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Design and Analysis of Rocket Model

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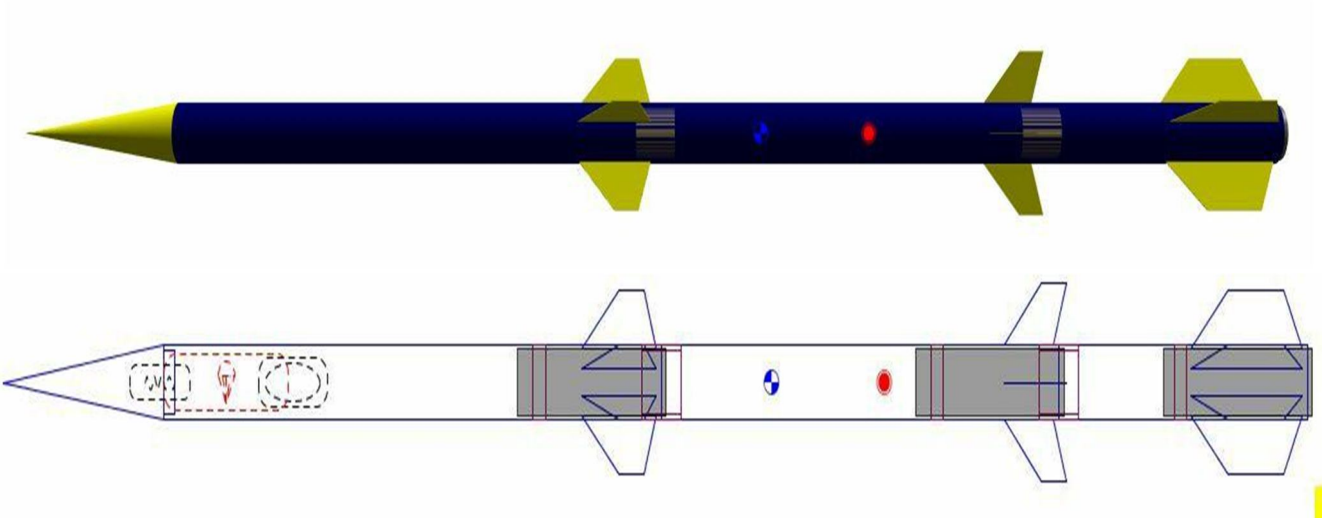
Abstract: Our project consists of designing and analysing a model rocket with the payload of 10 Kilogram capable of reaching 30kms apogee. It makes a lucid way for students to gain a better experience with the model rocket. In this project "Dhruva M 33" is taken as a fundamental rocket design, and all 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.

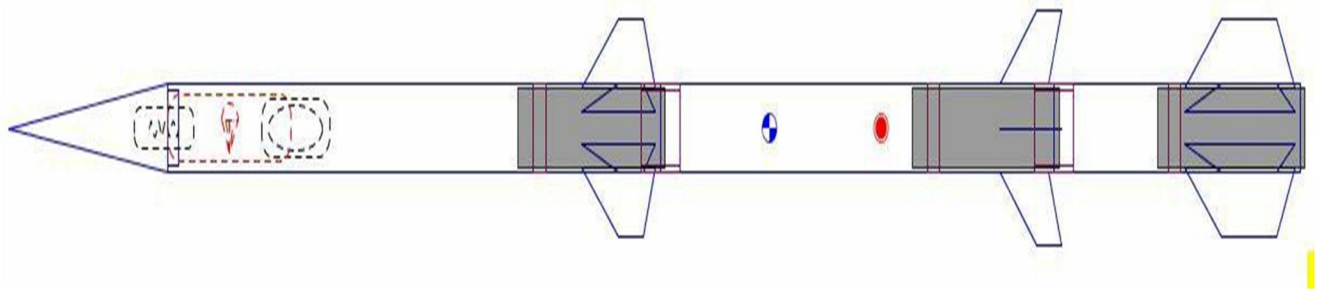
I. INTRODUCTION

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



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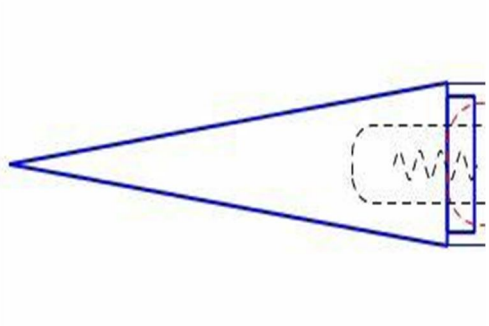
The model rocket is named KarnaB44.This rocket consists of 3stages.2 booster stages and 1sustainer stage. This model is designed such that the total weight of the rocket is 148.211kg and it can reach an apogee of 33.173km.
1st stage consists of the nose cone, body tube and fins.(Further details explained 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.

