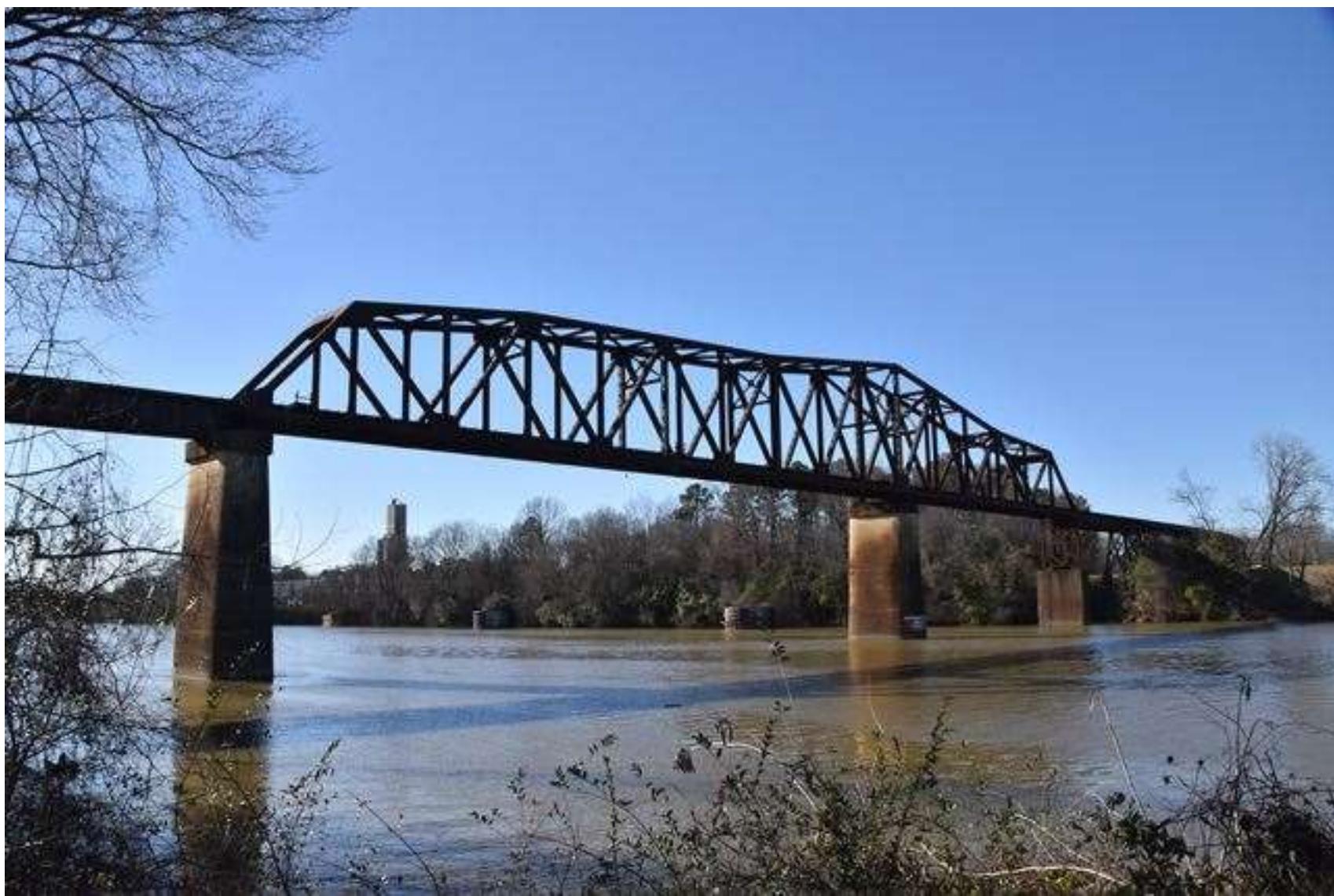


>> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<

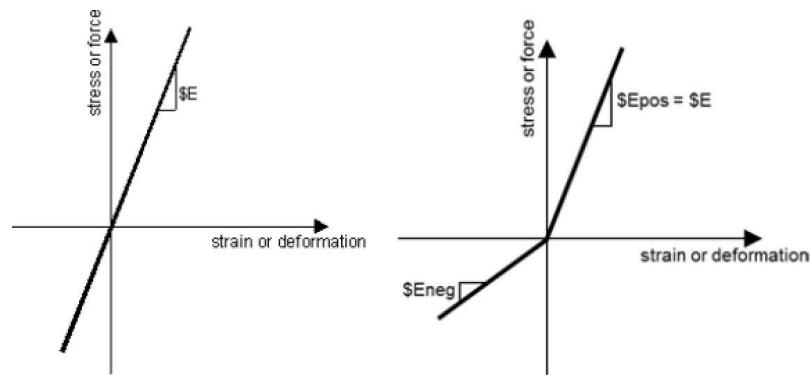
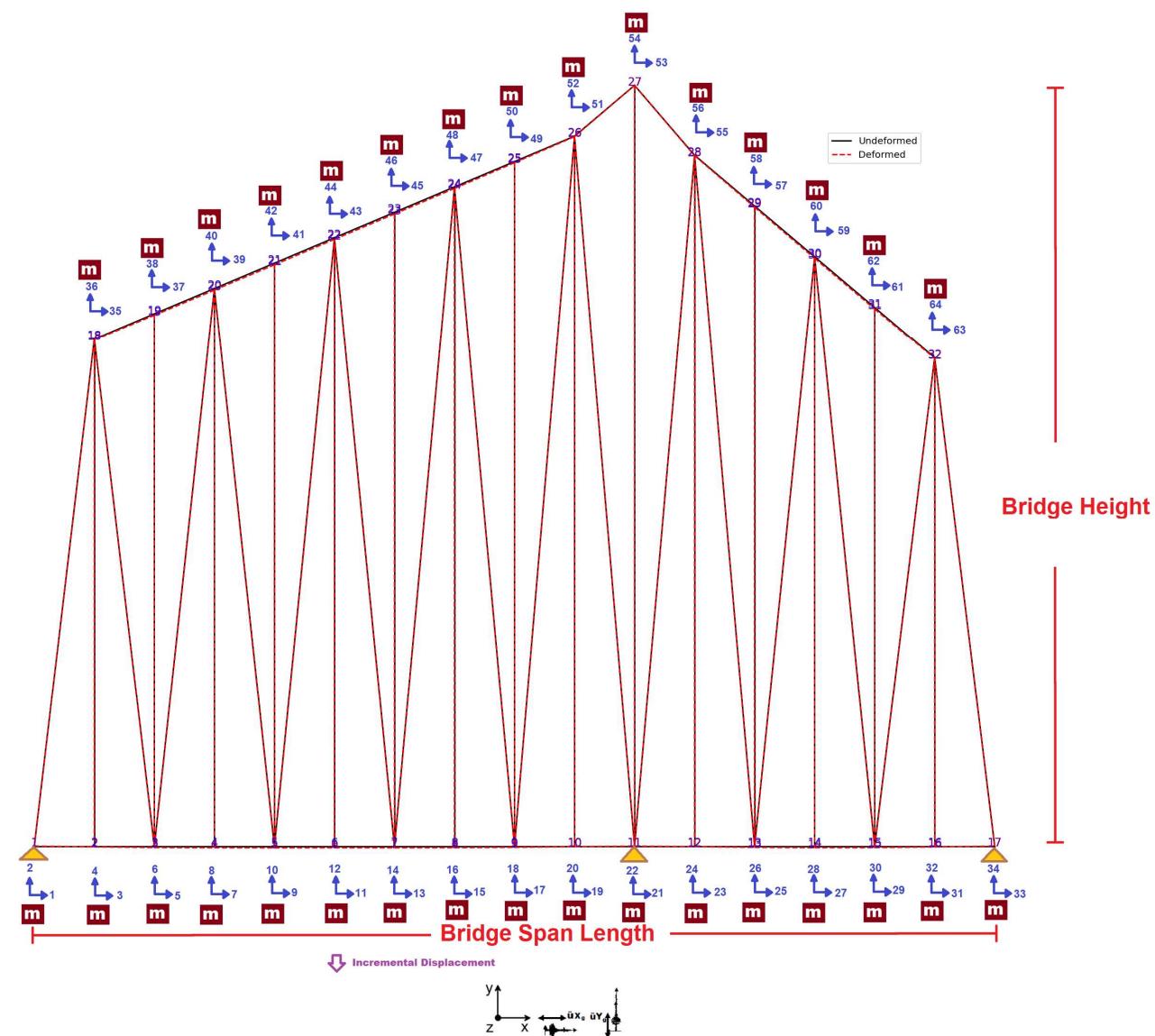
COMPREHENSIVE NONLINEAR SEISMIC ASSESSMENT OF STEEL TRUSS BRIDGES: AN OPENSEES FRAMEWORK FOR STATIC PUSHOVER, CYCLIC DEGRADATION, STATIC TIME-HISTORY AND DYNAMIC TIME-HISTORY ANALYSIS

THIS PROGRAM WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)

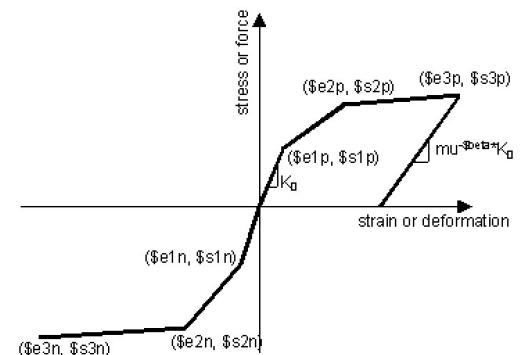




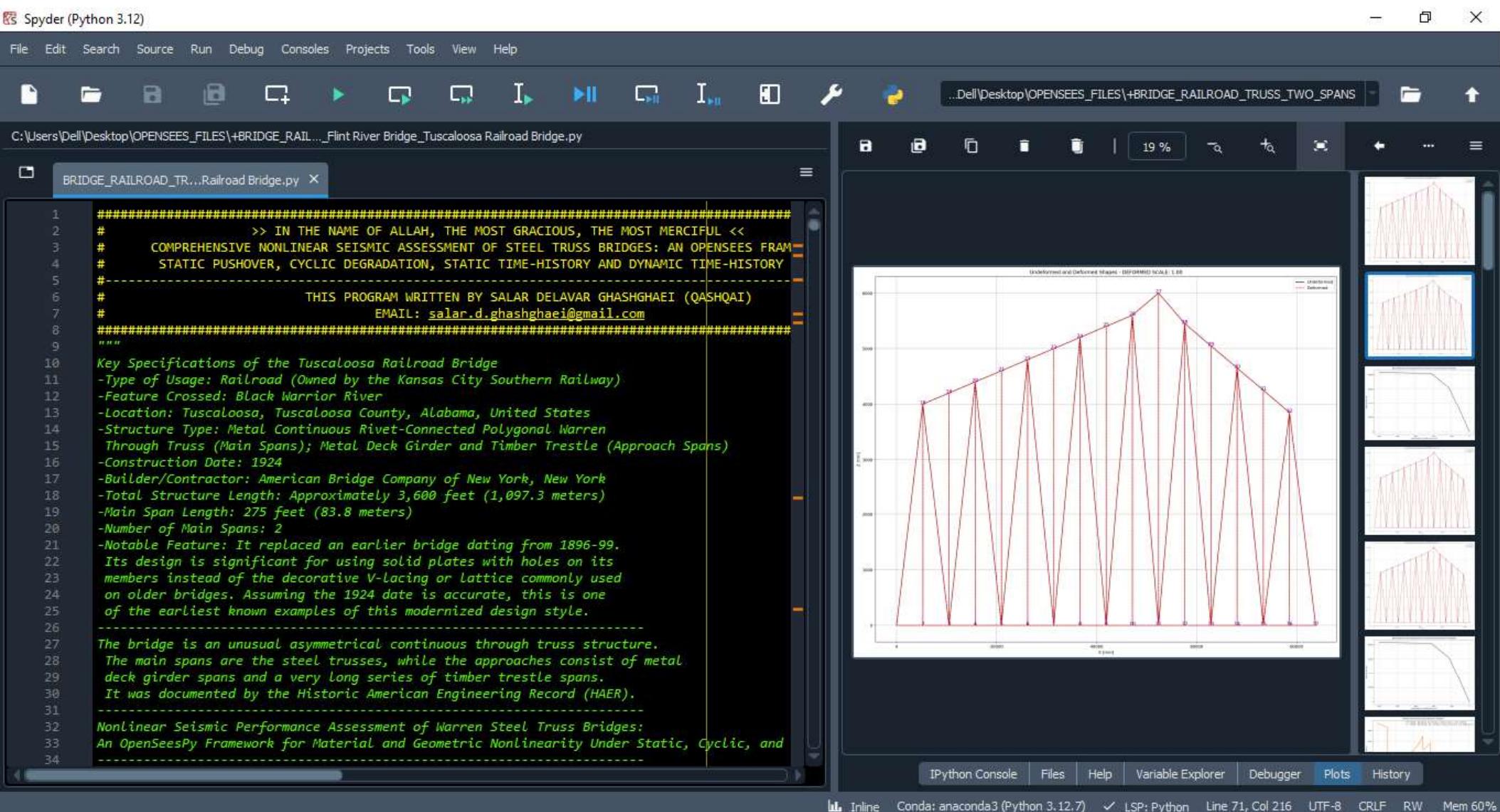




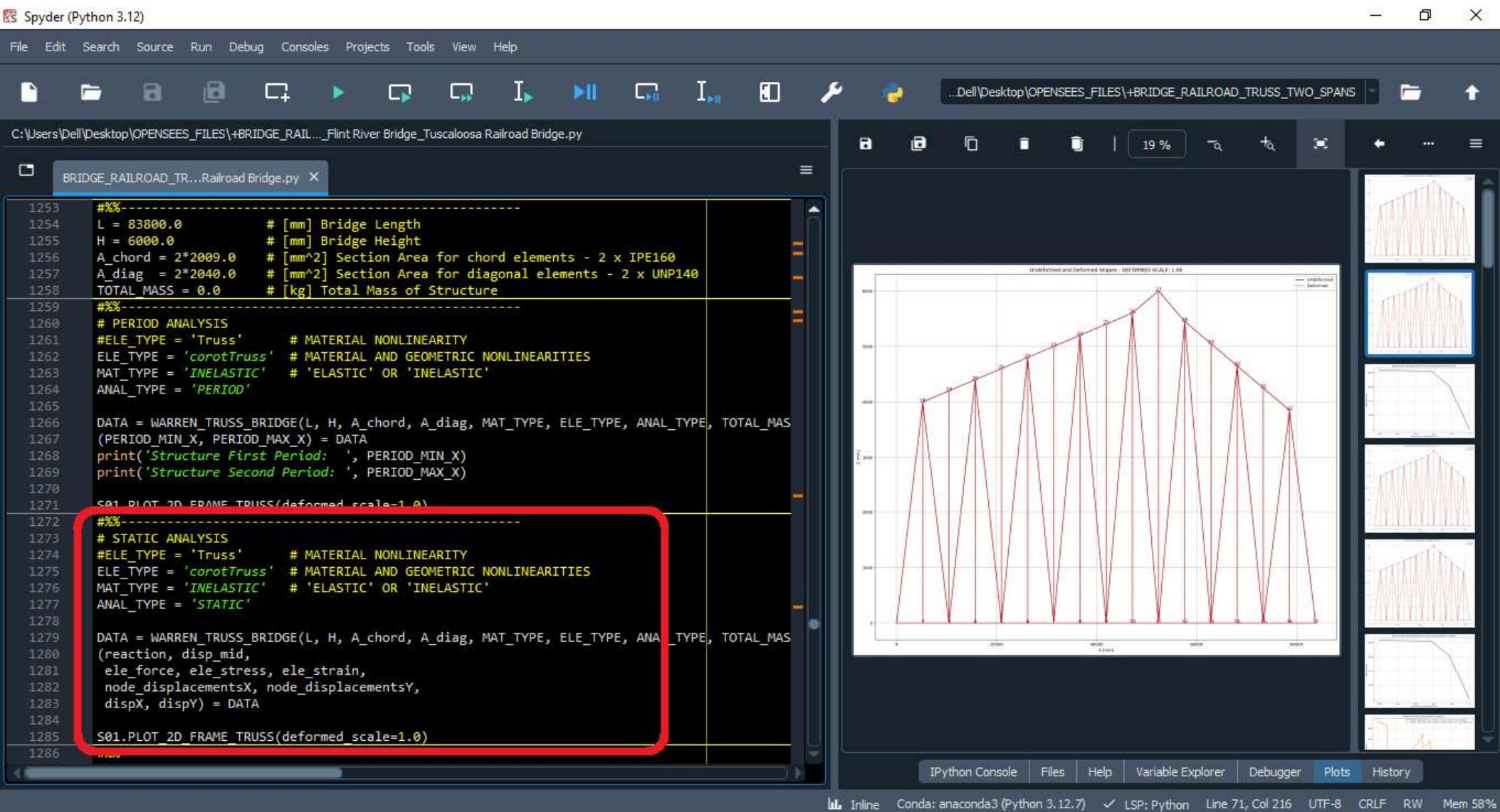
TRUSS ELEMENT ELASTIC MATERIAL

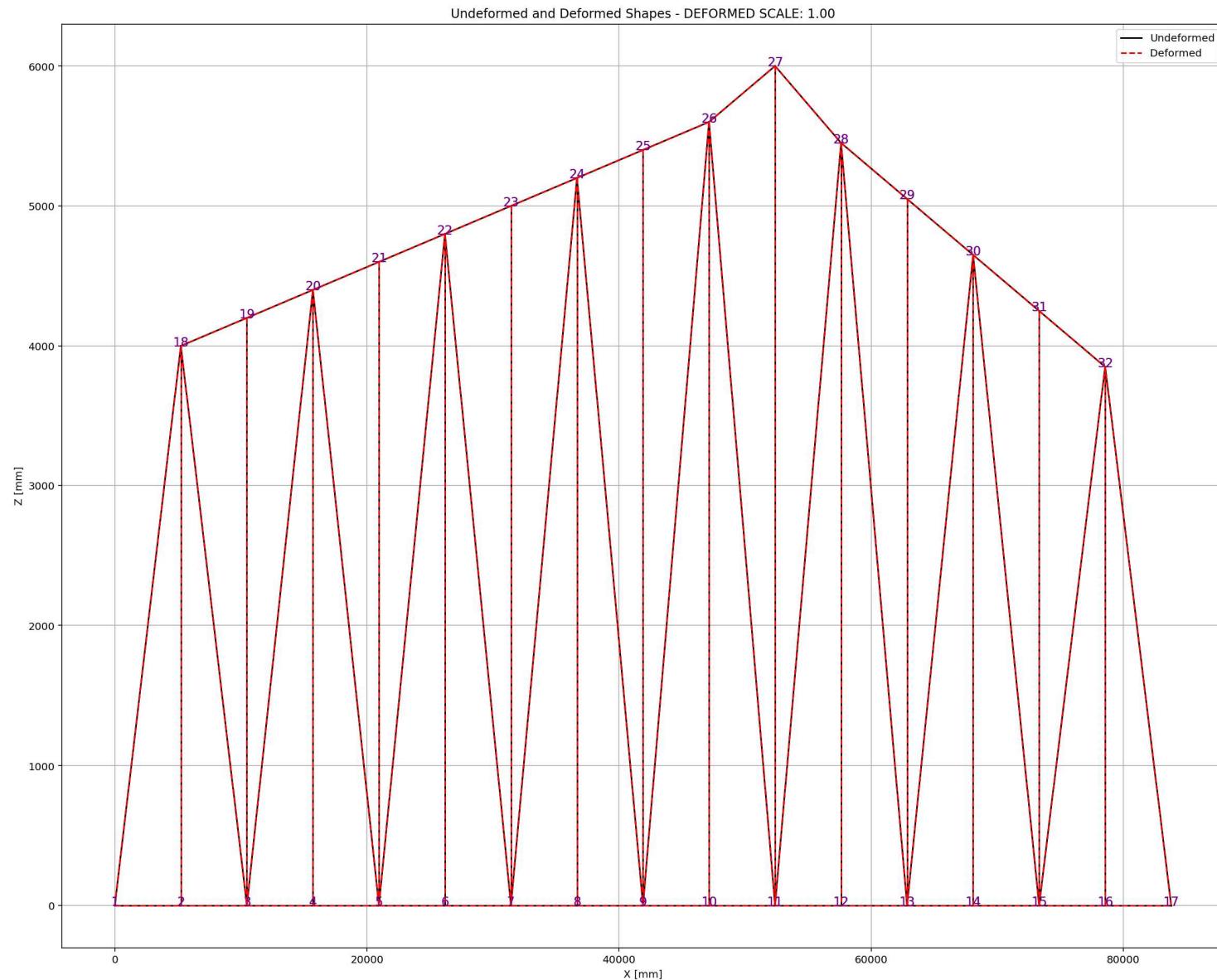


TRUSS ELEMENT INELASTIC MATERIAL



STATIC ANALYSIS





PUSHOVER ANALYSIS

Spyder (Python 3.12)

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C:\Users\Dell\Desktop\OPENSEES_FILES\+BRIDGE_RAIL...Flint River Bridge_Tuscaloosa Railroad Bridge.py

