AIRFRAME

INSIGHT-1

AGENDA

AIRFRAME

- Work
- Software

MODEL ROCKETS

Discussing about Model Rocketry and it's Structural aspects

INSIGHT-1

It's Mission constraints and Requirements

MATERIALS

How the materials for the Rocket and Launch pad was selected ?

WORK FLOW

Realizing, Designing, Simulating and Planning for the manufacturing of components of the Rocket and Launch pad

SUBSYSTEM ACTIVITIES

- Present Work
- Future Plans

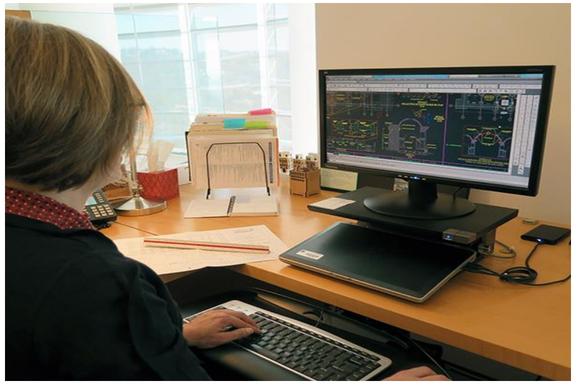
AIRFRAME

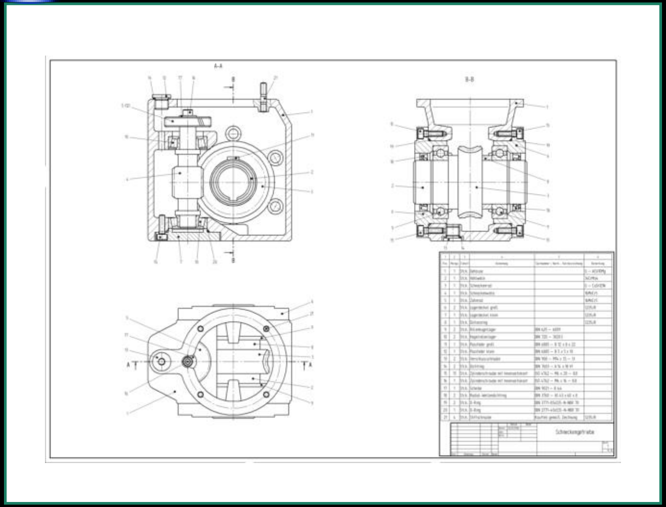
DISCUSSION

- Extensive Brainstorming on the constraints and the requirements
- Discussion on the materials for the Model Rocket
- Brain behind the developing of Launch pad for INSIGHT-1

DESIGNING

- Designing the CAD Model based on the constraints and Requirements
- Re-Iterating Designs based on the feedback received from different subsystem.



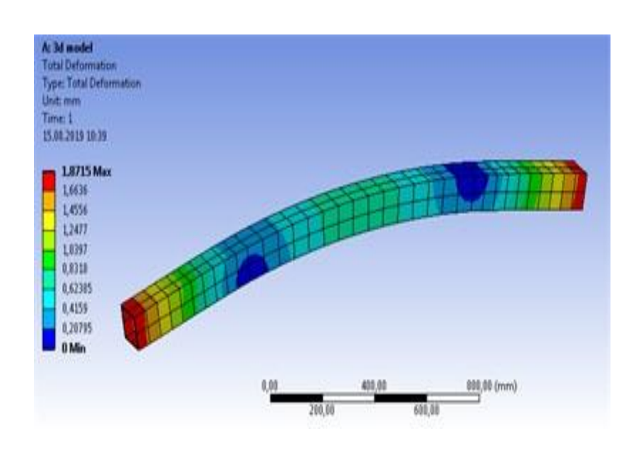


DRAFTING

- Important for manufacturers to produce components with desired Specs.
- Recording the Design Specification for future References

SIMULATIONS AND ANALYSIS

- Simulate the conditions
- Failure Analysis (if any)
- Load bearing ability of the material
- Possible Risks
- Ensuring Mission Success