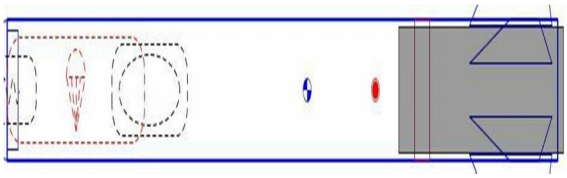
A. Stage1

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 18cm.The nose cone shoulder is of diameter 15cm and length of 4cm.

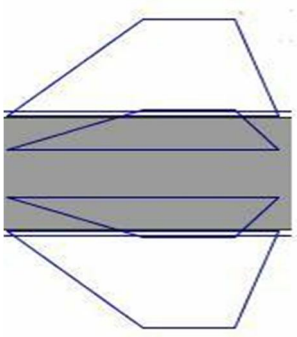
2) Bodytube 1



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

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

B. Fins



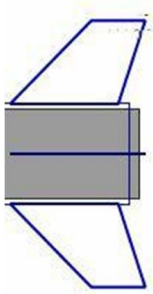
The fins are trapezoidal finset.
Fins are used for better stability tilted at an angle of 22.5 degrees
The fins are made of Carbon Fibre.

C. Stage2

1) Bodytube 2

The body tube is made of Fiber-Glass. The length of the bodytube 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/m^2 ENGINE BLOCK-17.6cm

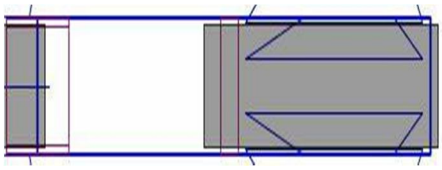
2) Fins



The fins are trapezoidal finset.4finsareusedforbetter stability. The fins are made of Carbon Fibre.

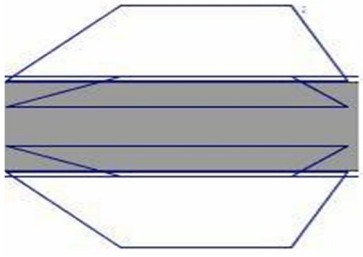
D. Stage3

1) Body Tube 3



The Body Tube is made of FiberGlass. The length of the body tube is 100cm and diameter(outer)is18cm.
Components Inside This Body Tube Are:
TUBE COUPLER–17.6outer diameter (Carbon Fiber)
MOTOR-O8000-P(Cesaroni)-Total impulse-41125N/m^2
ENGINE BLOCK-17.6cm outer diameter

2) Fins



The fins are trapezoidal fin set. Fins are used for better stability tiltedatan angle of 22.5 degrees
The fins are made of Carbon Fibr

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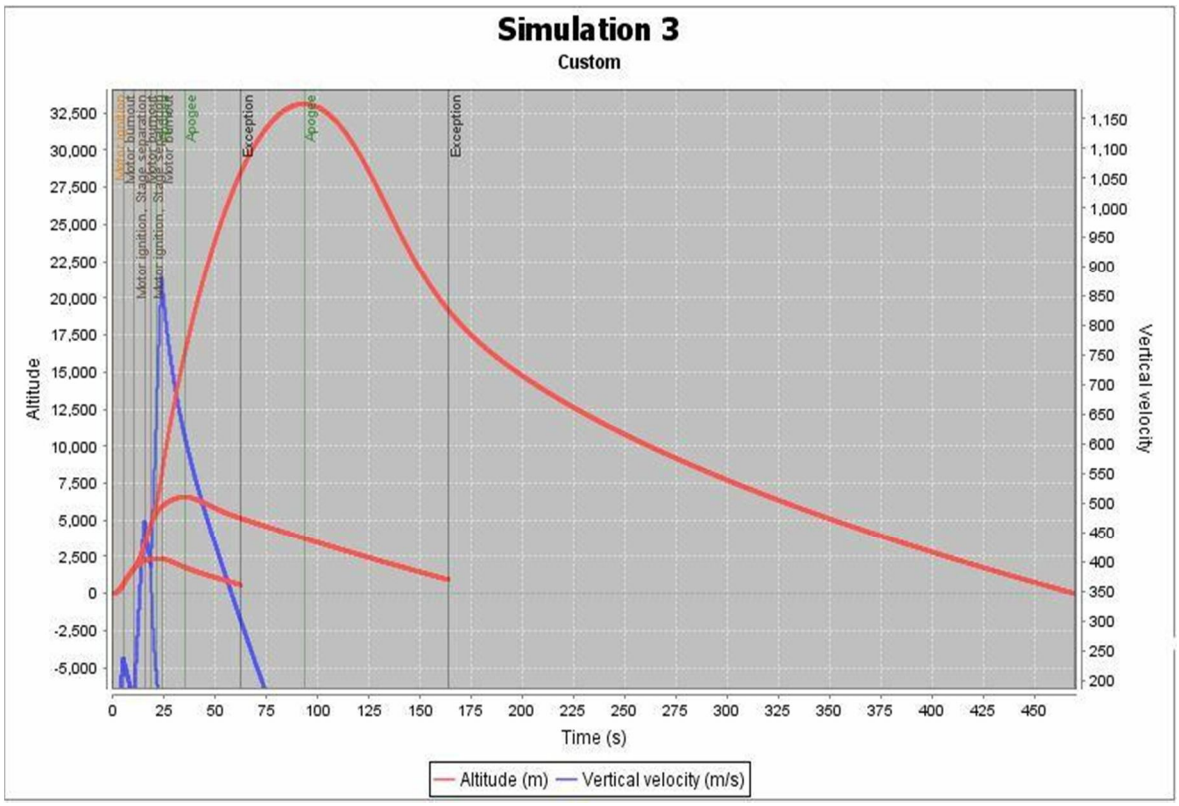
IV. PARAMETERS OF DHRUVA M 33

