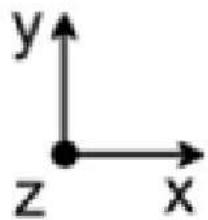
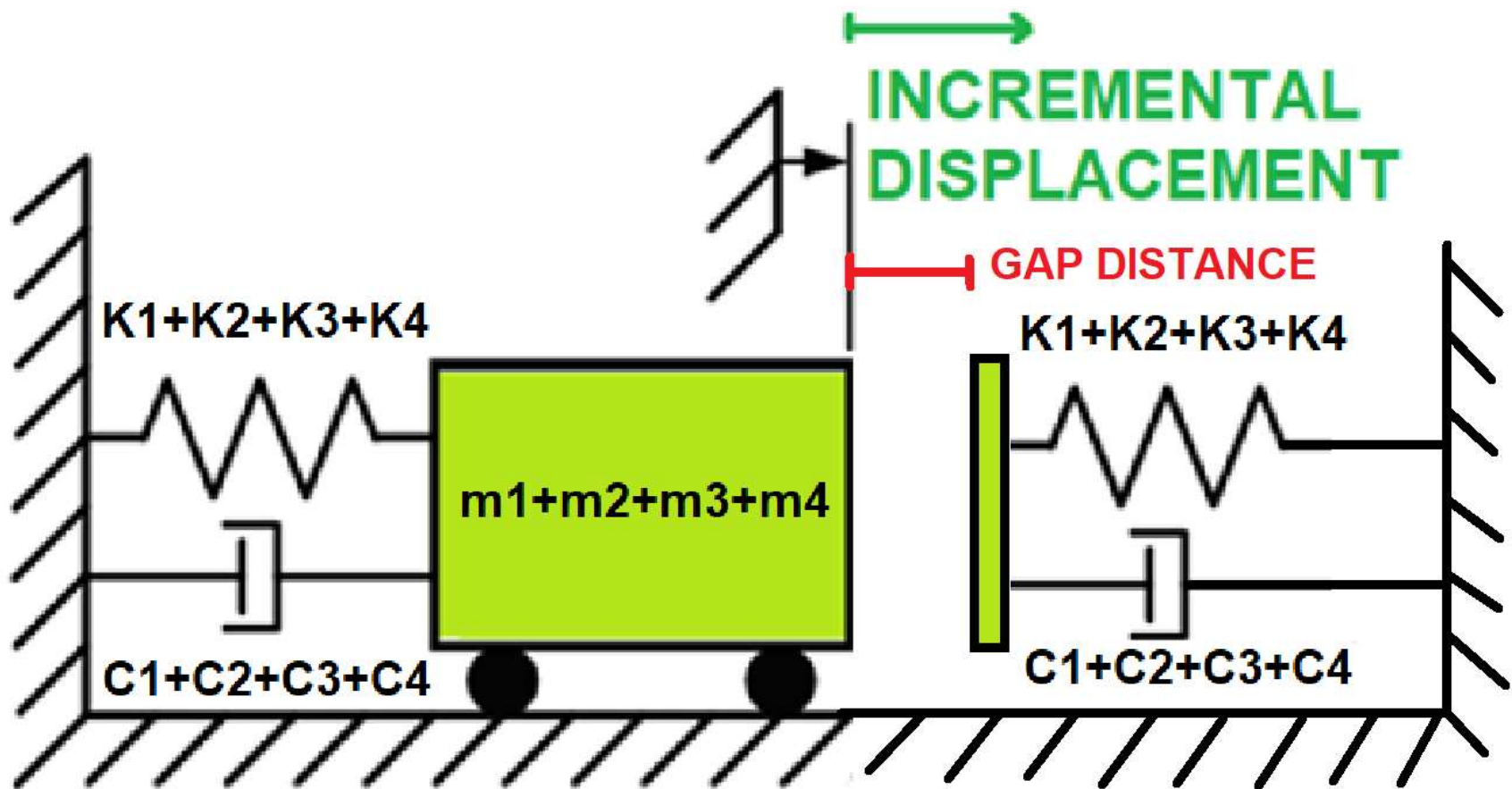
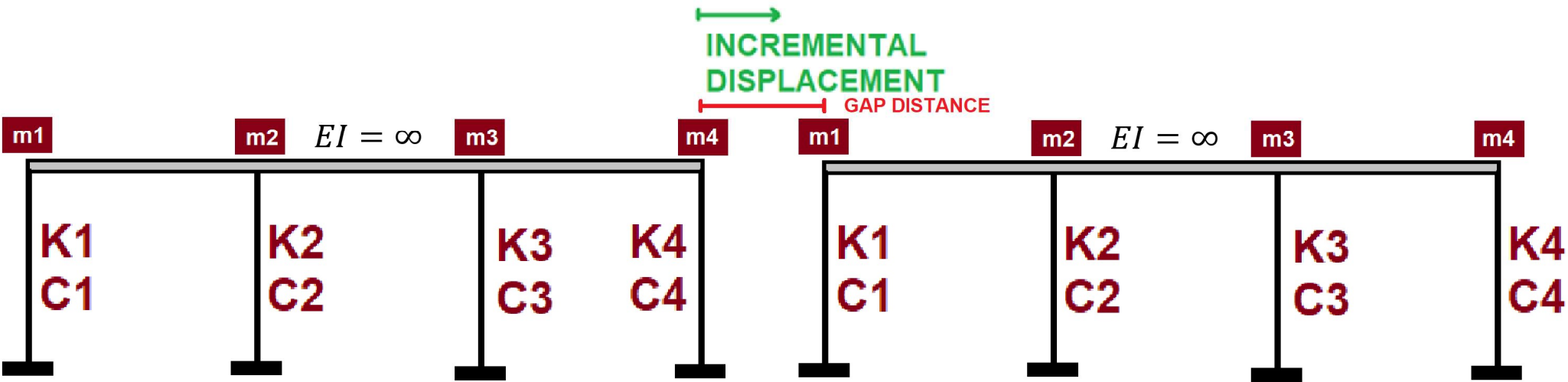


>> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<

CONTACT-DRIVEN PUSHOVER ANALYSIS OF INELASTIC SDOF SYSTEMS: MONITORING PERIOD SHIFTS DURING SECONDARY SPRING ACTIVATION IN OPENSEES

WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)





Spyder (Python 3.12)

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C:\Users\De\l\Desktop\OPENSEES_FILES\+CONTACT_PRO...TACT_PROBLEM_SDOF_PUSHOVER_MULTI_SPRING_PERIOD.py

CONTACT_PROBLEM_SD...I_SPRING_PERIOD.py

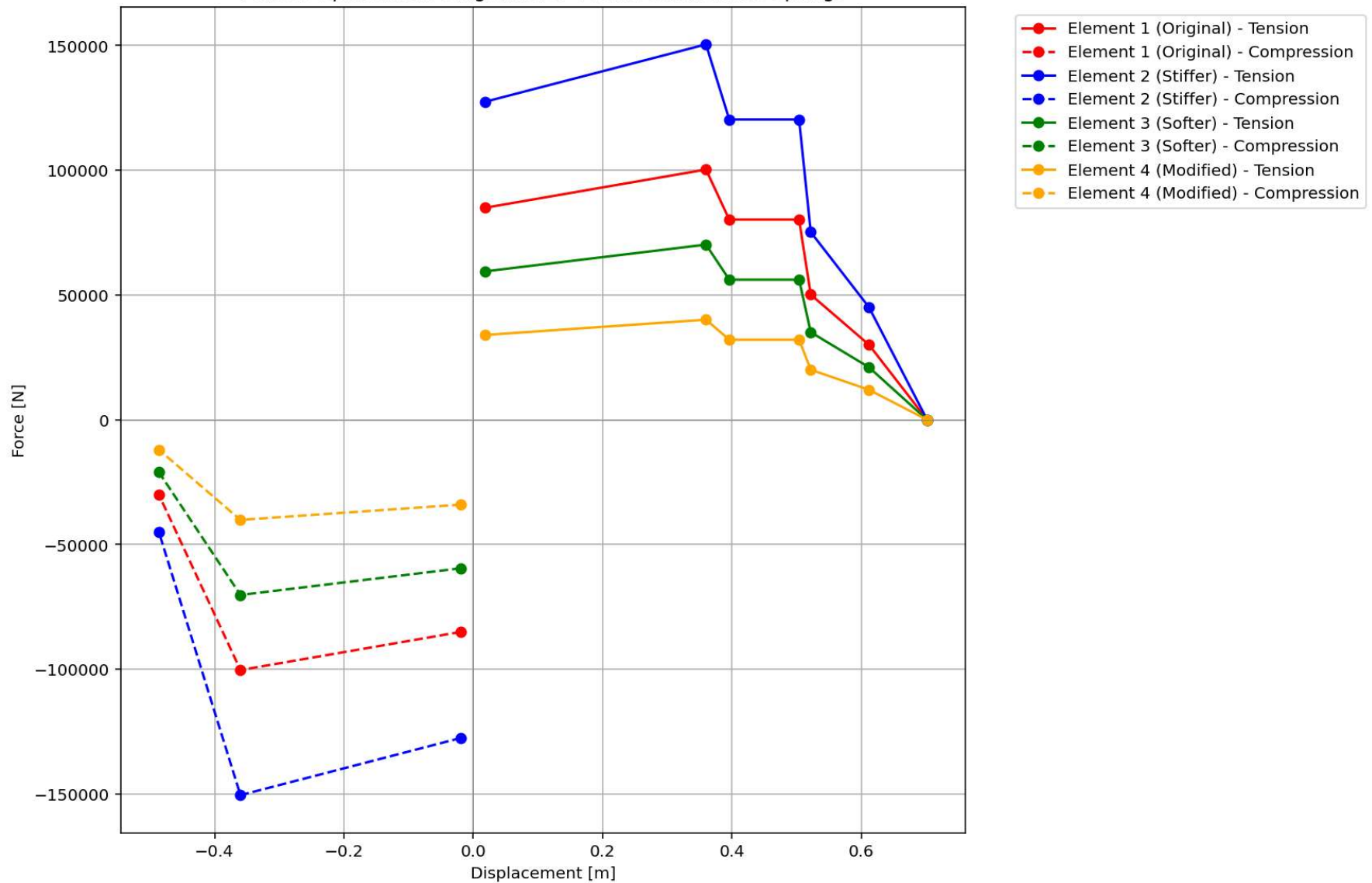
```
1 #####
2 # >> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<
3 # CONTACT-DRIVEN PUSHOVER ANALYSIS OF INELASTIC SDOF SYSTEMS: MONITORING PERIOD SHIFTS DURING
4 # SECONDARY SPRING ACTIVATION IN OPENSEES
5 # -----
6 # THIS PROGRAM WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)
7 # EMAIL: salar.d.ghashghaei@gmail.com
8 #####
9 """
10 This script simulates the nonlinear pushover response of a single-degree-of-freedom system with a
11 contact/gap mechanism. The structure has a primary spring (elastic or hysteretic) that activates
12 immediately, while a secondary parallel spring engages only when displacement exceeds a specified
13 gap distance. This models structural components that come into contact only after certain
14 deformation thresholds, such as gap-opening in masonry infills, pounding between adjacent structures,
15 or secondary bracing systems activating during strong seismic events.
16
17 The analysis tracks force-displacement response, stiffness degradation, and period elongation
18 as damage accumulates. The eigenvalue analysis at each step captures how the natural period
19 increases with structural softening, a critical indicator of seismic vulnerability during
20 progressive damage. Contact activation causes a sudden stiffness increase when the gap closes,
21 followed by further period evolution as the system yields.
22 """
23 import openseespy.opensees as ops
24 import numpy as np
25 import matplotlib.pyplot as plt
26 import time as TI
27 import ANALYSIS_FUNCTION as S01
28 import PERIOD_FUN as S02
29 import EIGENVALUE_ANALYSIS_FUN as S04
30 import BILINEAR_CURVE as S05
31
32 #%%-----
33 # Define parameters (units: m, N)
34 # Force-Displacement Relationship for Each Column # [N] Yield Force of Structure
35 FY = 85000.0
```