SOFTWARES

CATIA | ANSYS | SOLIDWORKS | FUSION 360

MODEL ROCKETS

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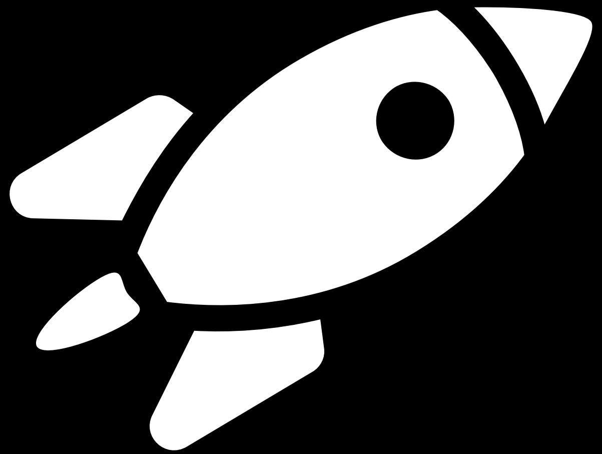
SPECIFICATIONS

- Apogee at Low Altitudes
- Constructed from Paper, Wood, Plastic and other lightweight materials.
- Young Students use it to understand the working of rockets and carry out small study.



Source: Wikipedia

INSIGHT-1

Mission Constraints

Source: Wikipedia

APOGEE: 2000 ft

MASS: 1.942 KG

MATERIALS

NOSE CONE

BODY TUBE

CENTERING RING AND BULKHEAD

PLA

- 3-D PRINTING
- SATISFIES THE CONSTRAINTS

MATERIALS

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NOSE CONE

BODY TUBE

CENTERING RING AND BULKHEAD

KRAFT PAPER

- EASY TO PROCURE
- HIGH STRENGTH WHEN USED IN LAYERS
- INEXPENSIVE
- IN HOUSE MANUFACTURING

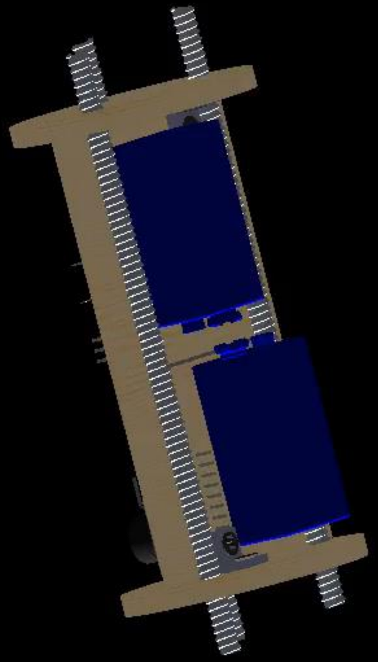
MATERIALS

- NOSE CONE
- BODY TUBE
- CENTERING RING AND BULKHEAD

PLYWOOD

- EASY AVAIBILITY
- LESS DAMAGE DUE TO ATMOSPHERIC CONDITIONS
- HIGH EFFICIENT IN COMPARISION TO BALSA
- MANUFACTURING CAN BE PERFORMED EASILY
- EXCELLENT SUPPORTING PROERTIES

AVIONICS BAY



Material Used

- Plywood
- Titebond Wood Glue
- M4 Threaded Rods (Al 6063)- 150 mm
- Sandpaper
- M3 screws
- L-Brackett
- U-Bolt

WEIGHT ANALYSIS

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Components	Qty	Weight per Component(g)	Total Weight(g)
Arduino Nano	1	7	7
Altimeter BMP388	1	0.561	0.561
IMU MPU 6500	1	5	5
MOSFET IRF540	4	9	36
OpAmp LM318	1	1	1
Batteries 9V	2	45	90
SD card module	1	4	4
Buzzer 150dB	1	1	1
Sled board	1	20	20
Threaded Rods(DIA 4mm LENGTH 15cm) Al-6063	3	5.1	15.3
Bulkheads	2	9.95	19.9
U-Bolts			20
		TOTAL WEIGHT	219.761
Contingency			10%
		FINAL WEIGHT	241.7371

Dimensions

Radius- 37.50 mm

Length- 235.62 mm

Materials

PLA (Polylactic Acid)

