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Research Paper

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Ply Angle Optimisation and Thermo-Mechanical Failure Assessment of Filament-Wound Carbon/Epoxy Composite Pressure Vessels Using SolidWorks Simulation

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ABSTRACT

Filament-wound carbon/epoxy composite pressure vessels are increasingly employed in aerospace, automotive, energy, water treatment, and mining applications owing to their high specific strength, lightweight characteristics, and corrosion resistance. This study investigated the effects of ply angle, internal pressure, and elevated temperature on the behaviour of filament-wound T300/LY5052 carbon/epoxy pressure vessels using SolidWorks Simulation. A quarter-symmetry finite element model incorporating a 12-ply symmetric laminate configuration, $[\pm\theta]_s$, was developed and subjected to mesh convergence analysis. Ply angles ranging from 0° to 90° at 5° intervals were evaluated under internal pressures of 15, 20, and 30 bar to identify the optimum laminate configuration, which was subsequently assessed under thermo-mechanical loading within a temperature range of 40–180 °C. Performance was evaluated using equivalent strain, total displacement, factor of safety, and Tsai–Hill, Tsai–Wu, and Maximum Stress failure criteria. The results showed that fibre orientation significantly influenced the response of the pressure vessel, with the 50° ply angle exhibiting the highest safety margins and lowest deformation responses. Compared with the 0° laminate, the optimum configuration reduced equivalent strain by approximately 56% and increased the Tsai–Hill factor of safety to about 3.9 while maintaining failure indices below their critical limits. Thermo-mechanical analyses further revealed that internal pressure dominated the structural response, whereas elevated temperatures had only marginal effects on structural reliability. The consistent identification of the 50° laminate by all three failure criteria strengthened confidence in the findings. For the geometry and loading conditions investigated, the proposed methodology provides a practical framework for the preliminary design and optimisation of lightweight, structurally reliable filament-wound composite pressure vessels.

Keywords - Carbon/epoxy composite, Filament winding, Mesh convergence, Ply angle optimisation, SolidWorks simulation, Thermo-mechanical analysis.

I. INTRODUCTION

Composite materials have become indispensable in modern engineering because of their high specific strength, stiffness, low density, superior fatigue performance, corrosion resistance, and ability to be tailored to specific applications. Among the various manufacturing techniques, filament winding has emerged as an effective method for producing spherical and cylindrical pressure vessels owing to its ability to provide precise fibre orientation control, high fibre volume fractions, and cost-effective fabrication (Azeem et al., 2022).

The growing demand for high-performance and lightweight storage systems has accelerated the adoption of filament-wound composite pressure vessels in aerospace propellant systems (Air et al., 2023), compressed natural gas and hydrogen storage applications (Bouhala et al., 2024) oil and gas installations, water treatment plants and mining industry. Compared with conventional metallic vessels, these composite structures offer significant weight savings, enhanced corrosion resistance, and improved durability, thereby motivating continuous efforts to improve their reliability and structural integrity under service conditions (Bouhala et al., 2024).

Pressure vessels are also important in water resources and mining engineering. In water treatment, high-pressure vessels are integral components of reverse osmosis desalination systems used for freshwater production from saline sources (Tayeh, 2024). In the mining industry, pressure vessels are extensively employed as autoclaves in pressure oxidation and high-pressure acid leaching processes for the extraction and recovery of valuable metals under severe thermo-chemical conditions (Saurebau, 2024). These demanding applications expose vessels to high pressures, corrosive environments, and elevated temperatures, thereby highlighting the need for lightweight, corrosion-resistant, and structurally reliable composite pressure vessels capable of maintaining structural integrity under diverse service conditions.

