

Nedjelja 9

Modeliranje periodičnih vibracija mašinskog sklopa konačnim elementima

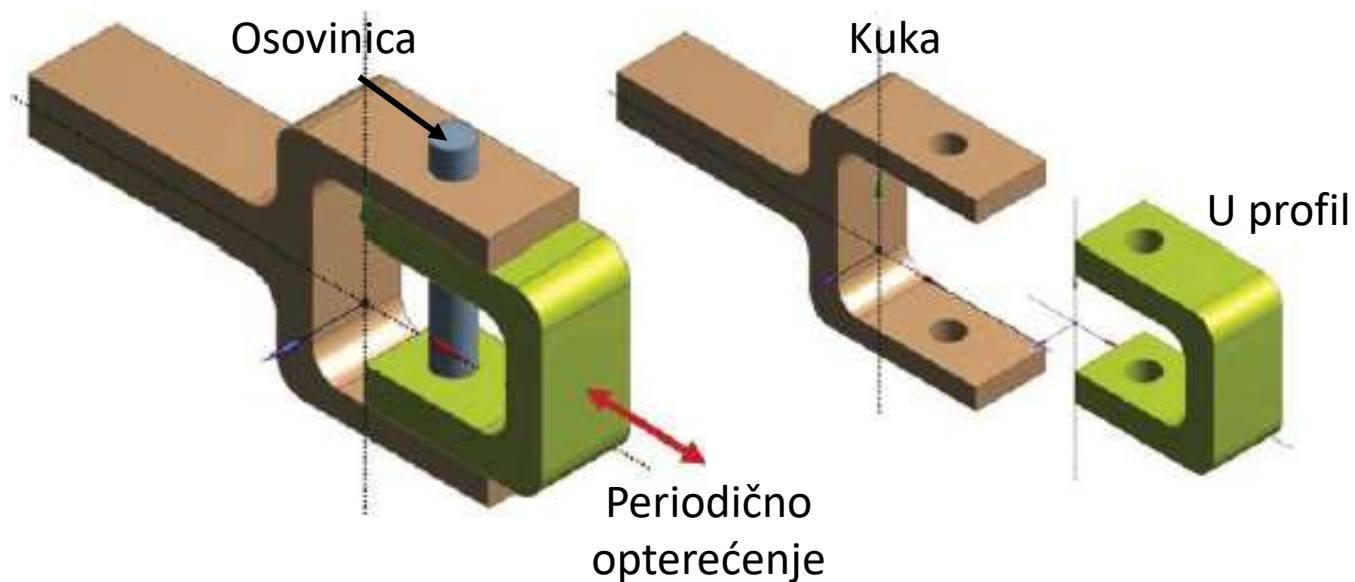
Postavka zadatka

Sklop na slici se sastoji od kuke, U profila i osovinice. Elementi sklopa su izrađeni od čelika ($E=200$ GPa, $\nu=0.3$, $\rho=7850$ kg/m³). Kontakte elemenata u sklopu modelirati kao kontakte koji onemogućavaju razdvajanje, ali omogućavaju međusobno klizanje bez trenja kontaktnih površina. Odrediti prvih 5 sopstvenih frekvencija i oblika oscilovanja sklopa i pomjeranja osovinice usled periodičnog opterećenja u pravcu dejstva opterećenja.

Postavka zadatka

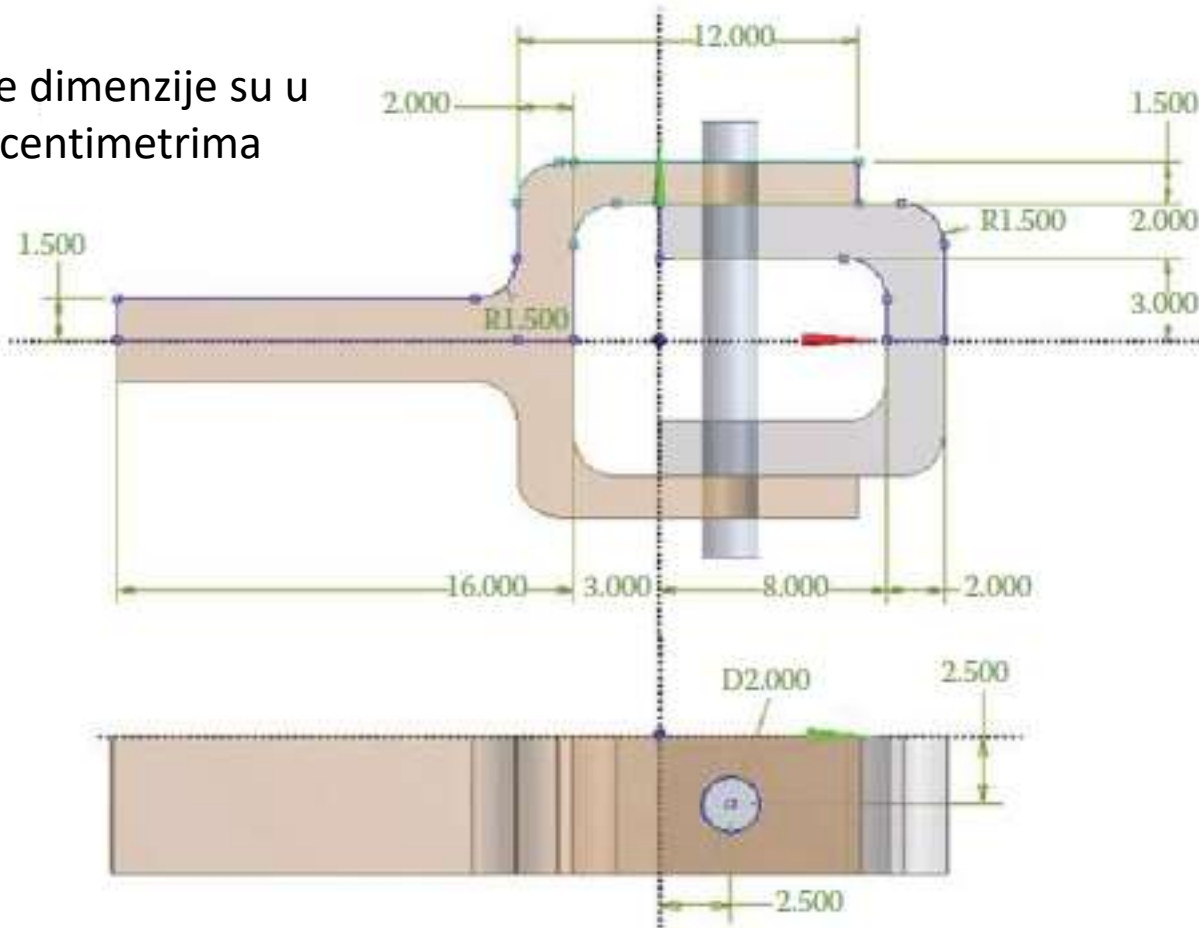
Granični uslovi: Nepokretni oslonci po krajnjoj lijevoj površini kuke

Opterećenje: Periodično opterećenje po krajanjoj desnoj površini U profila od 1 N/mm^2



