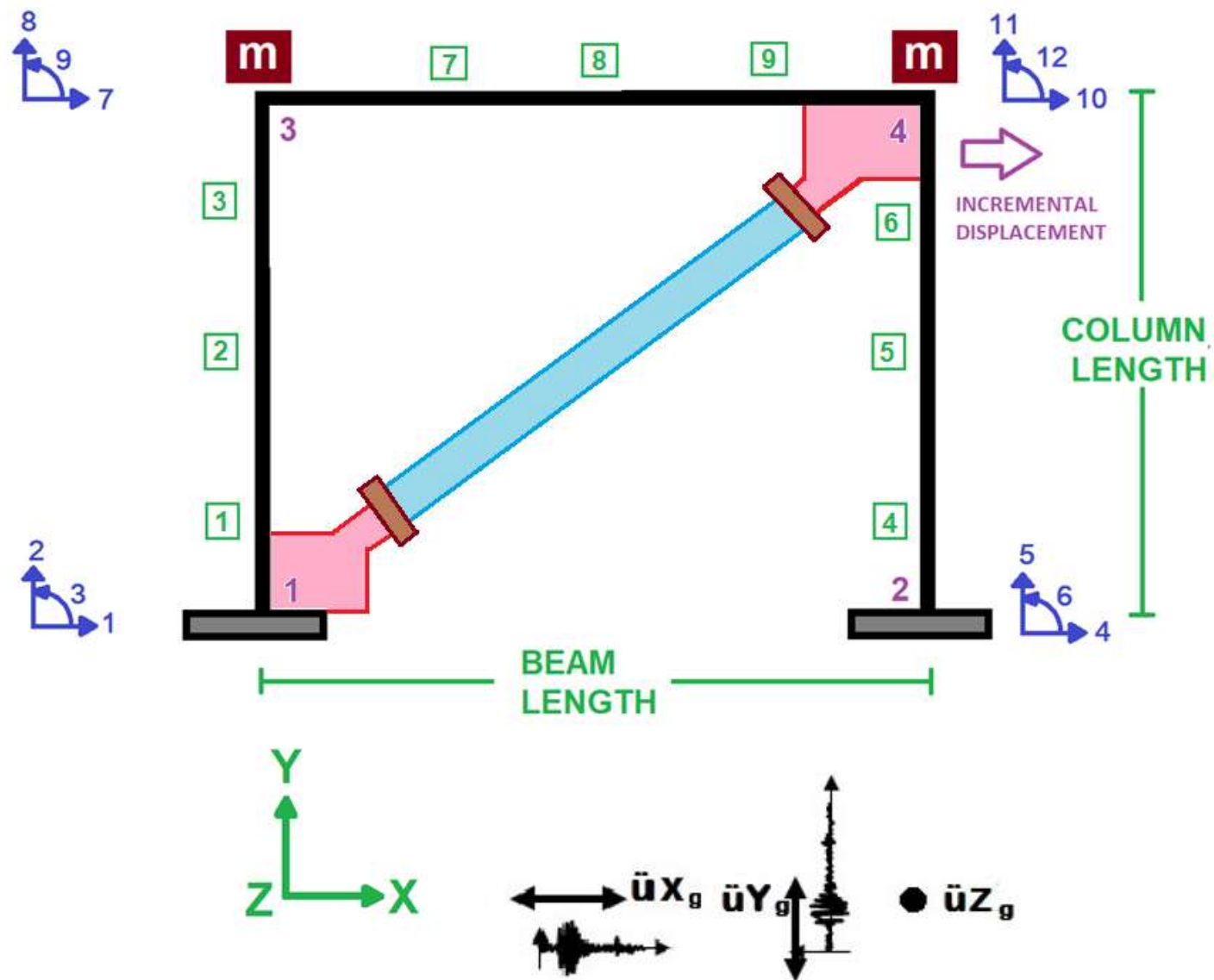
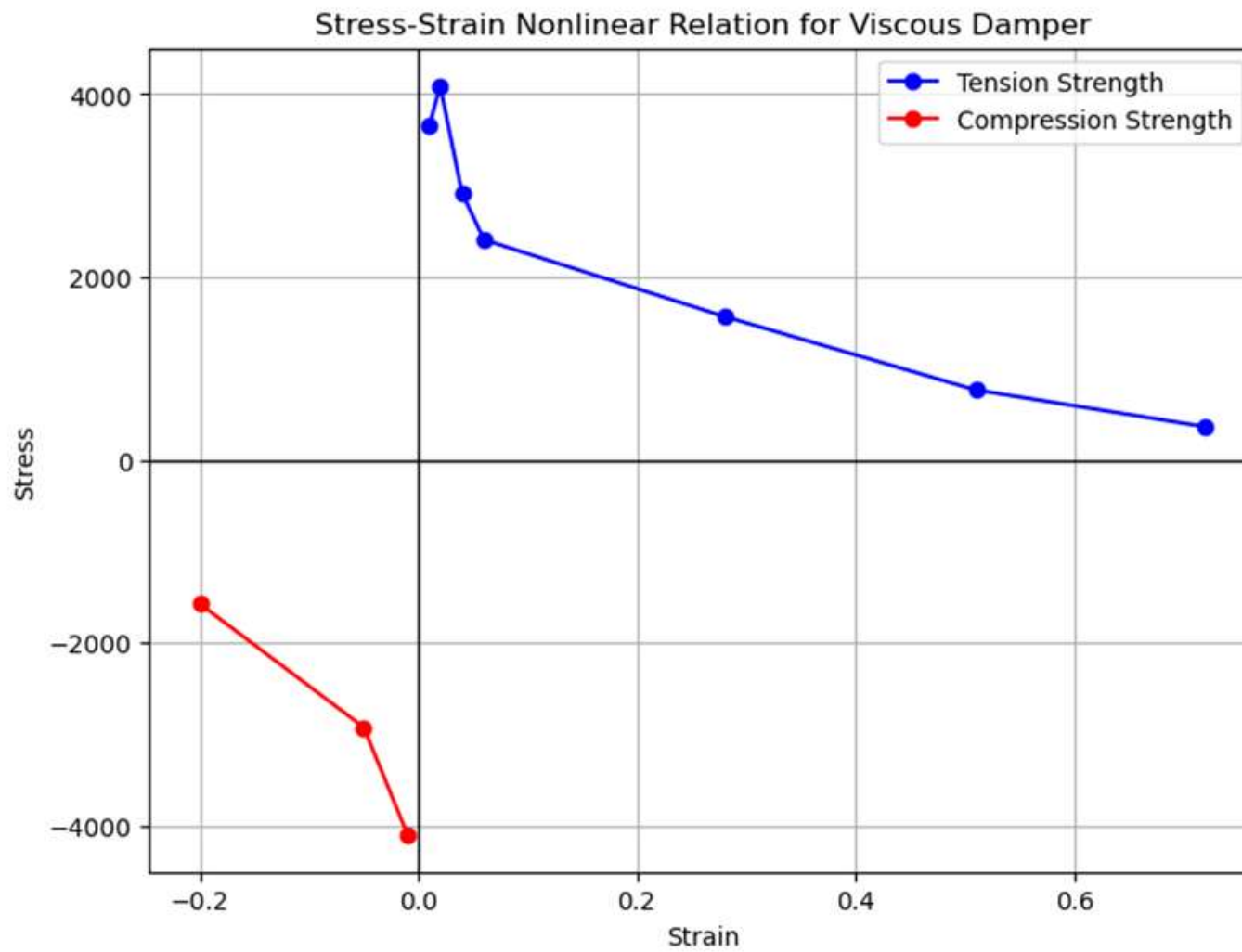


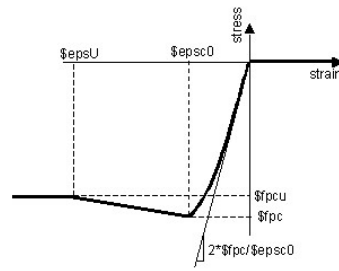
IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

ASSESSMENTS OF THE STRUCTURAL DUCTILITY DAMAGE INDEX WITH DIFFERENT CONFINEMENT ENHANCEMENT RATIO OF CONCRETE FRAME WITH VISCOUS DAMPER USING OPENSEES

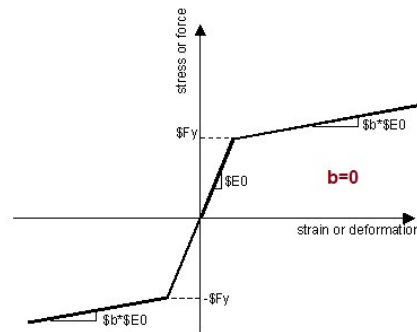
WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)



