PROJECT REPORT

ME205-DESIGN LAB-I

BEAM ANALYSIS

ACKNOWLEDGEMENT

This project was a very great learning experience for all of us. We would like to thank all our course instructors, **Dhiraj Sir**, **Manish Sir** and **Satwinder Sir** for giving us an opportunity to work on a project and get some hands-on experience.

Next, the project could not have been completed without the constant support and backing of **Rupinder Sir** who took time out and helped us whenever needed.

Finally, we would also like to thank **Harpreet sir** and our friends who helped us during the project.

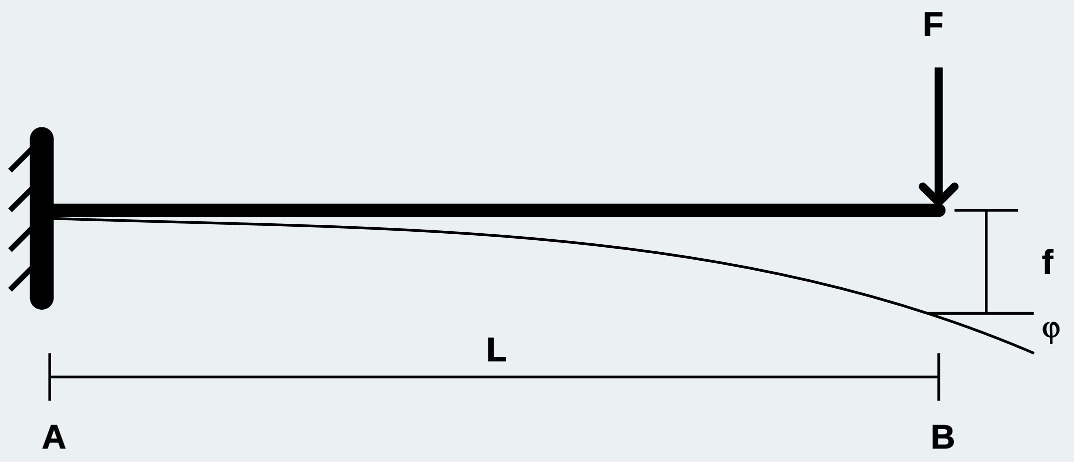
Team Details

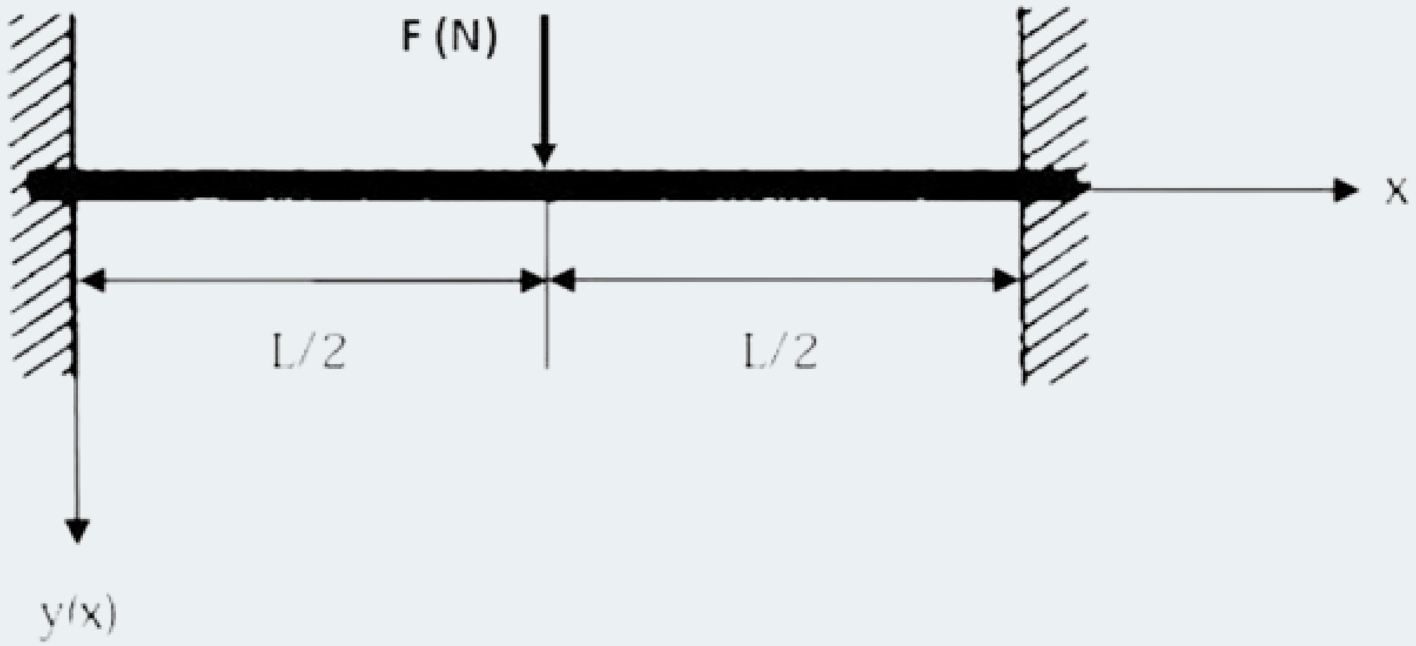
Group G

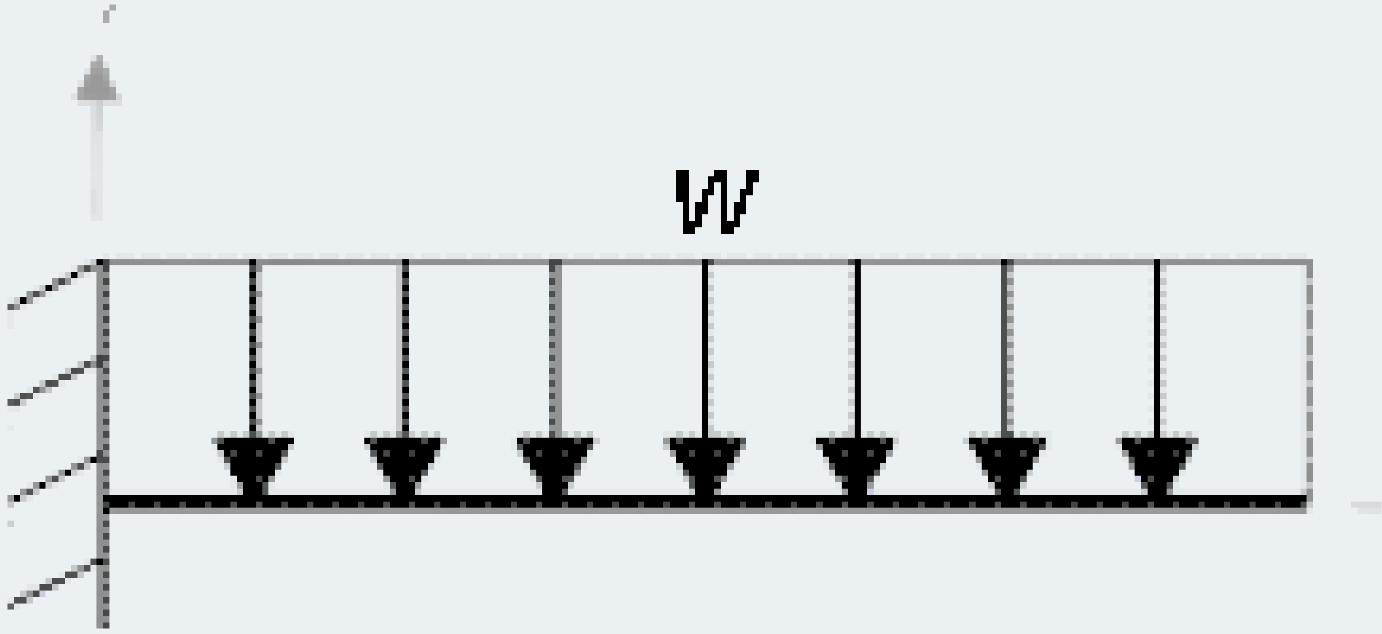
	Member Name	Contribution
01	Apeksha	Circuits, Model and Presentation (Content)
02	Aryan Prajapati	Circuits, Code and Presentation (Template/Content)
03	Ashutosh Bhutada	Ansys Analysis, Circuits and Presentation (Content)
04	Himanshu Bansal	Model, Ansys Analysis and Presentation (Content)
05	Manashvi Hare Krishna	Presentation (Template/Content) and Model

