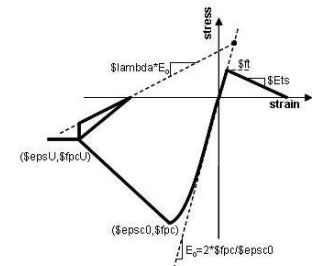
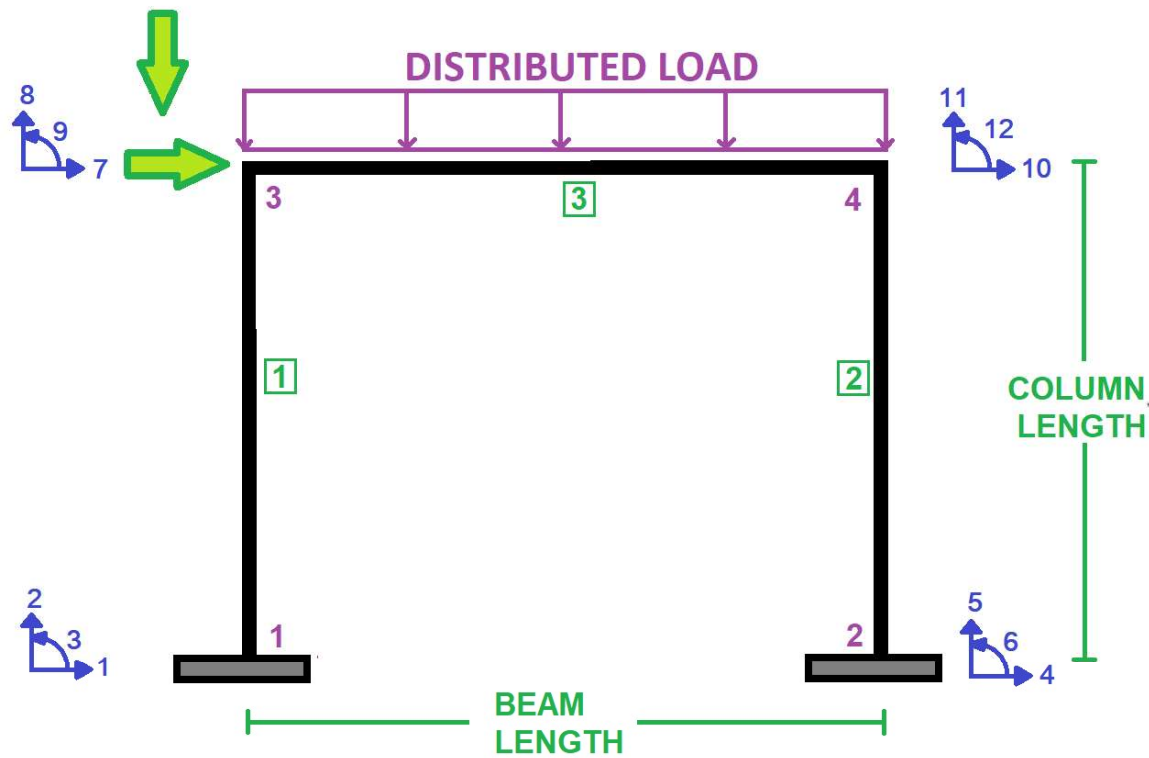


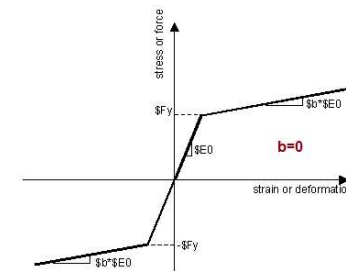
IN THE NAME OF ALLAH

**CREEP AND SHRINKAGE ANALYSIS OF CONCRETE FRAME.  
EVALUATING STRAIN HARDENING  
AND ULTIMATE STRAIN CRITERIA USING OPENSEES AND CALCULATE  
STRUCTURAL BEHAVIOR COEFFICIENT**