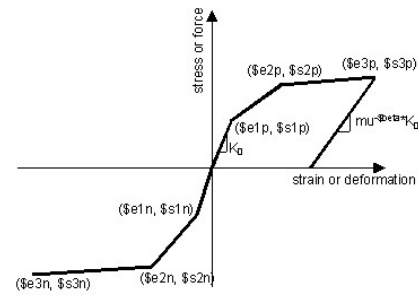




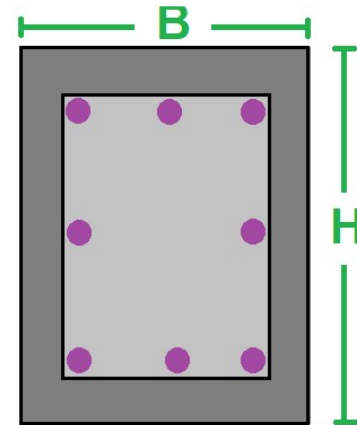
CORE AND COVER CONCRETE RELATION



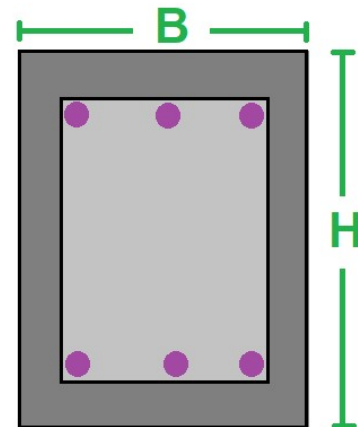
WITHOUT HARDENING AND ULTIMATE STRAIN



WITH HARDENING AND ULTIMATE STRAIN



COLUMN SECTION



BEAM SECTION

12345678910111213141516171819202122232425262728293031323334

```
#####
#                               >> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<
#                               ASSESSMENTS OF THE STRUCTURAL DUCTILITY DAMAGE INDEX WITH DIFFERENT
#                               CONFINEMENT ENHANCEMENT RATIO OF CONCRETE FRAME WITH VISCOUS DAMPER LIKE BEAM AND COLUMNS
#-----
#                               THIS PROGRAM WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)
#                               EMAIL: salar.d.ghashghaei@gmail.com
#####
"""
[1] Nonlinear Frame Modeling
- 2D RC frame with distributed plasticity using `nonlinearBeamColumn` elements.
- Fiber sections for beams/columns: confined core and unconfined cover concrete.

[2] Material Laws
- Concrete: `Concrete01` for confined/unconfined zones.
- Steel: `Hysteretic` model with pinching, hardening, and cyclic degradation.

[3] Seismic Loads
- Pushover: displacement-controlled lateral loading to failure.
- Dynamic: uniform excitation with user-defined ground motions (X/Y).

[4] Damping
- Rayleigh damping (a0, a1) calibrated via eigenvalue analysis (modes 1-2).

[5] Performance Metrics
- Ductility ratio  $\mu$ : from bilinearized pushover curve.
- Overstrength  $\Omega_o$ : yield vs. ultimate capacity.
- Damage Index (DI): normalized displacement demand/capacity.

[6] Advanced Solver
- HHT-a integrator (unconditionally stable) with Newton-Raphson iterations.

[7] Outputs
- Hysteretic responses: P-M, V- $\Delta$ , M- $\dot{\Delta}$ .
```

top\OPENSEES_FILES\CONCRETE_FRAME_EXAMPLES\+VISCOUS_DAMPER

32%

Time vs Displacement - MAX. ABS: 0.15733695771333667 | ξ (Calculated): 0.00000e+00 %

Help Variable Explorer Debugger Plots Files

Console 1/A

```
200.009999999996307 0.006174976937776194 -399.29621364504726

Period 01: 5.2080e+00 (s) - Period 02: 2.4396e+00 (s)

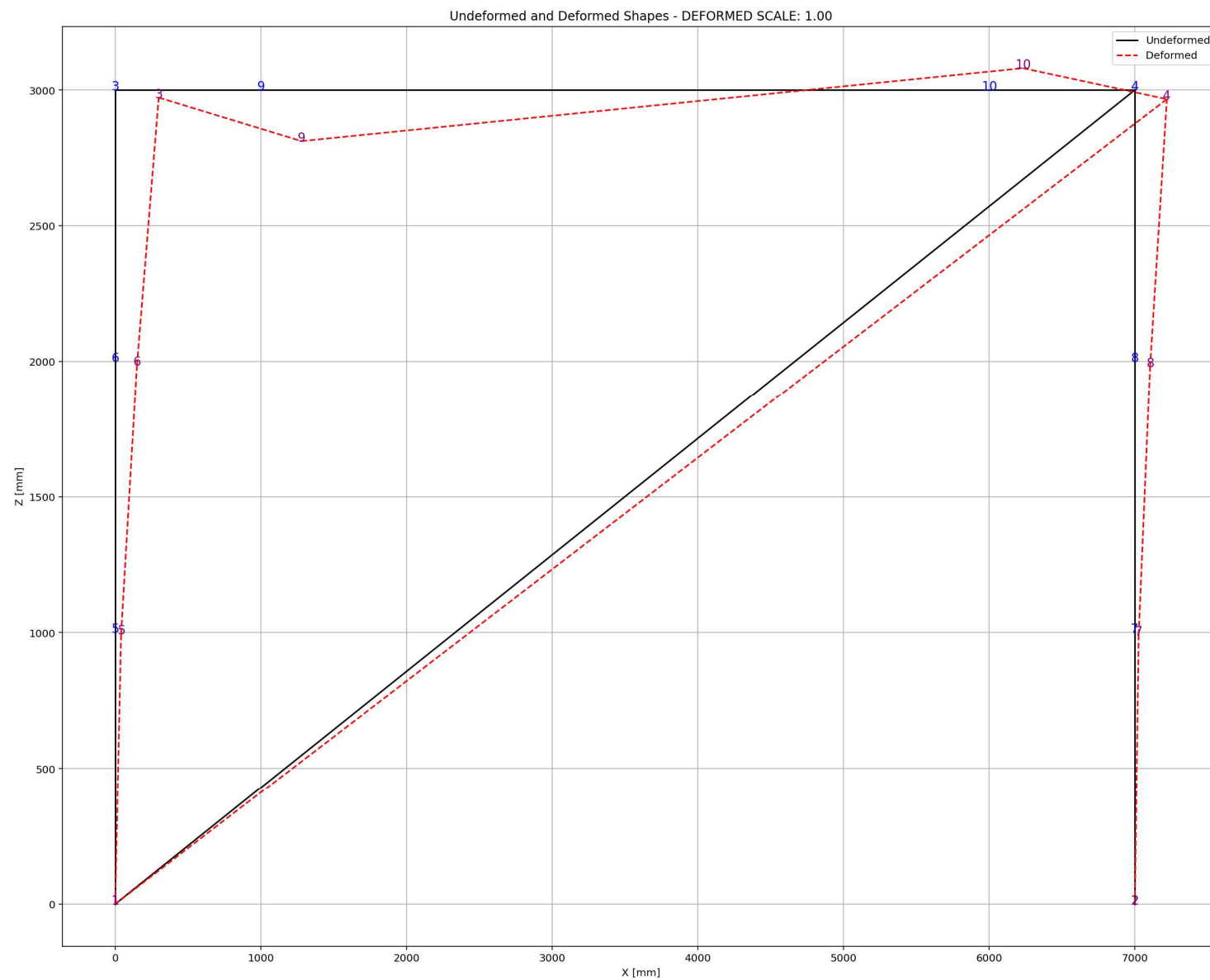
Total time (s): 186.0938

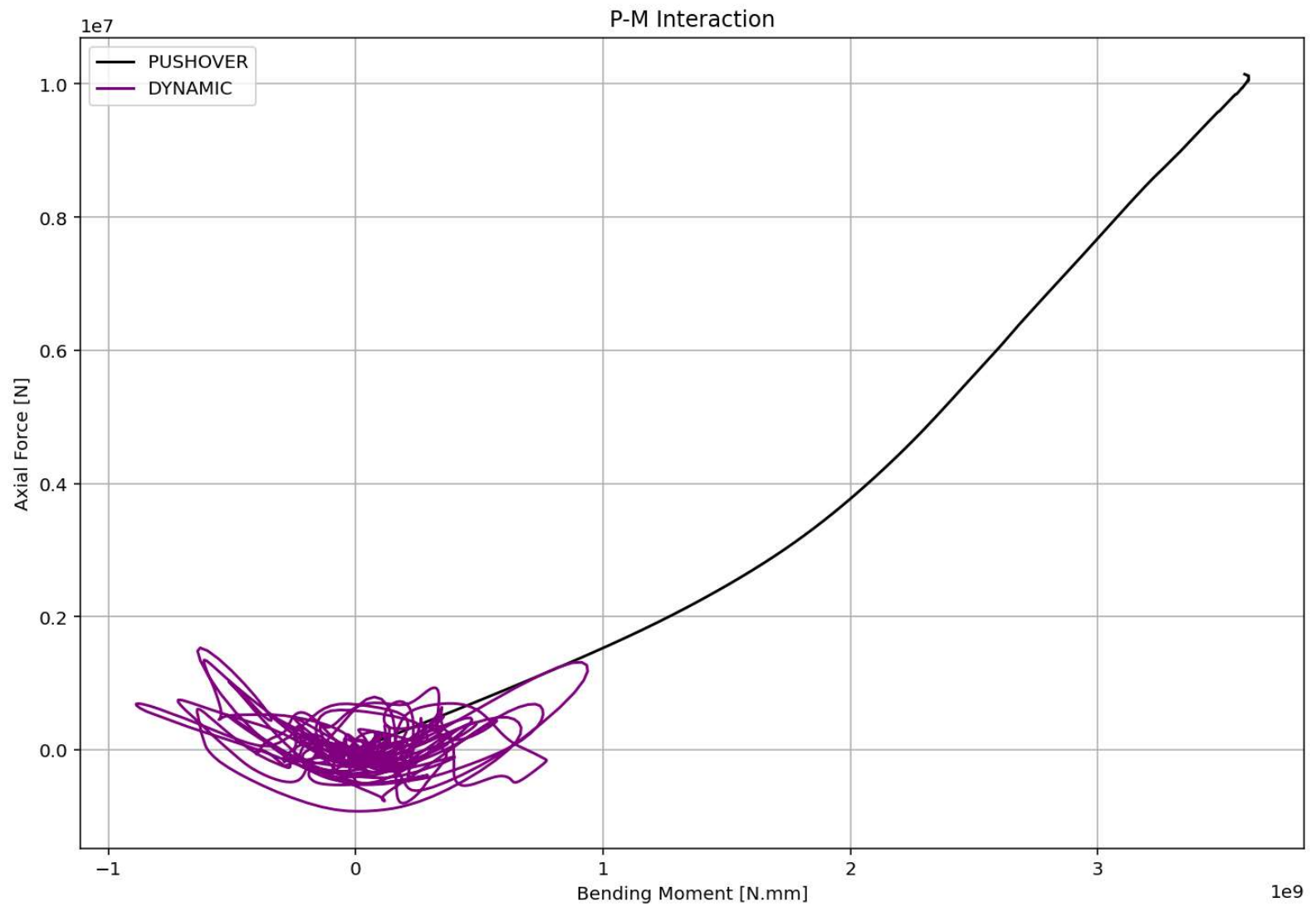
C:\Users\ DELL\Desktop\OPENSEES_FILES\CONCRETE_FRAME_EXAMPLES\
+VISCOUS_DAMPER\PLOT_2D.py:43: UserWarning: Legend does not support handles
for Text instances.
See: https://matplotlib.org/stable/tutorials/intermediate/
```