Manufacturing Technique

3D Printing

Dimensions

Outer Radius- 37.50 mm

Length- 730.00 mm

Thickness- 5.00 mm

Materials

Kraft Paper

Manufacturing Technique

In-house spiraling

Dimensions

Width- 71.50 mm

C_{root}- 155.162 mm C_{tip}- 83.176mm

Thickness- 5.00 mm

Materials

Plywood

Manufacturing Technique

In-house cutting &machining

CENTERING RING

Dimensions

Radius- 35.00 mm

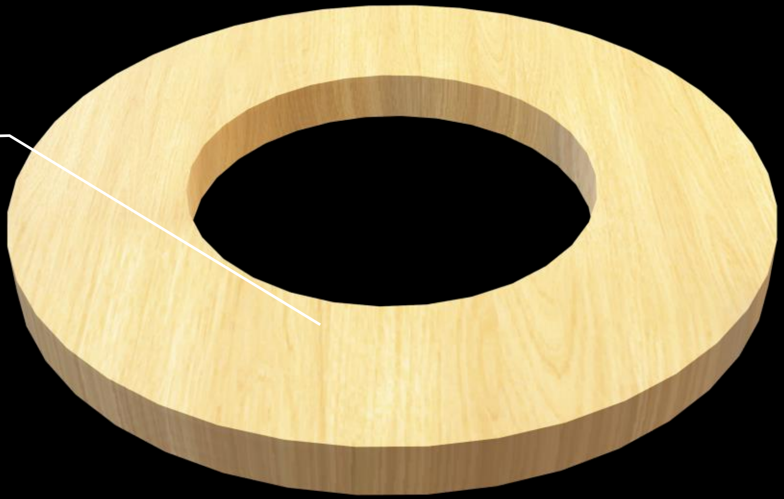
Thickness- 5.00 mm

Materials

Plywood

Manufacturing Technique

Cutting and Machining



BULKHEADS

Dimensions

Radius- 35.00 mm

Thickness- 5.00 mm

Materials

Plywood

Manufacturing Technique

Cutting and Machining

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LAUNCH PAD

Source: www.thekingofrandom.com

OBJECTIVES

LIGHT WEIGHT

EASY MANUFACTURABILITY

COST EFFECTIVE

DURABLE

Source: www.thekingofrandom.com

PROS

- Use 1/4" diameter lugs on large and heavy rockets -2 inches in diameter or larger, and up to a G size rocket engines.
- For high power rockets, use rail buttons.
- Small rockets [model or mid-power] -under 3 lbs. and 3 4 ft tall – launching lug with rod
- If rocket will be just fine on a 1/4" rod, - use the lug
- Launch lug presents little frontal area since they're hollow tubes, plus there's a bit of frontal area from the fillets along the lug/airframe join

PROS

- Rail buttons on small rockets are wider than a launch lug, they will produce more drag on a small rocket than a smaller lug.

- Lugs are a lot stronger because they have a larger base that touches the rocket's tube. Because the base of lugs are so wide, there is a lot of surface area for glue.

- They conform to the curvature of the tube. This increases the strength because as you set them on the tube, the glue spreads out and contacts the tube better.

- They align easier on the tube. Because they conform to the curvature of the tube, they sort of self-align. That means they are easier to make parallel to the tube, so that they aren't twisted.