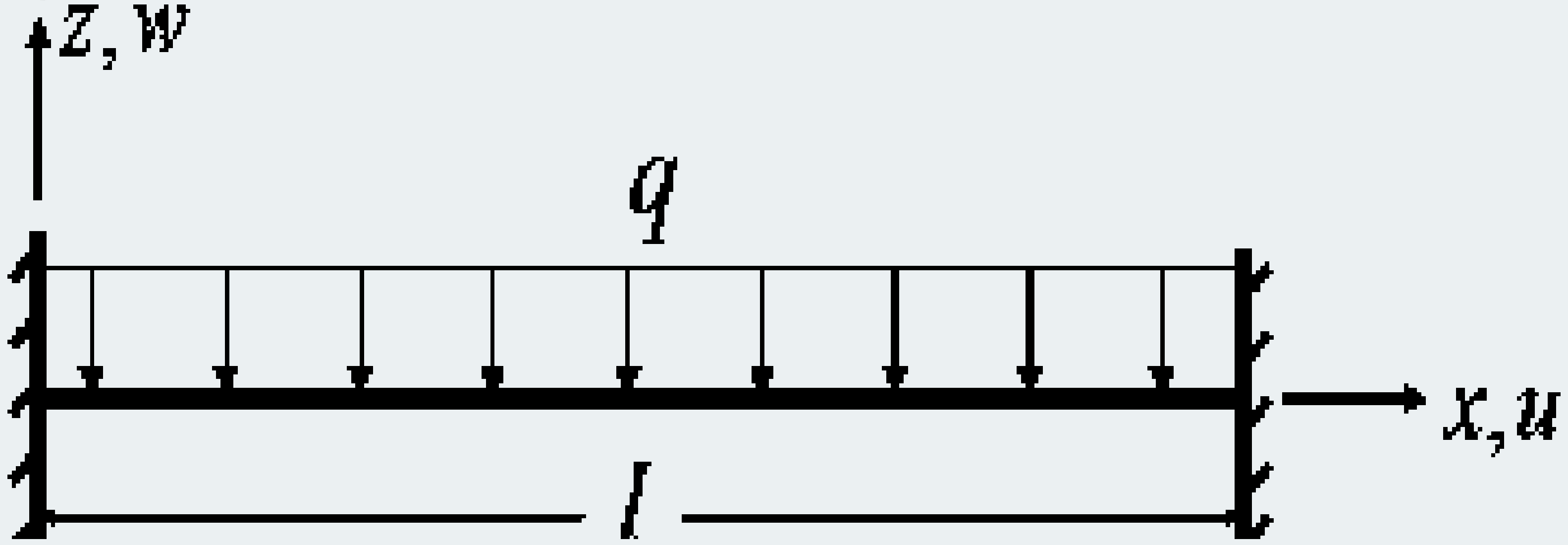
PROBLEM STATEMENT

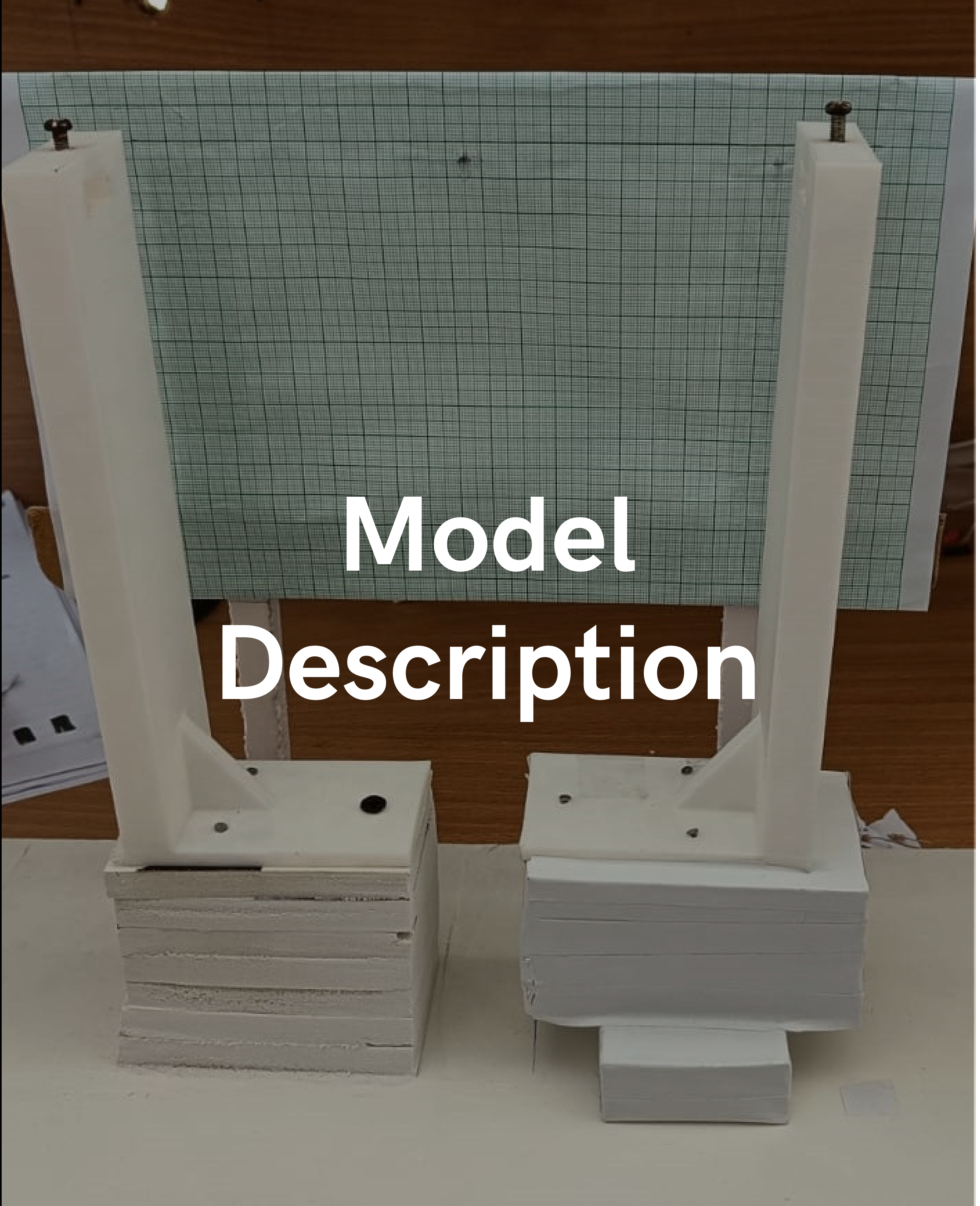
Determining the shear force and deflection in cantilever and fixed end beams under point load, uniformly distributed load conditions for different materials.











Two L shaped supports

Two L shape supports were 3D printed. The beams are fixed in the slots made using screws. One is fixed to the base and the other can be removed for the cantilever condition.

Beams Used

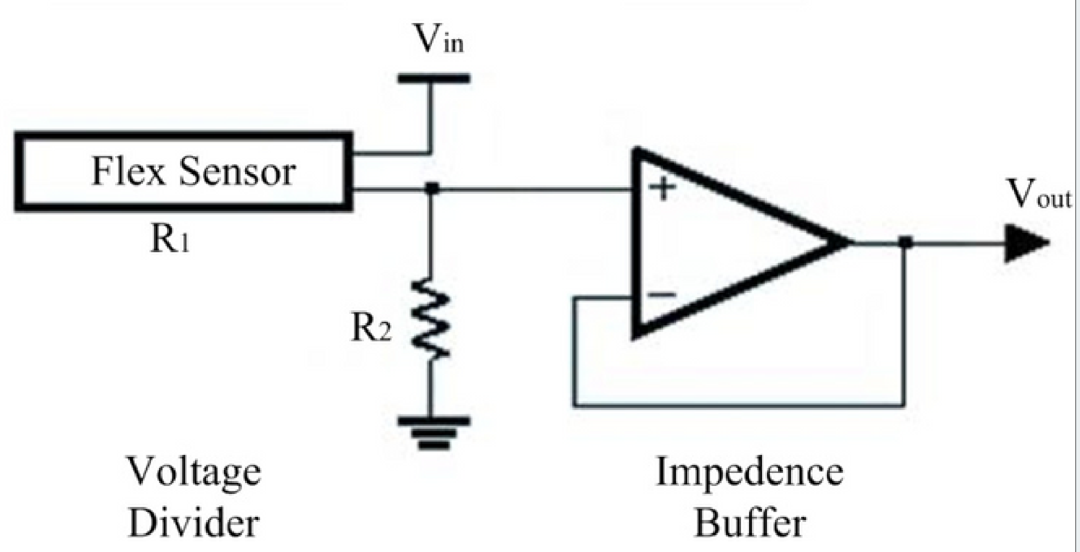
We have used three different types of beams :
A)PLA (Y=3.2GPa)
B)Aluminum Alloy (Y=40.47GPa)
C)Steel (Y=190GPa)

Weight

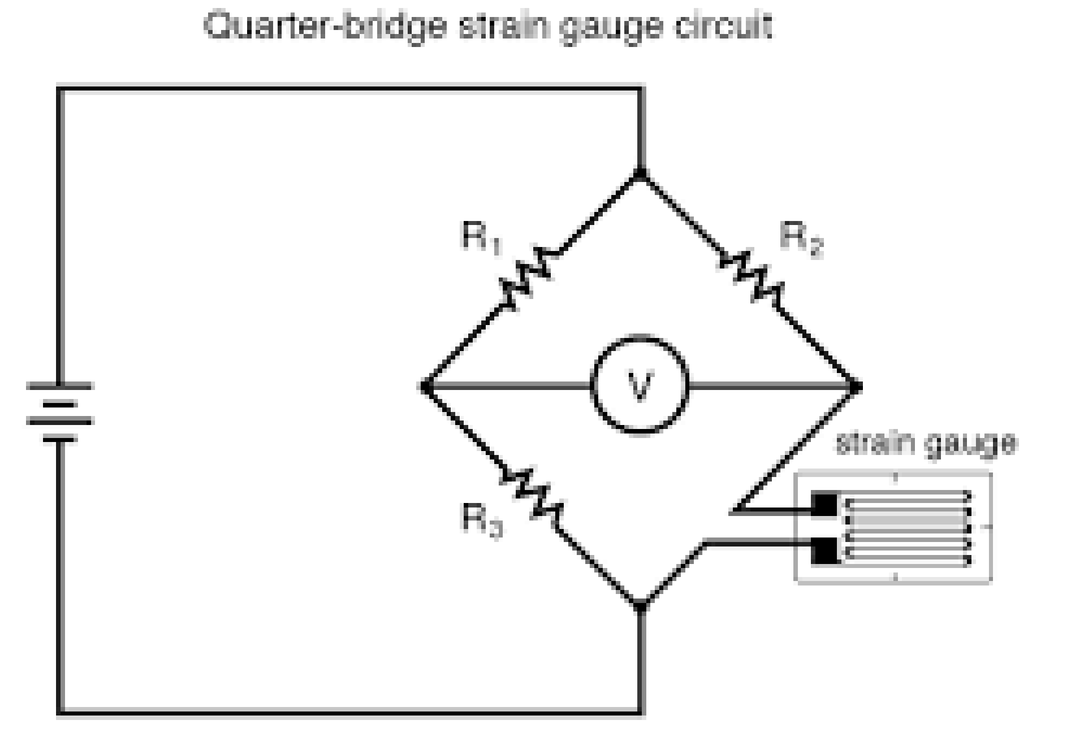
Slotted weights are used along with a hanger. The weights are added as required in multiples of 10g. For uniformly distributed load we used a mobile phone with length 165mm.