Carbon fibre-reinforced epoxy composites have attracted considerable attention in pressure vessel engineering because of their excellent strength-to-weight and stiffness-to-weight ratios (Azeem et al., 2022). Carbon fibres provide superior tensile properties, dimensional stability, and fatigue resistance, whereas epoxy matrices ensure efficient stress transfer and chemical resistance (Air et al., 2023). Furthermore, the anisotropic nature of carbon/epoxy laminates enables designers to tailor ply orientations to specific loading requirements. Despite these advantages, selecting fibre arrangements that simultaneously satisfy deformation, durability, and safety requirements remains a major challenge in composite pressure vessel design (Pati, 2024; Bouhala et al., 2024).

Recent advances in computational methods have established finite element analysis (FEA) as an indispensable tool for predicting the behaviour of composite pressure vessels prior to experimental validation. Previous studies have demonstrated the effectiveness of FEA in evaluating pressure vessel performance and highlighted the significant influence of fibre orientation on structural efficiency (Kangal et al., 2020; Kartav et al., 2021; Azeem et al., 2022). However, optimum ply orientation remains dependent on vessel geometry, loading conditions, and performance requirements, making ply-angle optimisation an active area of research.

Thermal loading is another important design consideration because elevated temperatures can induce thermal stresses and affect the integrity of constituent materials, thereby influencing structural reliability and service life. Sharma et al. (2022) demonstrated that thermal effects significantly affect the response of Type-IV composite pressure vessels under static loading, while Bouhala et al. (2024) emphasised the importance of appropriate numerical modelling for accurate behavioural prediction.

Despite these advances, most thermo-mechanical investigations have relied on sophisticated platforms such as ANSYS and ABAQUS (Bouhala et al., 2024), with relatively limited application of SolidWorks Simulation despite its accessibility in engineering practice. In addition, pressure and temperature effects have often been investigated independently (Magliano et al., 2024), with relatively few studies integrating thermo-mechanical loading and ply-angle optimisation using multiple performance indicators (Koutsawa & Bouhala, 2025). Consequently, there remains a need for practical methodologies that support the preliminary design and optimisation of composite pressure vessels using readily accessible engineering software.

Therefore, this study investigates the thermo-mechanical behaviour of a filament-wound T300/LY5052 carbon/epoxy composite pressure vessel subjected to combined temperature and internal pressure loading using SolidWorks Simulation 2023. The effects of ply angle on equivalent strain, displacement, factor of safety, and failure behaviour are evaluated to identify the optimum laminate configuration. By integrating ply angle optimisation with thermo-mechanical assessment, this study provides a practical framework for the preliminary design and optimisation of filament-wound composite pressure vessels.

II. MATERIALS AND METHODS

2.1 Study Design

A finite element-based numerical approach was employed to investigate the structural behaviour of filament-wound carbon/epoxy composite pressure vessels subjected to internal pressure and elevated temperature using SolidWorks Simulation. The study was conducted in two stages. First, ply-angle optimisation under internal pressure loading was performed to identify the laminate orientation that maximised safety margins while minimising deformation. Second, the thermo-mechanical behaviour of the optimum laminate configuration was evaluated under combined pressure–temperature loading. Structural performance was assessed using equivalent strain, total displacement, factor of safety (FOS), and the Tsai–Hill failure criterion, which is commonly employed for predicting failure in fibre-reinforced composites (Yeh & Liu, 2017). The corresponding factor of safety obtained from the Tsai–Hill criterion was used as the primary indicator of laminate integrity and structural reliability (Jadoon et al., 2022).

2.2 Geometric Modelling

A filament-wound composite pressure vessel with an overall height of 750 mm and an internal radius of 100 mm was considered. Owing to the geometric and loading symmetry of the vessel, a quarter-symmetry model was adopted to reduce computational cost while maintaining solution accuracy. Similar reduced modelling approaches have been successfully employed in the numerical analysis of composite pressure vessels (Muzamil et al., 2022; Regassa et al., 2025). The three-dimensional geometry was developed in the SolidWorks CAD environment by revolving the vessel cross-sectional profile about its longitudinal axis. Two orthogonal symmetry planes were subsequently introduced to define the quarter model used for finite element analysis.