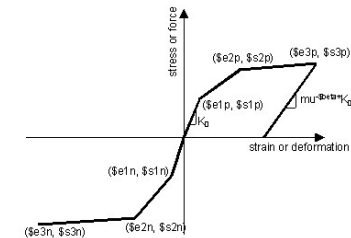
WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)



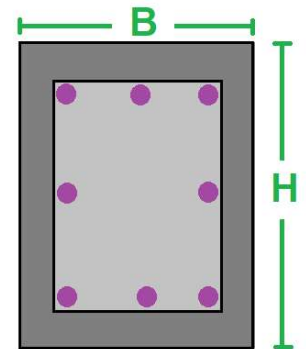
### CORE AND COVER CONCRETE REALTION



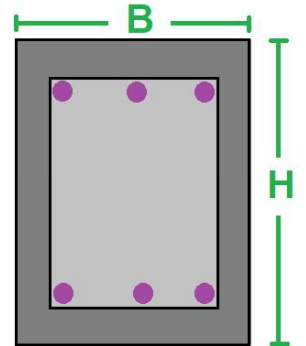
WITHOUT HARDENING AND ULTIMATE STRAIN



### WITH HARDENING AND ULTIMATE STRAIN



### COLUMN SECTION



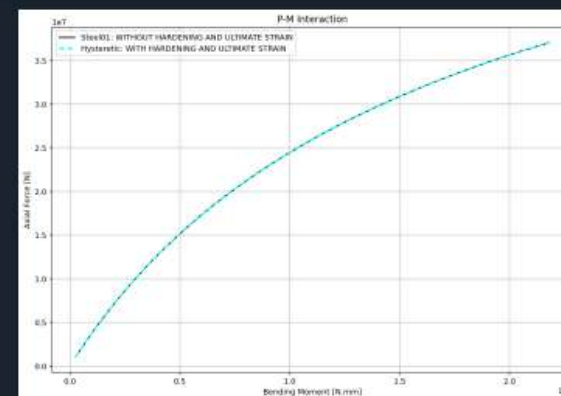
## BEAM SECTION

C:\Users\Dell\Desktop\OPENSEES\_FILES\CONCRETE\_FRAME\_ANALYSIS\CONCRETE\_FRAME\_CREEP\_AND\_SHRINKAGE.py

CONCRETE\_FRAME\_CREEP\_AND\_SHRINKAGE.py X

```
1 #####
2 # >> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<
3 # ANALYZING CREEP AND SHRINKAGE OF A CONCRETE FRAME. EVALUATING STRAIN HARDENIN
4 # AND ULTIMATE STRAIN CRITERIA USING OPENSEES AND CALCULATE STRUCTURAL BEHAVIOR CO
5 #-----
6 # THIS PROGRAM WRITTEN BY SALAR DELAVAR GHASHGHAEE (QASHQAEI)
7 # EMAIL: salar.d.ghashghaei@gmail.com
8 #####
9 """
10 1. The analysis compares nonlinear rotational behavior of concrete beam-column
11 elements under creep and shrinkage using OpenSees.
12 2. Two material models--*Steel01* (bilinear without degradation) and *Hysteretic*
13 (tri-linear with pinching and strength/stiffness degradation)-are used.
14 3. Both models are subjected to identical loading protocols to investigate pushover
15 response under increasing drift demands.
16 4. The *Steel01* model exhibits stable hysteresis loops with no degradation, reflecting
17 idealized elastic-plastic behavior.
18 5. In contrast, the *Hysteretic* model shows strength and stiffness degradation, capturing
19 post-peak deterioration and pinching effects.
20 6. Element rotation histories reveal increasing divergence as inelastic demand accumulates
21 across cycles.
22 7. The *Hysteretic* model produces reduced energy dissipation capacity due to pinching and
23 cumulative damage.
24 8. Peak rotation capacity is reduced in the *Hysteretic* model, indicating realistic modelin
25 of damage and failure modes.
26 9. The comparison highlights the limitations of bilinear idealizations in capturing cyclic
27 degradation in seismic applications.
28 10. Advanced modeling with calibrated degradation parameters is essential for accurate
29 seismic performance prediction and collapse assessment.
30
31 BOOK: Creep and Shrinkage, Their Effect on the Behavior of Concrete Structures
32 https://link.springer.com/book/10.1007/978-1-4612-5424-9
33 WIKOPEDIA:
34 https://en.wikipedia.org/wiki/Creep\_and\_shrinkage\_of\_concrete
```

