Design and Analysis of Rocket Model

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Abstract: Our project consists of designing and analysing a model rocket with the payload of 10 Kilogram capable of reaching 30kms apogee. It makes a lucid way for students to gain a better experience with the model rocket. In this project "Dhruva M 33" is taken as a fundamental rocket design, and all the factors affecting the model are analysed after designing the rocket which helps students to get a relevant idea about payload model rocket. All the different stages are also mentioned in the project which are primary requirement for the Model rocket. And with the help of stimulation entire process is explained properly. As a result, maximum apogee reached was 33.116 km and ground hit velocity was 49.3 m/s.

I. INTRODUCTION

Flying model rockets is a relatively safe and inexpensive way for students to learn the basics of forces and the response of a vehicle to external forces. Like an airplane, a model rocket is subjected to the forces of weight, thrust, and aerodynamics during its flight. A model rocket is a small rocket designed to reach low altitudes recovered by a variety of means. A model rocket can be made of cardboard, paper, plastic, wood etc. Modelling the Rocket is one of the most important practical way in which an individual can gain knowledge and experience. It is said that the hobby of modelling the rocket was invented by G. Harry Stine and Vernos Estes. However, theory and Experiment is inter connected so, we ought to refer some of the available books in our college library and some websites before starting the actual modelling process.

II. MODEL ROCKET DESIGN DHRUVA M33 ROCKET

III. ARCHITECTURE OF DHRUVA M 33 MODEL
The model rocket is named KarnaB44. This rocket consists of 3 stages: 2 booster stages and 1 sustainer stage. This model is designed such that the total weight of the rocket is 148.211 kg and it can reach an apogee of 33.173 km.

1st stage consists of the nose cone, body tube and fins. (Further details explained in the next section)
2nd and 3rd stage consists of just the body tube and the fins. (Further details explained in the next section)
To connect each of the body tubes the coupler has been installed.

A. Stage 1
1) Nosecone

The nose cone is of conical shape and made of brass. The length of the nose cone is 65 cm with base diameter of 18 cm. The nose cone shoulder is of diameter 15 cm and length of 4 cm.

2) Bodytube 1

The body tube is made of steel. The length of the body tube is 200 cm and the diameter (outer) is 18 cm.

Components inside this body tube are:
- PAYLOAD – 10 kg
- PARACHUTE - 400 cm diameter
- SHOCKCORD - 100 cm length
- MOTOR - O8000-P (Cesaroni)

B. Fins

The fins are trapezoidal finset.
Fins are used for better stability tilted at an angle of 22.5 degrees
The fins are made of Carbon Fibre.
C. Stage 2
   1) Bodytube 2

   The body tube is made of Fiber-Glass. The length of the body tube is 160cm and the diameter (outer) is 18cm.
   Components inside this body tube are:
   - TUBE COUPLER – 17.6 outer diameter (Carbon Fiber)
   - MOTOR O8000-P(Cesaroni) - Total impulse – 41125N/m²
   - ENGINE BLOCK – 17.6cm

2) Fins

   The fins are trapezoidal fin set. 4 fins are used for better stability. The fins are made of Carbon Fibre.

D. Stage 3
   1) Body Tube 3

   The Body Tube is made of Fiber Glass. The length of the body tube is 100cm and diameter (outer) is 18cm.
   Components Inside This Body Tube Are:
   - TUBE COUPLER – 17.6 outer diameter (Carbon Fiber)
   - MOTOR O8000-P(Cesaroni) - Total impulse – 41125N/m²
   - ENGINE BLOCK – 17.6 cm outer diameter

2) Fins

   The fins are trapezoidal fin set. Fins are used for better stability tilted at an angle of 22.5 degrees.
   The fins are made of Carbon Fibre.
IV. PARAMETERS OF DHRUVA M 33

Total Length Of Rocket-525cm
Total Mass of the rocket-148.211kg
Max Apogee-33.173km
Max velocity-883m/s(Mach2.86)
Max Acceleration–102m/s²
Stability–2.52cal
CG–309cm
CP–355cm

V. FLIGHT SIMULATIONS

The Altitude and Vertical Velocity Is Plotted With Respect to Time.
Different stages of flight are shown in the simulation graph. For example, Motor Burnout, stage separation etc.
The launch rod length was set to1100cm (double the length of the rocket)

VI. RESULTS

The maximum Apogee reached was 33.116km The maximum ground hit velocity was 49.3m/s

Hence the given problem statement was solved and the results have been shown.

VII. CONCLUSIONS

Looking back at this project the overall outcome of the result to be observed. This can be evaluated by looking at how our objectives were solely adjacent to what result we achieved. The result concluded that there were different graphical reactions for different stages of flight. It was even concluded that the graph for altitude was bell shape.
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