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CONS

- The high thrust motors put a lot of strain on the launch lugs

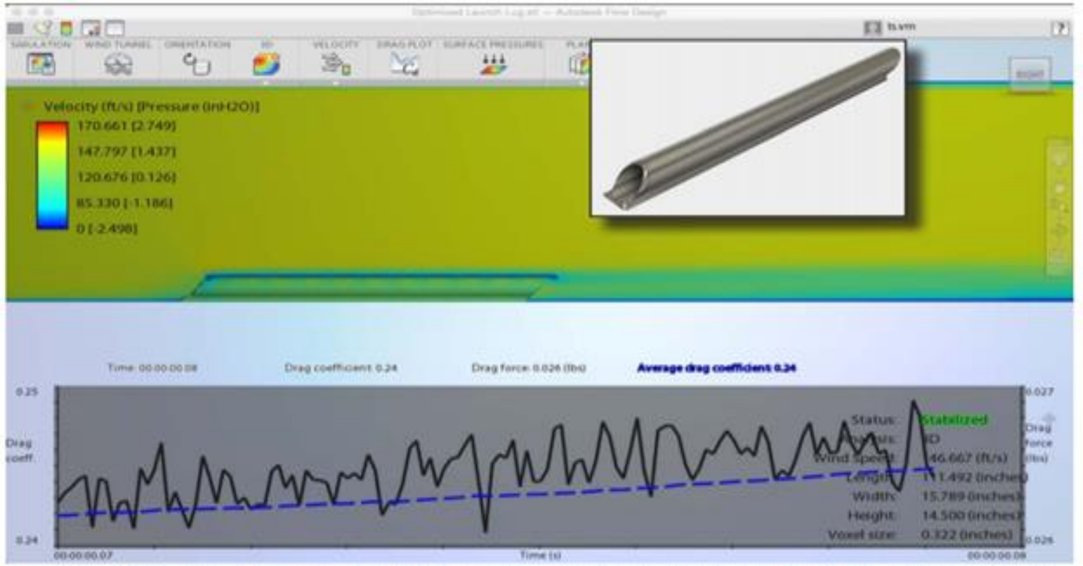
LAUNCH RAILS

- ➢ No on pad swaying
- ➢ More difficult to get on pad
- ➢ No rod whip and more likely to bind
- ➢ Expensive
- ➢ Availability of RAIL GUIDE
- ➢ If the rocket needs greater than a 1/4" rod (due to weight, size of the rocket, size of the motor(s)) go with buttons.

Source: rail-buttons.com/minimicro.html

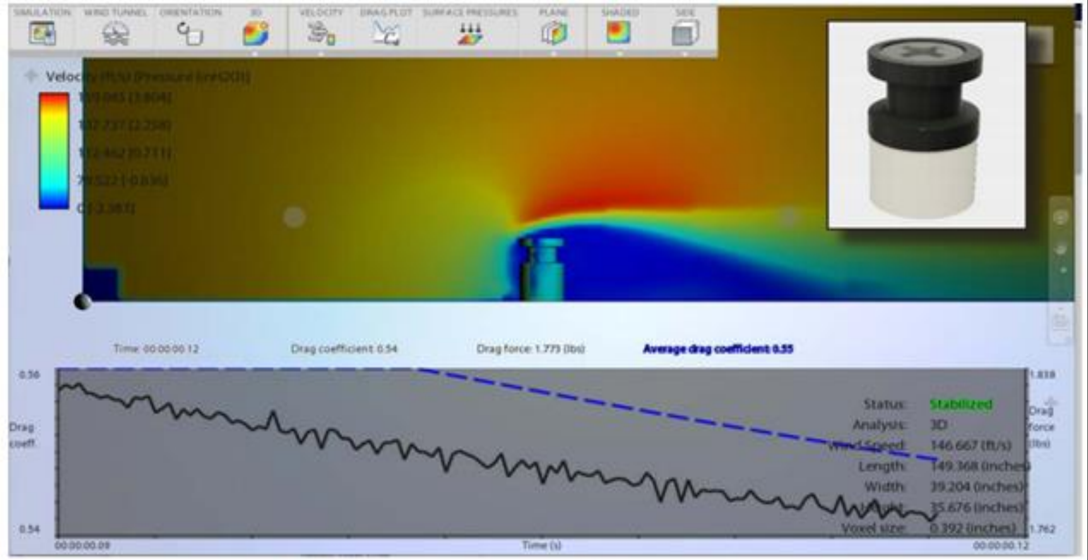
COMPARISION

LAUNCH LUGS



Sim #28 - 1/8" X 2" long launch lug with glue fillets, radiused LE, and Swept LE and TE - 100mph air flow