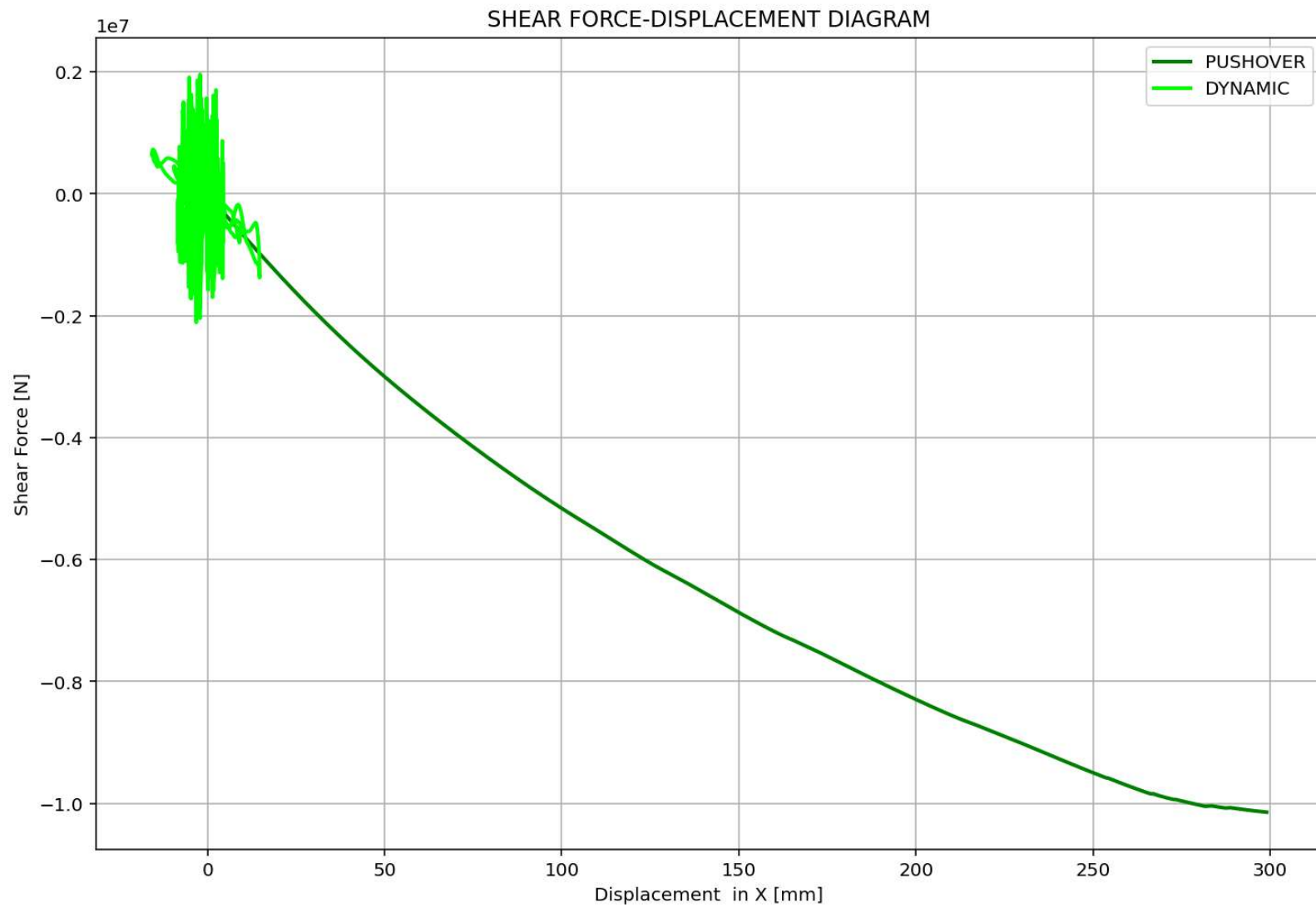
IPython Console History

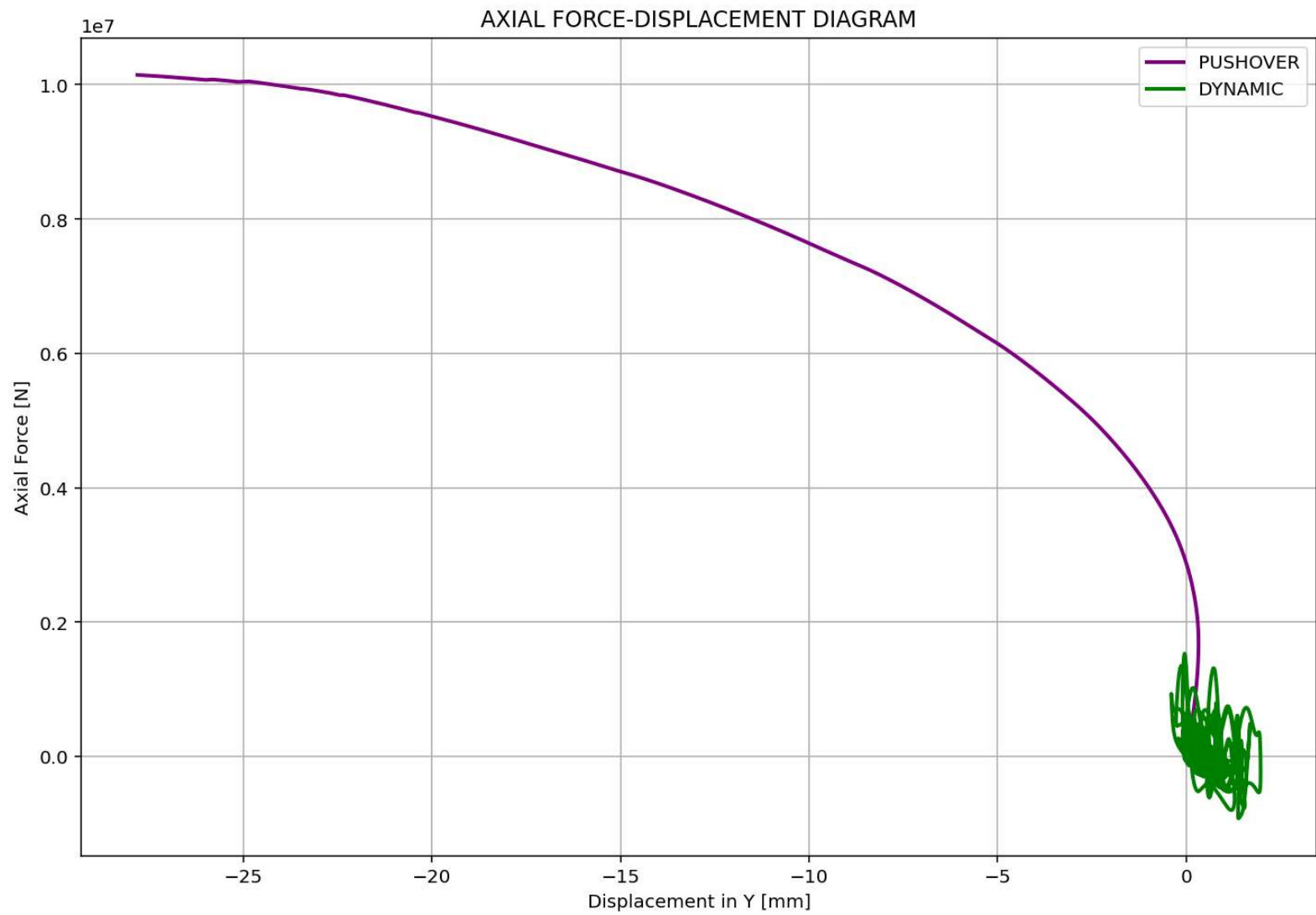
Inline Conda: anaconda3 (Python 3.12.7) ✓ LSP: Python Line 4, Col 118 UTF-8 CRLF RW Mem 39%

