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MODELLING AND ANALYSIS OF MULTI-LAYER PRESSURE VESSEL

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ABSTRACT

The multilayer pressure vessels are single divider round and hollow shaped metallic vessels. This is handling the High pressure inside of the container, used in industries such as chemical processing, oil and gas and aerospace. System designing as the weight of the working liquid broadens, increase in the thickness of the vessel needed to hold that liquid. Those layers are engineered to provide structural integrity, enhance safety and prevent leakage or rupture under extreme pressure conditions.

In this project "MODELLING AND ANALYSIS OF MULTI LAYER PRESSURE VESSEL" the investigation is done by considering the E glass epoxy material and S2 glass epoxy materials in the multilayer weight vessel the multilayer weight vessel is dissected in ANSYS, a versatile Finite Element Package for stresses made in them the conclusions are drawn from the multilayer weight vessel by looking at ANSYS estimations of the structural analysis done by using Resin Epoxy ,Pvc, E and S2 glass epoxy materials and to determine the stress values.

Keywords:
Modelling, Analysis, Properties, Applications.

INTRODUCTION

A pressure vessel is a closed container designed to hold gases or liquids at a pressure substantially different from the ambient pressure. These vessels find widespread application in various industries, including chemical processing, oil and gas, and manufacturing. Now, a multilayer pressure vessel is an advanced iteration of this concept. It goes beyond the traditional single- layer design by incorporating multiple layers of different materials. This innovation aims to improve structural integrity, enhance safety, and optimize performance when dealing Strategic combination of materials in multilayer pressure vessels makes them pivotal in ensuring reliability and efficiency in diverse industrial scenarios.

Fig-1: Horizontal Pressure Vessel in Steel

In many nations, vessels over a specific size and weight must be worked to a formal code. In the United States that code is the ASME Boiler and Pressure Vessel Code (BPVC). These vessels additionally require an approved assessor to approve each new vessel built and every vessel has a nameplate with relevant data about the vessel, for example, most extreme passable working weight, greatest temperature, least outline metal temperature, what organization made it, the date, its enlistment number (through the National Board), and ASME's legitimate stamp for weight vessels(U-stamp)

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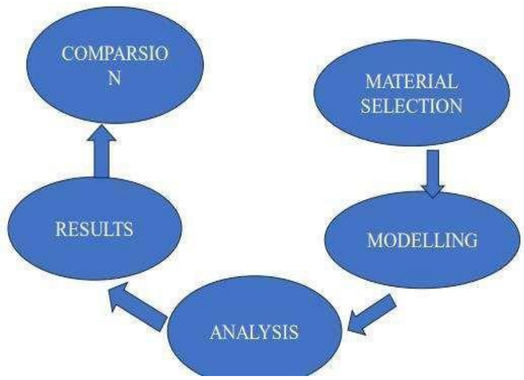
METHODOLOGY



The methodology for modeling and analyzing a multilayer pressure vessel involves defining its geometry and material properties, setting boundary conditions, and employing finite element analysis (FEA) to simulate stress and strain distributions. Interlayer interactions and failure criteria are considered, followed by sensitivity analysis and optimization to enhance design. Validation against experimental data ensures accuracy and reliability in predicting real-world behavior

MODELING OF PRESSURE VESSEL

CATIA is a 3D solid modeling package which allows users to develop full solid models in a simulated environment for both design and analysis. In CATIA; you sketch ideas and experiment with different designs to create 3D models. CATIA is used by students and professionals to produce simple and complex parts, assemblies, and drawings. Design in a modeling package such as CATIA is beneficial because it saves time that would otherwise be spent prototyping the designCatia is the one of the computers aided three-dimensional interface applications with help of module and tools by parametric condition that can create any 3d dimensional components.

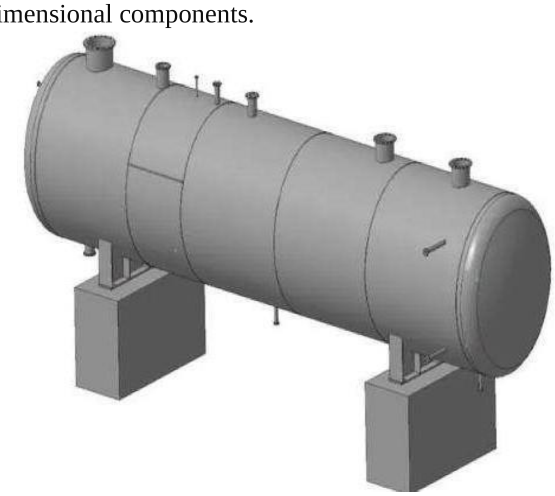


Figure 3.1: Modelling of Pressure Vessel

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MODELLING OF PRESSURE VESSEL IN CATIA V5