2.3 Material Properties

The pressure vessel was assumed to be fabricated from T300 carbon fibre reinforced LY5052 epoxy resin and modelled as a linear elastic orthotropic material. The orthotropic elastic constants, strength properties, density, and thermal expansion coefficients were adopted from the T300/LY5052 material data reported by Uguzo et al. (2025). The use of thick-walled filament-wound composite structures and failure assessment approaches adopted in this study is consistent with previous investigations on thick composite pipes (Guz et al., 2017; Wang et al., 2023). The material properties employed in the analyses are presented in Table 1 and were assigned uniformly to all laminate plies.

Table 1: Properties of T300/LY5052 carbon/epoxy composite

Property	Symbol	Value	Unit
Material model	–	Linear elastic orthotropic	–
Density	ρ	1570	kg/m ³
Elastic modulus	E_1	135	GPa
Elastic modulus	$E_2 = E_3$	8	GPa
Poisson's ratio	$\nu_{12} = \nu_{13}$	0.27	–
Poisson's ratio	ν_{23}	0.49	–
Shear modulus	$G_{12} = G_{13}$	3.80	GPa
Shear modulus	G_{23}	2.6845	GPa
Tensile strength	X_t	1860	MPa
Tensile strength	Y_t	76	MPa
Compressive strength	X_c	1470	MPa
Compressive strength	Y_c	85	MPa
Shear strength	S	98	MPa
Thermal expansion coefficient	α_1	3×10^{-6}	K ⁻¹
Thermal expansion coefficient	$\alpha_2 = \alpha_3$	2×10^{-5}	K ⁻¹

2.4 Composite Lay-Up Definition

A symmetric laminate configuration was adopted to eliminate bending–extension coupling. The laminate consisted of a 12-ply $[\pm\theta]_6$ s stacking sequence with an overall wall thickness of 12 mm. Similar thick-walled filament-wound composite configurations have been employed in stress and failure analyses of multilayer offshore composite pipes (Guz et al., 2017) and in the optimal design of thick-walled composite structures subjected to complex loading conditions (Wang et al., 2023).

The adopted thickness is also representative of moderate-pressure applications, such as reverse osmosis desalination systems operating under sustained pressurised conditions. Here, θ denotes the fibre orientation angle and s represents symmetry about the laminate mid-plane. The ply angle was treated as the primary design variable during the optimisation process.

2.5 Finite Element Modelling

Finite element analyses were conducted using the composite shell module of SolidWorks Simulation 2023. The laminate definition incorporated the orthotropic material properties, ply number and thickness, fibre orientation, laminate symmetry, and activation of the Tsai–Hill failure criterion. Linear elastic material behaviour and small deformation assumptions were adopted throughout the simulations.

2.6 Boundary Conditions, Symmetry and Mesh Generation

Symmetry boundary conditions were imposed on the two orthogonal planes of the quarter-symmetry model by restraining the normal displacement while permitting in-plane deformation. The pressure vessel was modelled under closed-end conditions, with uniform internal pressures of 15, 20, and 30 bar applied normal to the internal surface without additional end restraints, thereby allowing the natural development of hoop and axial stresses. For thermo-mechanical analyses, temperatures ranging from 40 °C to 180 °C were superimposed on the pressure loads. The quarter-symmetry model and the corresponding loading and boundary conditions are illustrated in Figure 1.

2.6.1 Mesh Convergence Analysis

A mesh convergence study was conducted to verify the numerical reliability of the finite element solutions under the most severe loading condition (30 bar). Seven progressively refined standard meshes (M1 to M7) were analysed, and the minimum Tsai–Hill factor of safety (HFOS) was monitored. The minimum HFOS decreased from 6.169 for the coarsest mesh (M1) to 4.528 for M5, after which the solutions stabilised, yielding values of 4.542 and 4.535 for M6 and M7, respectively. The percentage differences reduced from 16.3% (M1 to M2) and 8.4% (M2 to M3) to only 0.31% (M5 to M6) and 0.15% (M6 to M7), indicating mesh-independent solutions. Consequently, Mesh M5, comprising 1,788 elements, was selected for subsequent analyses because it provided an appropriate balance between computational efficiency and numerical accuracy.