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/s^2
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

	Name	Configuration	Velocity off rod	Apogee	Velocity at depl...	Optimum delay	Max. velocity	Max. acceleration	Time to apogee	Flight time	Ground hit velocity
1	Simulation 3	[O8000-P; O8000-P; O...	32.7 m/s	33116 m	N/A	69.4 s	884 m/s	103 m/s²	93.3 s	470 s	49.3 m/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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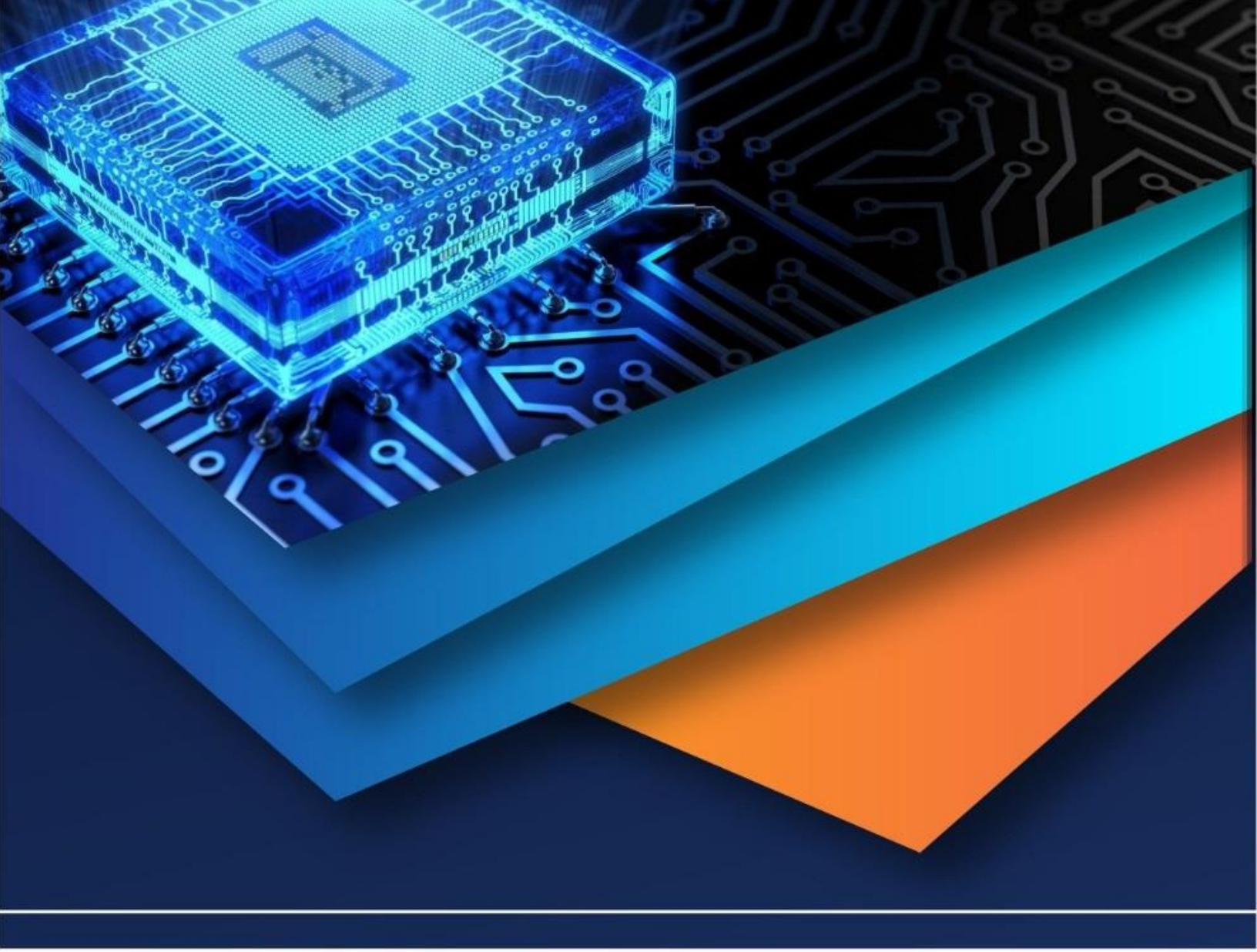

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