Postavka zadatka

Sve dimenzije su u centimetrima

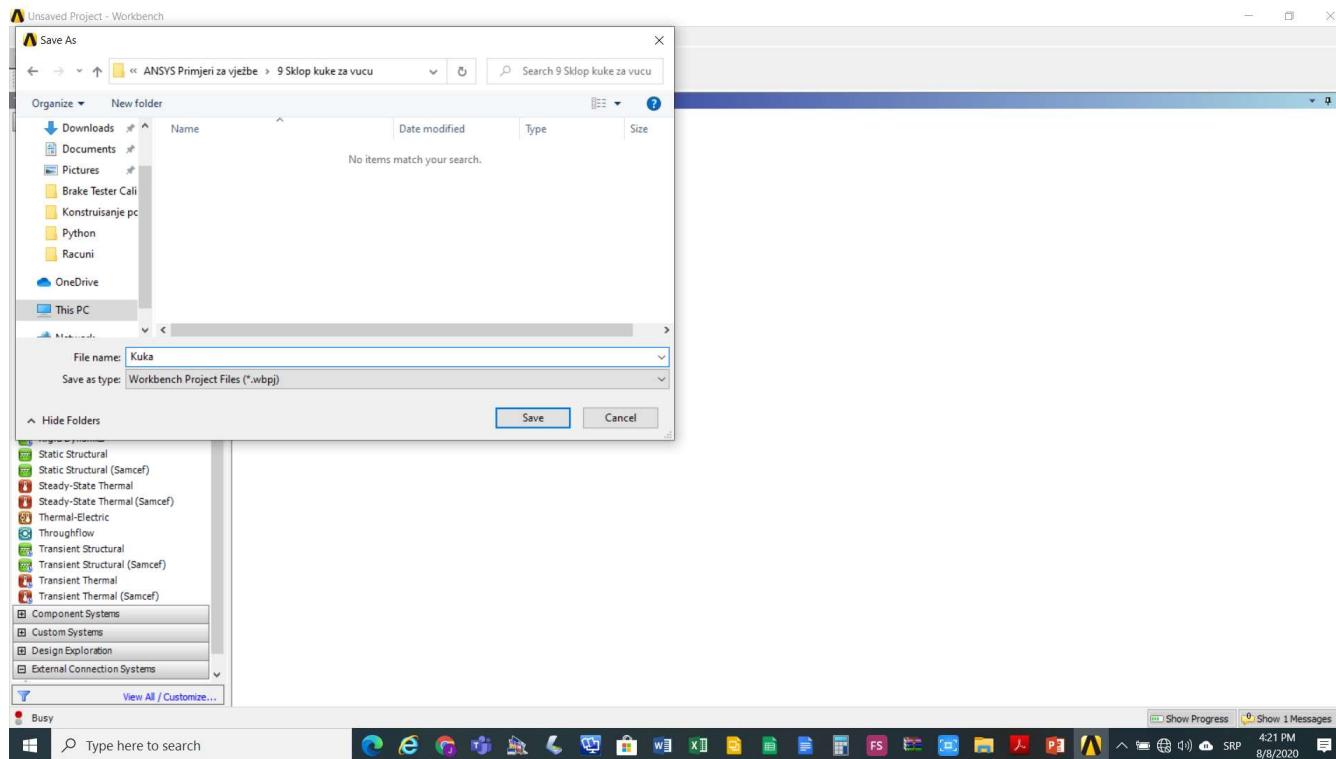


Kuka



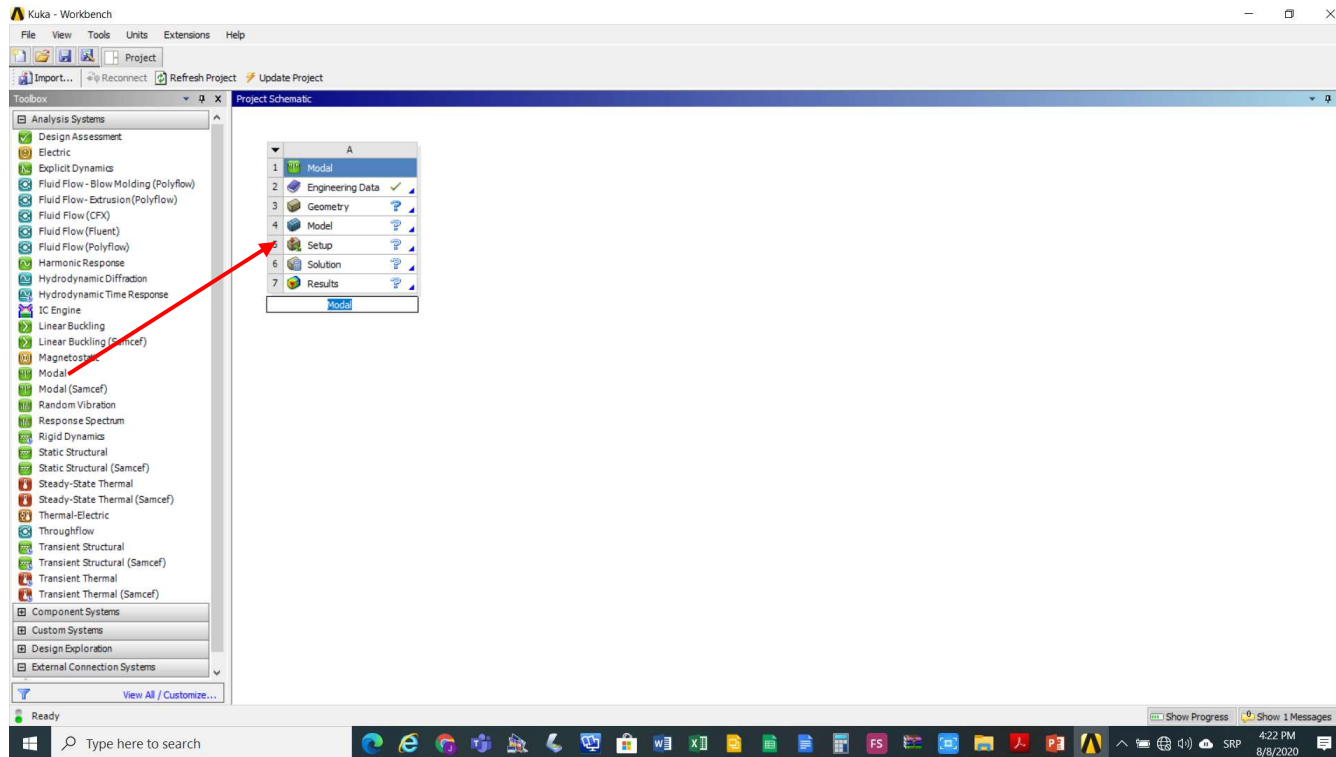
Modeliranje periodičnih vibracija

Aktivirati program ANSYS i sačuvati prazan projekat pod nazivom Kuka



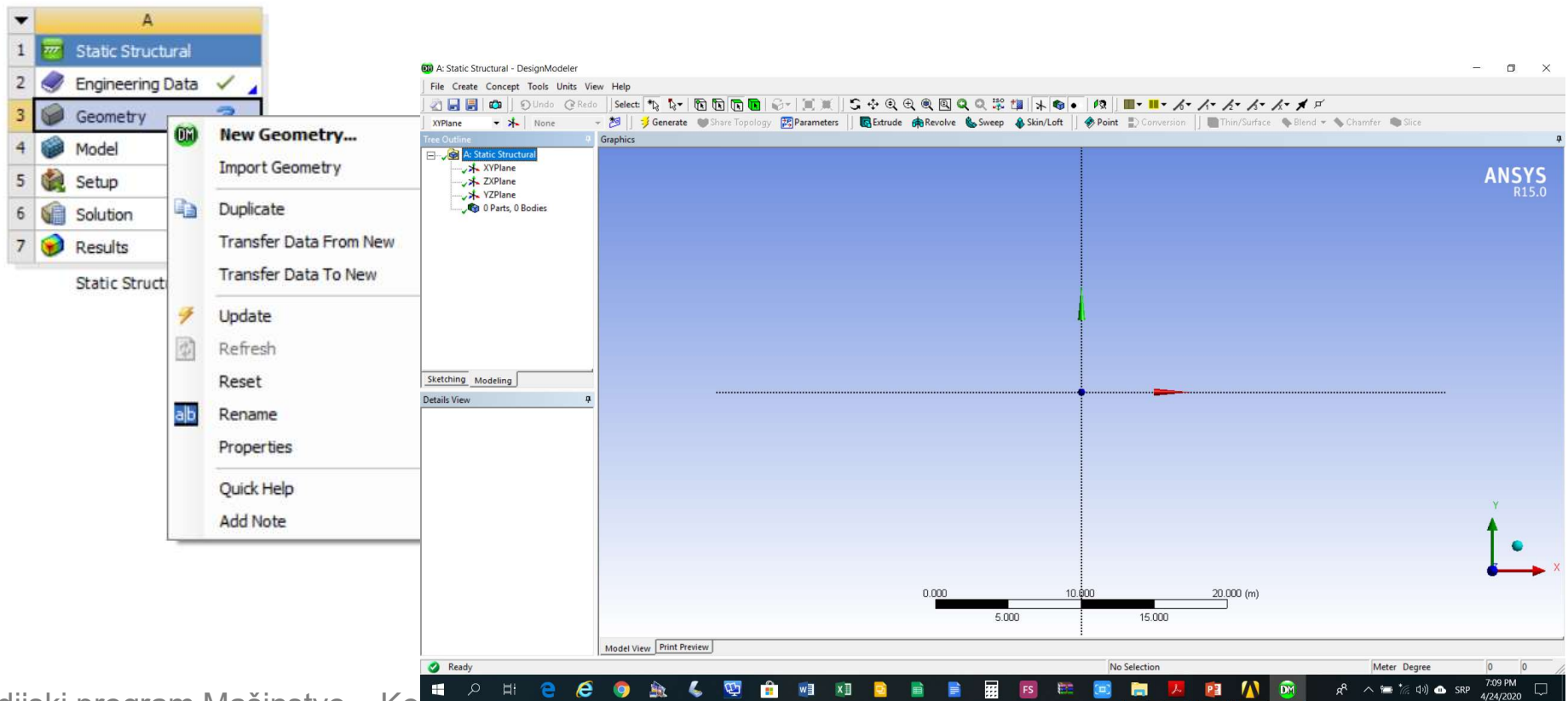
Modeliranje periodičnih vibracija

Kreirati modalnu analizu (*Modal*) na shemi projekta (*Project Schematic*)



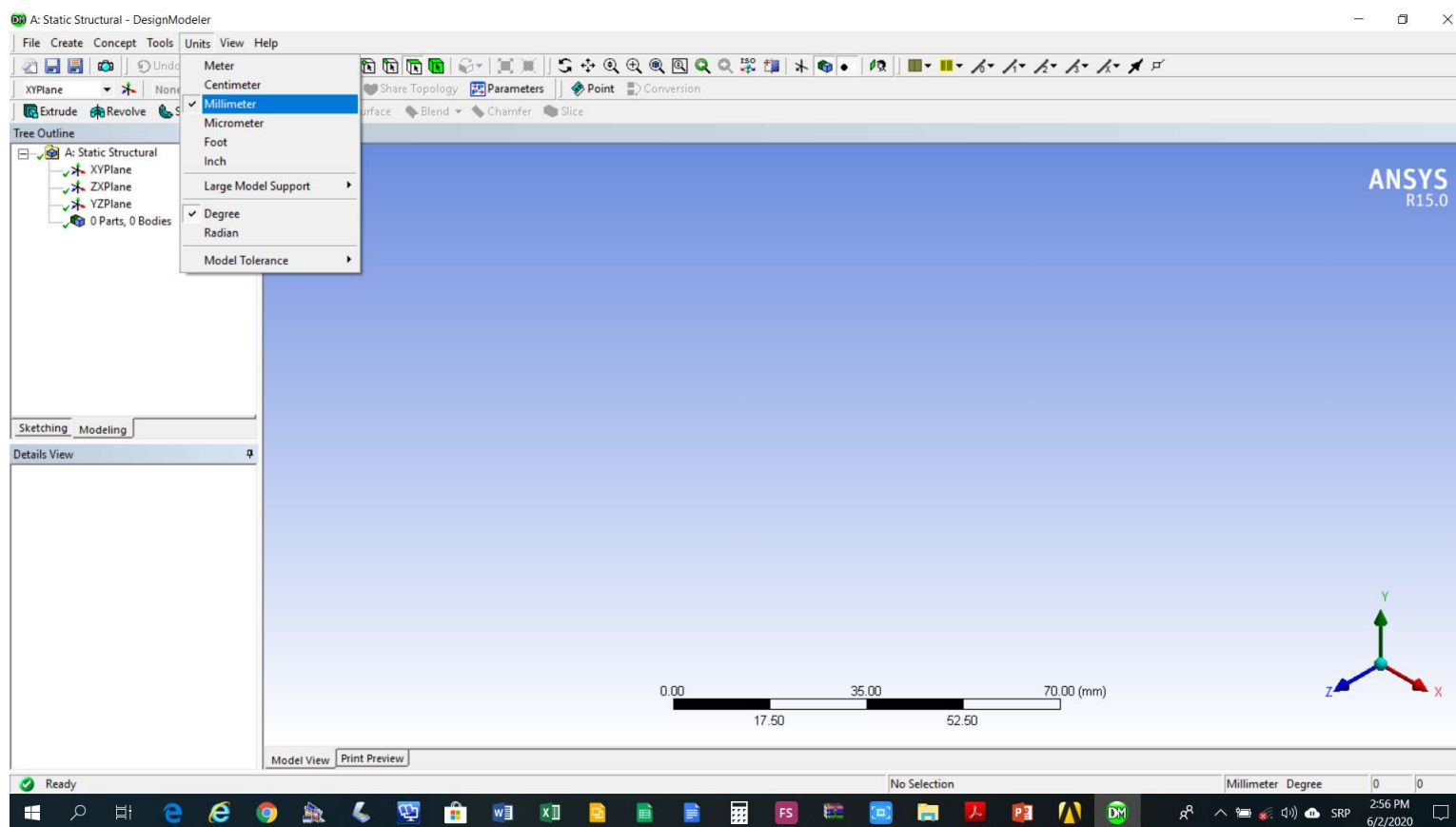
Modeliranje periodičnih vibracija

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



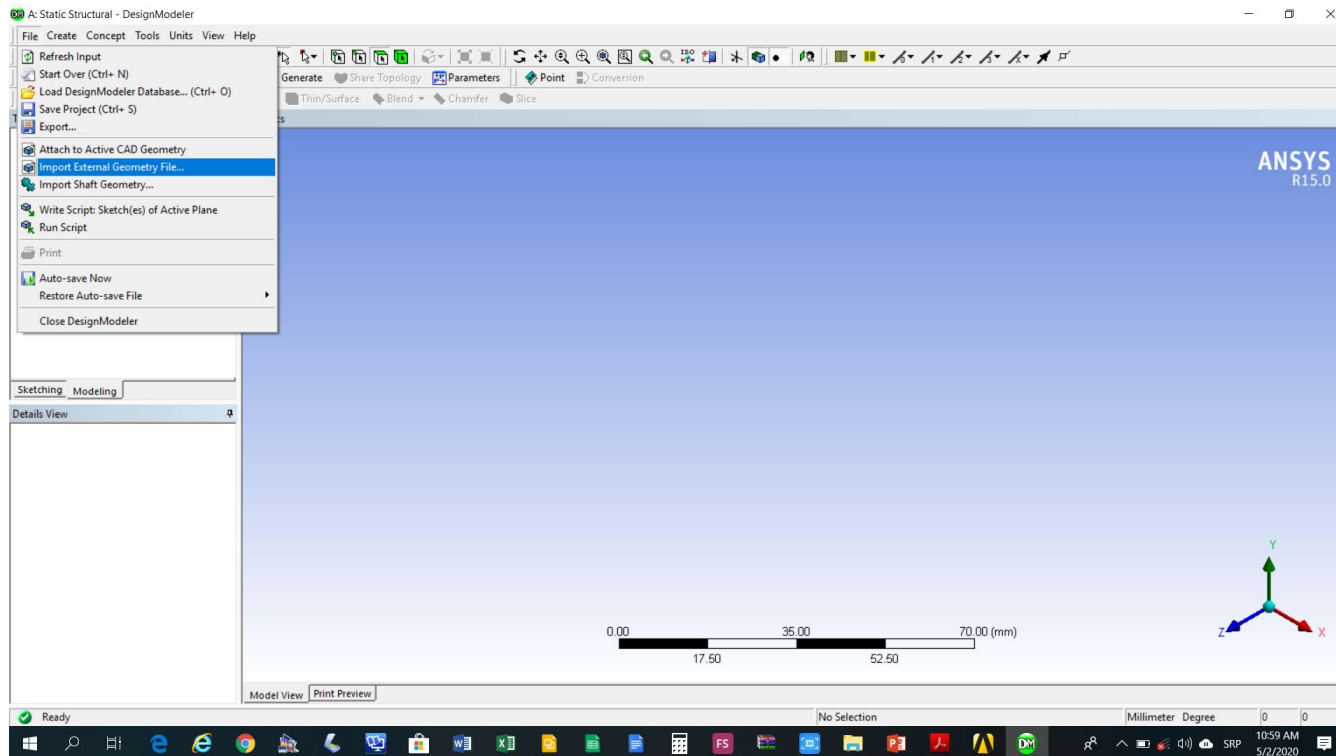
Modeliranje periodičnih vibracija

Podesiti dužinske jedinice (Units->Milimeter)



