Design and Development of Rukma Vimana Nozzle

M. Prashanth Reddy, V V S H Prasad, G.V.R.Seshagiri Rao, C.Labesh Kumar

Abstract: Rukma vimana is a part extraction from vimana Shastra. This project deals with nozzle system of ancient rukma vimana for vertical take-off systems. Nozzle design is very important to provide the necessary lift to the vimana. In the vimana Shastra a provision has been identified to create external heat supply to the streamed flow system in nozzle. In the present work external heat is applied to the nozzle section and to estimate the coefficient of lift. An attempt is being made to create CAD modelling and perform ANSYS fluent analysis to validate theoretical correlations. Keywords: Bumper, dynamic and modal analysis,

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I. INTRODUCTION

There are three types of vimanas mentioned in vimana Shastra classified depending upon the importance: - maantrika, taantrika and kritaka. All these are described and designed by analyzing the resources available in earth and also depending on the human intelligence. Rukma vimana is one of the kritaka vimanas and it is similar to a rocket. Profile and geometry of the Rukma vimana is adapted to our project study using new technology [Creo, ANSYS (Fluent), 3D printing].

➢ **RUKMA VIMANA AND ITS SPECIFICATIONS**

Geometry – The geometry is again a cylinder-cone combination with a base diameter of feet, height of 20 feet, and cone height of 80 feet. The text mentions a dimension of 1000 feet for the base. However, the drawing shows only 100 feet. This is a geometrical contradiction.

Fig: 1.1 *Rukma Vimana*

II. LITERATURE REVIEW

1. Shivanandam M et al. (**2015**) They mention numerous propulsion which includes Mercury propulsion. Vaimanika Shastra presents entire manual for Design, Material selection, Manufacture, Operation, Space suits, Food, Tackling enemies, Becoming invisible etc. S.B.Talpade, Sanskrit scholar has designed and built an aircraft based on Vedic principles and verified the first unmanned flight.

2. T. V. Vineeta et al (2014) The MRV UAV idea is proposed particularly to create VTOL, the raise fans configuration just like Rukma vimana, consequently the decision Mini Rukma Vimana Unmanned Air Vehicle. Lift fanatics are the primary a part of the MRV UAV. Using the MRV UAV, the missions end up loads extra simpler and much less hard to be completed.

3. Bogdan-Alexandru Belega et al. (**2015**) Nozzle could be a device designed to regulate the speed of flow, speed, direction, mass, shape, and/or the pressure of the stream that exhaust from them. Nozzles are available a range of shapes and sizes betting on the mission of the rocket, this is often important for the understanding of the performance characteristics of rocket. By the right geometrical style of the nozzle, the exhaust of the propellant gases are regulated in such how that most effective rocket speed may be reached.

4. Gutti Rajeswara Rao et al. (2013) The outcomes of ratio and Nozzle stress ratios (NPR) on Mass flow, most stress, and maximum pace and on maximum pressure ar studied victimisation Fluent Analysis. The classical one dimensional inviscid principle could now not monitor the advanced waft alternatives during a indirect divergent nozzle correctly. The code fluent has been wont to cypher glide employing a coupled and axisymmetric oblique Divergent nozzle for diverse nozzle ratios and for diverse physicist numbers.

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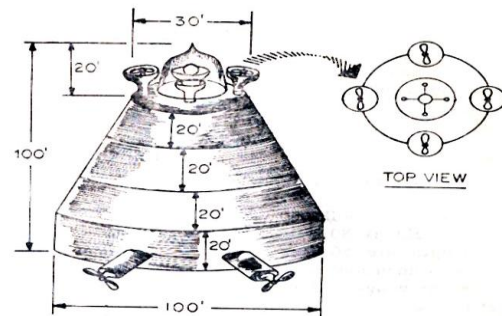
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III. METHODOLOGY

Building a model in Solid Works sometimes starts with a 2nd sketch (although 3D sketches are accessible for power users). The sketch consists of pure mathematics like points, lines, arcs, conics (except the hyperbola), and splines. Dimensions are intercalary to the sketch to outline the scale and site of the pure mathematics. Relations are wont to outline attributes like tangency, similarity, perpendicularity, and disk shape. The constant nature of Solid Works implies that the size and relations drive the pure mathematics, not the opposite manner around. The size within the sketch is controlled severally, or by relationships to different parameters within or outside of the sketch. In an assembly, the analog to sketch relations are mates. Even as sketch relations outline conditions like tangency, similarity, and disk shape with relevancy sketch pure mathematics, assembly mates outline equivalent relations with relevancy the individual elements or elements, permitting the straightforward construction of assemblies.

Manufacturing

By the usage of the important competencies of the software program almost about the single statistics supply precept, it gives a wealthy set of tools in the manufacturing surroundings inside the shape of tooling format and simulated CNC machining and output. Tooling options cover strong point equipment for moulding, die-casting and modern tooling layout.

