DYNAMOMETER DESIGN FOR SMALL DC MOTORS

Senior Project Presentation

Course: ME429
Instructor: Assoc. Prof. Hasan Bedir

TABLE OF CONTENTS

Problem Statement

Designing a **tabletop, absorption-type** dynamometer utilizing **a DC motor for braking**, dedicated to measuring the **power characteristics of a DC motor** with a rated **power range of 50-100 W** and a **torque range of 0.1 – 0.3 Nm**.

DESIGN GOALS

- It must be a tabletop dynamometer – allowing ease of installation and storage.
- It must allow for easy mounting of testing motor – enabling to test different motors with ease.
- It must be compatible with a variety of shaft diameters – allowing to test motors with different shaft diameters.
- It must be a low-cost dynamometer – allowing building a prototype to be feasible for the ME 492 course later on.

DESIGN CONSTRAINTS

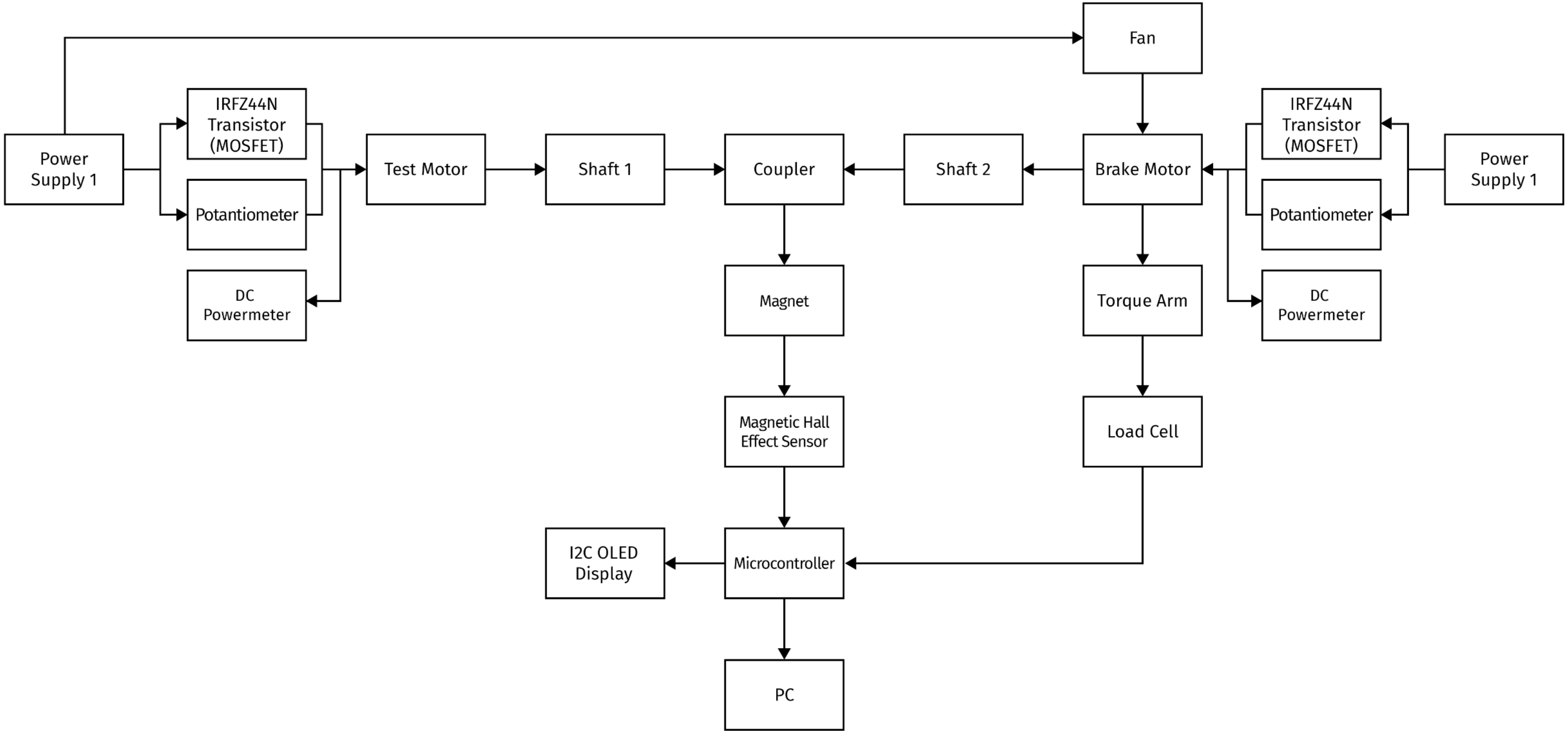
Cost	<= 2000 ₺
Size	<= 70 x 40 cm
Brake motor	rated power: 200 W torque : ~0.4 Nm
Range of test motors	rated power: 50-100 W torque: 0.1-0.3 Nm

INDEPENDENT VARIABLE
Rotational Speed
Materials
Geometric Configuration
Dimensions

DEPENDENT VARIABLE
Torque
Power

AMONG THREE DESIGN OPTIONS WE CHOSE THE FOLLOWING...