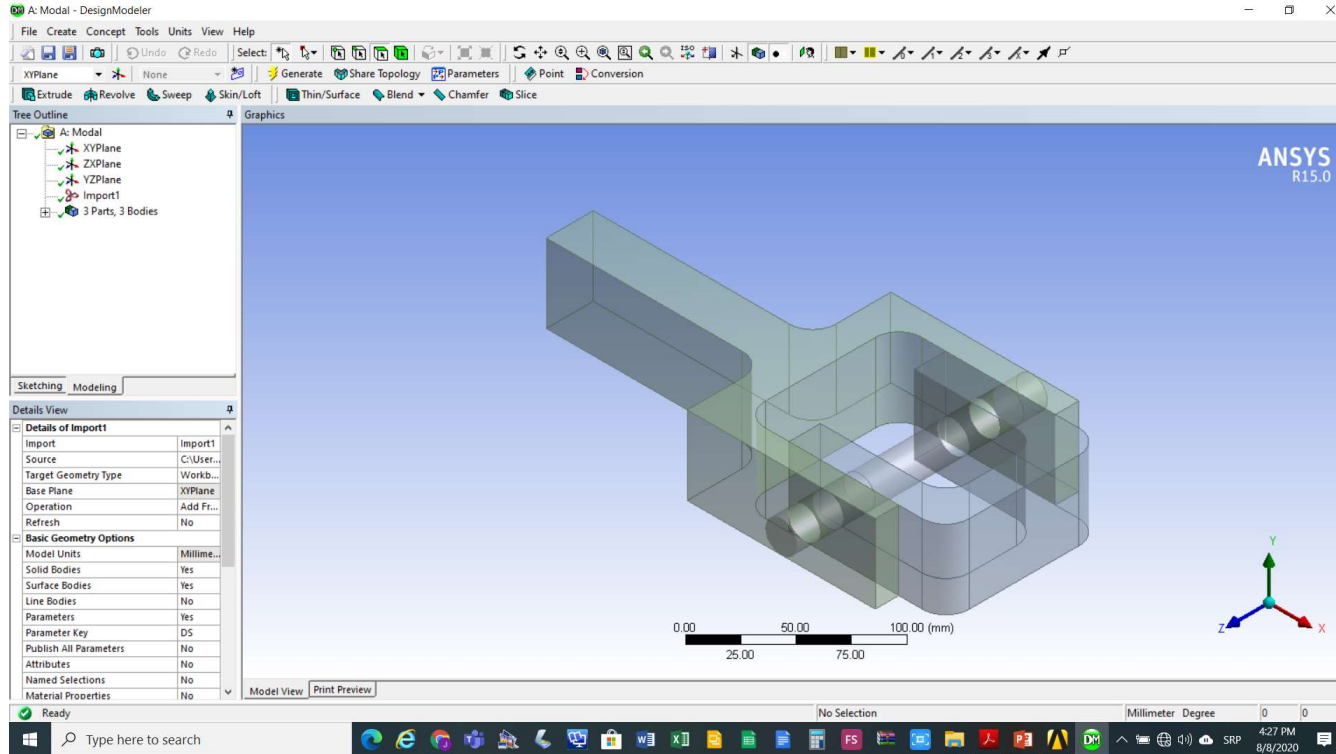
Modeliranje periodičnih vibracija

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



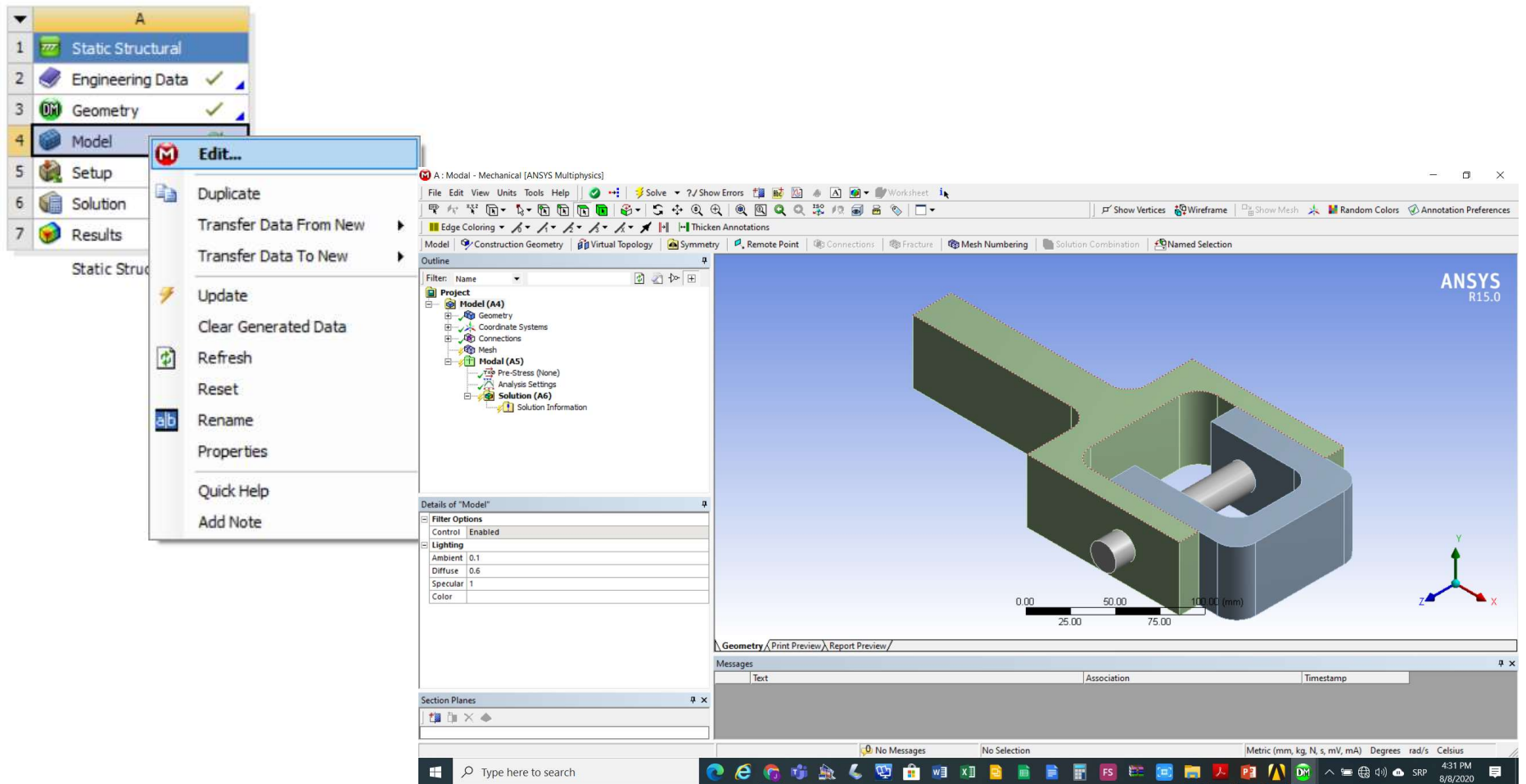
Modeliranje periodičnih vibracija

Učitavanje eksterno generisane geometrije
okončati komandom *Generate*



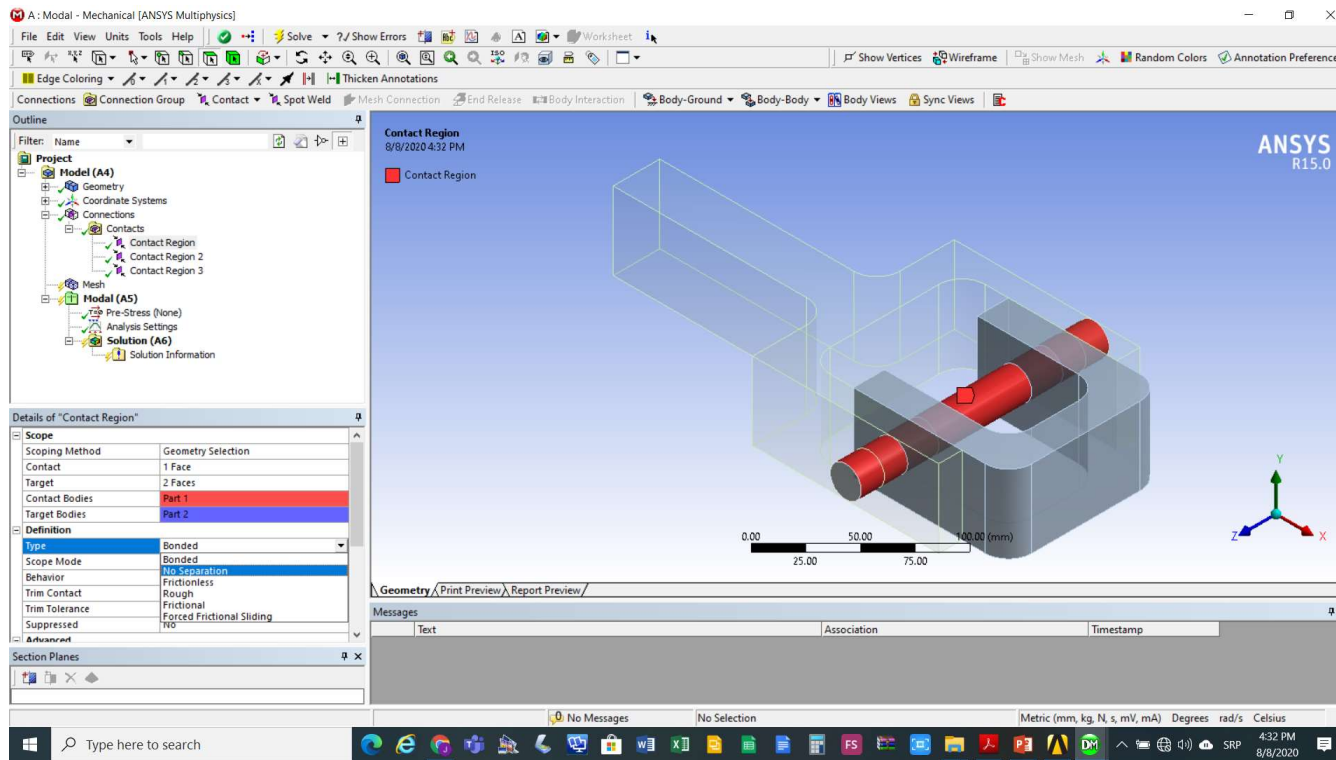
Modeliranje periodičnih vibracija

Aktivirati modul Modal (*Model*->*Edit*)



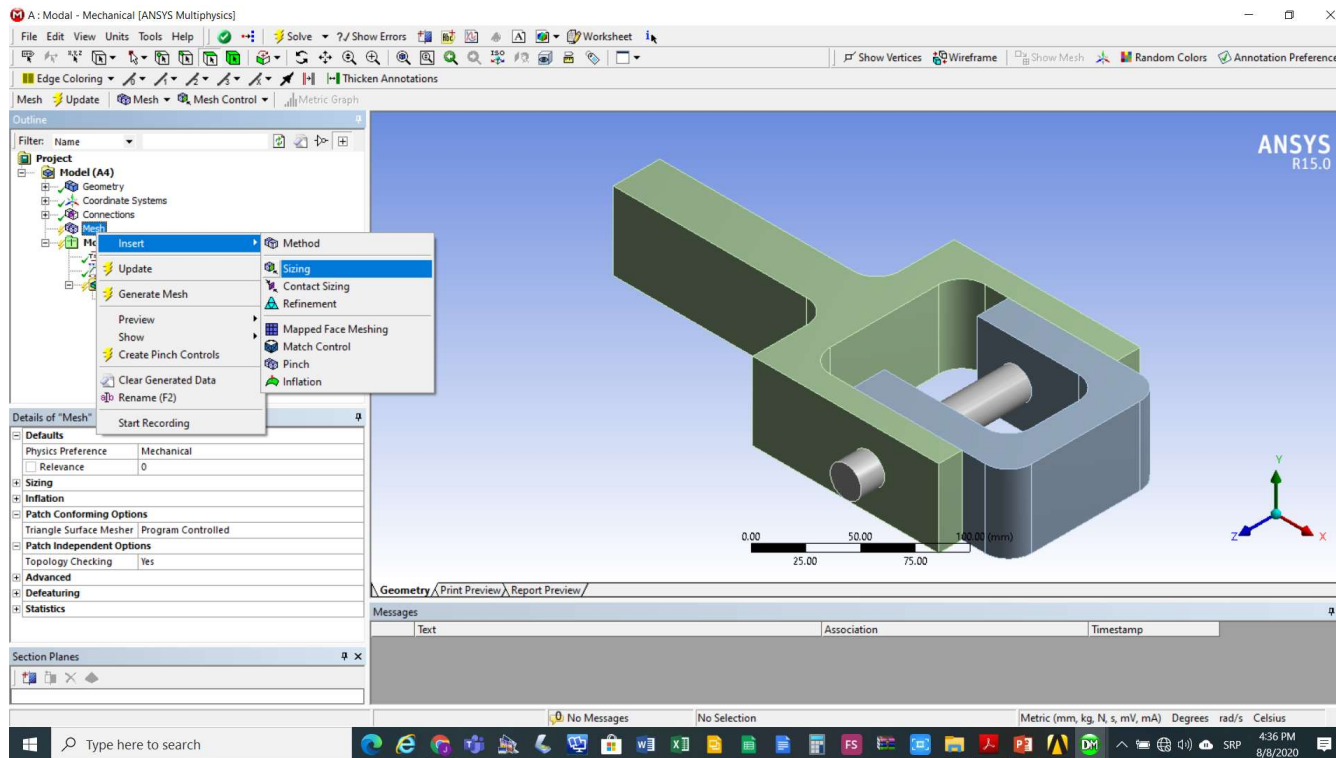
Modeliranje periodičnih vibracija

Podesiti sve automatski detektovane kontakte
Details of Contact Region->*Definition*->*Type*->*No Separation*



