DESIGN AND ANALYSIS OF PROPELLER BLADE OF A MARINE SHIP

Potharaju Raju[1], G.RaghuPhanidhar [2], T.Prashant[3], B. Ajay Kumar[4]

[1]Assistant Professor, Department of Mechanical Engineering, CMR College of Engineering & Technology, Hyderabad.

[2,3,4] Student, Department of Mechanical Engineering, CMR College of Engineering & Technology, Hyderabad.

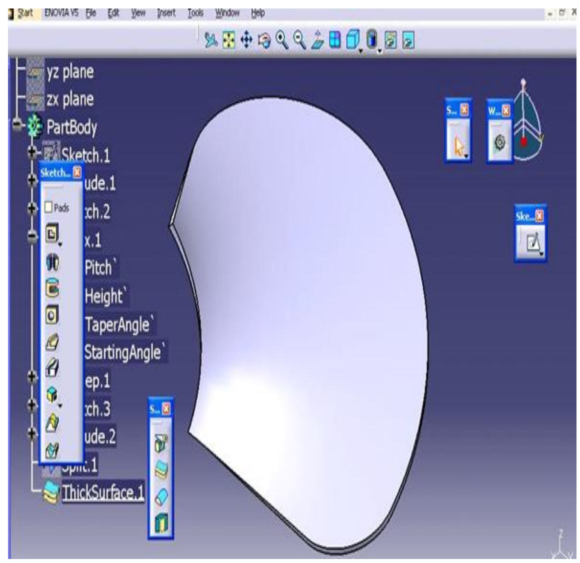
ABSTRACT

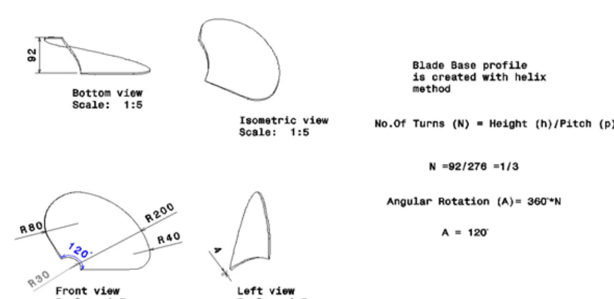
Most of the marine propellers are made of metal material such as bronze or steel. The advantages of replacing metal with CFRP composite materials are that the latter is lighter and corrosion-resistant. Another important advantage is that the deformation of the composite propeller can be controlled to improve its performance. Propellers always rotate at a constant velocity that maximizes the efficiency of the engine. When the ship sailsat the designed speed, the inflow angle is close to its pitch angle. When the ship sails at a lower speed, the inflow angle is smaller. Hence, the pressure on the propeller increases as the ship speed decreases. The propulsion efficiency is also low when the inflow angle is far from the pitch angle. If the pitch angle can be reduced when the inflow angle is low, then the efficiency of the propeller can be improved. In addition the load-bearing fibers can be aligned and stacked to reduce fluttering and to improve the hydrodynamic efficiency. Composites can offer the potential benefits of reduced corrosion and cavitations damage, improved fatigue performance, lower noise, improved material damping properties, and reduced lifetime maintenance cost. Traditionally marine propellers are made of manganese-nickel-aluminum-bronze (MAB) or nickel-aluminum-bronze (NAB) for superior corrosion resistance, high-yield strength, reliability, and affordability.

Keywords: Marine engine propeller, composite material, Ansys, ship building.