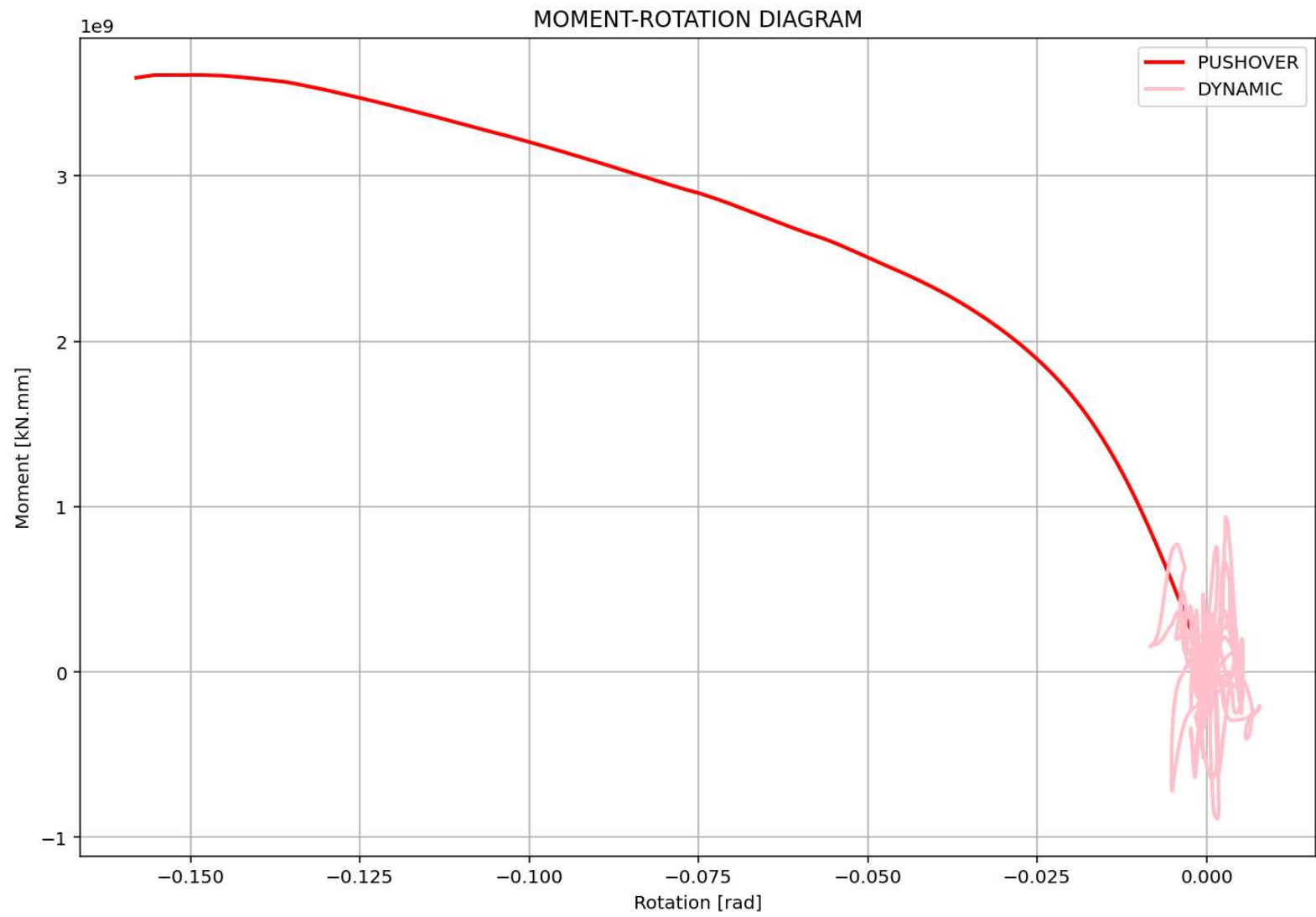
NONLINEAR STATIC ANALYSIS (PUSHOVER)