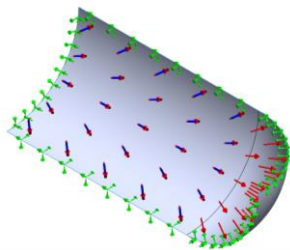


Figure 1: Quarter-symmetry finite element model showing the symmetry boundary conditions, and internal pressure loading adopted in the analysis.

Table 2: Mesh convergence analysis based on minimum Tsai–Hill factor of safety

Mesh Level	No. of Elements	Minimum HFOS	Difference (%)
M1	235	6.169	–
M2	237	5.166	16.3
M3	450	4.731	8.4
M4	870	4.576	3.3
M5	1,788	4.528	1.0
M6	3,165	4.542	0.31
M7	7,154	4.535	0.15

The convergence analysis confirmed that the reported finite element responses were governed by the structural characteristics of the laminate rather than mesh discretisation effects.

2.7 Ply Angle Optimisation Procedure

Ply angle optimisation was performed under internal pressure loading by varying the fibre orientation angle from 0° to 90° at 5° intervals, resulting in 19 laminate configurations. For each configuration, equivalent stress, equivalent strain, total displacement, factor of safety, and Tsai–Hill failure index were evaluated. The optimum ply orientation was selected based on minimum stress, strain, displacement, and Tsai–Hill failure index, together with the maximum factor of safety.

2.8 Thermo-Mechanical Analysis

The optimum laminate configuration identified from the ply angle optimisation study was subsequently subjected to coupled thermo-mechanical loading under internal pressures of 15 bar, 20 bar, and 30 bar.

Temperatures ranging from 40 °C to 180 °C were selected to represent moderate and elevated service conditions. The lower limit (40 °C) reflects typical operating environments, whereas the upper limit (180 °C) was chosen to assess the effects of elevated temperatures while remaining within the thermal stability range generally reported for epoxy-based composite systems (Barra et al., 2023). Similar temperature conditions have been employed in thermo-mechanical investigations of composite pressure vessels under combined loading (Sharma et al., 2022).

2.9 Output Parameters and Failure Assessment

Structural performance was evaluated using equivalent strain, total displacement, the Tsai–Hill failure index, and the corresponding factor of safety (HFOS). The Tsai–Hill criterion implemented in SolidWorks Simulation was used to assess laminate failure, with failure assumed when the failure index reached or exceeded unity ($FI \geq 1$), whereas values below unity indicated safe operation. The Tsai–Hill failure index and HFOS served as the primary indicators of laminate integrity and structural reliability, while equivalent strain and total displacement were used to quantify the deformation response under thermo-mechanical loading.

2.10 Data Analysis

Simulation outputs were exported to Microsoft Excel for post-processing and graphical presentation. Descriptive analyses were performed to examine the effects of ply angle, internal pressure, and temperature on stress, strain, displacement, factor of safety, and Tsai–Hill failure index. The resulting trends were used to identify the optimum laminate configuration and formulate practical recommendations for the preliminary design and optimisation of filament-wound carbon/epoxy composite pressure vessels.

III. RESULTS AND DISCUSSION

3.1 Mesh Convergence Analysis Results

The numerical reliability of the finite element model was verified through a mesh convergence study using progressively refined high-quality standard meshes. The minimum Tsai–Hill factor of safety (HFOS) was adopted as the convergence parameter because it directly reflects the failure response of composite laminates. As shown in Figure 2, the minimum HFOS decreased from 6.169 for Mesh M1 to 4.535 for Mesh M7, indicating improved resolution of the structural response.