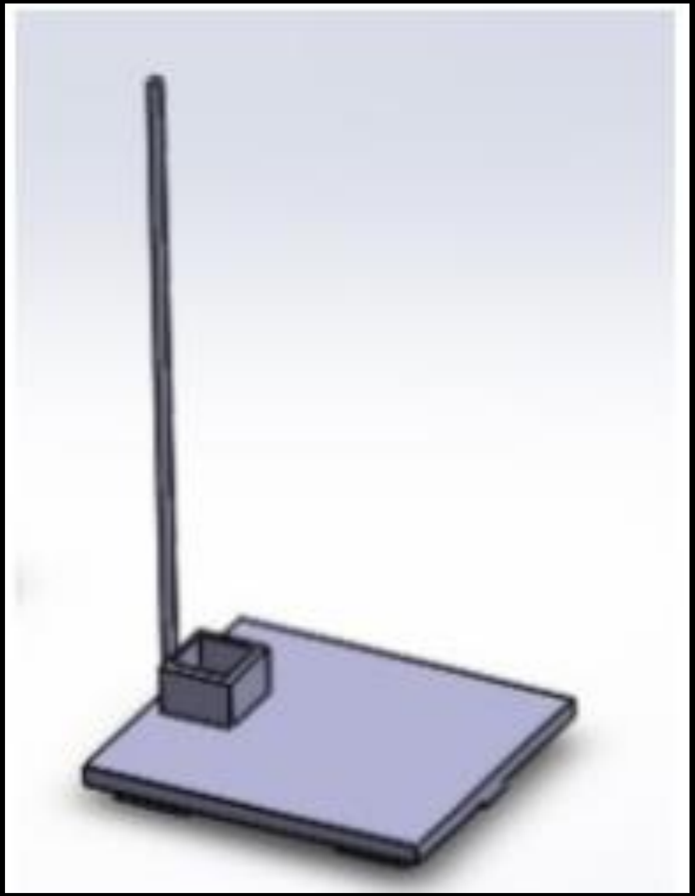
LAUNCH RAILS

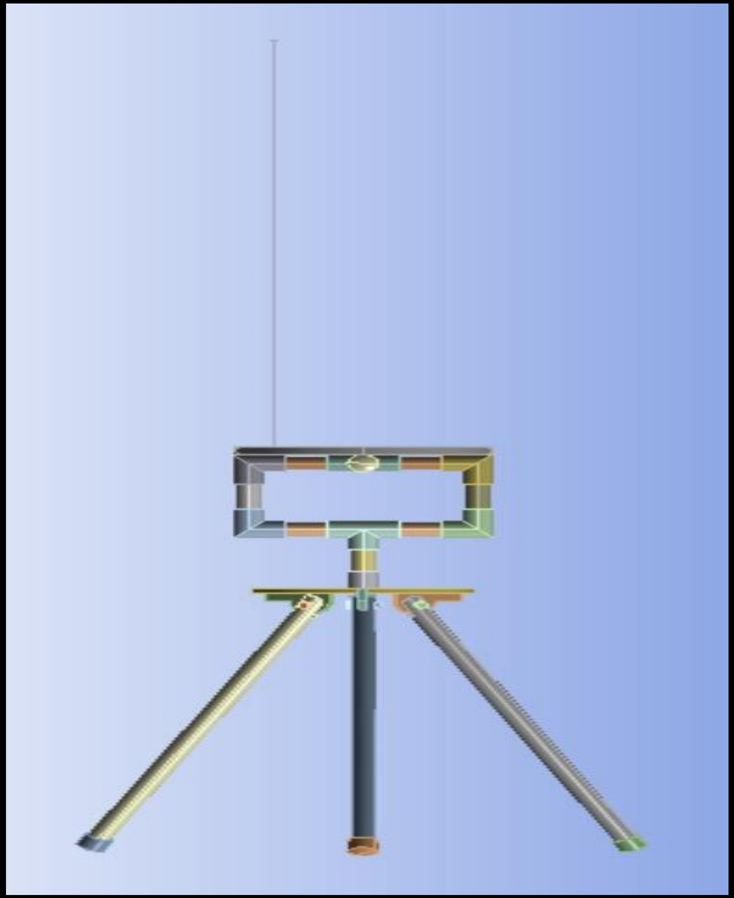


Sim #12 Drag of standard 1010 Rail button on a 1/4" high stand-off at 100 mph air flow

Data taken: Drag-of-Lugs-Buttons-Guides-T.-VanMilligan-NARCON-2017.pdf

LAUNCH PAD DESIGNS





FINALISED DESIGN FOR LAUNCH PAD

- These stand is made by very cheap and easily procurable material like plywood , adhesives (which can be reused for making stand after rocket is done) , a steel plate and a steel rod .
- The total cost of the stand is in between 700-800 Rs and is easy to make.
- Its approx. weight would be 1-1.5 Kg and it is also foldable so easy to carry.
- It could be adjusted with different dimension of rocket by adjusting the length of the iron rod
- Its maintenance is also easy and could be repaired manually .
- The legs of the stand could be replaced by PVC if required .