...EXAMPLES\CREEP\_AND\_SHRINKAGE\CREEP\_AND\_SHRINKAGE\_ANALYSIS 25 %



Help Variable Explorer Debugger Plots Files

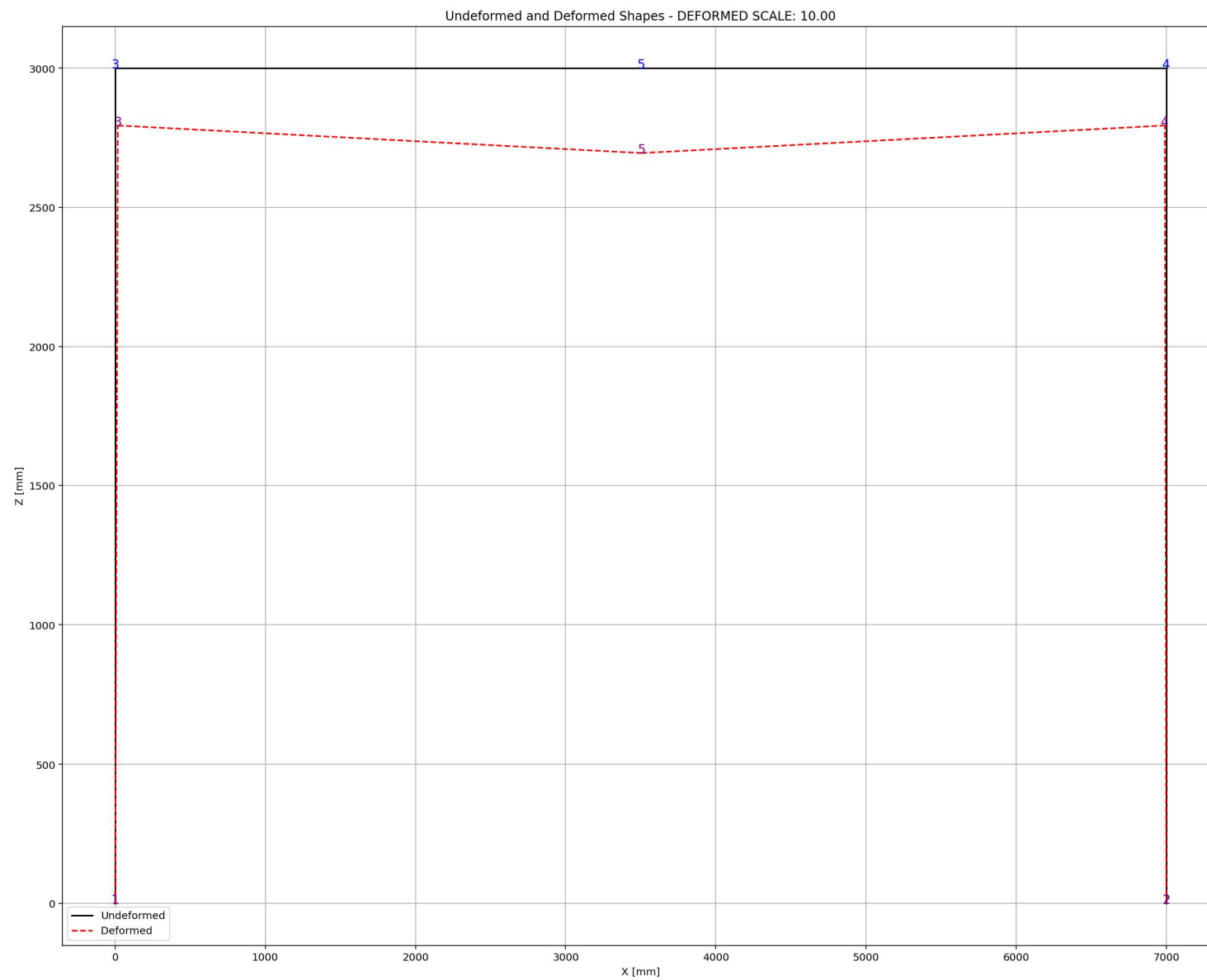