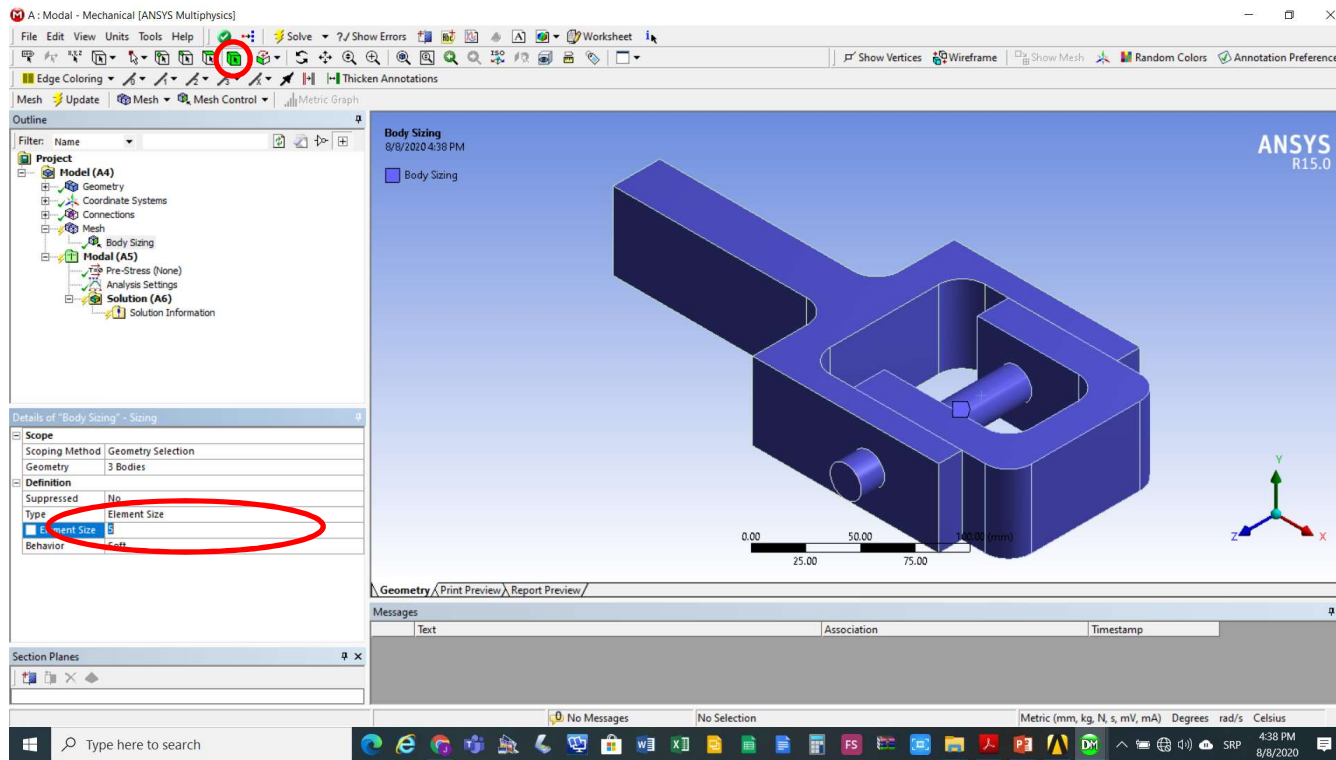
Modeliranje periodičnih vibracija

Definisati veličinu konačnih elemenata *Mesh->Insert->Sizing*



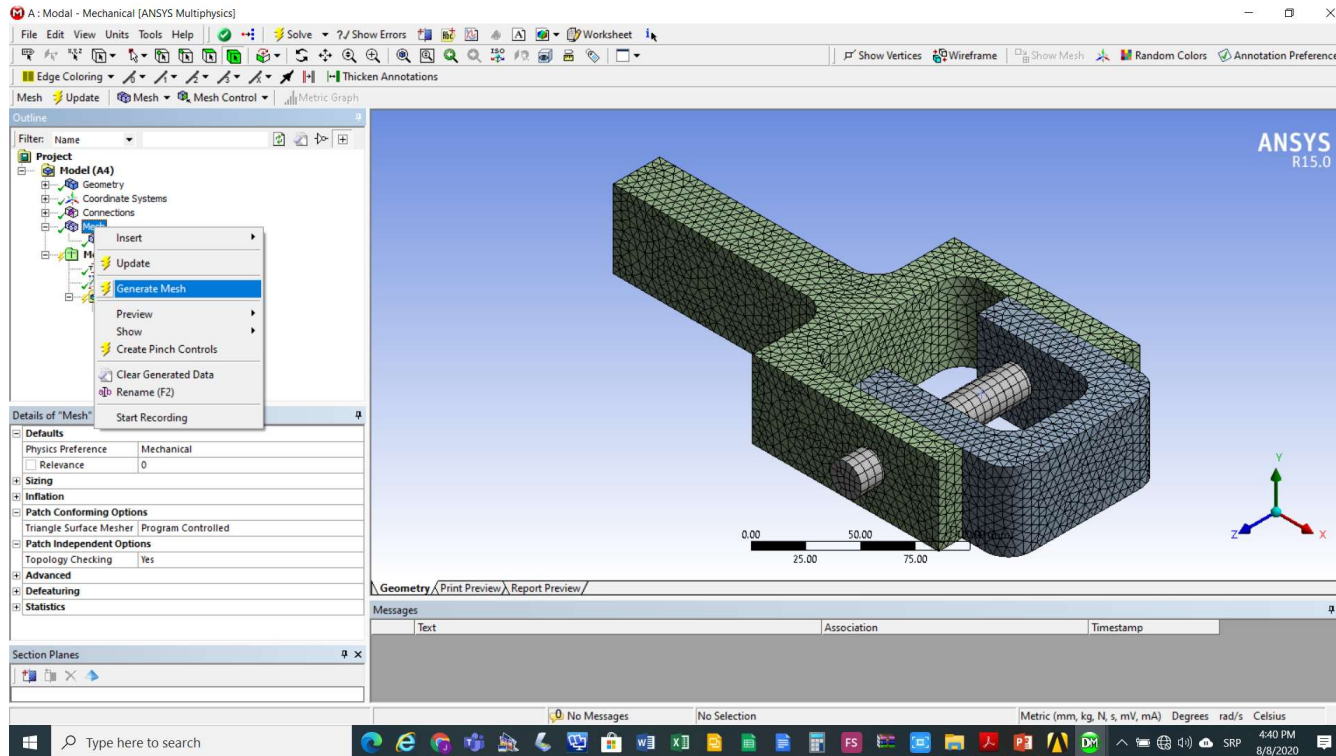
Modeliranje periodičnih vibracija

U polje *Details of Sizing*->*Element Size* unijeti 5 mm. Izabrati sva tri tijela i aktivirati *Details of Sizing*->*Geometry*->*Apply*



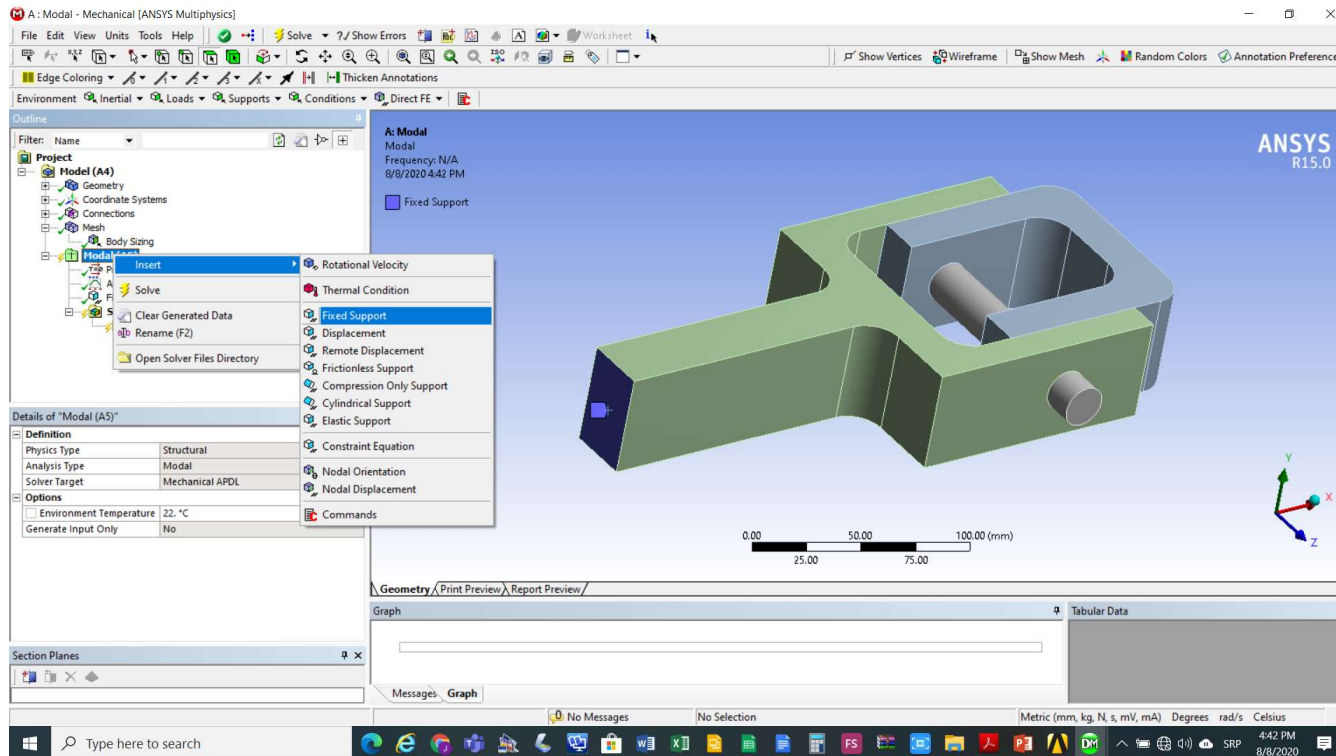
Modeliranje periodičnih vibracija

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



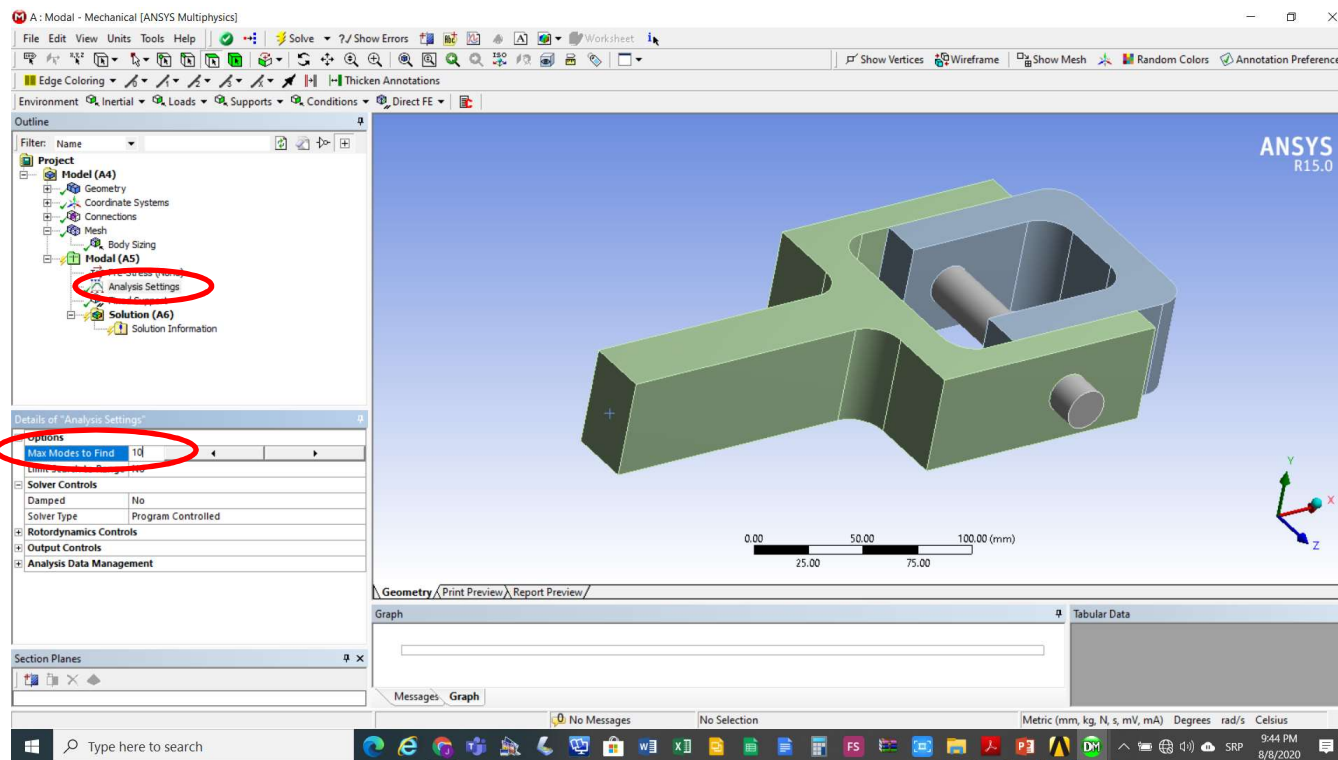
Modeliranje periodičnih vibracija

Dodati nepokretni oslonac na krajnju lijevu površine kuke *Modal->Insert->Fixed Support*



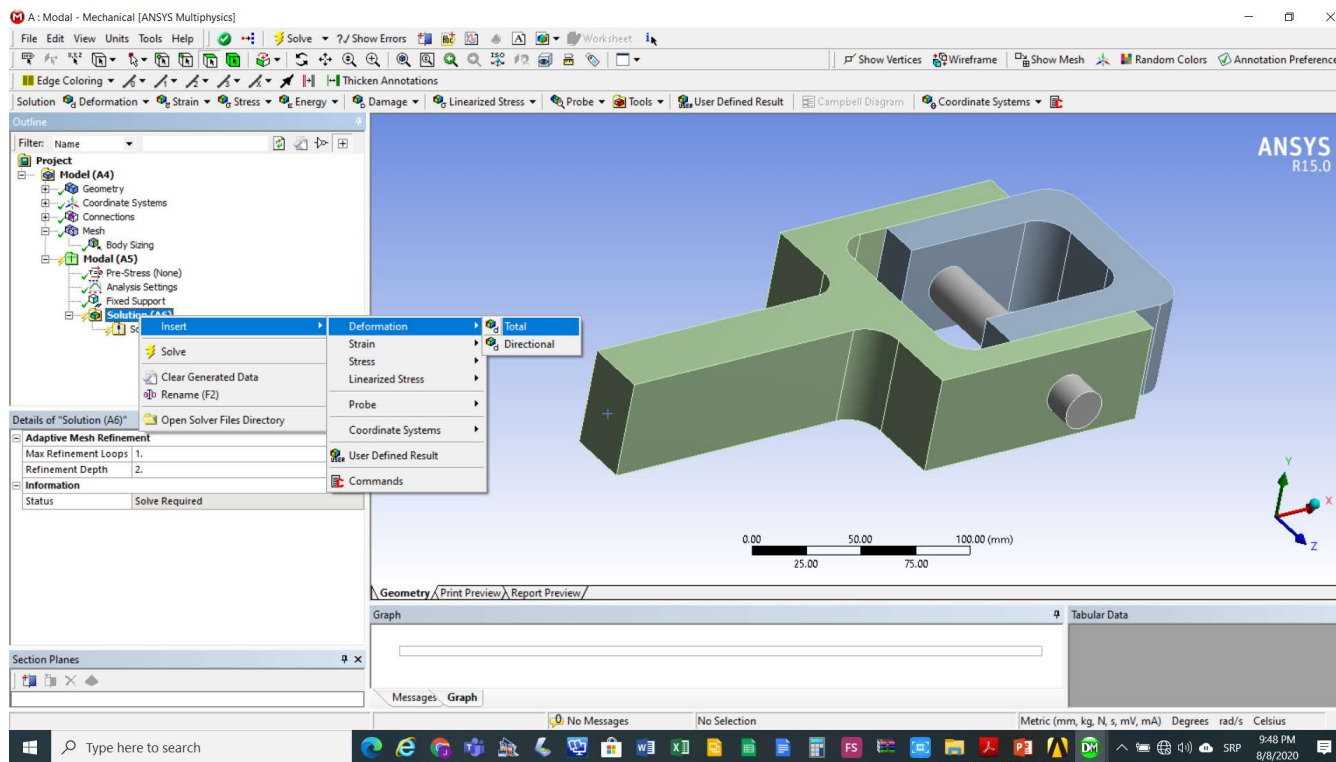
Modeliranje periodičnih vibracija

Podesiti broj sopstvenih frekvencija i oblika oscilovanja koje treba odrediti u polju *Details of Analysis Settings*->*Max Modes to Find* na 5



