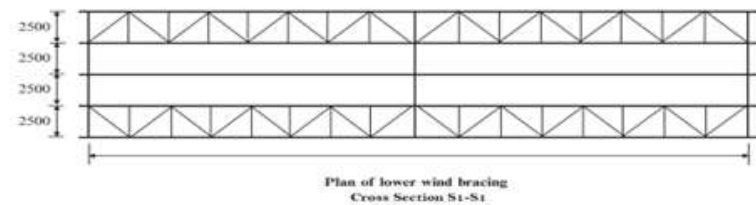
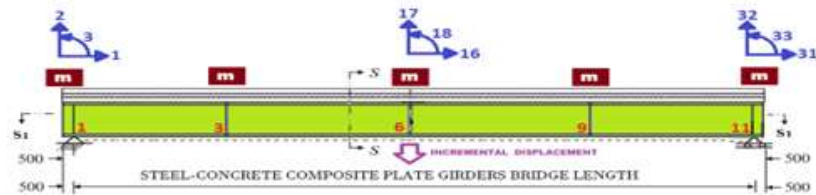
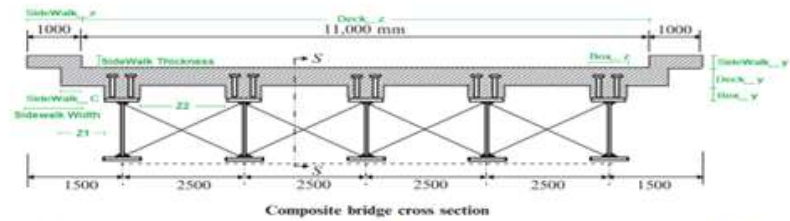


>> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<

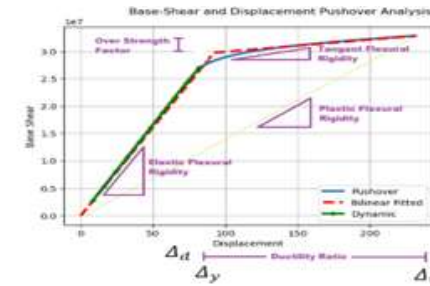
# **STEEL-CONCRETE COMPOSITE PLATE GIRDERS BRIDGE SUPERSTRUCTURE RUNNING MOMENT-CURVATURE, PUSHOVER AND DYNAMIC ANALYSIS FOR CALCULATE STRUCTURAL DUCTILITY DAMAGE INDEX**

WRITTEN BY SALAR DELAVAR GHASHGHAEE (QASHQAI)

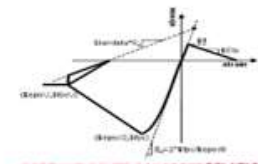
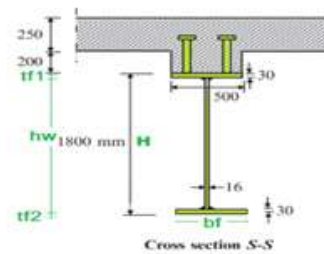
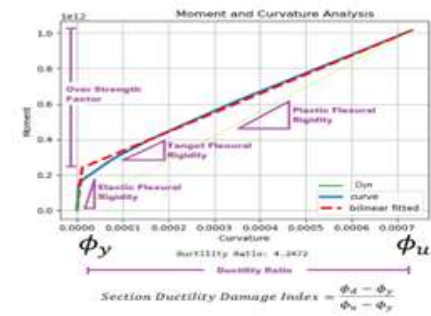




$$\text{Structure Ductility Damage Index} = \frac{\Delta_d - \Delta_y}{\Delta_u - \Delta_y}$$

$$\Delta_{dt} = \text{Lateral Displacement from Dynamic Analysis}$$
 $\Delta_y$  = Lateral Yield Displacement from Pushover Analysis
$$\Delta_u = \text{Lateral Ultimate Displacement from Pushover Analysis}$$


$$\text{Structure Ductility Damage Index} = \frac{\Delta_d - \Delta_y}{\Delta_w - \Delta_y}$$



$$\text{Axial Ductility Damage Index} = \frac{\epsilon_d - \epsilon_y}{\epsilon_u - \epsilon_y}$$

$$\text{Section Ductility Damage Index} = \frac{\phi_d - \phi_y}{\phi_u - \phi_y}$$

$$\text{Structure Ductility Damage Index} = \frac{\Delta_d - \Delta_y}{\Delta_u - \Delta_y}$$



C:\Users\Dell\Desktop\OPENSEES\_FILES\SINGLE\_SPAN\_... \SINGLE\_SPAN\_SIMPLE\_SUPPORTED\_COMPOSITE\_BRIDGE.py

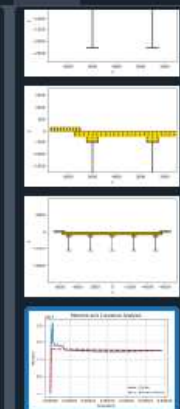
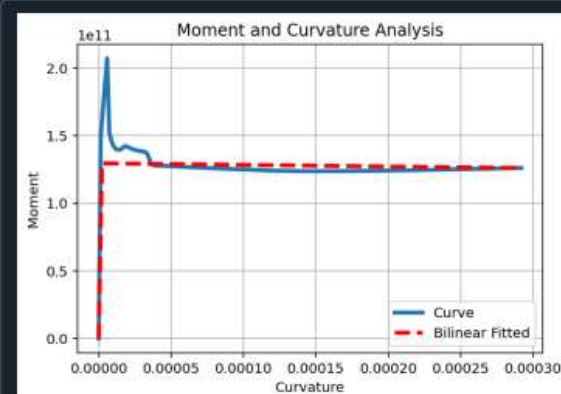
EL-COMPUTING.py x CONCRETE\_FRAME\_DUCTILITY\_DAMAGE\_INDEX.py x SINGLE\_SPAN\_SIMPLE...OMPOSITE\_BRIDGE.py x

```

1  # #####
2  #                                     IN THE NAME OF ALLAH
3  #                                     STEEL-CONCRETE COMPOSITE PLATE GIRDERS BRIDGE SUPERSTRUCTURE
4  #                                     RUNNING MOMENT-CURVATURE, PUSHOVER AND DYNAMIC ANALYSIS FOR CALCULATE
5  #                                     OPTIMUM STRUCTURAL DUCTILITY DAMAGE INDEX
6  # -----
7  #                                     THIS PROGRAM WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)
8  #                                     EMAIL: salar.d.ghashghaei@gmail.com
9  # #####
10
11 #import the os module
12 import os
13 import time as TI
14 import numpy as np
15 import openseespy.opensees as op
16 import opsvis as opsv
17 import matplotlib.pyplot as plt
18 import ANALYSIS_FUNCTION as S02
19 import PLOT_2D as S04
20 import SALAR_MATH as S05
21
22 #%%-----
23 # Create a directory at specified path with name 'directory_path'
24 #import os
25 directory_path = 'C:\\\\OPENSEESPY_SALAR'
26
27 # Check if the directory already exists
28 if not os.path.exists(directory_path):
29     os.mkdir(directory_path)
30     print(f"Directory '{directory_path}' created successfully.")
31 else:
32     print(f"Directory '{directory_path}' already exists. Skipping creation.")
33 #-----
34 # Create folder name
35 FOLDER_NAME = 'COMPOSITE BRIDGE OPTIMIZATION'
    
```

C:\Users\Dell

45 %



Help Variable Explorer Debugger Plots Files

Console 1/A x

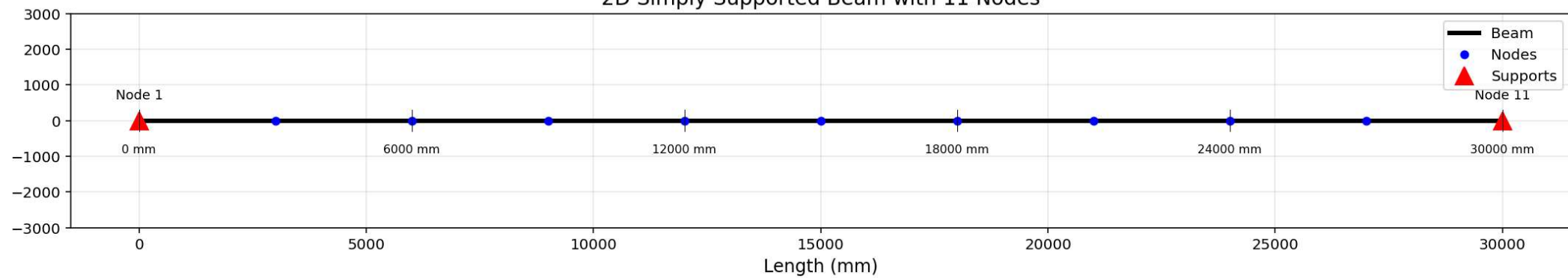
```

CTestNormDispIncr::test() - iteration: 2 current Norm: 1.04382e-14
(max: 1e-08, Norm deltaR: 0.00119821)
1218 -5.1041642071227905e-16 -7.450580596923828e-09
1219 1.841482195566861e-16 -9.685754776000977e-08
1220 -8.135819203360762e-18 -1.4901161193847656e-08
1221 -1.3730480488676494e-17 6.705522537231445e-08
1222 -7.018724453083643e-18 0.0
1223 1.6628443172577976e-16 7.450580596923828e-09
CTestNormDispIncr::test() - iteration: 2 current Norm: 2.66403e-14
(max: 1e-08, Norm deltaR: 0.0029853)
CTestNormDispIncr::test() - iteration: 2 current Norm: 2.69497e-14
    
```