STATIC STRUCTURAL

Why?

Static Structural Analysis determines the stress, displacement, strain and forces in structures or components caused by loads. Loads are extremely significant in a rocket and hence, performing static structural on the components can give information on failure and region of high stresses thereby helping in rethink the dimensions or the material.

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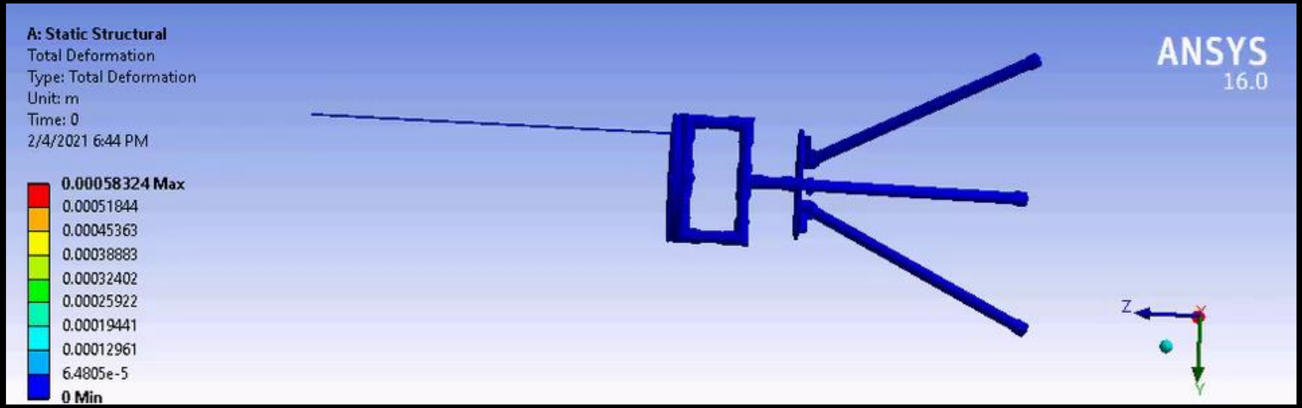
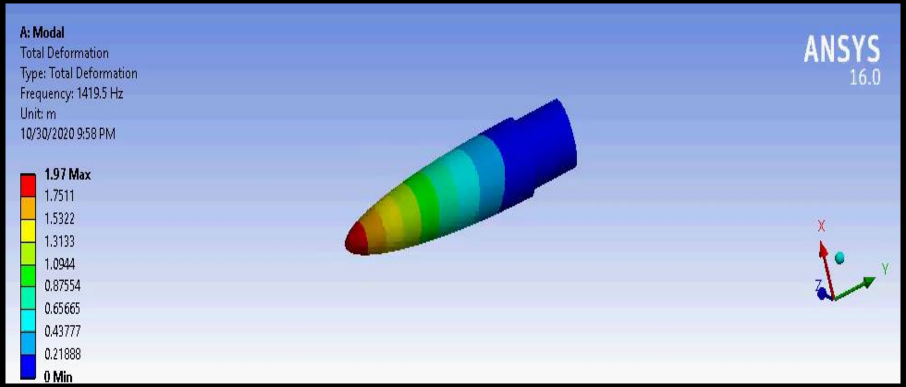


MODAL ANALYSIS

Why ?