Graph frame

For the calibrated paper method, two supports were fixed and a frame was made on which the graph was stuck. A pencil stuck on the beam was used for measurement.

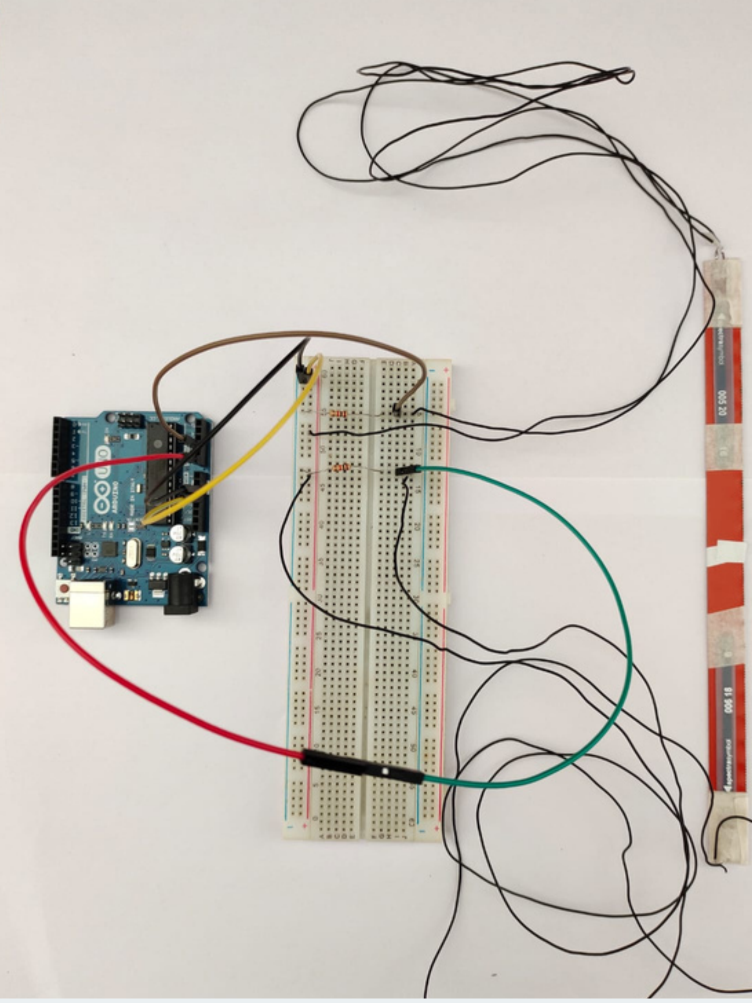


Sensors and their Circuits



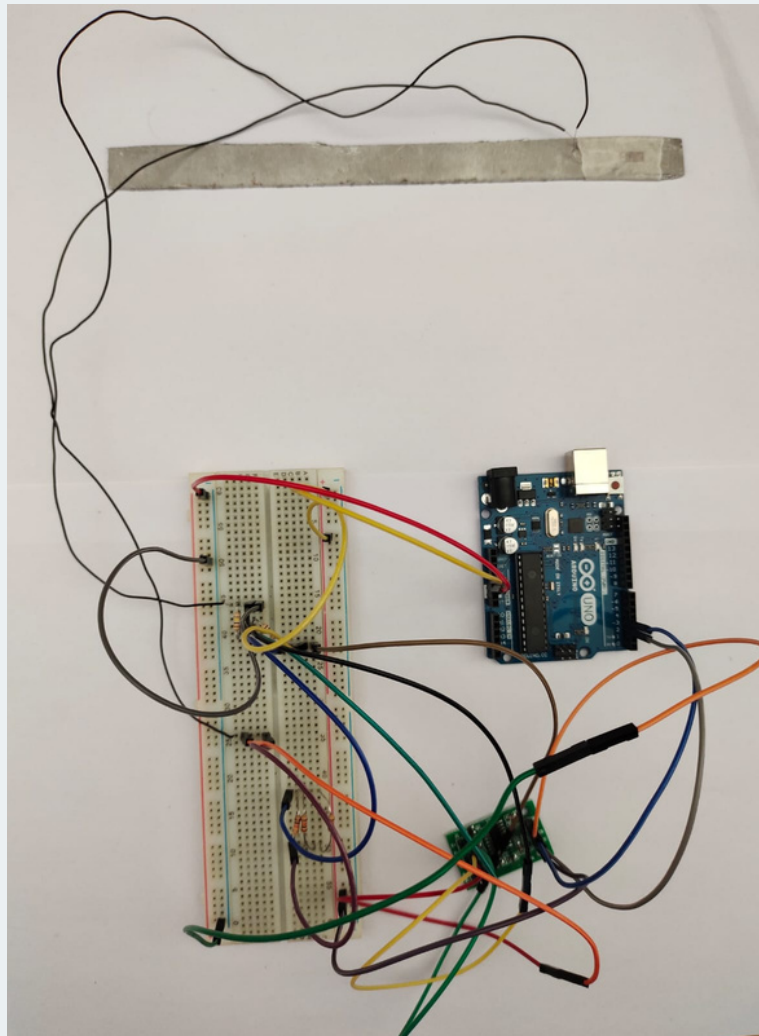
Flex Sensor

It measures the amount of deflection or bend. It works similar to variable resistance where the sensor is stuck to the surface, and resistance of sensor element varies as the surface bends. The voltage required to activate the sensor ranges from 3.3V - 5V DC. The sensitivity of the sensor is 1 degree. It is also known as flexible potentiometer.



Strain Gauge

Strain gauge is a type of electrical sensor whose primary use is to measure force and strain.There will be change in resistance of strain gauge when force is applied and this change will give a different electrical output.Sensitivity at 1000 με is ~0.5 mV/V.



DEFLECTION MEASUREMENT METHODS

CALIBRATED SCALE

Pencil is fixed at the end in one case and at the middle in the other case. The initial position of the pencil is marked on the graph paper and the final reading is obtained after the load is applied. The least count of paper is 1mm.

FLEX SENSOR

The sensor is attached at the end of the steel beam and its reading is displayed on the serial monitor. The monitor shows the angular deflection and vertical deflection is obtained using trigonometry.

STRAIN GAUGE

Strain gauges are attached at middle and ends of the Aluminum Alloy. When load is applied on the beam then strain gauge will get stretched ,eventually showing deflection. on the serial monitor.