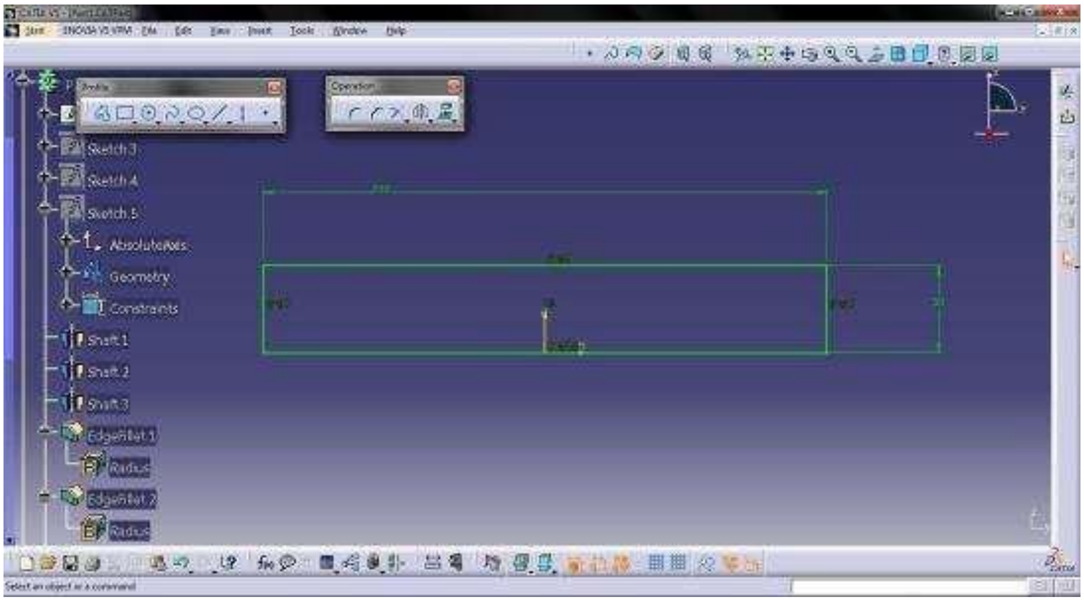

Fig-3.1: Draw a Rectangle Using Profile Tool Bar

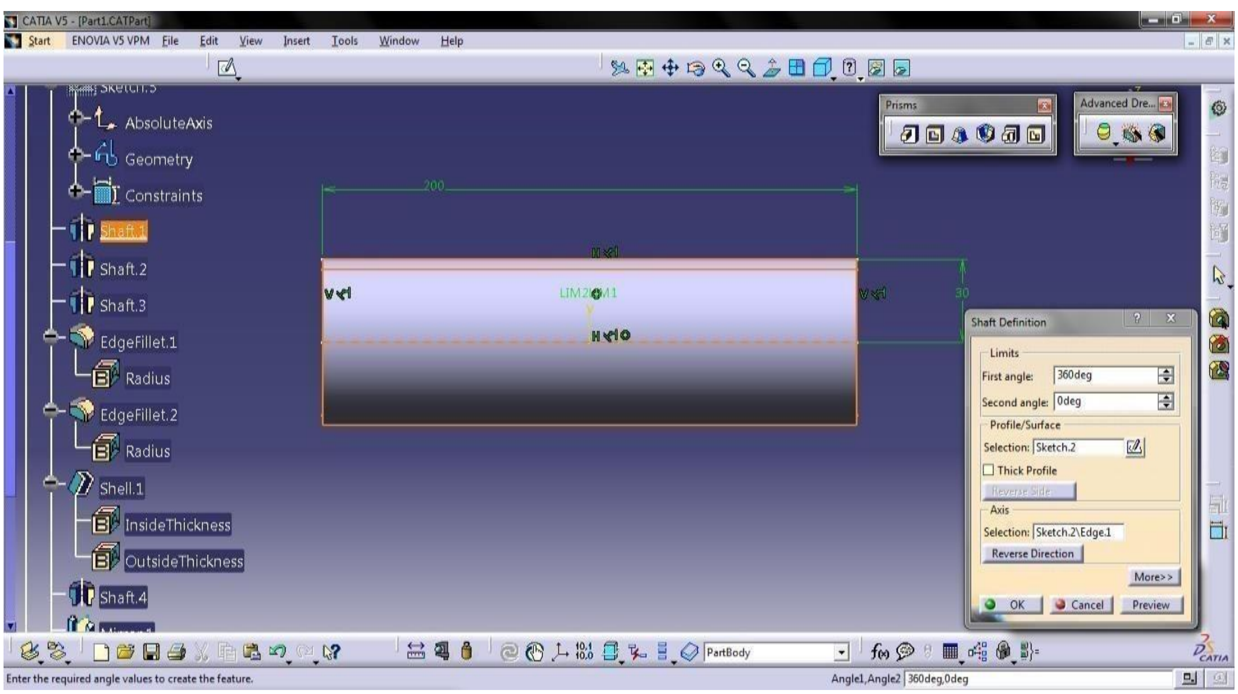

Fig-3.3: Shaft Tool for Pipe

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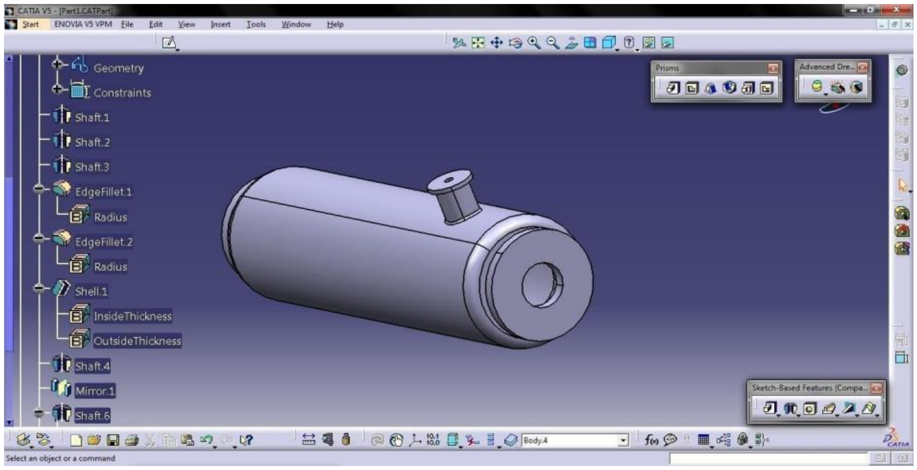

Fig-2.5: Shell for Thickness

INTRODUCTION TO ANSYS

Ansys a product of ANSYS inc. Is a world's leading, widely distributed and popular commercial package. It is widely used by designers/analysis in industries such as aerospace, automotive, manufacturing, nuclear, electronics, biomedical, and much more. Ansys provides simulation solutions that enable designers to simulate design performance directly on the desktop. In this way, it provides fast efficient and cost-efficient product development from design concept stage to perfonnance validation stage of product development cycle.

INTRODUCTION TO FEA

The finite element analysis (FEA) is a computing technique that is used to obtain approximately. Solution to boundary valve problems. It uses a numerical method called finite element method (FEM).in FEA involves the computer model of a design that is