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DESIGN OF SHIP PROPELLER BY USING MACROS TECHNIQUE

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ABSTRACT

In this paper, the ship propeller is designed using macros and the materials are compared. Expanded use of lightweight materials in the marine applications the epoxy composites was chosen which has high performance characteristics and a lightweight thermosetting matrix resin. Propeller is an essential component for underwater vehicles such as ship, submarines etc. This supports the vehicle to move at its operating speed. This works on the Bernoulli's principle and Newton's third law. In this paper, the propeller geometry is designed using macros. The solid model was created in CATIA software. The simulation and modal analysis are performed in ANSYS workbench. Then the material results are compared with the previous material. Finally, the better material for ship propeller is determined.

***Keywords: Propeller design, Macros, Catia, Ansys workbench, Structural analysis*.**

I.INTRODUCTION

For the past few years there have been critical innovative work in the field of propeller designs in order to protect the safety of goods, travellers and the crew and in the mean time reducing the expenses and by improving the efficiency. Ship Propeller is used for propulsion regardless of their sort and size.

A propeller is a sort of whirling fan, which is used to move the ship or aircraft forward by utilizing the power created by the engine. The transmitted power is changed from rotational movement to produce a push or thrust which imparts energy to the fluid (i.e. water or air), bringing about a force that follows up on the ship and drives it forward. The pressure variation between the front and aft side of the blade creates acceleration in the water present behind the blade, which makes the ship start sailing. Propellers continually turn at a steady velocity, which increases the efficiency of the engine. Propellers create push through the generation of lift by their rotating blades.

The propeller whose name originates from the Latin word "propeller". A proficient screw propeller was innovated at the start of the nineteenth century as an efficient power source for the steam engine.

Principle of propeller:

- A ship propels based on Bernoulli's principle and Newton's third law.
- It works by pushing mass in the reverse direction we need to go, thereby following Newton's law, which produces equivalent, and reverse reaction.
- It is based on the concept of driving back and forth.

The propeller efficiency is inversely proportional to the number of blades. For 2 blade propeller the efficiency is high .But in order to accomplish more strength and considering the loads subjected on the ships 2 blade propeller are not utilized for trader ships.

Criteria	3-blade	4-blade	5-blade
Manufacturing cost	Low	Medium	High
Strength and durability	Low	Medium	High

II.OBJECTIVES OF THE WORK

- The main objective of the work is to design the propeller using macros. Here the program was written in macros and made to run the program. Then the design appears in the CATIA software.
- Analysis is done using ANSYS workbench for both the materials i.e. aluminium and inconel 625.
- Comparison of results between the two materials used and concluding the best one.

III.DESIGN METHODOLOGY

The Methodology followed in this undertaking project is as per the following:

Performing design calculations for the propeller.

- Create a 3D Model of the Existing boat propeller of 2D Drawings. The CATIA V5 R21 programming is utilized to make 3D modelling.
- Convert the 3D model to form a solid model and import it into ANSYS to execute the finite element analysis.
- Perform the static analysis of the propeller by applying the allowed loads.
- Perform Modal Analysis of the propeller and figure the natural frequencies in the field of activity.
- The investigation is performed to confirm the best material (Inconel and aluminum) for the propeller at the most extreme load conditions which breaks down the static and dynamic conditions.

IV.MACROS

With reference to computers, a macros is a programmable design which decodes a set of sequence of input into a set of output. Macros can be utilized to make tasks less iterative by representing a complicated series of keystrokes, mouse movements, commands, or different sorts of information. Macros are a device which enable a designer to re-utilize code. The macro statement contains the name of the macro definition and usually some variable parameter information. Macros will be helpful especially when a series of instructions is utilized for a number of times (and possibly by different programmers working on a project).