PROPOSED SOLUTION



PROS AND CONS OF PROPOSED SOLUTION

PROS	CONS
Data acquisition via arduino	Harder to build since more parts and coding is involved
Possible to generate rpm/torque/power plots on PC	Less precise measurement
Display of power, rpm and torque values all together on a single OLED screen	
Takes up less space due to the sizes of load cell and IR Sensor	
Cheaper due to the price of sensors	
Sufficiently clear signal	

3 DESIGN AND ANALYSIS

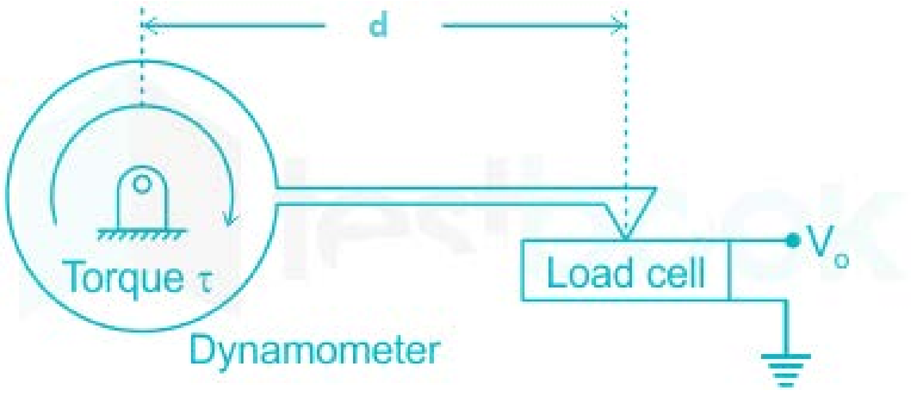
As we have covered before, our study mainly depends on the following two equations:

- $P = \tau \,.\, N \,.\, \frac{2\pi}{60}$

Where P is the Power, τ is the Torque and N is the angular speed of the rotating shaft.

- $\tau = F \,.\, d$

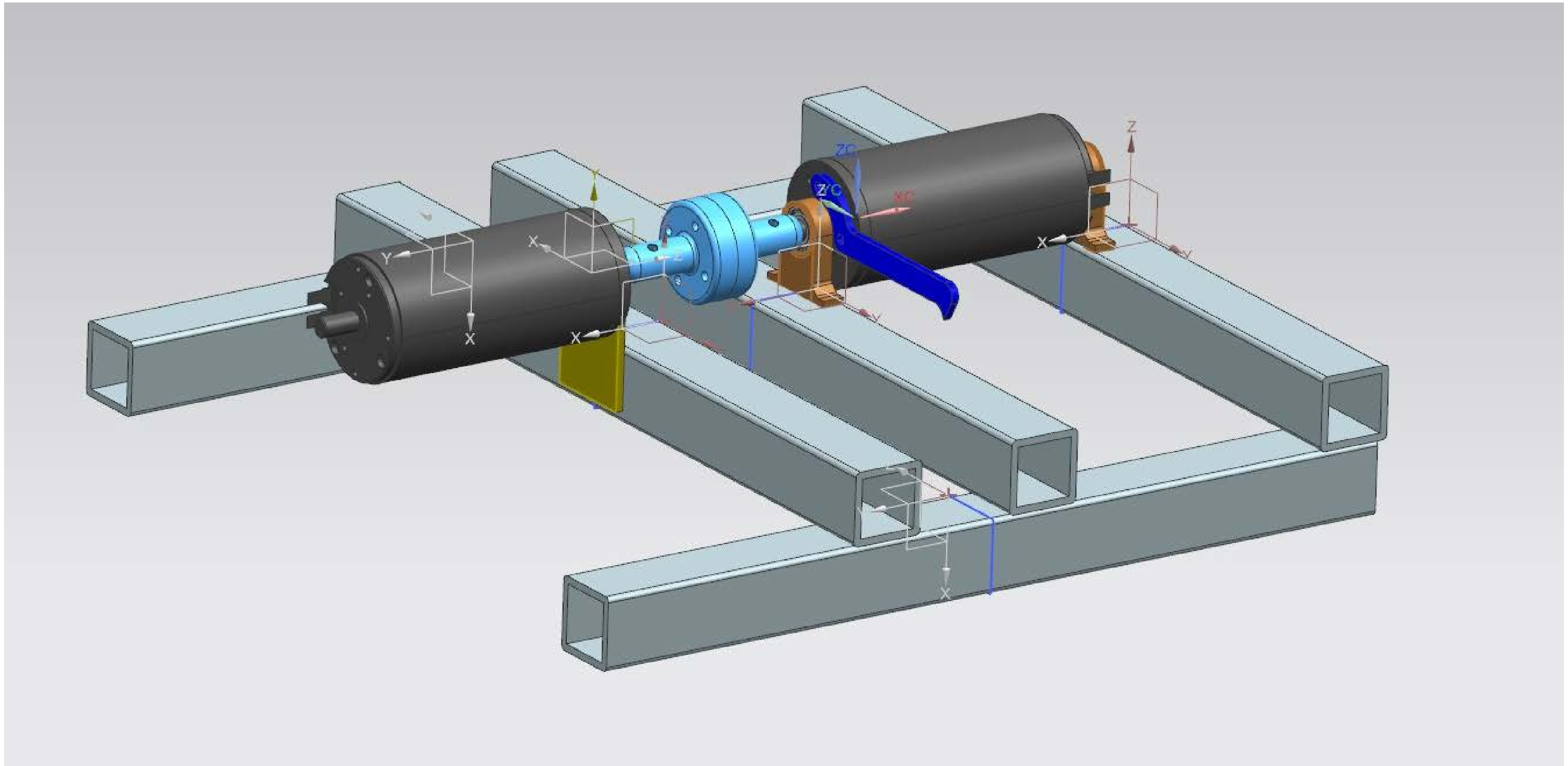
Where F is the force reading in the load cell and d is the length of the torque arm.