The largest reductions in HFOS occurred during the early stages of refinement, decreasing by 16.3% between M1 and M2 and by 8.4% between M2 and M3. Subsequent refinements resulted in smaller changes of 3.3% (M3 to M4) and 1.0% (M4 to M5). Beyond M5, the variations reduced to 0.31% (M5 to M6) and 0.15% (M6 to M7), confirming that mesh independence had been achieved.

Consequently, Mesh M5, comprising 1,788 elements, was selected for all subsequent analyses because it provided an appropriate balance between numerical accuracy and computational efficiency.

3.2 Effect of Ply Angle on Structural Performance

The structural performance of the filament-wound carbon/epoxy pressure vessel was investigated by varying the fibre orientation angle from 0° to 90° at intervals of 5° under internal pressure loading. The resulting variations in factor of safety, equivalent strain, total displacement, and equivalent stress are presented in Figures 3 to 6. The results demonstrate that fibre orientation significantly influences the load-carrying capacity, deformation behaviour, and failure resistance of the composite pressure vessel.

3.2.1 Factor of Safety Response

Figure 2 illustrates the variation of factor of safety (FOS) with increasing ply angle based on the Tsai–Hill, Tsai–Wu, and Maximum Stress failure criteria. The FOS remained relatively constant at low fibre orientations (0°–20°), followed by a progressive increase up to approximately 50°, after which a rapid decline was observed as the ply angle approached 90°. The corresponding figure is shown immediately after this subsection

The maximum FOS values were approximately 3.9, 4.2, and 4.0 for the Tsai–Hill (HFOS), Tsai–Wu (WFOS), and Maximum Stress (MFOS) criteria, respectively. Among the three criteria, the Tsai–Wu criterion predicted the highest safety margins, whereas the Tsai–Hill criterion yielded the most conservative estimates.

The optimum ply angle was identified as 50°, corresponding to the highest safety margins under all failure criteria. This behaviour can be attributed to improved load sharing between the circumferential and longitudinal stresses generated by internal pressure. Although fibre orientations around $\pm 55^\circ$ are traditionally

recommended for filament-wound pressure vessels, the present results indicate that a slightly lower orientation of 50° provides improved structural performance for the geometry, material system, and loading conditions considered.

3.2.2 Equivalent Strain Response

The variation of equivalent strain with increasing ply angle is presented in Figure 3. The strain decreased progressively from approximately 0.0055 at 0° to a minimum value of approximately 0.0024 at 50° , beyond which a sharp increase was observed, reaching approximately 0.0087 at 90° .

The reduction in strain at intermediate ply angles indicates enhanced laminate stiffness and improved resistance to pressure-induced deformation. Fibres oriented at approximately 50° effectively transfer loads between the circumferential and axial directions, thereby reducing the overall deformation of the pressure vessel. The coincidence of minimum strain and maximum factor of safety further confirms the suitability of the 50° ply orientation as the optimum laminate configuration.

3.2.3 Displacement Response

Figure 4 presents the variation of total displacement with increasing ply angle. Similar to the strain response, displacement decreased progressively with increasing fibre orientation until reaching a minimum at 50° , after which displacement increased towards 90° .

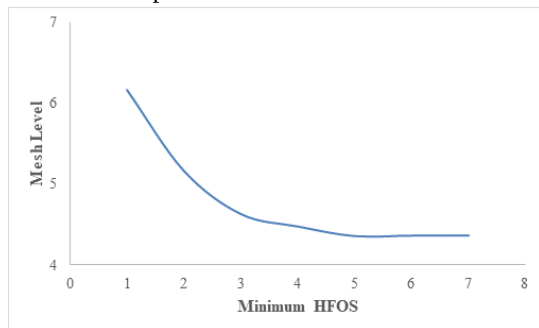


Figure 2: Mesh convergence analysis based on the minimum Tsai-Hill factor of safety (HFOS)