loaded and analyzed for specific results, much as stress, deformation, deflection, natural frequencies, mode shapes, temperatures distribution and soon. In FEA simulation the loading condition of design and determination the design responses in those conditions. It can be used in new product design as well as in exiting product refinement. The concept of FEA can be explained through a basic measurement of dimensions. In FEA simulation the loading condition of design and determination the design responses in those conditions. It can be used in new product design as well as in exiting product refinement.

RESULTS

After the analysis is finished the next important step is to understand the evaluated results. In this project, we evaluated deformation so far.

Select total deformation under the solution node in the tree outline, the total deformation of the model is displayed in the graphics screen. Also, the corresponding legend is displayed in the graphics screen.

Aluminum Alloy+ Stainless Steel+ Resin Epoxy

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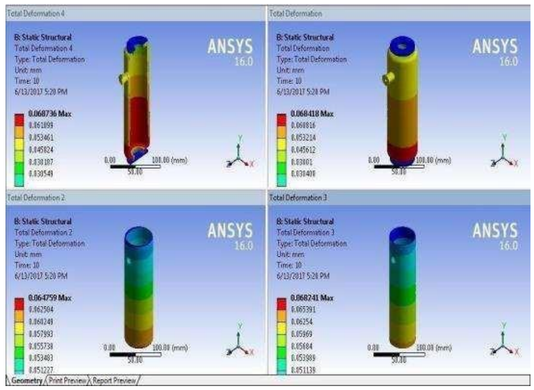