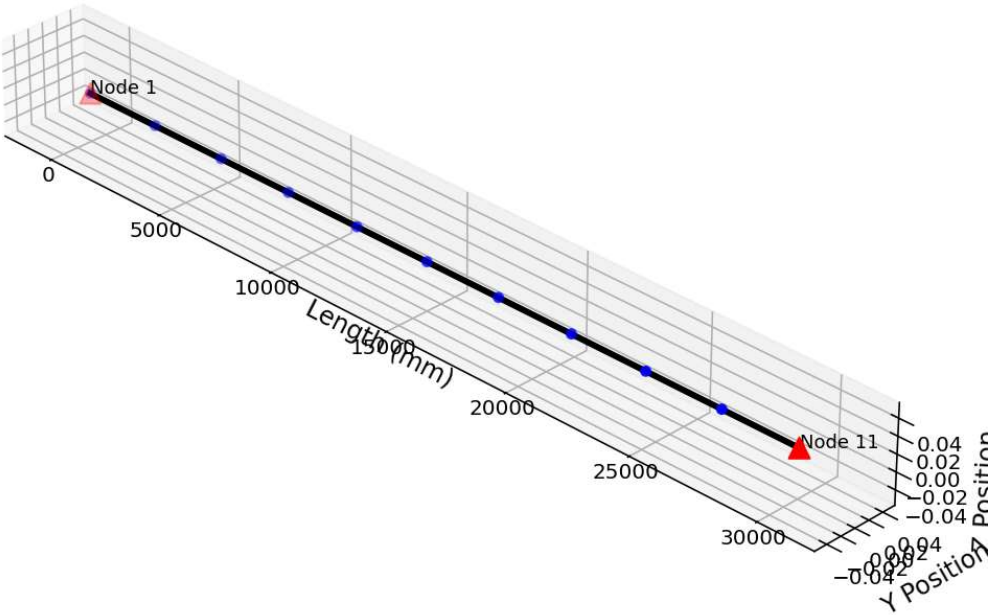
IPython Console History

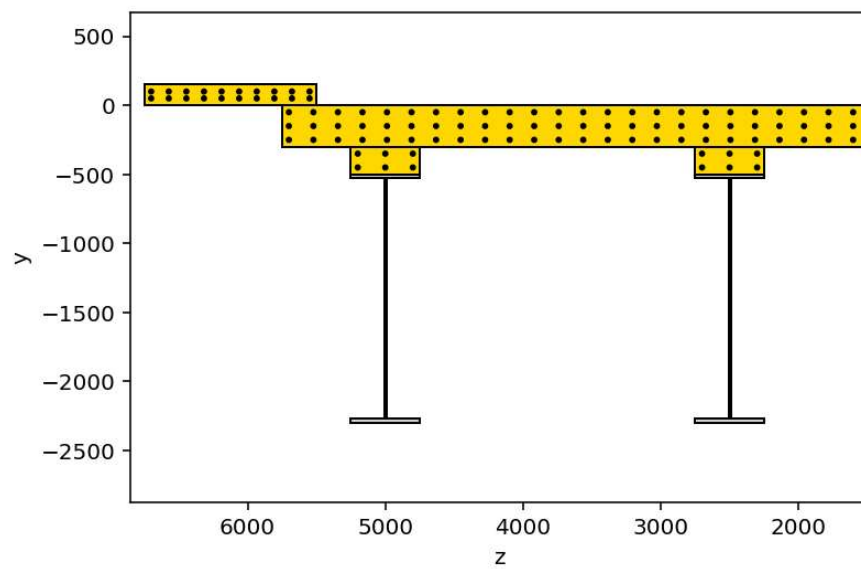
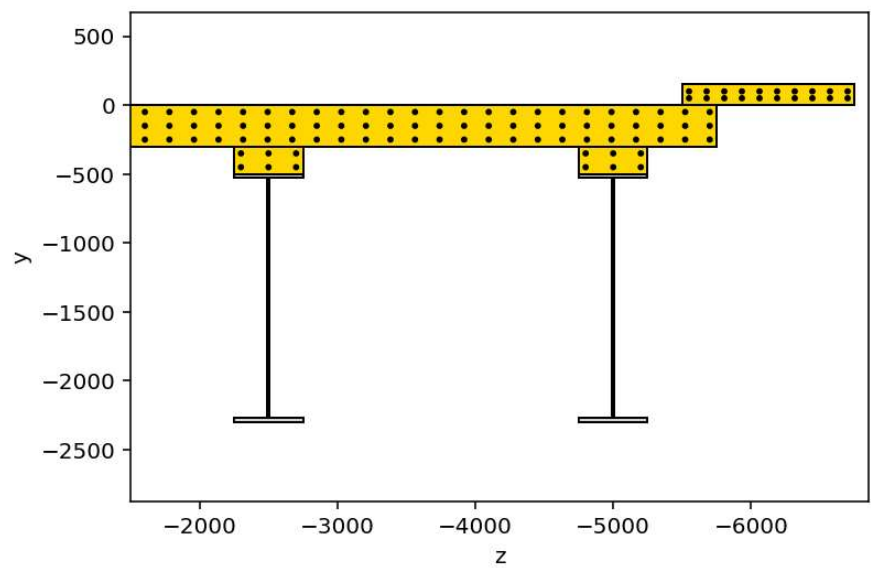
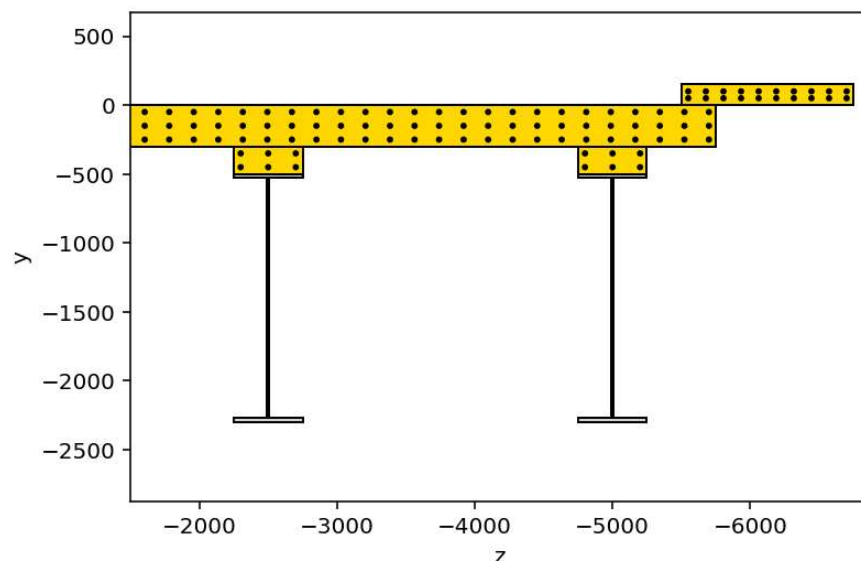
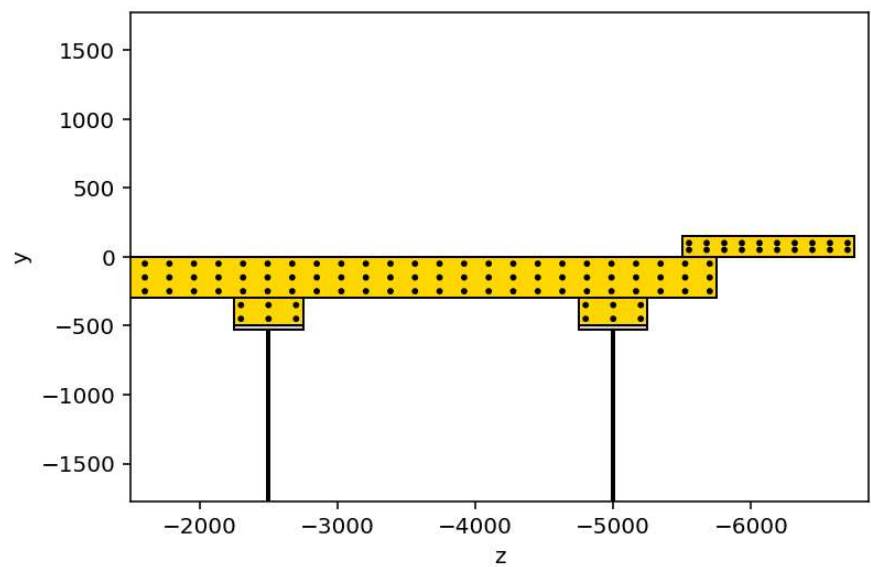


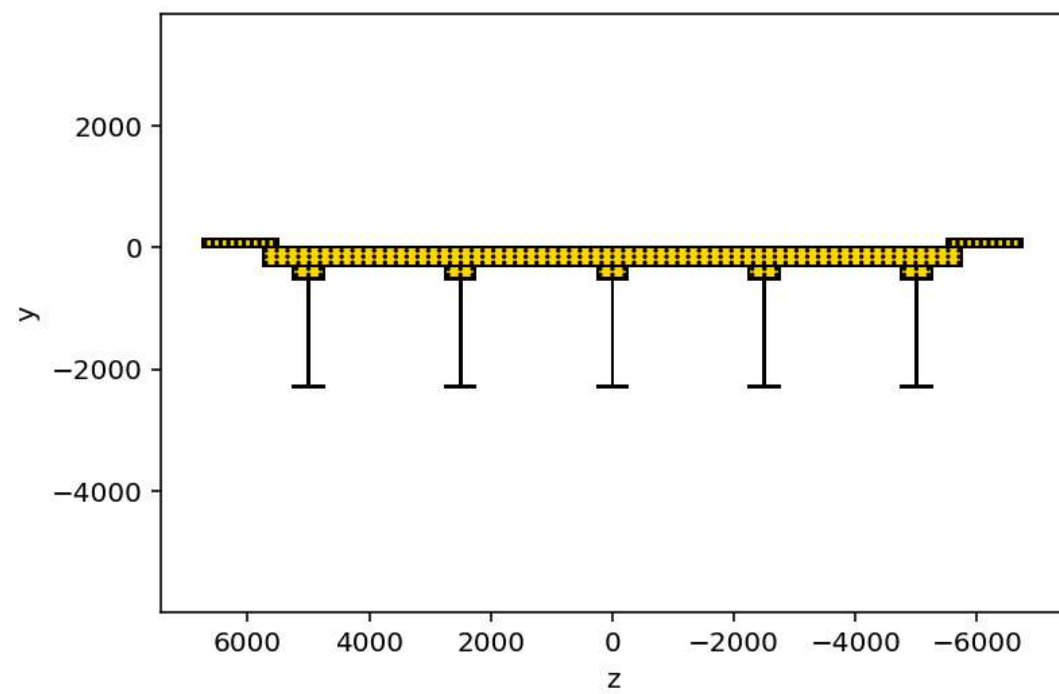
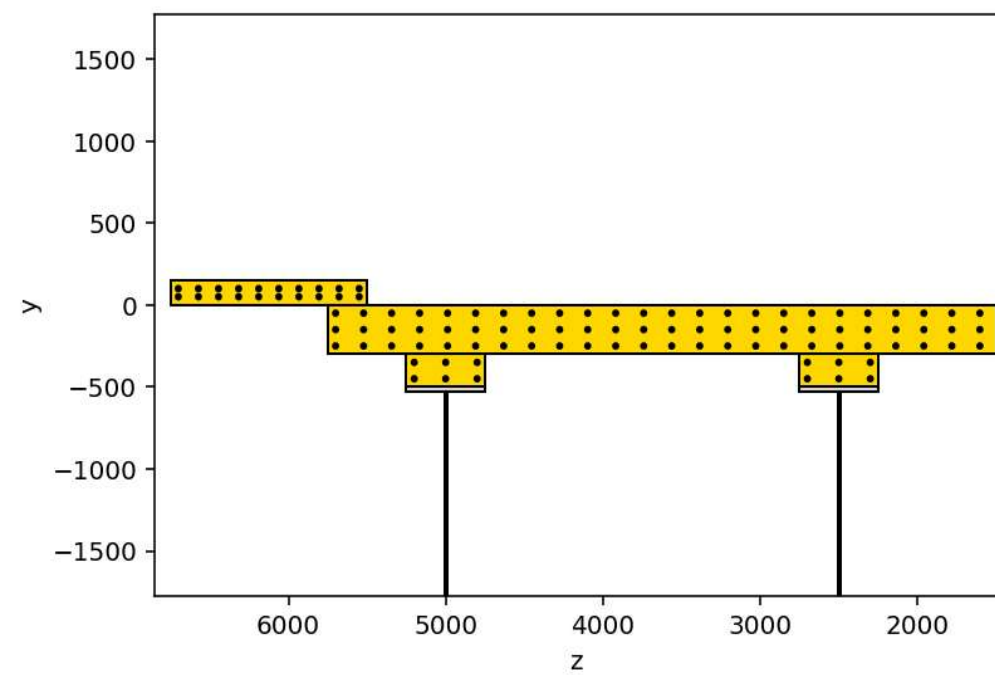
2D Simply Supported Beam with 11 Nodes



