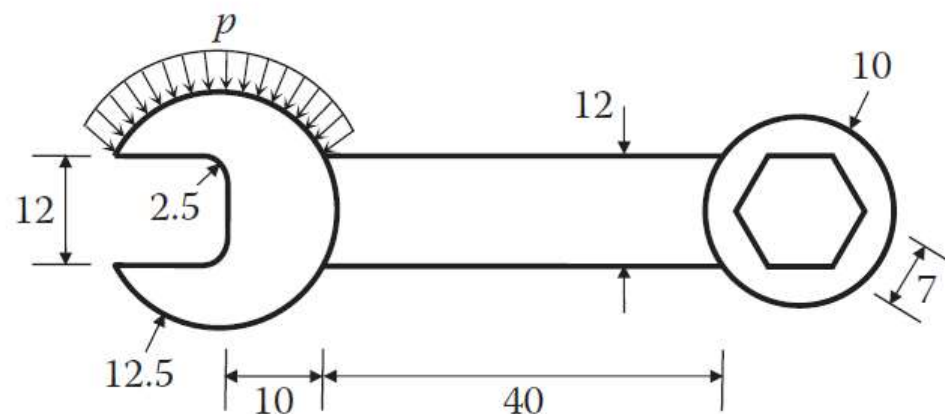


Nedjelja 4

Modeliranje problema ravnog stanja napona konačnim elementima

Postavka zadatka

Okasto-vilasti ključ prikazan na slici, debljine 3 mm, izrađen je od nerđajućeg čelika sledećih karakteristika: $E=193$ GPa i $\nu=0.27$. Odrediti maksimalna pomjeranja i von Mises-ove napone. Granični uslovi: duž ivica šestougona otvora su nepokretni oslonci, $p=2$ MPa.

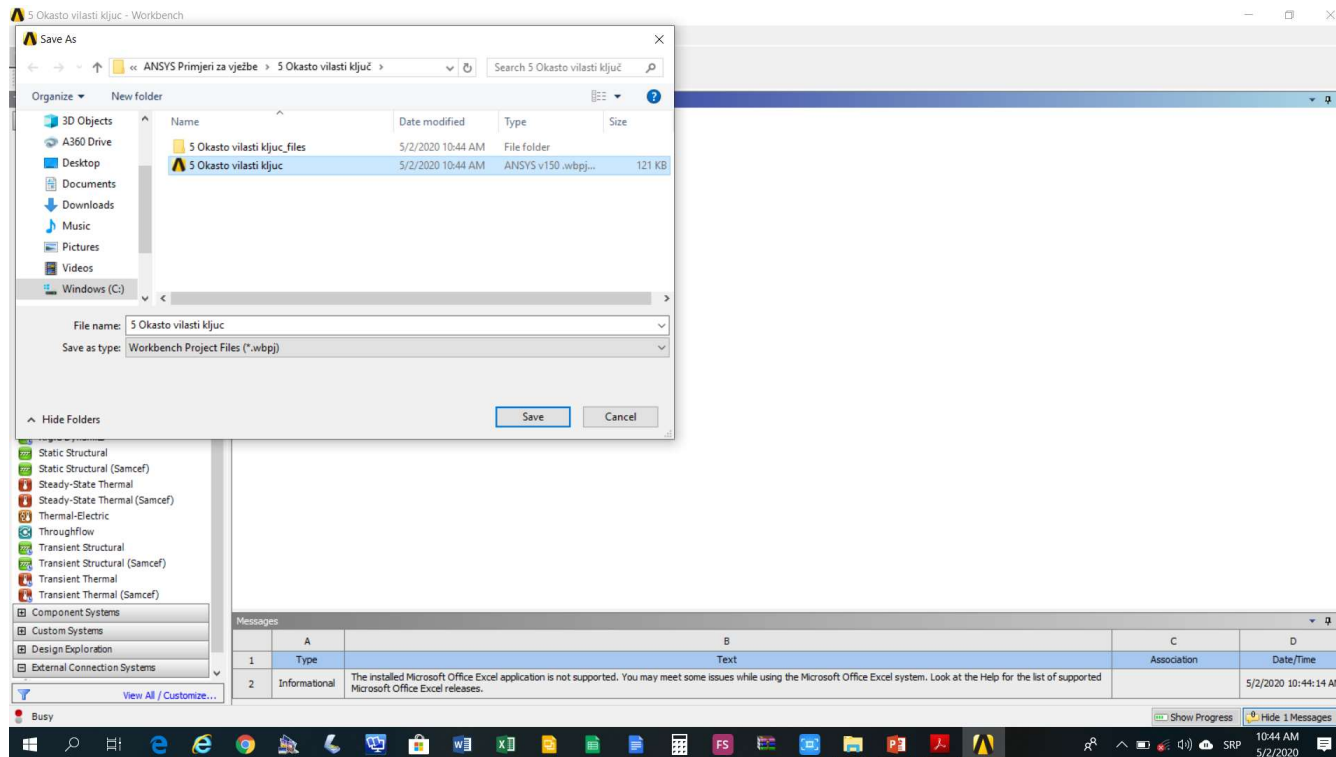


Okasto-vilasti ključ



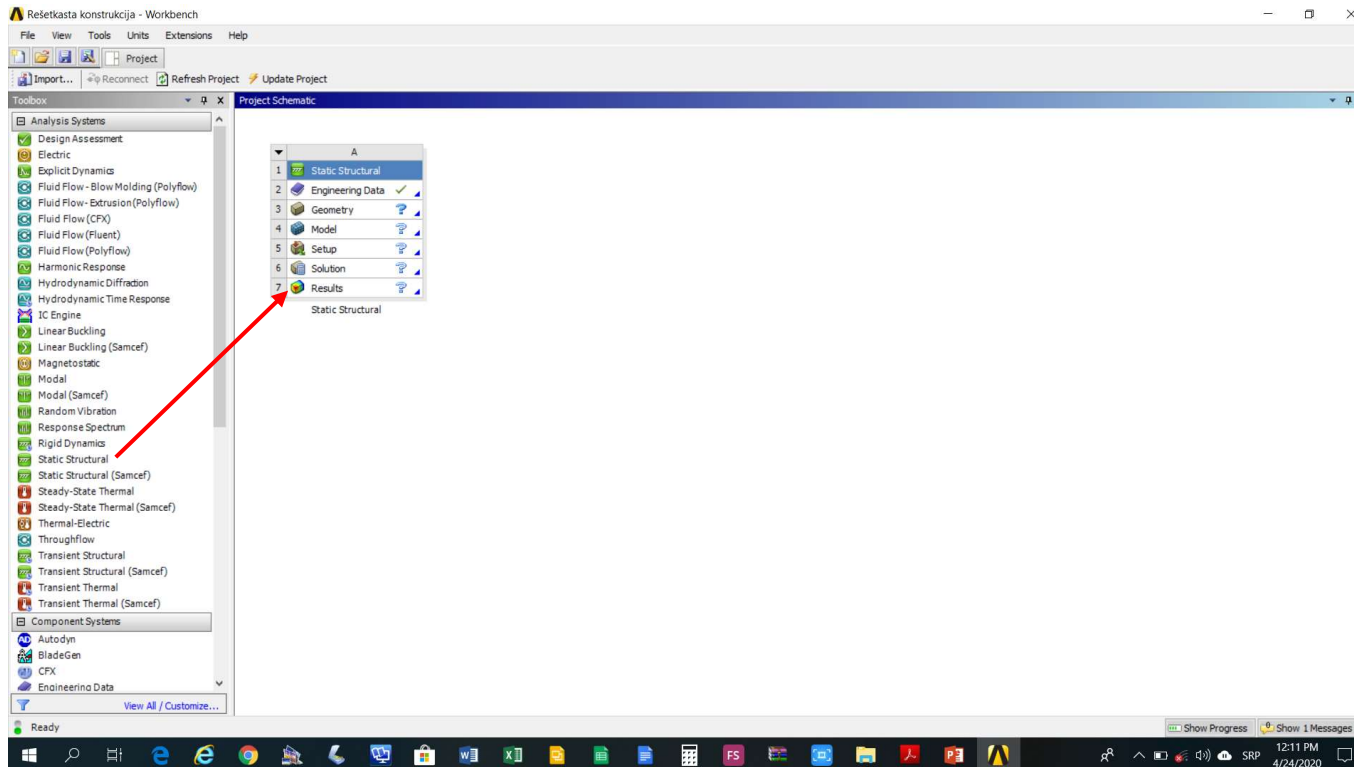
Modeliranje 2D problema

Aktivirati program ANSYS i sačuvati prazan projekat pod nazivom Okasto vilasti ključ



Modeliranje 2D problema

Kreirati statičku linearnu analizu (*Static Structural*) na shemi projekta (*Project Schematic*)



Modeliranje 2D problema

Aktivirati modul Engineering Data (*Engineering Data->Edit*) i dodati novi materijal *Click here to add new material*

The screenshot displays the ANSYS Workbench Engineering Data interface. On the left, the 'Engineering Data' component is selected, and a context menu is open with 'Edit...' highlighted. The main window shows the 'Properties of Outline Row 3: Structural Steel' table, which lists various material properties and their values. A 'Click here to add a new material' button is visible at the bottom of the table. The 'Table of Properties Row 2: Density' window shows the density value of 7850 kg m⁻³ for Structural Steel. The 'Chart of Properties Row 2: Density' window shows a graph of Density (kg m⁻³) versus Temperature (C).

| Property | Value | Unit |
|---|----------------------|--------------------|
| Density | 7850 | kg m ⁻³ |
| Isotropic Secant Coefficient of Thermal Expansion | | |
| Isotropic Elasticity | | |
| Derive from | Young's Modulus a... | |
| Young's Modulus | 2E+11 | Pa |
| Poisson's Ratio | 0.3 | |
| Bulk Modulus | 1.6667E+11 | Pa |
| Shear Modulus | 7.6923E+10 | Pa |
| Alternating Stress Mean Stress | Tabular | |
| Strain-Life Parameters | | |
| Tensile Yield Strength | 2.5E+08 | Pa |
| Compressive Yield Strength | 2.5E+08 | Pa |
| Tensile Ultimate Strength | 4.6E+08 | Pa |
| Compressive Ultimate Strength | 0 | Pa |

| Temperature (C) | Density (kg m ⁻³) |
|-----------------|-------------------------------|
| 1 | 7850 |
| 2 | 7850 |

Modeliranje 2D problema

Unijeti karakteristike novog linearno elastičnog i izotropnog materijala (*Isotropic Elasticity*)

The screenshot displays the ANSYS Workbench interface with the following components:

- Toolbox:** A list of material models on the left. "Linear Elastic" is circled in red, and "Isotropic Elasticity" is selected below it.
- Properties of Outline Row 4: Nerđajuć čelik:** A table defining material properties.