V.MACROS VB SCRIPTING

```
Language="VBSCRIPT"
Sub CATMain()
Set partDocument1 = CATIA.ActiveDocument
Set part1 = partDocument1.Part
Set hybridBodies1 = part1.HybridBodies
Set hybridBody1 = hybridBodies1.Item("Geometrical Set.1")
Set sketches1 = hybridBody1.HybridSketches
Set originElements1 = part1.OriginElements
Set reference1 = originElements1.PlaneYZ
Set sketch1 = sketches1.Add(reference1)
Dim arrayOfVariantOfDouble1(8)
arrayOfVariantOfDouble1(0) = 0.000000
arrayOfVariantOfDouble1(1) = 0.000000
arrayOfVariantOfDouble1(2) = 0.000000
arrayOfVariantOfDouble1(3) = 0.000000
arrayOfVariantOfDouble1(4) = 1.000000
arrayOfVariantOfDouble1(5) = 0.000000
arrayOfVariantOfDouble1(6) = 0.000000
arrayOfVariantOfDouble1(7) = 0.000000
arrayOfVariantOfDouble1(8) = 1.000000
sketch1.SetAbsoluteAxisData arrayOfVariantOfDouble1
part1.InWorkObject = sketch1
Set factory2D1 = sketch1.OpenEdition()
Set geometricElements1 = sketch1.GeometricElements
Set axis2D1 = geometricElements1.Item("AbsoluteAxis")
Set line2D1 = axis2D1.GetItem("HDirection")
line2D1.ReportName = 1
Set line2D2 = axis2D1.GetItem("VDirection")
line2D2.ReportName = 2
Set point2D1 = factory2D1.CreatePoint(-51.685165, 34.387375)
point2D1.ReportName = 3
Set point2D2 = factory2D1.CreatePoint(51.685150, 34.387375)
```

```
point2D2.ReportName = 4
Set line2D3 = factory2D1.CreateLine(-51.685165, 34.387375, 51.685150, 34.387375)
line2D3.ReportName = 5
line2D3.StartPoint = point2D1
line2D3.EndPoint = point2D2
Set point2D3 = factory2D1.CreatePoint(51.685150, -46.623390)
point2D3.ReportName = 6
Set line2D4 = factory2D1.CreateLine(51.685150, 34.387375, 51.685150, -46.623390)
line2D4.ReportName = 7
line2D4.EndPoint = point2D2
line2D4.StartPoint = point2D3
Set point2D4 = factory2D1.CreatePoint(-51.685165, -46.623390)
point2D4.ReportName = 8
Set line2D5 = factory2D1.CreateLine(51.685150, -46.623390, -51.685165, -46.623390)
line2D5.ReportName = 9
line2D5.StartPoint = point2D3
line2D5.EndPoint = point2D4
Set line2D6 = factory2D1.CreateLine(-51.685165, -46.623390, -51.685165, 34.387375)
line2D6.ReportName = 10
line2D6.EndPoint = point2D4
line2D6.StartPoint = point2D1
Set constraints1 = sketch1.Constraints
Set reference2 = part1.CreateReferenceFromObject(line2D3)
Set reference3 = part1.CreateReferenceFromObject(line2D1)
Set constraint1 = constraints1.AddBiEltCst(catCstTypeHorizontality, reference2, reference3)
constraint1.Mode = catCstModeDrivingDimension
Set reference4 = part1.CreateReferenceFromObject(line2D5)
Set reference5 = part1.CreateReferenceFromObject(line2D1)
Set constraint2 = constraints1.AddBiEltCst(catCstTypeHorizontality, reference4, reference5)
constraint2.Mode = catCstModeDrivingDimension
Set reference6 = part1.CreateReferenceFromObject(line2D4)
Set reference7 = part1.CreateReferenceFromObject(line2D2)
Set constraint3 = constraints1.AddBiEltCst(catCstTypeVerticality, reference6, reference7)
constraint3.Mode = catCstModeDrivingDimension
Set reference8 = part1.CreateReferenceFromObject(line2D6)
Set reference9 = part1.CreateReferenceFromObject(line2D2)
Set constraint4 = constraints1.AddBiEltCst(catCstTypeVerticality, reference8, reference9)
constraint4.Mode = catCstModeDrivingDimension
```