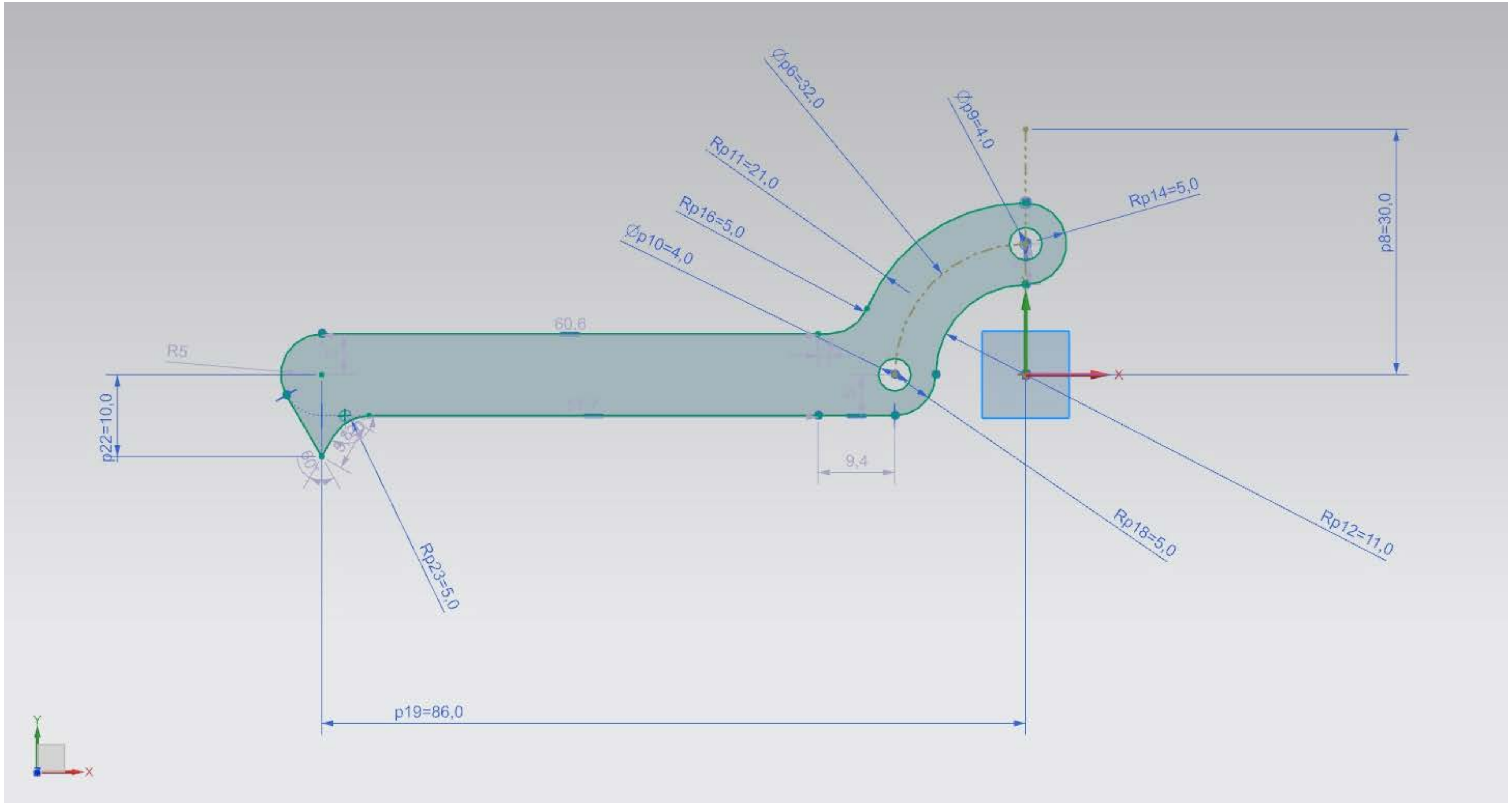
The torque can be obtained in two steps:

- Measuring the force applied on the load cell
- Multiplying the force value with the length of the torque arm

CAD ASSEMBLY OF THE PROPOSED SOLUTION



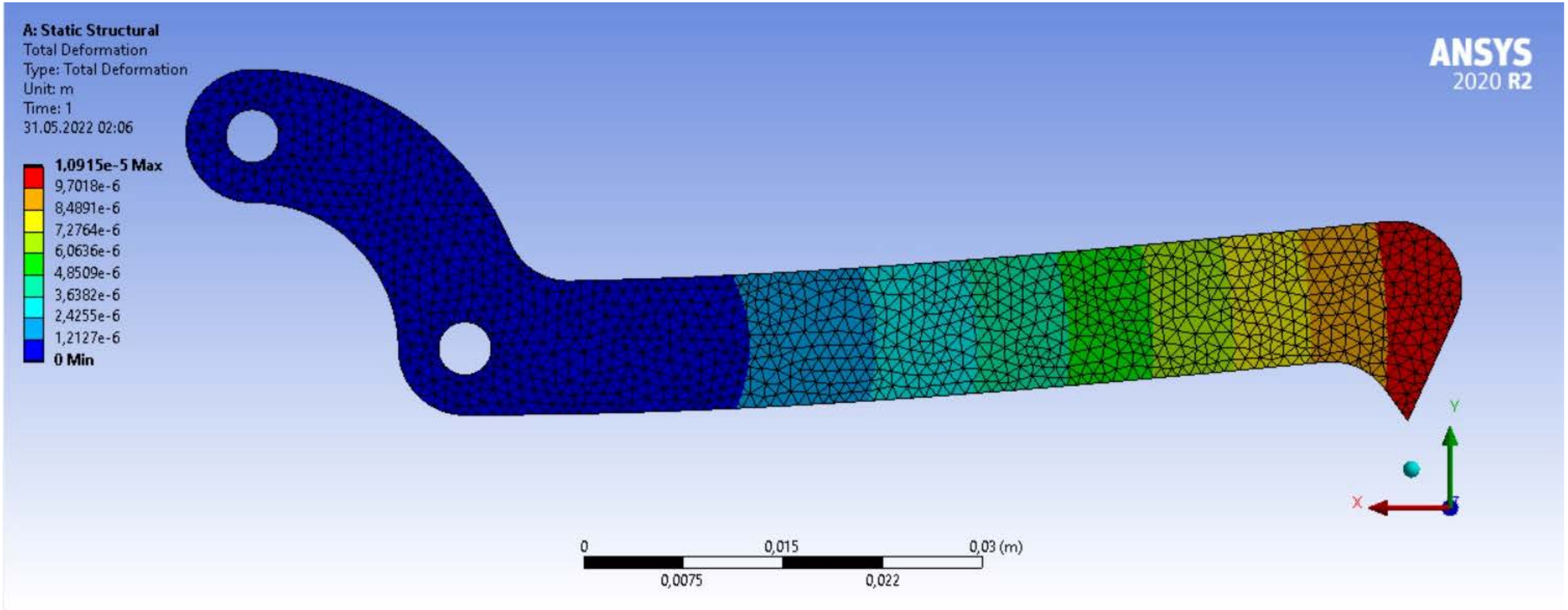
TORQUE ARM



Øp6=32,0
Øp9=4,0
Rp11=21,0
Rp14=5,0
Rp16=5,0
Øp10=4,0
p8=30,0
60,6
R5
p22=10,0
9,4
Rp23=5,0
Rp18=5,0
Rp12=11,0
p19=86,0

