

# **National University of Sciences & Technology**

## **FEA LAB PROJECT**

**Name:** Faizan Munir

**Semester:** ME VII A

**Department:** Mechanical Engineering

**Roll No:** ME 1900

**Instructor Name:** Engr Affan Ahmed Khan

## 1. Introduction

This report presents the basic setup and results of both **Static Structural** and **Transient Structural** analyses performed on a pentagon-based 3D extruded geometry.

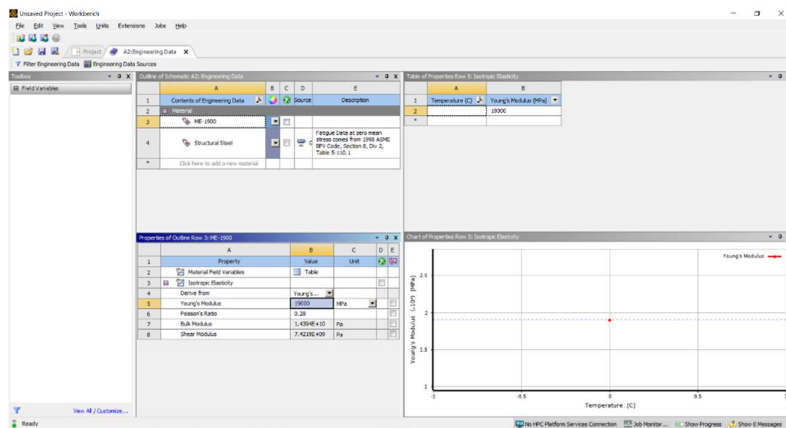
The purpose of the report is to observe how the structure responds to static load and time-dependent varying loads.

## 2. Material Properties

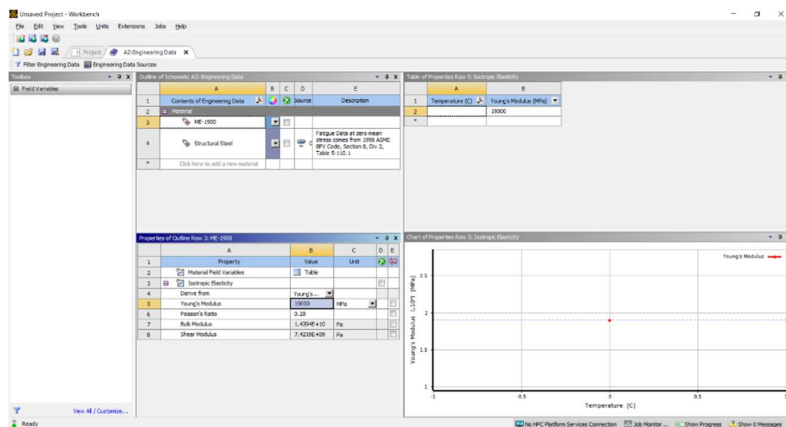
Material used: **ME-1900**

- Young's Modulus: **19000 MPa**
  - Poisson's Ratio: **0.28**
  - Density: **7850 kg/m<sup>3</sup>**
- Other values derived from isotropic elasticity.

### Material Properties (Static)



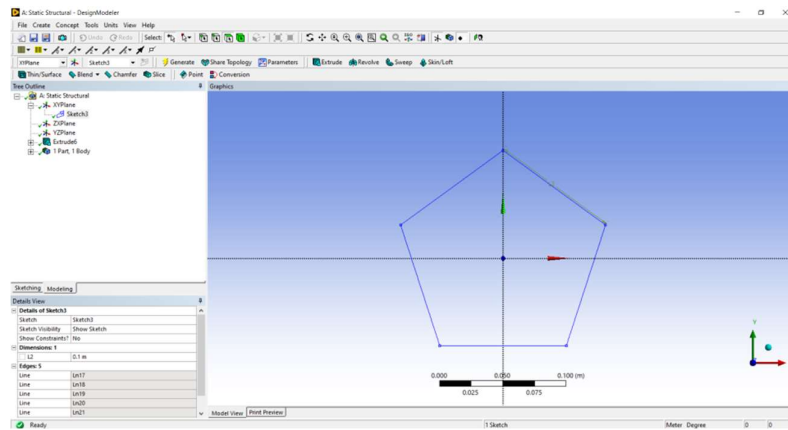
### Material Properties (Transient)