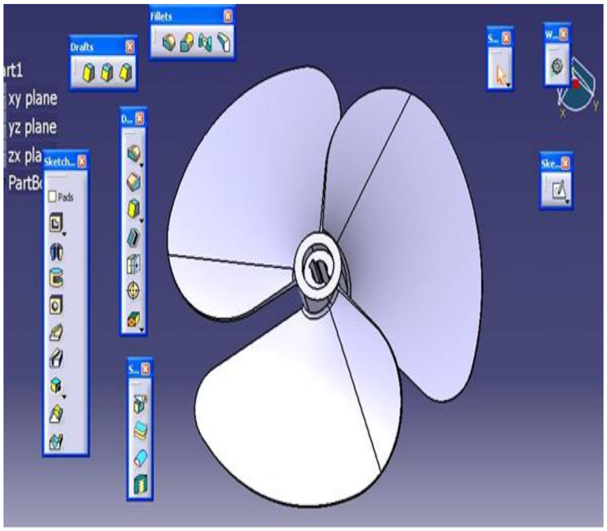
INTRODUCTION

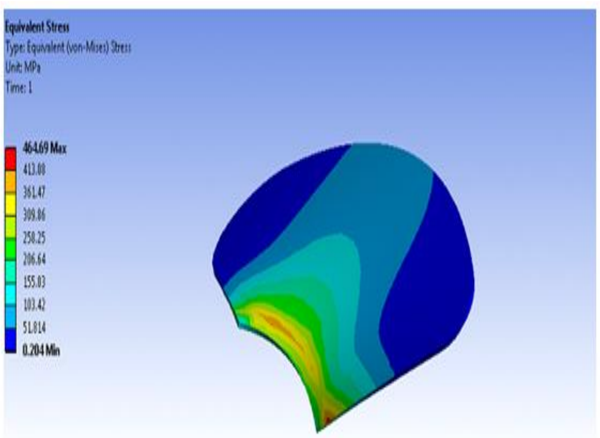
Marine propeller is a component which forms the principal part of ships since it gives the required propulsion. Fiber reinforced plastics are extensively used in the manufacturing of various structures including the marine propeller. The hydrodynamic aspects of the design of composite marine propellers have attracted attention because they are important in predicting the deflection and performance of the propeller blade. For designing an optimized marine propeller one has to understand the parameters that influence the hydro-dynamic behavior. Since propeller is a complex geometry, the analysis could be done only with the help of numerical tools. Most marine propellers are made of metal material such as bronze or steel. The advantages of replacing metal with an FRP composite are that the latter is lighter and corrosion-resistant. Another important advantage is that the deformation of the composite propeller can be controlled to improve its performance. Propellers always rotate at a constant velocity that maximizes the efficiency of the engine. When the ship sails at the designed speed, the inflow angle is close to its pitch angle. When the ship sails at a lower speed, the inflow angle is smaller. Hence, the pressure on the propeller increases as the ship speed decreases. The propulsion efficiency is also low when the inflow angle is far from the pitch angle. If the pitch angle can be reduced when the inflow angle is low, then the efficiency of the propeller can be improved. Traditionally marine propellers are made of manganese-nickel-aluminum-bronze (MAB) or nickel-aluminum-bronze (NAB) for superior corrosion resistance, high-yield strength, reliability, and affordability. More over metallic propellers are subjected to corrosion, cavitations damage; fatigue induced cracking and has relatively poor acoustic damping properties that can lead to noise due to structural vibration. Moreover, composites can offer the potential benefits of reduced corrosion and cavitations damage, improved fatigue performance, lower noise, improved material damping properties, and reduced lifetime maintenance cost. In addition the load-bearing fibers can be aligned and stacked to reduce fluttering and to improve the hydrodynamic efficiency.





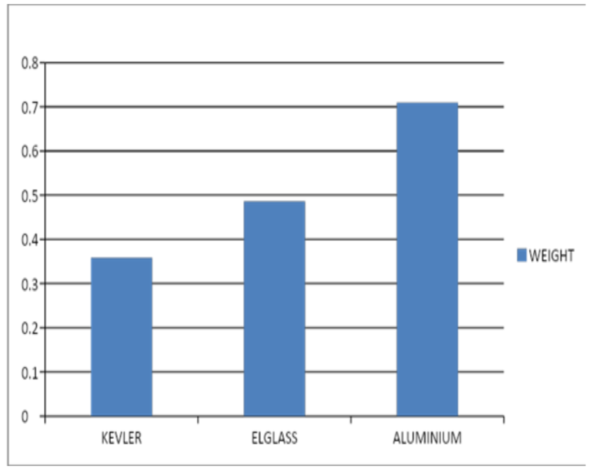
Model of Propeller





WEIGHT COMPARISION OF THREE MATERIALS

MATERIAL	WEIGHT
KEVLER	0.358
ELGLASS	0.486
ALUMINIUM	0.709



CONCLUSION

We conclude that composite propellers have more advantages over the conventional metallic propellers. We concentrated on the metal and composite structural analysis of the propeller blade carried out by using the finite element method.By comparing the deformation we can say that kelver will be having more advantages Kelver can with stand more amount of loads stress when compared and by seeing the weight comparison kelver is having less weight when observed with E-glass and Aluminium materials.