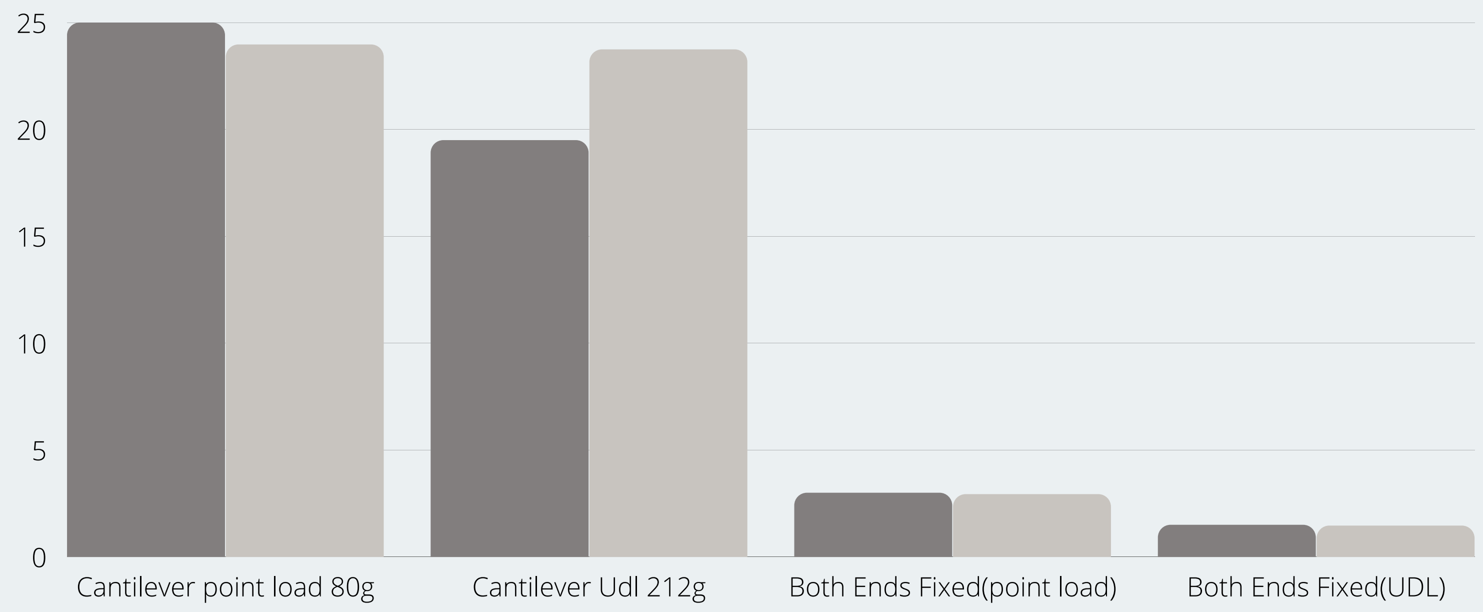
Experimental Readings

VS

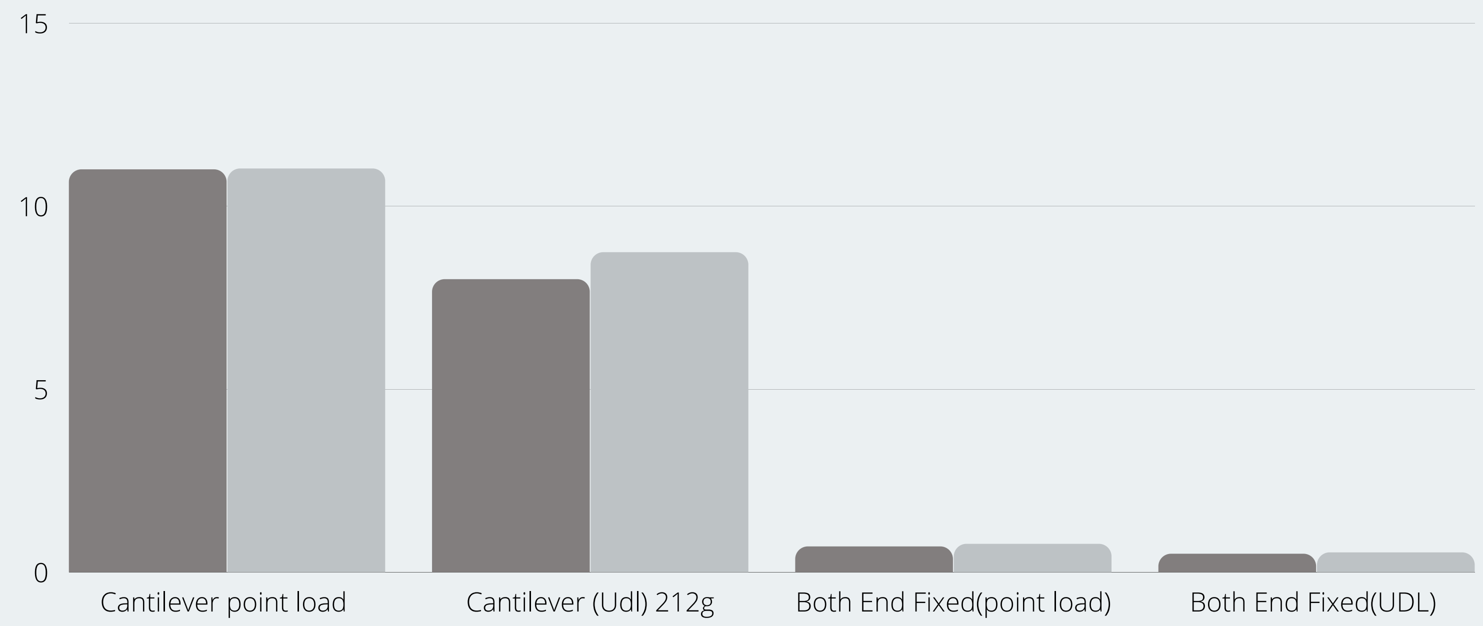
Theoretical Readings

With Error Analysis

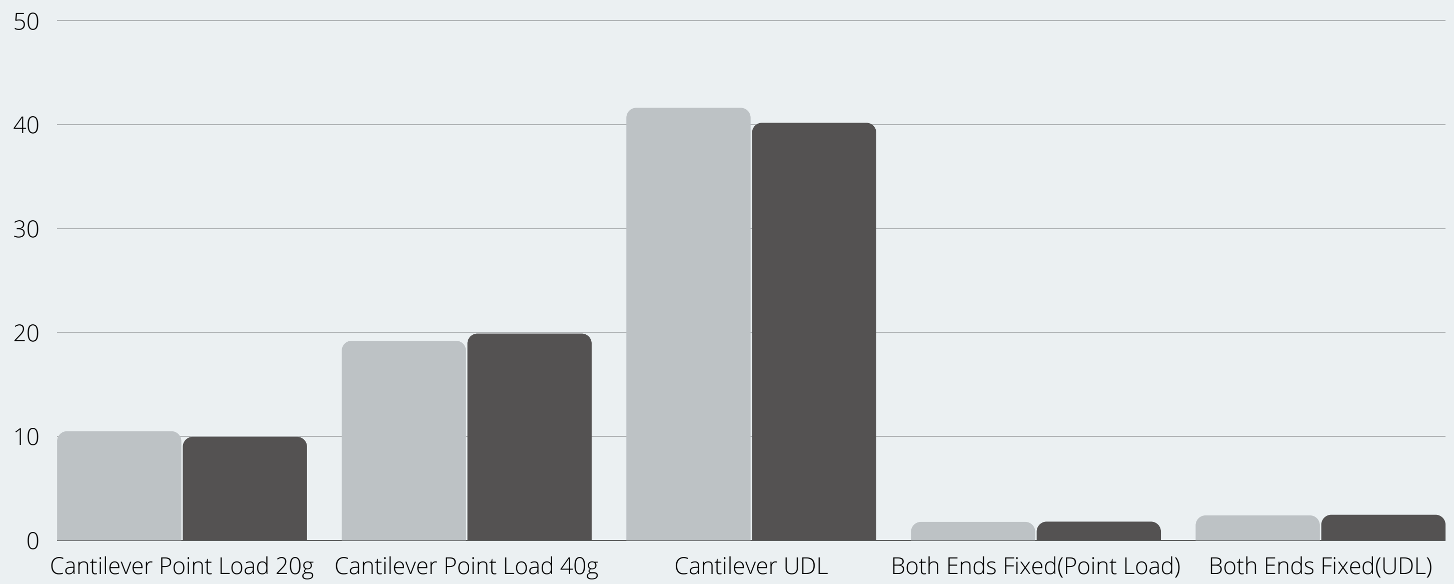
Material Type: **PLA**							
	Load (in g)	Experimental Readings		Theoretical Readings		Shear Stress (MPa)	Error (%)
		Deflection in one end fixed (mm)	Deflection in both ends fixed (mm)	Deflection in one end fixed(mm)	Deflection in both ends fixed (mm)		
Point Load	80	25		23.975	-	4.472	4.27
	630		3	-	2.9344	4.497	2.23
UDL	212	19.5		23.745	-	5.7514	17.8
	630		1.5	-	1.4630	2.6419	2.53



Material Type: **Aluminium Alloy**							
	Load (in g)	Experimental Readings		Theoretical Readings		Shear Stress (MPa)	Error (%)
		Deflection in one end fixed (mm)	Deflection in both ends fixed (mm)	Deflection in one end fixed(mm)	Deflection in both ends fixed (mm)		
Point Load	100	11	-	11.023	-	17.992	0.21
	450	-	0.7	-	0.7698	12.622	9.1
UDL	212	8	-	8.7366	-	18.904	8.43
	630	-	0.5	-	0.5368	9.091	6.85