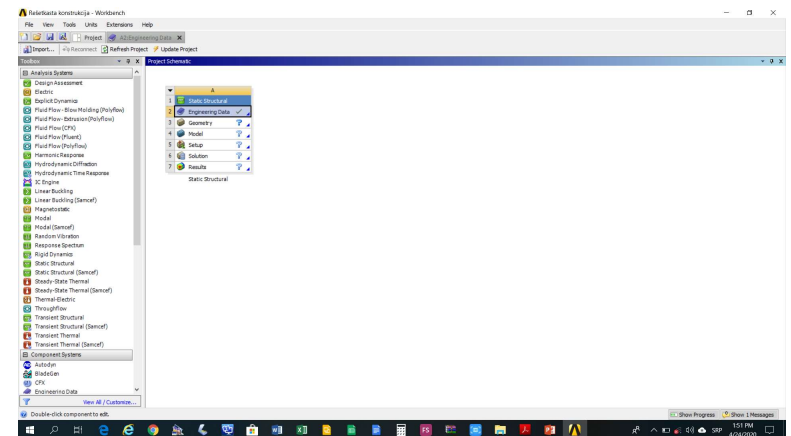
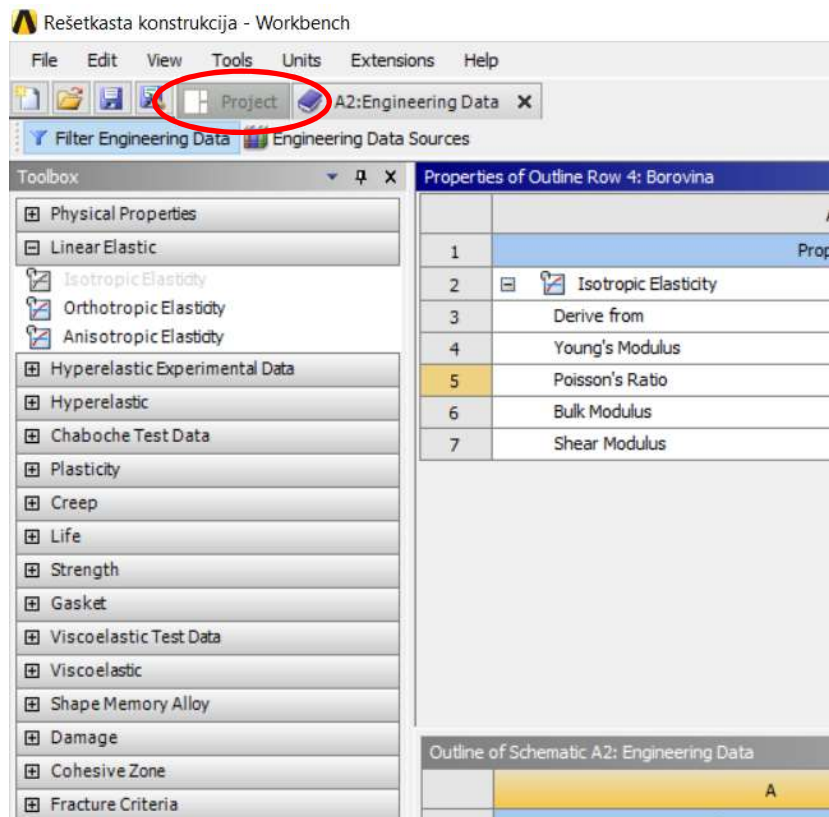
| Property | Value | Unit |
|----------|----------------------|----------------------|
| 1 | | |
| 2 | Isotropic Elasticity | |
| 3 | Derive from | Young's Modulus a... |
| 4 | Young's Modulus | 1.93E+11 Pa |
| 5 | Poisson's Ratio | 0.27 |
| 6 | Bulk Modulus | 1.3986E+11 Pa |
| 7 | Shear Modulus | 7.5984E+10 Pa |
- Outline of Schematic A2: Engineering Data:** A table listing materials.

| Material | Description |
|----------|----------------------------------|
| 1 | Contents of Engineering Data |
| 2 | Material |
| 3 | Structural Steel |
| 4 | Nerđajuć čelik |
| * | Click here to add a new material |
- Table of Properties Row 6: Isotropic Elasticity:** A table showing the Bulk Modulus property.

| Temperature (C) | Bulk Modulus (Pa) |
|-----------------|-------------------|
| 1 | 1.3986E+11 |
| 2 | |
| * | |
- Chart of Properties Row 6: Isotropic Elasticity:** A graph of Bulk Modulus [Pa] vs Temperature [C]. The y-axis ranges from 0 to 2.0E+11, and the x-axis ranges from -1 to 1. A red dot is plotted at (0, 1.3986E+11), with a horizontal dashed line extending from it.

Modeliranje 2D problema

Izabrati opciju *Project* za povratak na shemu projekta



Modeliranje rešetkaste konstrukcije

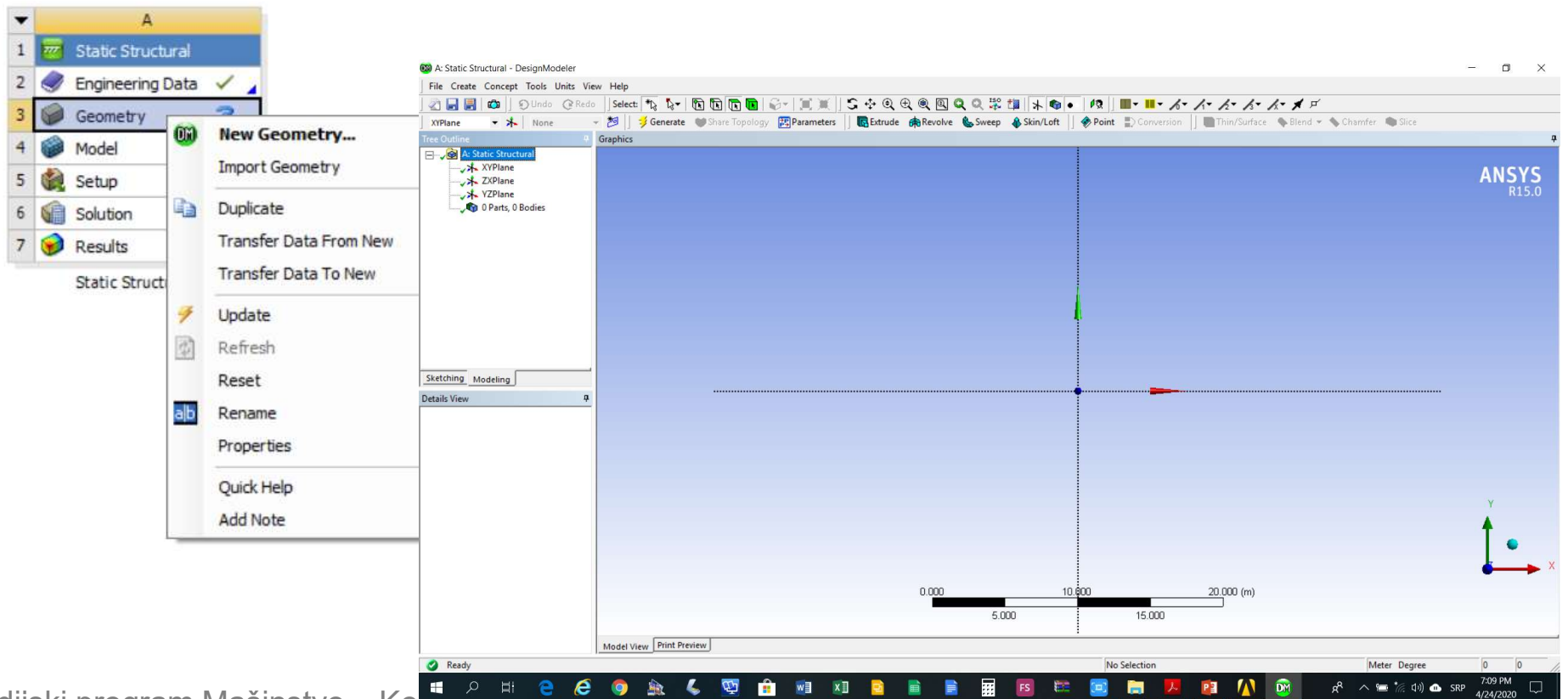
Izvršiti podešavanja modula Design Modeler
(*Geometry*->*Properties*->*Analysis Type* = 2D)

The screenshot shows the ANSYS Workbench interface. The 'Geometry' object is selected in the Project Schematic, and its 'Properties' dialog is open. The 'Analysis Type' is set to '2D' and 'Surface Bodies' is checked. The 'Properties' dialog is divided into several sections: General, Basic Geometry Options, and Advanced Geometry Options. The 'Analysis Type' is set to '2D' and 'Surface Bodies' is checked.

| Property | Value |
|-----------------------------------|-------------------------------------|
| Component ID | Geometry |
| Directory Name | SYS |
| Notes | |
| Used Licenses | |
| Last Update Used Licenses | |
| Geometry Source | |
| Geometry File Name | |
| Basic Geometry Options | |
| Surface Bodies | <input checked="" type="checkbox"/> |
| Line Bodies | <input type="checkbox"/> |
| Parameters | <input checked="" type="checkbox"/> |
| Parameter Key | DS |
| Attributes | <input type="checkbox"/> |
| Named Selections | <input type="checkbox"/> |
| Material Properties | <input type="checkbox"/> |
| Advanced Geometry Options | |
| Analysis Type | 2D |
| Use Associativity | <input checked="" type="checkbox"/> |
| Use Coordinate Systems | <input type="checkbox"/> |
| Import Work Points | <input type="checkbox"/> |
| Reader Mode Saves Updated File | <input type="checkbox"/> |
| Import Using Instances | <input checked="" type="checkbox"/> |
| Smart CAD Update | <input type="checkbox"/> |
| Compare Parts On Update | No |
| Enclosure and Symmetry Processing | <input checked="" type="checkbox"/> |
| Decompose Disjoint Geometry | <input checked="" type="checkbox"/> |
| Mixed Import Resolution | None |

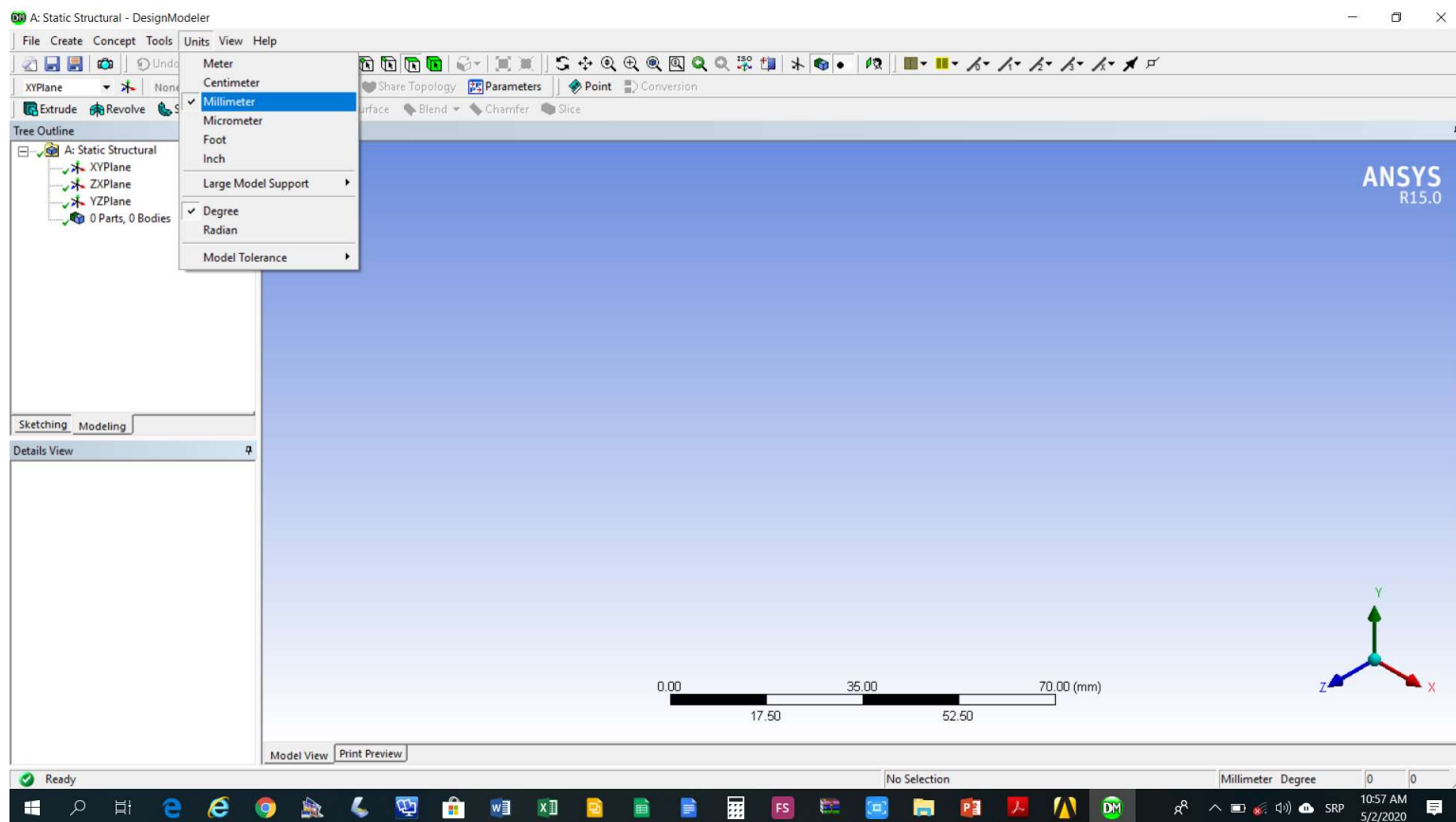
Modeliranje 2D problema

Aktivirati modul Design Modeler (*Geometry->New Geometry*)