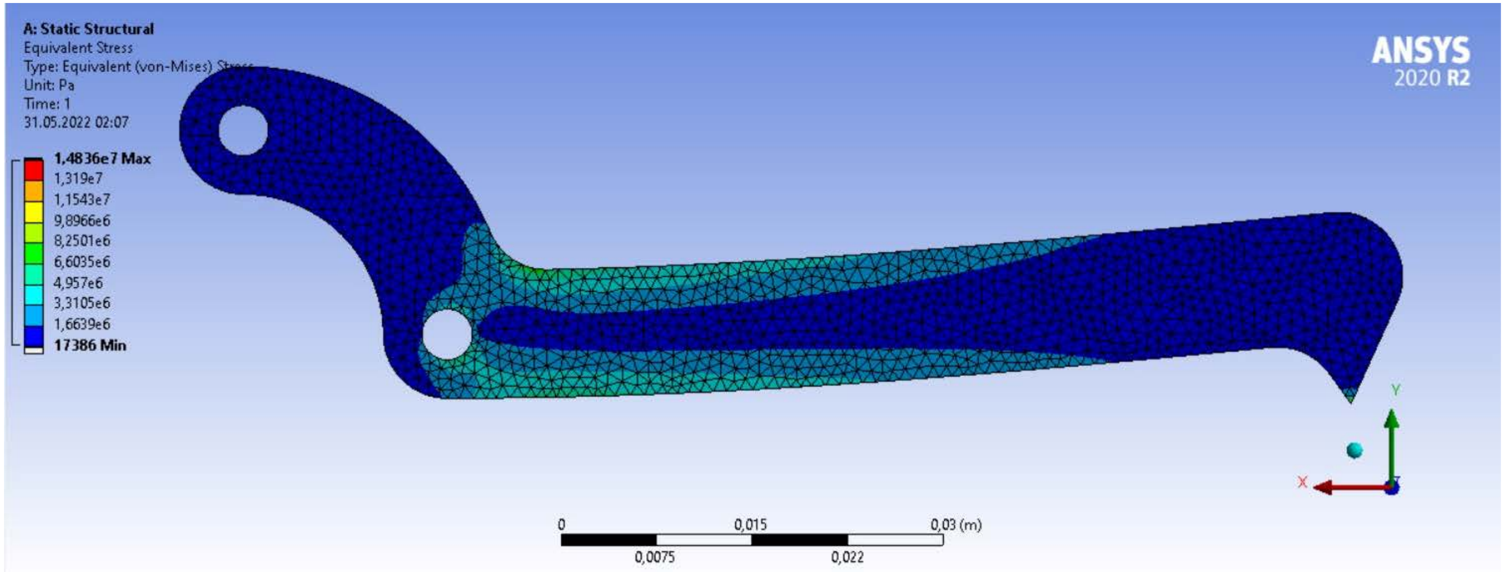
STRUCTURAL ANALYSIS OF TORQUE ARM

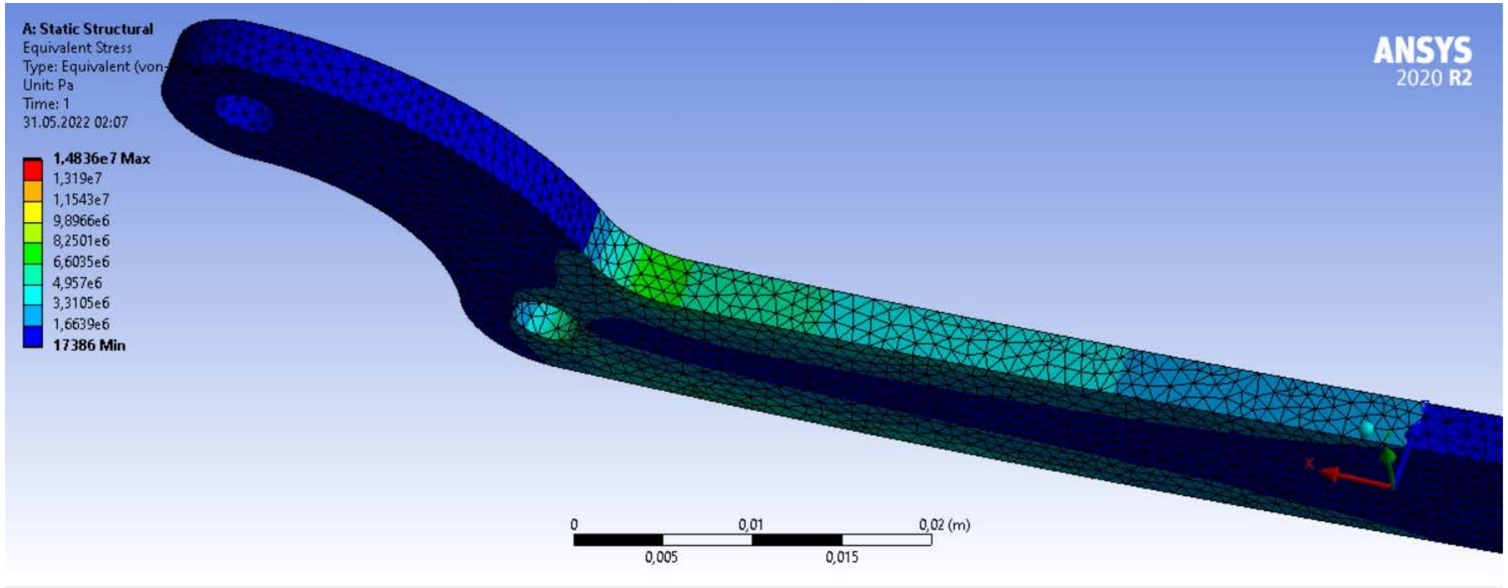
Total Deformation



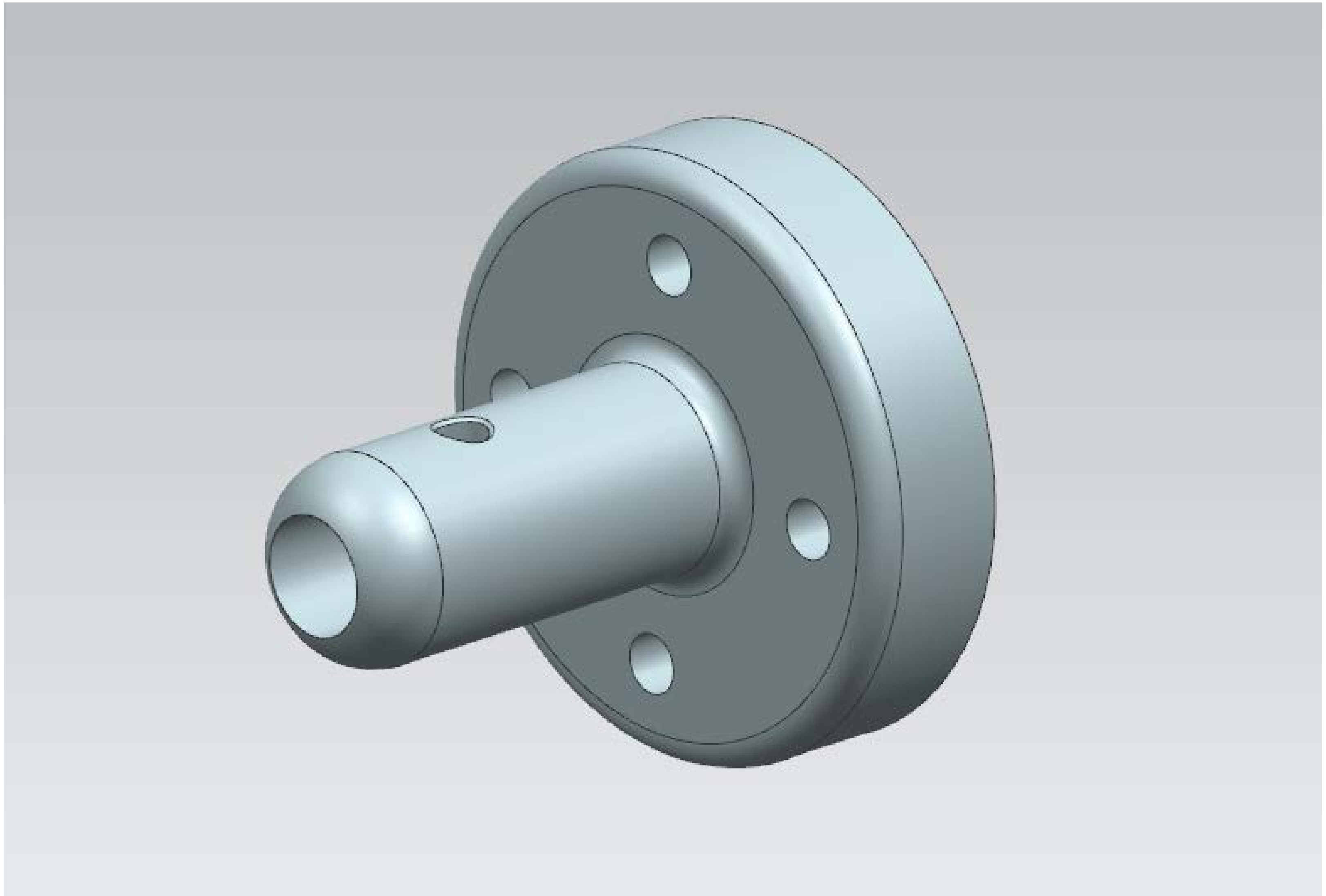
STRUCTURAL ANALYSIS OF TORQUE ARM

Equivalent Stress

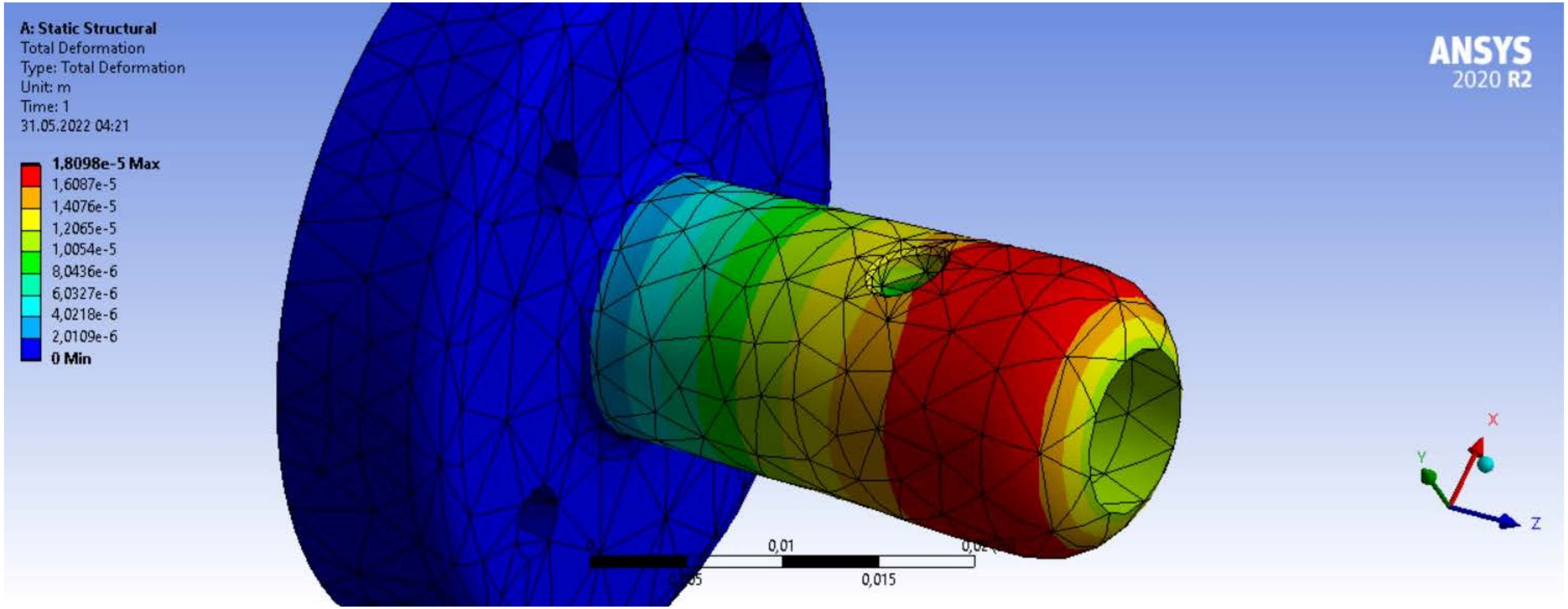




FLANGE COUPLING

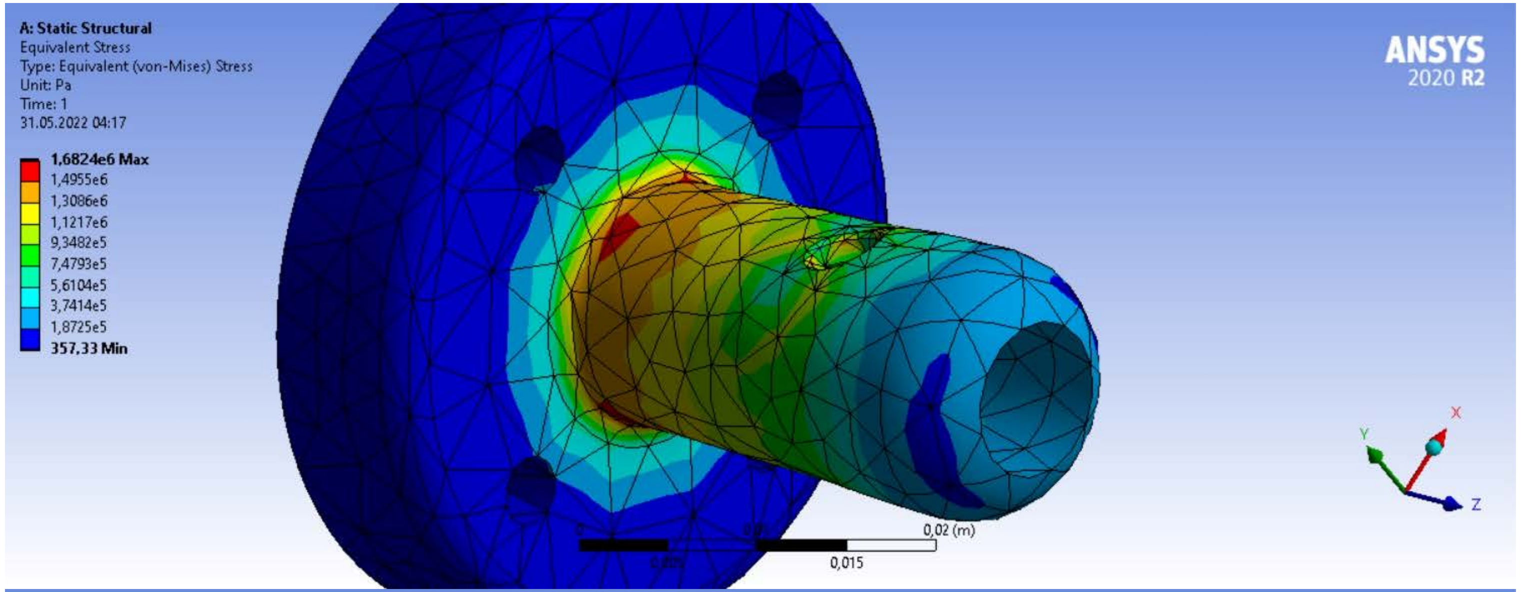


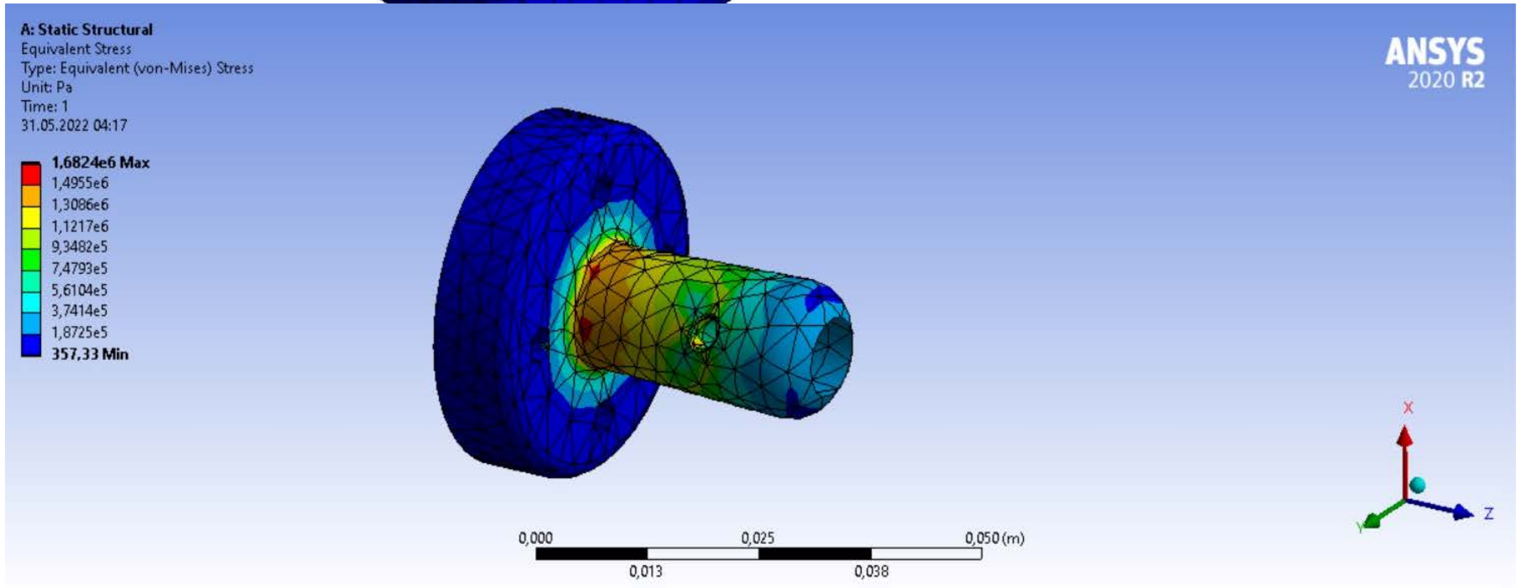
Total Deformation



STRUCTURAL ANALYSIS OF FLANGE COUPLING

Equivalent Stress





4 COST ANALYSIS

Part List	Technical Specs			Approximated Cost Quantity (#)	Cost (₺)