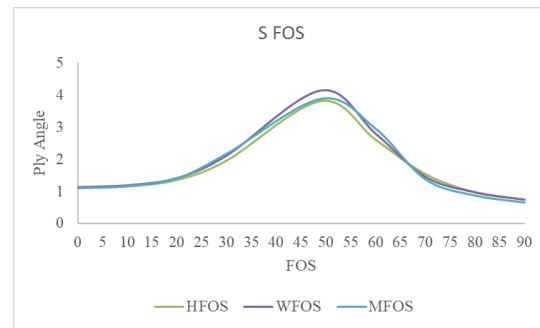


Figure 3: Variation of factor of safety with increasing ply angle based on Tsai-Hill, Tsai-Wu, and Maximum Stress criteria

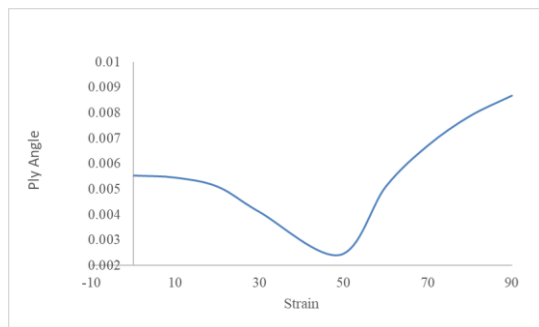


Figure 4: Variation of equivalent strain with increasing ply angle.

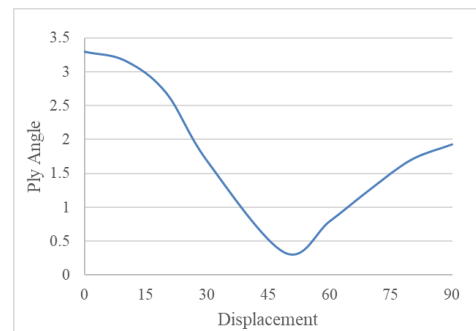


Figure 5: Variation of total displacement with increasing ply angle

Reduced displacement reflects improved structural rigidity and dimensional stability under pressure loading. Excessive deformation may adversely affect sealing efficiency, dimensional tolerances, and long-term service performance. Consequently, the optimum laminate should simultaneously minimise displacement while maintaining adequate safety margins.

The displacement response obtained in this study demonstrates that ply angle optimisation contributes significantly to enhancing the serviceability characteristics of filament-wound composite pressure vessels.

3.3 Thermo-Mechanical Behaviour of the Optimised Laminate

Following ply angle optimisation, the optimum laminate configuration corresponding to a fibre orientation of 50° was subjected to coupled pressure-temperature loading to investigate its thermo-mechanical response.

The increase in stress with temperature may be attributed to the mismatch in thermal expansion characteristics between the carbon fibres and epoxy matrix, which generates additional thermal stresses within the laminate. Elevated temperatures may also reduce matrix stiffness, thereby increasing local stress concentrations. Despite this increase, the stress levels remained substantially below the longitudinal tensile strength of the composite material, indicating that the pressure vessel retained adequate load-carrying capability throughout the investigated temperature range.

3.3.1 Effect of Temperature on Tsai–Wu Factor of Safety

The variation of Tsai–Wu factor of safety (WFOS) with temperature is shown in Figure 6. A slight reduction in WFOS was observed, decreasing from approximately 4.364 at 40 °C to 4.361 at 180 °C, corresponding to a reduction of approximately 0.07%.

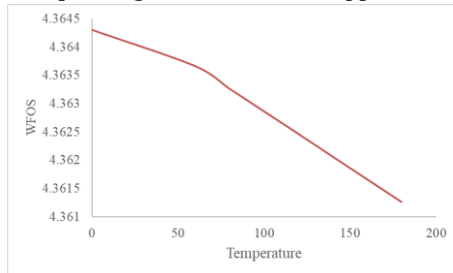


Figure 6: Variation of Tsai–Wu factor of safety with temperature at the optimum ply angle

The minimal reduction in WFOS indicates that temperature had little influence on the structural integrity of the T300/LY5052 pressure vessel within the investigated range. This behaviour may be attributed to the high stiffness and low thermal sensitivity of carbon fibres, together with the thermal stability of the LY5052 epoxy matrix below severe degradation conditions. Consequently, internal pressure remained the dominant parameter governing the structural response, while elevated temperatures produced only marginal changes in the safety margins. None of the predicted Tsai–Wu failure indices approached the critical value of unity, confirming the adequacy of the optimised laminate under coupled thermo-mechanical loading conditions.