Console 1/A X

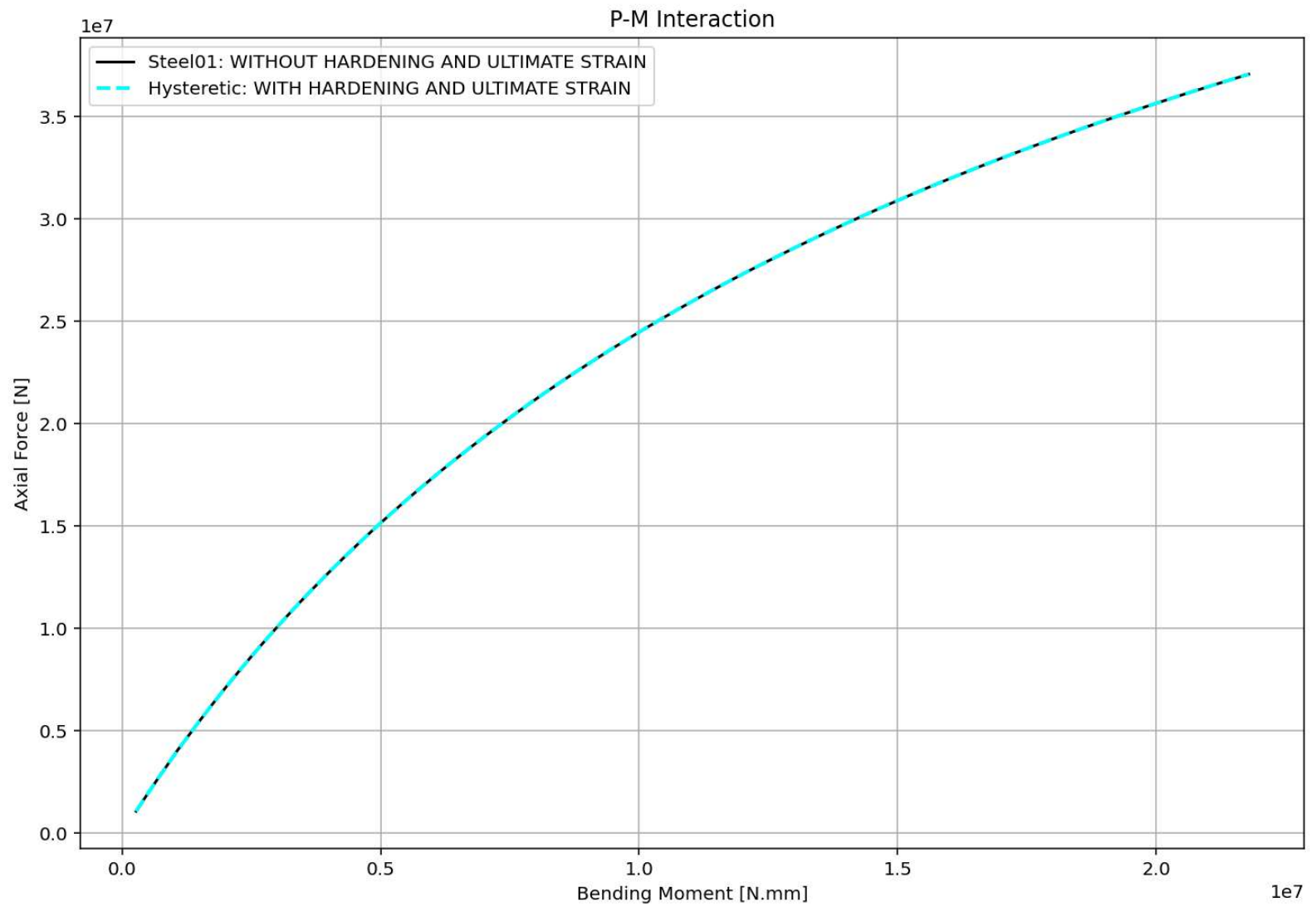
```
Lobatto
End 1 Forces (P V M): 1.85307e+07 216781 2.03723e+08