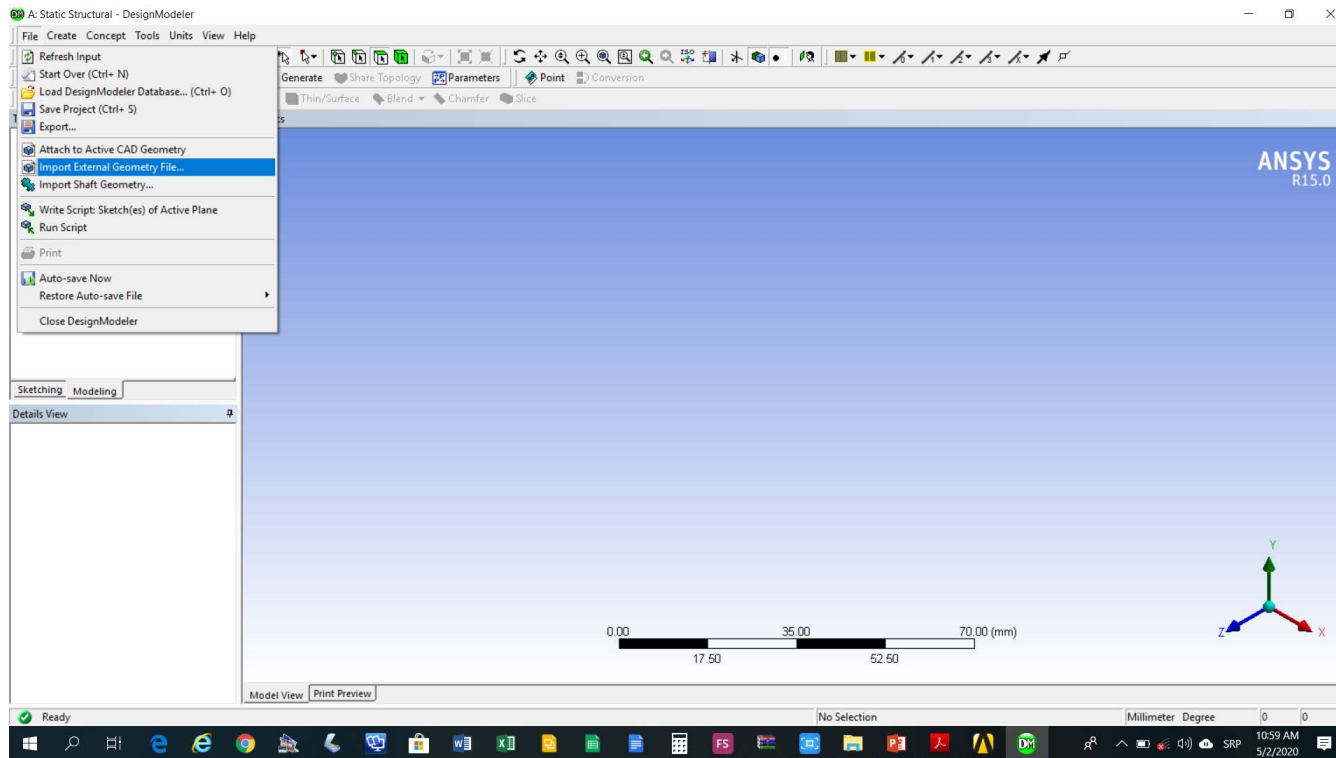
Modeliranje 2D problema

Podesiti dužinske jedinice (Units->Milimeter)



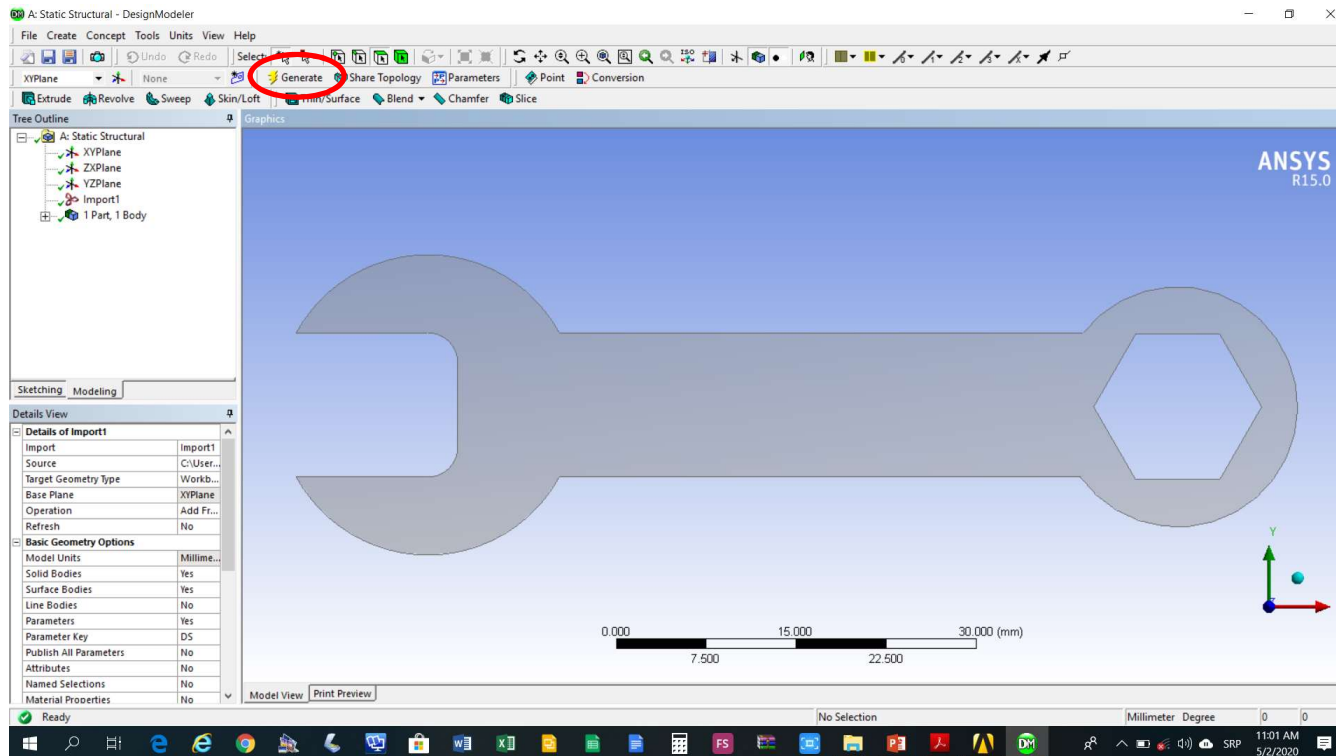
Modeliranje 2D problema

Učitavanje eksterno generisane geometrije (File->*Import External Geometry File*) *.iges format