In the elastic impact, energy conservation principle is considered here; kinetic energy is conserved before the impact and again converted to elastic energy. Kinetic energy of automobile and the impact or during its maximum deflection can be expressed as follows:

IV. DESIGN CALCULATIONS:

Let

ve = exit velocity of air through propeller

vac = aircraft air speed (or) velocity (m/s)

$vpitch$ = propeller pitch speed (m/s)

f = Thrust (N)

$m*$ = mass flow rate (kg/s) = ρave

ρ = density of air (kg/m3) = 1.225 kg/m3

a = area through propeller normal to the flow (m2)

p = pressure (Pa (or) N/m2)

d = diameter of the propeller (inch)

Area of the propeller = $\frac{\pi}{4} \times$ d2

  d = 10 inch = 25.4cm = 0.254m

  a = 0.05064506m2

  Propeller static thrust: f = m* ×ve

  Propeller dynamic thrust:

  Fd = m*Δv = m*(ve - vac)

    Ve ~ Vpitch = RPMprop * Pitchprop * 1ft/12in * 1mile/5280ft * 60min/1hr

        = 9700*4.7*1/12*1/5280*60

      ve ~ vpitch = 43.17mph = 19.53565m/s

Considering the empirical correction factor the final static thrust is given as:

F = 1.225* Π (0.0254d) 2/4*(RPM*Pitch*0.0254*1min/60sec) 2*(d/3.29546*Pitch) 1.5

F = 11.988N

From the above calculated values of static thrust and propeller pitch speed

According to FROUDES MOMENTUM THEORY (or) Actuator Disc Theory, the assumptions are made for a rotor in hover:

V0 = 0

Vd = Vh = Vi

Ve =   2Vh = 2Vi

F = T = m* Ve = ρAVh(Ve)

F = 2 ρAVh2

Vh = sqrt (F/2ρA)

DL = disc loading = T/A (or) F/A

    =11.988/0.05064506

    = 236.7114969N/m2

Vh =   sqrt(DL/2ρ)

Vh = 9.829391513 m/s

Ve =   2Vh = 19.65878303 m/s

Ve = 19.66 m/s

We consider the inlet velocity of the nozzle as:

V1 = rω

ω = 2ΠN/60 = 1015.266666667 rad/sec

V1 = rω = 10"/2*10-2*2.54*1015.266666667

V1= 128.938 m/s

V2 = 1.5V1

V2 = 1.5*128.938

V2 = 193.408 m/s

Therefore from the above calculations the values of V1 and V2 are obtained and are compared with the analytical solution.

FINAL ASSEMBLY

Geometry creation

Dimensions

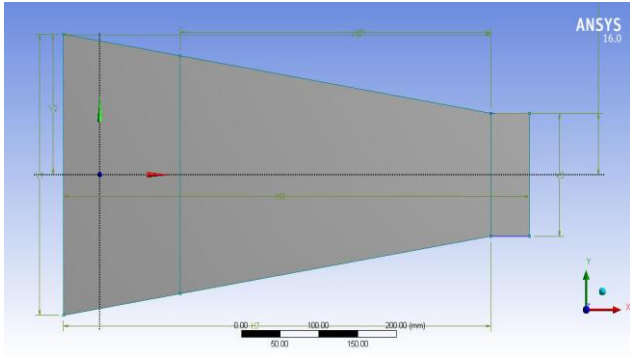|	
Inlet Dia D	= 320 mm
Through Dia d	= 160 mm
Length of the Nozzle	= 550 mm

Fig: 1.3 Nozzle Geometry
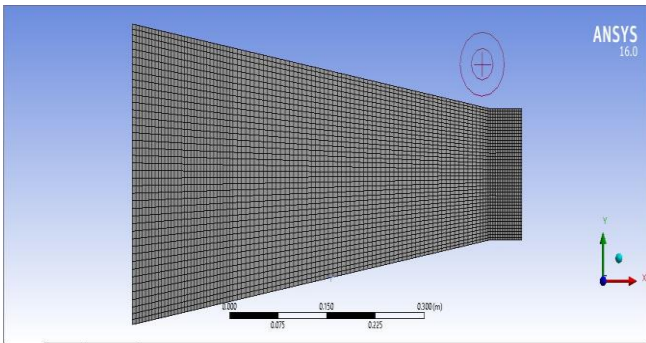
Grid generation

