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DESIGN AND ANALYSIS OF A SCREW PROPELLER IN MARINE VEHICLE

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Santhosh V
PG Scholar, Department of Mechanical Engineering, Alagappa Chettiar Government College of Engineering and Technology, Karaikudi- 630 004

ABSTRACT

In marine vehicle like ships, submarine and torpedoes use propeller for its propulsion, Propeller is to develop the thrust and propulsive efficiency. The paper deals with modeling and analyzing of a screw propeller. There are several important parameters to be considered for modeling screw propeller by using solidworks software. Static and dynamic analysis is to be carried out in Ansys fluent software..Thus the simulation of screw propeller provides maximum velocity to the outlet. So, the velocity distribution has been observed. Then the velocity distribution is displayed by means of velocity magnitude in (m/s) and static pressure in (pascal).

***Keywords**: Screw propeller, thrust, propulsive efficiency and dynamic analysis.*

1. Introduction

A marine propeller is sometimes known as a screw propeller. The propeller is a type of fan that transmits power by converting rotational motion into thrust. A pressure difference is produced between the forward and rear surfaces of the airfoil-shaped blade, and a fluid (such as air or water) is accelerated behind the blade. Propeller dynamics can be modeled by both Bernoulli's principle and Newton's third law. 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.The thrust and torque of a propeller are created by the pressure differences on either side of the blades, which is related to relative velocity and blade geometry. The relative velocity is a function of the rotational speed (and radius) and the speed of water in the ship, s wake. Reducing the propeller speed and increasing its diameter also increases the efficiency.

2. Model Definition

The geometry of the model is first decided and the whole setup of the propeller is designed around it. The dimensions are presented in table 1.The modeling geometry is presented in fig. 1.

Table 1 Dimension specifications of the propeller setup

Parameter	Dimension(mm)
Hub diameter	1000
Hub length	1250
Blade length	1000
Propeller diameter	3000
No of blades	5
Profile types	B- series
Pitch diameter ratio	0.5

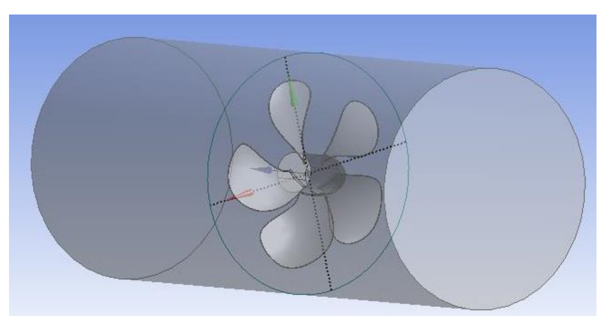

Fig. 1 Geometric model of a propeller

3. Material Definition

The propeller is used as an Aluminum (AA6063). It is a soft, durable, light weight, malleable metal with an appearance ranging from silvery to dull grey, depending on the surface roughness. Aluminum is non-magnetic and non-sparking. It is also insoluble in

**Corresponding Author - E- mail: santhoshshivan.v@gmail.com*

alcohol, though it can be soluble in water in certain forms. Aluminum has about one-third the density and stiffness of steel. It is ductile and easily machined, cast, drawn and extruded. Corrosion resistance can be excellent due to a thin surface layer of aluminum oxide that forms when the metal is exposed to air, effectively preventing further oxidation. The strongest aluminum alloys are less corrosion resistant due to galvanic reactions with the alloyed copper. The strength of the aluminum alloys exceeds the strength of mild steel. The important factors in selecting aluminum and its alloys are their high strength-to-weight ratio, resistance to corrosion by many chemicals, high thermal and electrical conductivity, nontoxicity, reflectivity, appearance, and ease of formability, machinability, and their nonmagnetic nature
The chemical composition is shown in table 2.

Table 2 Chemical Composition of AA6061

S.No	Element	Composition %
1	Al	Balance
2	Si	0.2
3	Mg	0.45
4	Fe	0.35
5	Cu	0.10
6	Cr	0.10
7	Mn	0.10
8	Ti	0.10
9	Zn	0.10

4. Simulation Using Finite Element Analysis and Their Results

It is a computerized numerical analysis for solving complex mathematical models mostly in mechanical engineering for performance analysis. It involves performance analysis throughout the model which is discretized in the form of mesh. A 3D-axisymmetric model is chosen for the creation in Solidworks software and analysis is carried out in ANSYS-FLUENT. However, complexities in the geometry, properties and in the boundary conditions that are seen in most real world problems usually means that an exact solution cannot be obtained in a reasonable amount of time. The FEM is one such approximate solution technique.