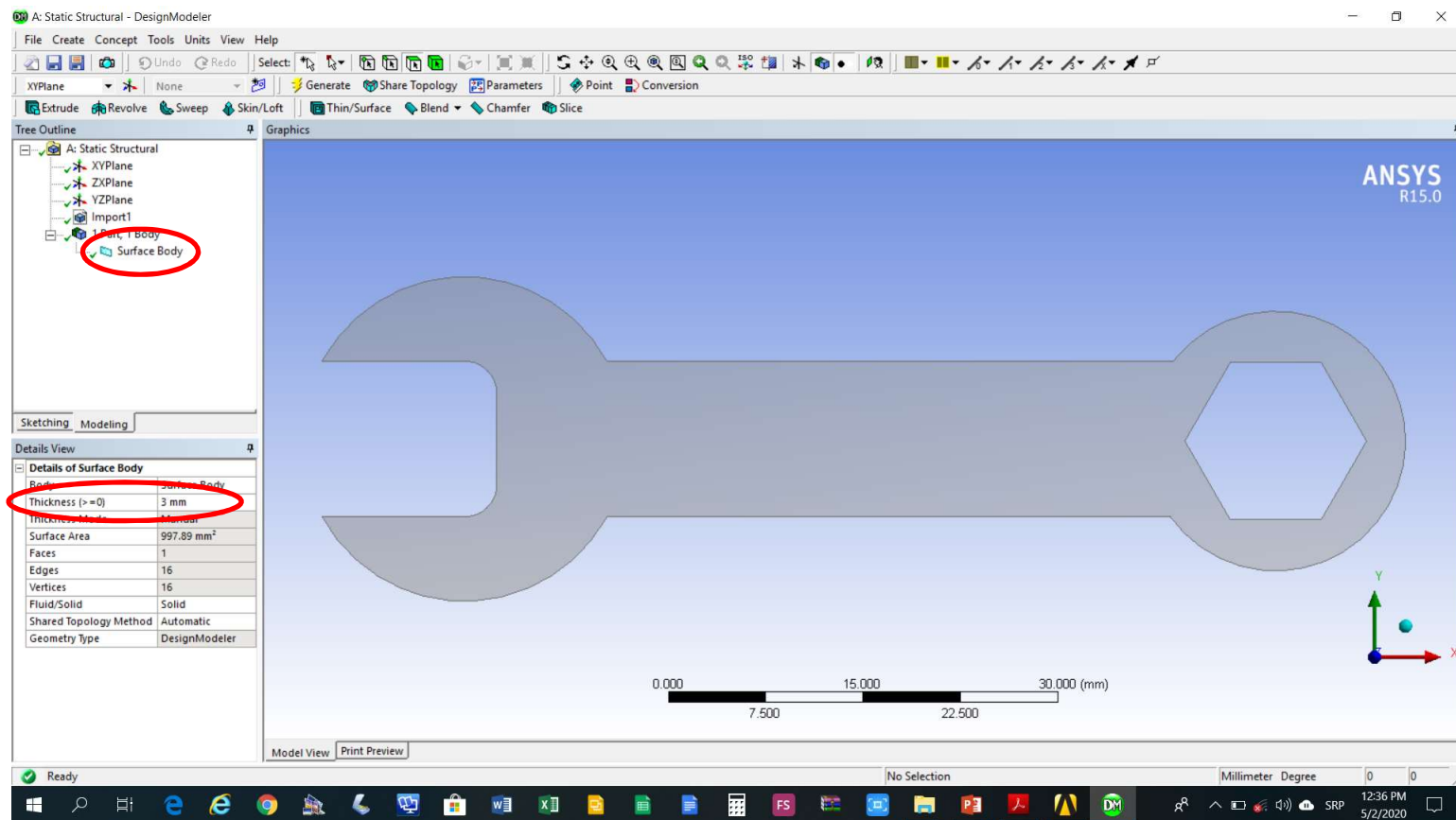
Modeliranje 2D problema

Učitavanje eksterno generisane geometrije
okončati komandom *Generate*



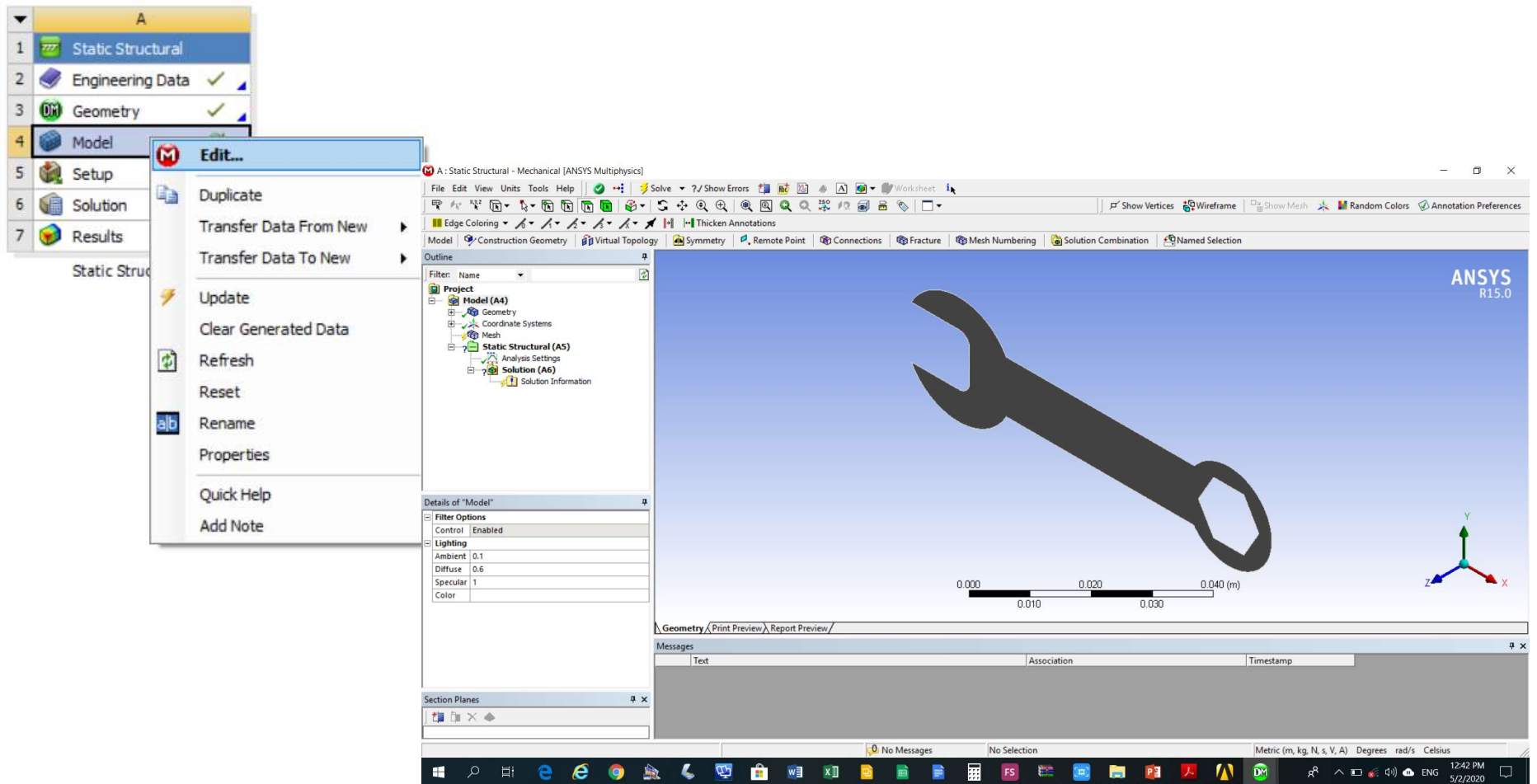
Modeliranje 2D problema

Podešavanje debljine učitanoj površini u polje *Details of Surface Body*->*Thickness* unijeti 3 mm



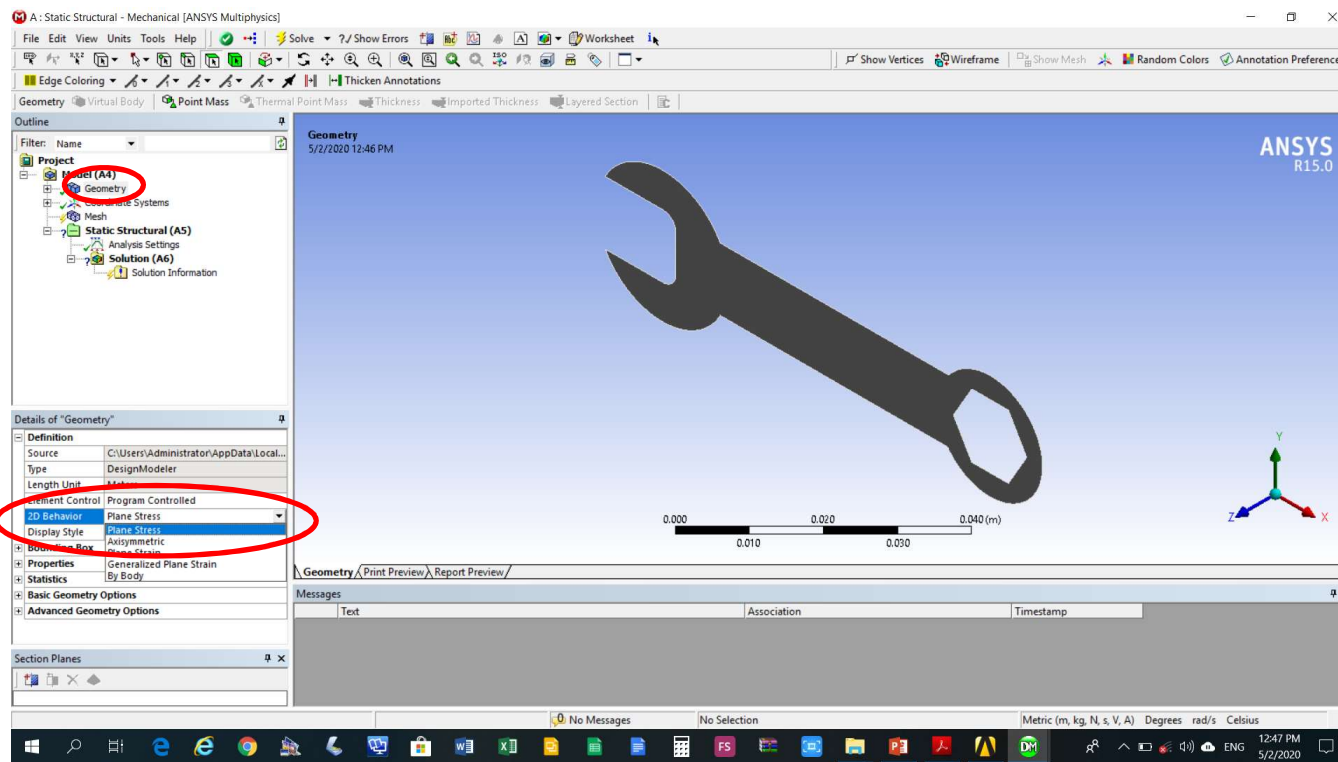
Modeliranje 2D problema

Aktivirati modul Static Structural (*Model*->*Edit*)



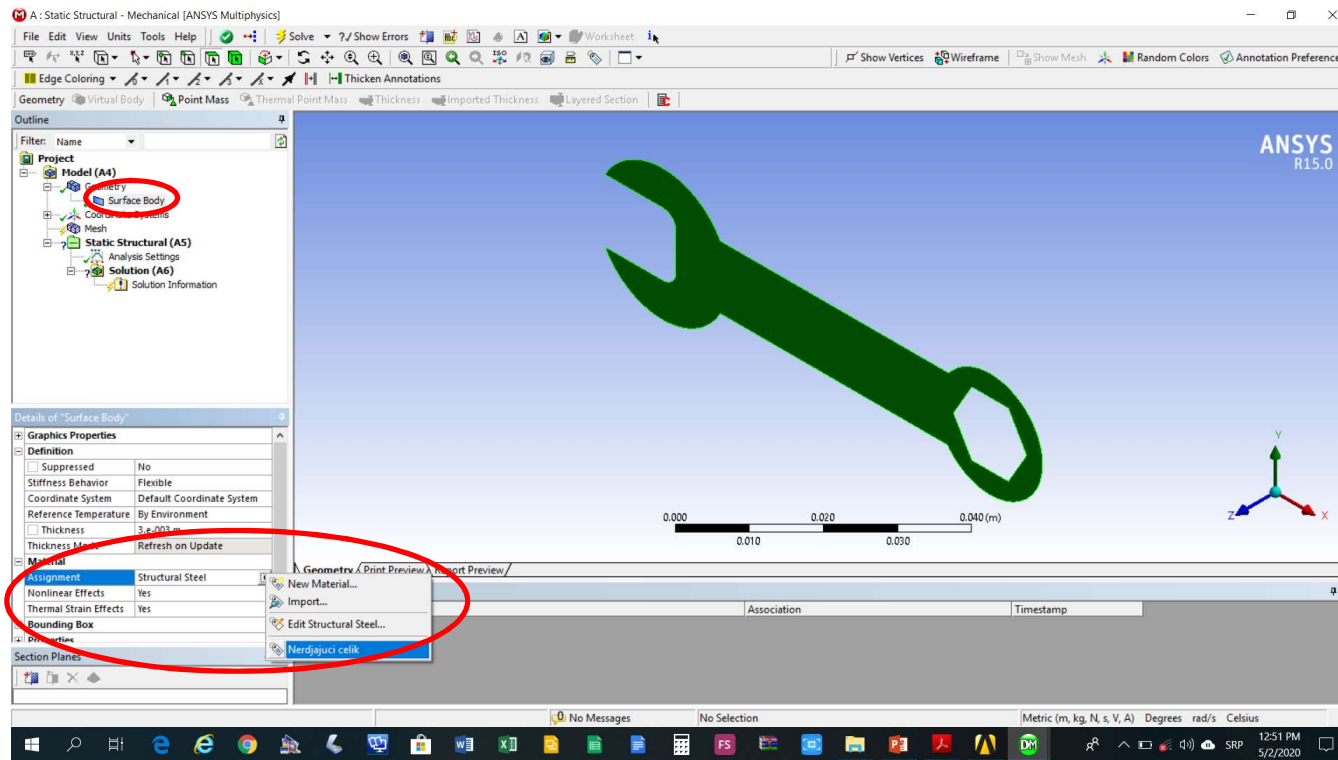
Modeliranje 2D problema

Izabrati analizu ravanskog stanja napona sa liste *Details of Geometry*->*2D Behaviour* izabrati *Plane Stress*



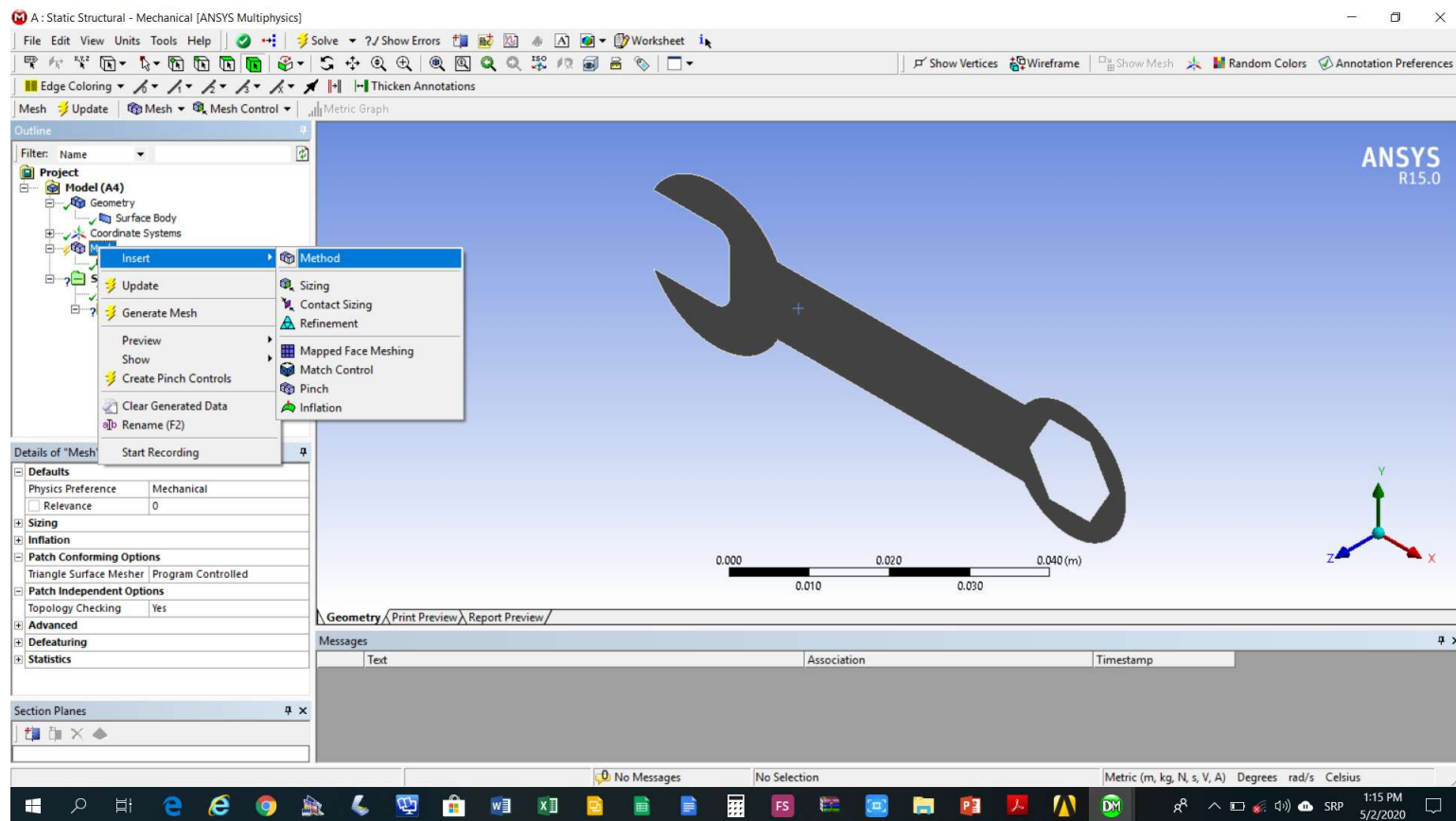
Modeliranje 2D problema

Dodjeliti odgovarajući materijal sa liste *Details of Surface Body*->*Material*->*Assignment* izabrati *Nerđajući čelik*