Fig: 1.4 Meshing

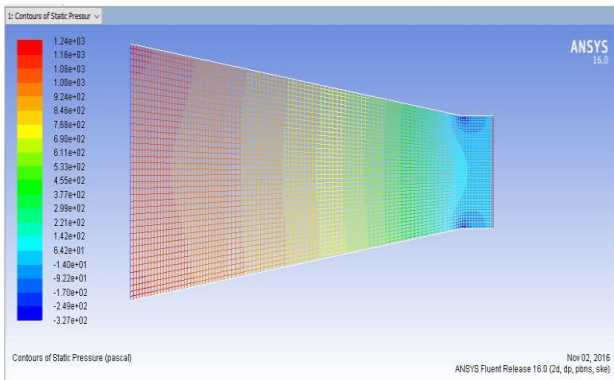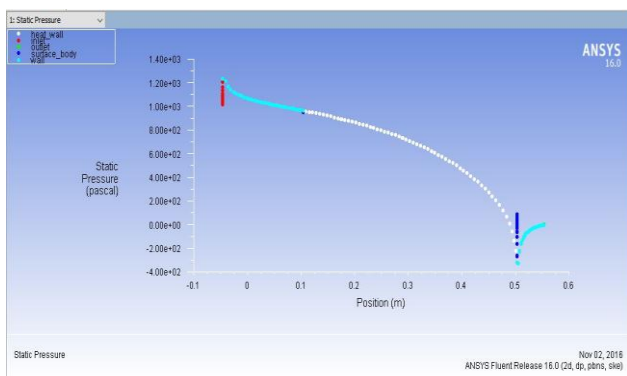**Results And Discussions**

Fig: 1.5 Pressure contour

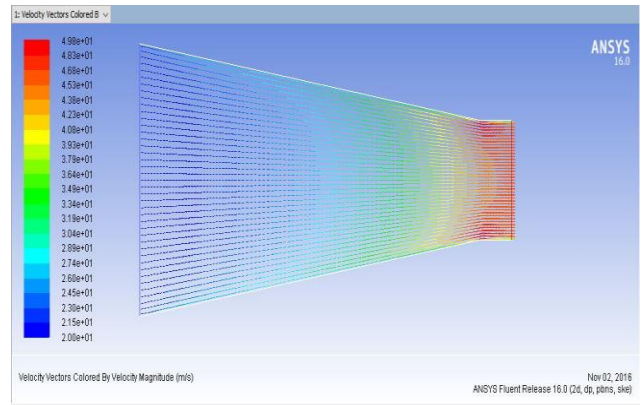**Pressure vs Position Graph**

Graph: 1.6 Pressure vs Position Graph

Velocity

Fig: 1.7 Velocity vector

Temperature
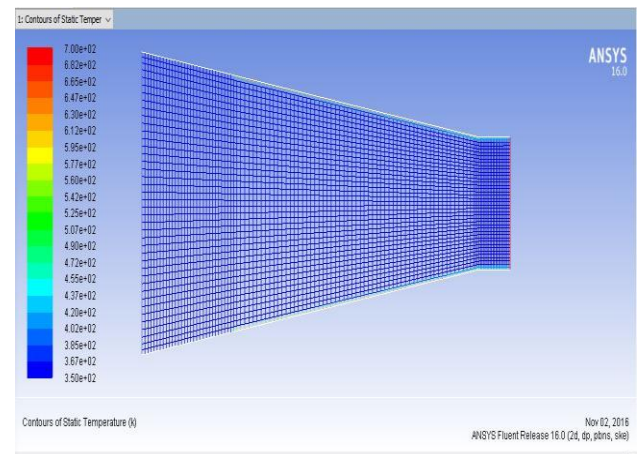
Fig: 1.8 Temperature vector

V. RESULTS AND DISCUSSIONS

Velocity Variation

Table 1.0 Velocity Variation with Application of Heat

Velocity Variation with Application of Heat		
Inlet Velocity (V_1)	Exit Velocity (V_2)	Velocity Ratio(V_2/V_1)
5	12.5	2.5
10	24.8	2.48
15	37.2	2.48
20	49.6	2.48
30	74.3	2.477
40	99.2	2.48
50	124	2.48
70	174	2.486
100	248	2.48
150	373	2.487
300	760	2.533

Table 1.1 Velocity Variations without Application of Heat

Velocity Variation With Out Application of Heat		
Inlet Velocity (V_1)	Exit Velocity (V_2)	Velocity Ratio (V_2/V_1)
5	12.5	2.5
10	24.8	2.48
15	36.9	2.46
20	49.2	2.46
30	73.7	2.457
40	98.4	2.46
50	123	2.46
70	172	2.457
100	248	2.48
150	373	2.487
300	760	2.533

VI. CONCLUSION

It is to be iterative process to establish the optimal size of the nozzle to get the high thrust value for getting lift. Here nozzle section geometry kept content and mass flow rate has been varied. From the above table it is observed that there is change in exit velocity. At low velocity by heat addition is not contributing to increase the exit velocity. At inlet velocity 15m/s a significant velocity change is observed at exit section and this clearly shows that the heat addition is contributing towards velocity change at exit section. At 100 m/s inlet velocity it is observed that no velocity change is observed at exit though it is having heat transfer. This because of the fluid interaction with boundary with small duration of time.

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