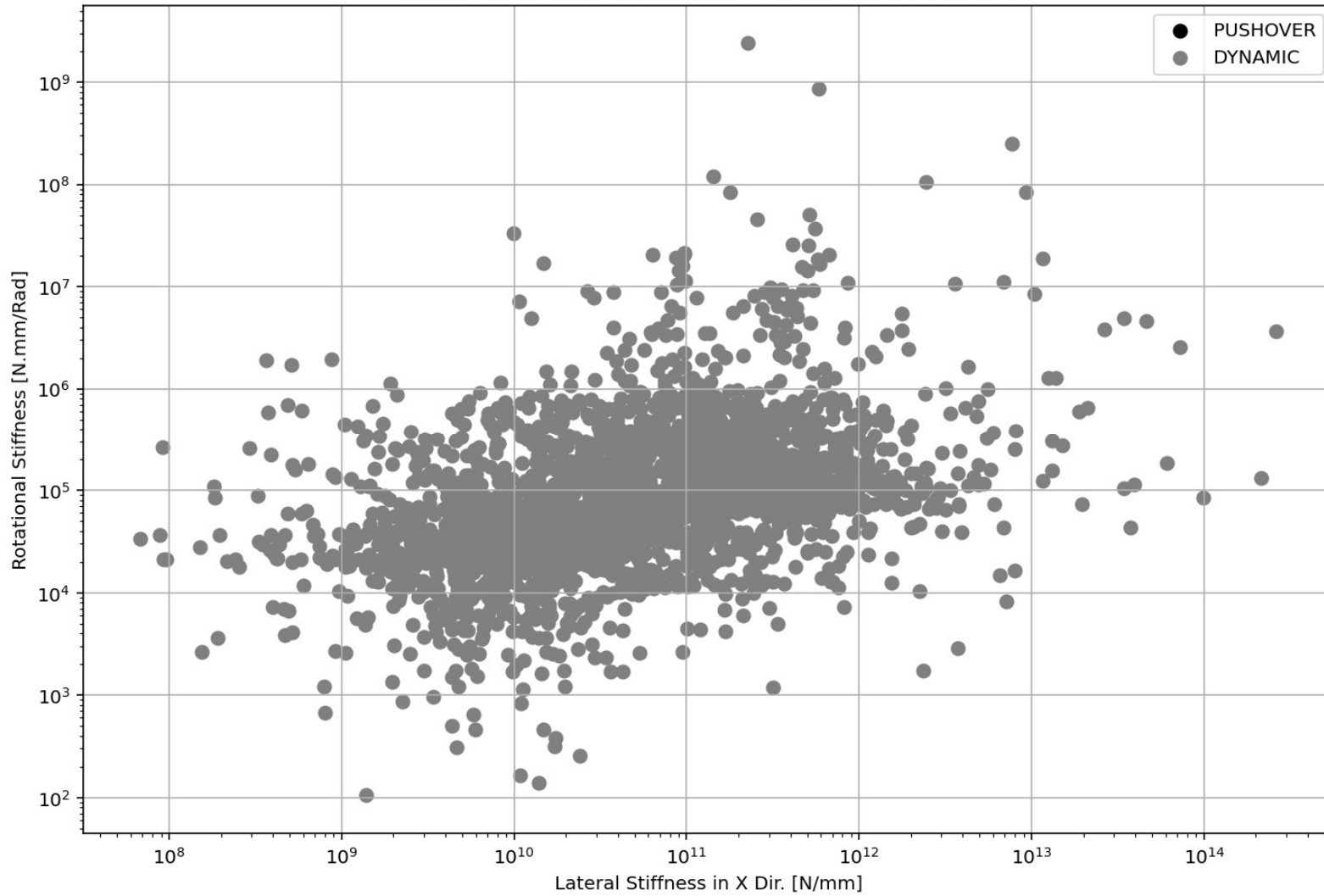




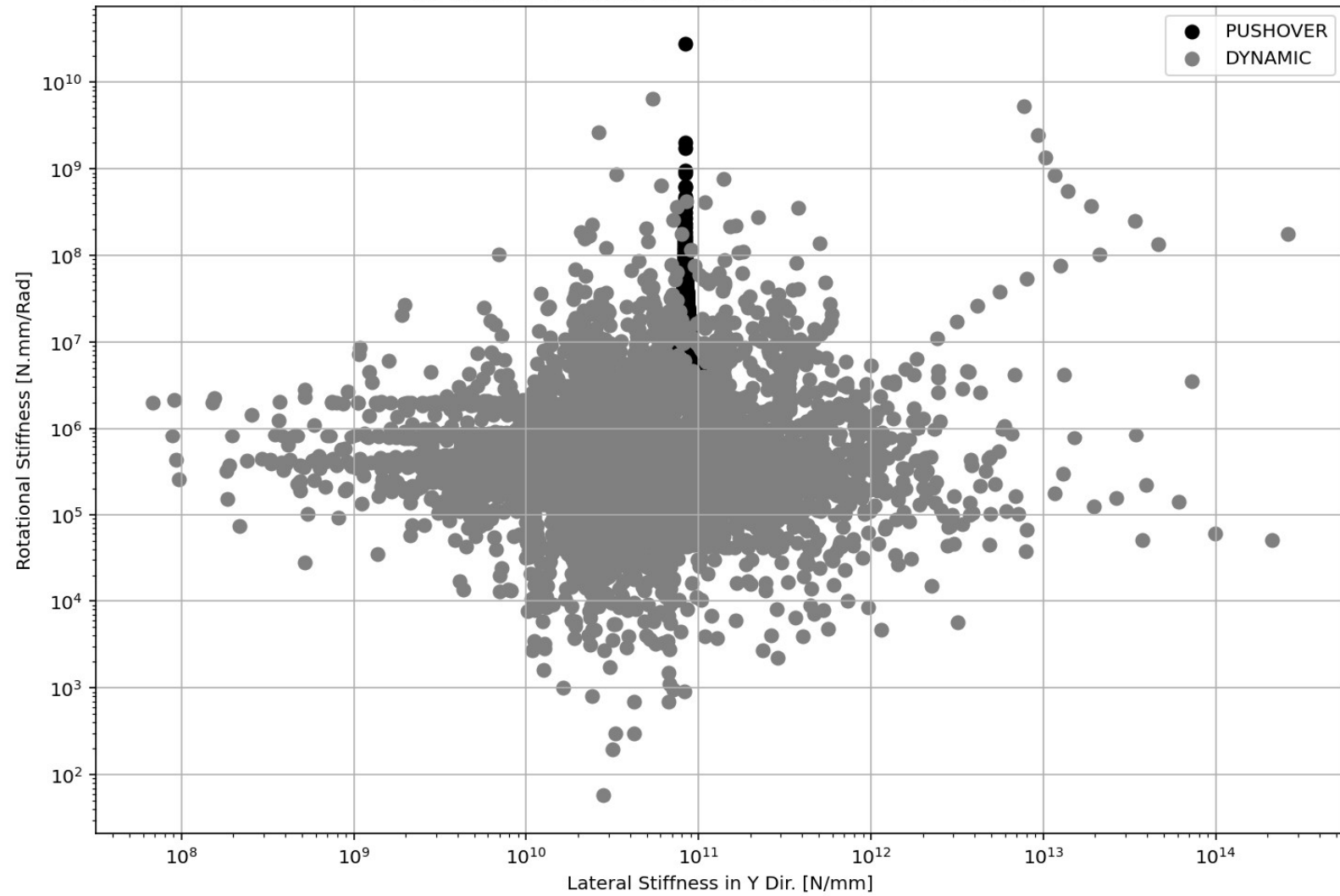


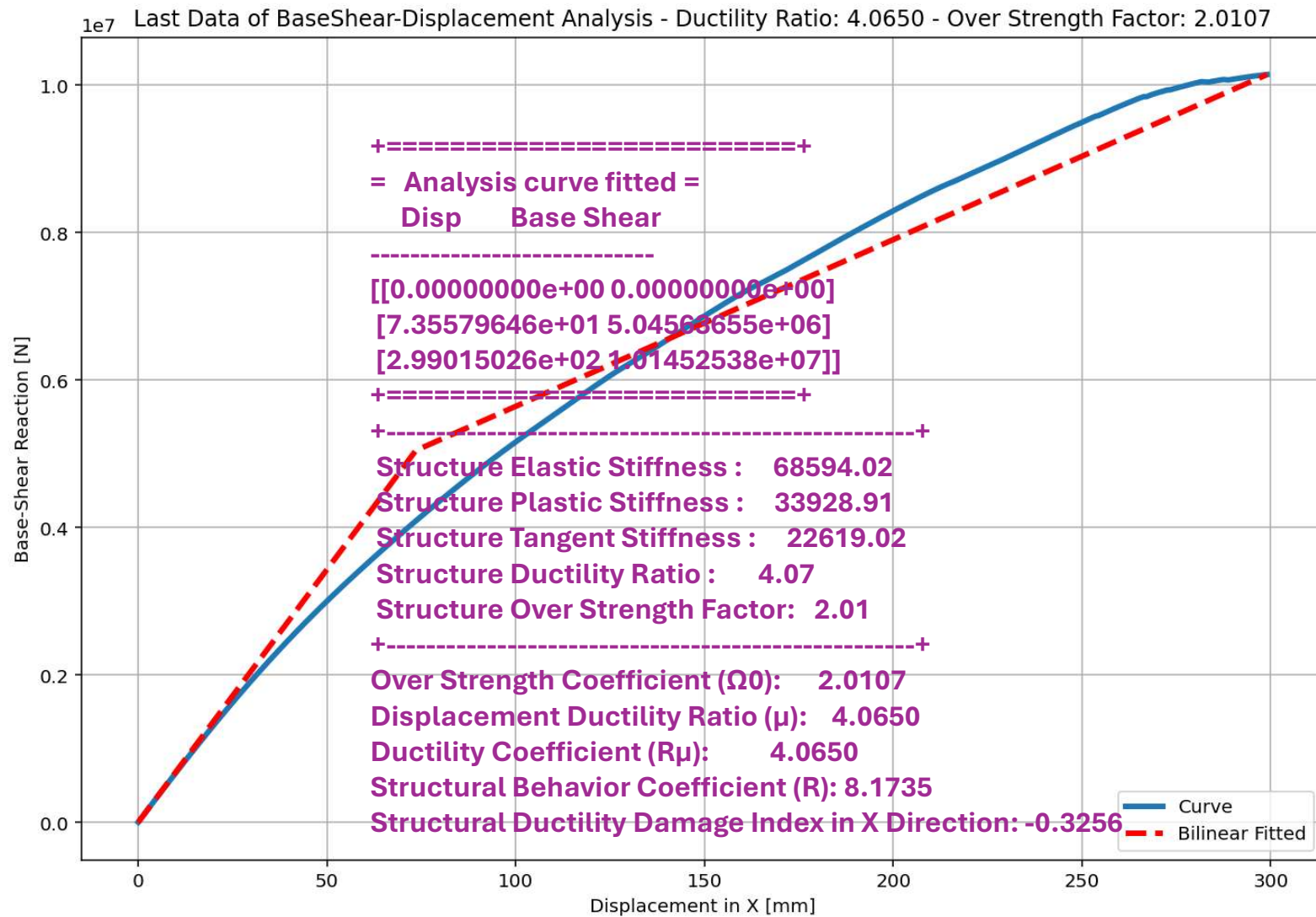


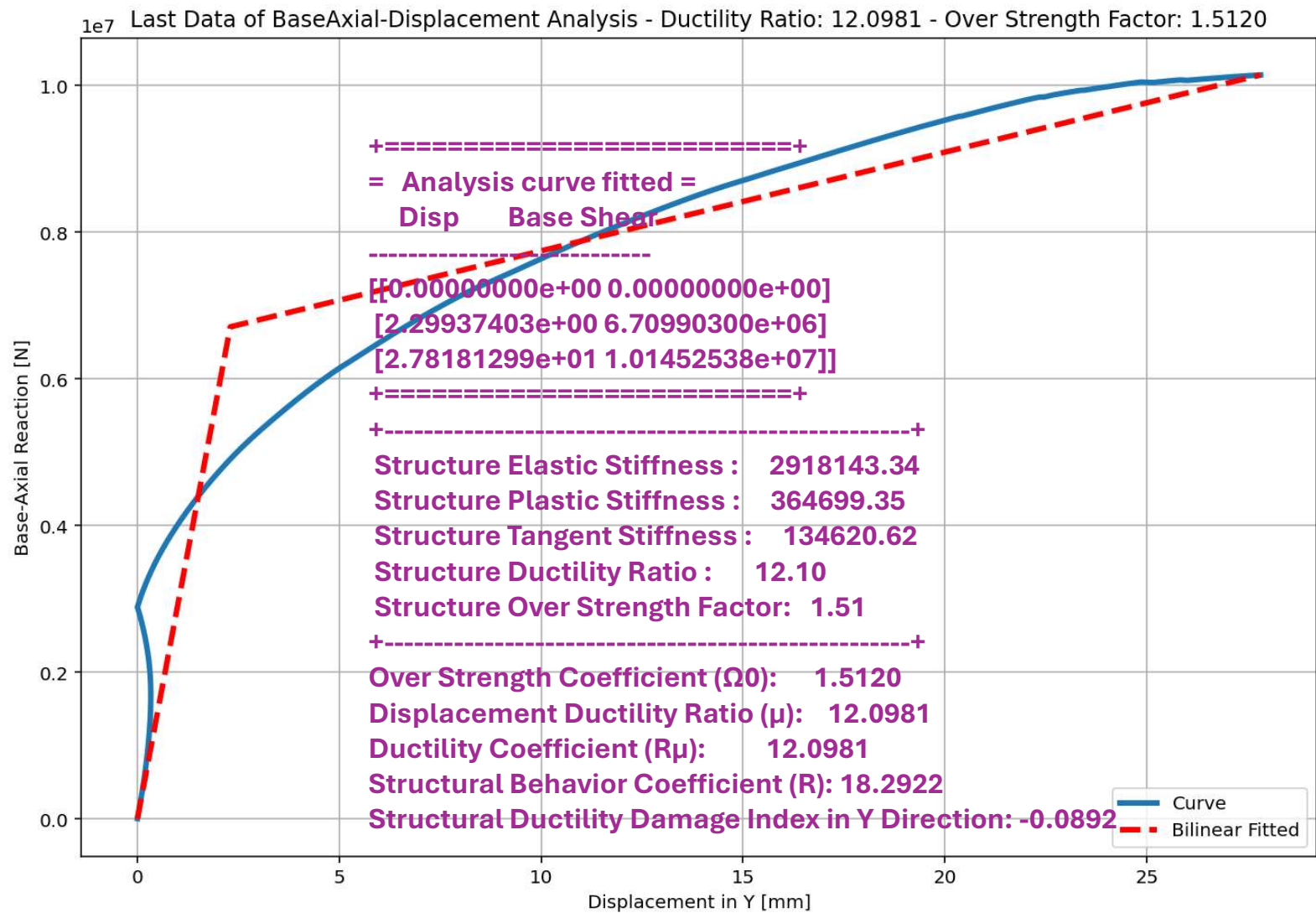
ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM



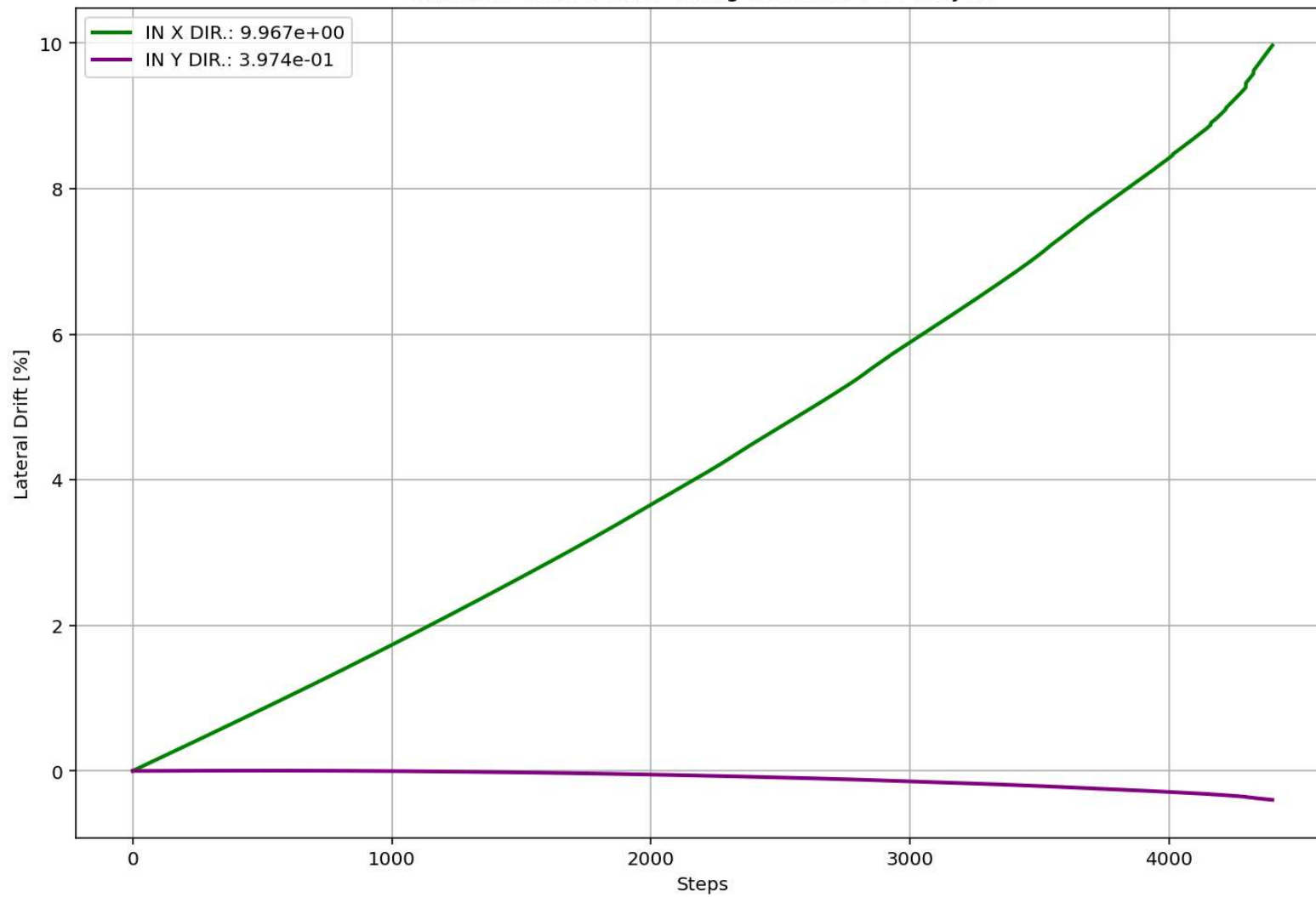
ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM



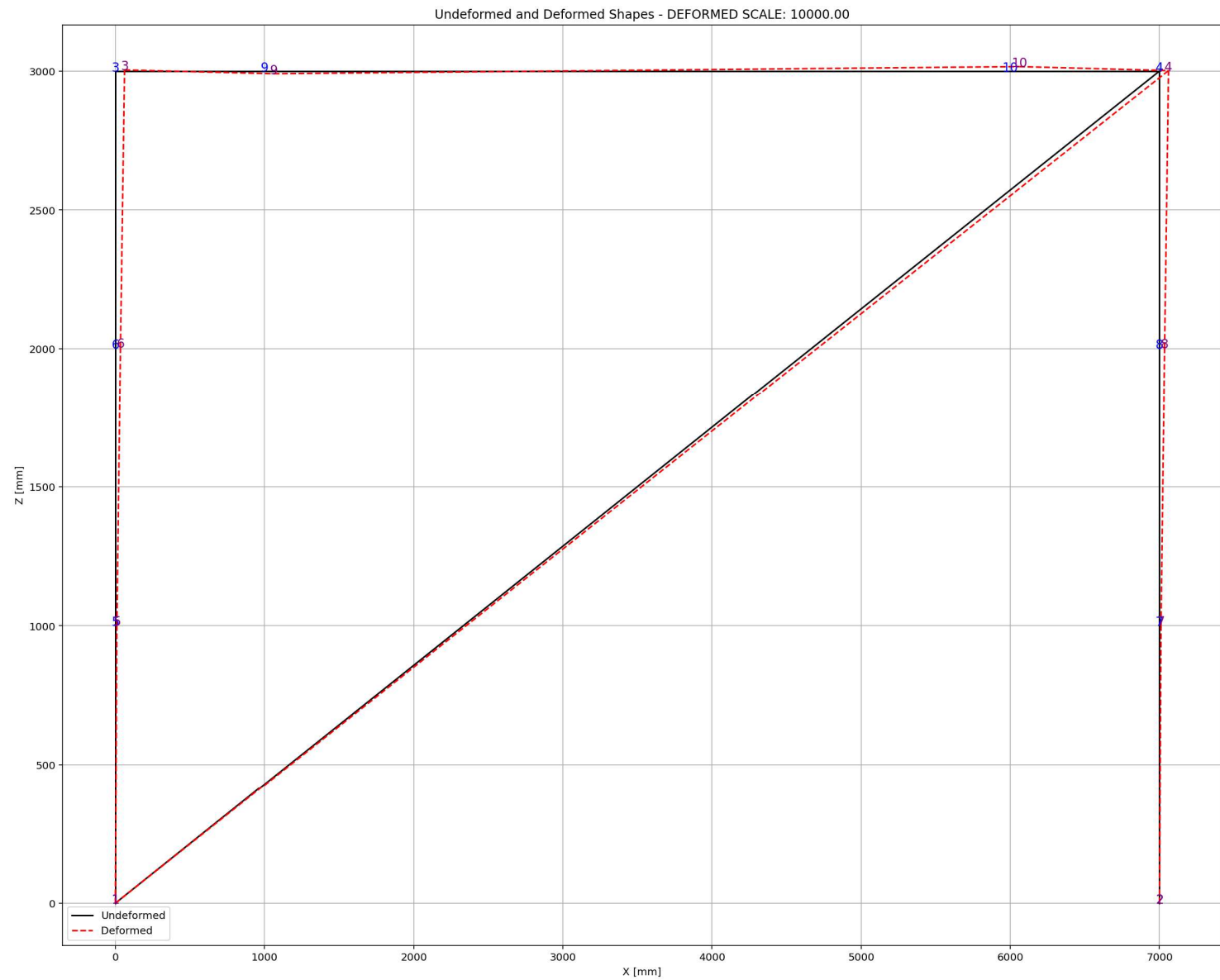


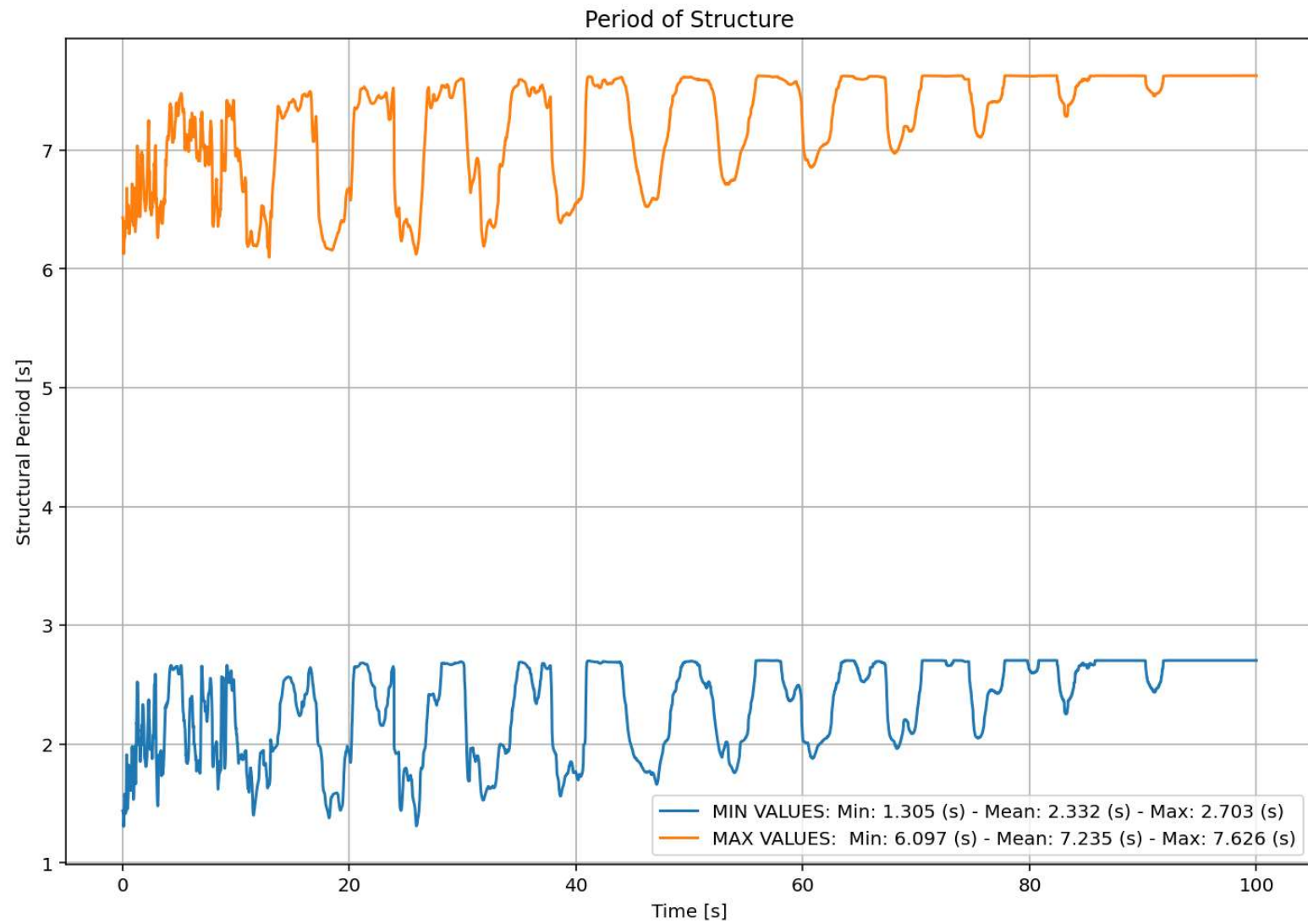


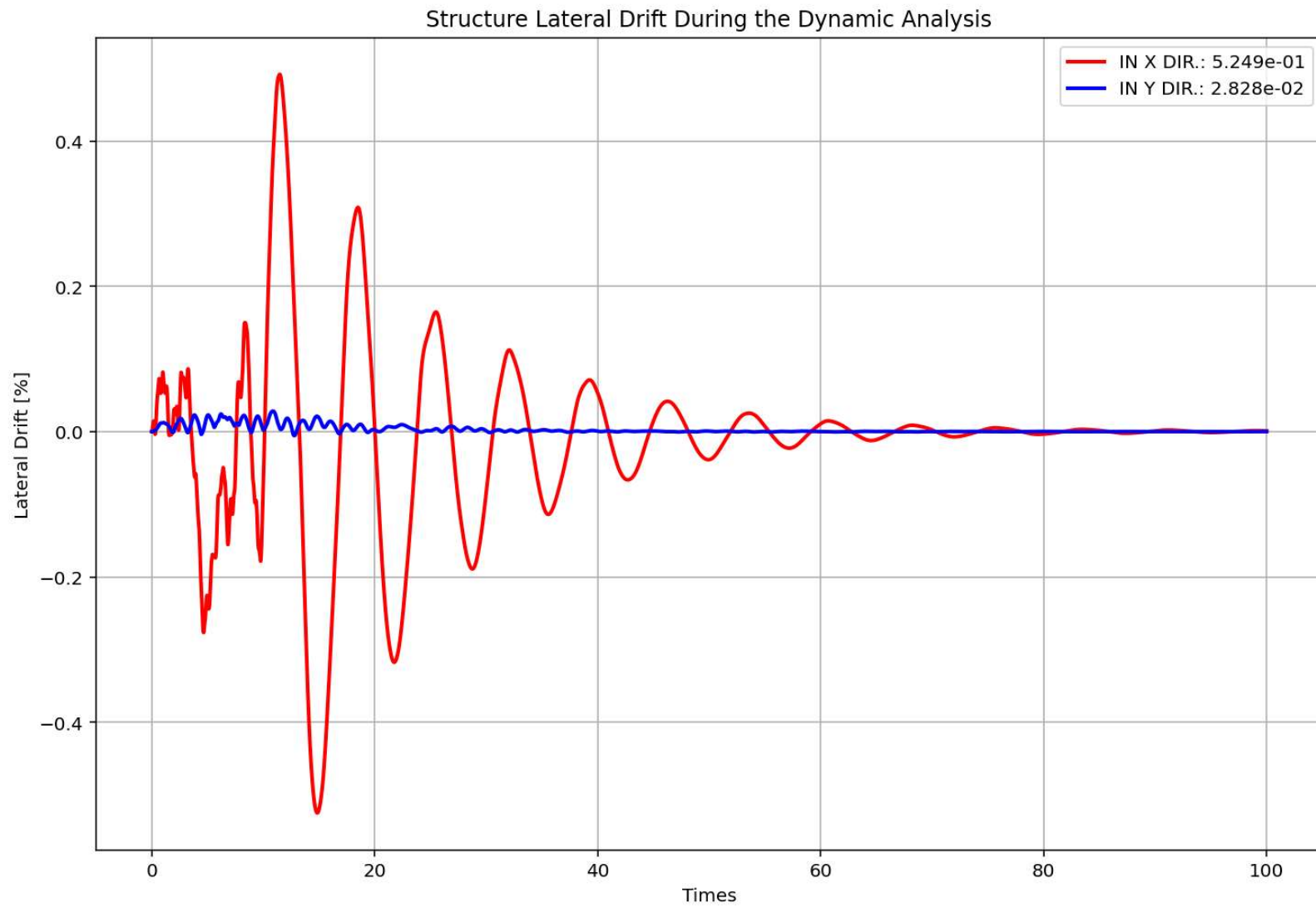
Structure Lateral Drift During the Pushover Analysis