BRIDGE RAILROAD TR...Railroad Bridge.pv X

```
1287 # PUSHOVER ANALYSIS (STATIC TIME-HISTORY ANALYSIS)
1288 #ELE_TYPE = 'Truss'          # MATERIAL NONLINEARITY
1289 ELE_TYPE = 'corotTruss'     # MATERIAL AND GEOMETRIC NONLINEARITIES
1290 MAT_TYPE = 'INELASTIC'      # 'ELASTIC' OR 'INELASTIC'
1291 ANAL_TYPE = 'PUSHOVER'
1292
1293 DATA = WARREN_TRUSS_BRIDGE(L, H, A_chord, A_diag, MAT_TYPE, ELE_TYPE, ANAL_TYPE, TOTAL_MAS
(reaction_PUSH, disp_mid_PUSH,
ele_force_PUSH, ele_stress_PUSH, ele_strain_PUSH,
node_displacementsX_PUSH, node_displacementsY_PUSH,
dispX_PUSH, dispY_PUSH,
PERIOD_MIN_PUSH, PERIOD_MAX_PUSH) = DATA
1299
1300
1301 XDATA = disp_mid_PUSH
1302 YDATA = reaction_PUSH
1303 XLABEL = 'Displacement in Middle Span [mm]'
1304 YLABEL = 'Base Reaction [N]'
1305 TITLE = 'Base Reaction and Displacement of Structure During Pushover Analysis'
1306 COLOR = 'black'
1307 SEMILOGY = False
1308 PLOT(XDATA, YDATA, TITLE, XLABEL, YLABEL, COLOR, SEMILOGY)
1309
1310 # BILINEAR CURVE DATA
1311 DATA = S07.BILINEAR_CURVE(np.abs(disp_mid_PUSH), np.abs(reaction_PUSH), SLOPE_NODE=10)
1312 (X_PUSH, Y_PUSH, Elastic_ST, Plastic_ST, Tangent_ST, Ductility_Rito, Over_Strength_Factor)
1313
1314 # PLOT STRUCTURAL PERIOD DURING THE ANALYSIS
1315 plt.figure(0, figsize=(12, 8))
1316 plt.plot(disp_mid_PUSH, PERIOD_MIN_PUSH, linewidth=3)
1317 plt.plot(disp_mid_PUSH, PERIOD_MAX_PUSH, linewidth=3)
1318 plt.title('Period of Structure During Pushover Analysis')
1319 plt.ylabel('Structural Period [s]')
1320 plt.xlabel('Displacement [mm]')
```

...Dell\Desktop\OPENSEES_FILES\+BRIDGE_RAILROAD_TRUSS_TWO_SPANS

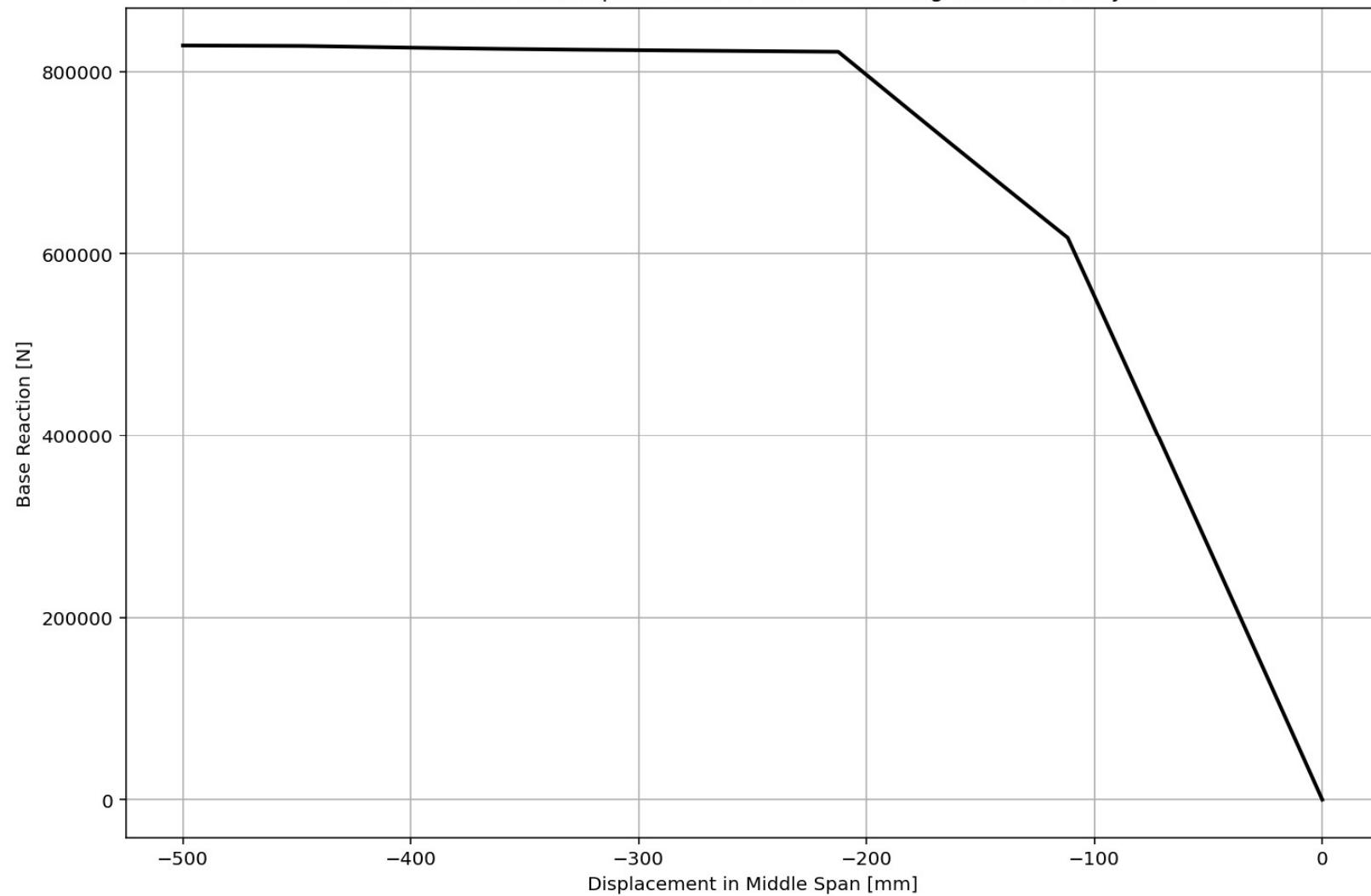
19 %

Undeformed and Deformed Shapes - DEFORMED SCALE: 1.00

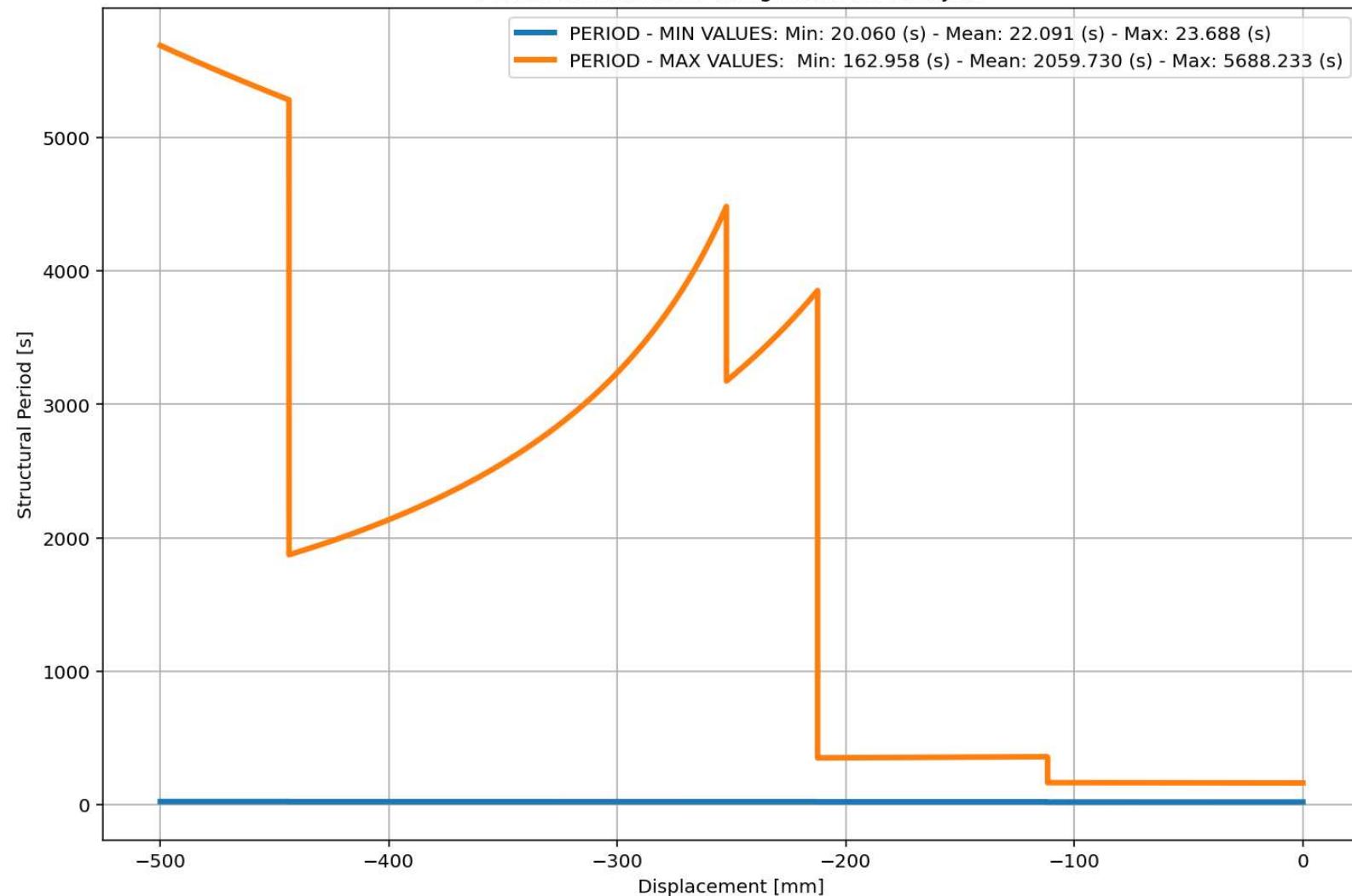
IPython Console Files Help Variable Explorer Debugger Plots History

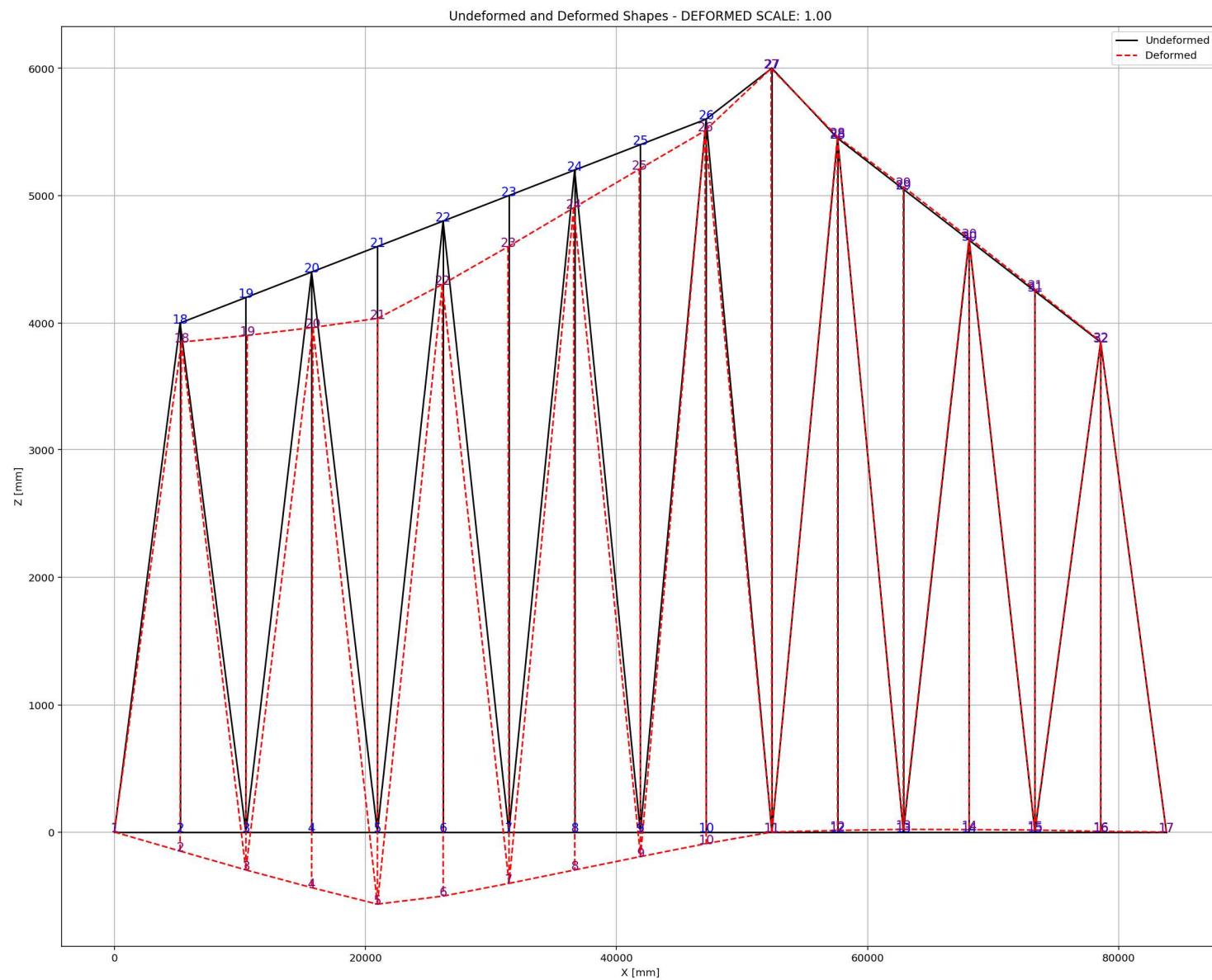
Inline Conda: anaconda3 (Python 3.12.7) ✓ LSP: Python Line 71, Col 216 UTF-8 CRLF RW Mem 59%

Base Reaction and Displacement of Structure During Pushover Analysis



Period of Structure During Pushover Analysis





CYCLIC DISPLACEMENT ANALYSIS

Spyder (Python 3.12)

File Edit Search Source Run Debug Consoles Projects Tools View Help

C:\Users\DELL\Desktop\OPENSEES_FILES\+BRIDGE_RAIL..._Flint River Bridge_Tuscaloosa Railroad Bridge.py

BRIDGE_RAILROAD_TR...Railroad Bridge.py X

```
1330 # CYCLIC DISPLACEMENT ANALYSIS (STATIC TIME-HISTORY ANALYSIS)
1331 #ELE_TYPE = 'Truss'          # MATERIAL NONLINEARITY
1332 ELE_TYPE = 'corotTruss'     # MATERIAL AND GEOMETRIC NONLINEARITIES
1333 MAT_TYPE = 'INELASTIC'      # 'ELASTIC' OR 'INELASTIC'
1334 ANAL_TYPE = 'CYCLIC_DISPLACEMENT'
1335
1336 DATA = WARREN_TRUSS_BRIDGE(L, H, A_chord, A_diag, MAT_TYPE, ELE_TYPE, ANAL_TYPE, TOTAL_MAS
1337 (reaction_CP, disp_mid_CP,
1338 ele_force_CP, ele_stress_CP, ele_strain_CP,
1339 node_displacementsX_CP, node_displacementsY_CP,
1340 dispX_CP, dispY_CP,
1341 PERIOD_MIN_CP, PERIOD_MAX_CP) = DATA
1342
1343
1344 XDATA = disp_mid_CP
1345 YDATA = reaction_CP
1346 XLABEL = 'Displacement in Middle Span [mm]'
1347 YLABEL = 'Base Reaction [N]'
1348 TITLE = 'Base Reaction and Displacement of Structure During Cyclic-Displacement Analysis'
1349 COLOR = 'black'
1350 SEMILOGY = False
1351 PLOT(XDATA, YDATA, TITLE, XLABEL, YLABEL, COLOR, SEMILOGY)
1352
1353 # PLOT STRUCTURAL PERIOD DURING THE ANALYSIS
1354 plt.figure(0, figsize=(12, 8))
1355 plt.plot(disp_mid_CP, PERIOD_MIN_CP, linewidth=3)
1356 plt.plot(disp_mid_CP, PERIOD_MAX_CP, linewidth=3)
1357 plt.title('Period of Structure During Cyclic Displacement Analysis')
1358 plt.ylabel('Structural Period [s]')
1359 plt.xlabel('Displacement [mm]')
1360 #plt.semilogy()
1361 plt.grid()
1362 plt.legend([f'PERIOD - MIN VALUES: Min: {np.min(PERIOD_MIN_CP):.3f} (s) - Mean: {np.mean(P
1363 f'PERIOD - MAX VALUES: Min: {np.min(PERIOD_MAX_CP):.3f} (s) - Mean: {np.mean(P
```

..\\Dell\\Desktop\\OPENSEES_FILES\\+BRIDGE_RAILROAD_TRUSS_TWO_SPANS

30 %

Base Reaction and Displacement of Structure During Cyclic-Displacement Analysis

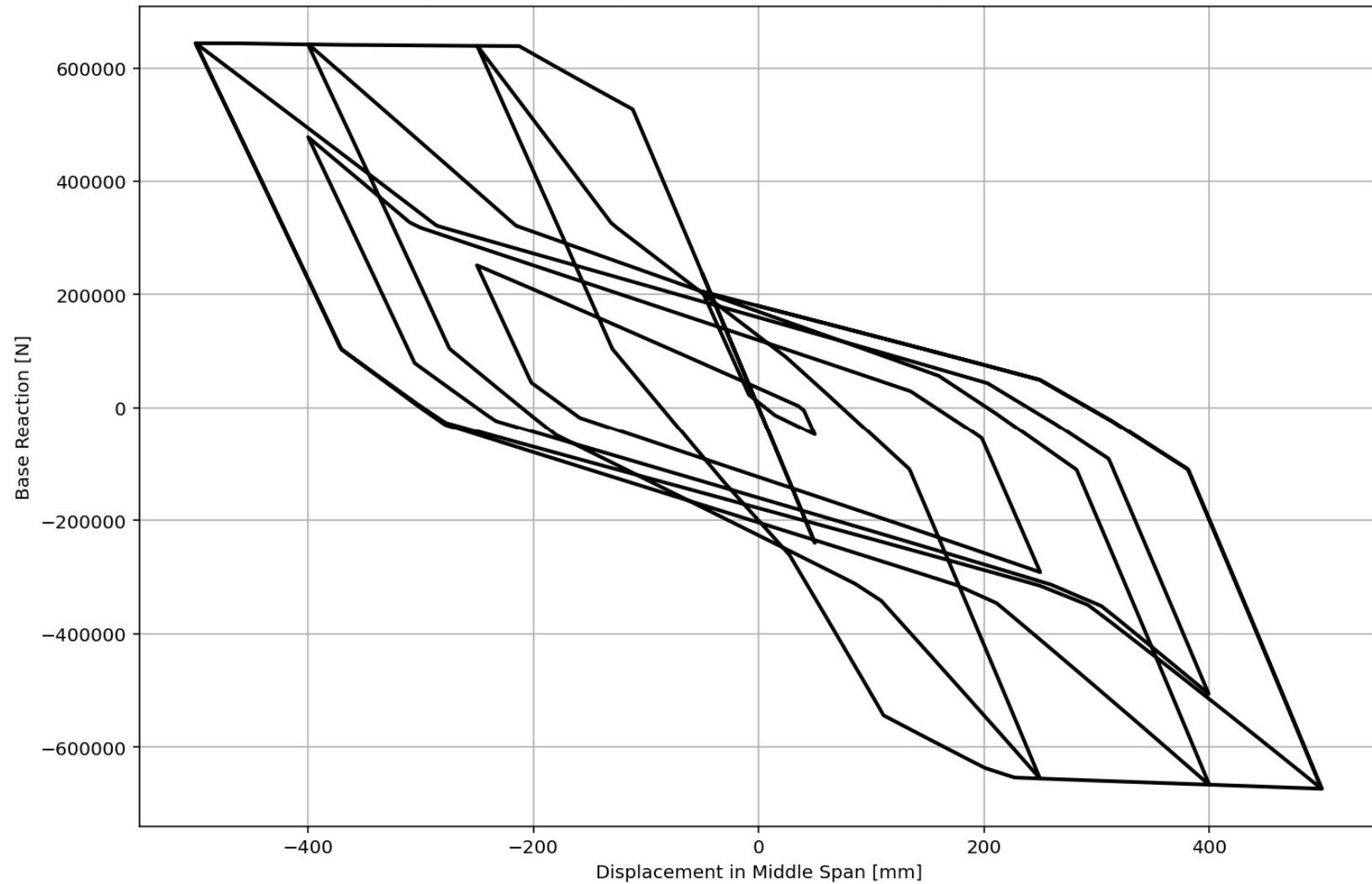
Base Reaction [N]

Displacement in Middle Span [mm]