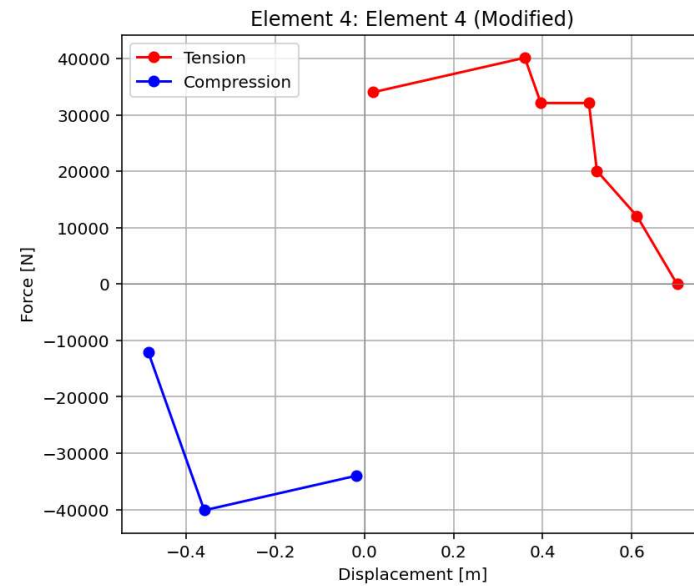
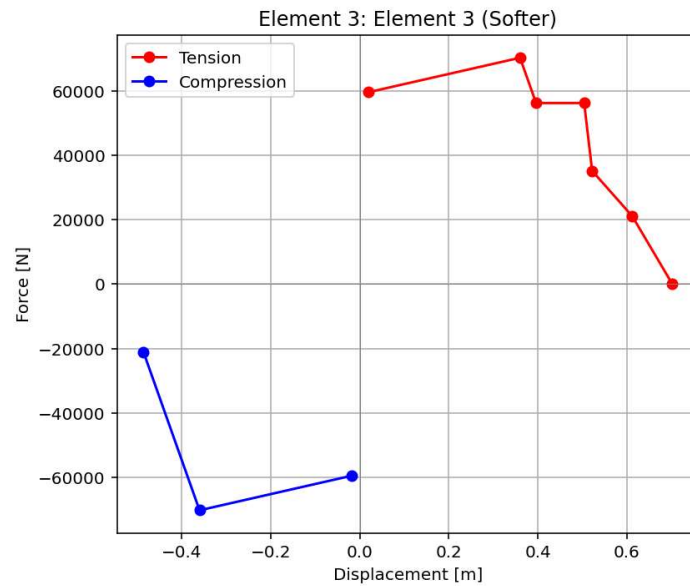
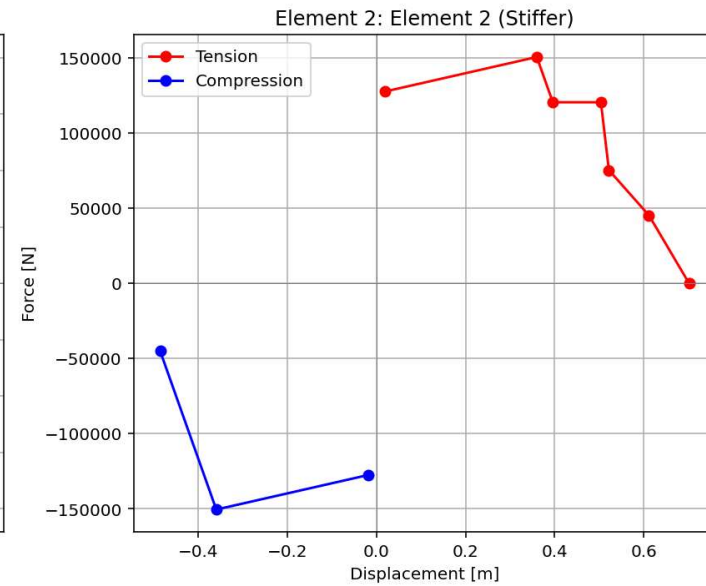
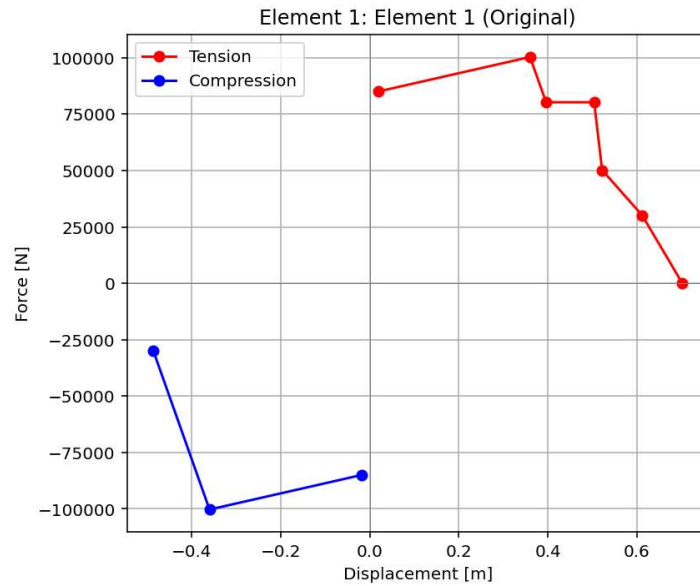
Elements Force vs Displacement During Inelastic Pushover Analysis