Modal analysis is the study of the dynamic properties of a system in the frequency domain. They give an overview of the limits of the response of a system. This is helpful in the rocket to ensure that the range of frequencies that the rocket system does not cause any fracture or damage.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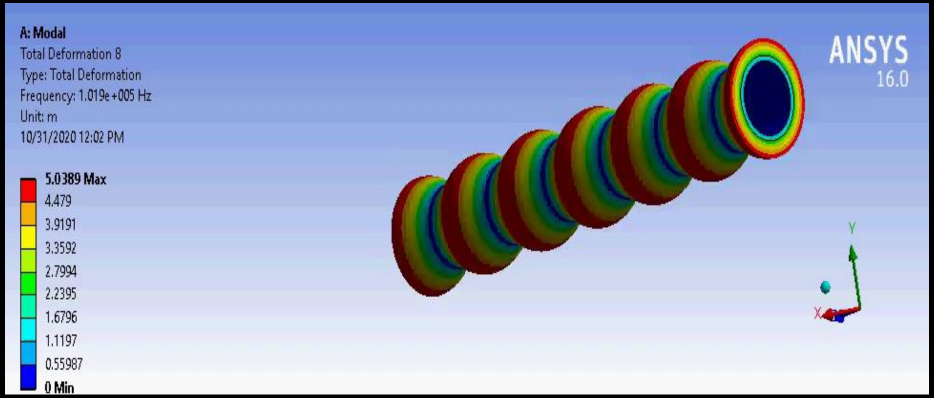
0 Min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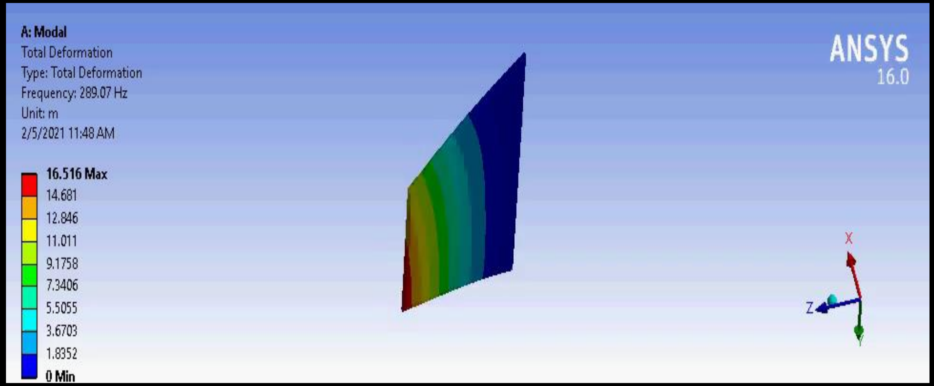
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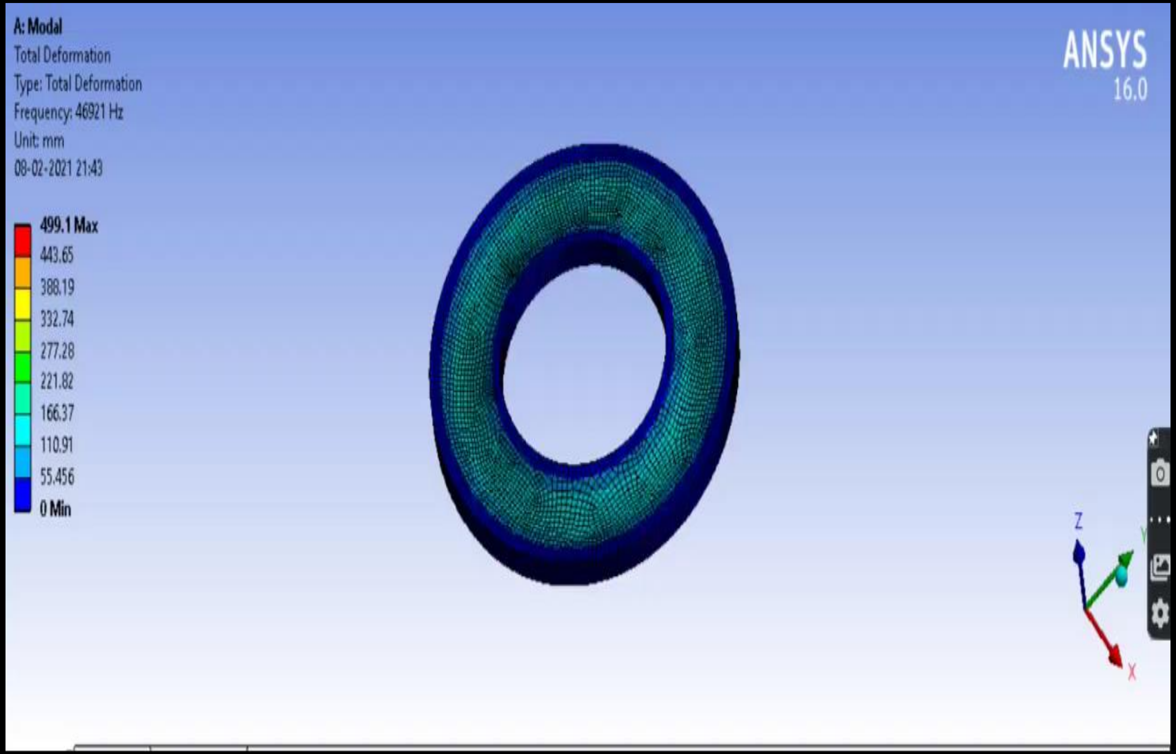