EpoxyFig-8.1- Total Deformation

Aluminum Alloy+ Stainless Steel+ PVC

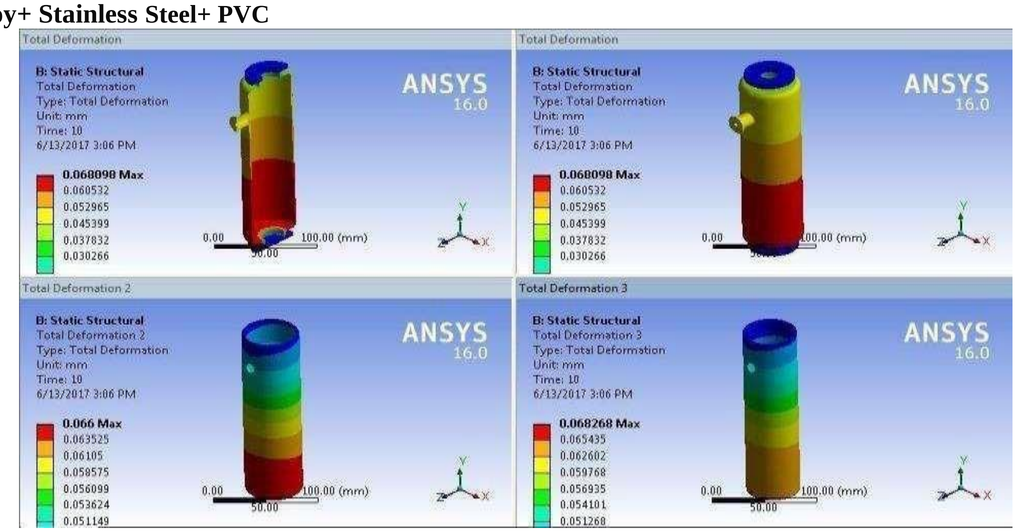

Fig-8.1- Total Deformation

TABLE

Total Deformation Results of Static Structural Analysis

S.no		Equivalent stress at 10 mpa pressure			
	Material	Last on vessel	First on vessel	Middle on vessel	All vessel
1	Al+ss+resin	491.42	6.6796	61.629	491.42
2	Al+ss+pvc	493.335	0.01931	87.801	493.35
3	Al+ss+e glass	491.41	25.571	62.28	491.41
4	Al+ss+s glass	491.47	26.39	62.274	491.47

Equivalent Stress Results of Static Structural Analysis

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S.no		Equivalent stress at 10 mpa pressure			
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4	Al+ss+s glass	491.47	26.39	62.274	491.47

CONCLUSION

From the table comparing Resin Epoxy, PVC, E Glass Epoxy, and S2 Glass for multi-layer pressure vessels highlights several key factors that are crucial for modeling and analysis. S2 Glass Epoxy exhibits superior tensile strength and modulus of elasticity, making it a promising choice for applications demanding robust structural performance. Resin Epoxy and E Glass Epoxy also offer favorable characteristics, with notable chemical resistance and moderate mechanical properties. PVC, while flame retardant and suitable for certain applications, may lack the mechanical strength required for demanding pressure vessel environments. Finally concluded that when varying different layers combination along with composites, the pressure vessels have bearded while observing with different materials and their contact positions

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REFERENCES

1. M. Jadav Hyder, M Asif, "Enhancement of Location and Size of Opening in A Pressure Vessel Cylinder Using ANSYS". Designing Failure Analysis. Pp 1-19, 2008.

2. Joship kacmarcik Nedelijko Vukojevic ,"Examination of Design Method for Opening in Cykindrical Shells Under Internal Pressure Reinforced by Flush(Set on) Nozzles".

3. V.N. Skopinsky and A.B. Smetankin, "Displaying and Stress Analysis ofNozzle Connectionsln Ellipsoidal Heads Of Pressure Vessels UnderExternal Loading." Int. J. Of Applied Mechanics and Engineering, Vol.11, No.4, Pp.965-979, 2006

4. **J.** Tooth, Q.H. Tang, Z.F.Sanga, "Similar Study of Usefulness forPad Reinforcement in Cylindrical Vessels under External Load onNozzle". Worldwide Journal of Pressure Vessel and Piping 86, Pp273-279, 2009

Pravin Narale, P.S. Kachare , "Basic Analysis of Nozzle Attachment on Pressure Vessel Design," International of Engineering Research and Application, Vol.2, Pp 1353-1358, 2012

6. Arman Ayobstress , "Examination of Torispherical shell with Radial Nozzle", Nuclear Engineering, Malaysia, Vol.67,2006

7. V.N. Skopinsky, "Worry in Ellipsoidal Pressure Vessel Heads with Noncentral Nozzle;" Nuclear Engineering and Design 198, Pp 317-323, 2000

8. Jaroslav Mackerle , "Limited Element in the Analysis of Pressure Vessel and Piping, An addendum: A Bibliography (2001-2004)," International Journal of Pressure Vessel and Piping 82, Pp571-592,2005