3D Simply Supported Beam with 11 Nodes

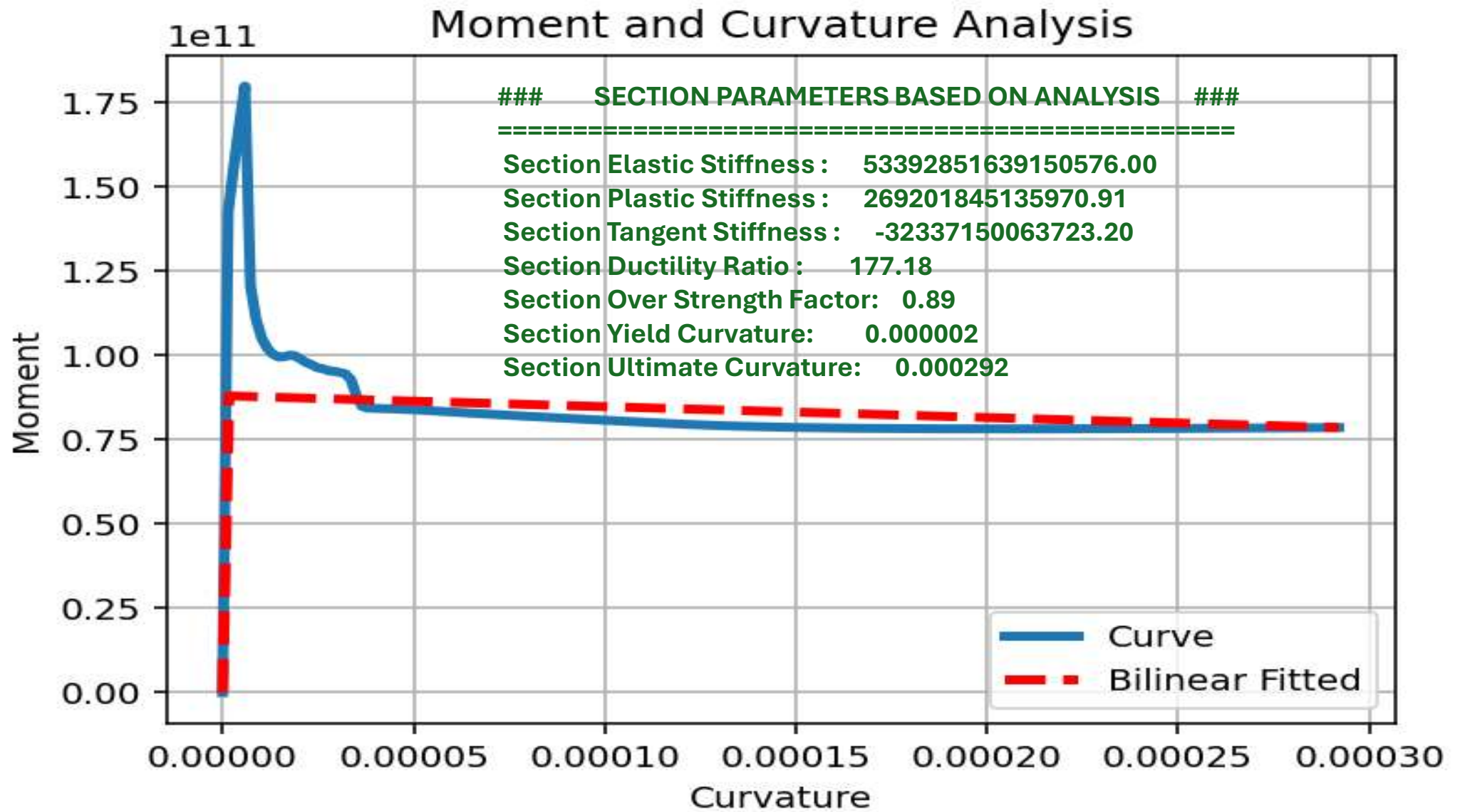




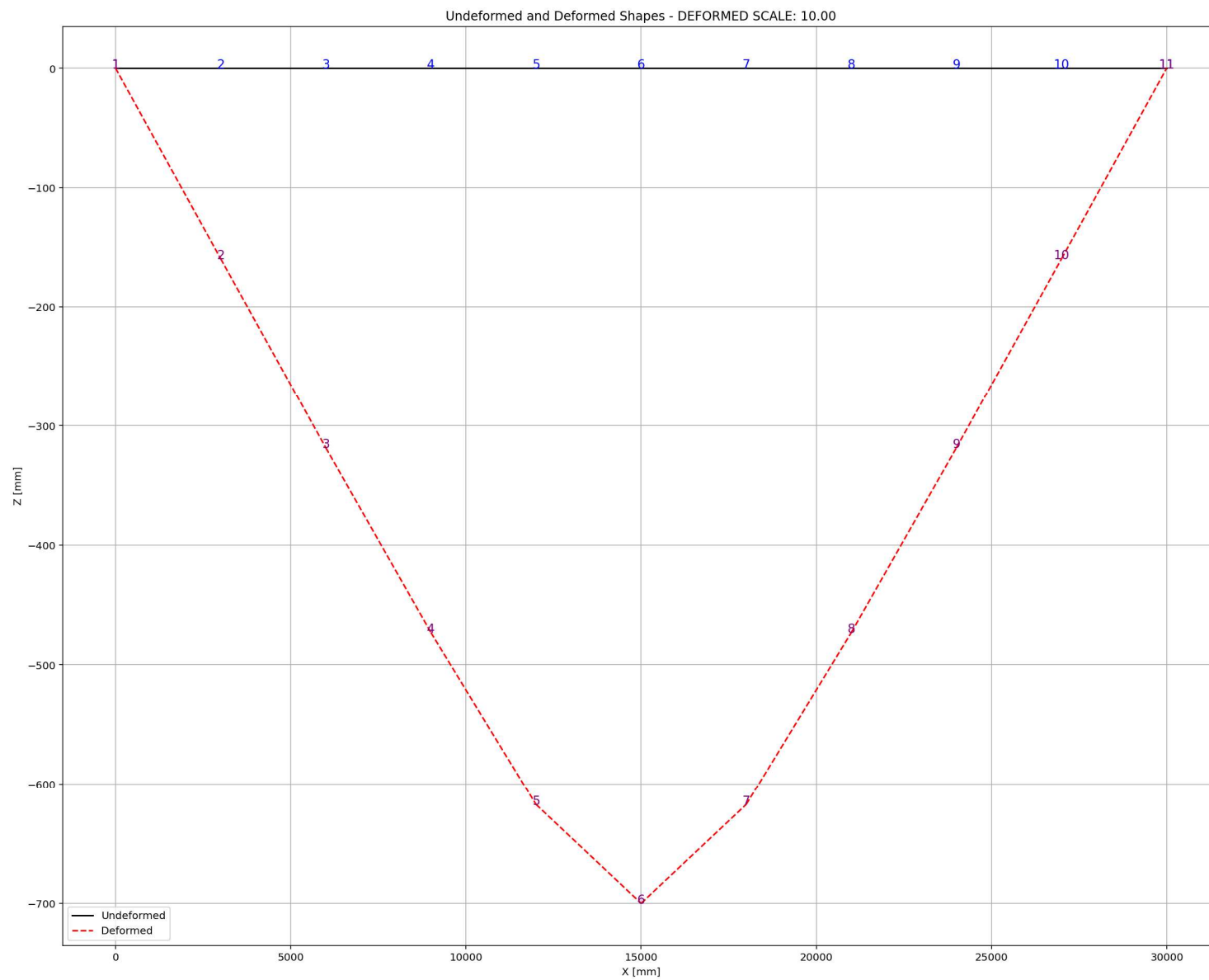


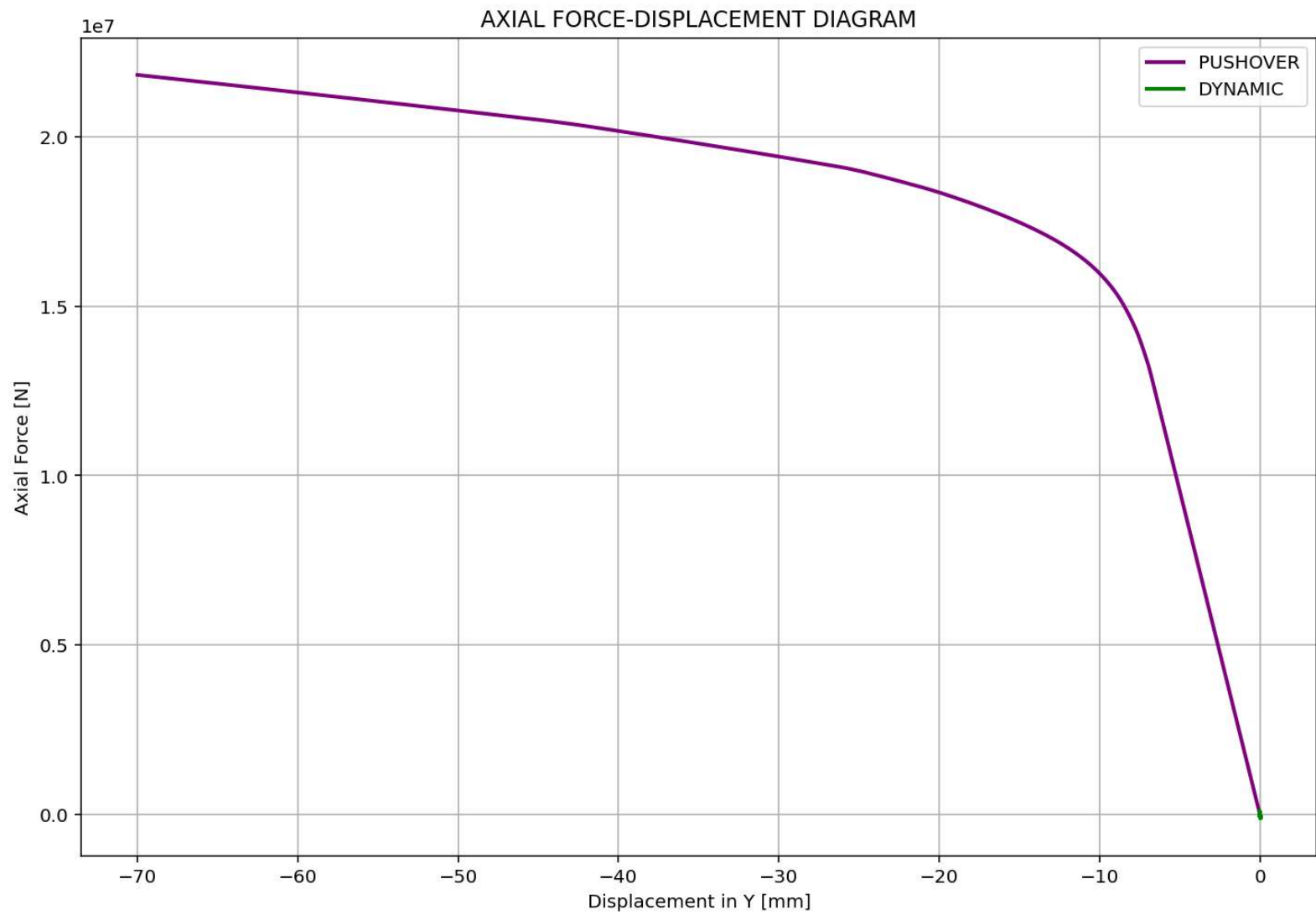


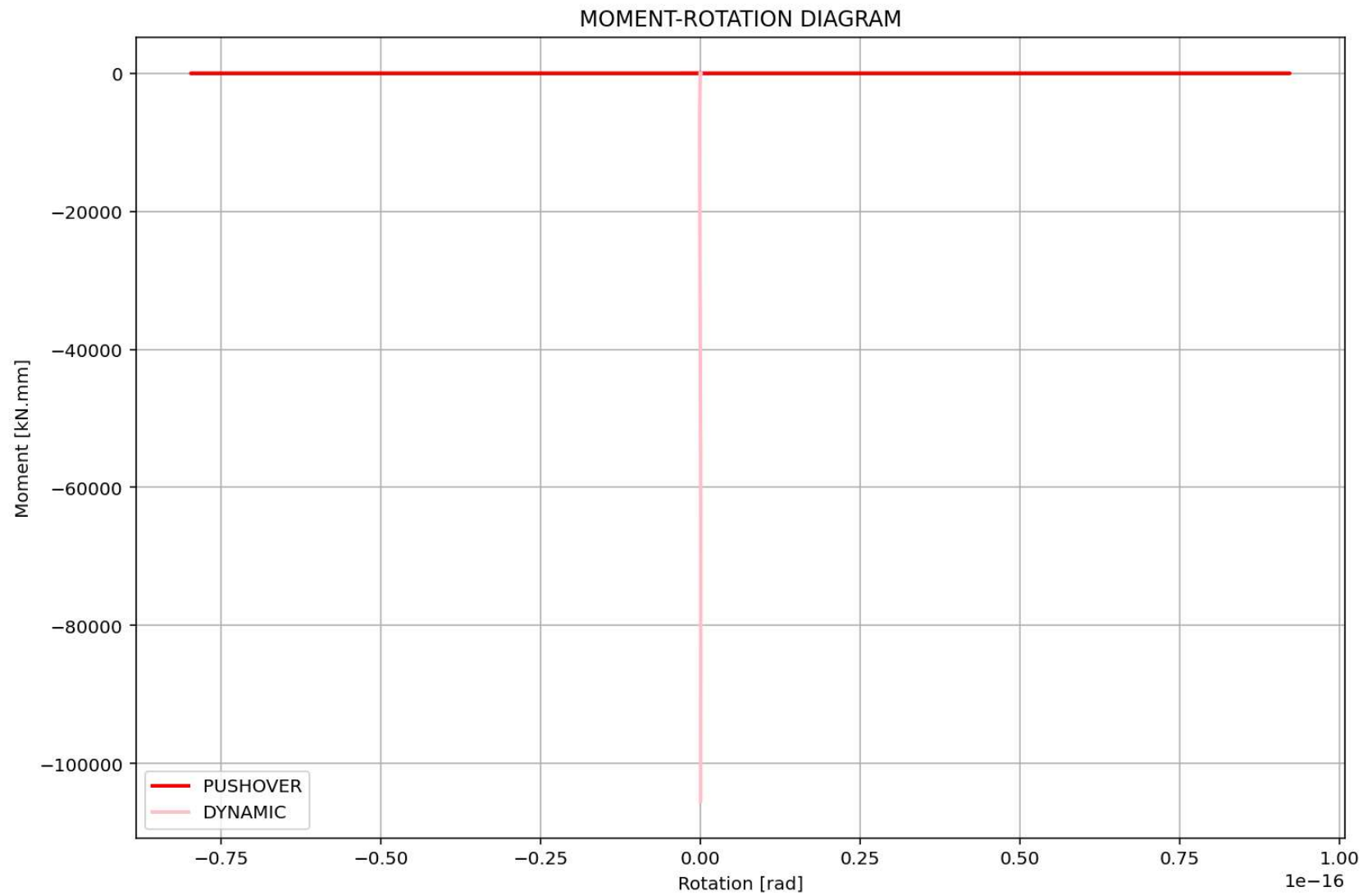
# **MOMENT-CURVATURE ANALYSIS**



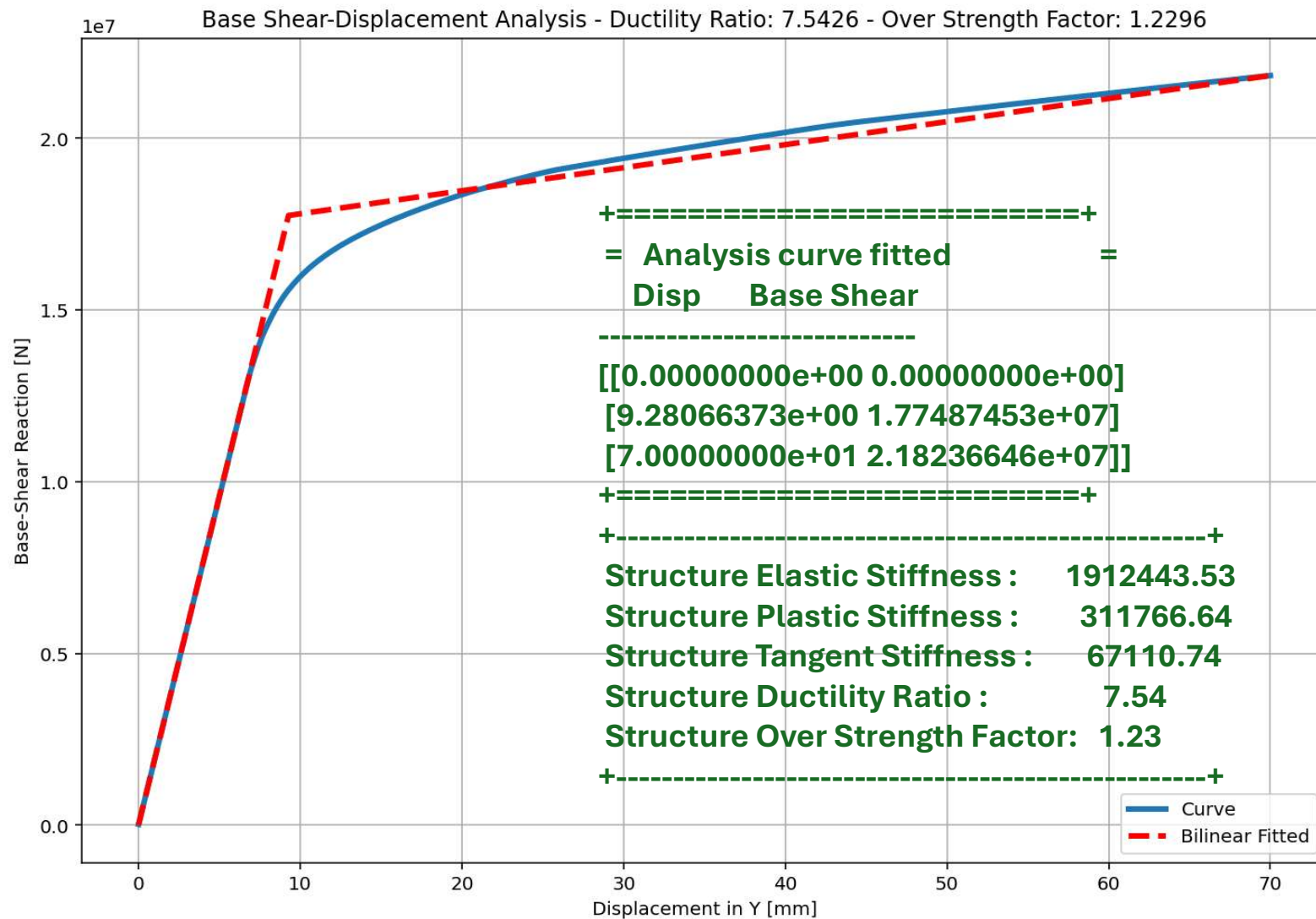
# **NONLINEAR STATIC ANALYSIS (PUSHOVER)**