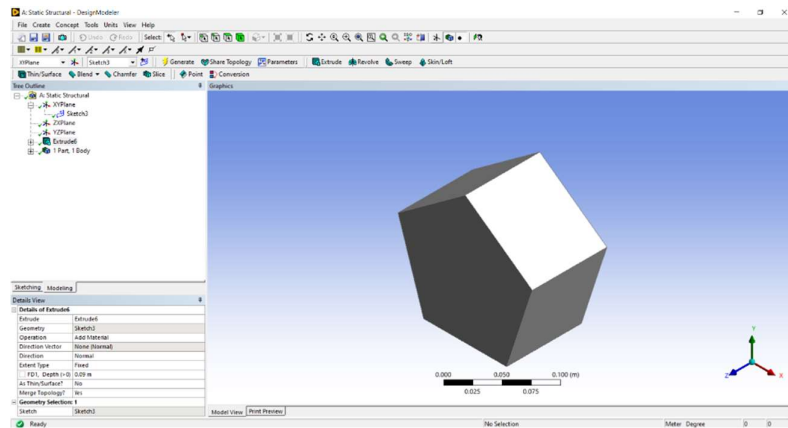
### 3. Geometry Creation

A pentagon shape was sketched on the XY-plane and extruded to a depth of **0.09 m**.

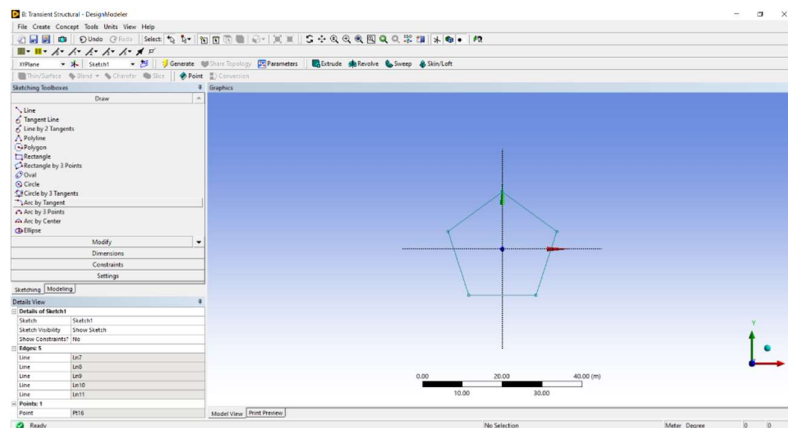
#### Sketch (Static)



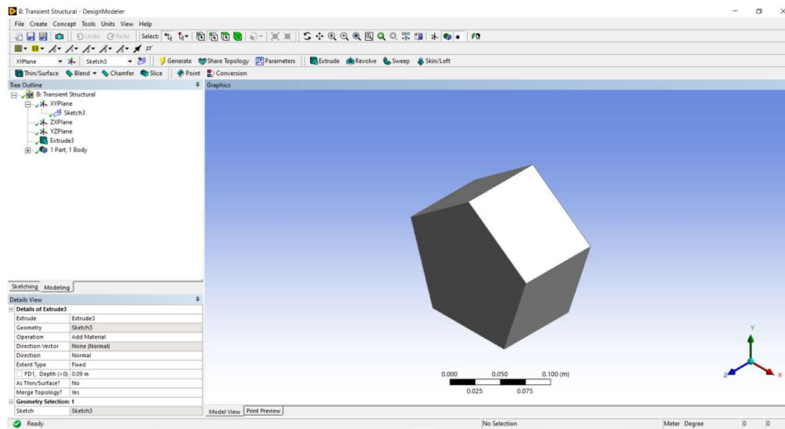
#### Extruded Body (Static)