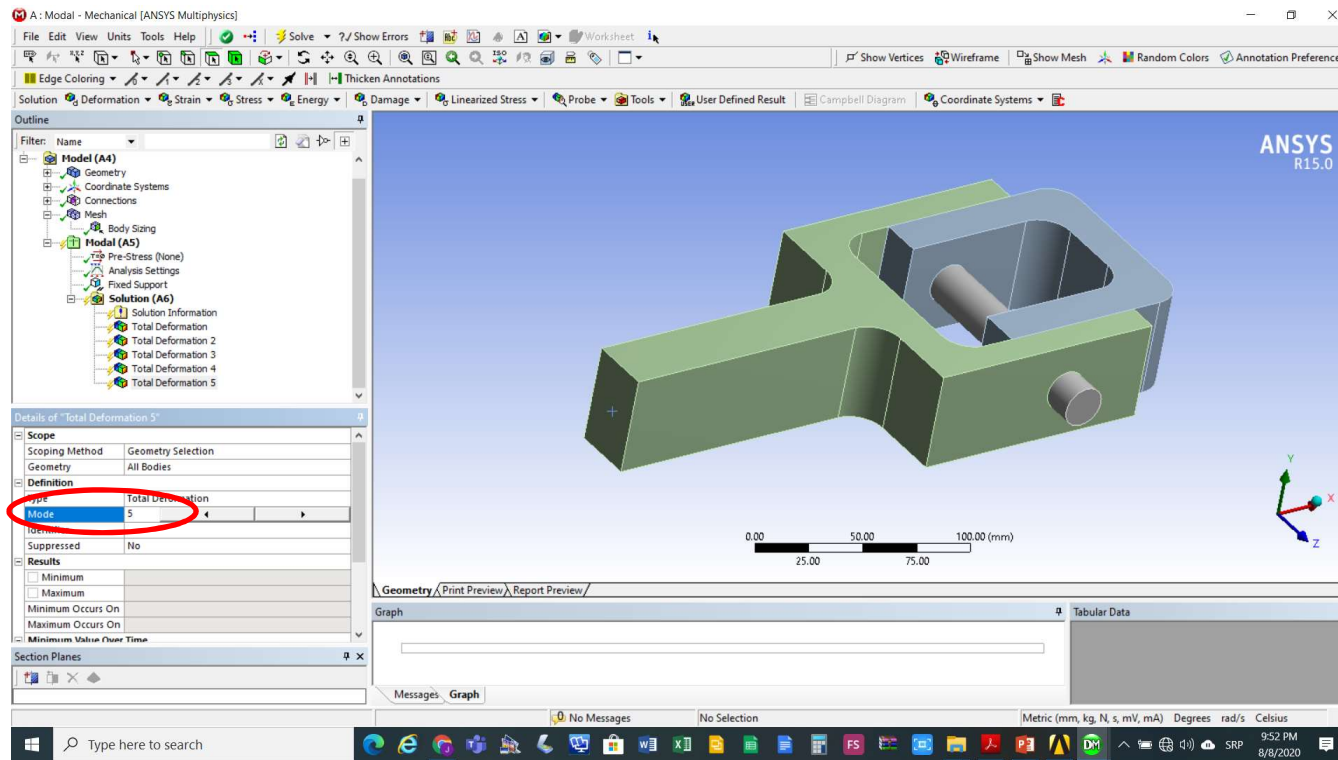
Modeliranje periodičnih vibracija

Izabrati opciju za određivanje oblika oscilovanja koja se želi realizovati *Solution->Insert->Total Deformation*



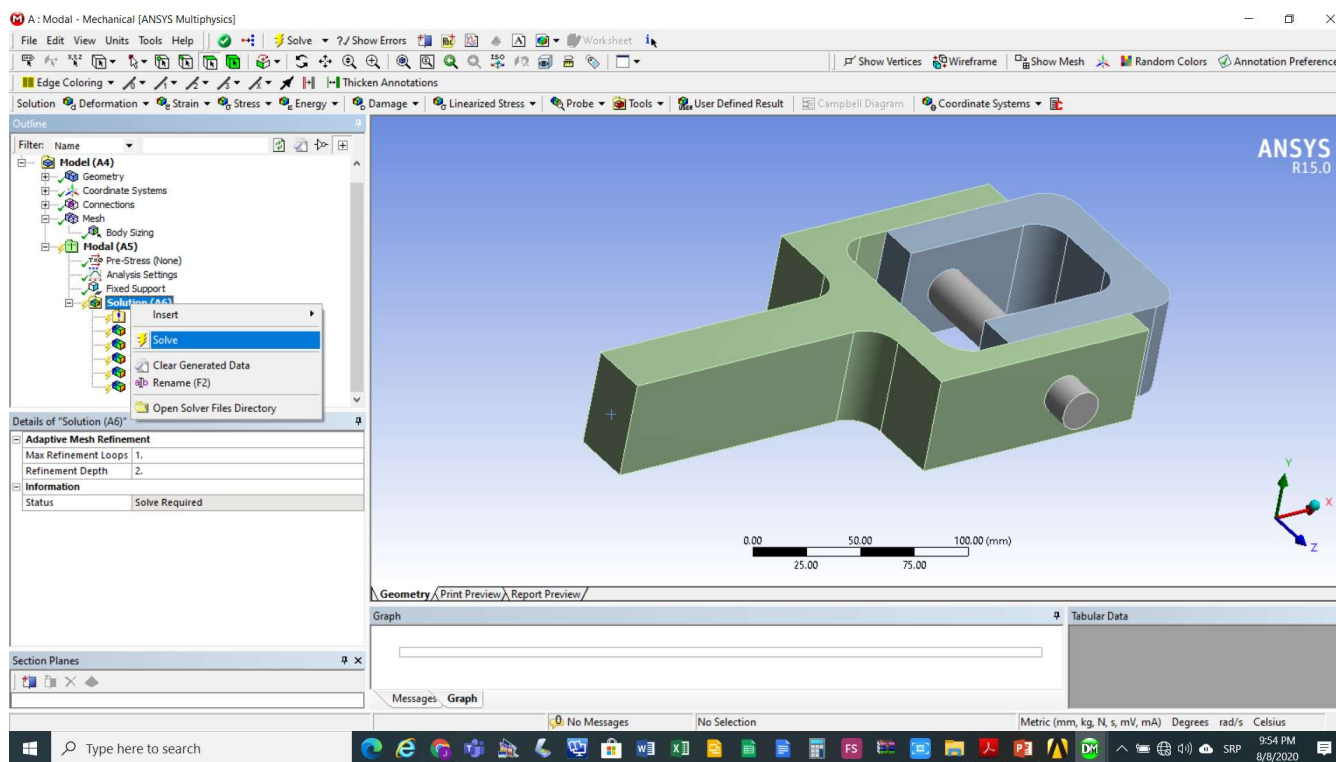
Modeliranje periodičnih vibracija

Podesiti oblike oscilovanja koji treba odrediti u poljima *Details of Total Deformation*->*Modes* na vrijednosti od 1 do 5