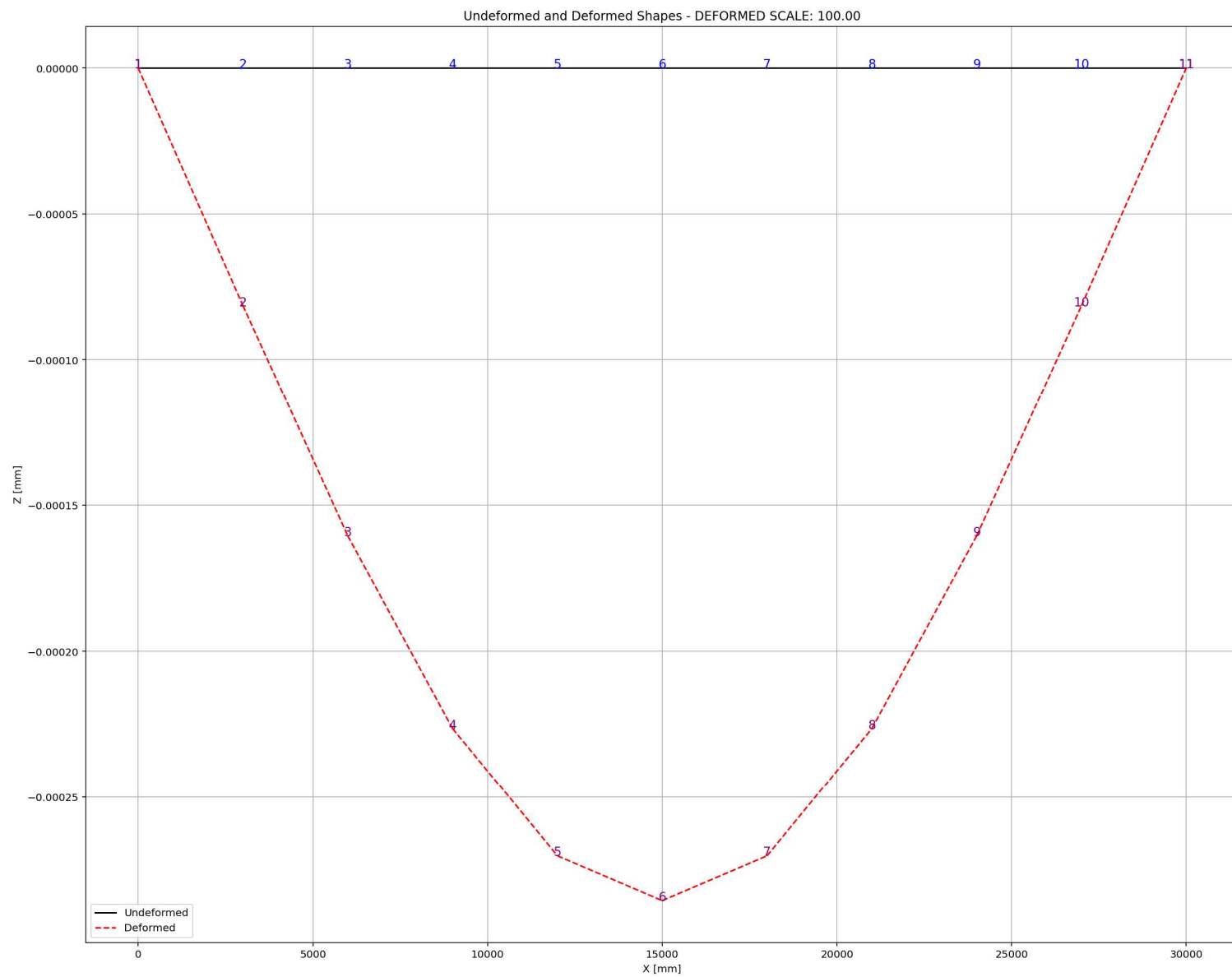


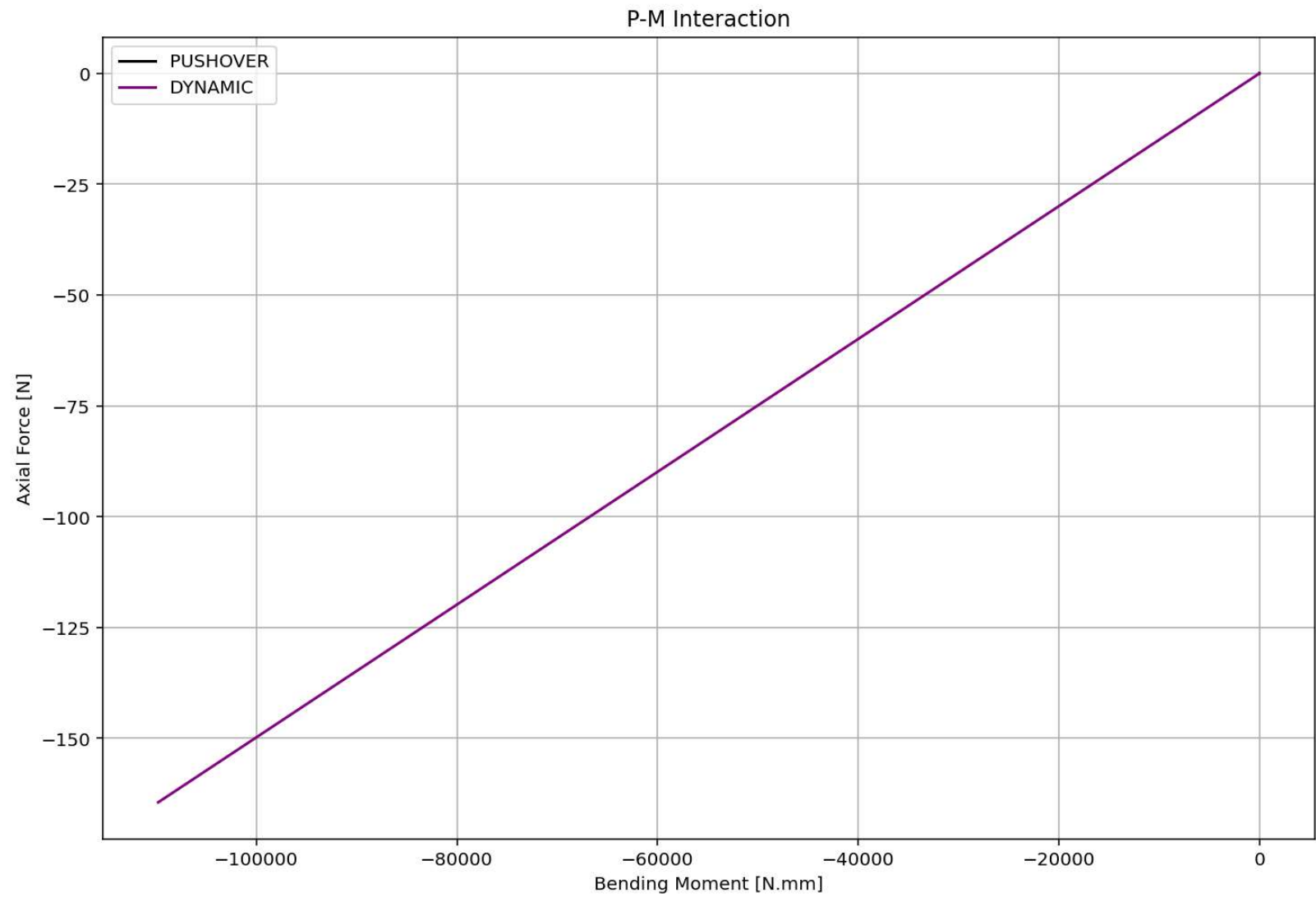


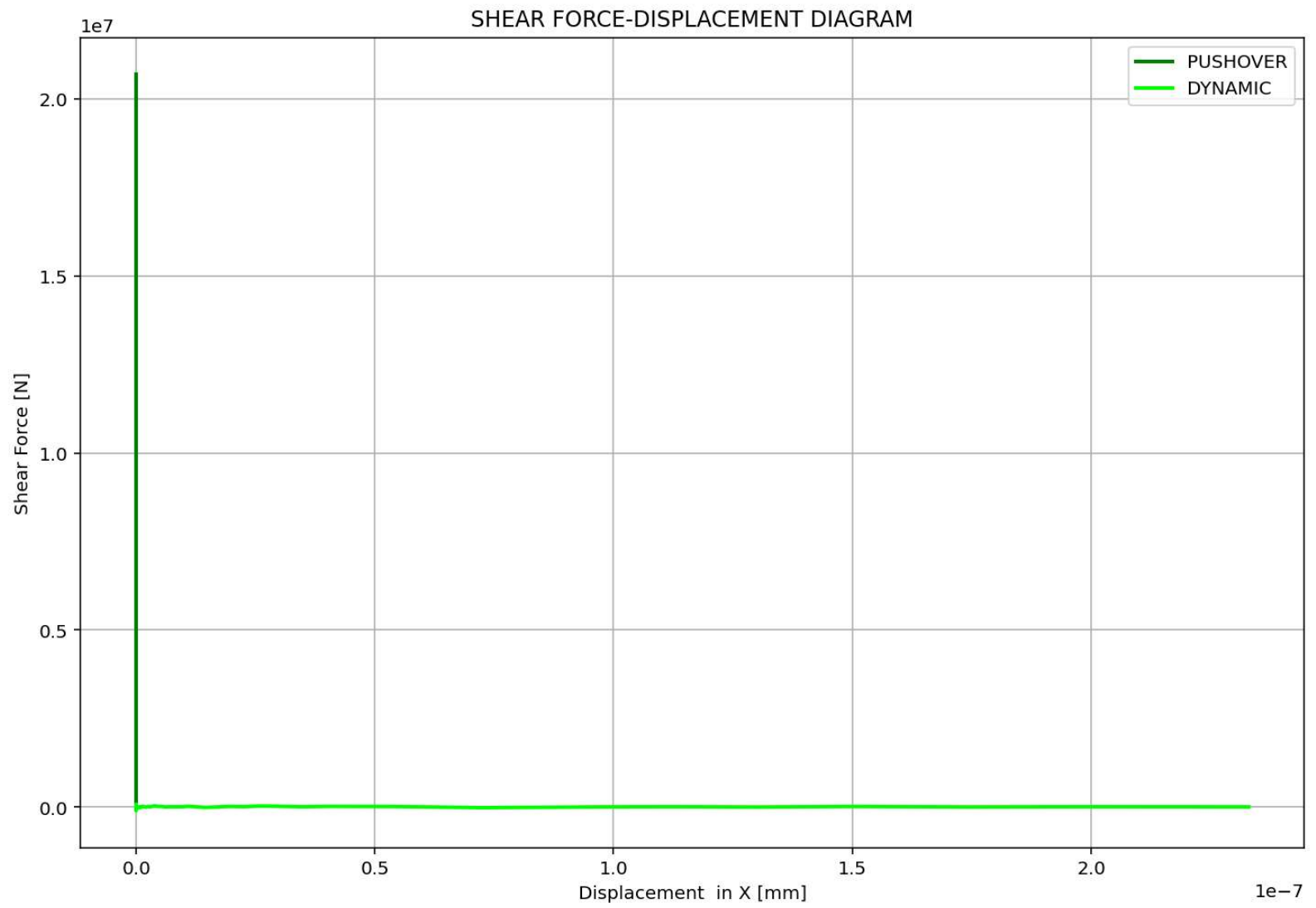




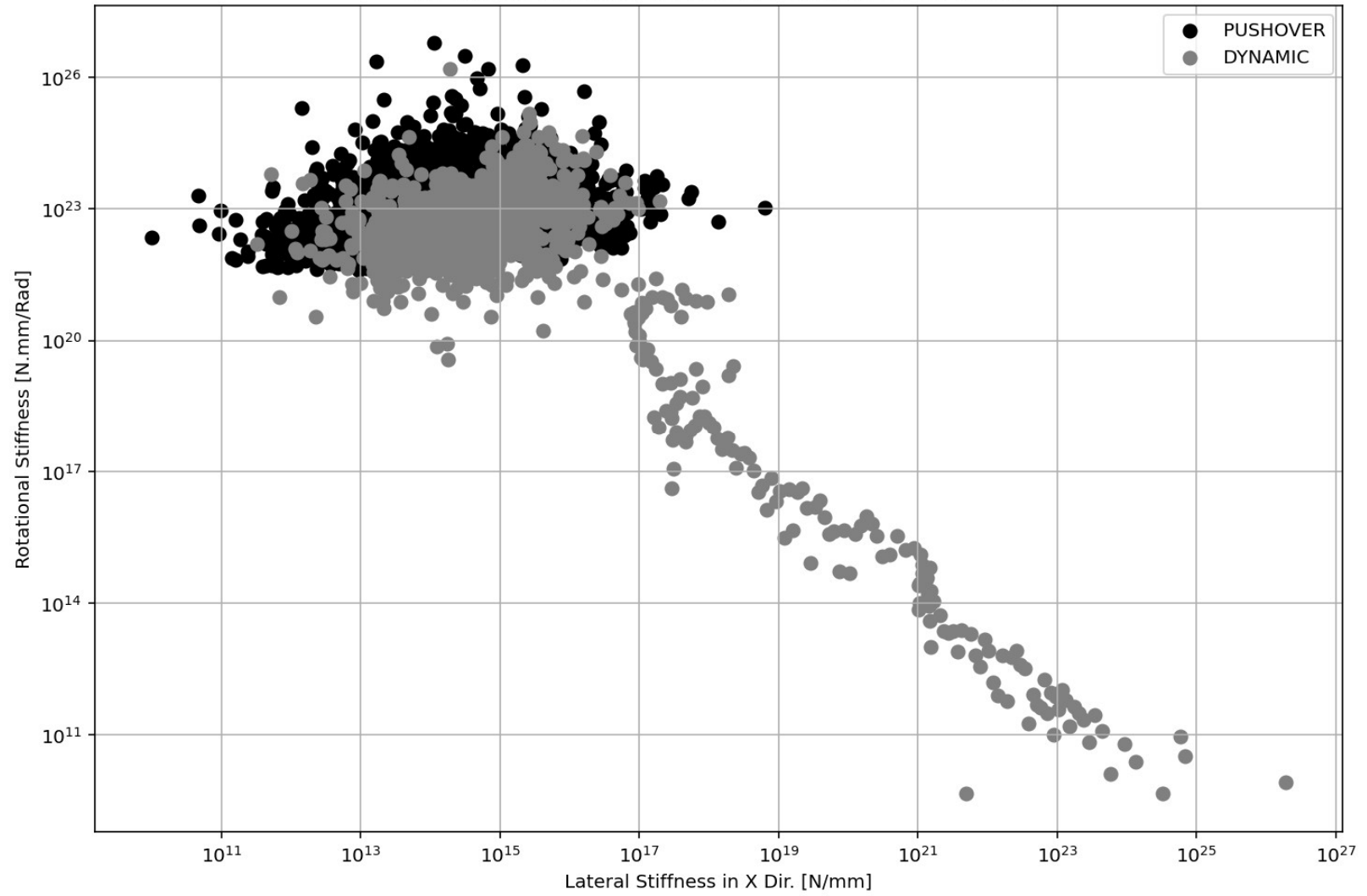