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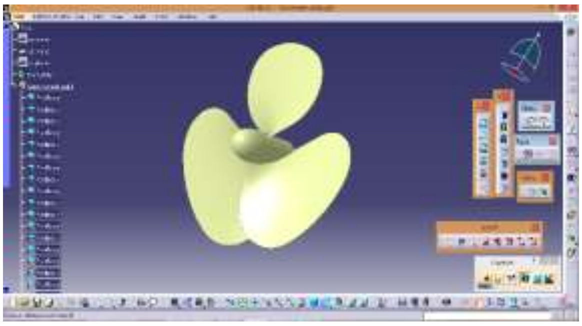
```
sketch1.CloseEdition
part1.InWorkObject = hybridBody1
part1.UpdateObject sketch1
Set bodies1 = part1.Bodies
Set body1 = bodies1.Item("PartBody")
part1.InWorkObject = body1
part1.InWorkObject = body1
Set shapeFactory1 = part1.ShapeFactory
Set pad1 = shapeFactory1.AddNewPad(sketch1, 20.000000)
Set limit1 = pad1.FirstLimit
Set length1 = limit1.Dimension
length1.Value = 50.000000
part1.UpdateObject pad1
Set sketches2 = body1.Sketches
Setreference10=part1.CreateReferenceFromName("Selection_RSur:(Face:(Brp:(Pad.1;0:(Brp:(Sketch.1;5)));No
ne:();Cf11:());Pad.1_ResultOUT;Z0;G4074)")
Set sketch2 = sketches2.Add(reference10)
Dim arrayOfVariantOfDouble2(8)
arrayOfVariantOfDouble2(0) = 0.000000
arrayOfVariantOfDouble2(1) = 0.000000
arrayOfVariantOfDouble2(2) = 34.387375
arrayOfVariantOfDouble2(3) = 1.000000
arrayOfVariantOfDouble2(4) = 0.000000
arrayOfVariantOfDouble2(5) = 0.000000
```

VI.MODELLING OF PROPELLER



CALCULATIONS:

Geometric specification of propeller

Diameter : 60 mm

Number of blades : 3

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Hand of operation : Left hand

Type of propeller : Controllable pitch propeller

Calculations:

Total Area Of the circle = πR2

= 3.141 x 302

= 2826.9 mm2

Total Blade Area = π r2 x DAR

= 2826.9X0.92

=2600.748 mm2

(DAR = TBA/TAC = 2600.748/2826.9=92 %)

Therefore DAR = Disc area Ratio

Relationship between Pitch & Pitch Angle

Pitch (P) = 2π r X Tan a

Where: (θ) = pitch angle

R = radius

Π =3.14159

Pitch Angle (θ) = 120°

Pitch (P) = 2x π x30xTan 120°

=326.422 mm

Speed = (RPM/Ratio)(Pitch/C)(1-S/100)

Assume Ratio =1/2,

Gear ratio(C) = 1

Slip(S) =0

Speed = (1000/0.5X326.316/1)(1-0/100)

Speed = 652844X60/106

=39.17064km/hr

The thrust (T) is equal to the mass flow rate (.m) times the difference in velocity (V).

T = m x (VB–VA)

Mass Flow Rate per hr (m) = area of blade x speed of the boat

= 2600.74 x 10-6 x39.17064 x 103

= 101.872 m3 /hr

Thrust (T) = m x (VB–VA)

= 101.840 x 39.1581 x 103

Thrust(T) = 4990416.91 N

VII.FUTURE SCOPE

The present work consists of only design of ship propeller using macros technique. There is also a scope of future work to be carried out for static and dynamic analysis of ship propeller using different types of materials.

VIII.CONCLUSION

All the above work deals with design of ship propeller using macros. Firstly, all the information is collected and the previous works were outlined.Propeller 3D model is modelled in CATIAV5R21 using macros technique

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