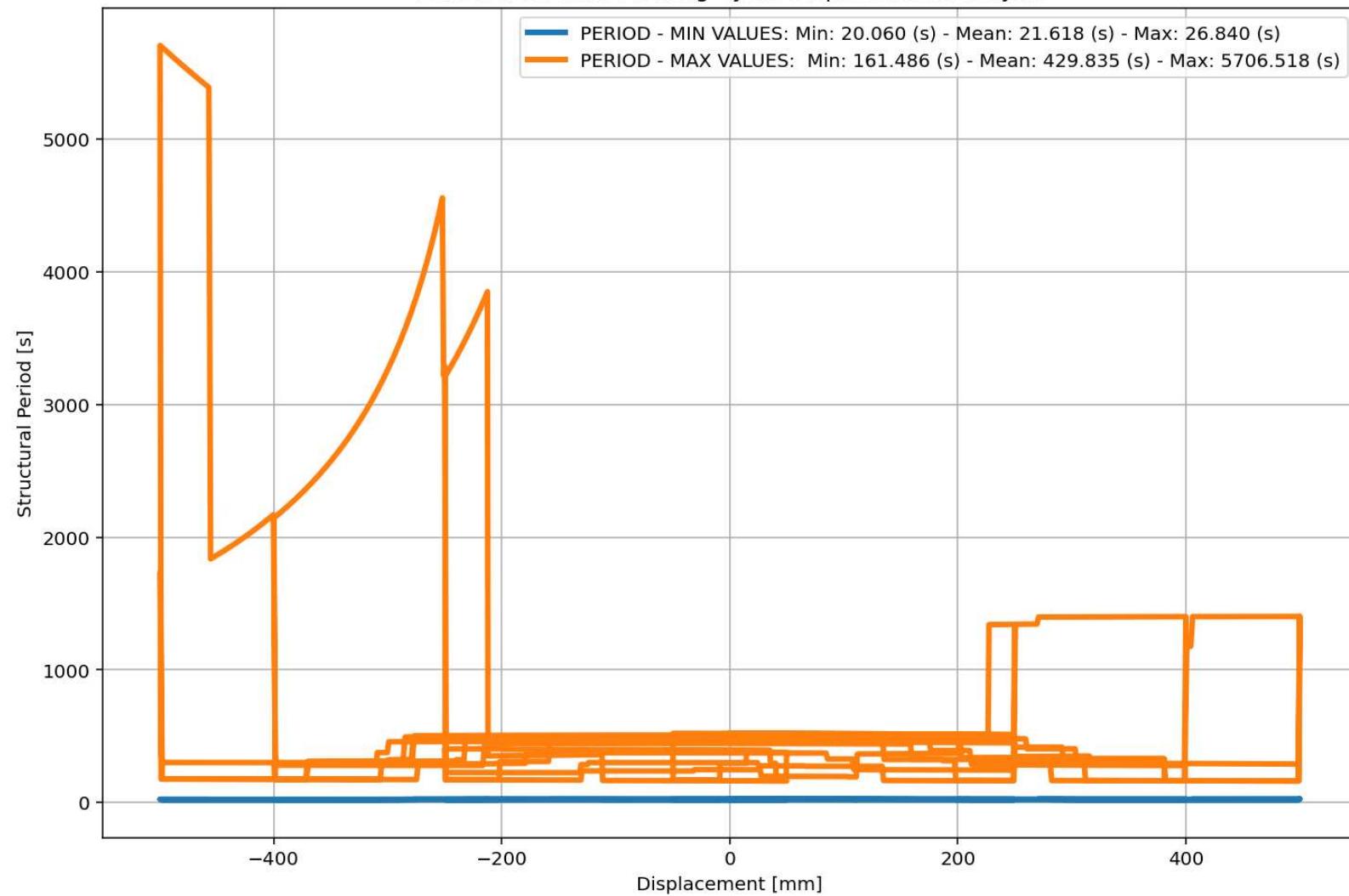
IPython Console Files Help Variable Explorer Debugger Plots History

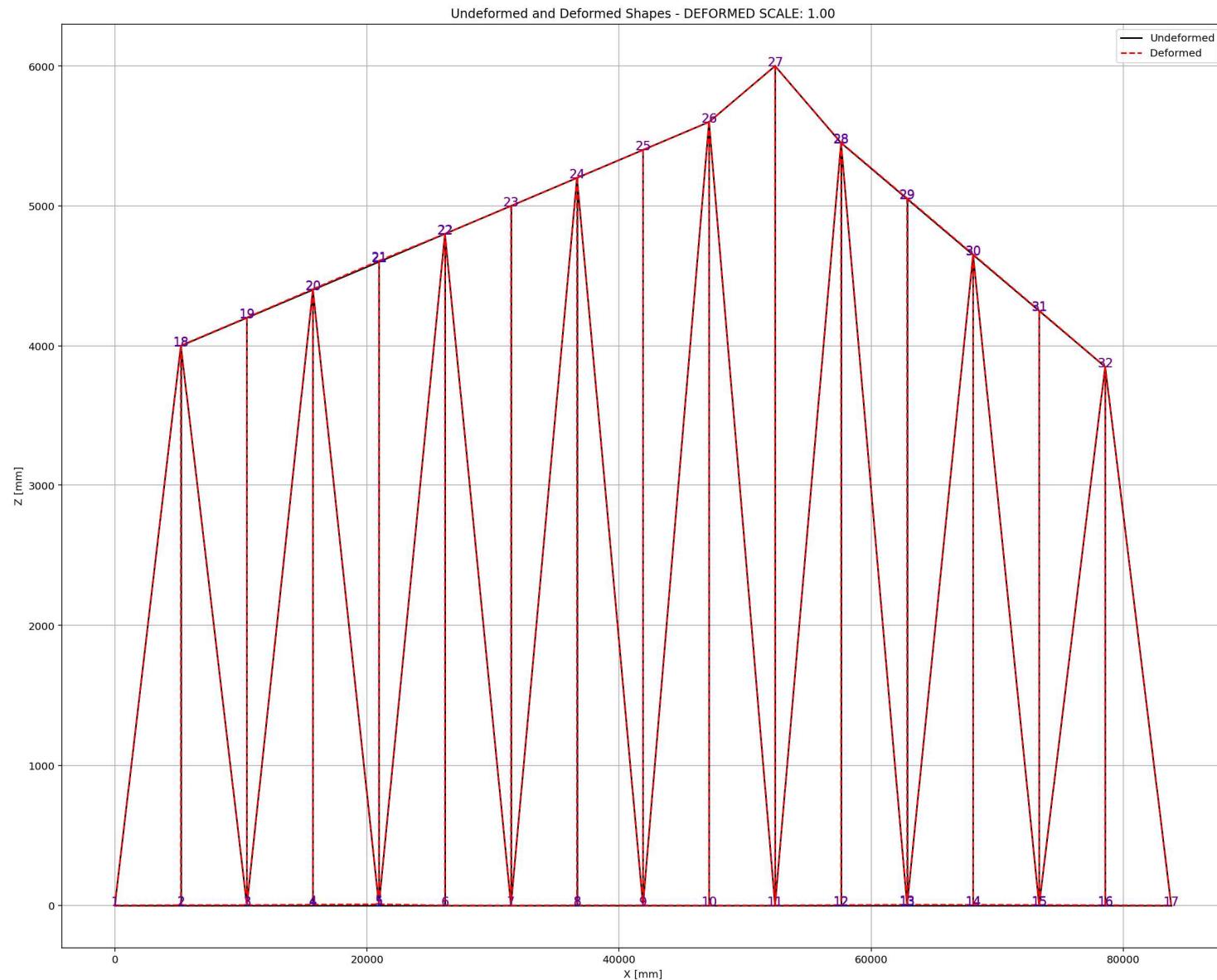
Inline Conda: anaconda3 (Python 3.12.7) ✓ LSP: Python Line 71, Col 216 UTF-8 CRLF RW Mem 59%

Base Reaction and Displacement of Structure During Cyclic-Displacement Analysis

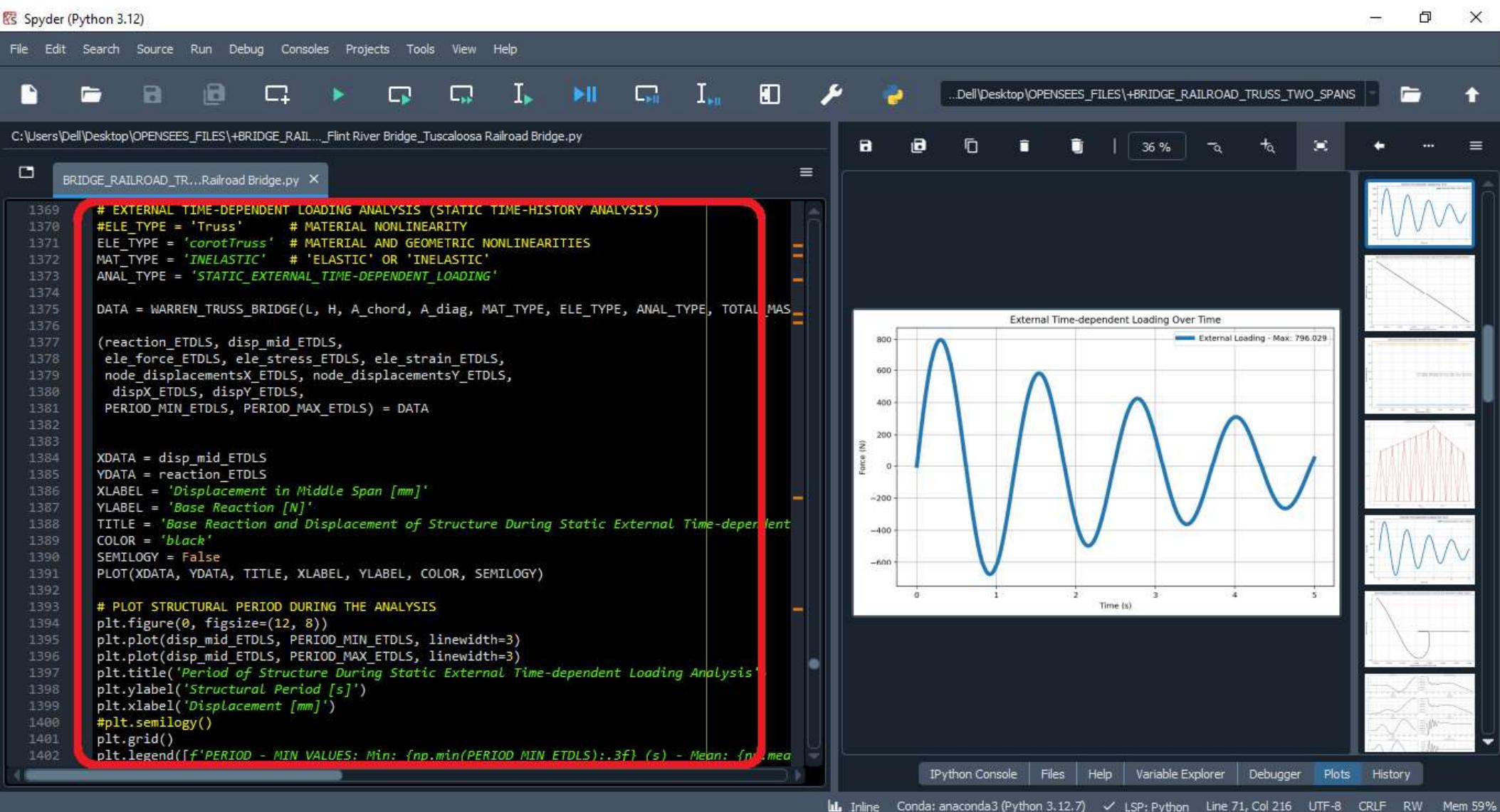


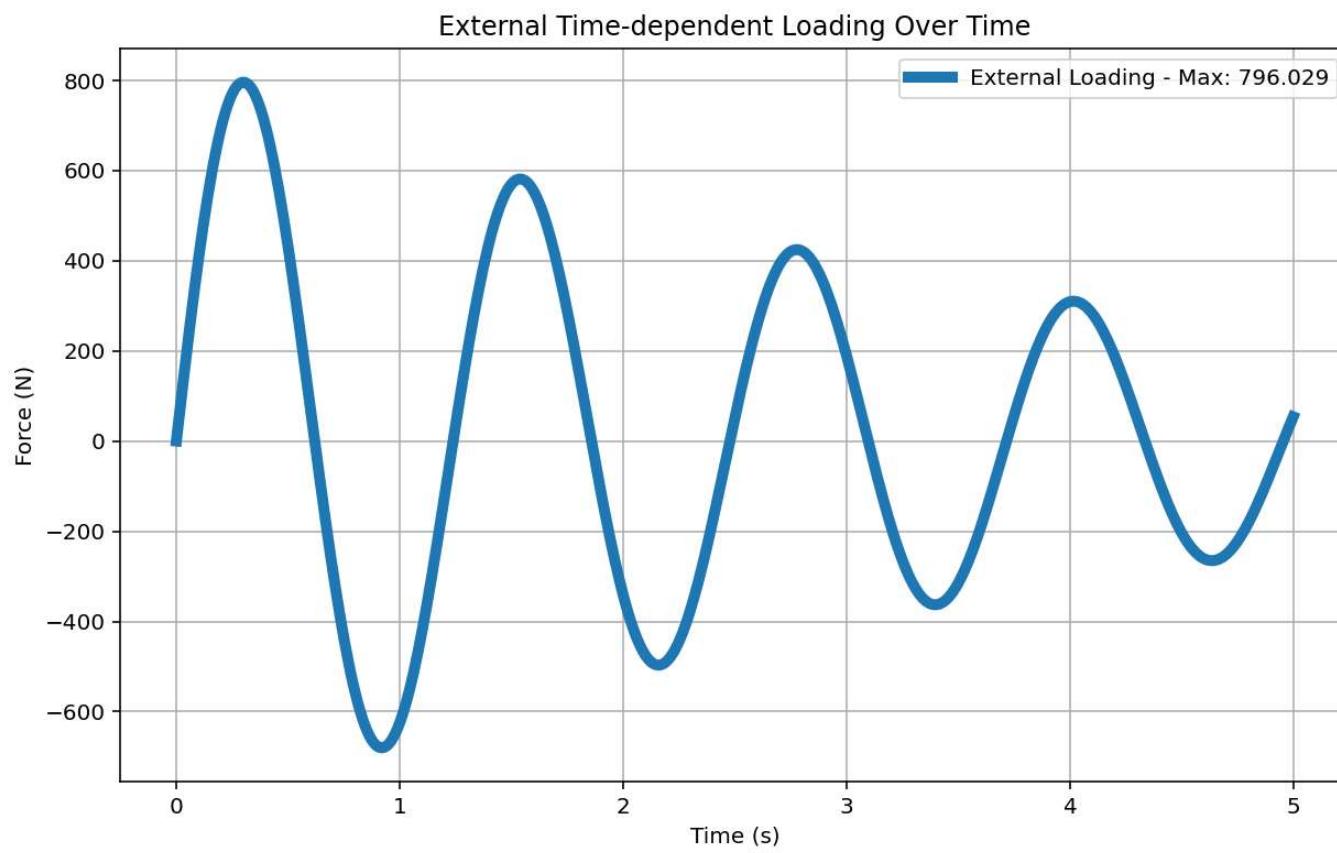
Period of Structure During Cyclic Displacement Analysis



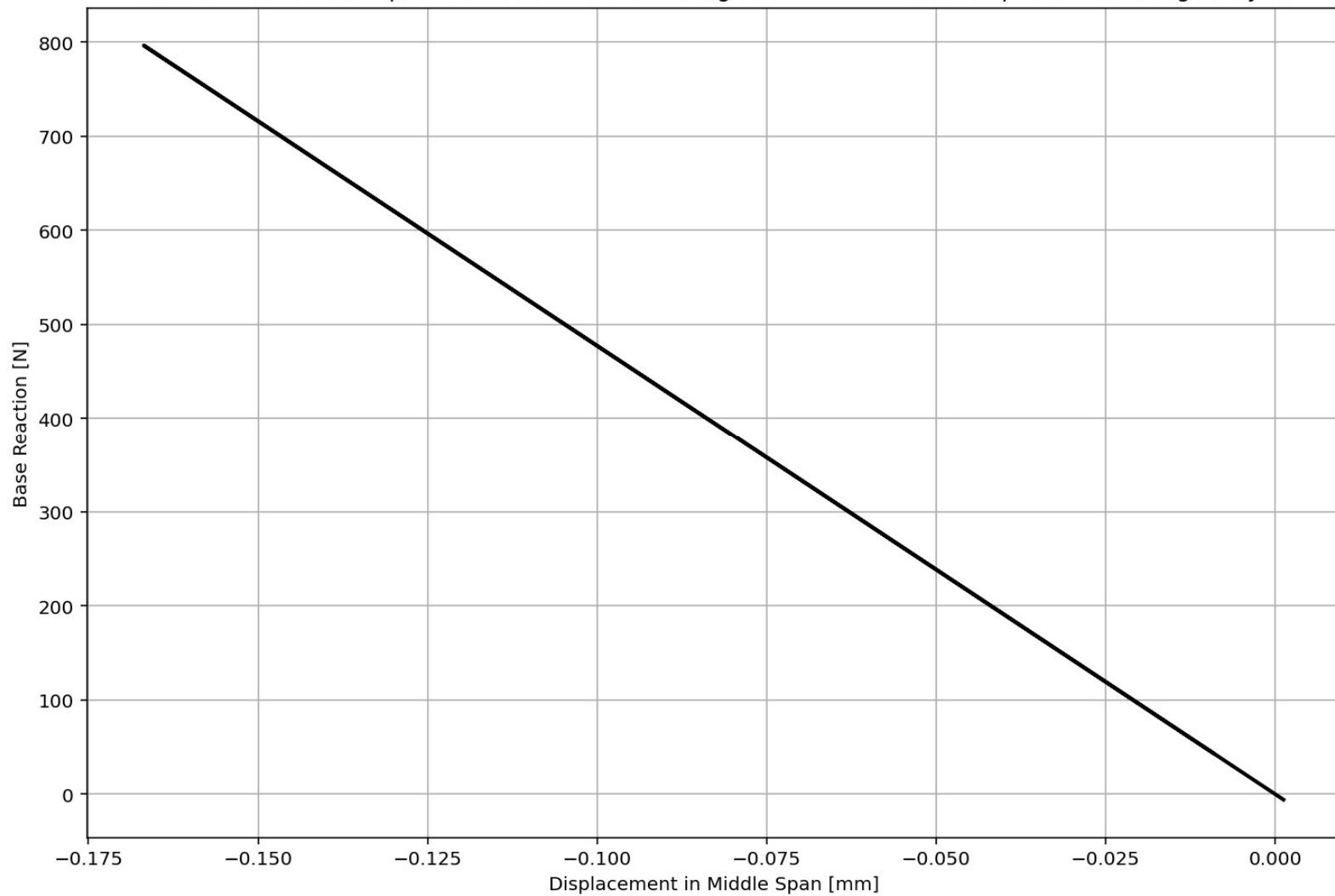


STATIC TIME-HISTORY WITH EXTERNAL TIME- DEPENDENT LOADING ANALYSIS

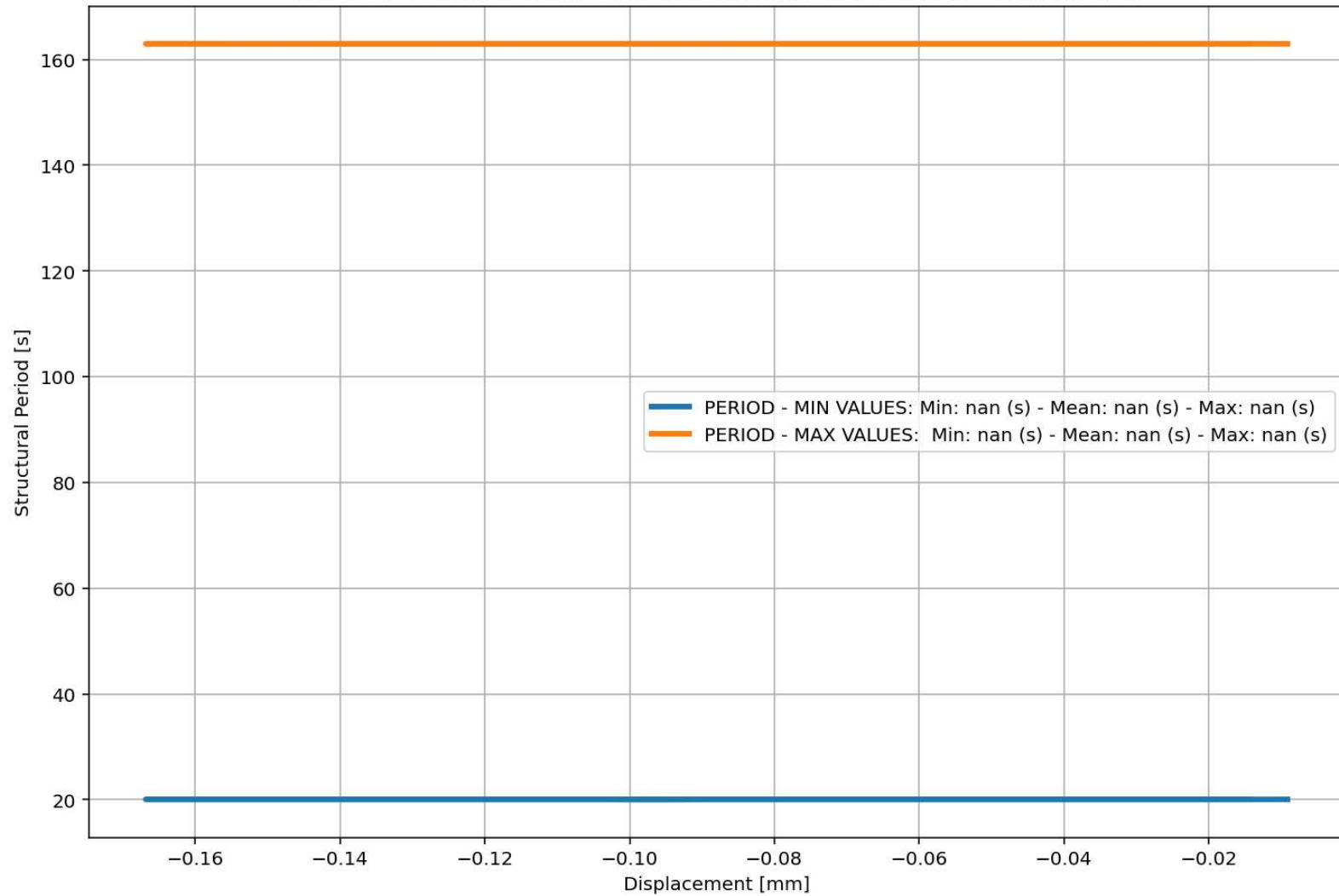


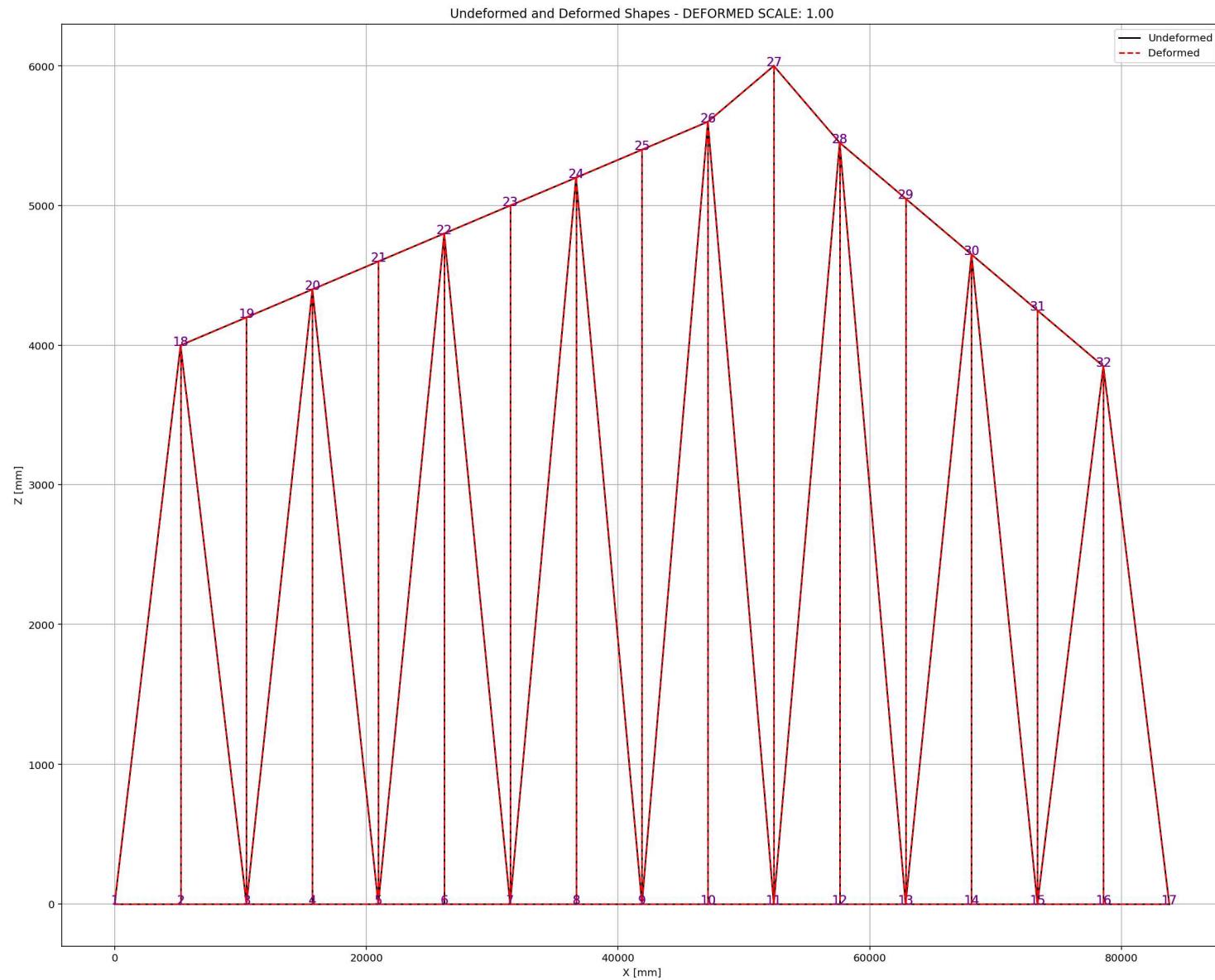


Base Reaction and Displacement of Structure During Static External Time-dependent Loading Analysis