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ANSYS
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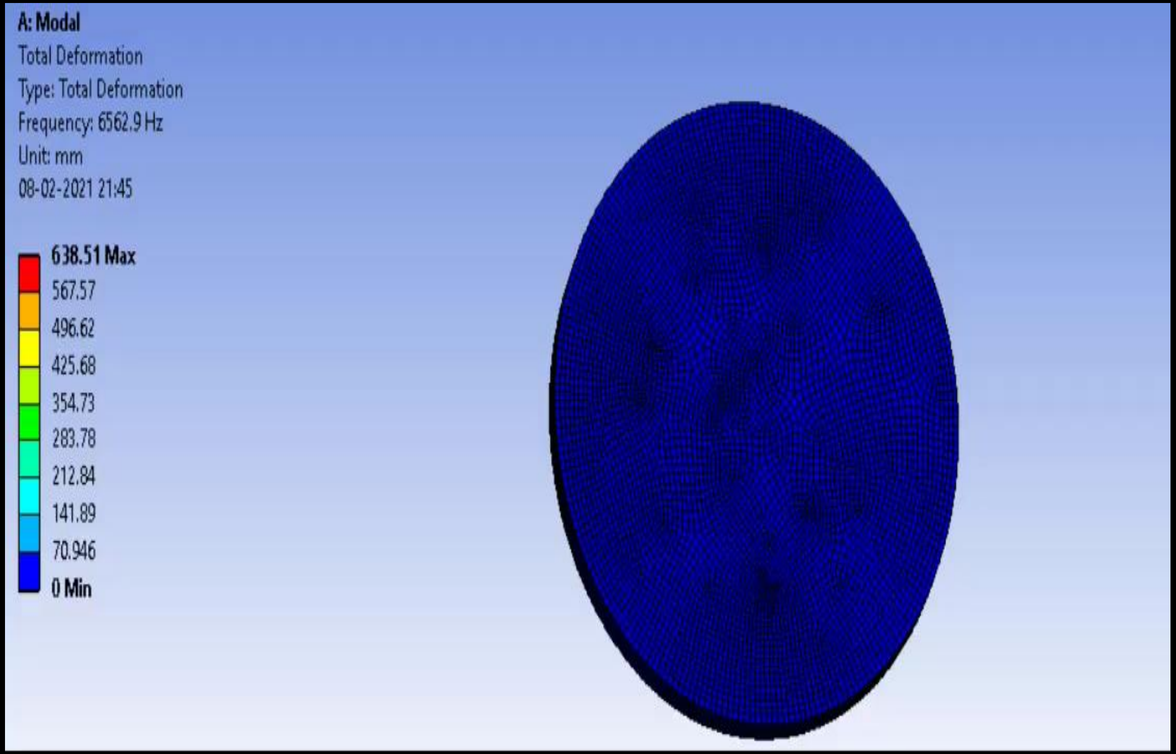
Z
Y
X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425.68
354.73
283.78
212.84
141.89
70.946
0 Min

SUBSYSTEM ACTIVITIES

GLEX 2021
GLOBAL SPACE EXPLORATION CONFERENCE

Design·A·thon

FUTURE PLANS

Altair HyperWorks

IAC DUBAI 2021

REACH US

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THANK YOU

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