hemispherical and flat circular end connection pressure vesselsare shown in the figure. The results computed is in the form circumferential and longitudinal stresses shown in figures which indicates for axi symmetric analysis, hemispherical and ellipsoidal end pressure vessel acquires less stress than other ends. The results also computedin equivalent (von mises) stress, maximum principal stress and minimum principal stress are shown in table and graphical representation of stresses is shown in figure.

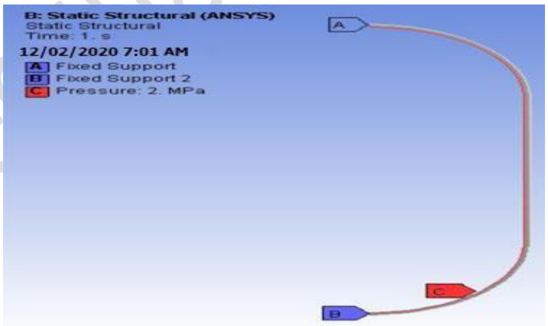

Figure5.8:Hemisphericalend15^0

Figure5.9:Flat circularend0^0

Boundary condition for axisymmetric pressure vessel:

Vol 13, Issue 01, Jan /2022
ISSN NO:0377-9254

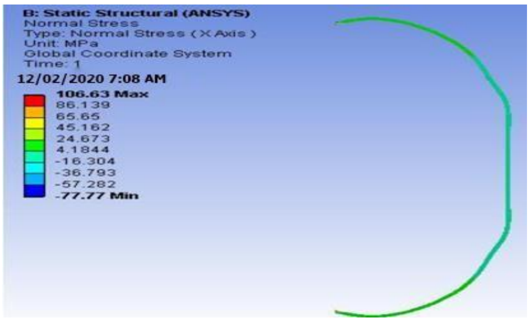

Figure. 5.10: circum ferential Stress

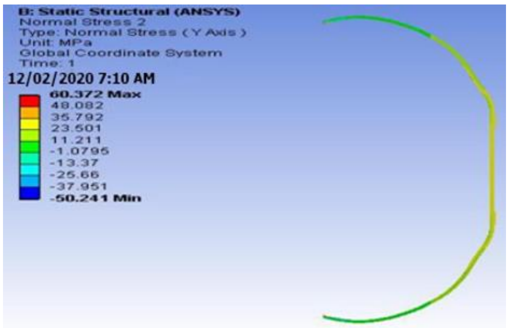

Figure5.11: Longitudinal Stress Circumferential and longitudinal stress on hemi spherical end pressure vessel

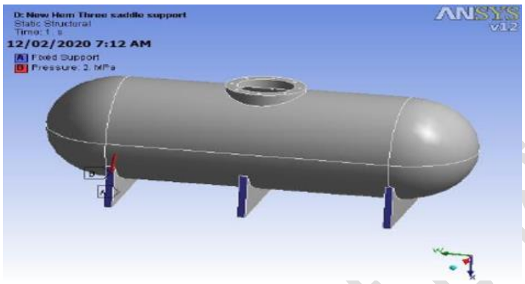

Figure5.12:Hemi sphericalend15^{0}

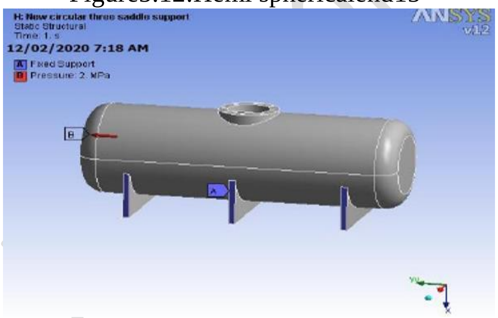

Figure5.13:Flat circular end0^{0}

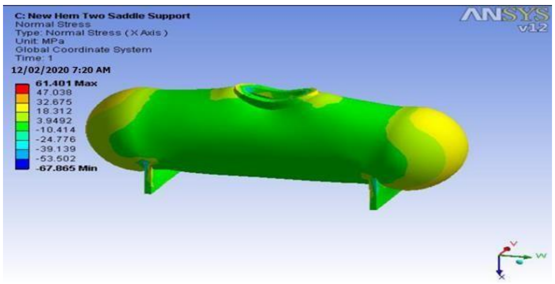

Figure5.14:Circumferential stress

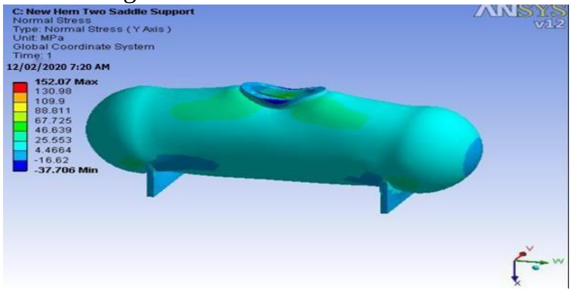

Figure5.15:Longitudinal stress

Circumferential and longitudinal stresses on hemispherical end pressure vessel with two saddle support:

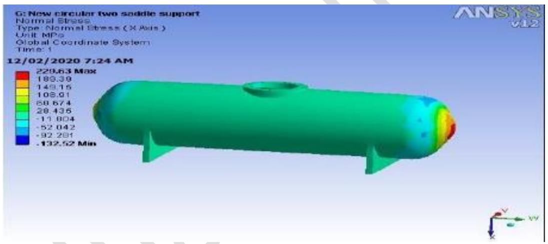

Figure5.16: Circumferential stress

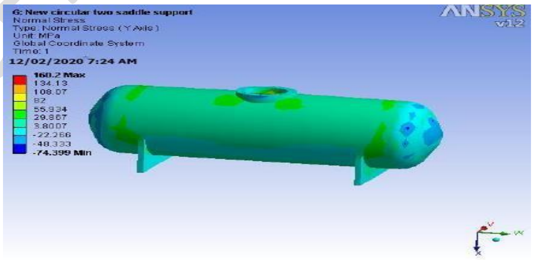

Figure5.17: Longitudinal stress

PRESSUREVESSELWITHSADDLESUPPORT 90^{0}:

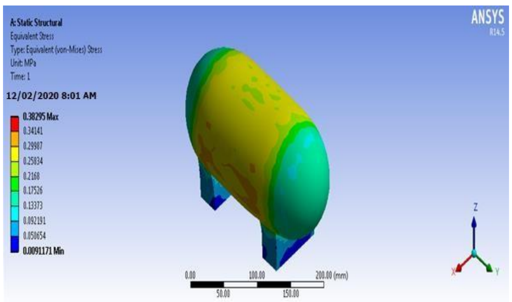

Figure5.18: vonmisses stress on pressure vessel

Vol 13, Issue 01, Jan /2022
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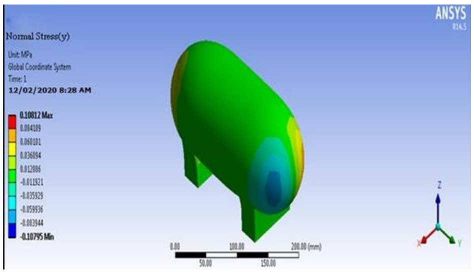


Figure5.19: Normal stressY

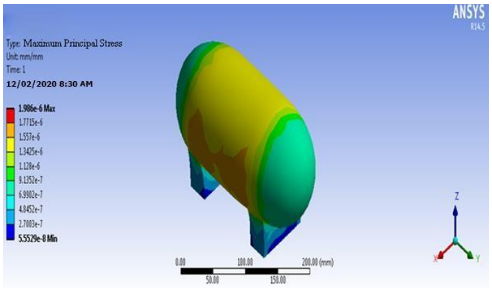
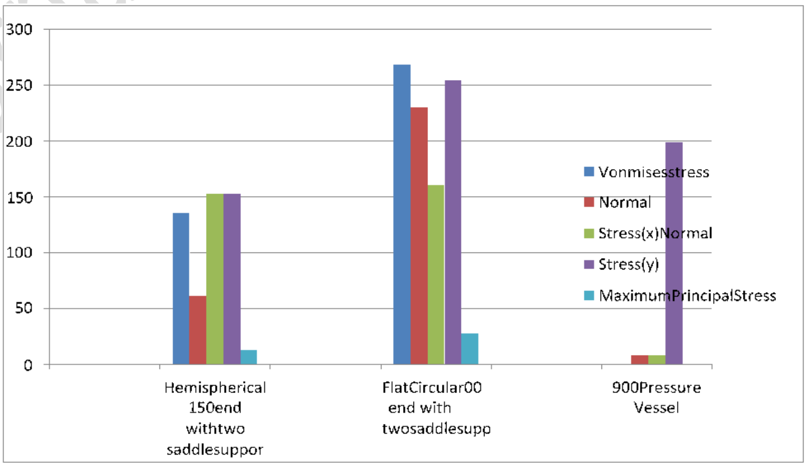


Figure 5.20 :Maximum Principal Stress

Table5.1:Analysis of Horizontal Pressure Vessel with Saddle Support

Type of Pressure Vessel	Von mises stress	Normal Stress(x)	Normal Stress(y)	Maximum Principal Stress	Minimum Prinicipal Stress
Hemispherical15^{0}end with two saddle support	135.54	61.401	152.07	152.46	12.4
Flat Circular0^{0}end with two saddle support	268.18	229.63	160.2	254.23	27.573
90^{0}Pressure Vessel	0.35295	8.0011	8.188	198.6	0.38363



Graph: Pressure Vessel with Saddle Support variations in different angles

6. CONCLUSIONS

This project work involves the comparison of conventional steel and Composite material cylindrical pressure vessel under static loading conditions. The model is preferred of in CatiaV5 R20 and then analysis is performed through ANSYS 15.0 from the result obtained. It maybe concluded that the development of a composite cylindrical pressure vessel having constantcross sectional area, where the stress level at any station in the Composite pressure vessel is considered drop and rise due to the orientation of composite, has proved to be very effective. Taking weight into consideration, It may be concluded that 7 layers gives lesser weight. But, taking stress and weight into consideration, 10 layers is giving the desired result. The results are found to be effective for the composite lamina for 90^0 orientations. The deformation is tending to reduce for the 10 layers composite orientation so as the Equivalent Stress. The Lamina stacking sequence is appropriate which is free from extension – bending, coupling which reduces the effectives tiffness of the lamina, since the laminate sare symmetric.

Appropriate number of plies needed in each orientation and thickness of the shell is safe from static and buckling analysis is concerned. The comparison plots obtain desired results for stresses and deformations with lamina orientations for the chosen composite materials.

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