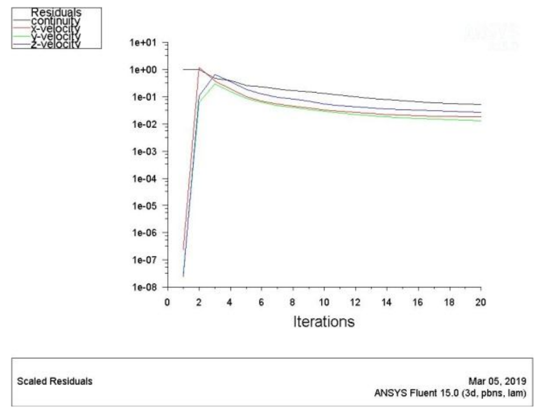

Fig. 2 Scaled residual graph on inlet flow velocity of a propeller

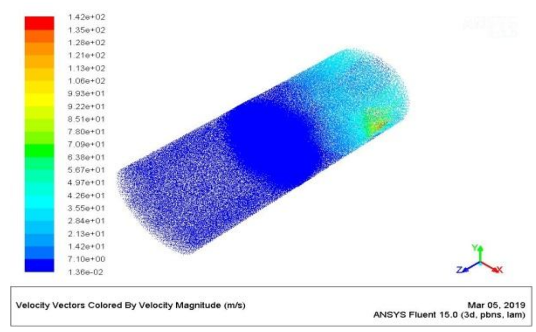

Fig.3 Velocity vector diagram by velocity magnitude (m/s).

The maximum pressure exerted by the propellers is seen to be at the intersection of the blade and the surface of the hub. Here, it can be looked towards the tip of the propeller blade, the pressure decreases, and the pressure is at its lowest in the region surrounding the blade.

The velocity vector demonstrates how the velocity of water changes across the surface of the blade. It has a value of 5 m/s at the inlet and decreases at the tip of the hub and also between the contact of propeller blades and hub. Towards the tip of the blades, the velocity of water is seen to increase, while right behind the propeller hub, it almost has no velocity.

From the figure 3 and 4 it is also verified by the Bernoulli's principle, when the outlet velocity increases suddenly drop in pressure variation and vice versa.Also observed from the figure 3 the maximum velocity is $9.54*10^2$ pa.

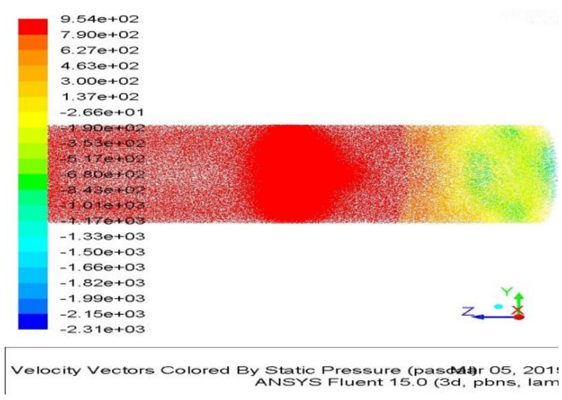

Fig. 4 Velocity vector diagram by static pressure (pascal)

5. Conclusion

The marine propeller with 5 blades has been modeled in solidworks and its working terminology has been studied. The propeller simulation has been performed in ansys fluent software.

Then the flow trajectories of velocity and pressure of a propeller have been displayed in figure 3 and figure 4 respectively.

References

1. *Carlton J (2007), "Marine propellers and propulsion", Oxford: Butterworth-Heinemann.*
2. *Watson DGM (1998), "Practical ship design", Elsevier Science.*
3. *Bertram V (2000), "Practical ship hydrodynamics", Oxford: Butterworth-Heinemann.*
4. *Elliot W S (1989), "Computer-aided mechanical engineering: 1958 to 1988", CAD, Vol.21 (5), 274- 288.*
5. *Bezier P (1990) "Style, Mathematics and NC", CAD, Vol. 22(9), 524-526.*
6. *Nittel M F (1989), "Numerically controlled machining of propeller blades", Marine Technology, Vol.26.*
7. *Grigson C W B (1982), "Propeller roughness, its nature and its effect upon the drag coefficients of blades and ship power", Technical report, R.I.N.A.*
8. *Morgan W B, Silovic V and Denny S B (1968), "Propeller lifting-surface corrections", Trans. Society of Naval Architects and Marine Engineers, Vol.76, 309-47.*
9. *Palle Prasad and Lanka BosuBabu (2017), "Design And Analysis of the Propeller Blade", International Journal Of Advances In Mechanical And Civil Engineering, Vol.4 (2).*
10. *Barru Harish, Kondapalli Siva Prasad and Uma Maheswara Rao G, "Static Analysis of 4-Blade Marine Propeller", Journal of Aerospace Engineering & Technology, Vol. 5(2).*
11. *Fujisawa N (1995), "Measurements of basic performances for waterjet propulsion systems in water tunnel", Internat J Rotat Machin., Vol.2 (1), 43–50.*
12. *Schneekluth H and Bertram V (1998), "Ship design for efficiency and economy", Butterworth-Heinemann.*
13. *Ghose J P and Gokarn R P (2004), "Basic ship propulsion", Allied Publishers. Mercury Marine. Propeller Terminology. 2004.*
14. *Harvald S A (1983), "Resistance and propulsion of ships", Chapter-5, Determination of ship resistance.*
15. *Norbert Willem Herman Bulten (2006), "Numerical analysis of a water jet propulsion system", Eindhoven, Netherlands: Eindhoven University of Technology.*