REFERENCES

1. Properties of engineering materials by RA Higgin(second edition)

2. Engineering material properties and selection byKenneth G.BudinskiMichael K.Budinski

3. Mechanics of composite materials byRobert M.Johnes

4. An Accurate Four-Quadrant Nonlinear Dynamical Model for Marine...Ralf Bachmayer, Louis L Whitcomb, Mark AGrosenbaugh - 2000 - IEEE JOURNAL OF OCEANIC ENGINEERING

5. Nonlinear Output Feedback Control of Underwater Vehicle Propellers. Thor I Fossen, MogensBlanke - 2000 - IEEE JOURNAL OF OCEANIC ENGINEERING

6 Naga Sai Kalyan, C., Goud, B.S., Reddy, C.R., Bajaj, M., Rao, G.S., 2022, SMES and TCSC Coordinated Strategy for Multi-area Multi-source System with Water Cycle Algorithm Based 3DOF-PID Controller, Smart Science, 10.1080/23080477.2022.2054199

7 Krishnaveni, S., Harsha Priya, M., Harsha Vardhini, P.A., 2022, LabVIEW Implemented Smart Security System Using National Instruments myRIO, Lecture Notes in Networks and Systems, 10.1007/978-981-16-7018-3_10

8 Nayak, S.C., Misra, B.B., Dehuri, S., 2022, Hybridization of the Higher Order Neural Networks with the Evolutionary Optimization Algorithmsâ€"An Application to Financial Time Series Forecasting, Intelligent Systems Reference Library, 10.1007/978-981-16-8930-7_5

9 Babu, S.R., Krishna Varma, K.P.V., Mohan, K.S.S., 2022, Artificial Neural Network Technique for Estimating the Thermo-Physical Properties of Water-Alumina Nanofluid, Ecological Engineering and Environmental Technology, 10.12912/27197050/145583

11 Ting, L., Khan, M., Sharma, A., Ansari, M.D., 2022, A secure framework for IoT-based smart climate agriculture system: Toward blockchain and edge computing, Journal of Intelligent Systems, 10.1515/jisys-2022-0012

12 Cherukuri, S.K., Kumar, B.P., Kaniganti, K.R., Muthubalaji, S., Devadasu, G., Babu, T.S., Alhelou, H.H., 2022, A Novel Array Configuration Technique for Improving the Power Output of the Partial Shaded Photovoltaic System, IEEE Access, 10.1109/ACCESS.2022.3148065

13 Gunjan, V.K., Kumar, S., Ansari, M.D., Vijayalata, Y., 2022, Prediction of Agriculture Yields Using Machine Learning Algorithms, Lecture Notes in Networks and Systems, 10.1007/978-981-16-6407-6_2

14 Kumar, S., Gunjan, V.K., Ansari, M.D., Pathak, R., 2022, Credit Card Fraud Detection Using Support Vector Machine, Lecture Notes in Networks and Systems, 10.1007/978-981-16-6407-6_3

15 Sripada, S., Reddy, M.C., Sreekanth, T., Siripuram, R., Venkateshwarlu, K., 2022, Influence of Nano Filler (ZrO2) on Optical and Thermal Studies of Potassium Doped Polyethylene Oxide Solid Polymer Electrolytes, Materials Science Forum, 10.4028/www.scientific.net/MSF.1048.101

16 Jayachandran, M., Rao, G.S., Reddy, C.R., 2022, A Unique Interlinking Converter Control for Hybrid AC/DC Islanded Microgrids, Lecture Notes on Data Engineering and Communications Technologies, 10.1007/978-981-16-6605-6_12