IPython Console Files Help Variable Explorer Debugger Plots History

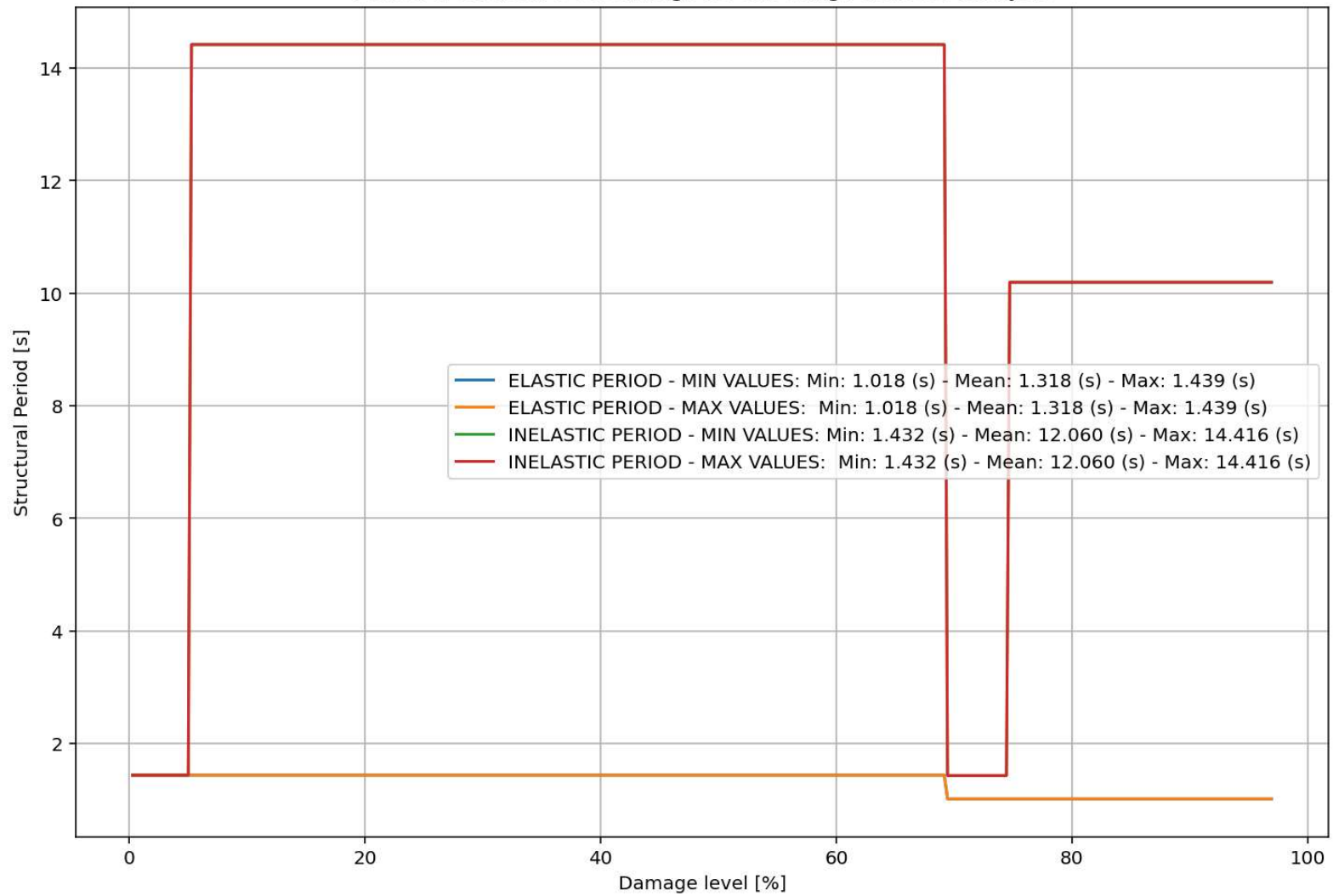