3.4 Failure Assessment and Design Implications

The Tsai–Hill, Tsai–Wu, and Maximum Stress criteria consistently identified the optimum ply orientation at 50°, thereby strengthening confidence in the optimisation results. The predicted failure indices remained below their respective critical limits under the investigated operating conditions, confirming the structural adequacy of the selected laminate configuration.

The agreement among the failure criteria and deformation responses indicates that ply angle optimisation can effectively improve the structural performance of filament-wound carbon/epoxy pressure vessels. For the T300/LY5052 pressure vessel geometry, 12-ply $[\pm\theta]_s$ laminate configuration, and thermo-mechanical loading conditions considered in this study, the 50° ply angle exhibited the most favourable structural performance. Elevated temperatures within the range of 40–180 °C had only a marginal influence on structural reliability, whereas internal pressure remained the dominant parameter governing the structural response.

Overall, the implementation of Tsai–Hill, Tsai–Wu, and Maximum Stress criteria within SolidWorks Simulation demonstrates the capability of this widely accessible engineering software to provide effective preliminary assessments of composite pressure vessels. The methodology adopted in this study offers a practical framework for the preliminary design and optimisation of similar filament-wound composite pressure vessels.

I.CONCLUSION

This study investigated the effects of ply angle, internal pressure, and elevated temperature on the structural behaviour of filament-wound T300/LY5052 carbon/epoxy pressure vessels using SolidWorks Simulation. The results demonstrated that fibre orientation significantly influenced structural performance, with the 50° ply angle exhibiting the highest safety margins and lowest deformation responses. Compared with the 0° laminate, the optimum configuration reduced the equivalent strain by approximately 56%, highlighting the importance of ply-angle optimisation.

Thermo-mechanical analyses revealed that internal pressure was the dominant parameter governing structural behaviour, whereas temperatures within the range of 40–180 °C had only a marginal influence on structural reliability. The Tsai–Hill, Tsai–Wu, and Maximum Stress criteria consistently identified the same optimum laminate configuration, thereby strengthening confidence in the findings.

For the T300/LY5052 pressure vessel geometry, 12-ply $[\pm\theta]_s$ laminate arrangement, and thermo-mechanical loading conditions considered in this study, the 50° ply angle provided the most favourable structural performance. However, this finding should be regarded as guidance for the preliminary design of similar filament-wound composite pressure vessels rather than as a universal recommendation. Overall, the proposed SolidWorks-based methodology provides a practical framework for the preliminary design and optimisation of lightweight, structurally reliable filament-wound composite pressure vessels.

AUTHOR(S) CONTRIBUTIONS

P. M. Kantu and N. S. Gukop conceived the study. N. S. Gukop developed the methodology, conducted the investigation, performed the simulations, carried out the formal analysis, prepared the visualizations, and wrote the original draft of the manuscript. P. M. Kantu supervised the research. M. I. Alifa contributed to the water resources engineering applications, improved the manuscript structure and formatting, and reviewed and edited the final manuscript. A. P. Akinola contributed to the mining engineering applications and reviewed and edited the final manuscript. M. M. Mangai reviewed and edited the final manuscript.

AI DISCLOSURE

AI was used to improve the language and presentation of the manuscript. The authors verified all content and take full responsibility for the manuscript.

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DECLARATION OF CONFLICT OF INTEREST

The authors declare that they have no conflict of interest.