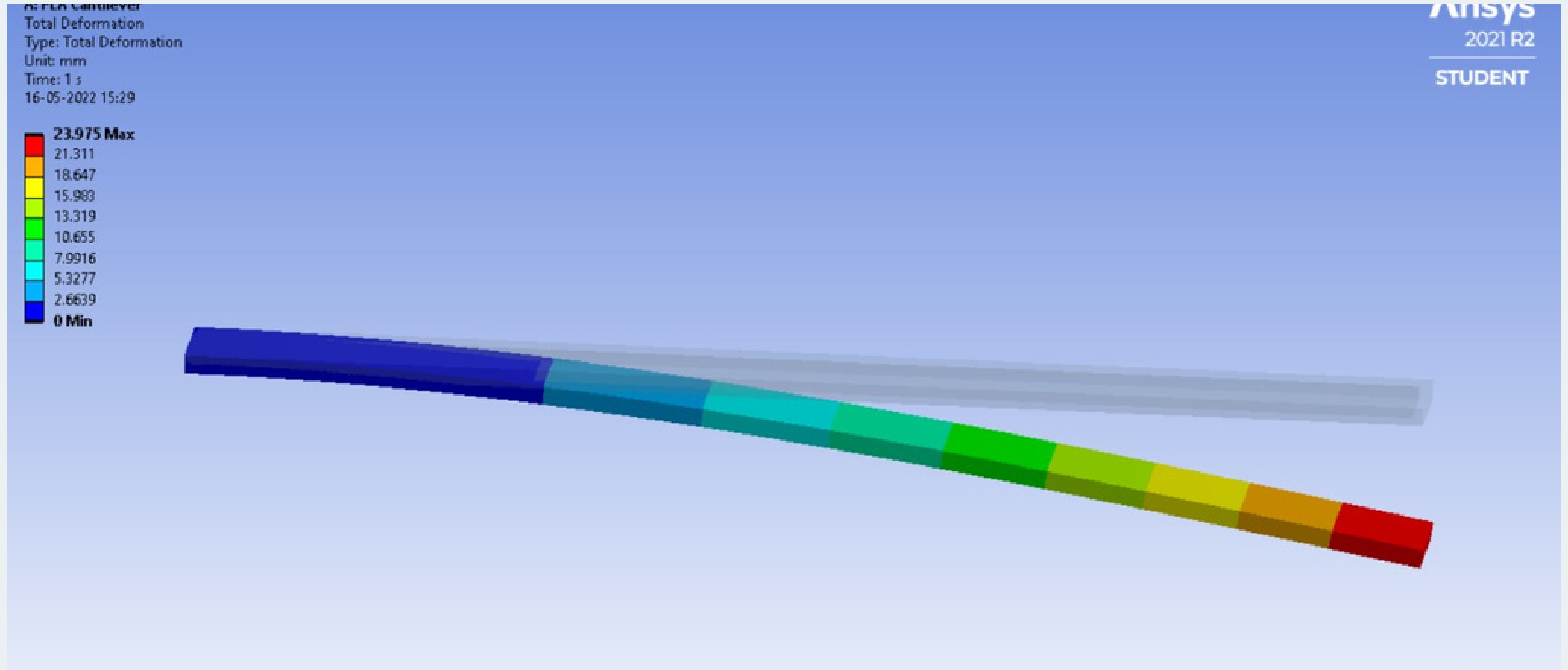


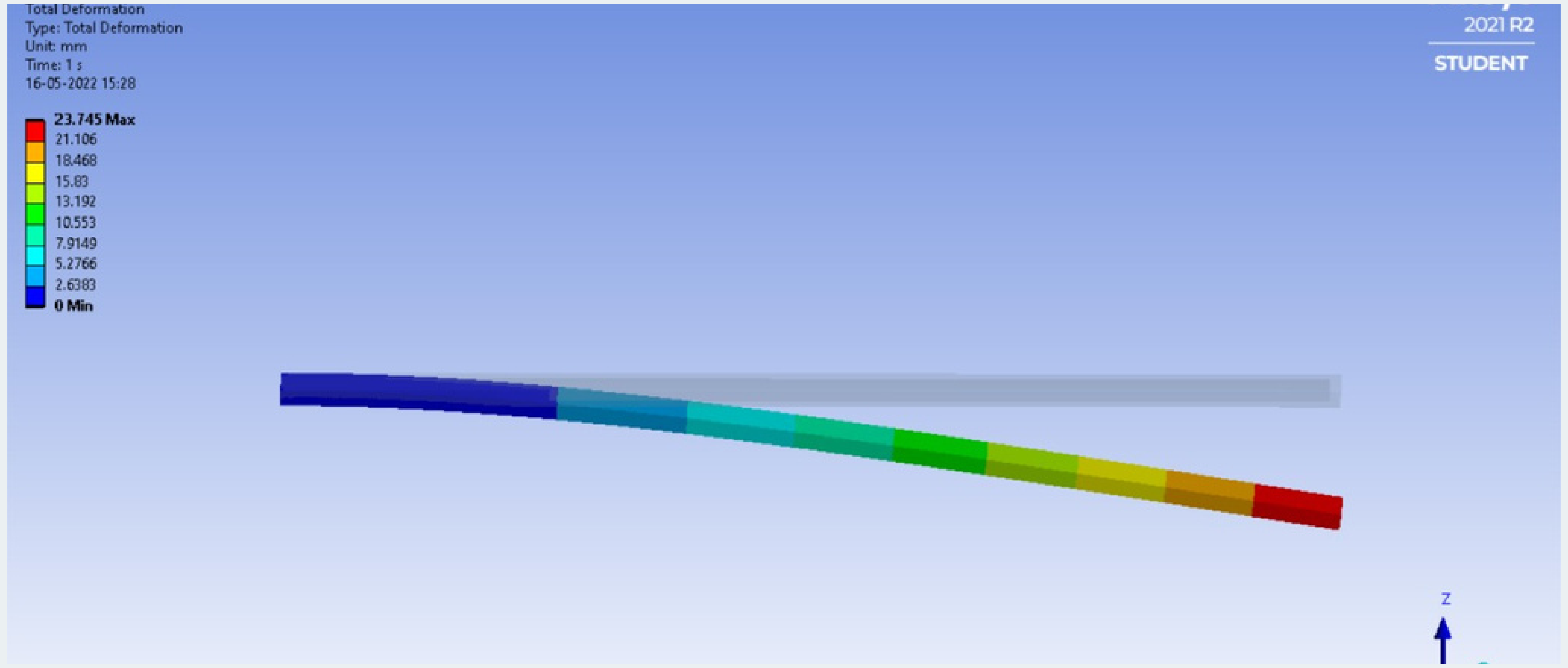
Material Type: **High Speed Steel**							
	Load (in g)	Experimental Readings		Theoretical Readings		Shear Stress (MPa)	Error (%)
		Deflection in one end fixed (mm)	Deflection in both ends fixed (mm)	Deflection in one end fixed(mm)	Deflection in both ends fixed (mm)		
Point Load	20	10.467	-	9.93	-	25.088	5.40
	40	19.169	-	19.861	-	50.126	3.48
	230	-	1.745	-	1.77	57.71	1.412
UDL	212	40.14	-	41.58	-	130.71	3.58
	630	-	2.37	-	2.43	70.2	2.47