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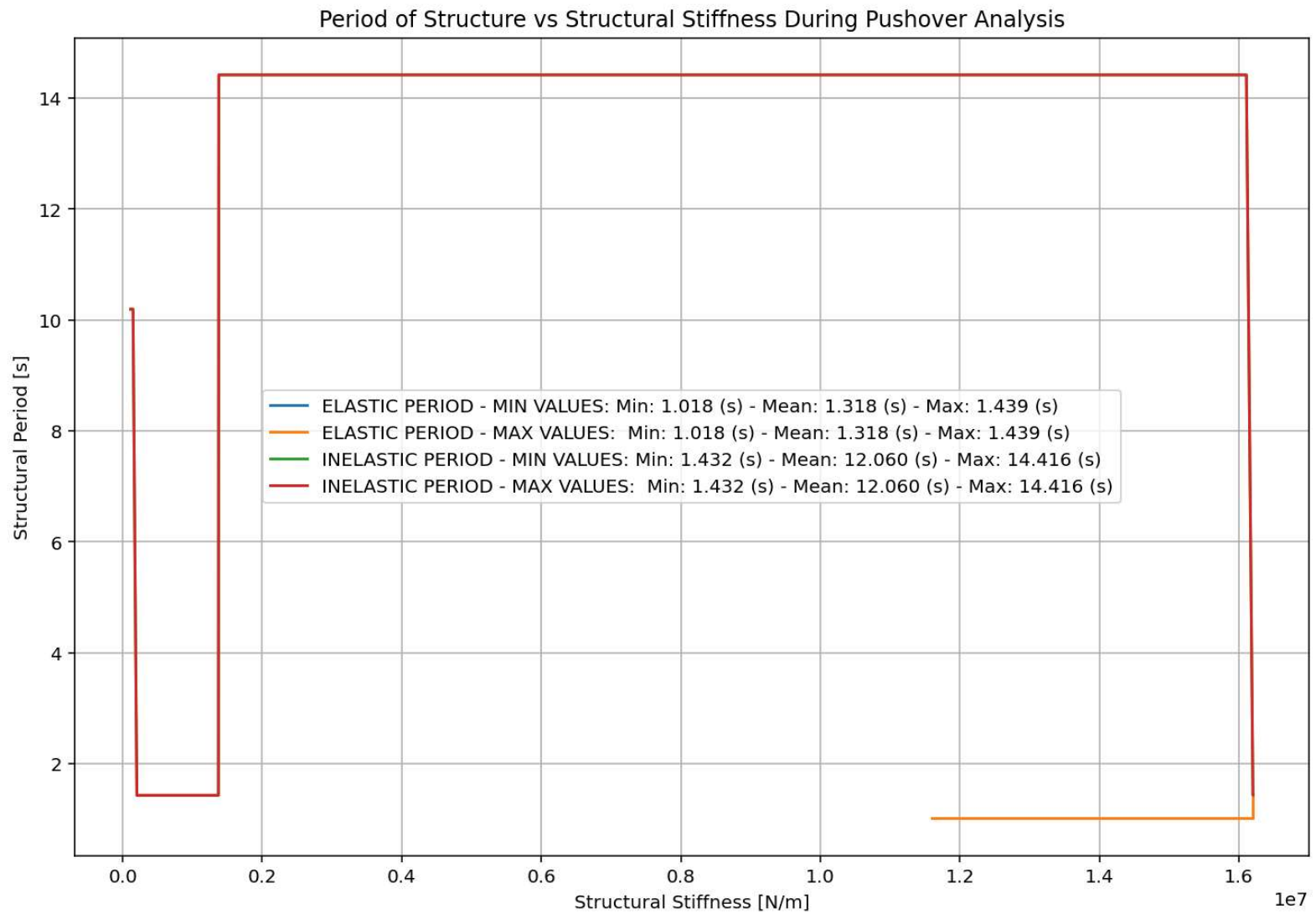
Force-Displacement Diagrams for 4 Different Inelastic Springs