#### Sketch (Transient)



### Extruded Body (Transient)



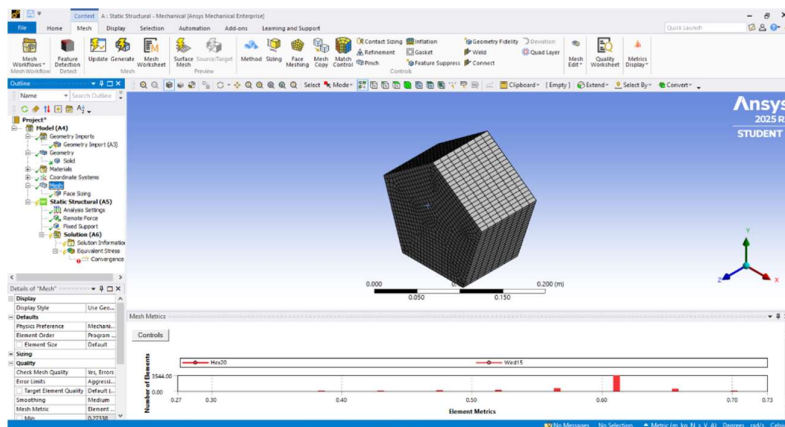
## 4. Meshing

ANSYS automatically generated a mesh using default mesh controls.

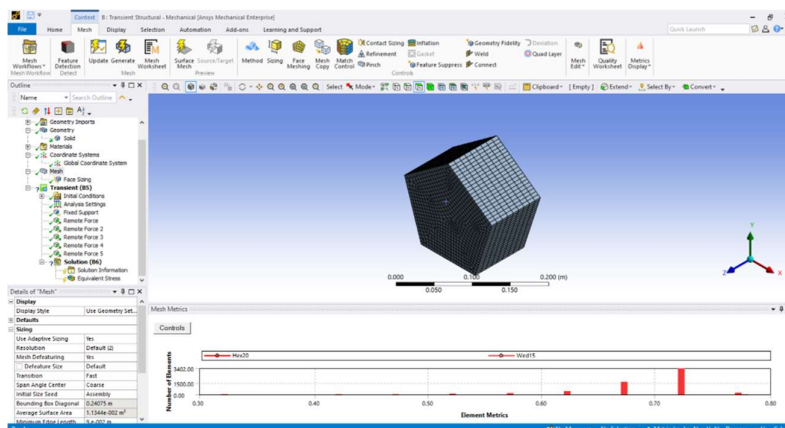
Element types include Hex20/Wedge elements.

Mesh quality is shown in screenshots.

### Mesh Metrics (Static)



### Mesh Metrics (Transient)

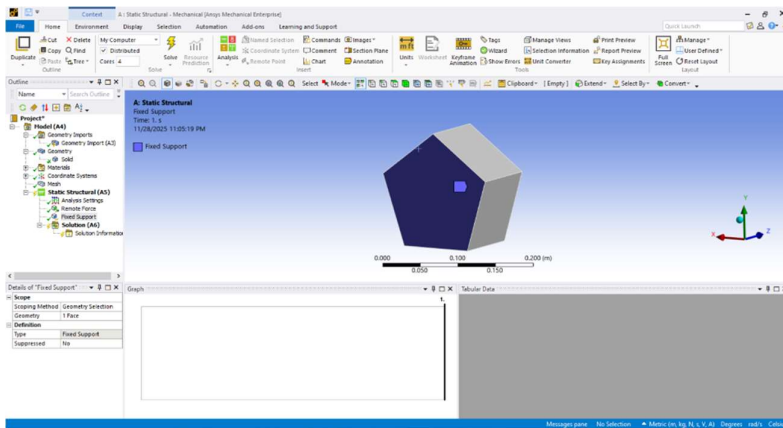


## 5. Static Structural Analysis

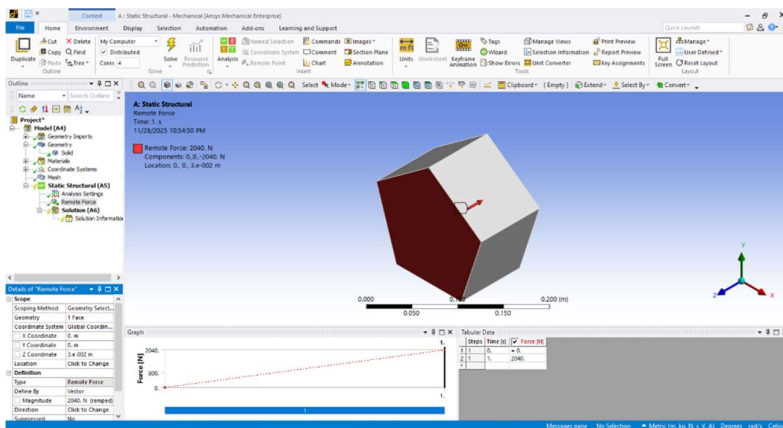
### 5.1 Boundary Conditions

- **Fixed Support** applied to one face of the pentagon.
- **Remote Force** of **2040 N** applied on opposite face (ramped).