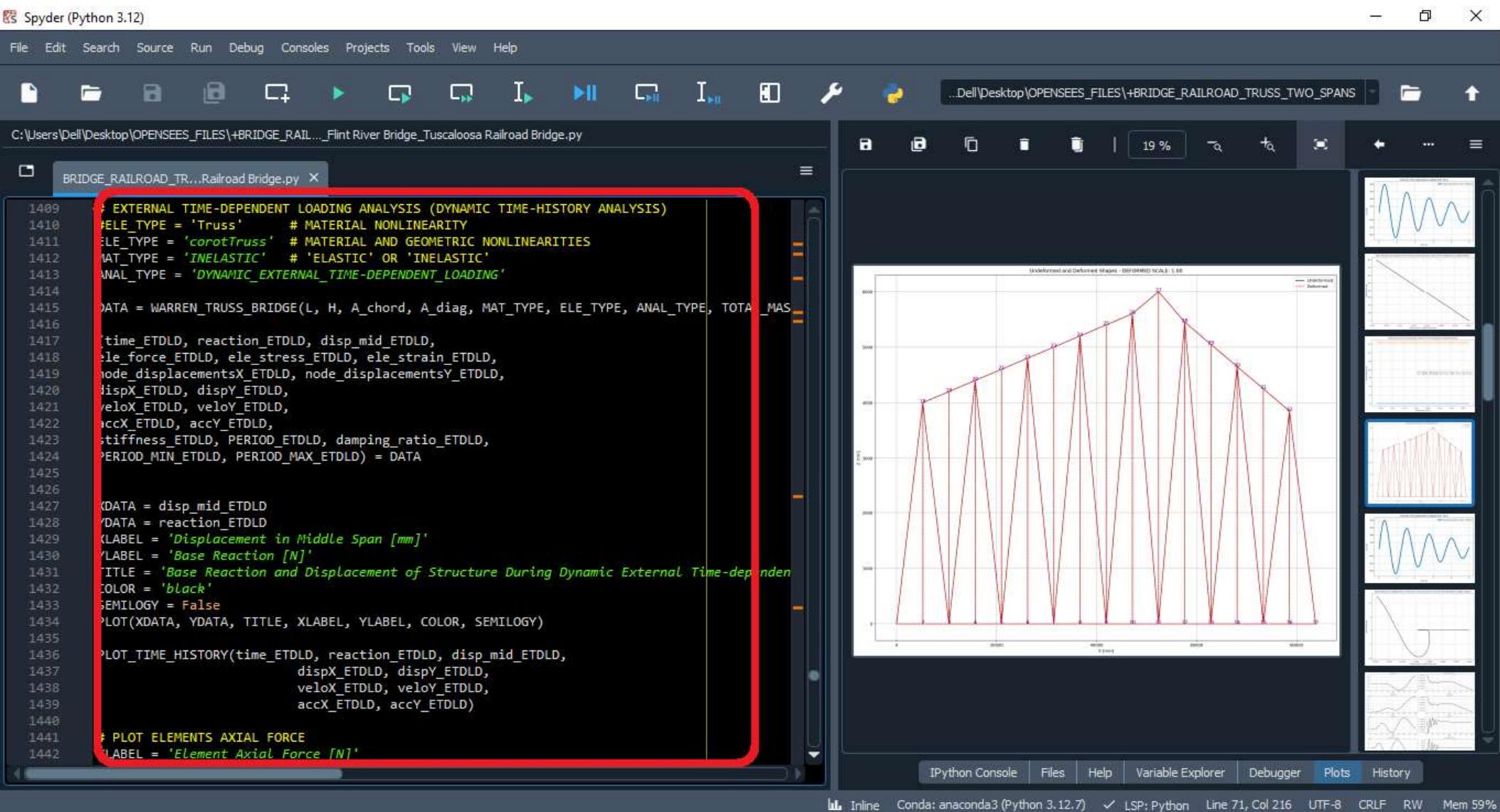


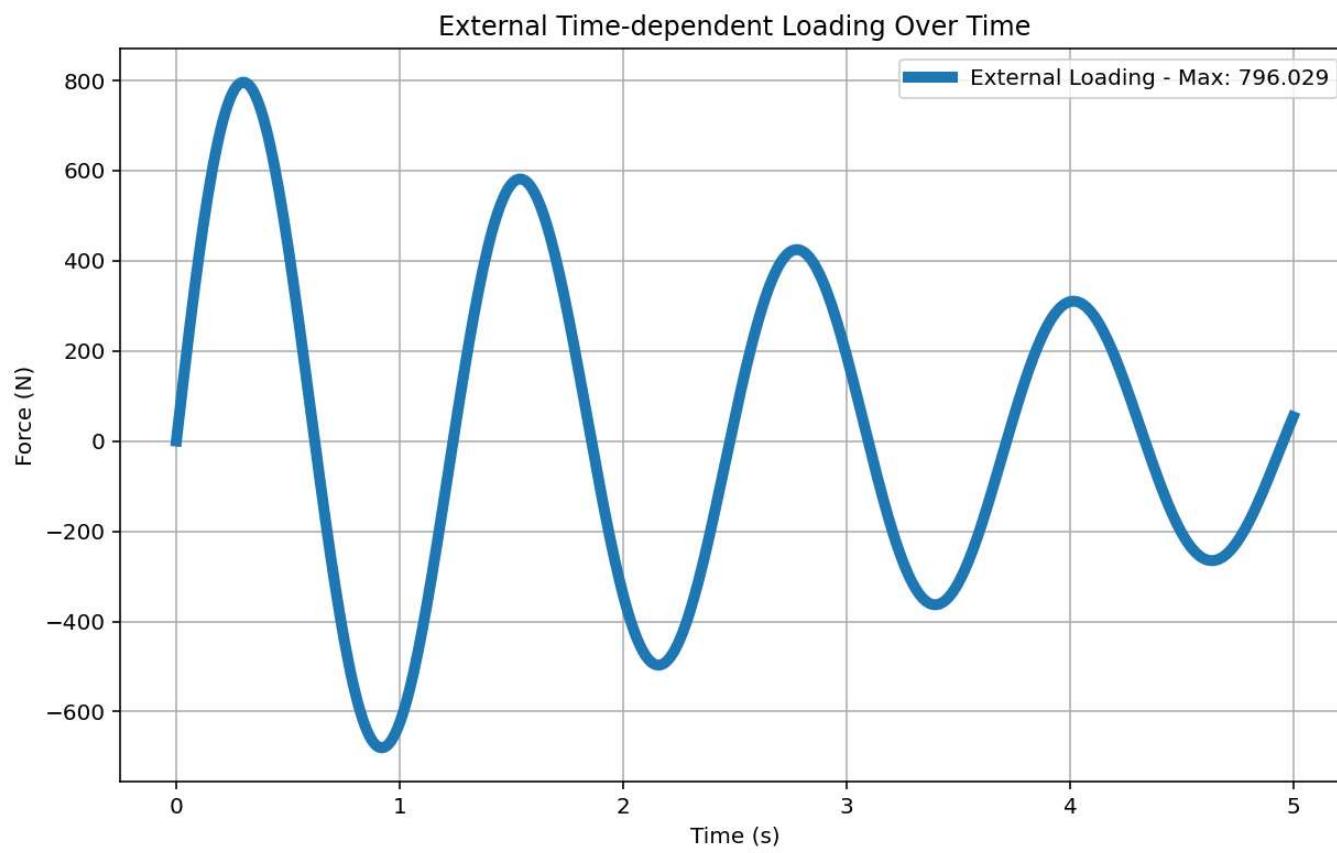
Period of Structure During Static External Time-dependent Loading Analysis



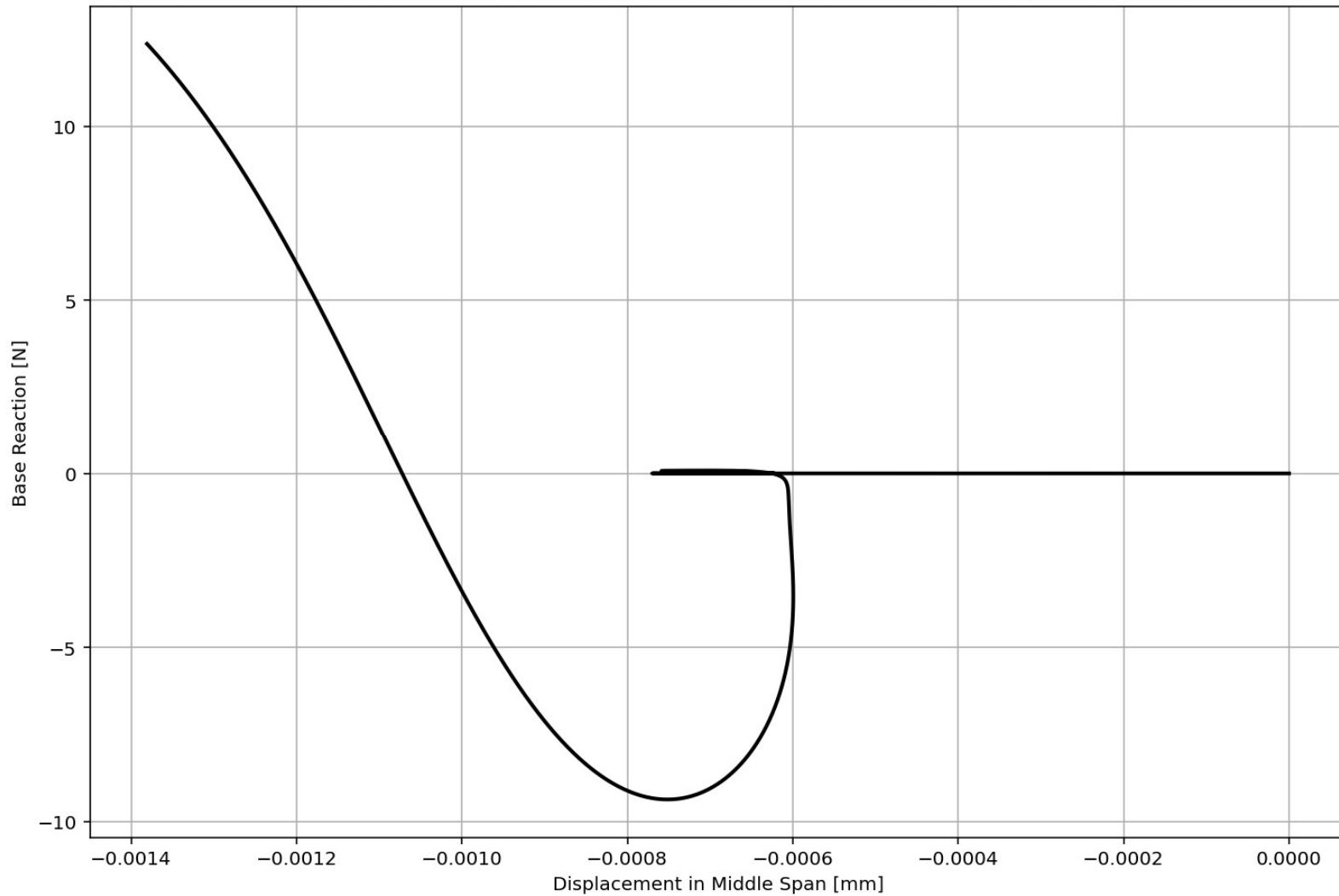


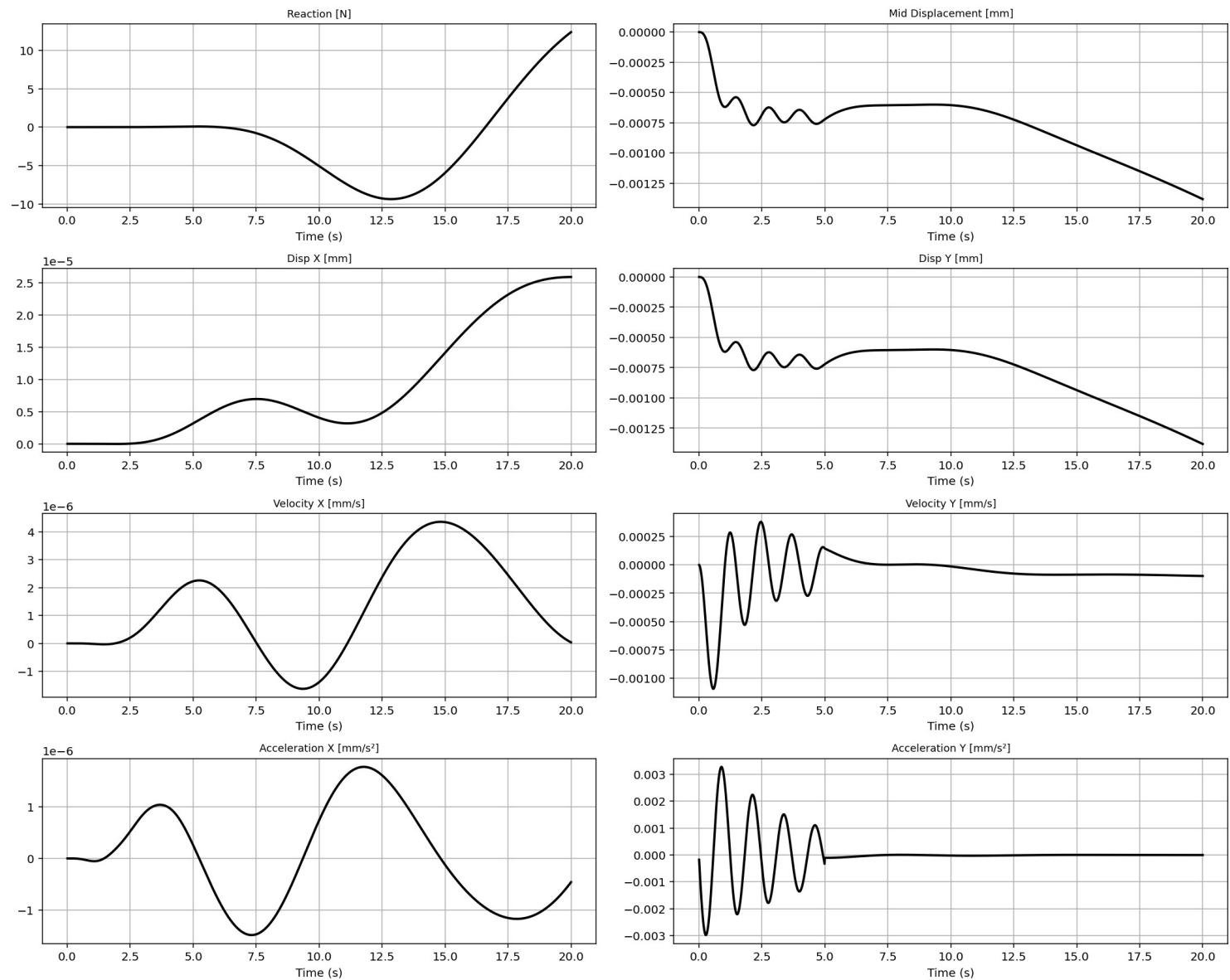
DYNAMIC TIME-HISTORY WITH EXTERNAL TIME- DEPENDENT LOADING ANALYSIS



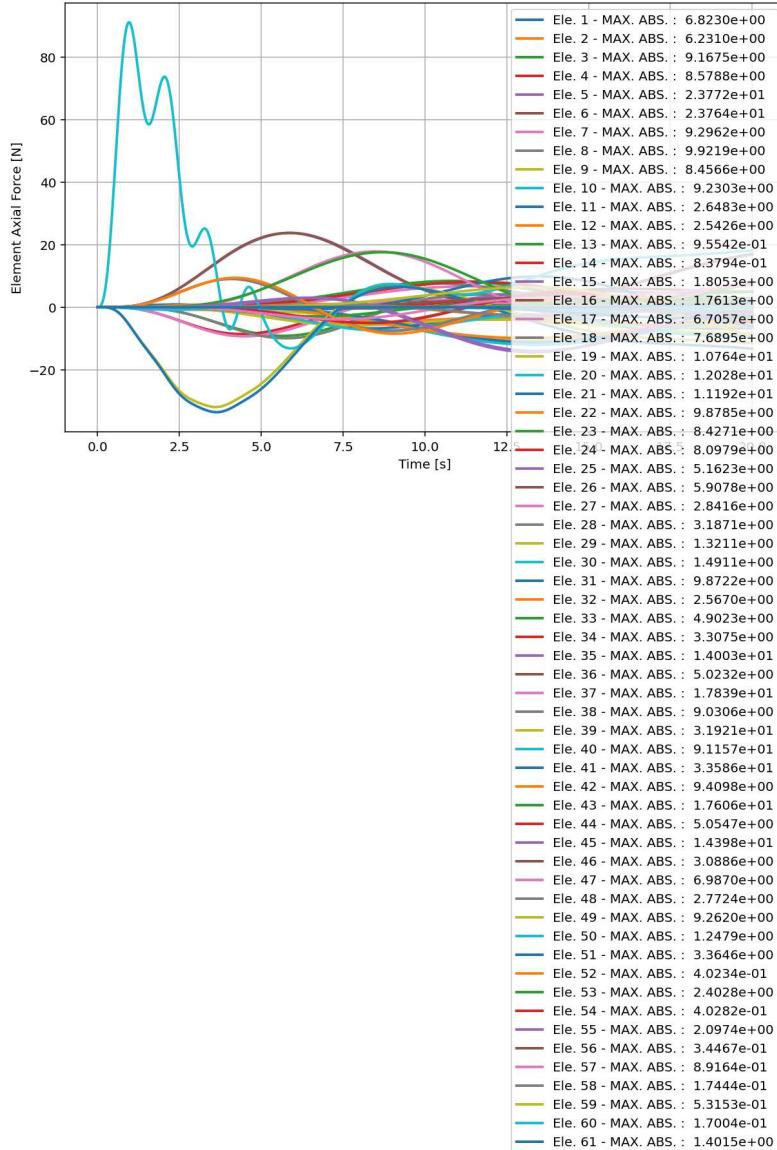


Base Reaction and Displacement of Structure During Dynamic External Time-dependent Loading Analysis