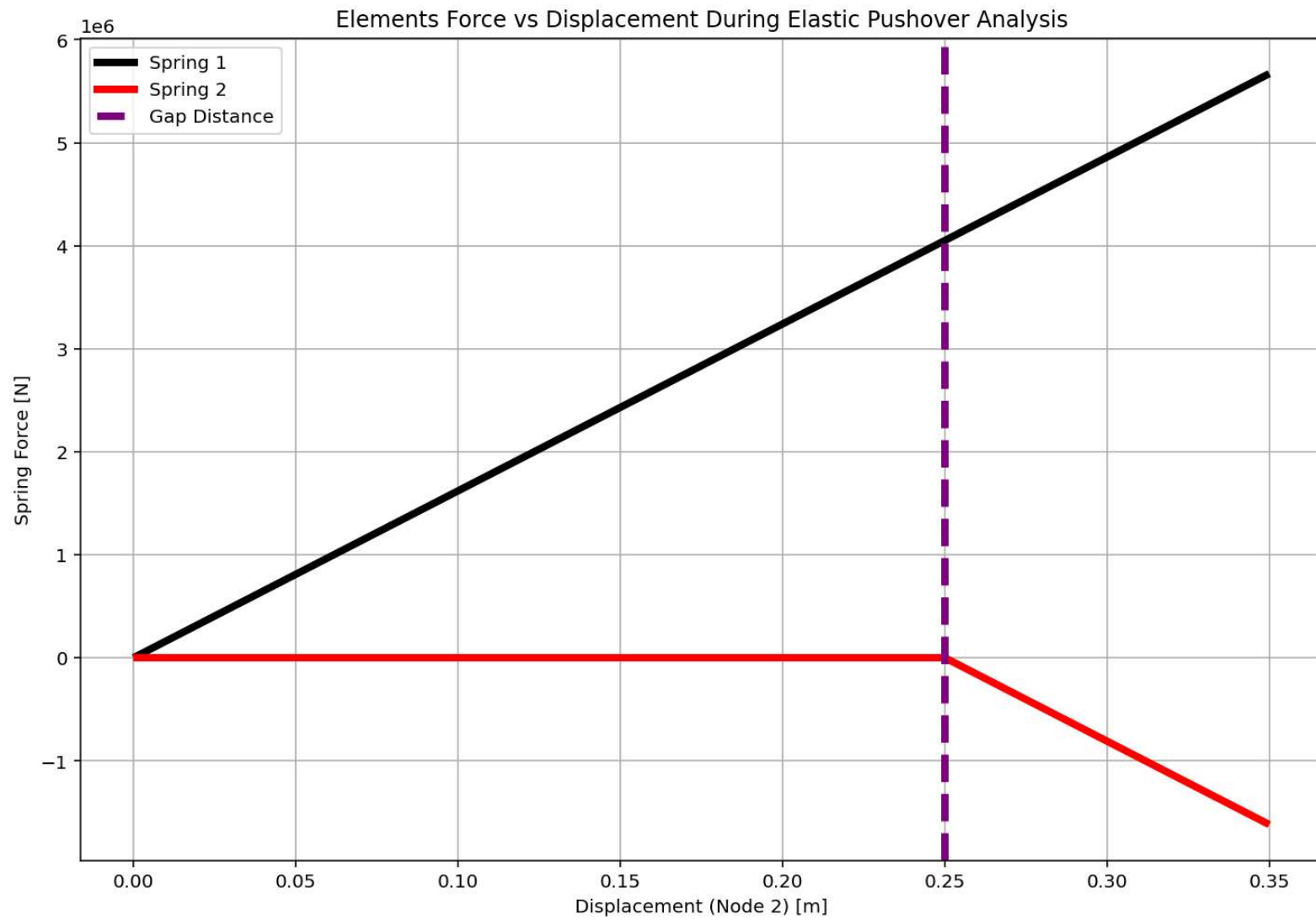




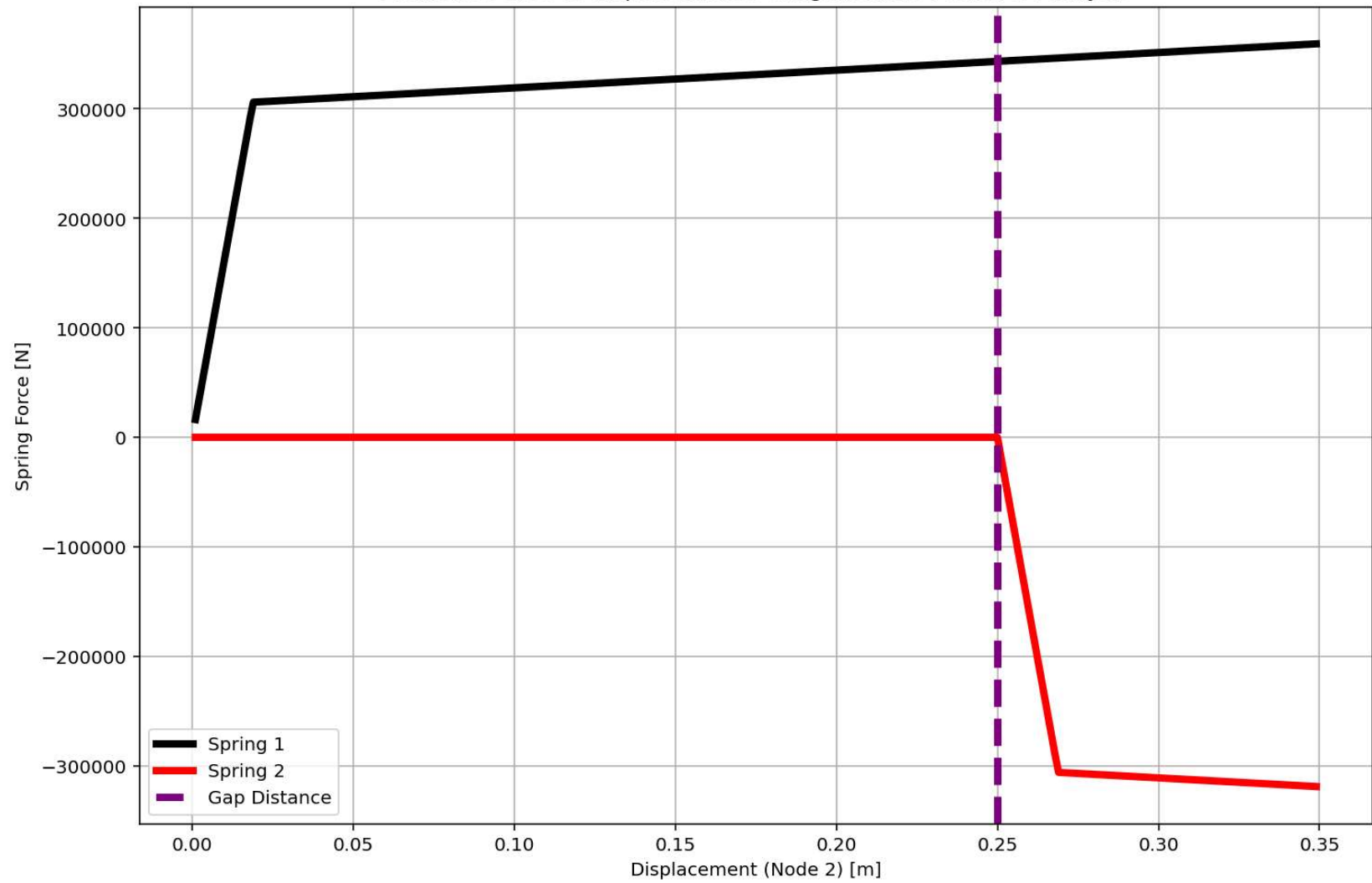
Period of Structure vs Damage level During Pushover Analysis