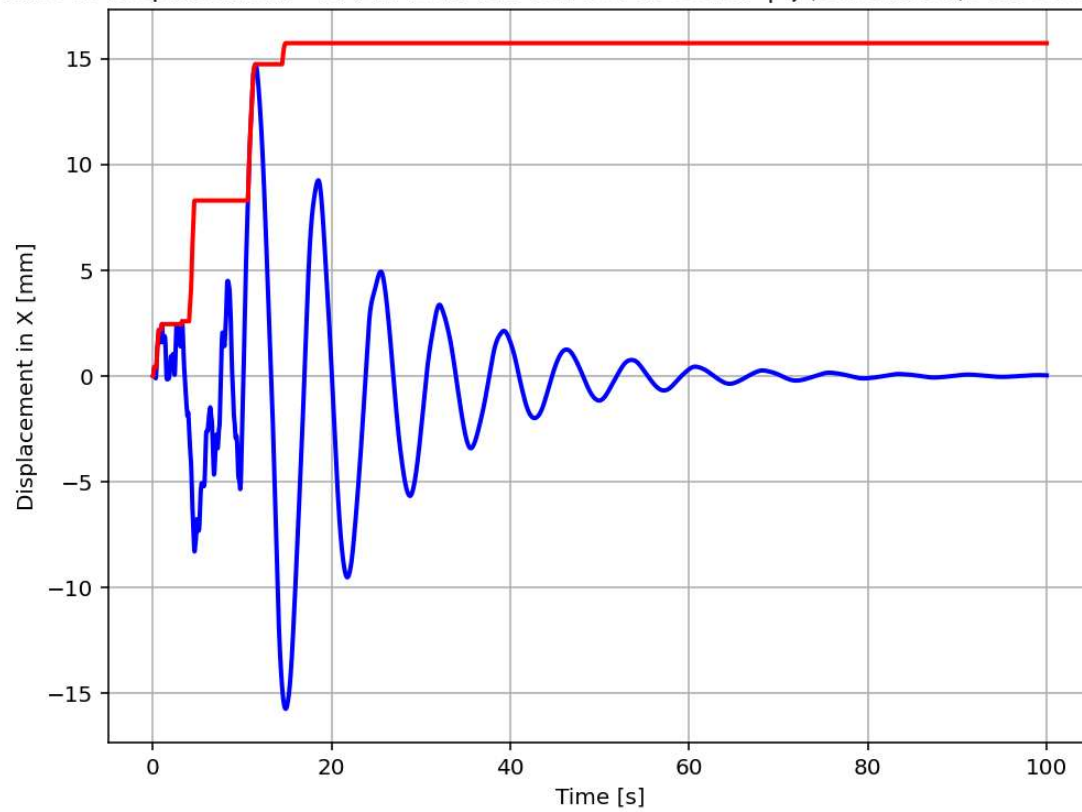
NONLINEAR DYNAMIC ANALYSIS

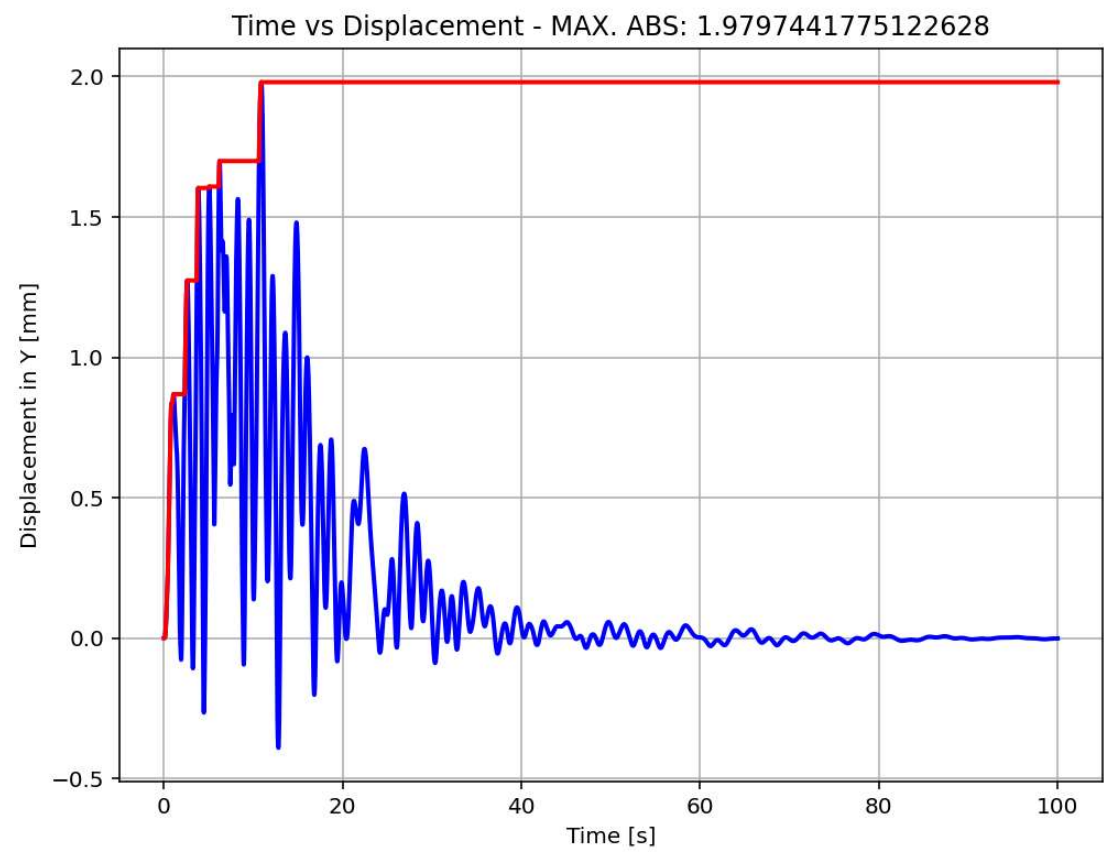


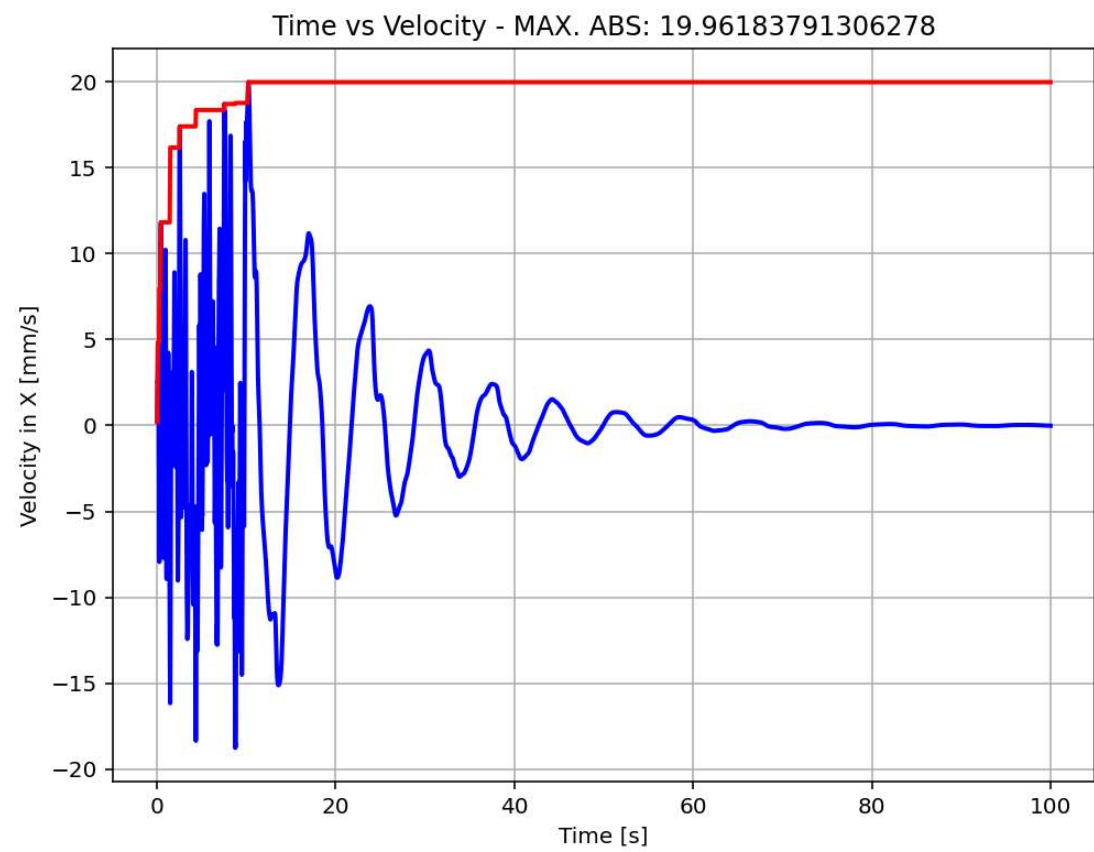




Time vs Displacement - MAX. ABS: 15.746140524135297 | ξ (Calculated): 0.00000e+00 %







Time vs Acceleration - MAX. ABS: 328.71357604658357