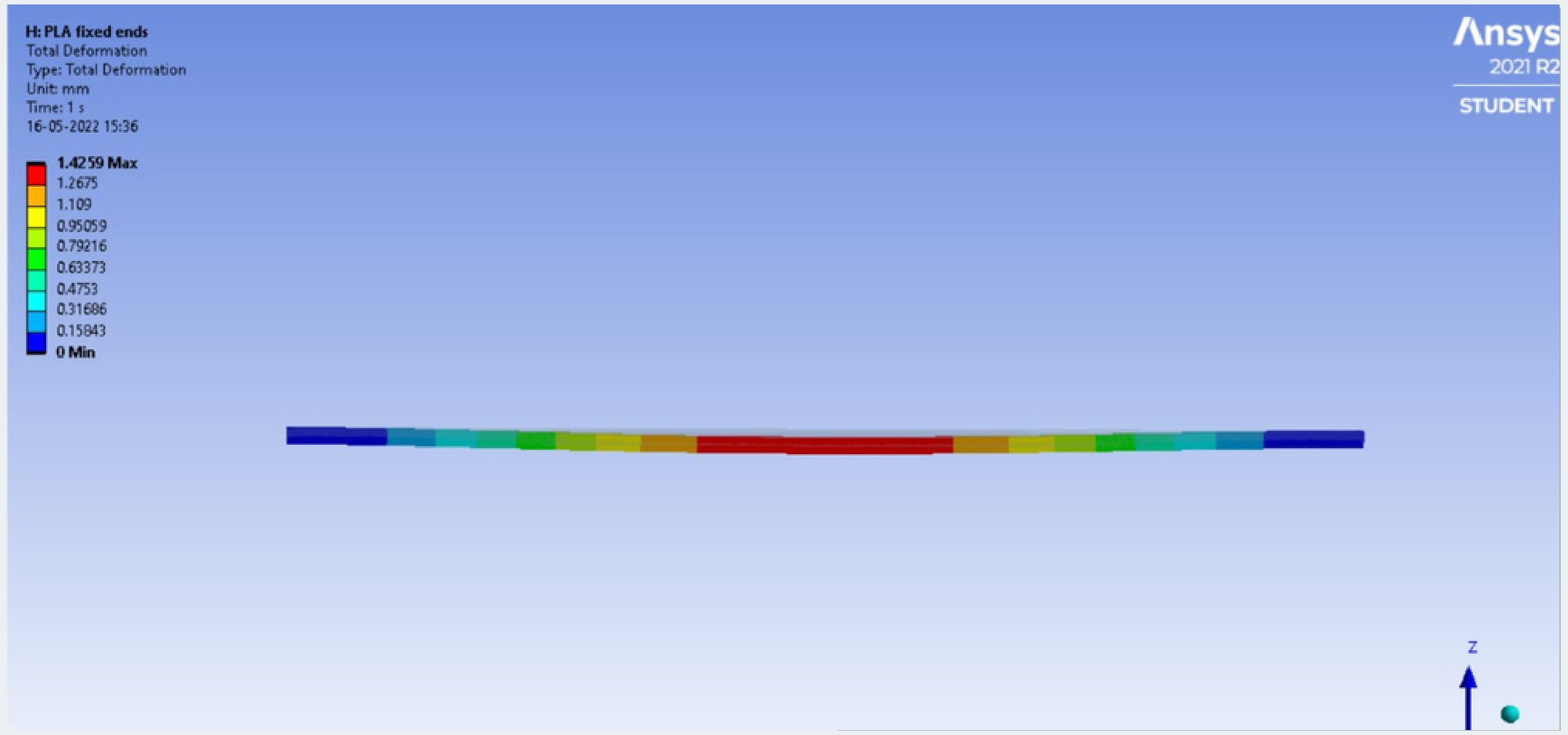
ANSYS ANALYSIS FOR DEFLECTION IN PLA

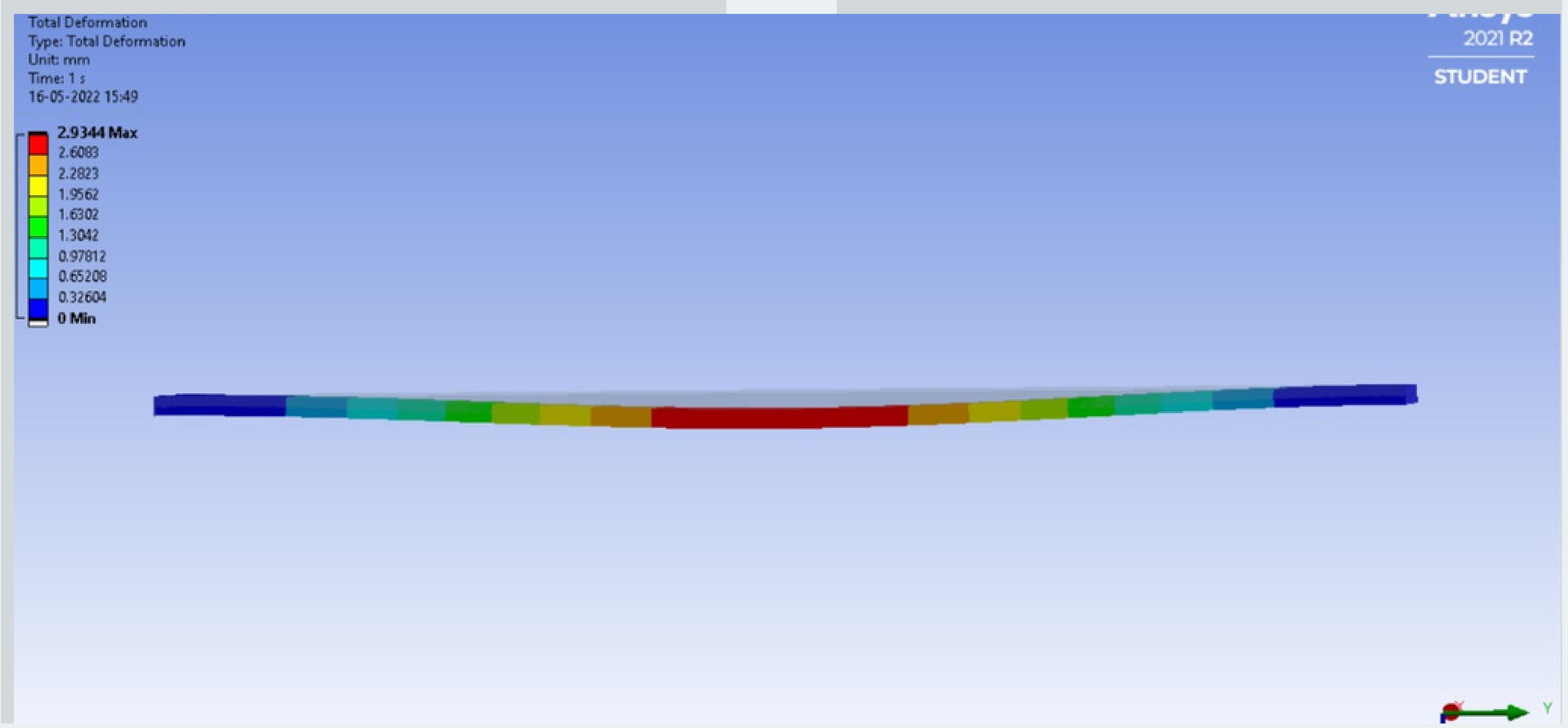
ONE END FIXED





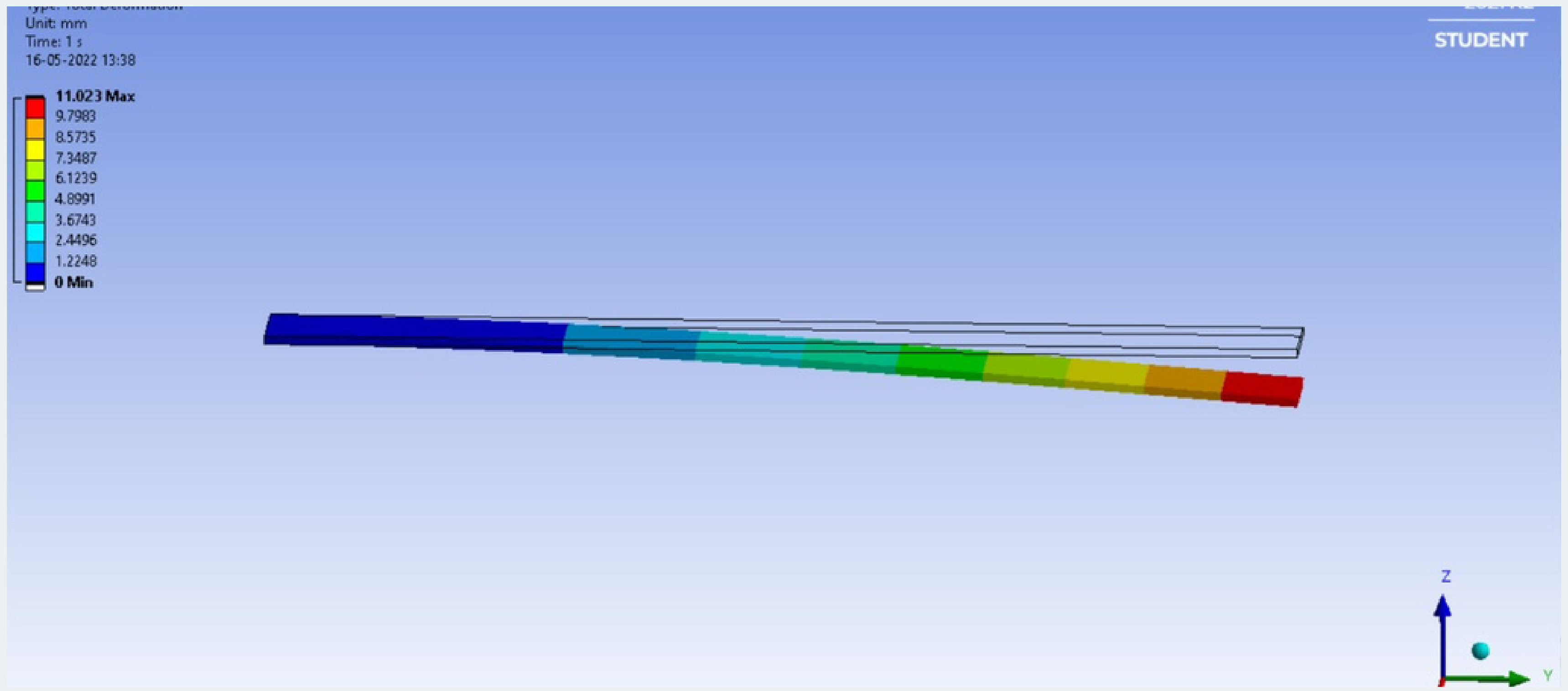
BOTH ENDS FIXED

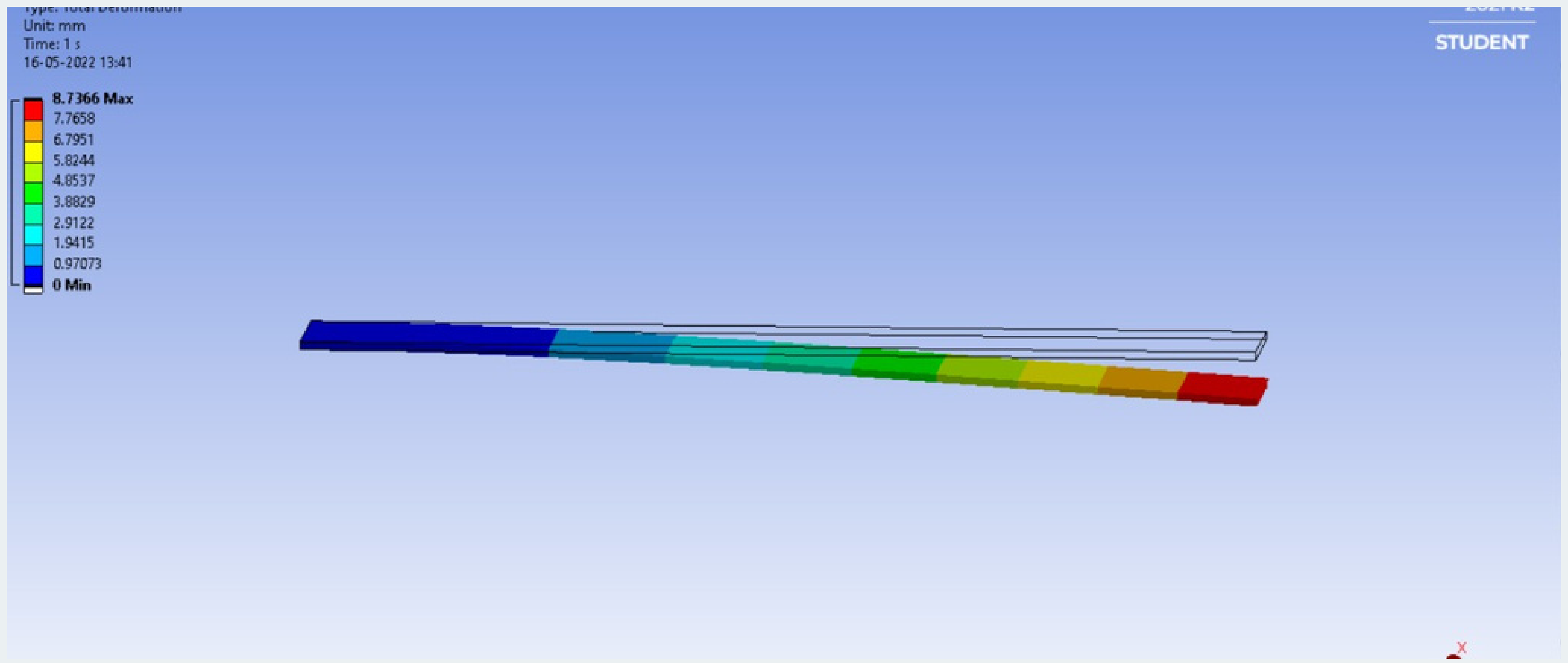




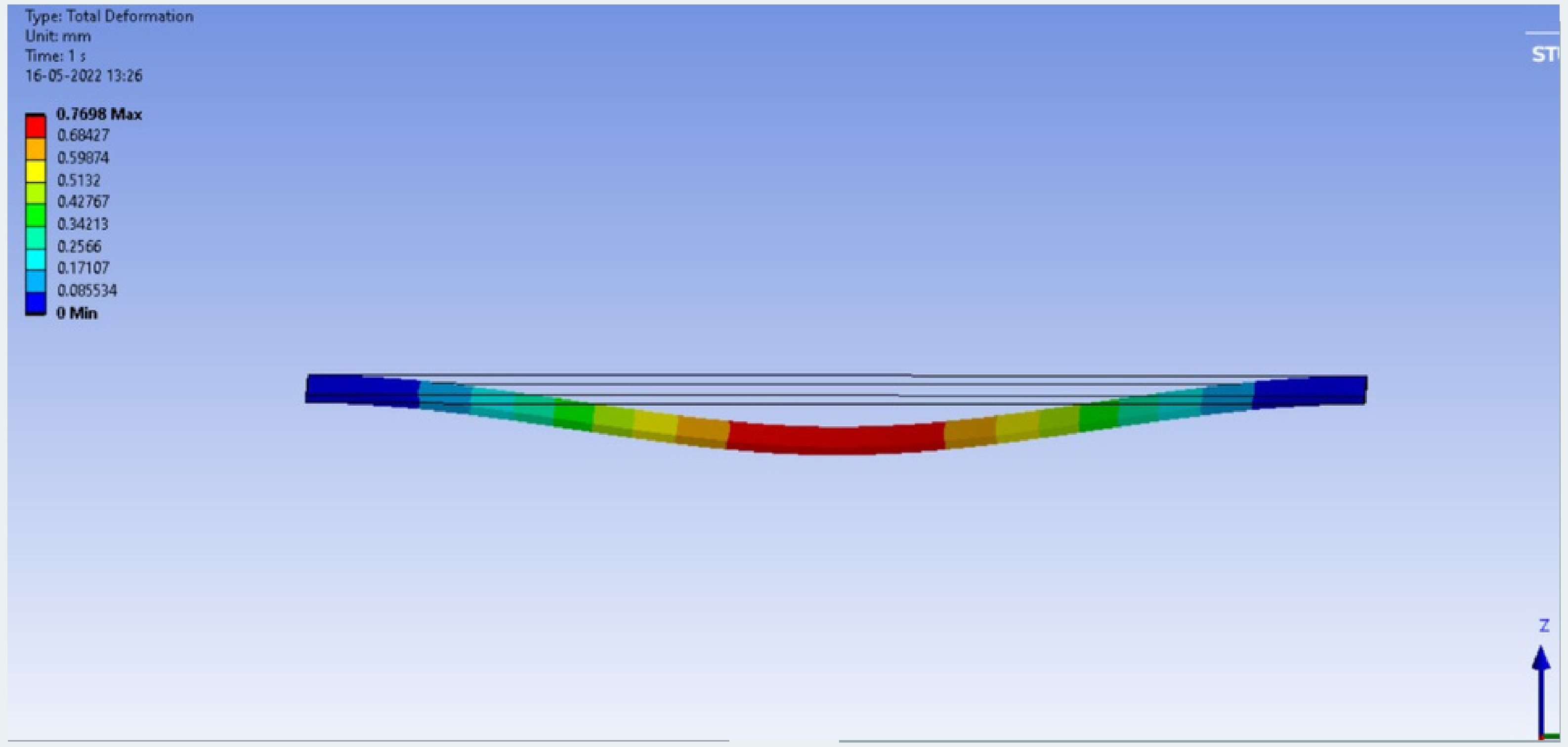
ANSYS ANALYSIS FOR DEFLECTION IN ALUMINUM ALLOY