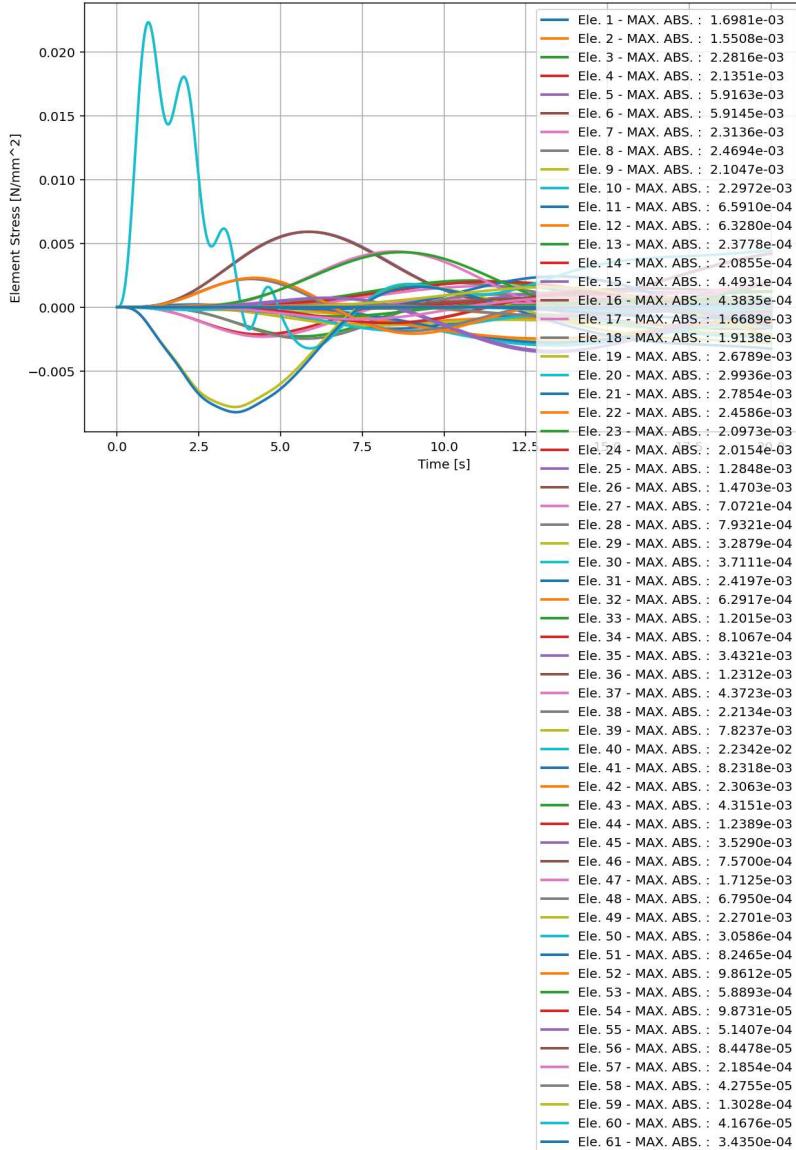




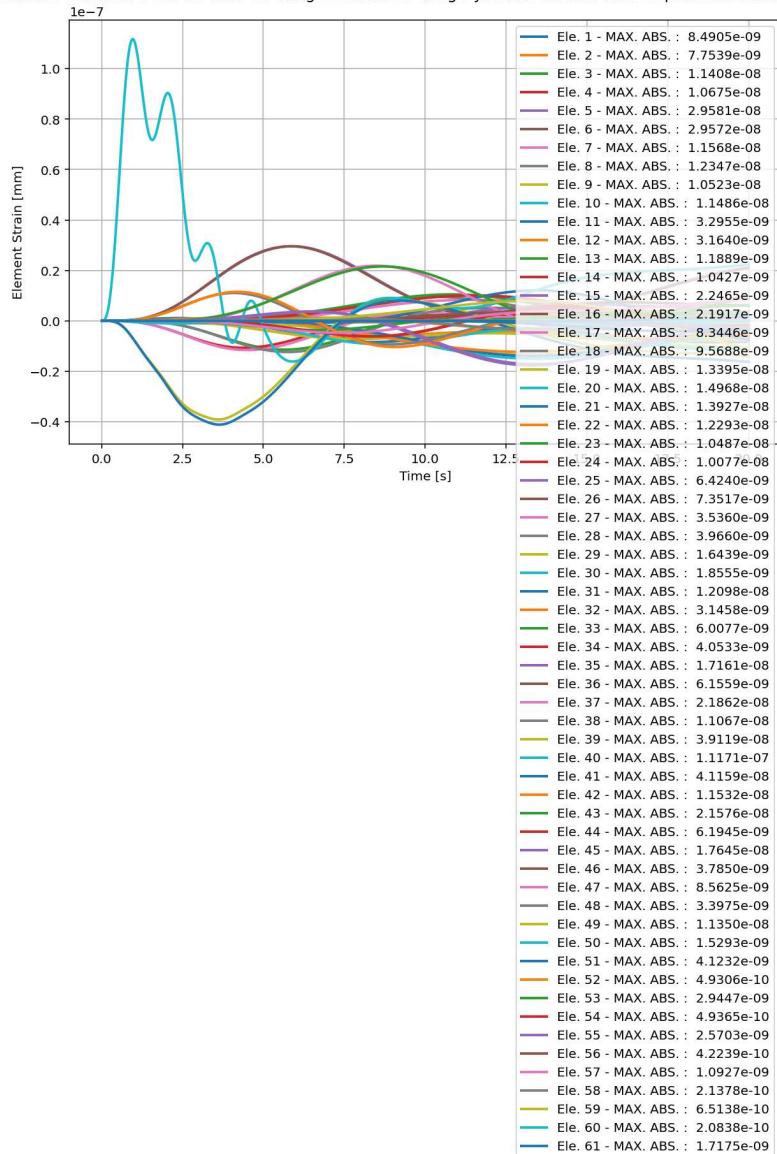
elements force in X Dir. vs Time for Bridge Structure During Dynamic External Time-dependent Loading Analysis

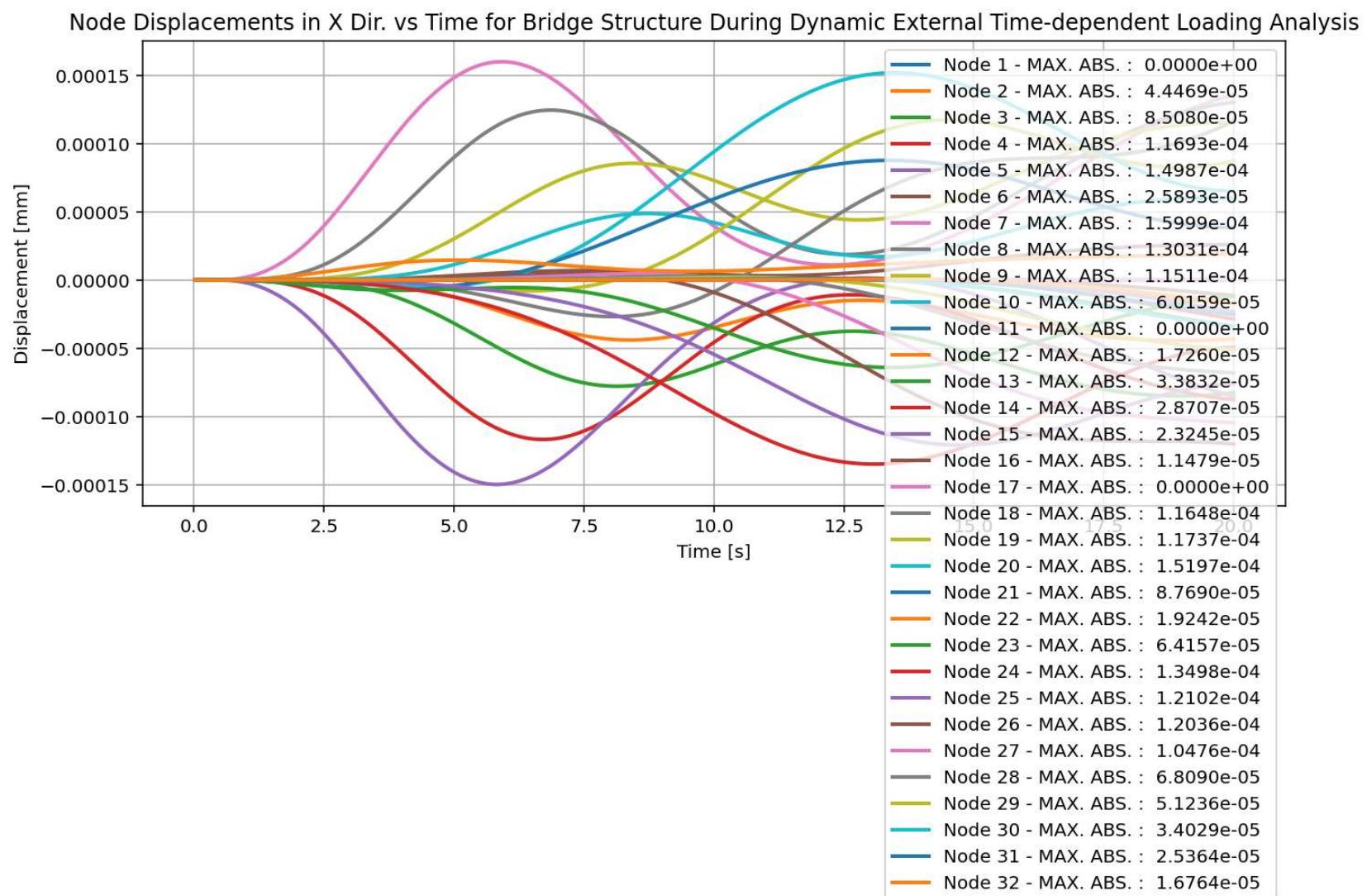


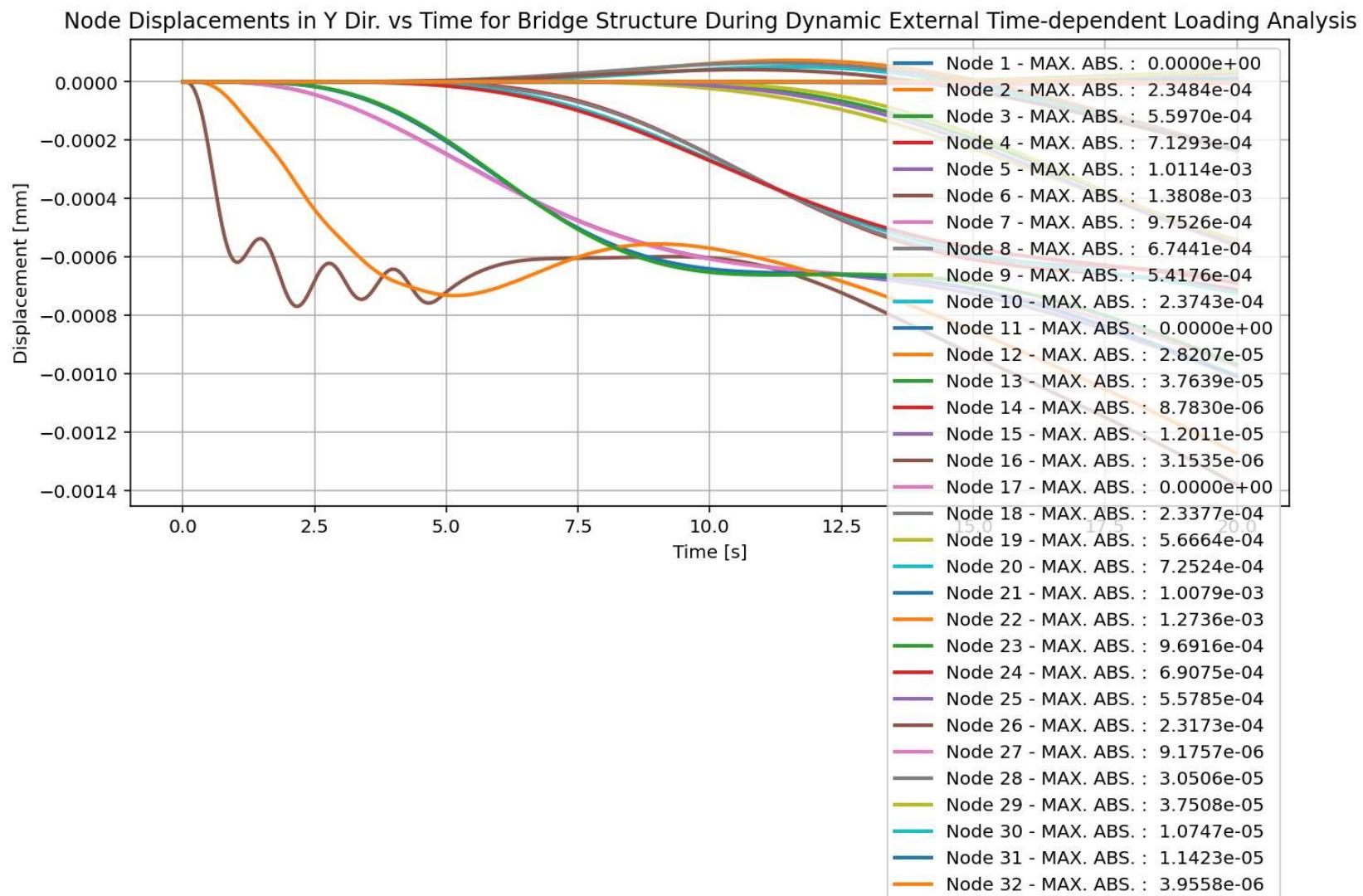
elements Stress in X Dir. vs Time for Bridge Structure During Dynamic External Time-dependent Loading Analysis



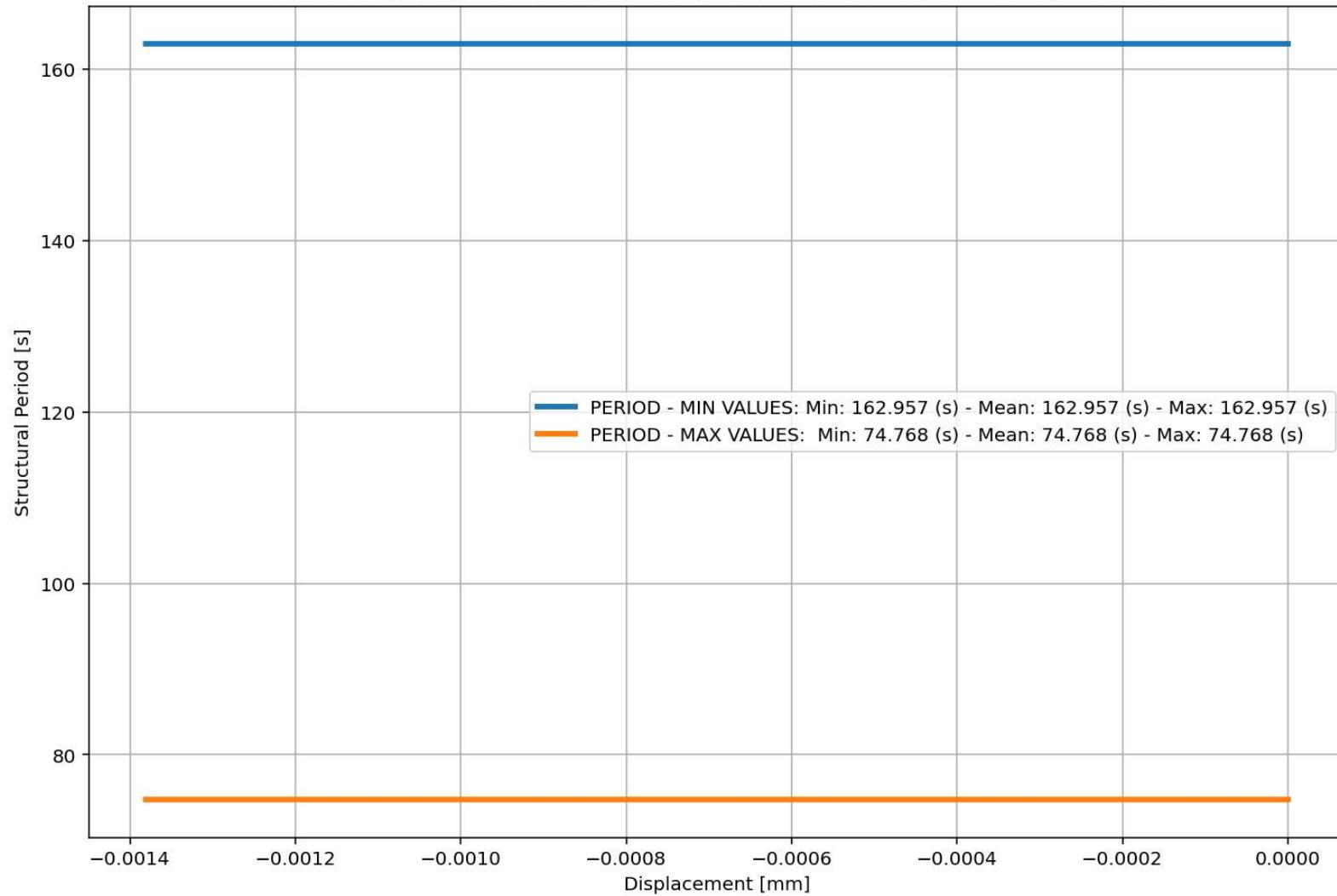
elements Strain in X Dir. vs Time for Bridge Structure During Dynamic External Time-dependent Loading Analysis