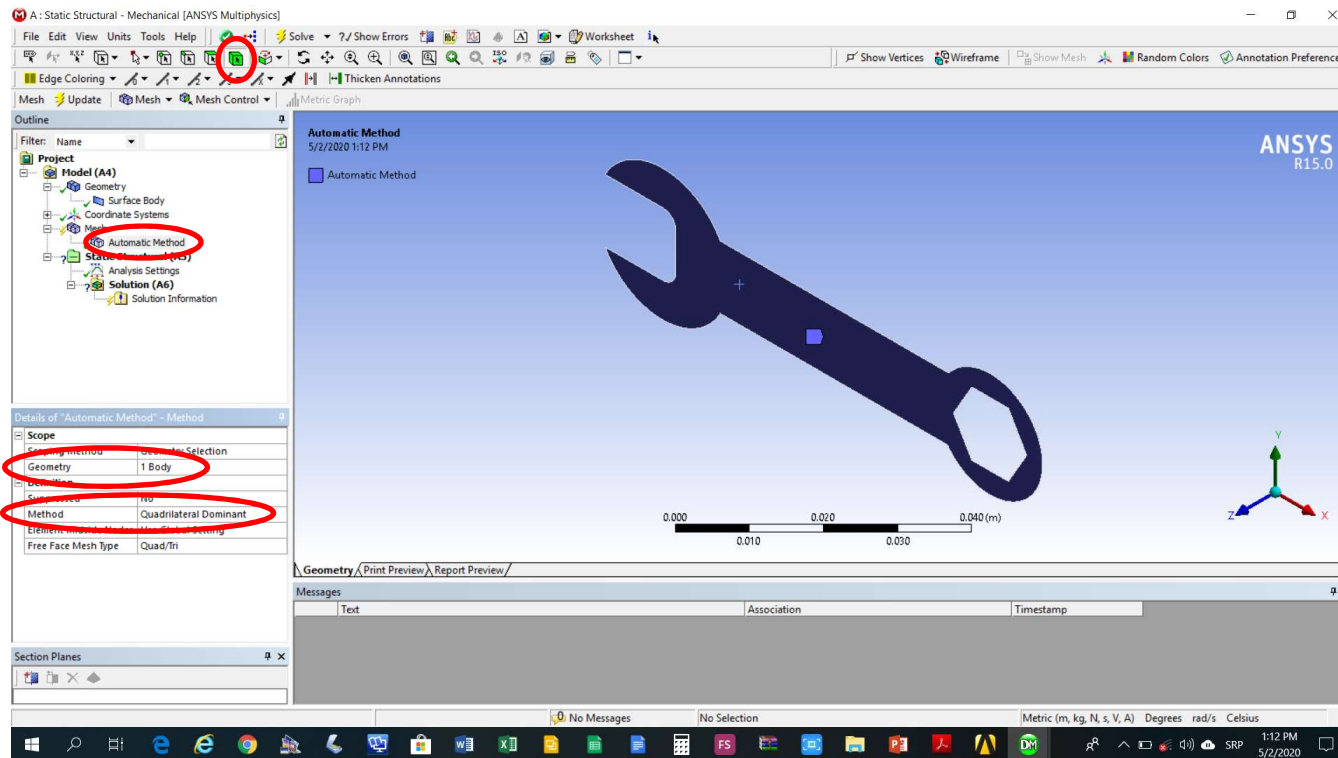
Modeliranje 2D problema

Izbor tipa konačnih elemenata (*Mesh->Insert->Method*)



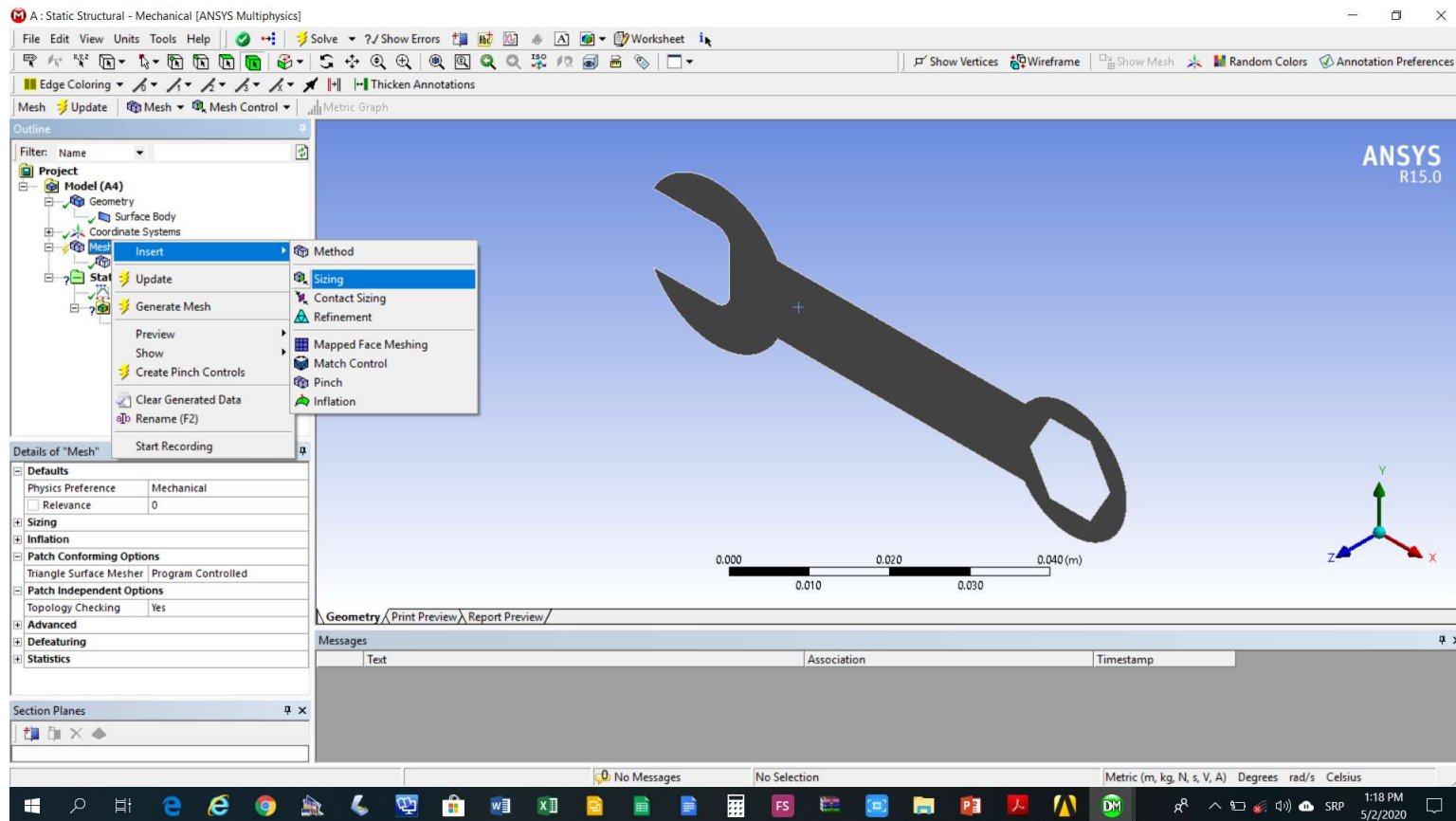
Modeliranje 2D problema

Izabrati *Surface Body* na koje treba primjeniti metodu za generisanje mreže (*Details of Automatic Method->Geometry->Apply*)



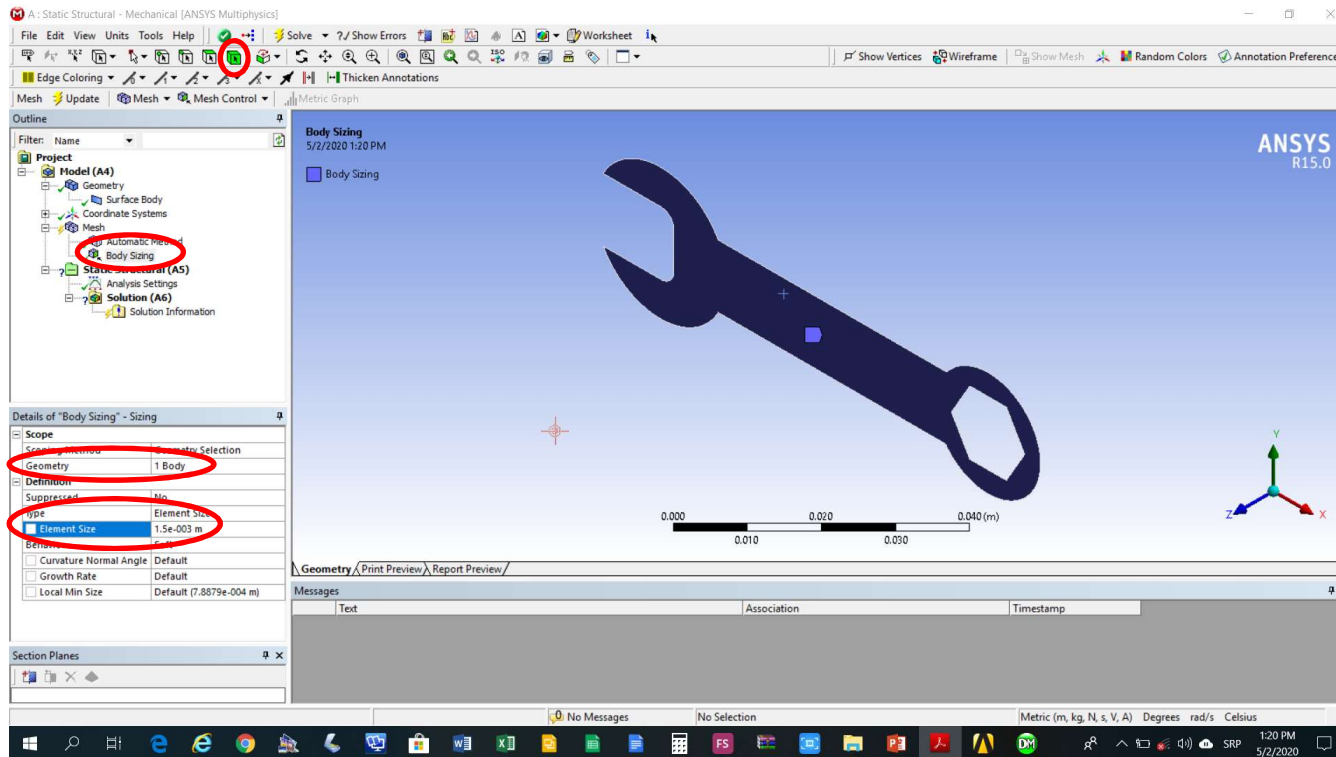
Modeliranje 2D problema

Podešavanje veličine konačnih elemenata
(*Mesh->Insert->Sizing*)