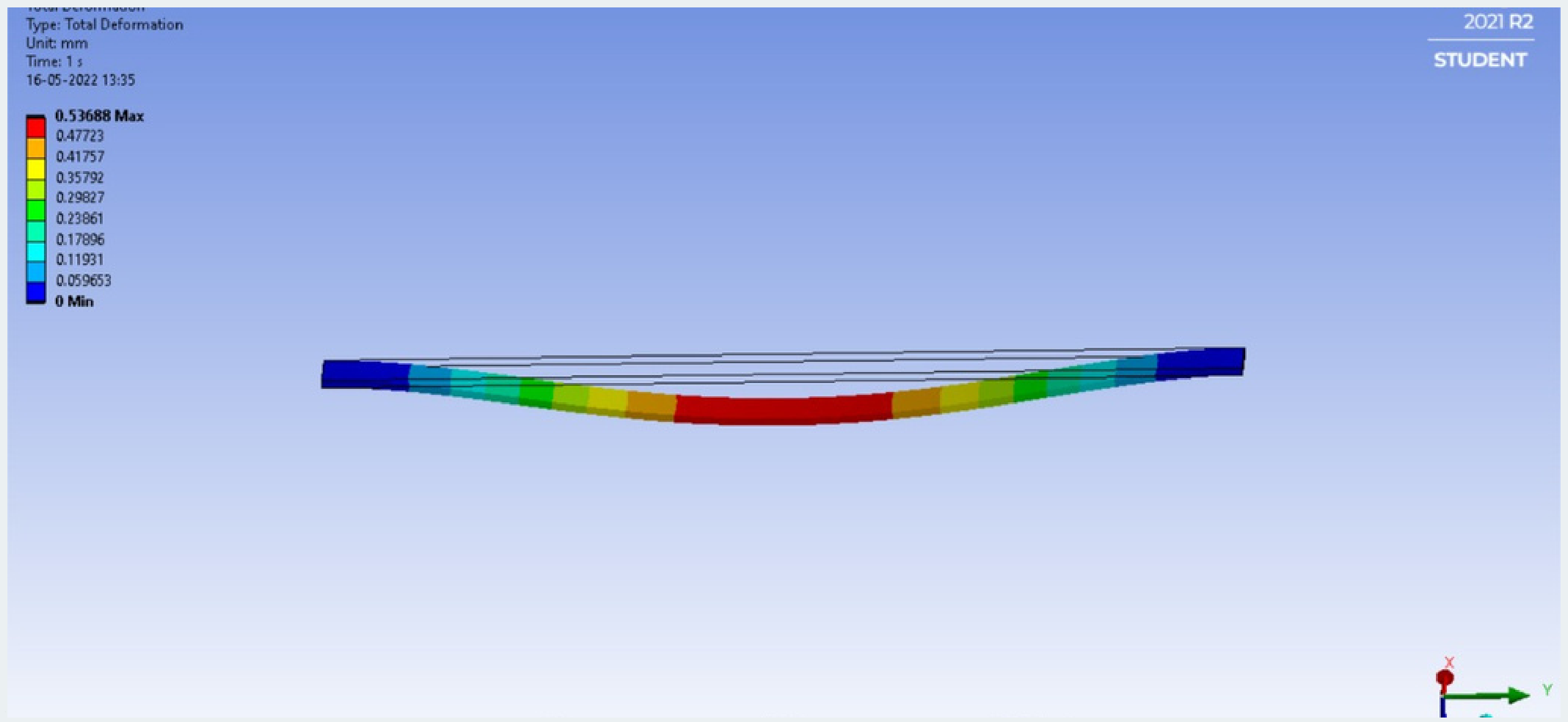
ONE END FIXED





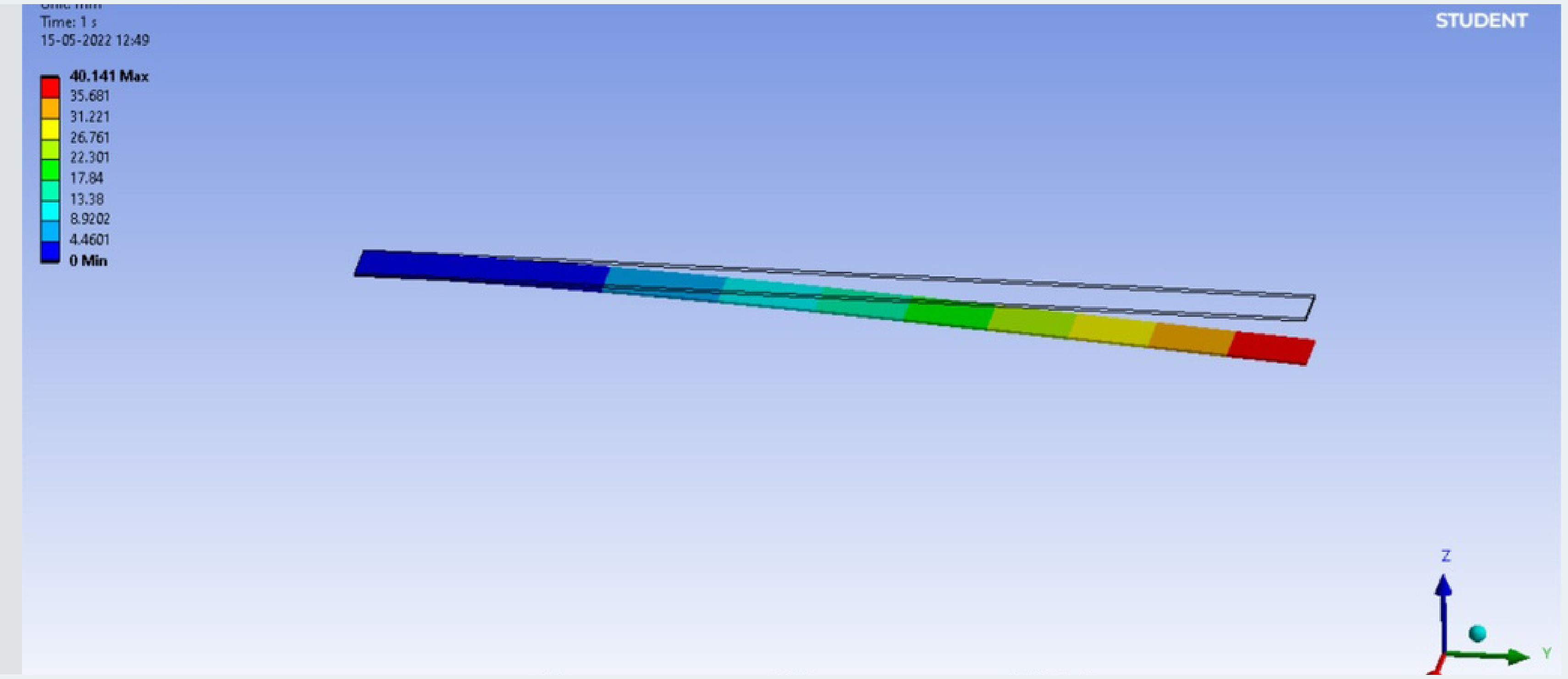
BOTH ENDS FIXED

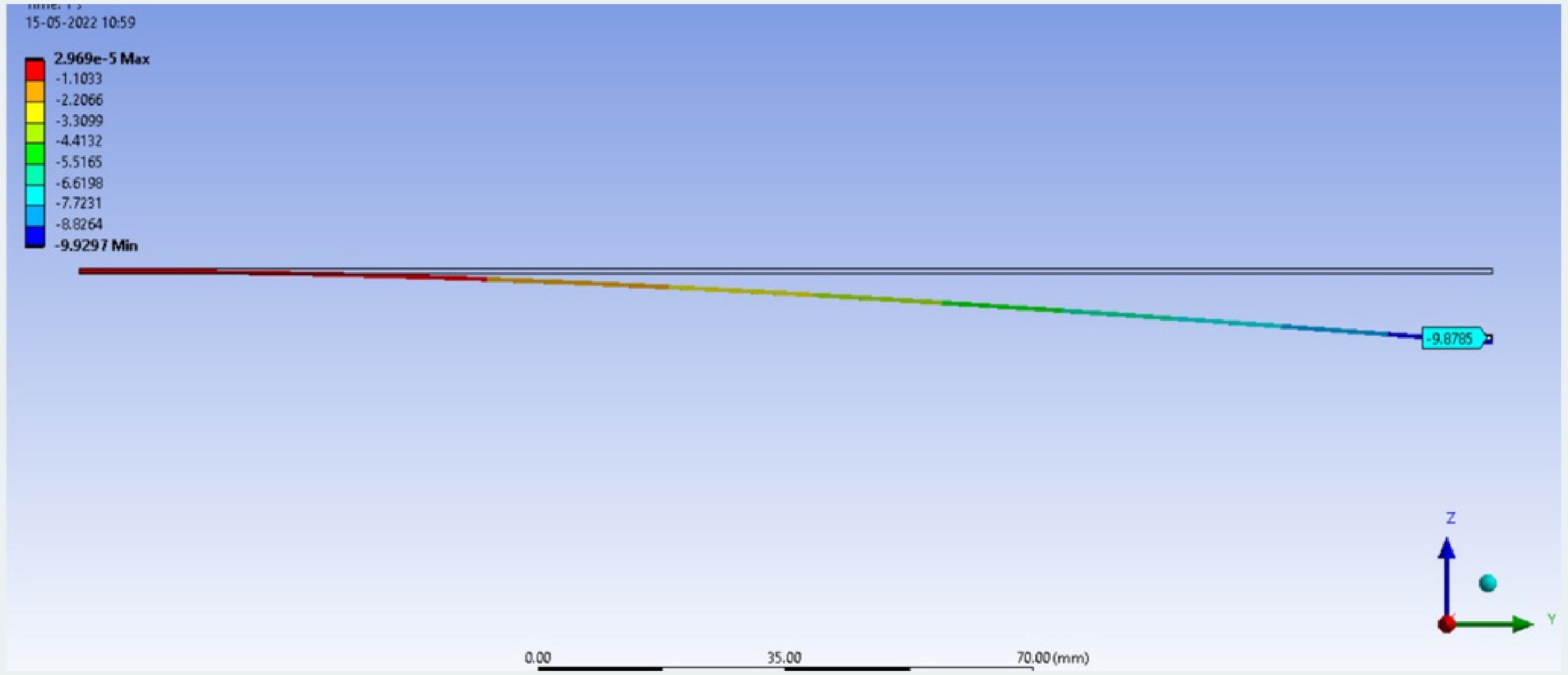




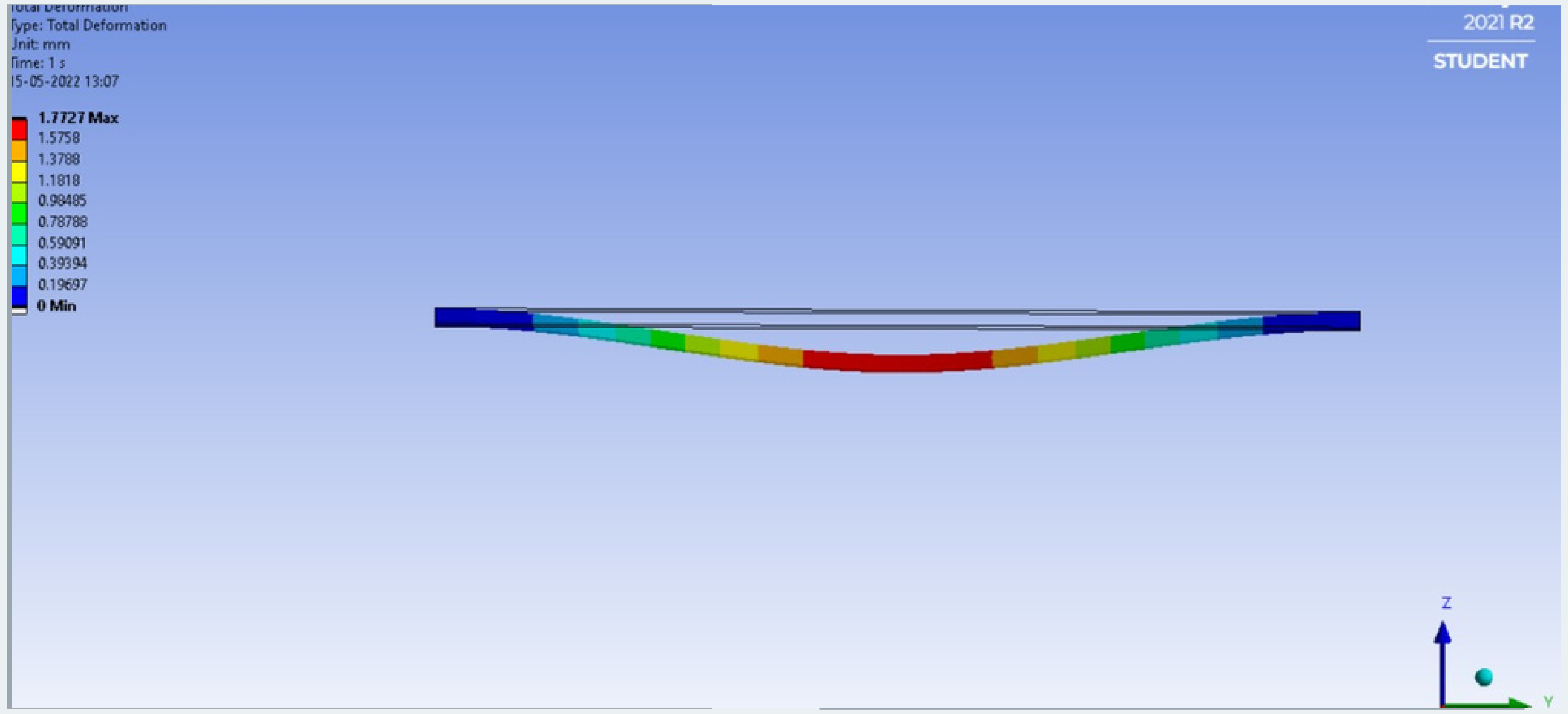
ANSYS ANALYSIS FOR DEFLECTION IN STEEL

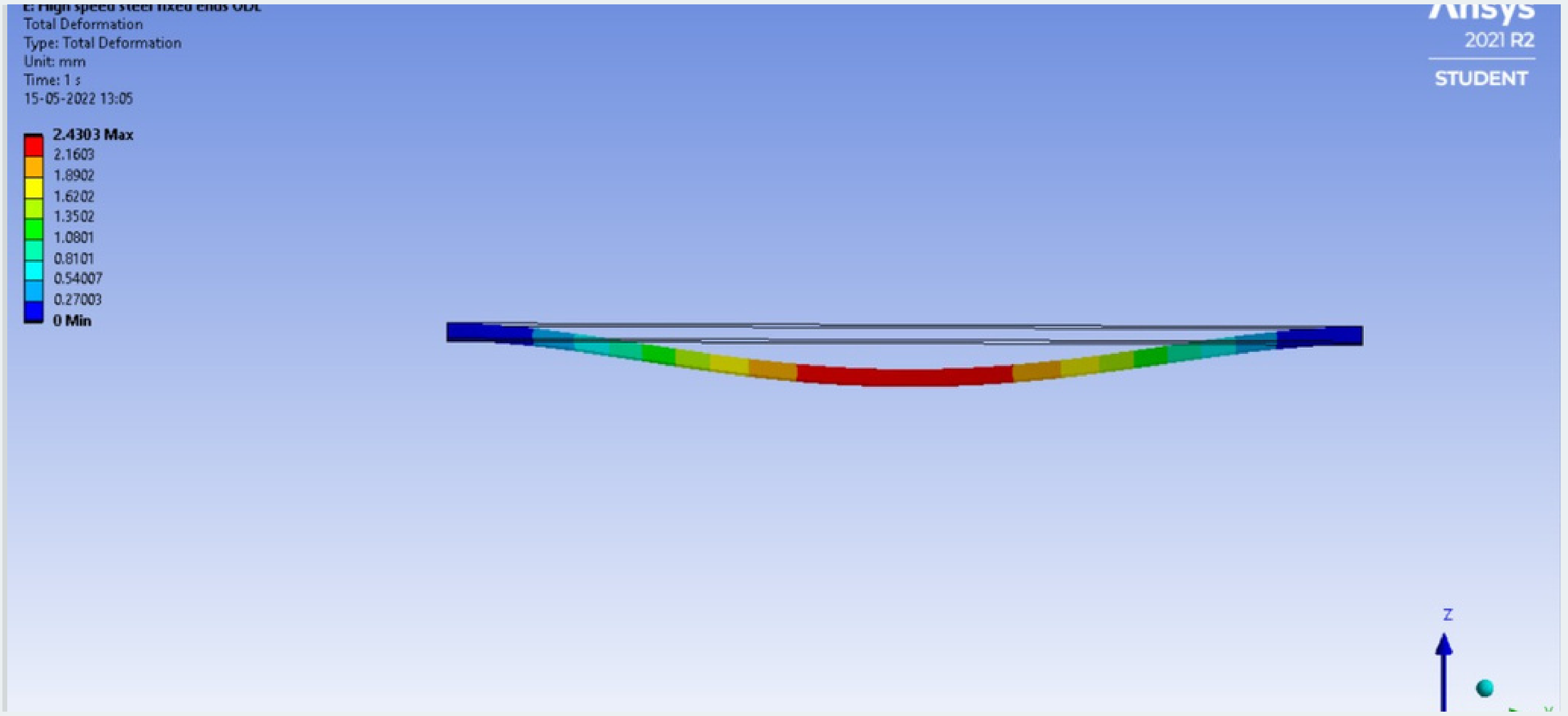
ONE END FIXED





BOTH ENDS FIXED





CONCLUSION

1. Most Accurate Approach - Flex Sensor

2. Errors well within the experimental limits
   - Irregular surface area
   - Variable Physical properties
   - Hollow beam (PLA)
   - Weight of Pencil considered negligible

3. Curious Case of 17% error

   Due to lack of knowledge of mass distribution in PLA beam

4. A Great learning experience !!!

THANK YOU

Any Questions?