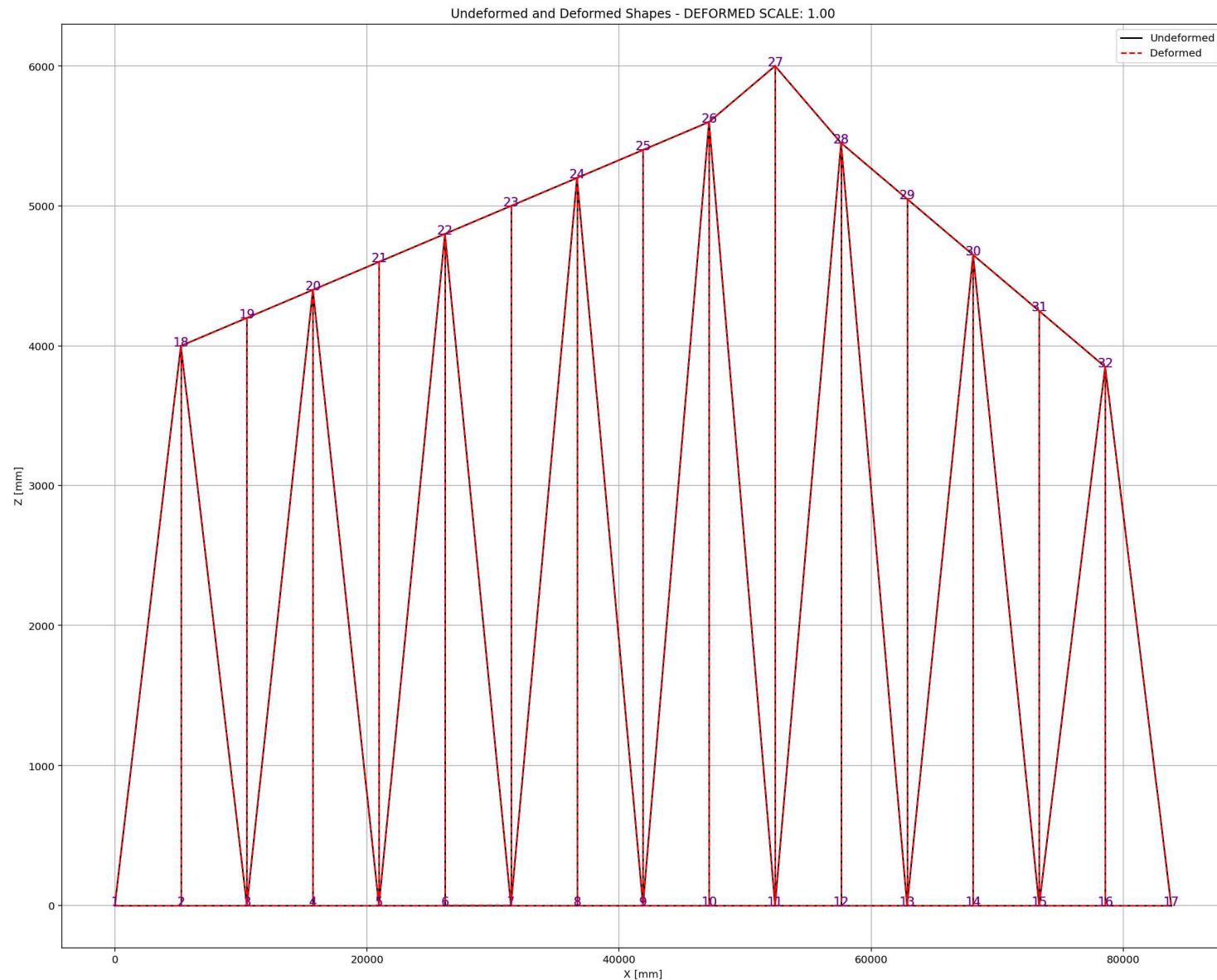




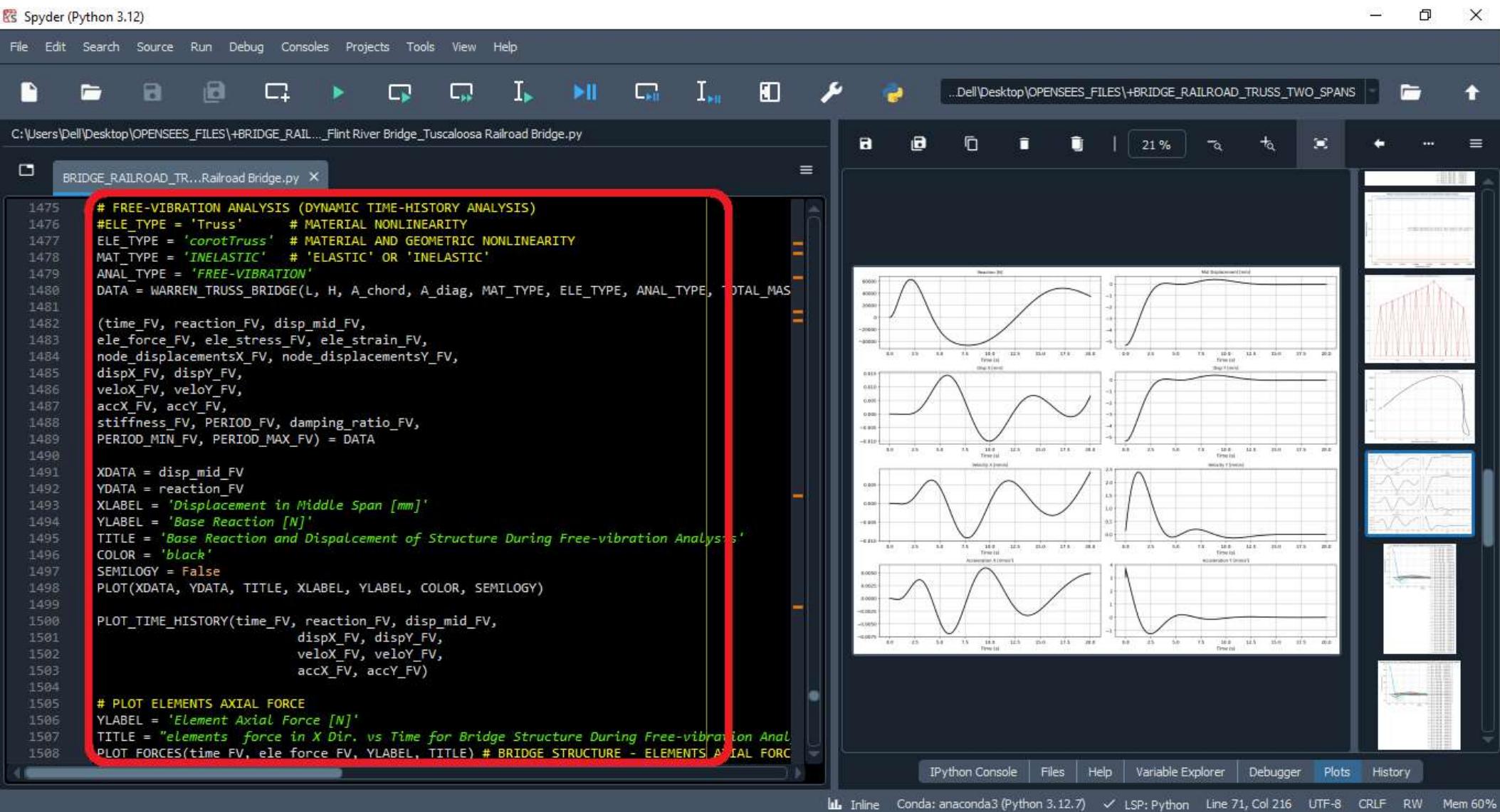


Period of Structure During Dynamic External Time-dependent Loading Analysis

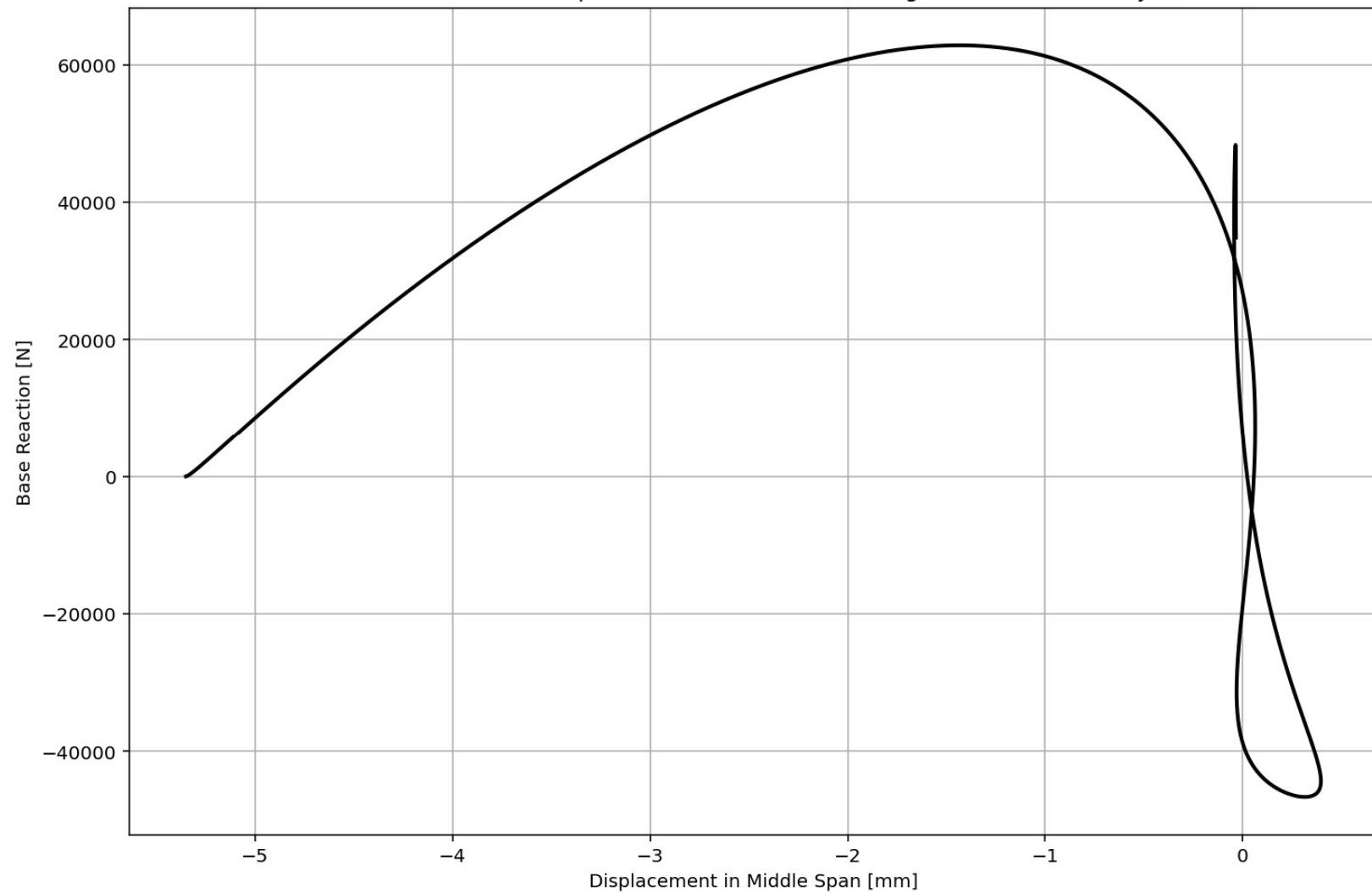


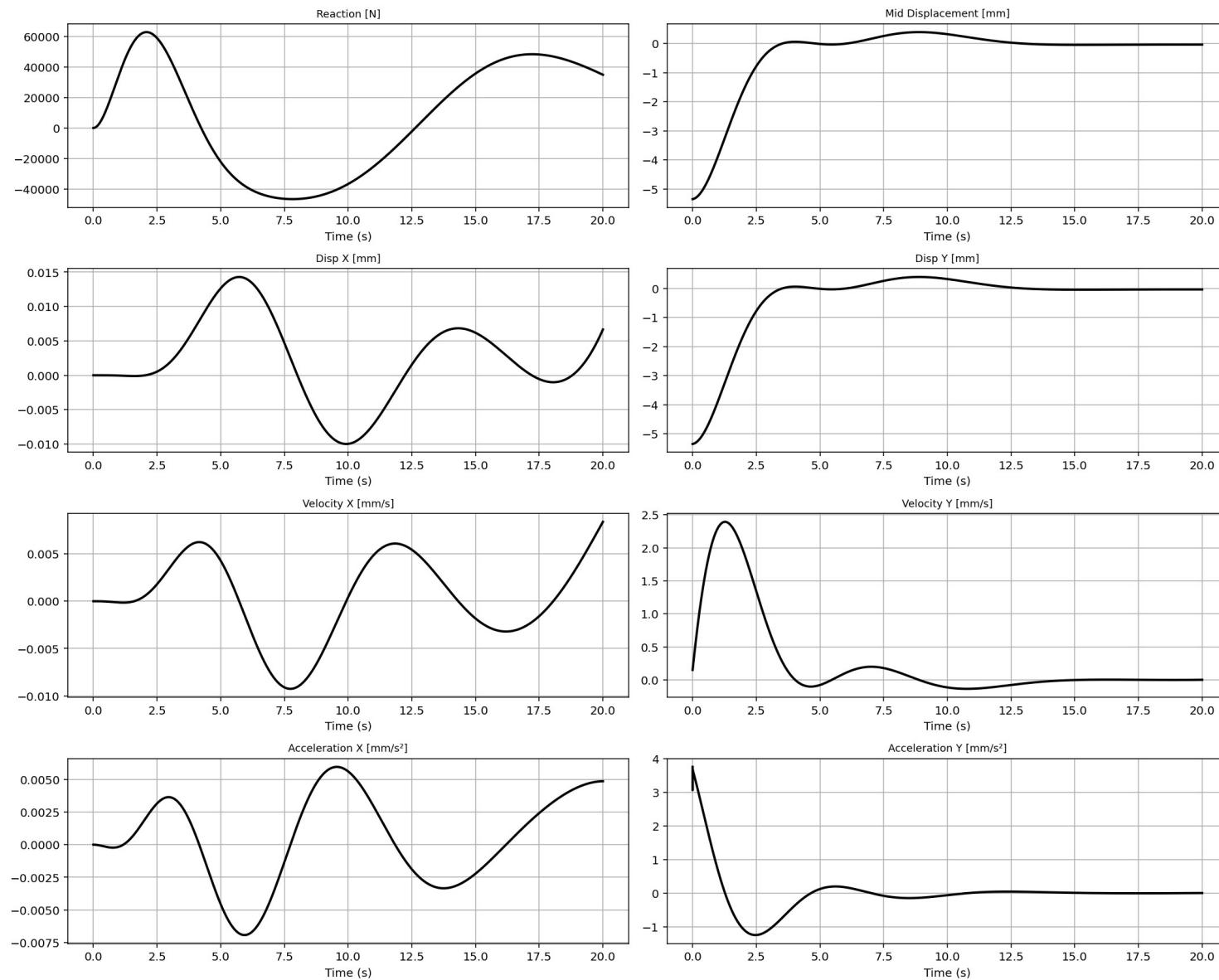


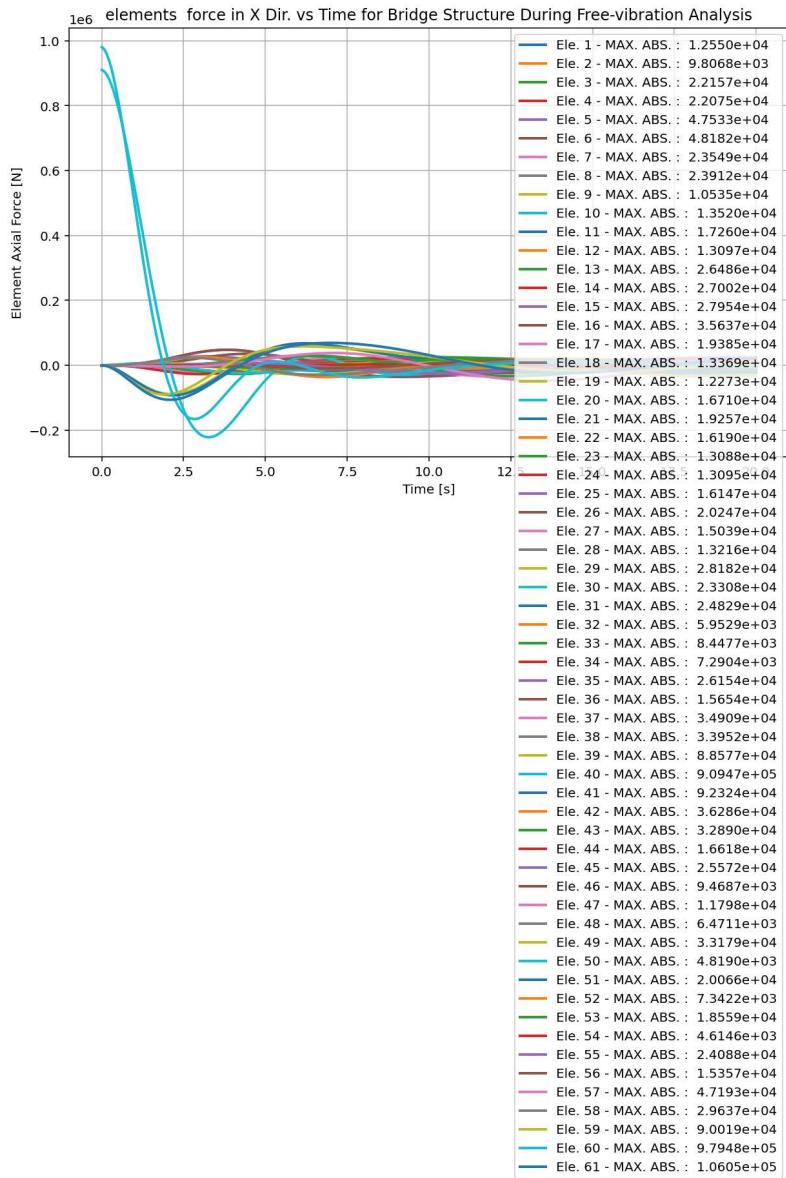
FREE-VIBRATION ANALYSIS



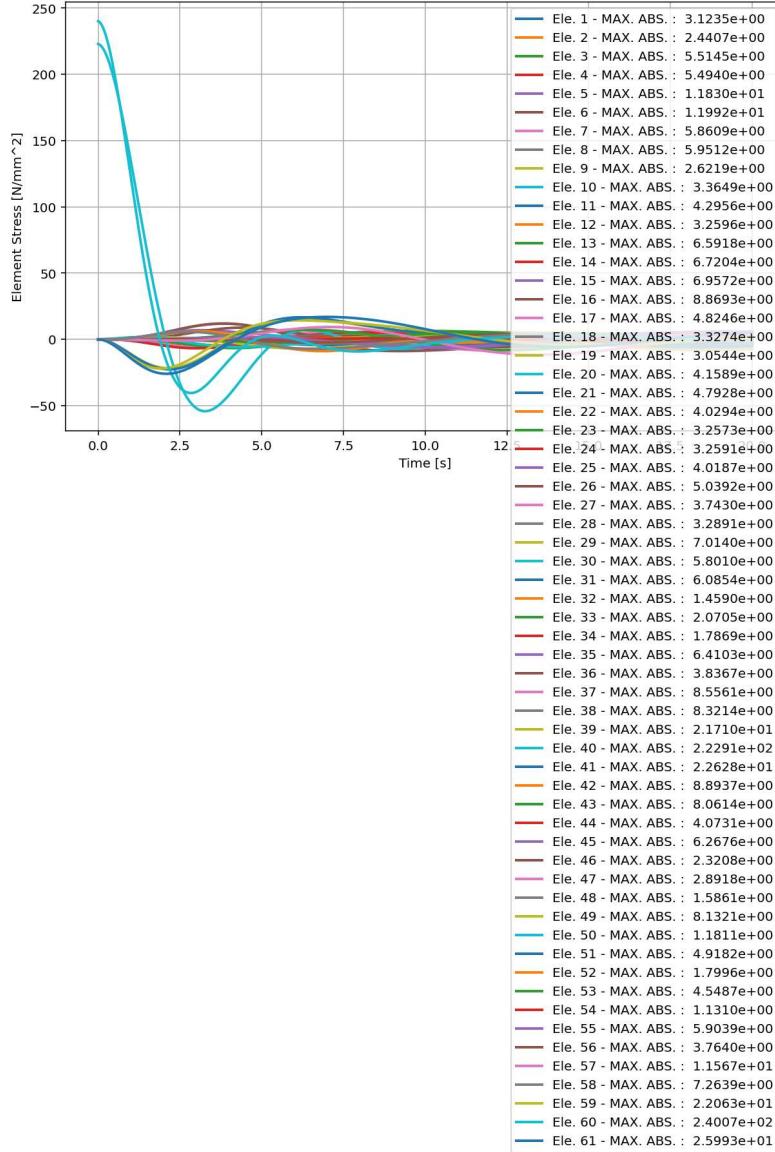
Base Reaction and Dispalcement of Structure During Free-vibration Analysis



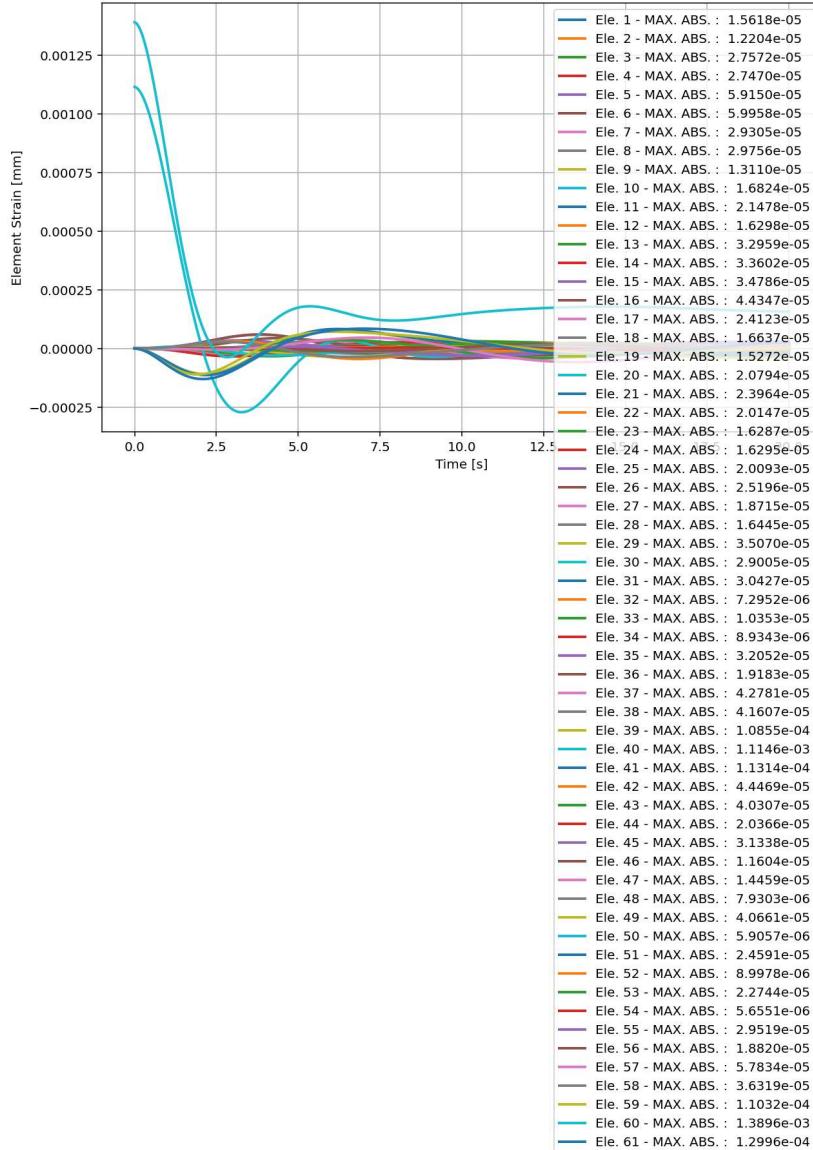




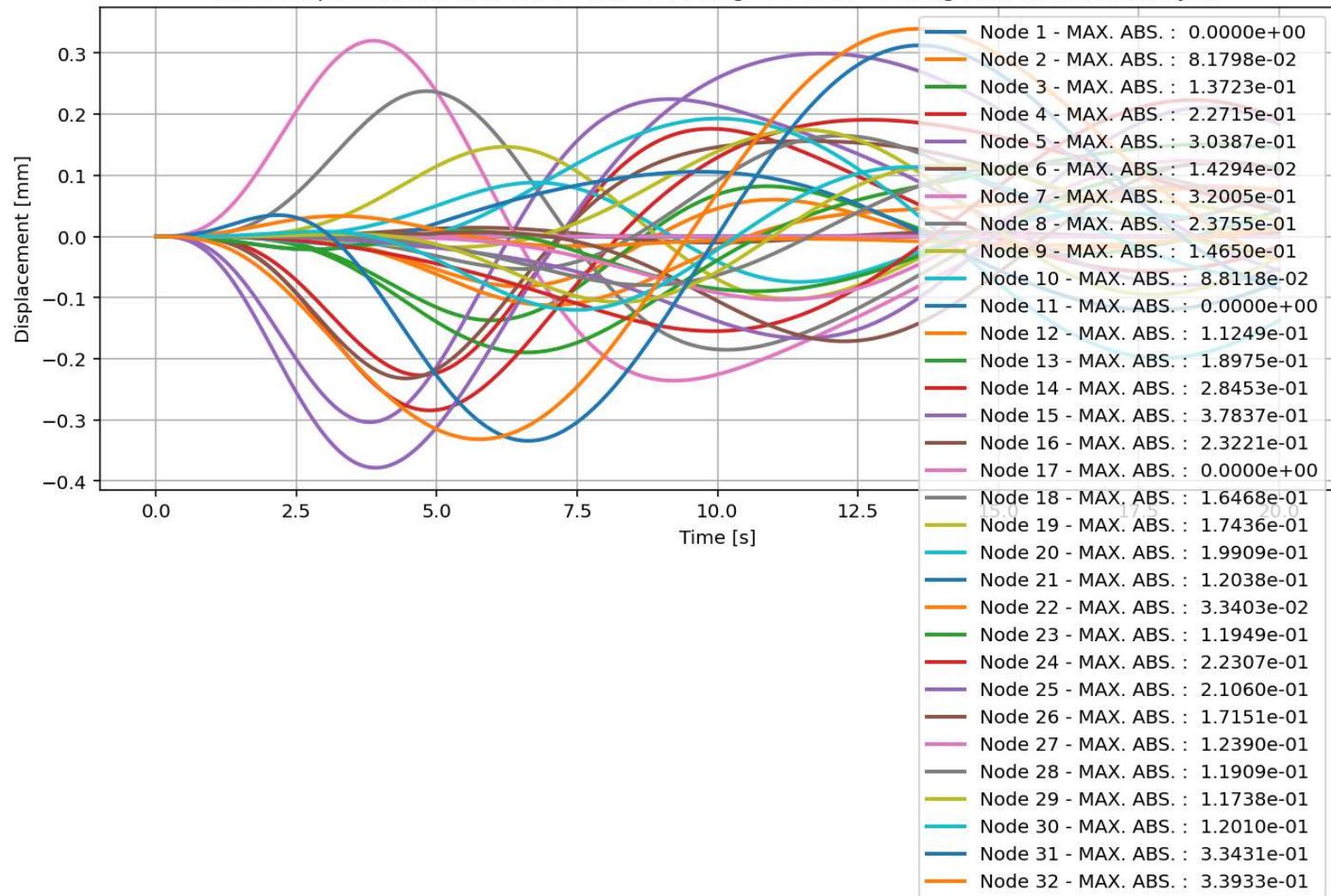
elements Stress in X Dir. vs Time for Bridge Structure During Dynamic External Time-dependent Loading Analysis