End 2 Forces (P V M): -1.85307e+07 -216781 4.4662e+08

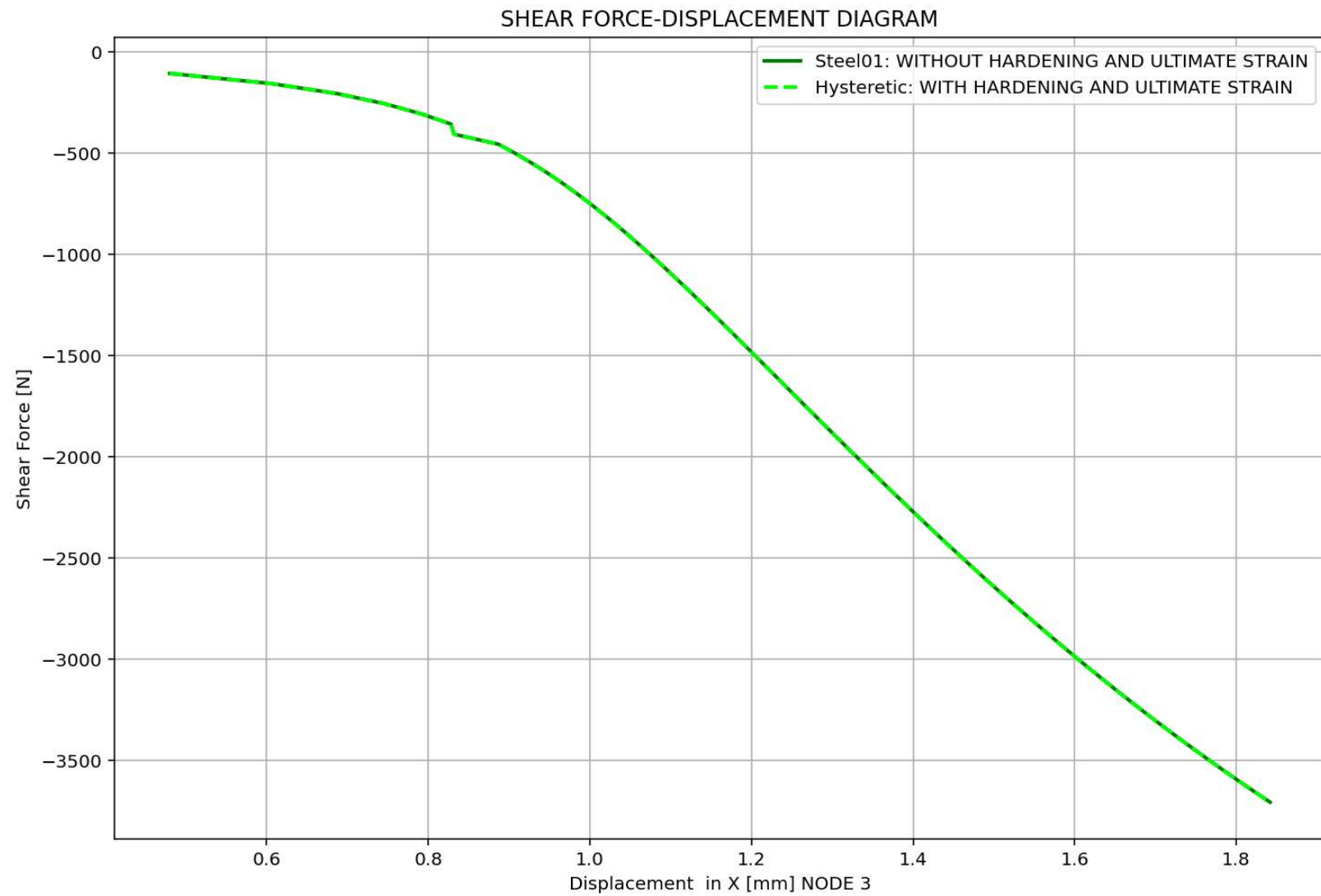
Element: 3 Type: ForceBeamColumn2d Connected Nodes: 3 5