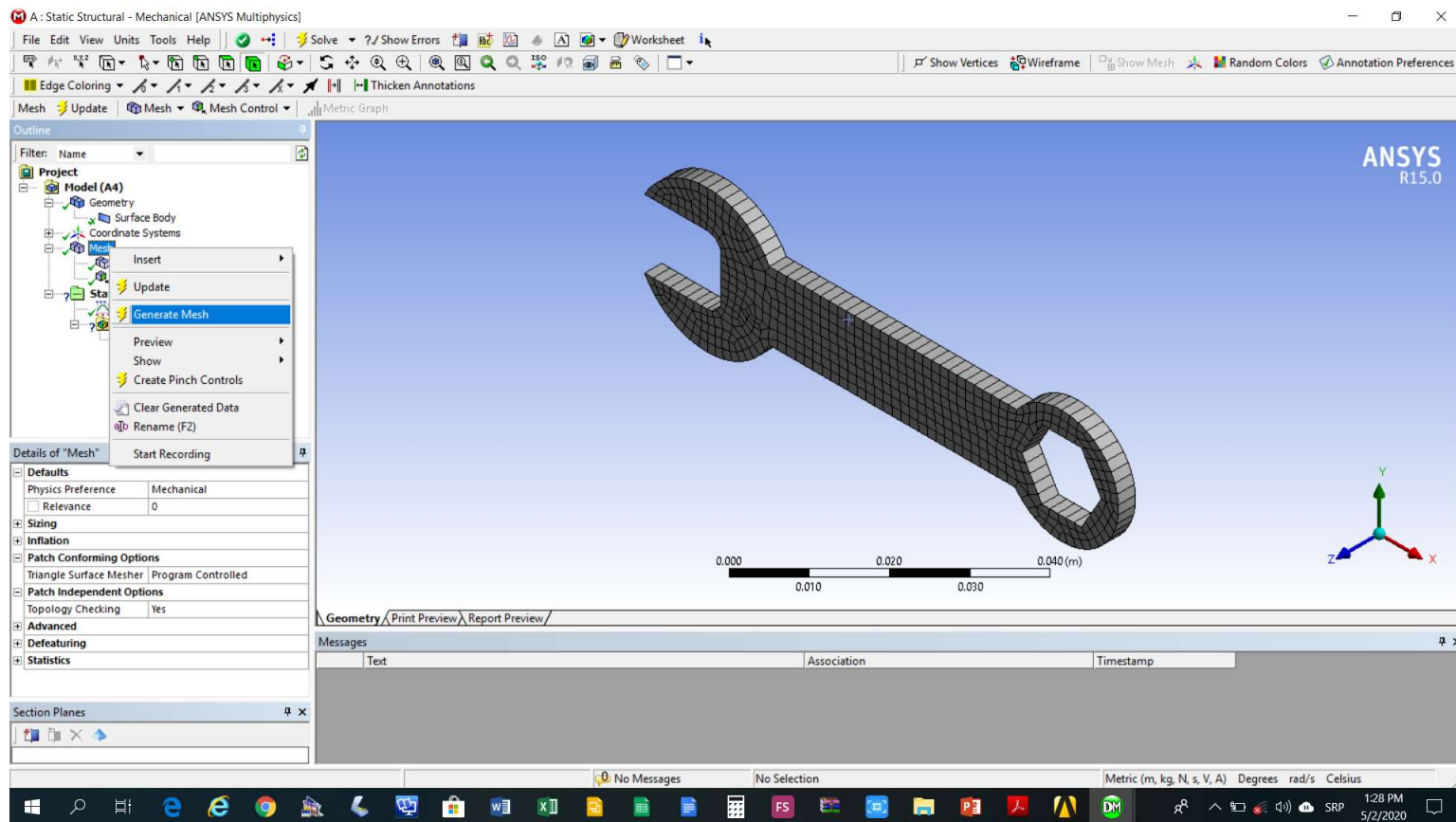
Modeliranje 2D problema

Podešavanje veličine konačnih elemenata, u polje *Details of Body Sizing*->*Element Size* unijeti $1.5e-3$



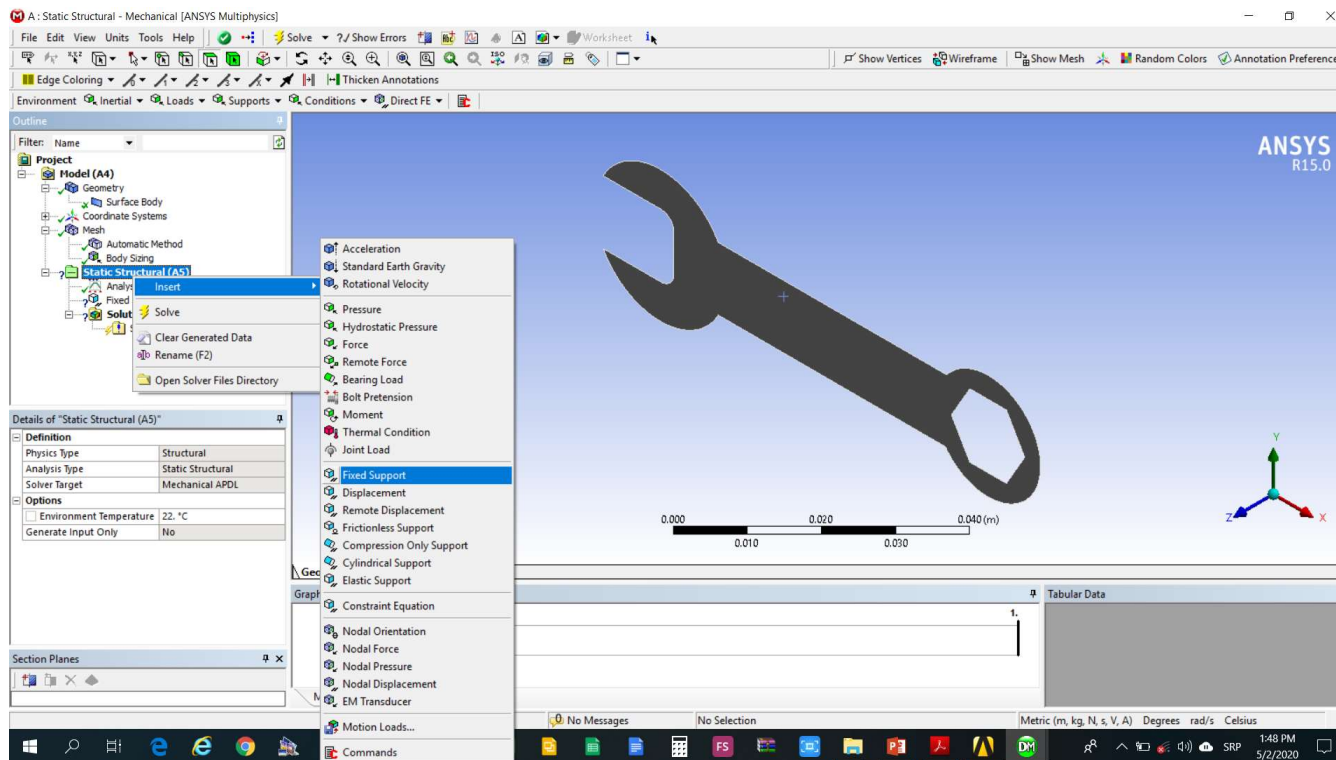
Modeliranje 2D problema

Generisati mrežu konačnih elemenata (*Mesh->Generate Mesh*)



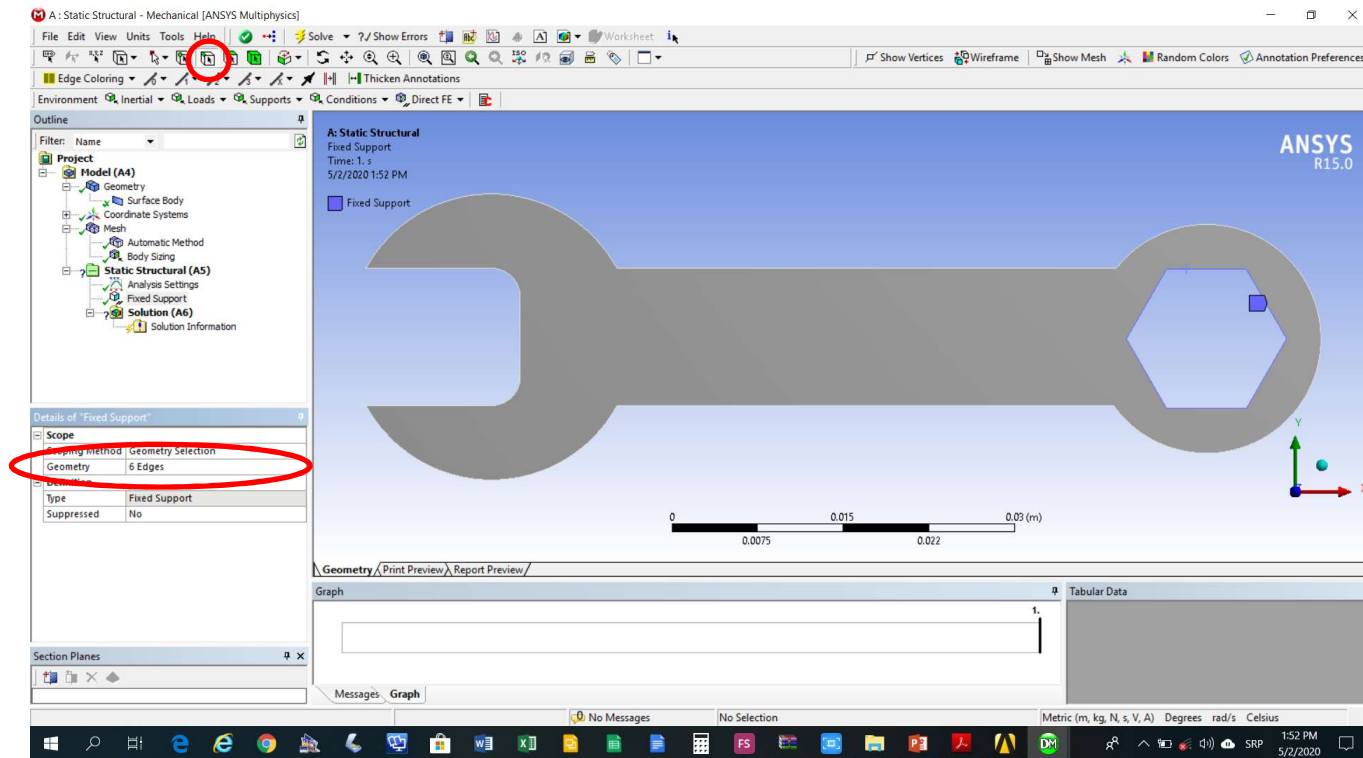
Modeliranje 2D problema

Postavljanje nepokretnih oslonaca (*Static Structural->Insert>Fixed Support*)