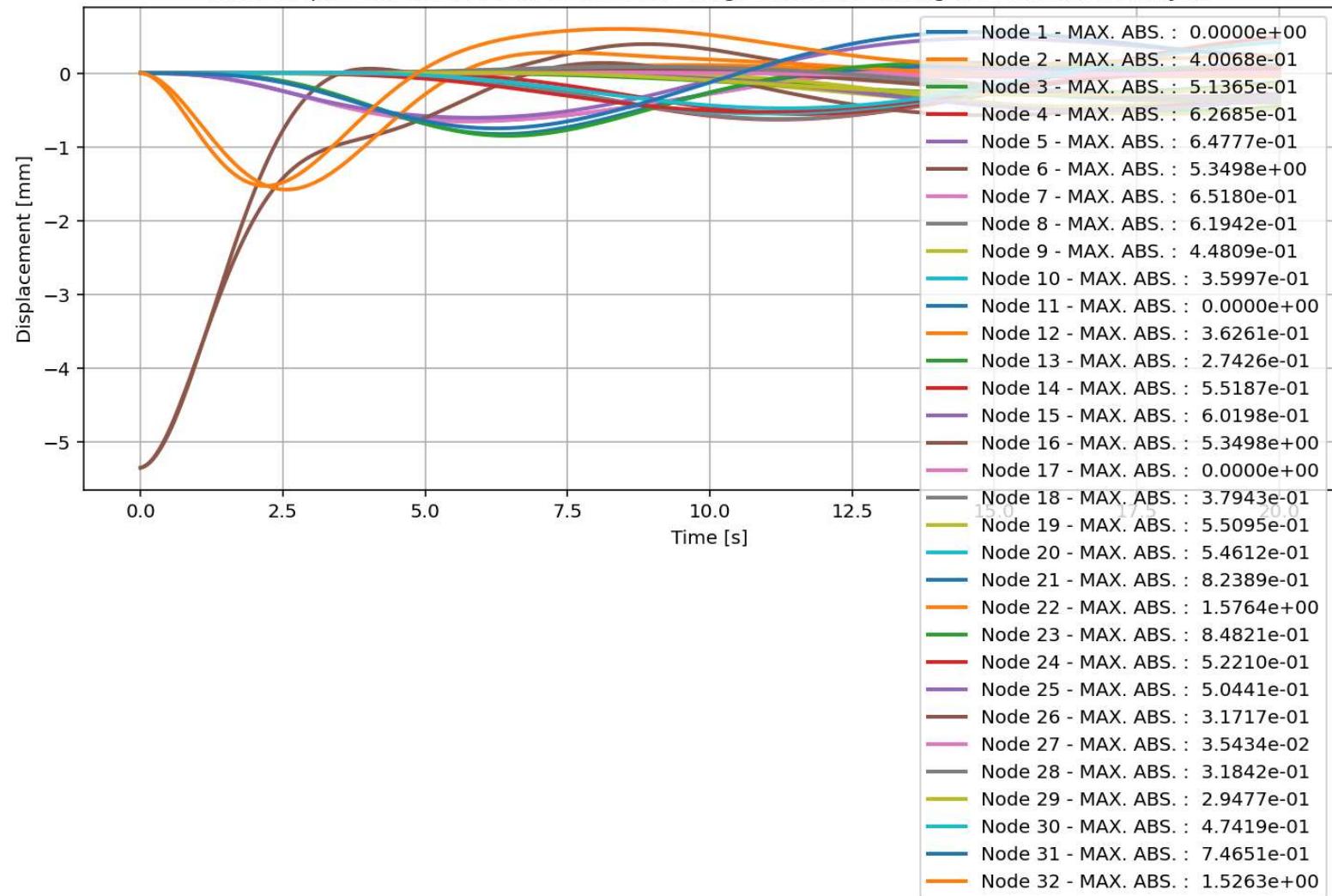
elements Strain in X Dir. vs Time for Bridge Structure During Dynamic External Time-dependent Loading Analysis



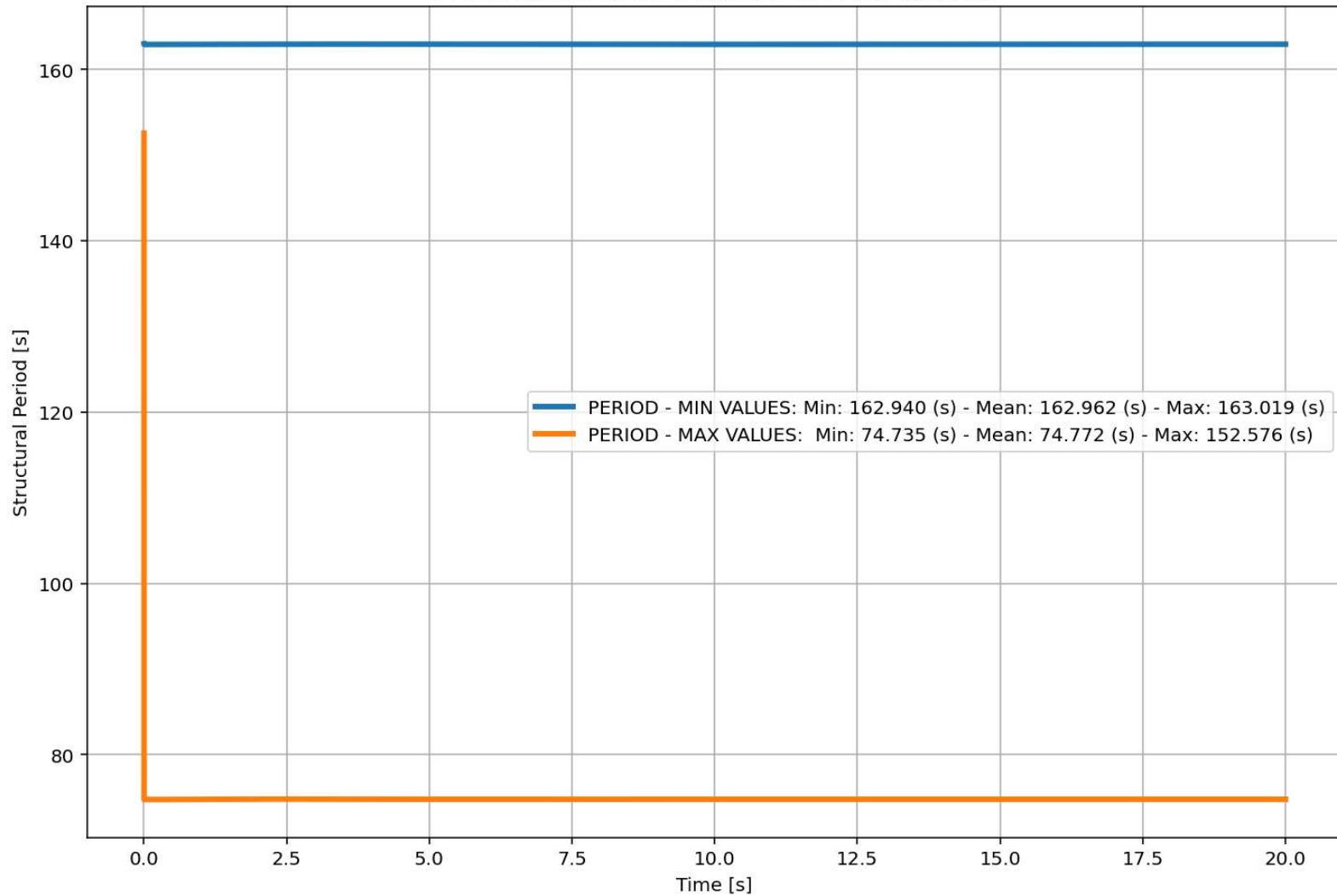
Node Displacements in X Dir. vs Time for Bridge Structure During Free-vibration Analysis

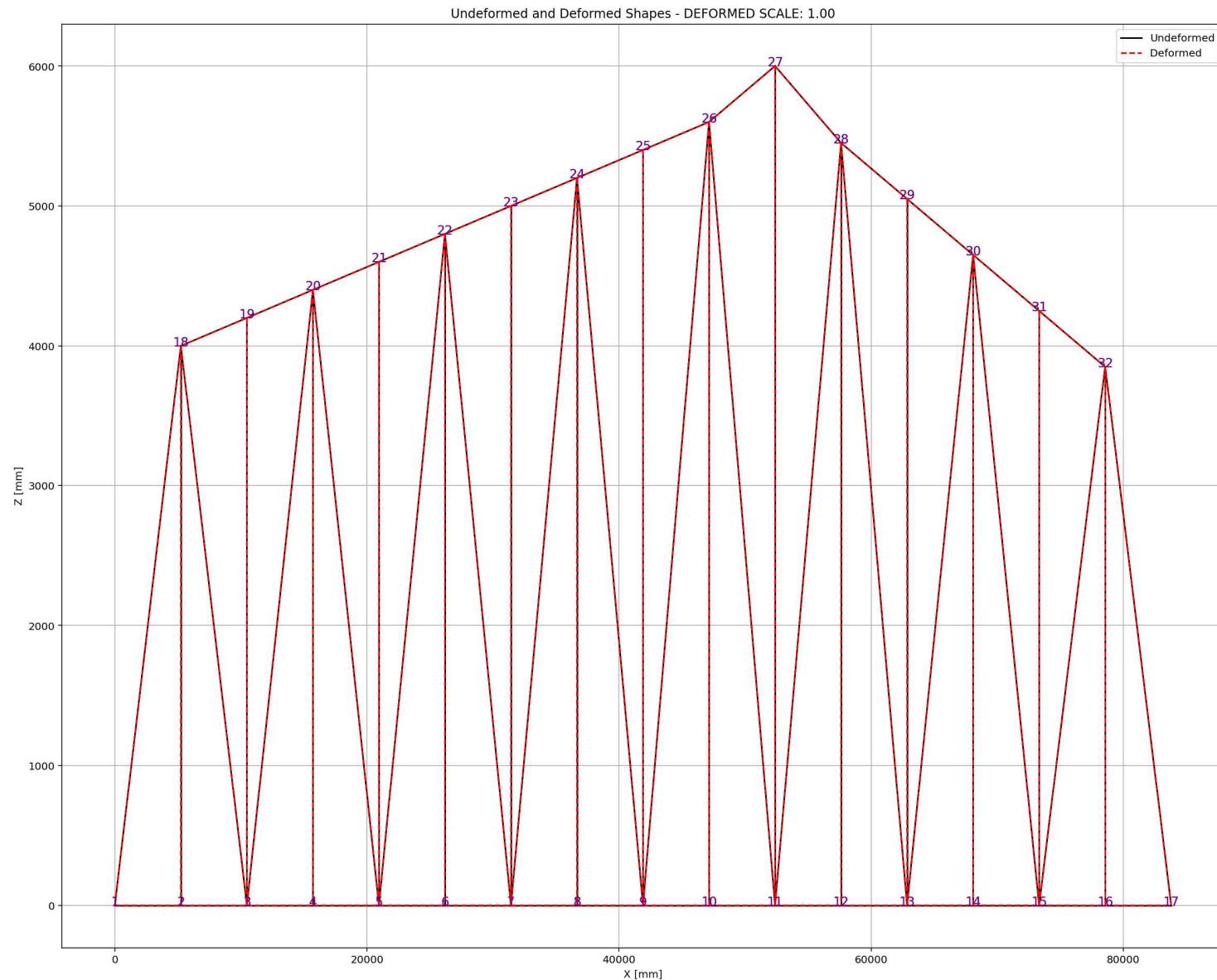


Node Displacements in Y Dir. vs Time for Bridge Structure During Free-vibration Analysis

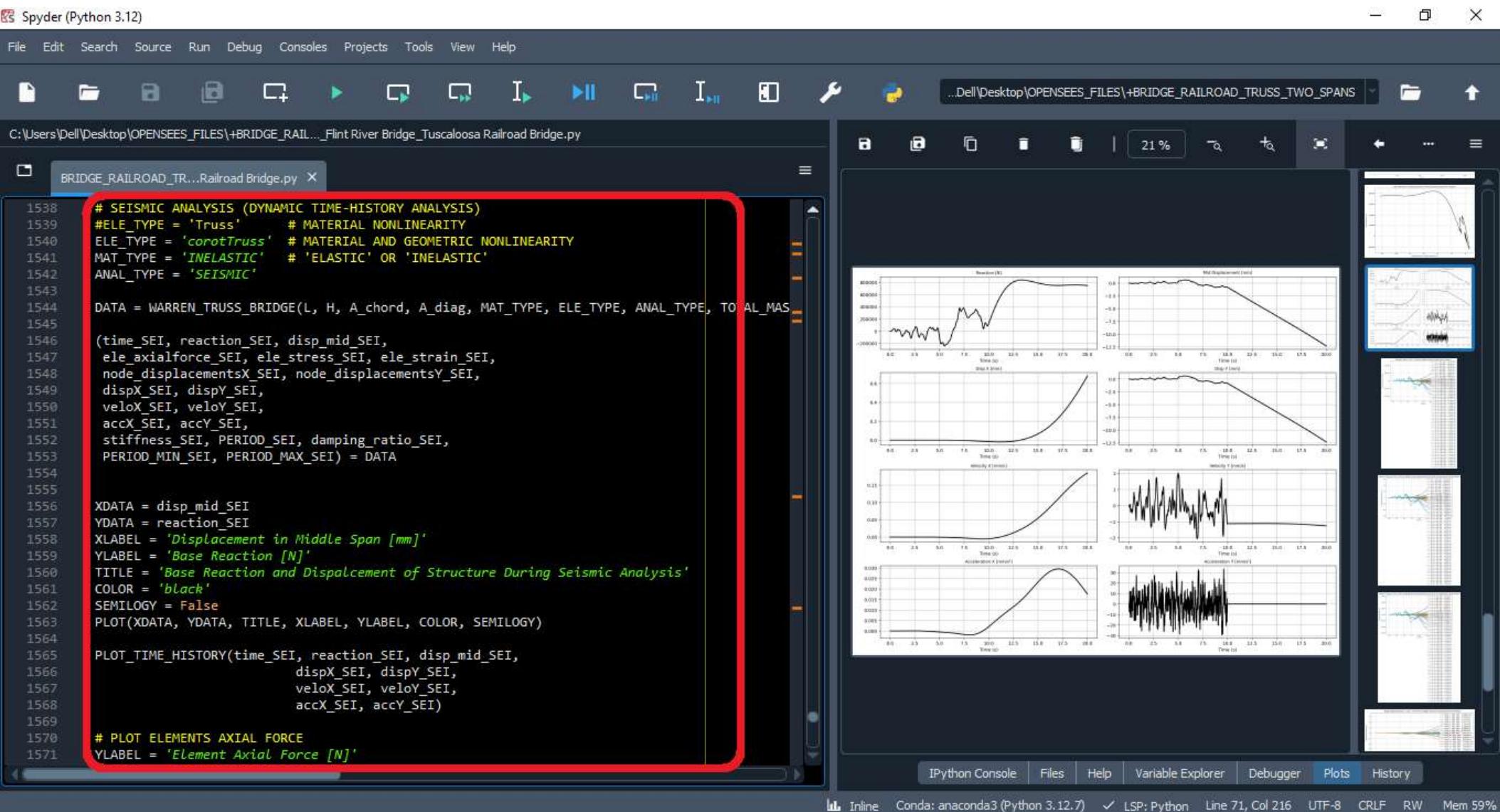


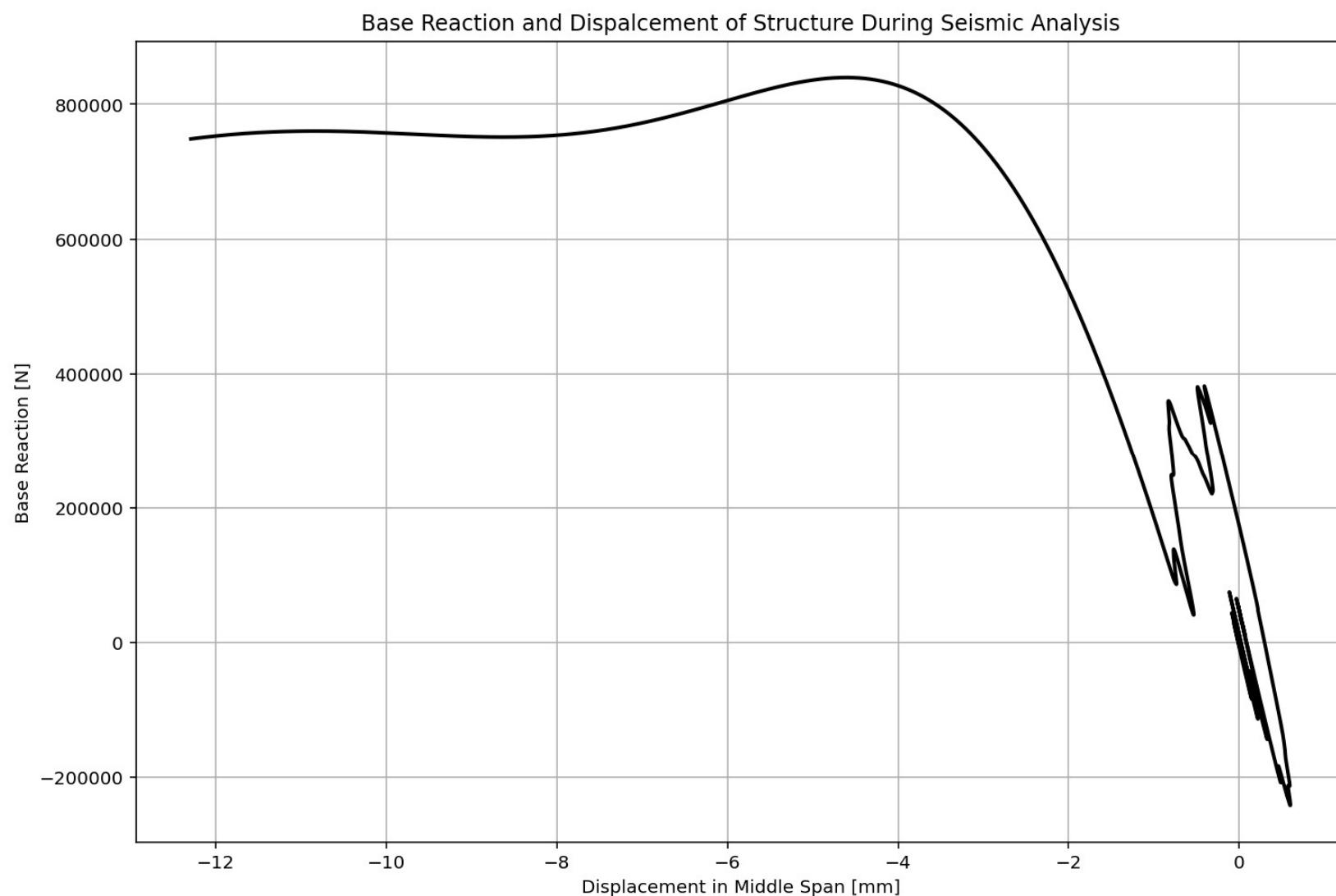
Period of Structure During Free-vibration Analysis