Brake Motor	Part Name	Maxon 578296		1	1500
	Power	200 W			
	Voltage	24 V			
	Torque	0.4 Nm			
Testing Motors	Specified Range	Power	50 - 100 Watt		
		Torque	0.1 - 0.3 Nm		
	Selected Motor 1	Part Name	63ZYT24-95-02	1	900
		Power	100 W		
		Torque	0.27 Nm		
		Voltage	24 V		
	Selected Motor 2	Part Name	632450-5350	1	600
		Power	50 W		
		Torque	0.1 Nm		
		Voltage	24 V		
Coupling				1	75
Torque Arm				1	100
Bearings					40
Aluminum Sigma Profile				2 (m)	200
Power Supply	Power	300 W		2	670
	Voltage	30 V			
	Current	10A			
AC Powermeter				1	150
DC Powermeter				1	150
Load Cell				1	50
Magn. Hall Effect Sensor				1	85
I2C OLED Display				1	70
				Total Cost	4590
				Real Cost	1820

Total cost of the project: **4590 ₺**

Since we already have the brake motor and power supplies, the project can be carried out with **1820 ₺.**

5 CONCLUSIONS

Through the structural analysis, it is concluded that the system executes the intended task without mechanically failing. In addition to that, the analysis of cost shows that our project is feasible to construct.

REFERENCES

- «Arduino Tutorial: Tachometer (RPM Counter)», Youtube, 2019. https://www.youtube.com/watch?v=u2uJMJWsfsg
- Fielding, Jeremy. «How to Measure Horse Power for Any Electric Motor», Youtube, 2020. https://www.youtube.com/watch?v=1Pd0lUKWe7o&t=312s
- «Dynamometer: Introduction and Types», 2021. https://mechanicalengineering.blog/dynamometer-introduction-types/
- «Dynamometer: Introduction, Types & Working », 2020. https://innovationdiscoveries.space/dynamometer-introduction-types-working/amp/

THANK YOU FOR YOUR ATTENTION!

Group E

Erkut Bahadır
Rabia Konuk
Ömer Faruk Seven