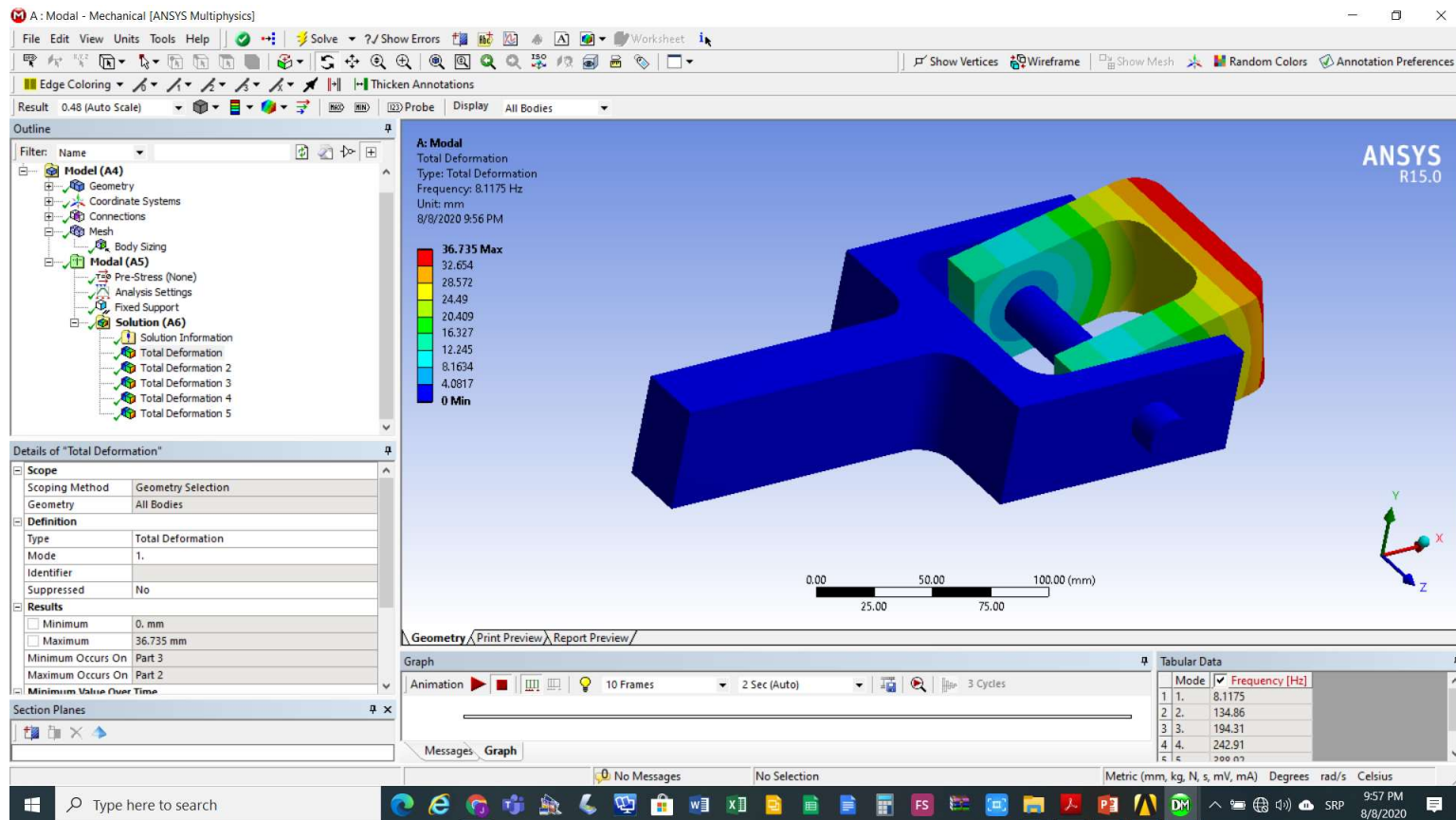
Modeliranje periodičnih vibracija

Aktivirati izvršenje analize *Solution*->*Solve*



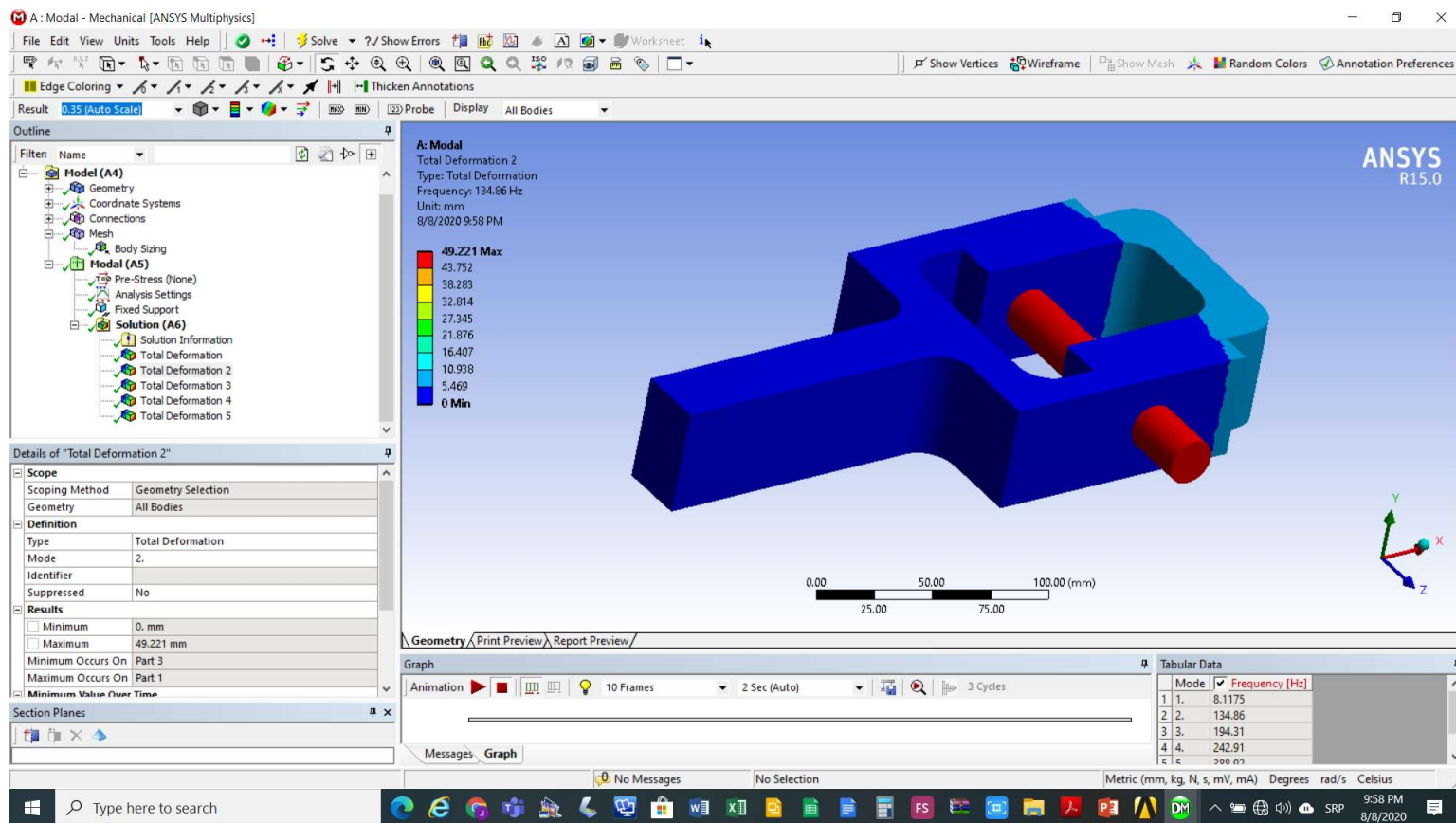
Modeliranje periodičnih vibracija

Prva sopstvena frekvencija i oblik oscilovanja



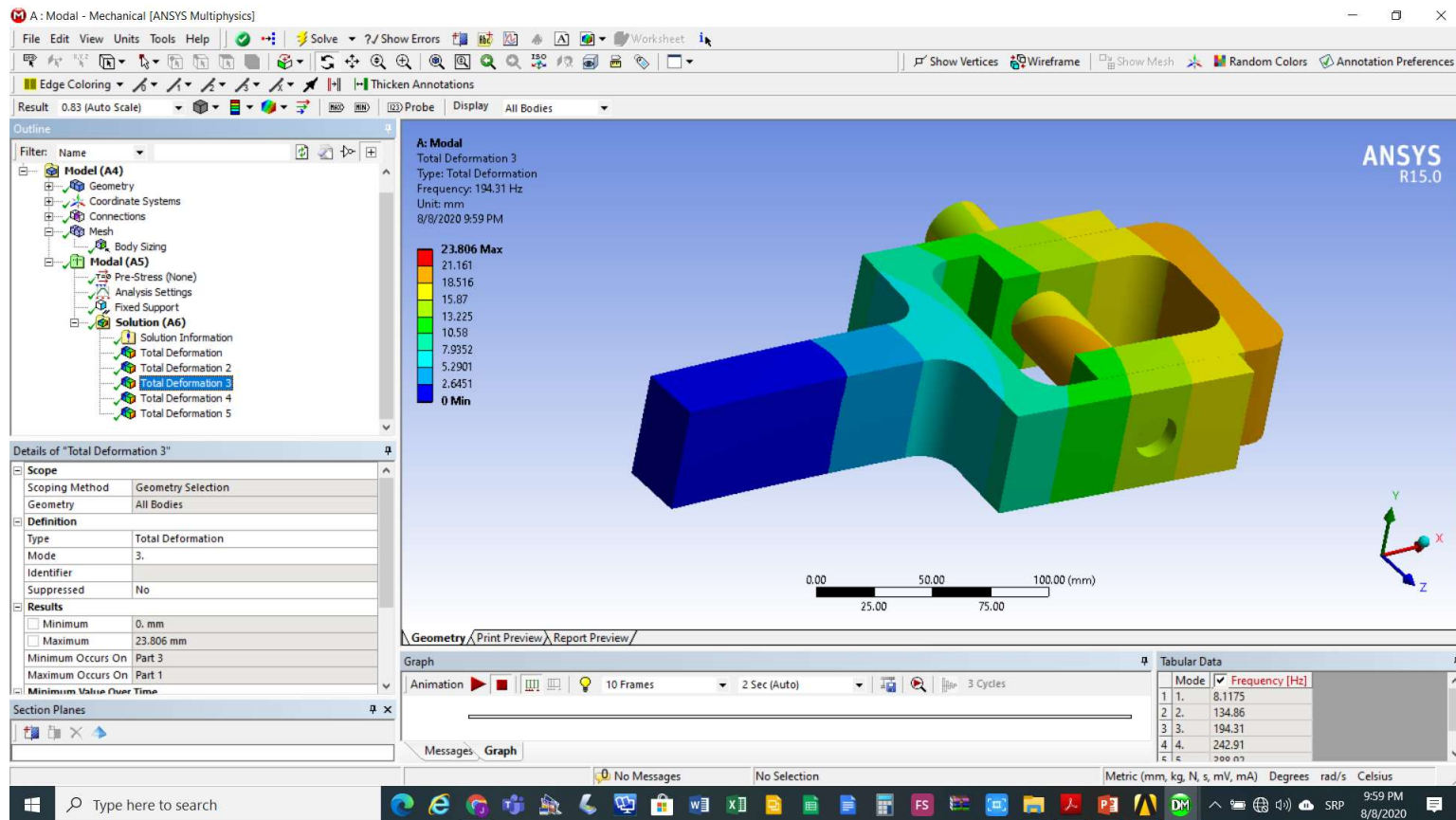
Modeliranje periodičnih vibracija

Druga sopstvena frekvencija i oblik oscilovanja



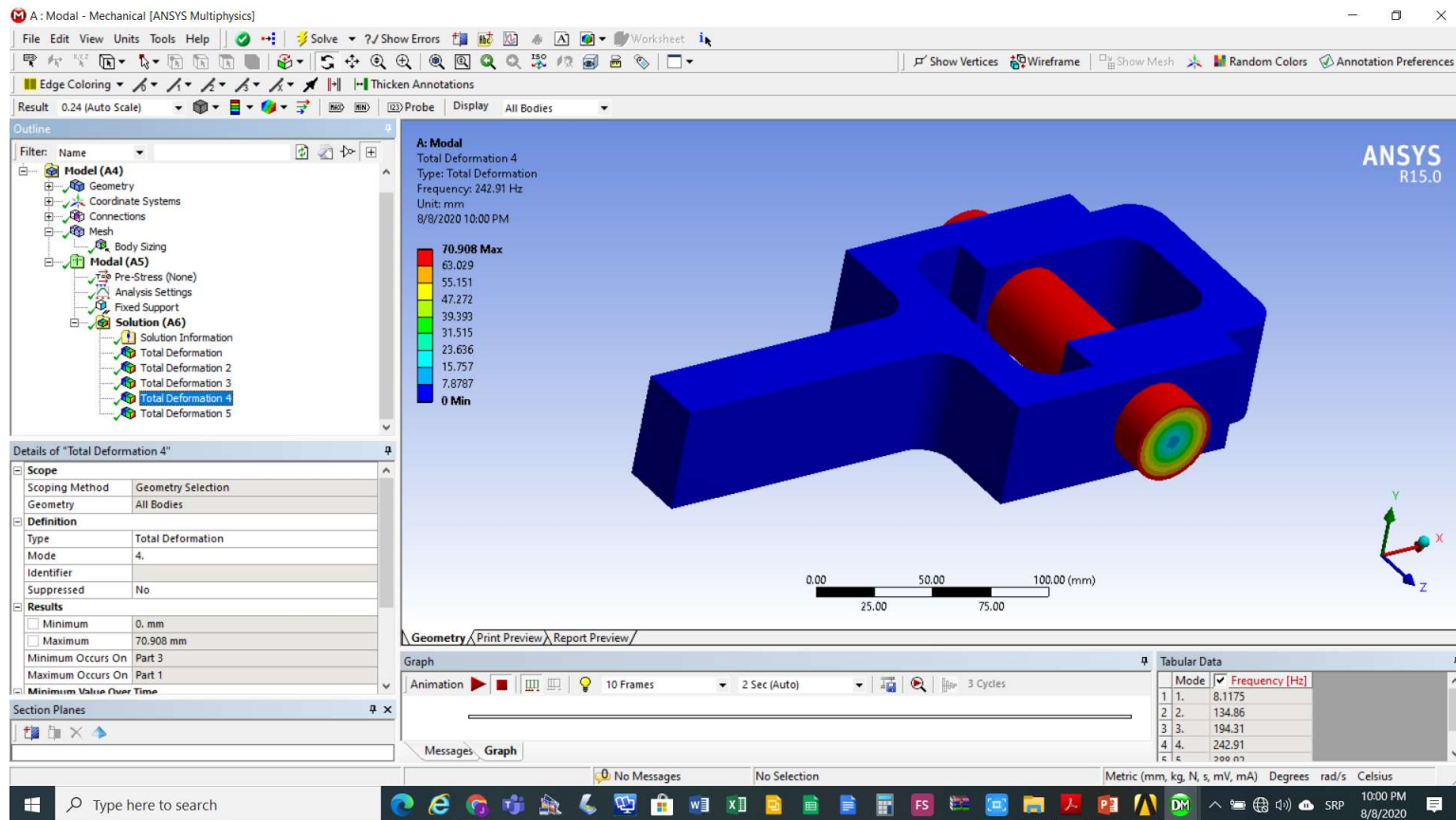
Modeliranje periodičnih vibracija

Treća sopstvena frekvencija i oblik oscilovanja



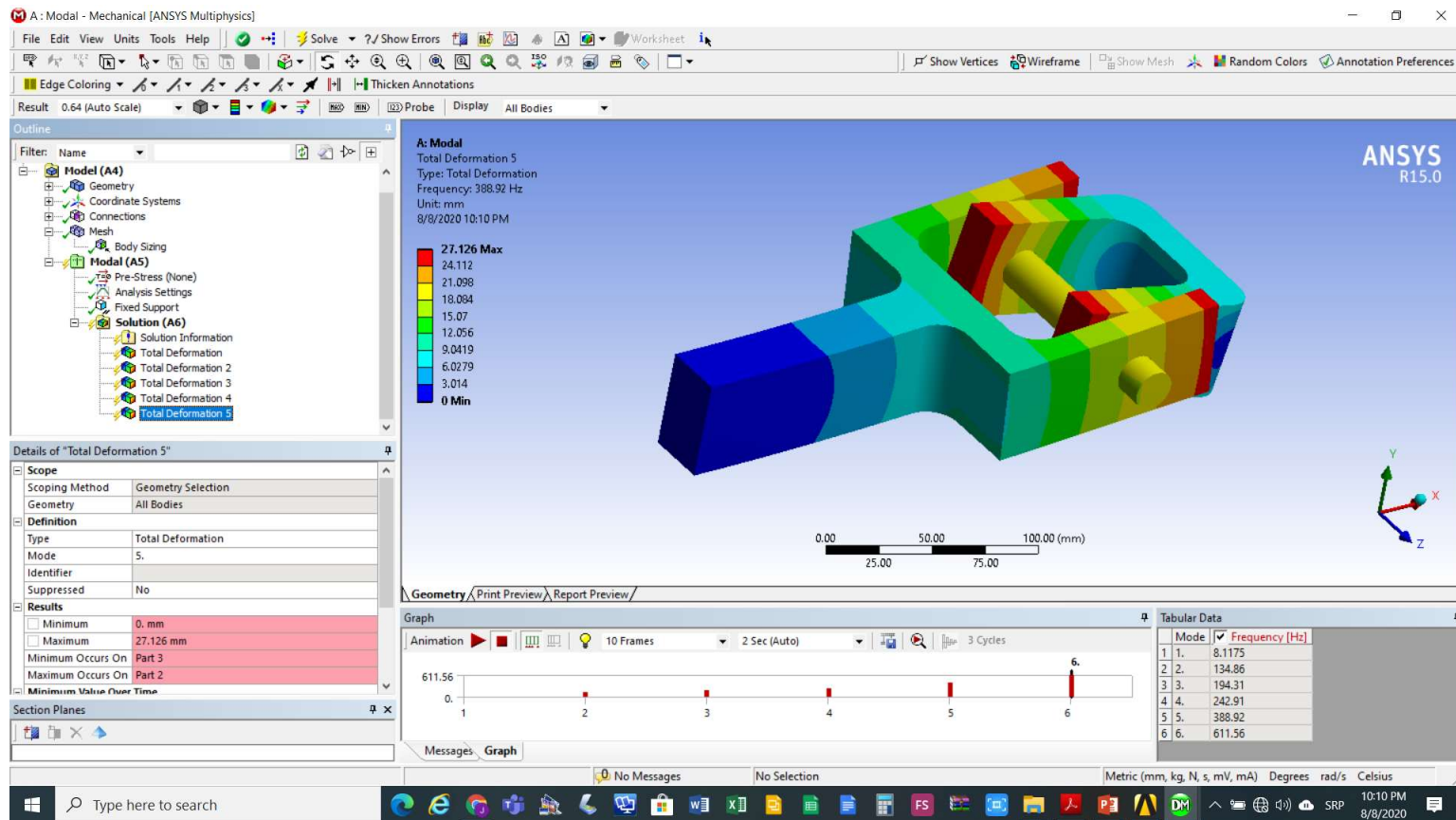
Modeliranje periodičnih vibracija

Četrta sopstvena frekvencija i oblik oscilovanja



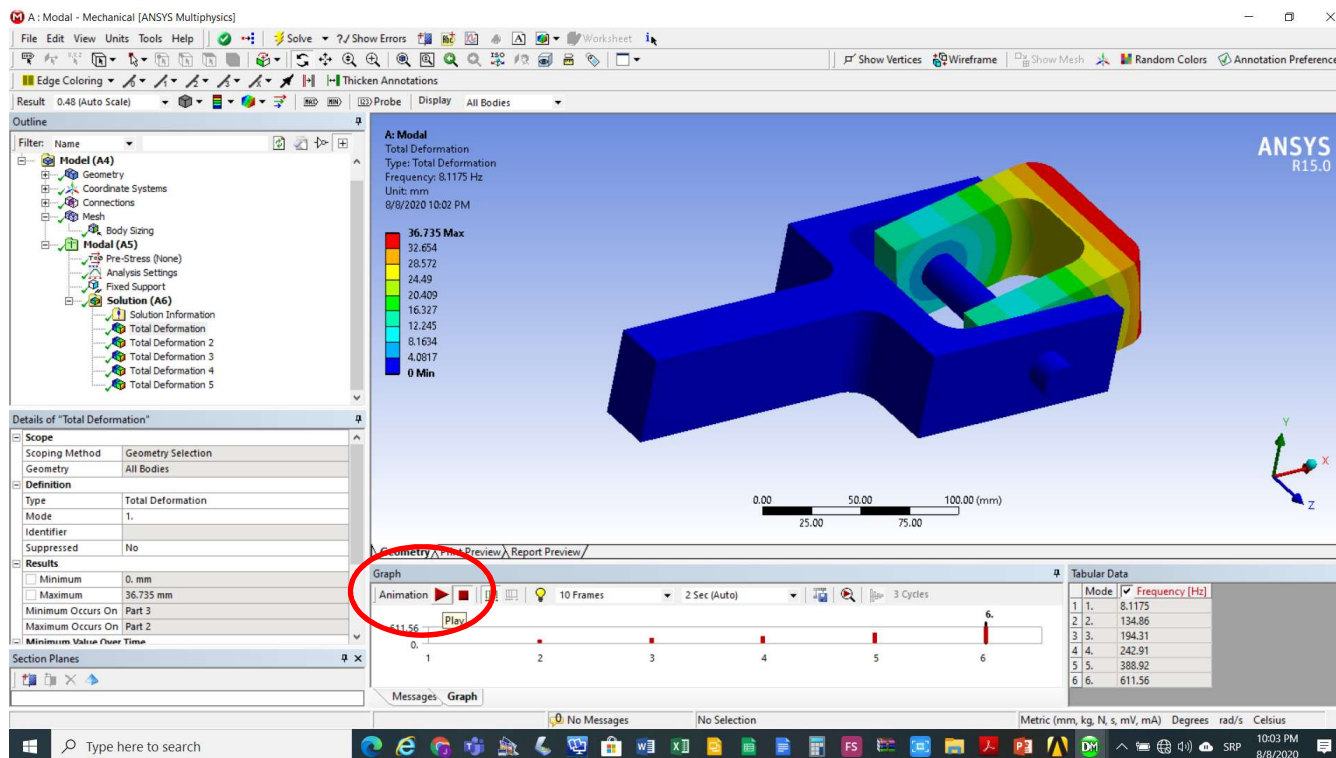
Modeliranje periodičnih vibracija

Peta sopstvena frekvencija i oblik oscilovanja



Modeliranje periodičnih vibracija

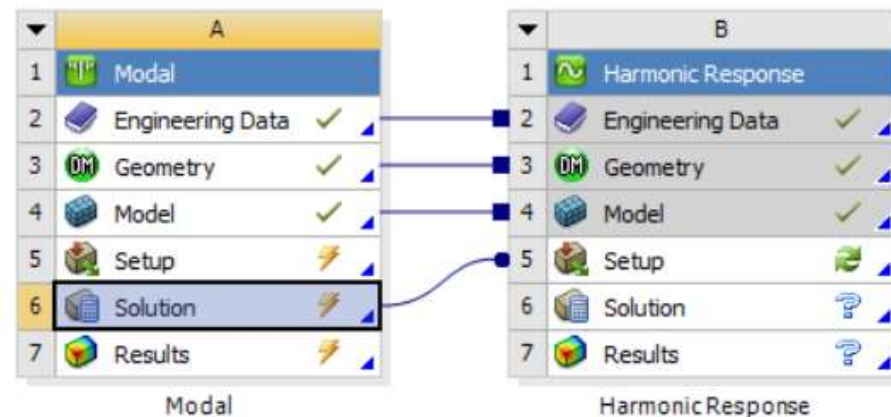
Simulacija oscilovanja na izabranoj sopstvenoj frekvenciji



Simulacija.avi (Command Line)

Modeliranje periodičnih vibracija

Napustiti modalnu analizu, a potom kreirati harmonijsku analizu izborom opcije *Transfer to Harmonic Analysis* sa padajućeg menija modalne analize čim se istovremeno uspostavljaju i veze modalne sa harmonijskom analizom



Modeliranje periodičnih vibracija

Aktivirati modul Multiple System (*Setup*->*Edit*)

The screenshot displays the ANSYS Multiphysics software interface. On the left, the 'Setup' menu is open, showing options like 'Duplicate', 'Transfer Data From New', 'Update', 'Refresh', 'Reset', 'Rename', 'Properties', 'Quick Help', and 'Add Note'. The main window shows a 3D model of a mechanical part with a scale bar (0.00 to 100.00 mm). The 'Outline' panel on the left lists the model hierarchy, including 'Mesh', 'Modal (A5)', 'Solution (A6)', and 'Harmonic Response (B5)'. The 'Details of "Harmonic Response"' panel shows the following settings:

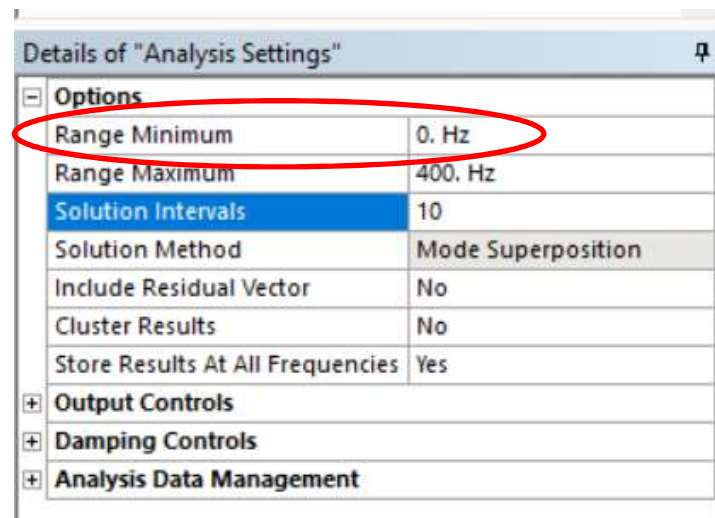
Definition	
Physics Type	Structural
Analysis Type	Harmonic Response
Solver Target	Mechanical APDL

Options	
Environment Temperature	22. °C
Generate Input Only	No

The bottom of the interface shows the Windows taskbar with the system clock at 8:07 AM on 8/9/2020.

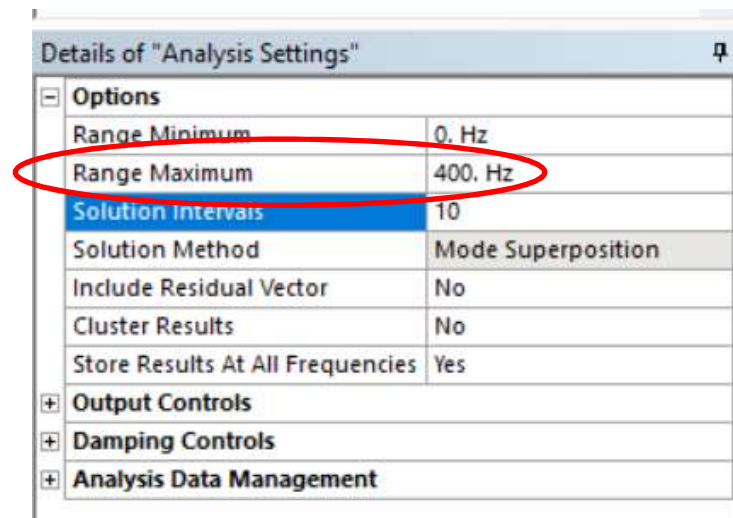