REFERENCES

- Air, A., Shamsuddoha, M., & Prusty, B. G. (2023). A review of Type V composite pressure vessels and automated fibre placement-based manufacturing. *Composites Part B: Engineering*, 253, 110573.
- Azeem, M., Ya, H. H., Alam, M. A., Kumar, M., Stabla, P., Smolnicki, M., ... & Mustapha, M. (2022). Application of filament winding technology in composite pressure vessels and challenges: a review. *Journal of Energy Storage*, 49, 103468.
- Barra, G., Guadagno, L., Raimondo, M., Santonicola, M. G., Toto, E., & Vecchio Cipriotti, S. (2023). A comprehensive review on the thermal stability assessment of polymers and composites for aeronautics and space applications. *Polymers*, 15(18), 3786.
- Bouhala, L., Koutsawa, Y., Karatrantos, A., & Bayreuther, C. (2024). Design of type-iv composite pressure vessel based on comparative analysis of numerical methods for modeling type-iii vessels. *Journal of Composites Science*, 8(2), 40.
- Guz, I. A., Menshykova, M., & Paik, J. K. (2017). Thick-walled composite tubes for offshore applications: an example of stress and failure analysis for filament-wound multi-layered pipes. *Ships and Offshore Structures*, 12(3), 304-322.
- Jadoon, J., Shazad, A., Muzamil, M., Akhtar, M., & Sattar, M. (2022). Finite Element Analysis of Composite Pressure Vessel Using Reduced Models. *Tecciencia*, 17(33).
- Kangal, S., Kartav, O., Tanoğlu, M., Aktaş, E., & Artem, H. S. (2020). Investigation of interlayer hybridization effect on burst pressure performance of composite overwrapped pressure vessels with load-sharing metallic liner. *Journal of Composite Materials*, 54(7), 961-980.
- Kartav, O., Kangal, S., Yüçetürk, K., Tanoğlu, M., Aktaş, E., & Artem, H. S. (2021). Development and analysis of composite overwrapped pressure vessels for hydrogen storage. *Journal of Composite Materials*, 55(28), 4141-4155.

- Koutsawa, Y., & Bouhala, L. (2025). Uncertainty analysis in the design of Type-IV composite pressure vessels for hydrogen storage. *Composites Part C: Open Access*, 16, 100544.
- Magliano, A., Perez Carrera, C., Pappalardo, C. M., Guida, D., & Berardi, V. P. (2024). A comprehensive literature review on hydrogen tanks: storage, safety, and structural integrity. *Applied Sciences*, 14(20), 9348.
- Pati, S., Deshmane, A., Korff, M., & Dickhut, T. (2024, November). Overview of the Challenges in High-Pressure Type V Hydrogen Tanks for Automotive Applications. In *Stuttgart Conference on Automotive Production* (pp. 402-414). Cham: Springer Nature Switzerland.
- Sharma, P., Sardar, H. H., & Neogi, S. (2022). Thermomechanical processing of Type-4 composite cylinders under static load. *Journal of Energy Storage*, 55, 105465.
- Tayeh, Y. A. (2024). A comprehensive review of reverse osmosis desalination: Technology, water sources, membrane processes, fouling, and cleaning. *Desalination and Water Treatment*, 320, 100882.
- Uguzo, S. O., Menshykov, O., Menshykova, M., & Kashtalyan, M. (2025). Thermomechanical Loading Induced Buckling and Failure Analysis of Thermoplastic Composite Pipes. *Marine* 2025, 2025.
- Wang, T., Menshykova, M., Menshykov, O., Guz, I. A., & Bokedal, N. K. (2023). Mechanical analysis of thick-walled filament wound composite pipes under pure torsion load: safety zones and optimal design. *Applied Composite Materials*, 30(2), 485-505.
- Regassa, Y & Warkina, R., (2025). Optimizing performance of hybrid fiber reinforced overwrapped pressure vessel. *Journal of Composite Materials*, 59(2), 187-206.
- Yeh, M. K., & Liu, T. H. (2017). Finite element analysis of graphite/epoxy composite pressure vessel. *Journal of Materials Science and Chemical Engineering.*, 5(7), 19-28.