#### Fixed Support (Static)



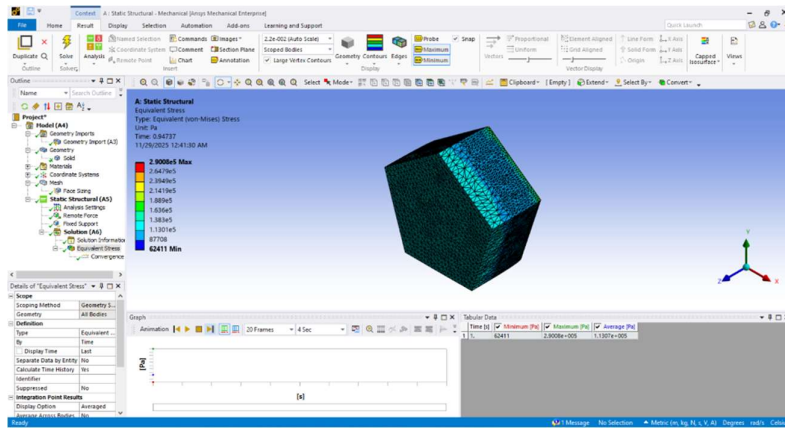
#### Remote Force (Static)



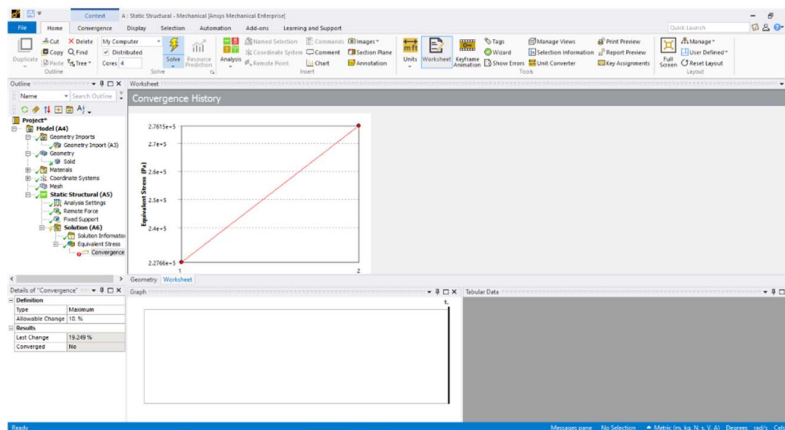
### 5.2 Static Results

- Equivalent (von-Mises) stress distribution was obtained.
- Maximum stress visible on the loaded face region.
- Convergence not achieved in last iteration due to large relative change ( $\approx 19\%$ ).