Modeliranje periodičnih vibracija

Zadati minimalnu vrijednost intervala frekvencije radnih vibracija koji se želi analizirati unošenjem vrijednosti nešto manje od prve sopstvene frekvencije, u polje *Details of Analysis Settings*->*Options*->*Range Minimum* unijeti 0 Hz



Modeliranje periodičnih vibracija

Zadati maksimalnu vrijednost intervala frekvencije radnih vibracija koji se želi analizirati unošenjem vrijednosti nešto veću od pete sopstvene frekvencije, u polje *Details of Analysis Settings->Options->Range Maximum* unijeti 400 Hz



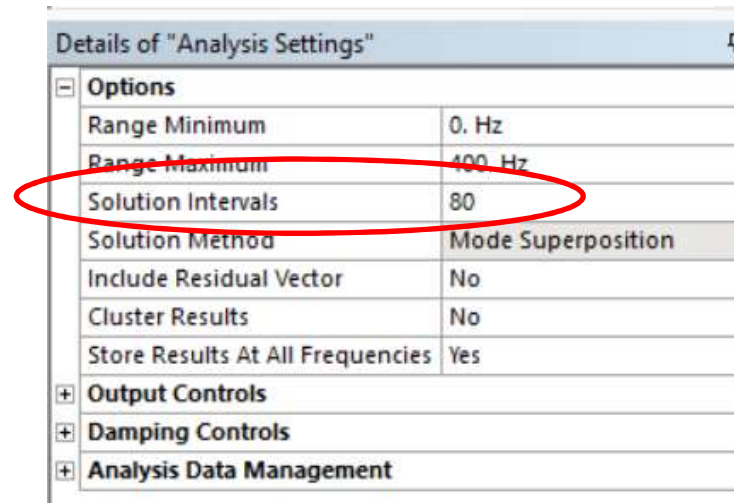
The screenshot shows a software dialog box titled "Details of 'Analysis Settings'". It contains several sections: "Options", "Solution Intervals", "Solution Method", "Include Residual Vector", "Cluster Results", "Store Results At All Frequencies", "Output Controls", "Damping Controls", and "Analysis Data Management". The "Options" section is expanded, showing a table with the following entries:

Property	Value
Range Minimum	0. Hz
Range Maximum	400. Hz
Solution Intervals	10
Solution Method	Mode Superposition
Include Residual Vector	No
Cluster Results	No
Store Results At All Frequencies	Yes

The "Range Maximum" row is circled in red, indicating the value 400. Hz.

Modeliranje periodičnih vibracija

Interval frekvencije radnih vibracija podijeliti na podintervale dijeleći ga sa brojem sopstvenih frekvencija dobijenih modalnom analizom, u polje *Details of Analysis Settings*->*Options*->*Solution Intervals* unijeti 80

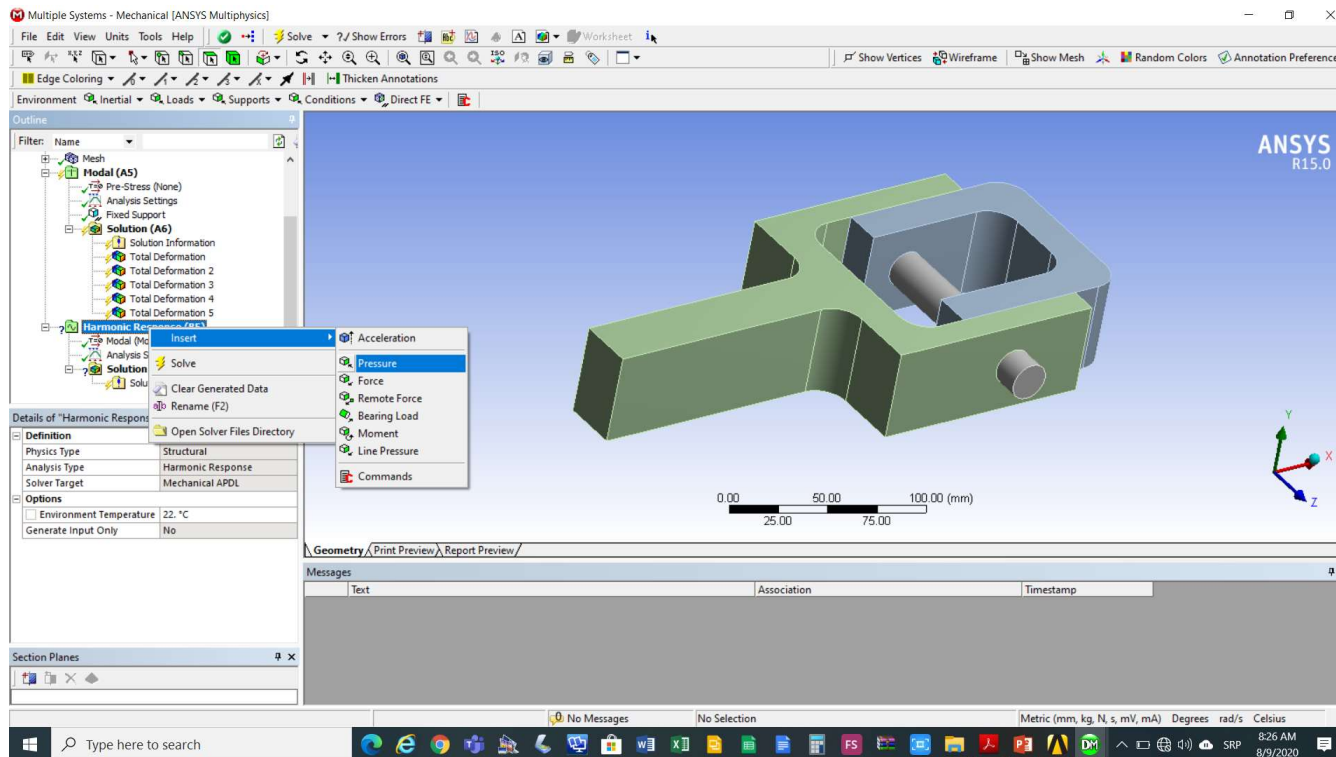


The image shows a screenshot of a software dialog box titled "Details of 'Analysis Settings'". The dialog is divided into several sections. The "Options" section is expanded, showing a table of settings. The "Solution Intervals" setting is circled in red. The "Solution Method" is set to "Mode Superposition". Other settings include "Range Minimum" (0. Hz), "Range Maximum" (400. Hz), "Include Residual Vector" (No), "Cluster Results" (No), and "Store Results At All Frequencies" (Yes). The "Output Controls", "Damping Controls", and "Analysis Data Management" sections are collapsed.