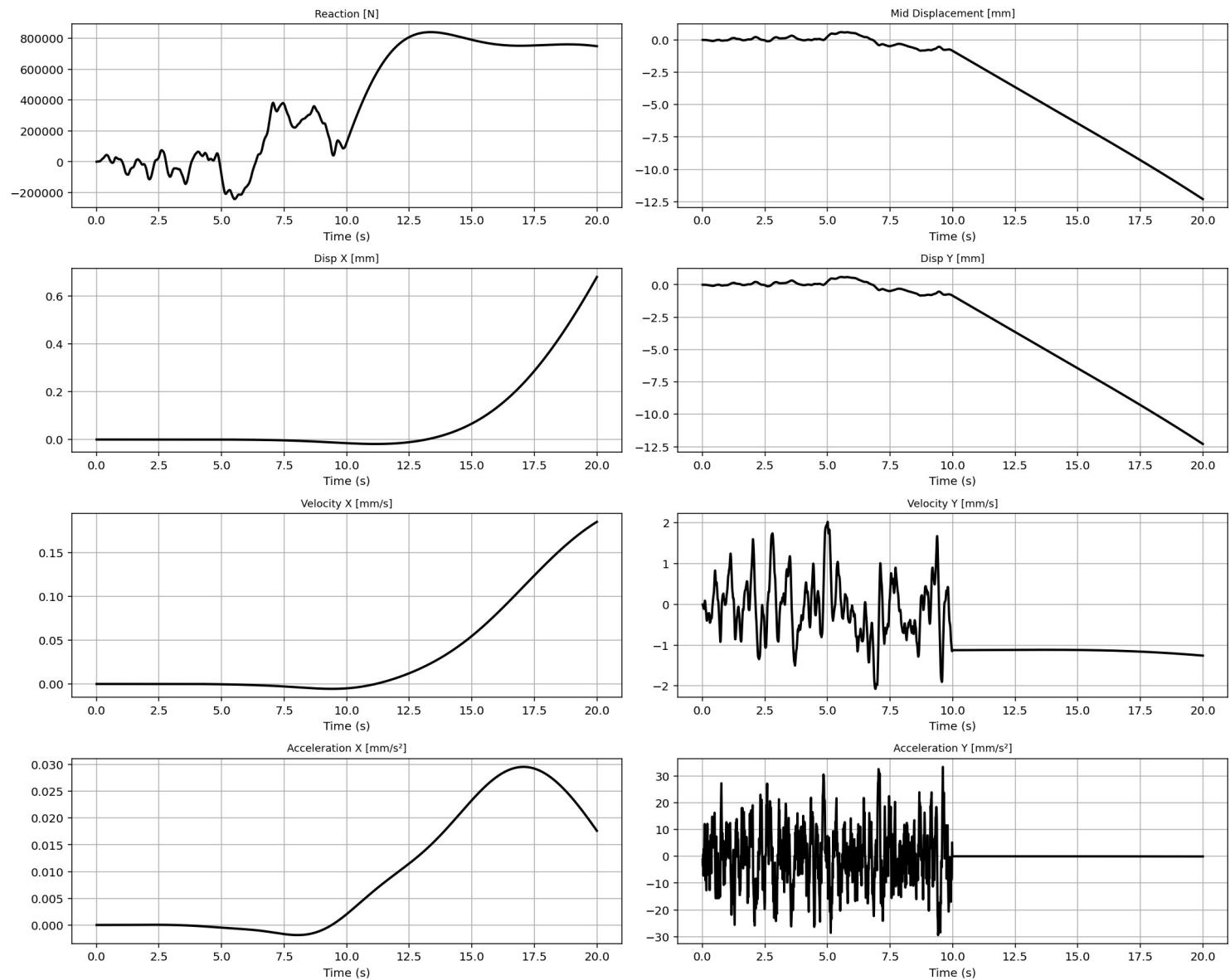


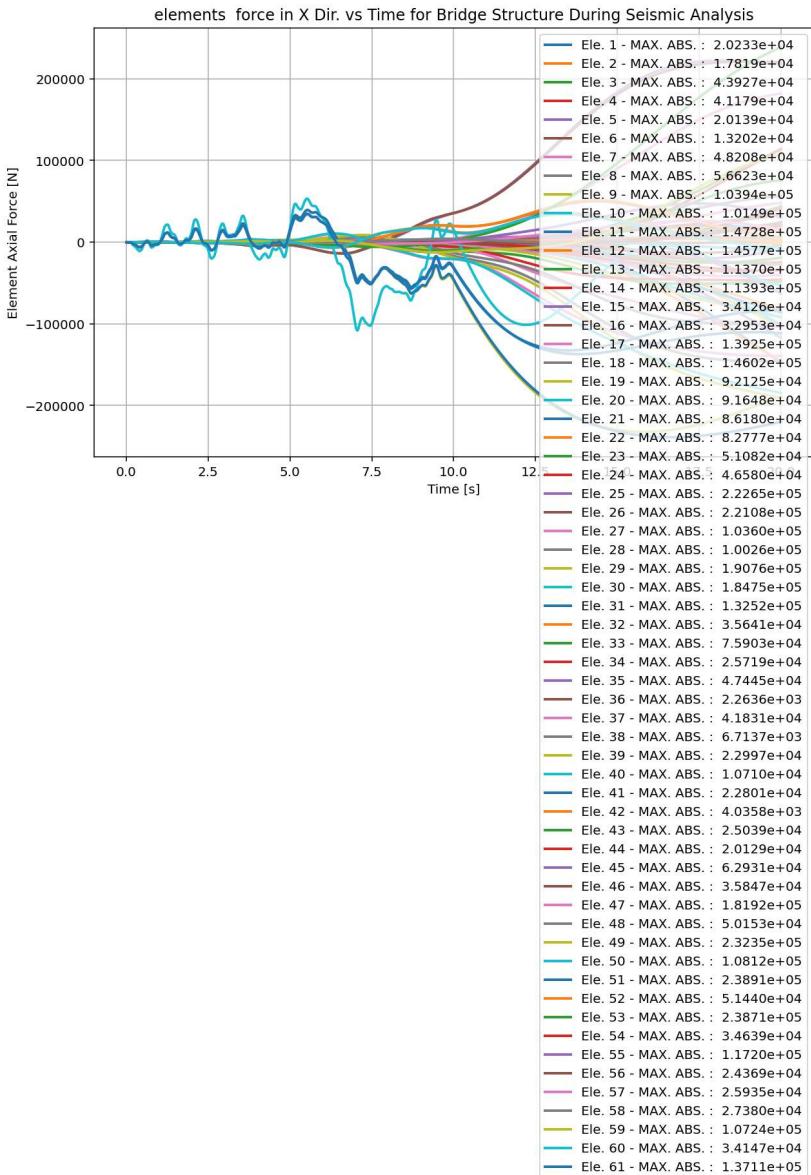


SEISMIC ANALYSIS

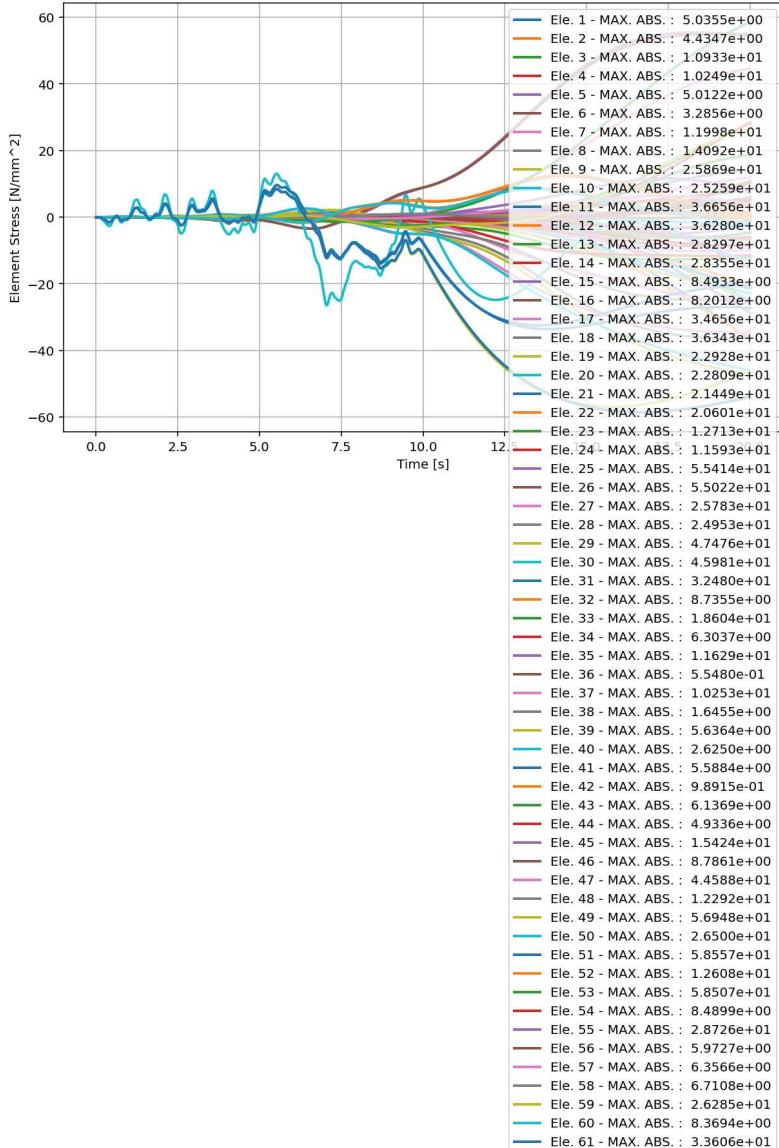




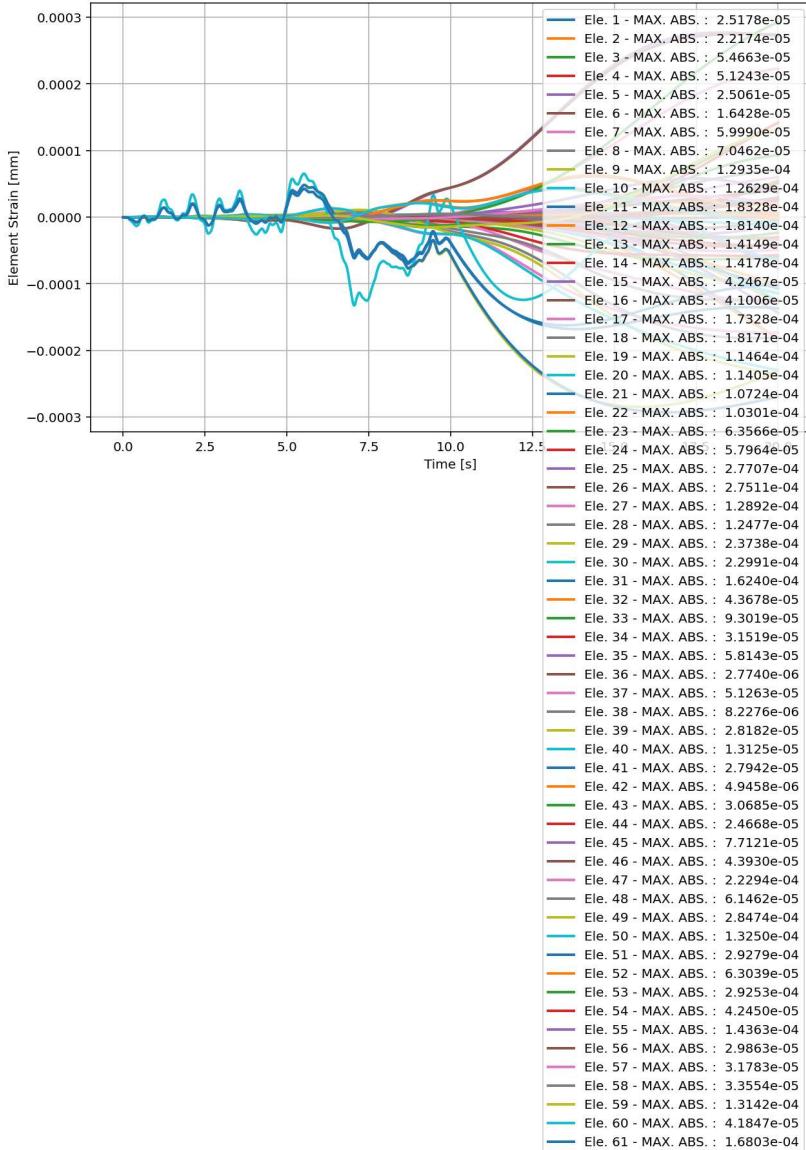




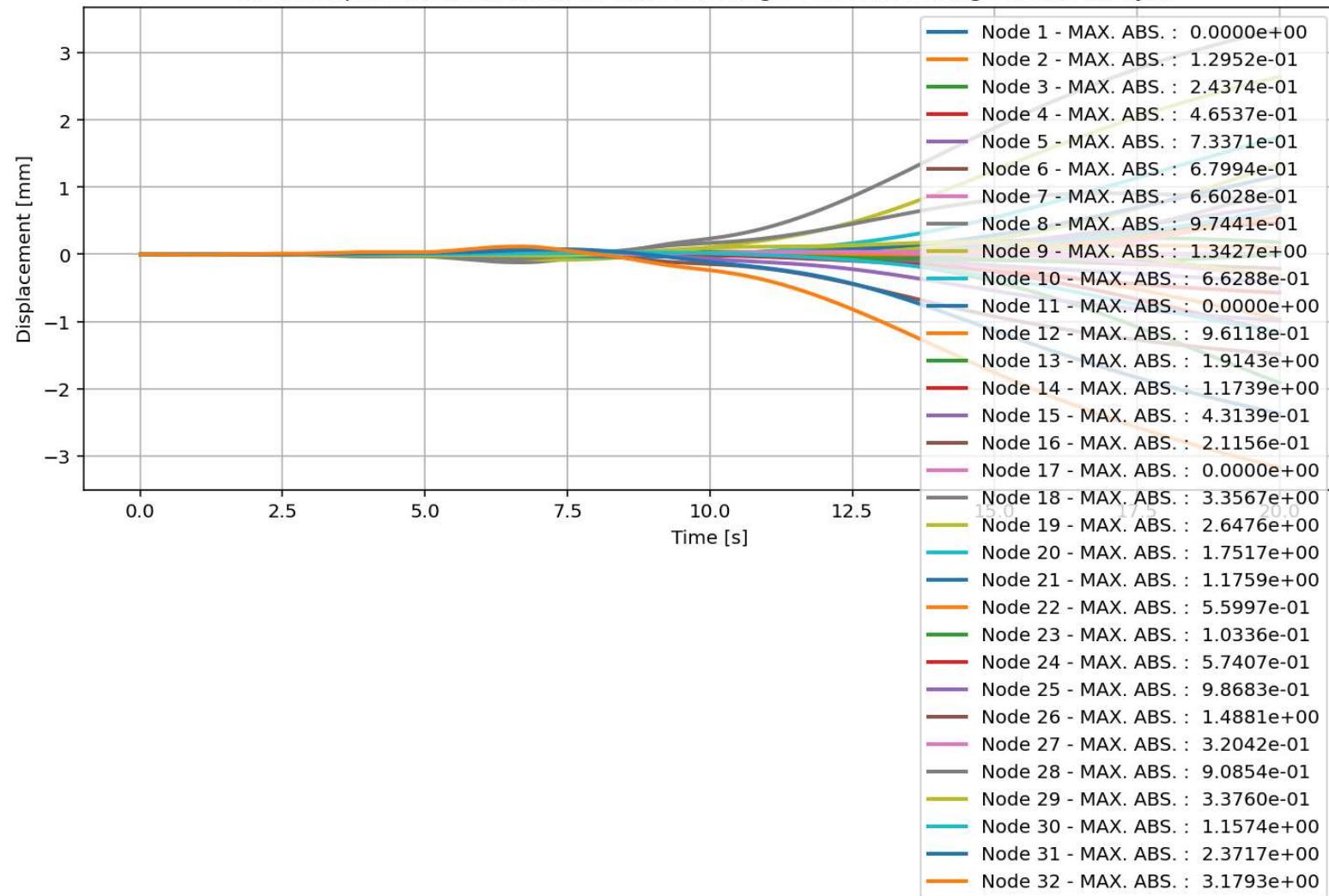
elements Stress in X Dir. vs Time for Bridge Structure During Dynamic External Time-dependent Loading Analysis

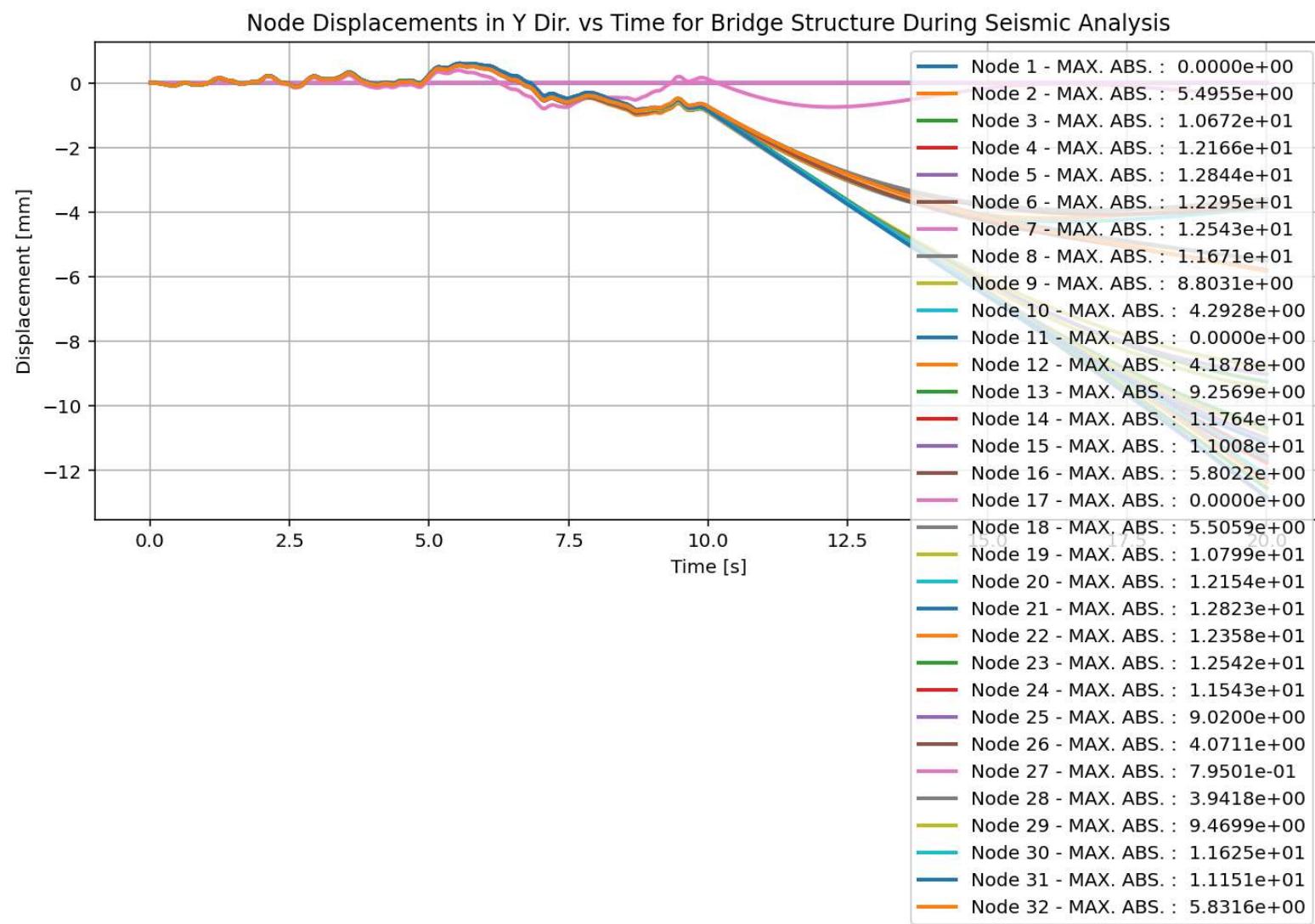


elements Strain in X Dir. vs Time for Bridge Structure During Dynamic External Time-dependent Loading Analysis

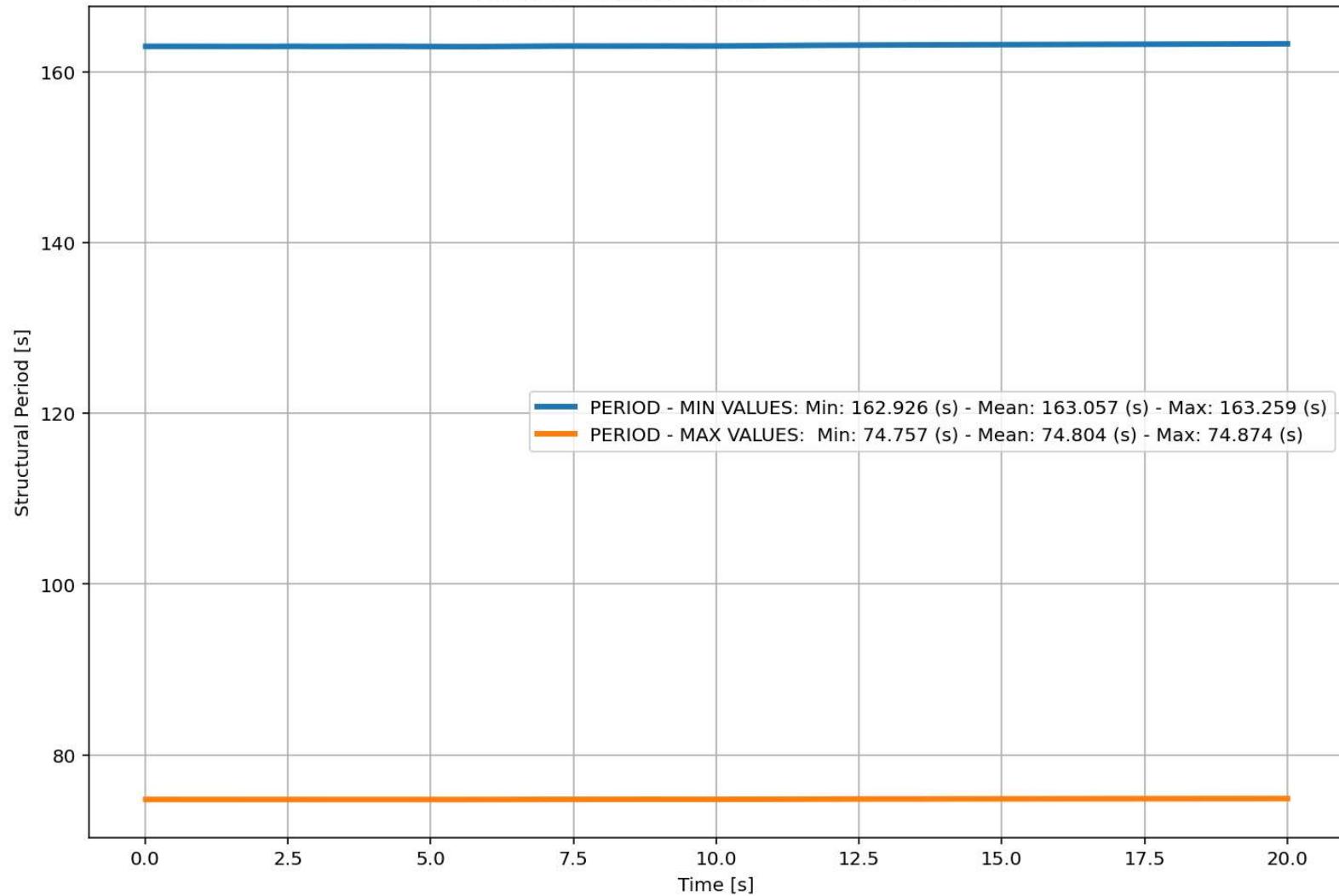


Node Displacements in X Dir. vs Time for Bridge Structure During Seismic Analysis





Period of Structure During Seismic Analysis



Last Data of BaseShear-Displacement Analysis - Ductility Ratio: 3.5720 - Over Strength Factor: 1.0615