## Equivalent Stress (Static)



## Convergence Plot (Static)

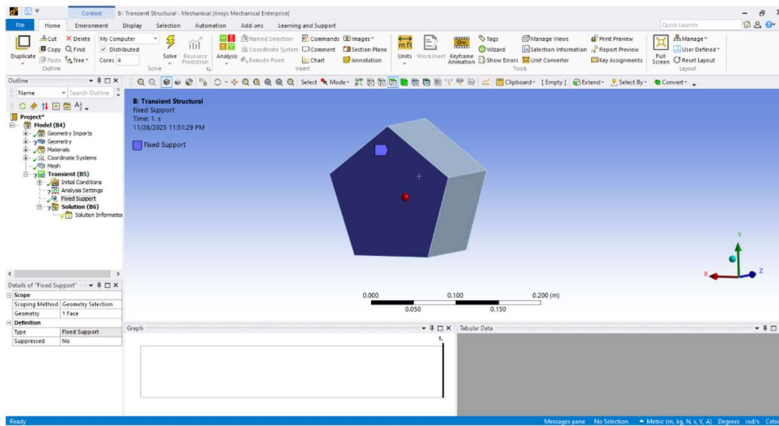


## 6. Transient Structural Analysis

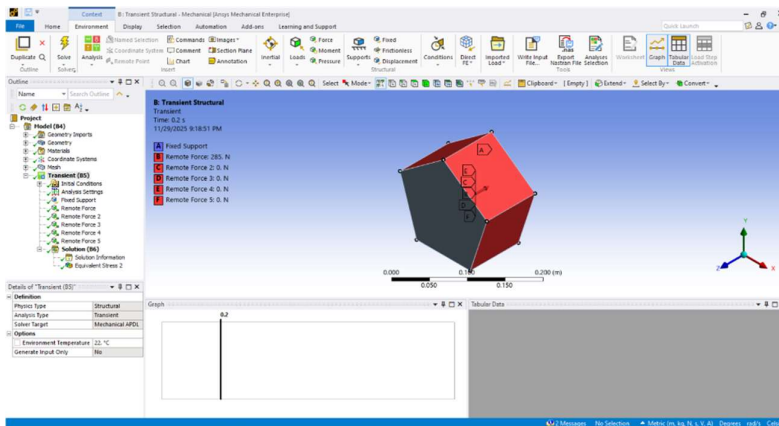
### 6.1 Boundary Conditions

- **Fixed Support** on one face.
- **Five Remote Forces** applied on five different faces with varying magnitudes:
  - Force 1: 285 N
  - Force 2: 285 N
  - Force 3: 285 N
  - Force 4: 285 N
  - Force 5: 285 N

## Fixed Support (Transient)



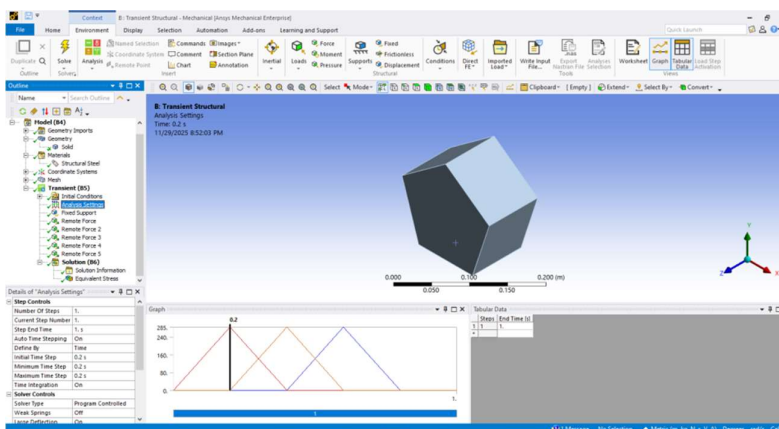
## Multiple Remote Forces (Transient)



## 6.2 Analysis Settings

- Step end time: **1.0 s**
- Initial time step: **0.2 s**
- Auto time stepping: **ON**
- Loads follow a triangular ramp-up and ramp-down pattern.

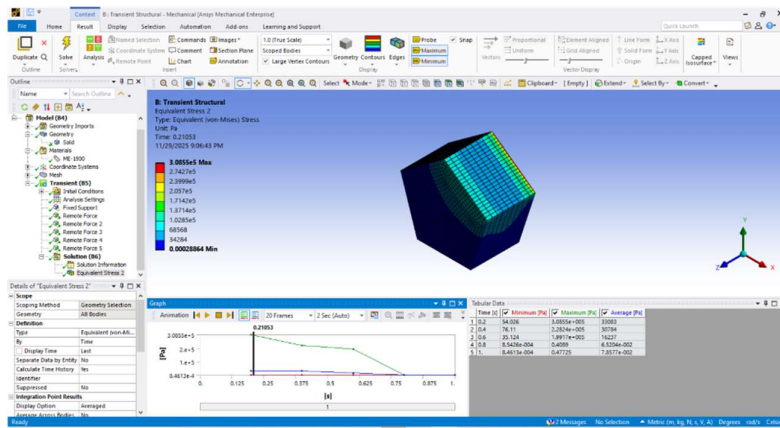
## Analysis Settings + Load Time Graph (Transient)



## 6.3 Transient Results

- Time-based equivalent stress distribution obtained.
- Maximum stress around **3.0855e5 Pa** at  $t \approx 0.21$  s.
- Stress decreases with time after load peak.

### Equivalent Stress (Transient)



## 7. Observations

- Stress concentrations were consistent with applied load faces.
- Static analysis shows expected deformation under constant load.
- Transient analysis shows dynamic response based on varying loads.
- Mesh quality was acceptable for student version settings.

## 8. Conclusion

Both static and transient analyses were successfully performed.

The screenshots capture all relevant settings including material setup, geometry, meshing, boundary conditions, and stress results.

The object behaves predictably under both constant and time-varying loads.