Details of "Analysis Settings"	
Options	
Range Minimum	0. Hz
Range Maximum	400. Hz
Solution Intervals	80
Solution Method	Mode Superposition
Include Residual Vector	No
Cluster Results	No
Store Results At All Frequencies	Yes
+ Output Controls	
+ Damping Controls	
+ Analysis Data Management	

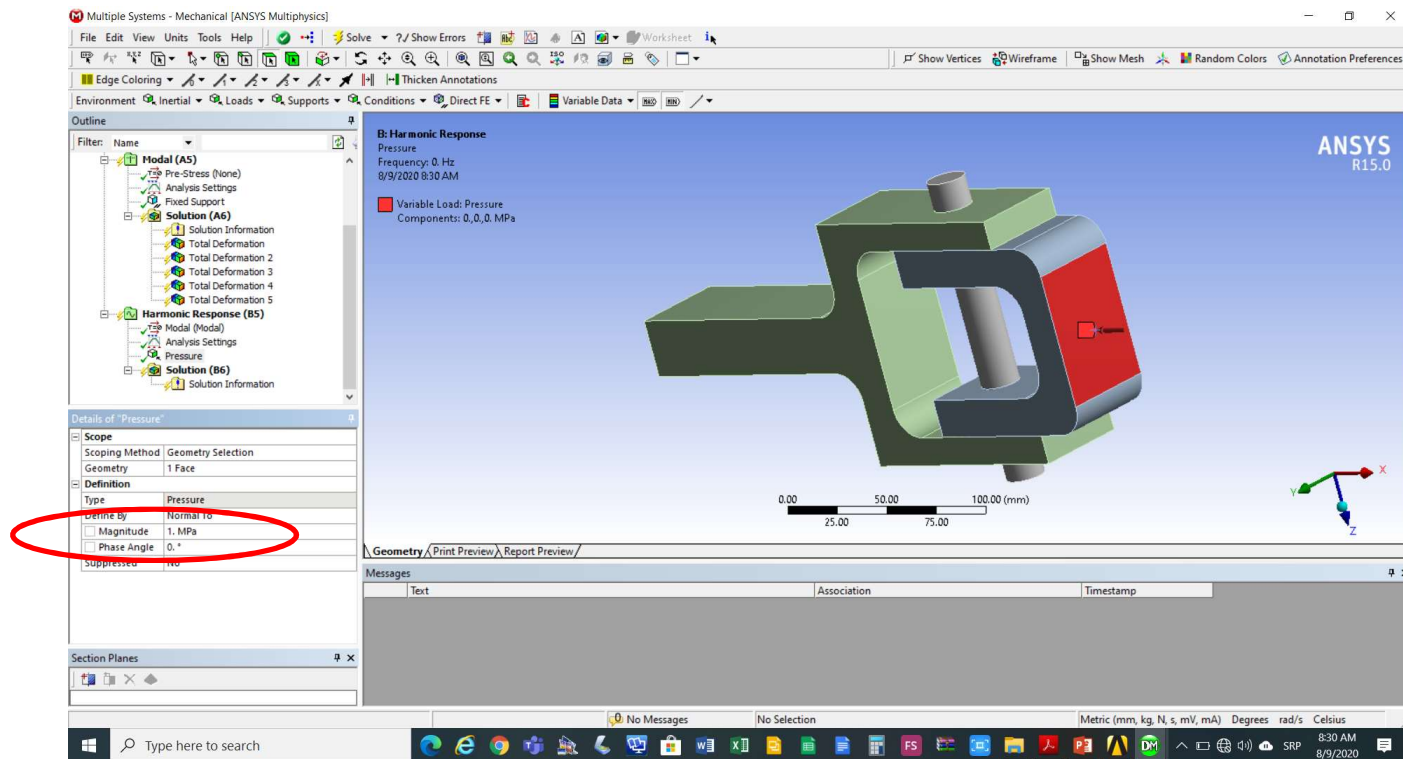
Modeliranje periodičnih vibracija

Dodati pritisak na krajnju desnu površinu U profila *Harmonic Response*->*Insert*->*Pressure*



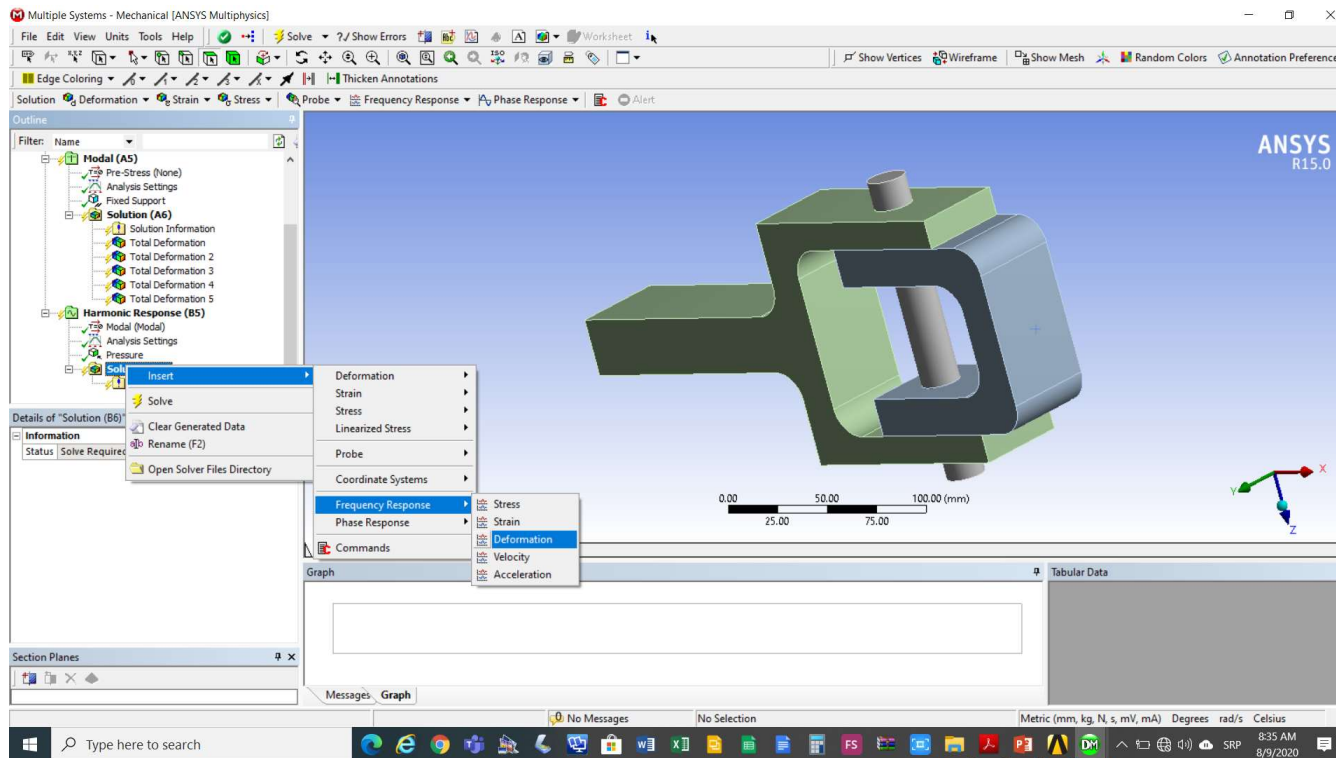
Modeliranje periodičnih vibracija

Zadati intezitet pritiska *Details of Pressure->Definition*, u polje *Magnitude* unijeti 1 MPa



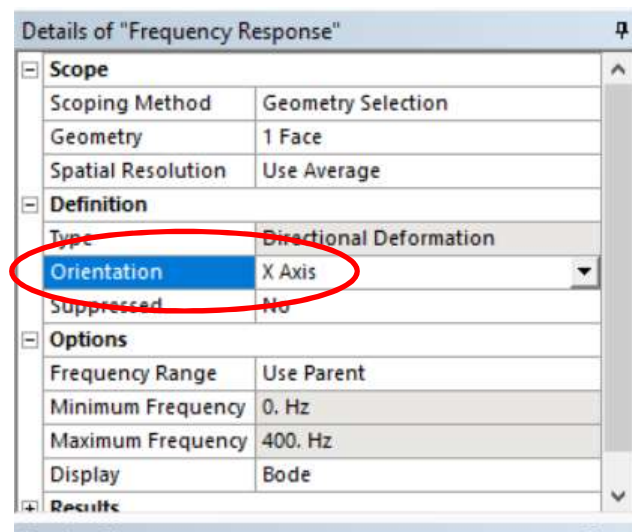
Modeliranje periodičnih vibracija

Izabrati opciju za određivanje pomjeranja izazvanih periodičnim vibracijama *Solution->Insert->Frequency Response->Deformation*



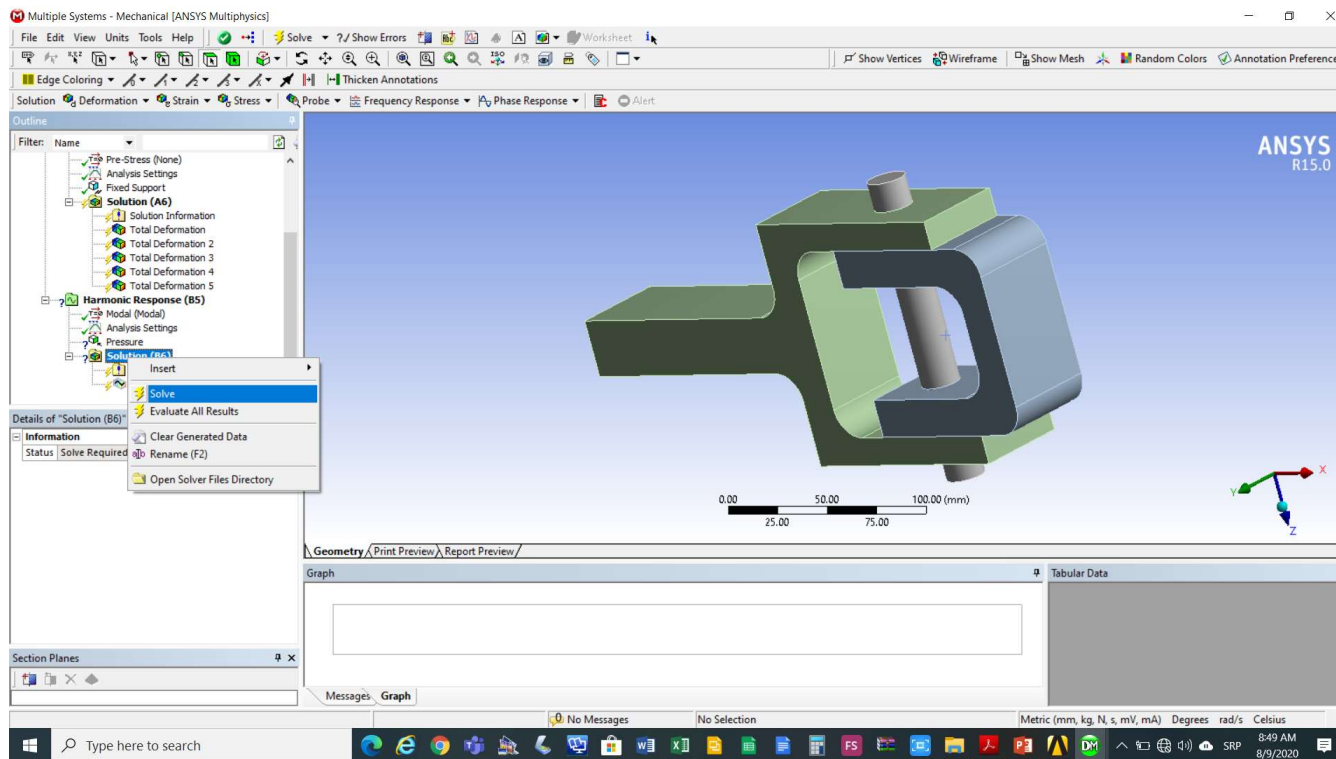
Modeliranje periodičnih vibracija

Da bi se pregledalo pomjeranje u pravcu x ose za pojedinačni element u polju *Details of Frequency Response*->*Scope*->*Geometry* izabrati omotač osovinice, a u polju *Details of Frequency Response*->*Definition*->*Orientation* izabrati *X Axis*



Modeliranje periodičnih vibracija

Aktivirati izvršenje analize *Solution*->*Solve*



Modeliranje periodičnih vibracija

Frekventni odgovor: Pomjeranja u pravcu x ose