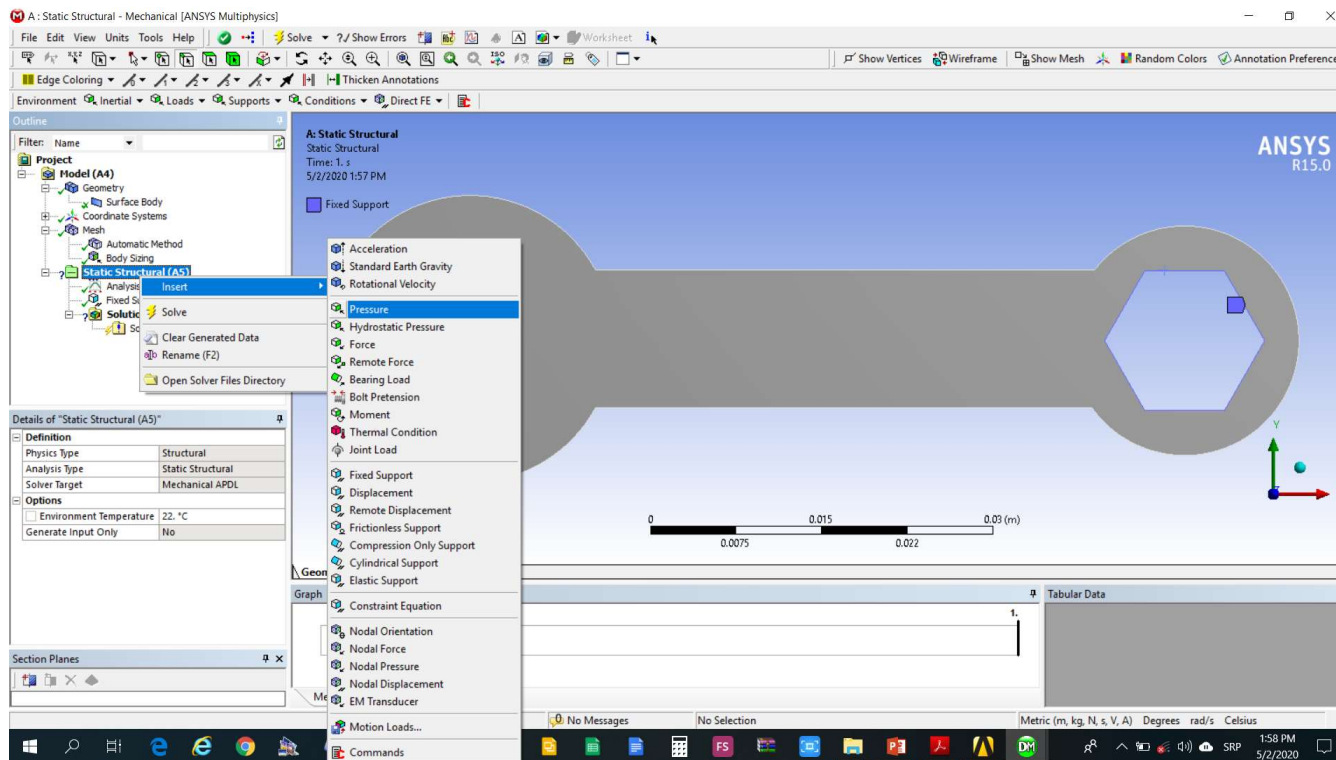
Modeliranje 2D problema

Postavljanje nepokretnih oslonaca (*Details of Fixed Support*->*Geometry*>*Apply*)



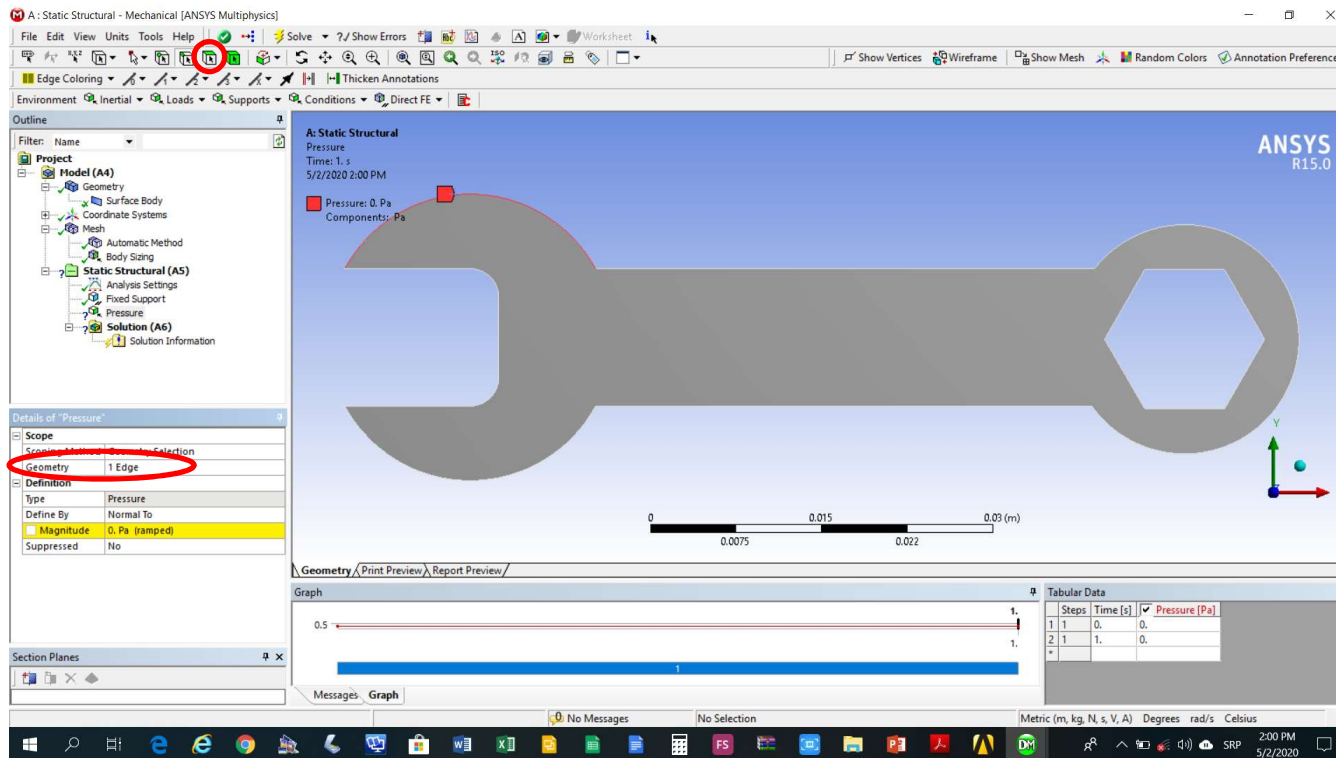
Modeliranje 2D problema

Zadavanje opterećenja (*Static Structural-
>Insert>Pressure*)



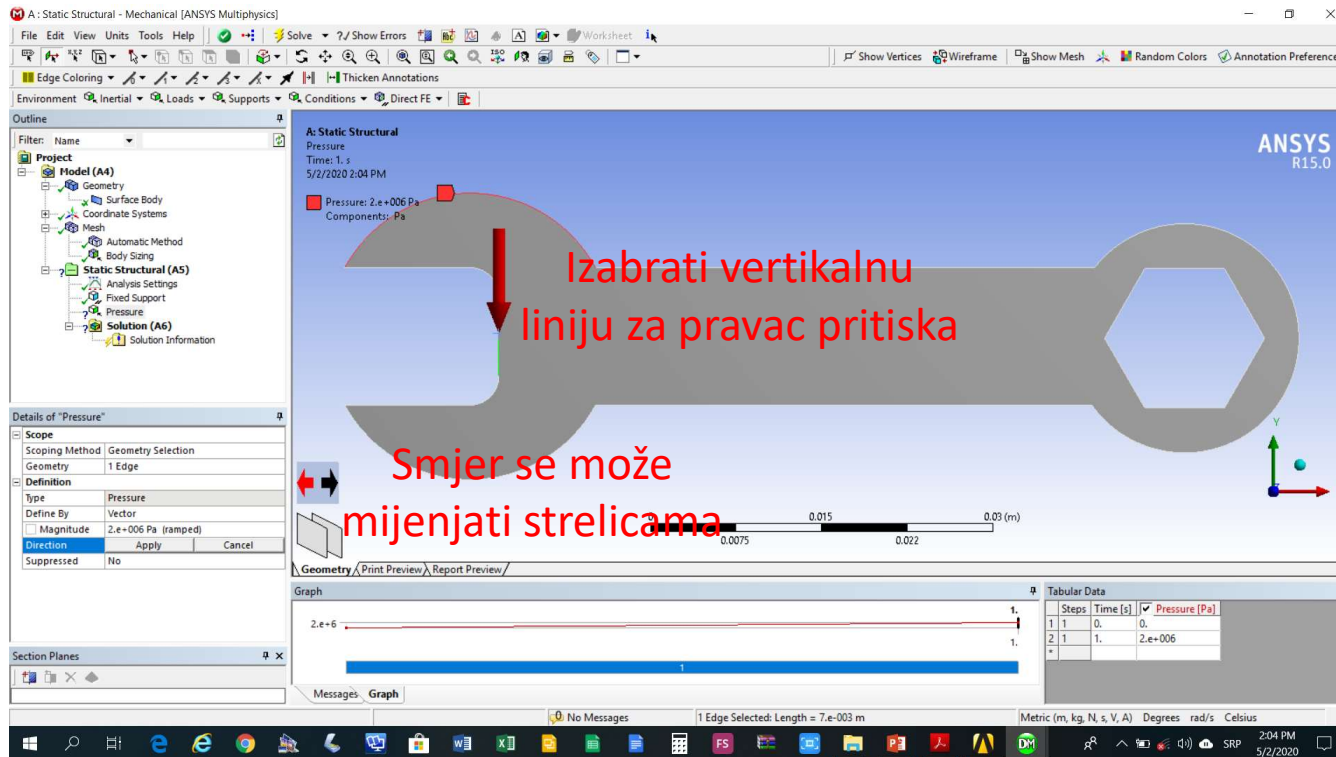
Modeliranje 2D problema

Izbor ivice po kojoj djeluje pritisak (*Details of Pressure->Geometry>Apply*)



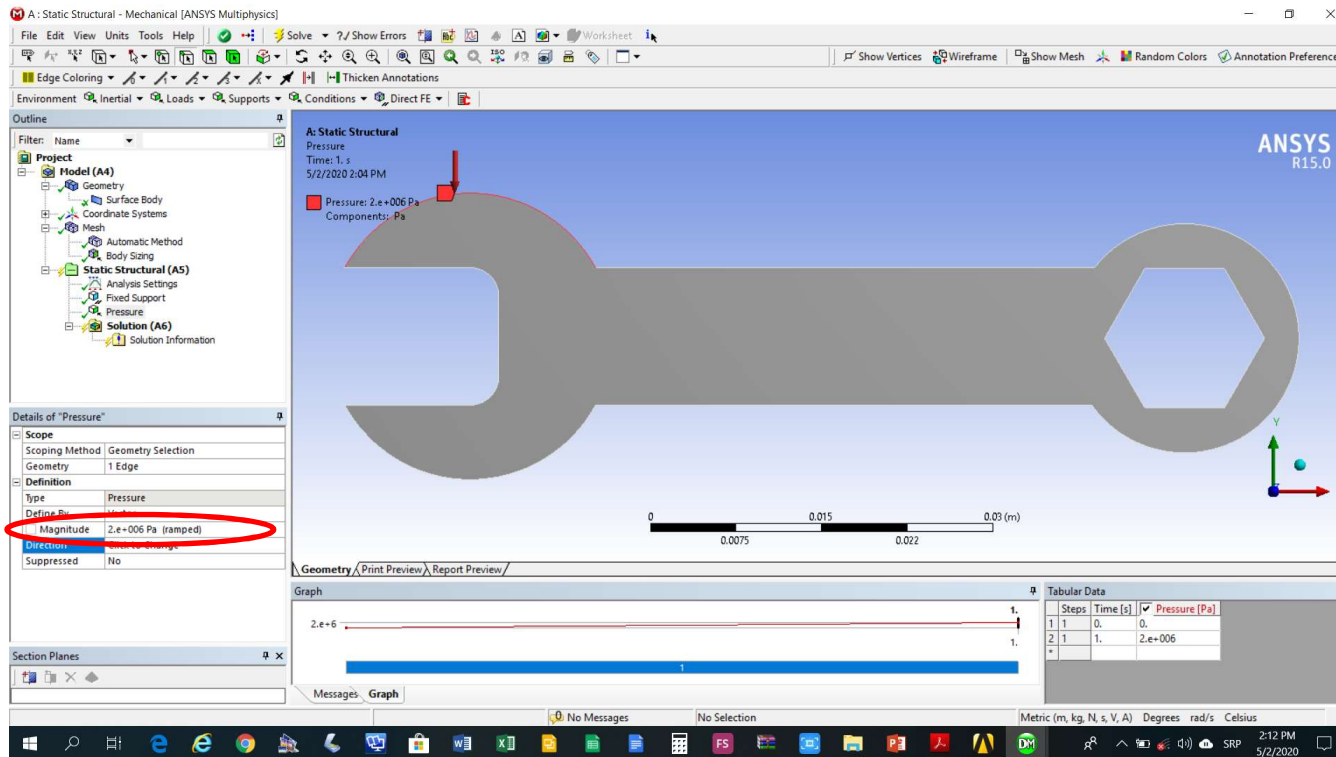
Modeliranje 2D problema

Zadavanje pravca pritiska (*Details of Pressure->Define by->Vector*) i (*Details of Pressure->Direction->Apply*)