# **NONLINEAR DYNAMIC ANALYSIS**





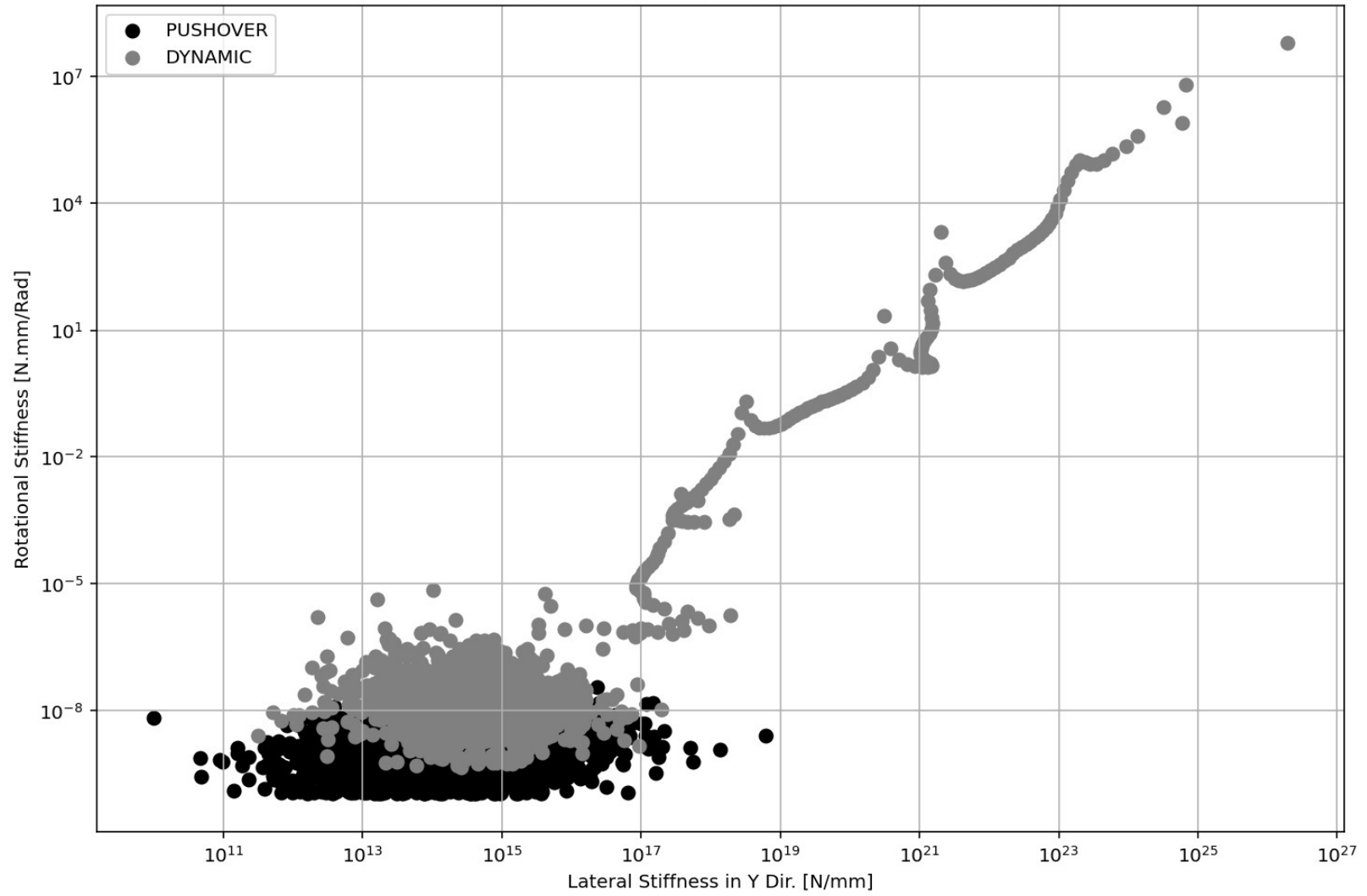


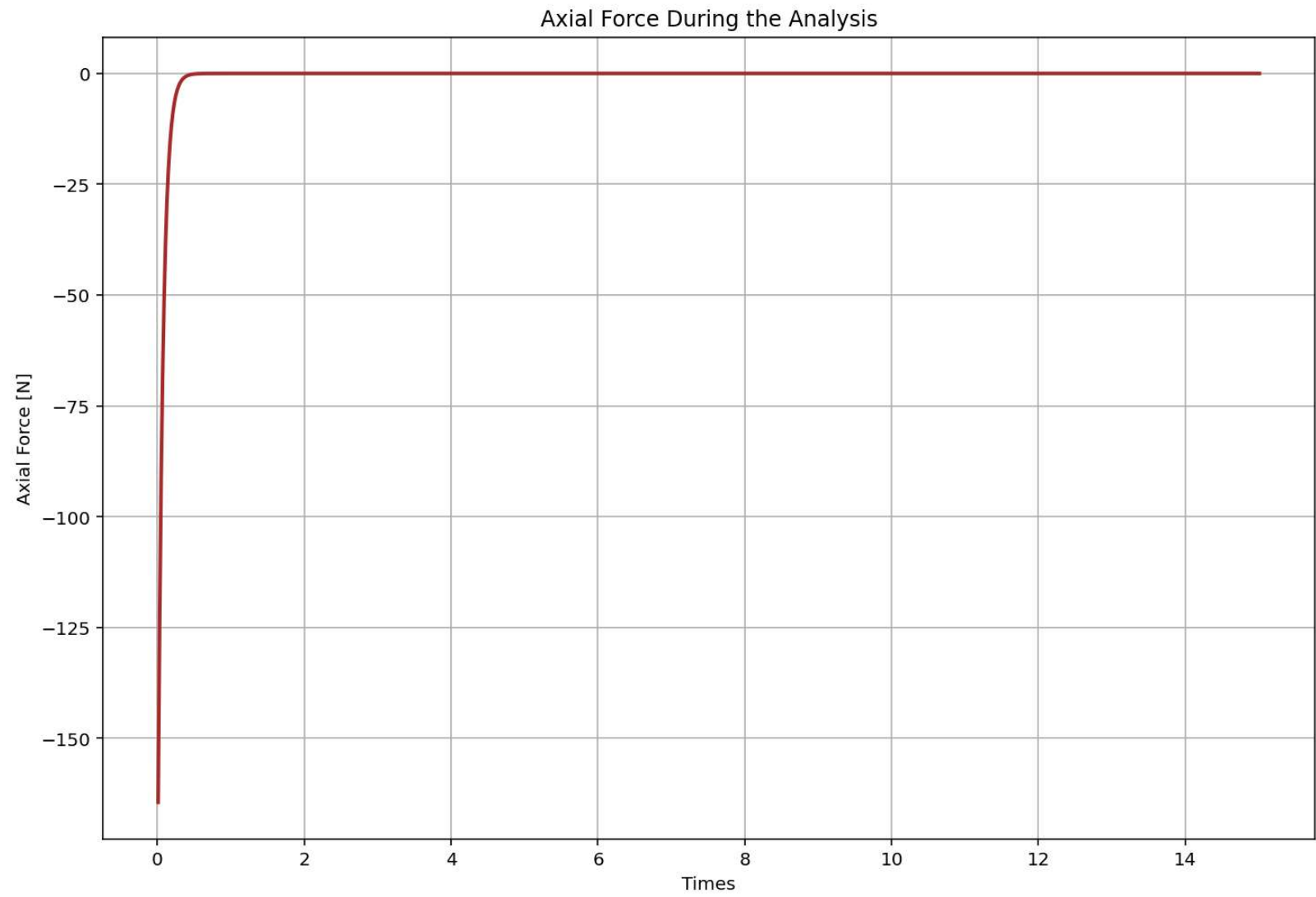
ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM

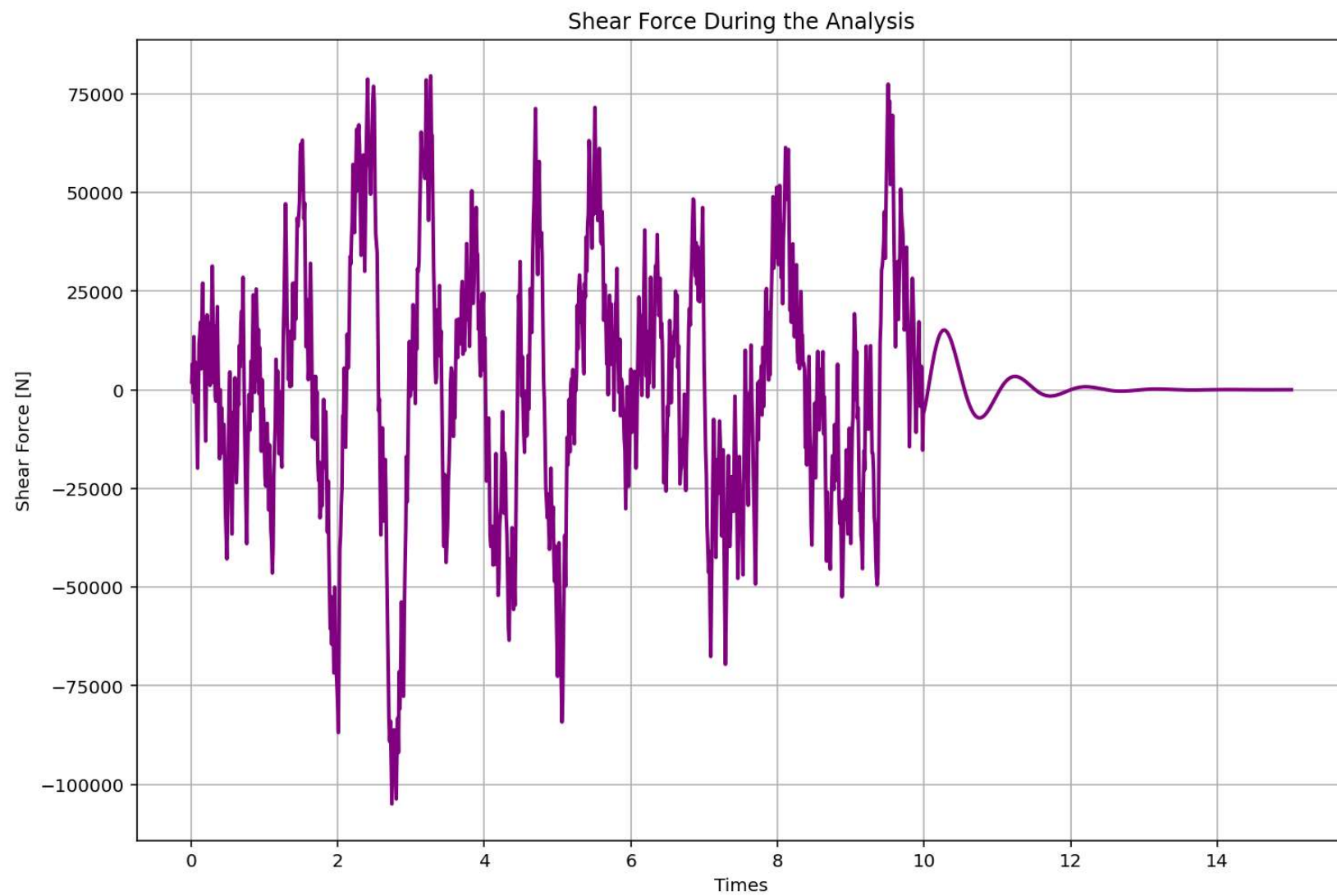


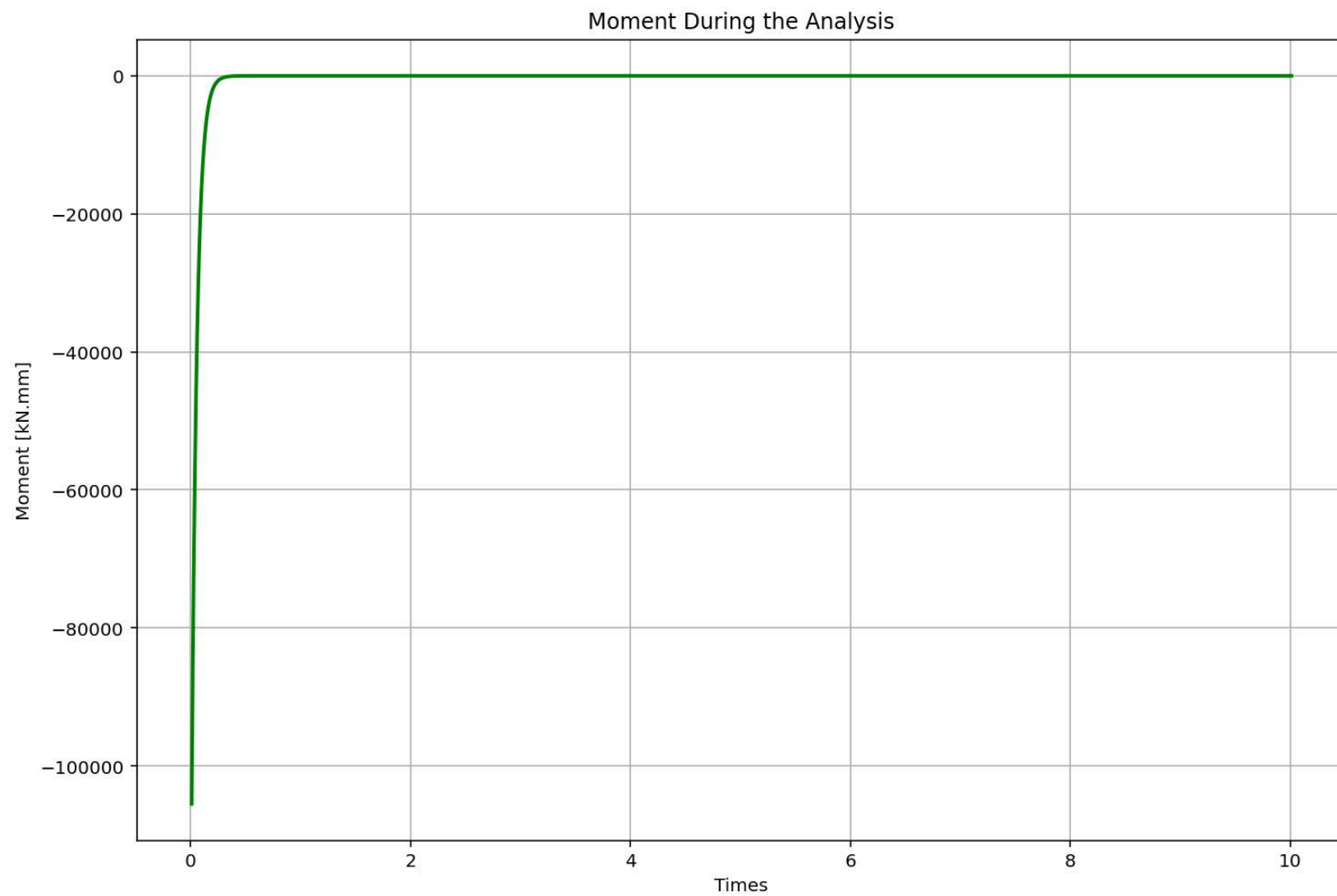


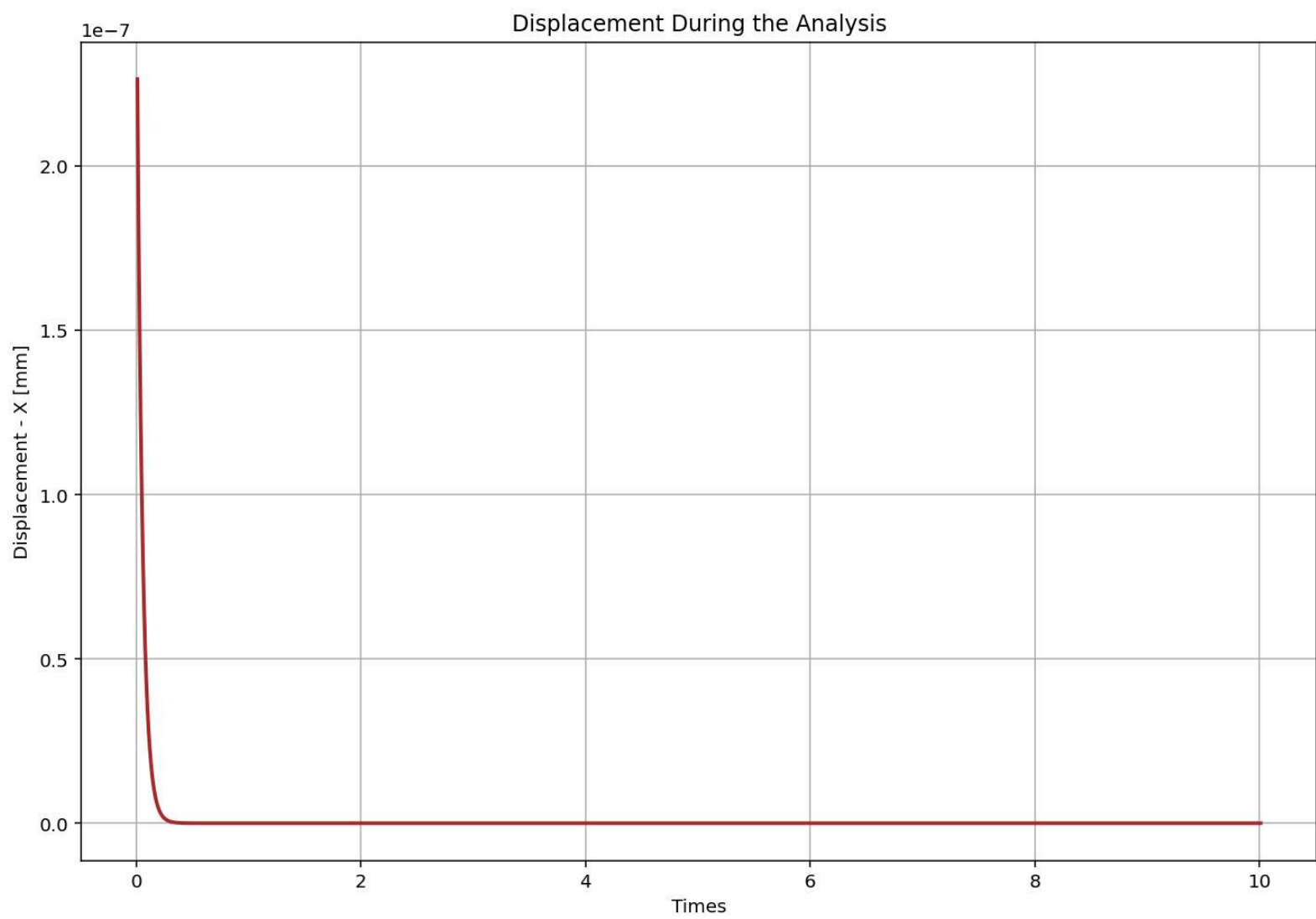
ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM

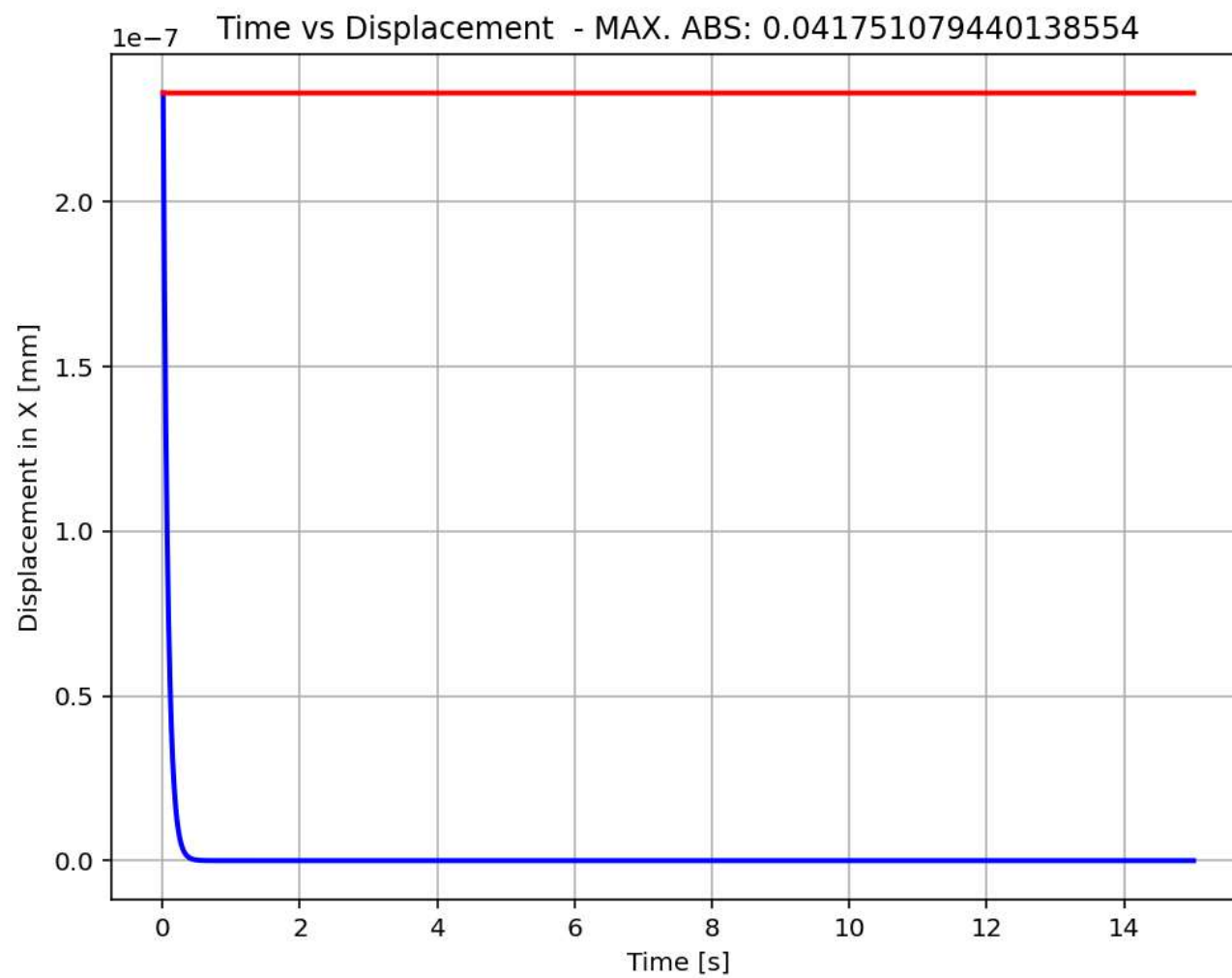






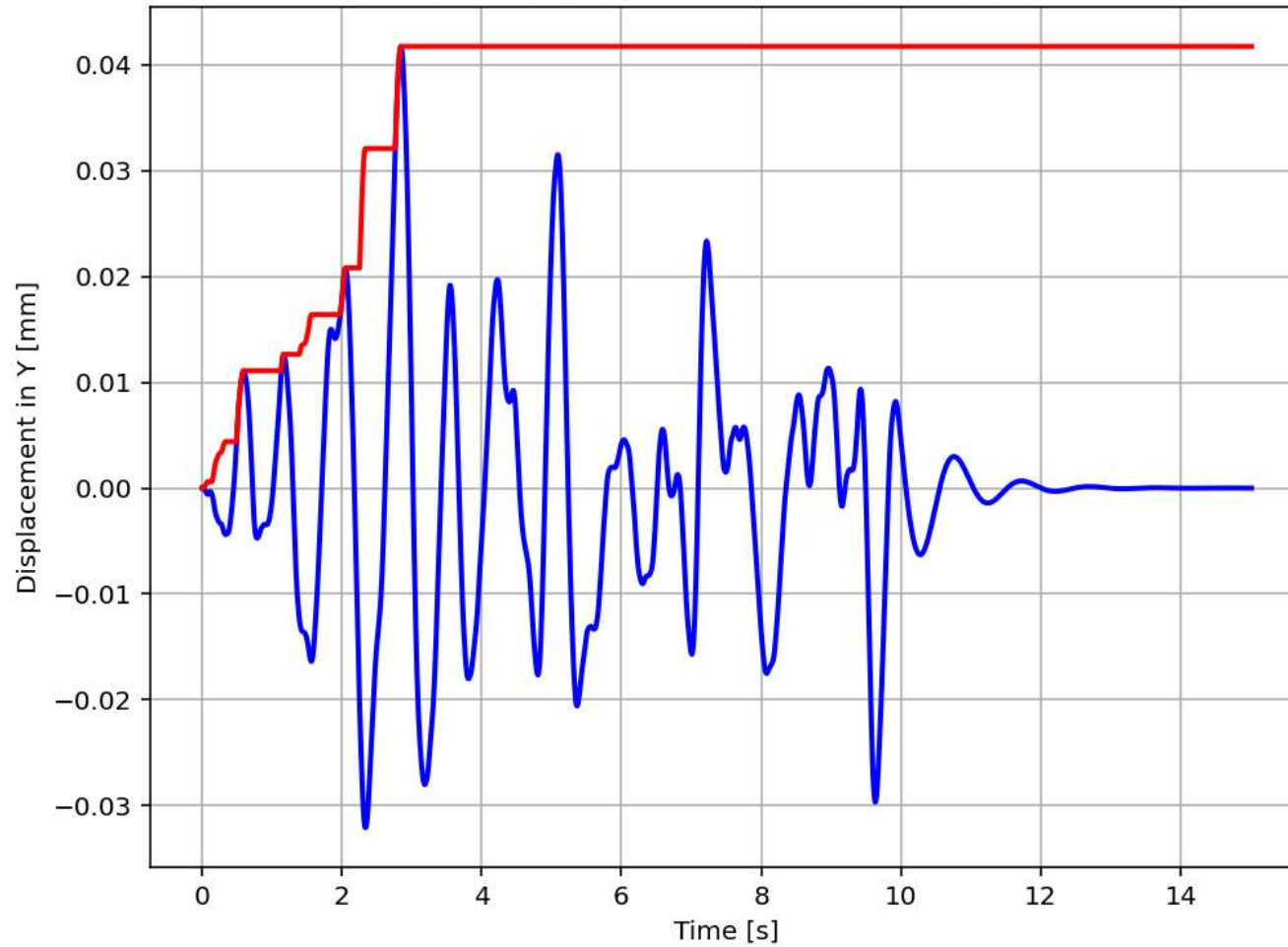




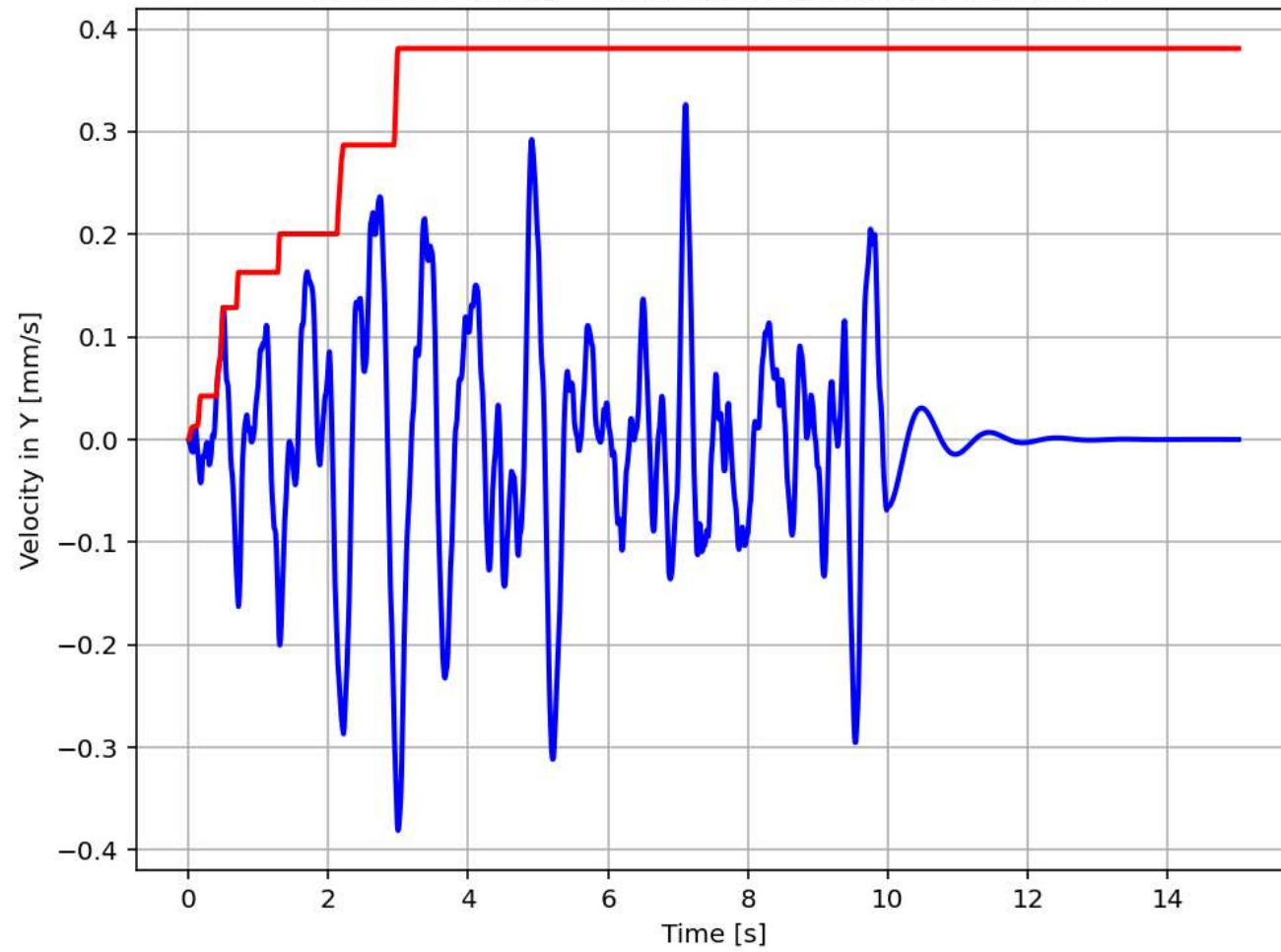


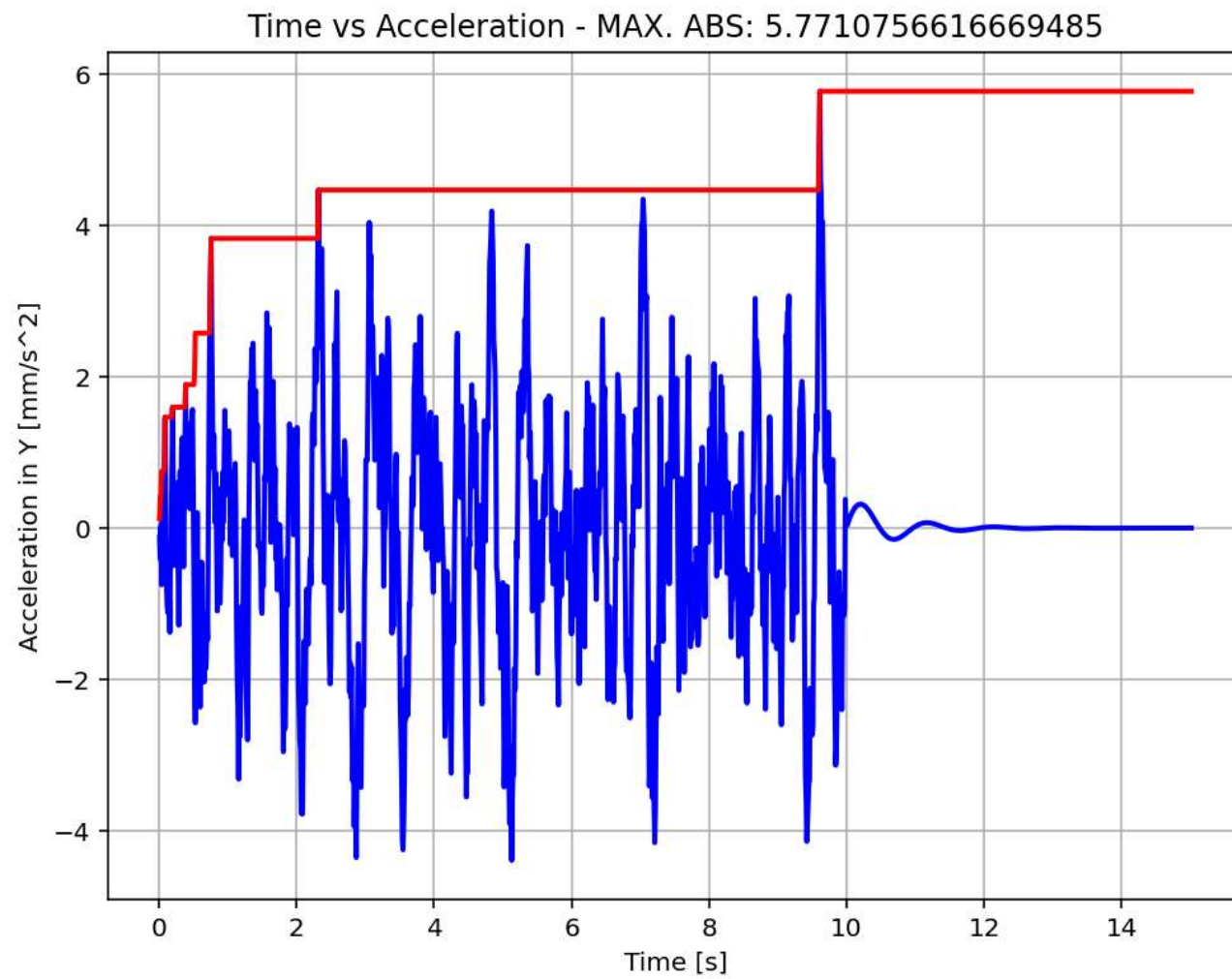


Time vs Displacement - MAX. ABS: 2.3302587455261378e-07

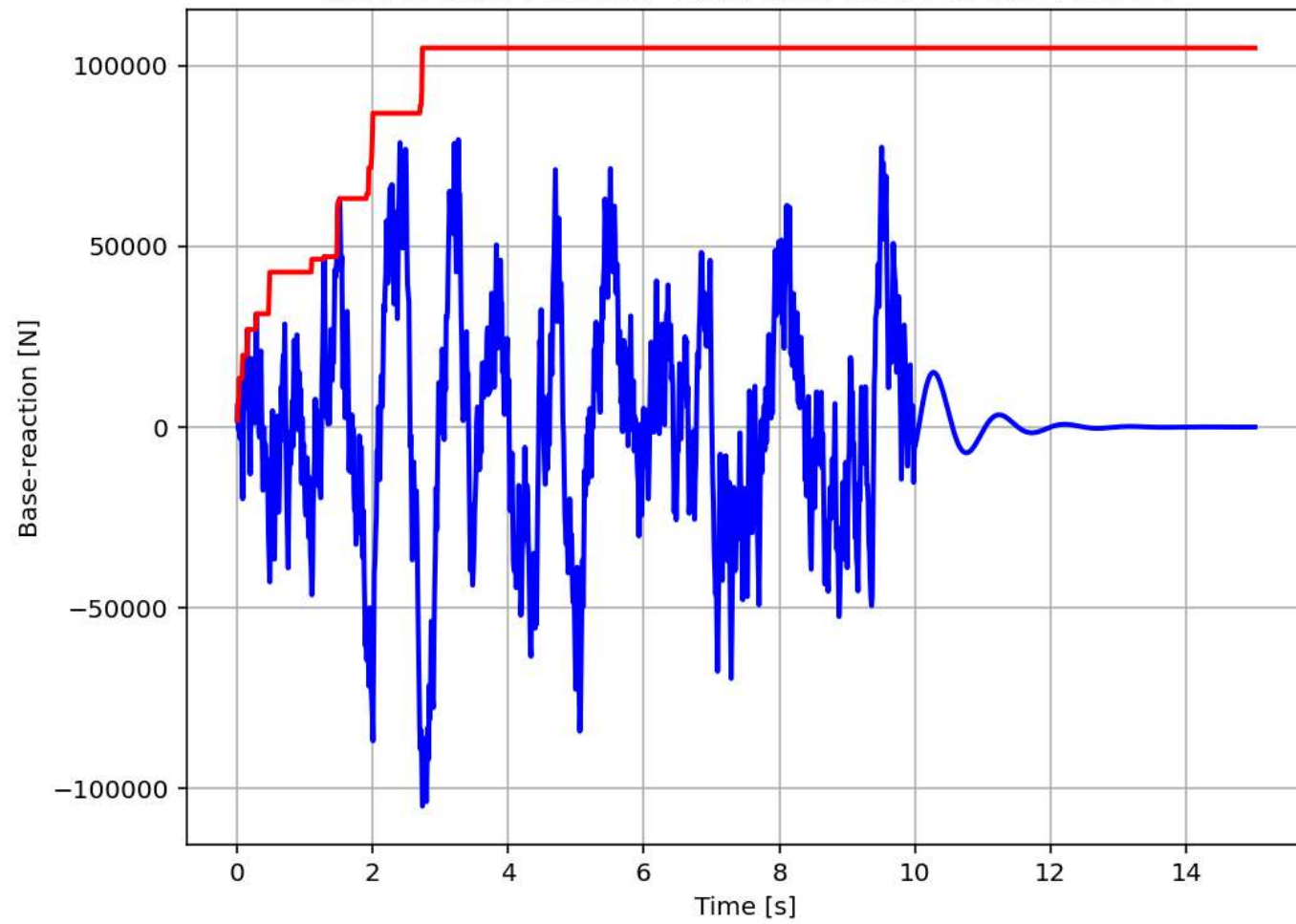


Time vs Velocity - MAX. ABS: 0.3810389748361544

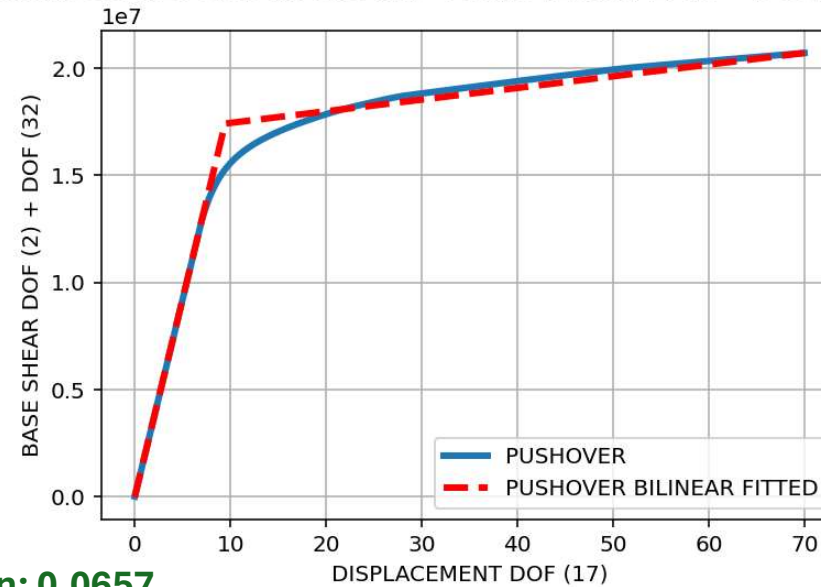




Time vs Base-reaction - MAX. ABS: 104966.14784407298



DISPLACEMENT BASE-SHEAR CURVE FOR DYNAMIC AND PUSHOVER ANALYSIS - DUCTILITY DAMAGE INDEX: -15.53 %



Over Strength Coefficient ( $\Omega_0$ ): -12.1215  
 Displacement Ductility Ratio ( $\mu$ ): -14.3483  
 Ductility Coefficient ( $R_\mu$ ): -14.3483  
 Structural Behavior Coefficient ( $R$ ): 173.9230  
 Structural Ductility Damage Index in Y Direction: 0.0657

### STRUCTURAL PARAMETERS BASED ON ANALYSIS ###

=====

Structure Elastic Stiffness : 0.00  
 Structure Plastic Stiffness : 0.00  
 Structure Tangent Stiffness : 0.00  
 Structure Ductility Ratio : -14.35  
 Structure Over Strength Factor: -12.12  
 Structure Yield Displacement: 9.45  
 Structure Ultimate Displacement: 70.00  
 Structure Demand Displacement: 0.04  
 Structure Ductility Damage index: -15.53 %