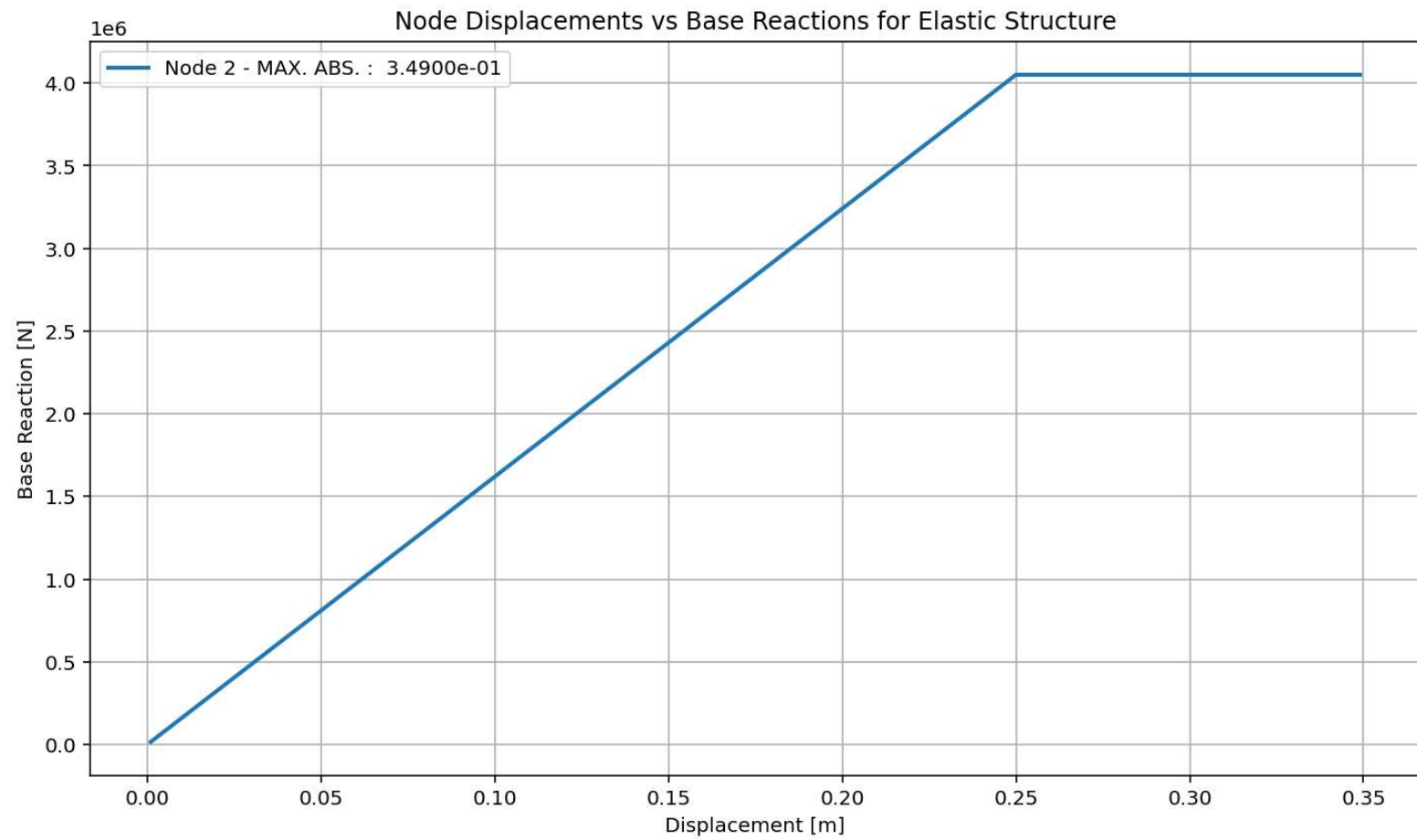






Elements Force vs Displacement During Inelastic Pushover Analysis





Node Displacements vs Base Reactions for Inelastic Structure