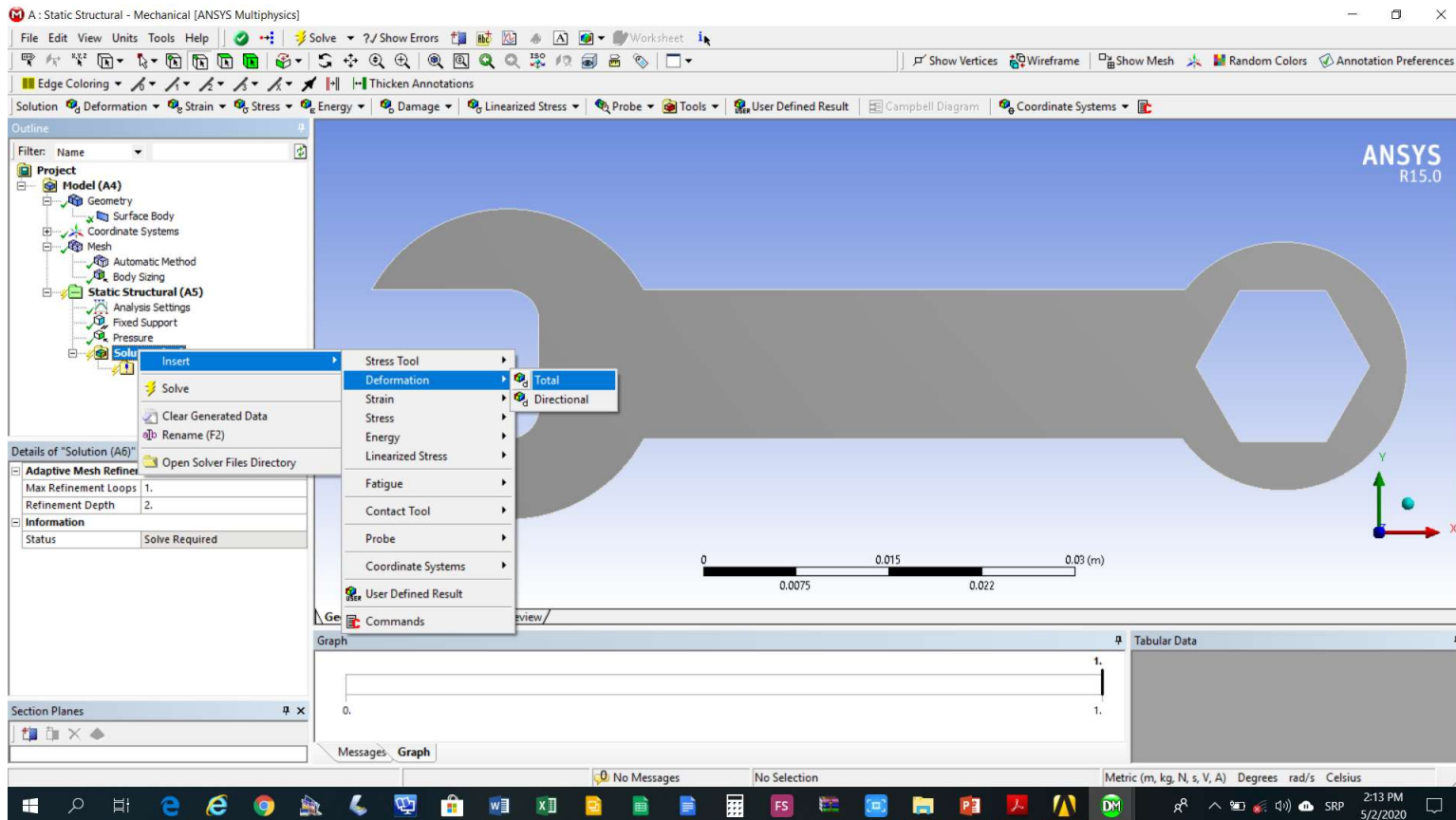
Modeliranje 2D problema

Zadavanje inteziteta pritiska, u polje *Details of Pressure*->*Magnitude* unijeti 2e6



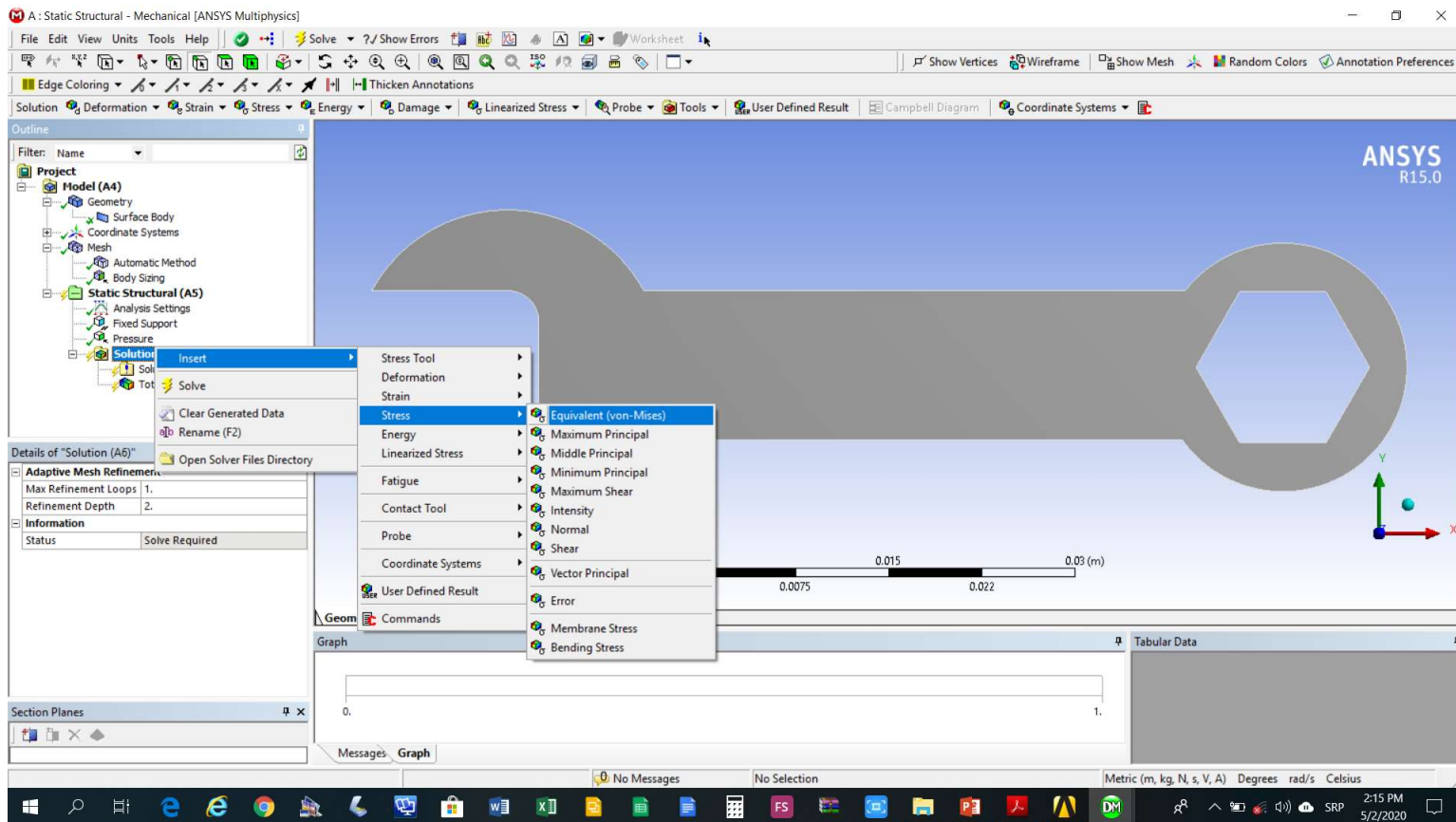
Modeliranje 2D problema

Izabrati analizu pomjeranja



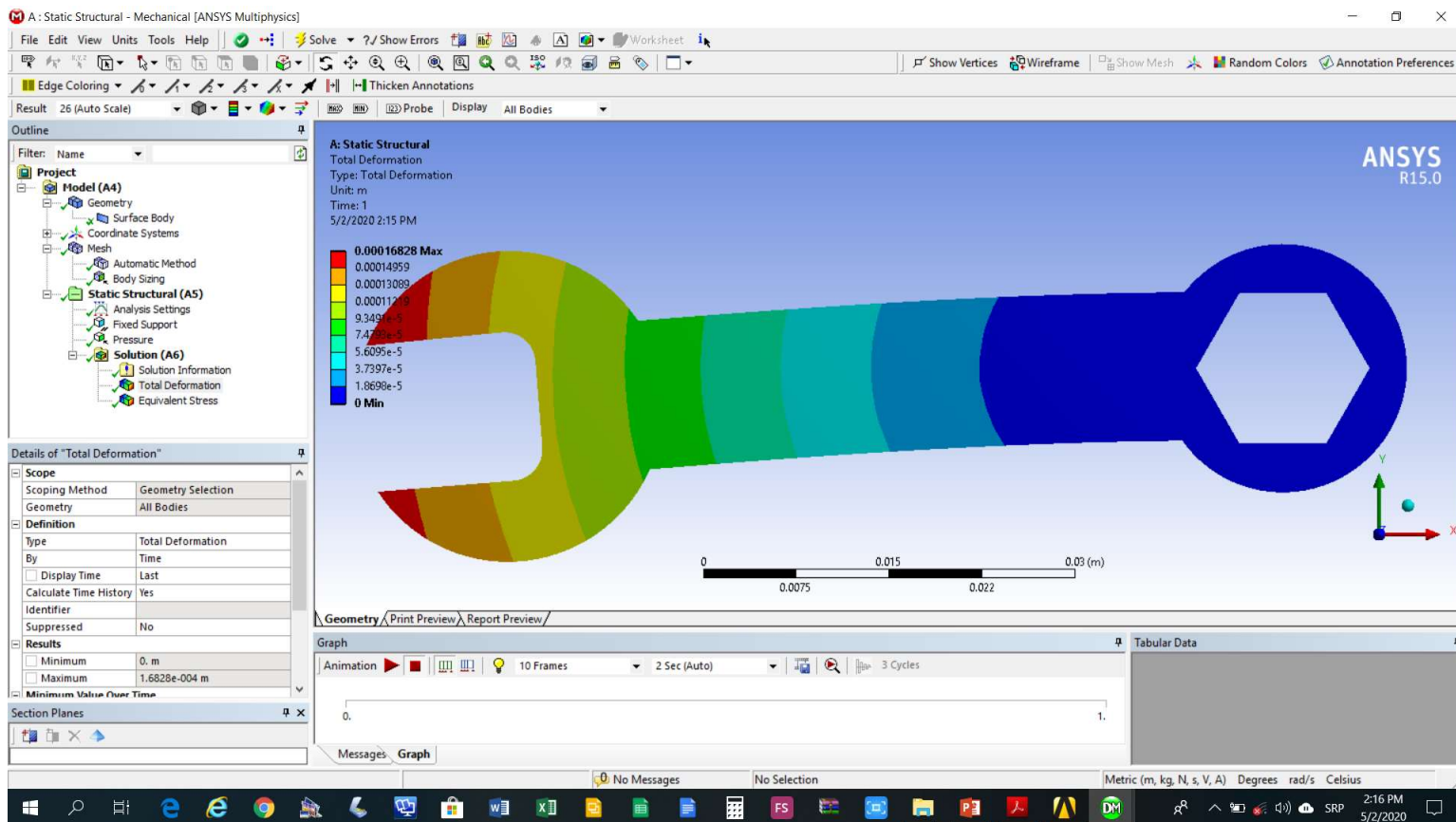
Modeliranje 2D problema

Izabrati analizu von Mises-ovih napona



Modeliranje 2D problema

Polje pomjeranja



Modeliranje 2D problema

Polje von Mises-ovih napona