Number of Sections: 5 Mass density: 0
Lobatto
End 1 Forces (P V M): 222863 29.6978 -2.08298e+07
End 2 Forces (P V M): -222863 -29.6978 2.09338e+07

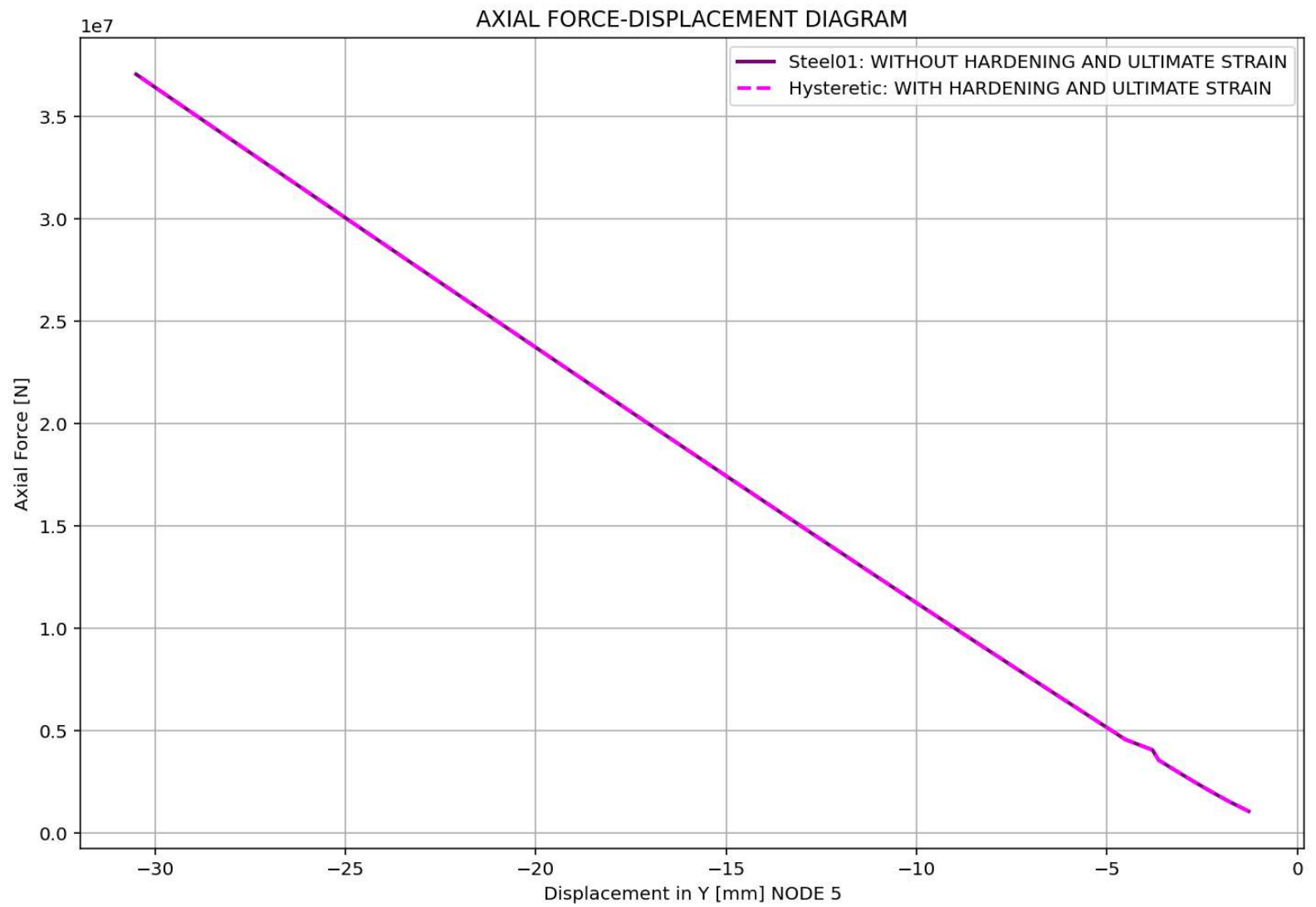
In [2]:
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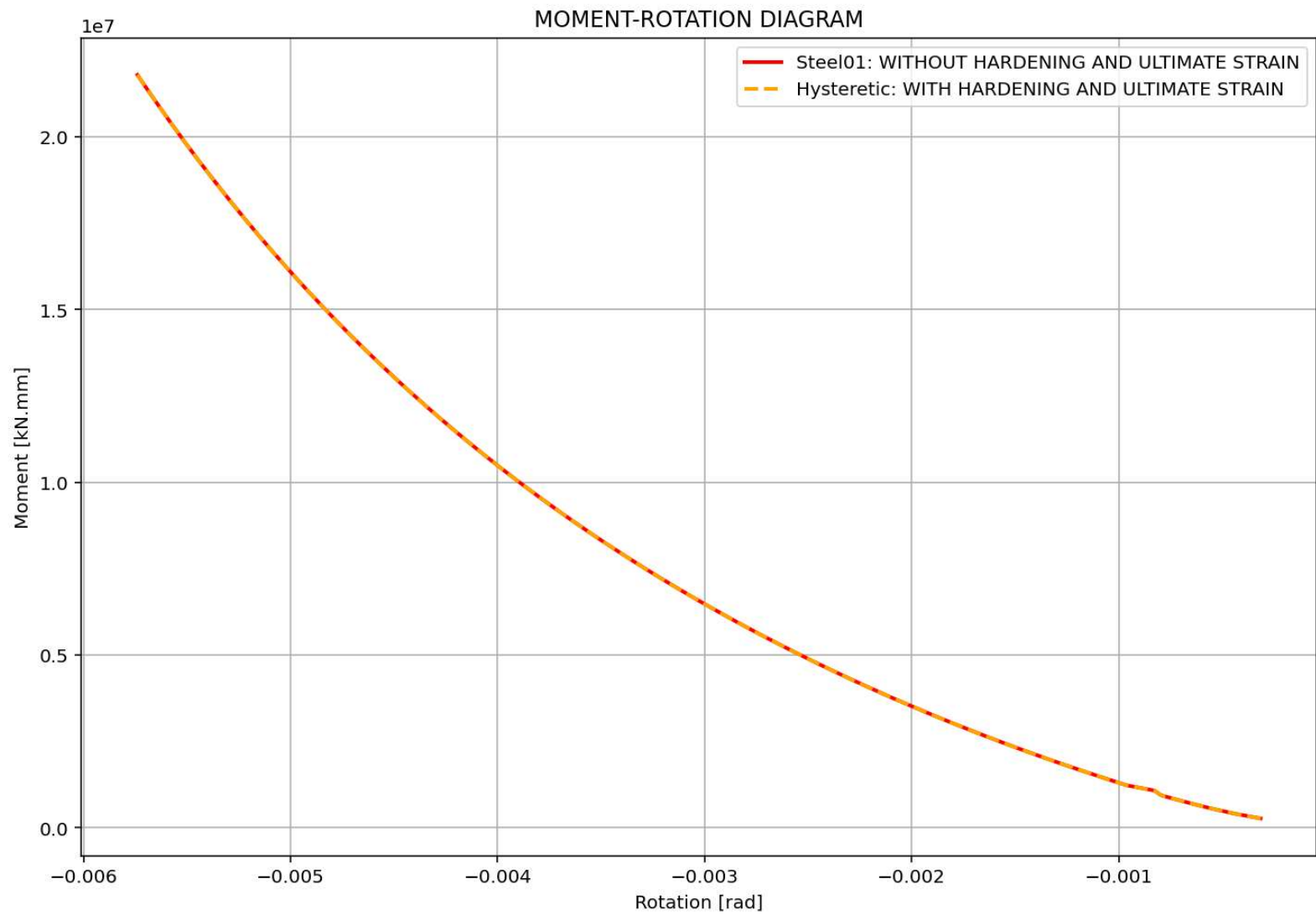
IPython Console History



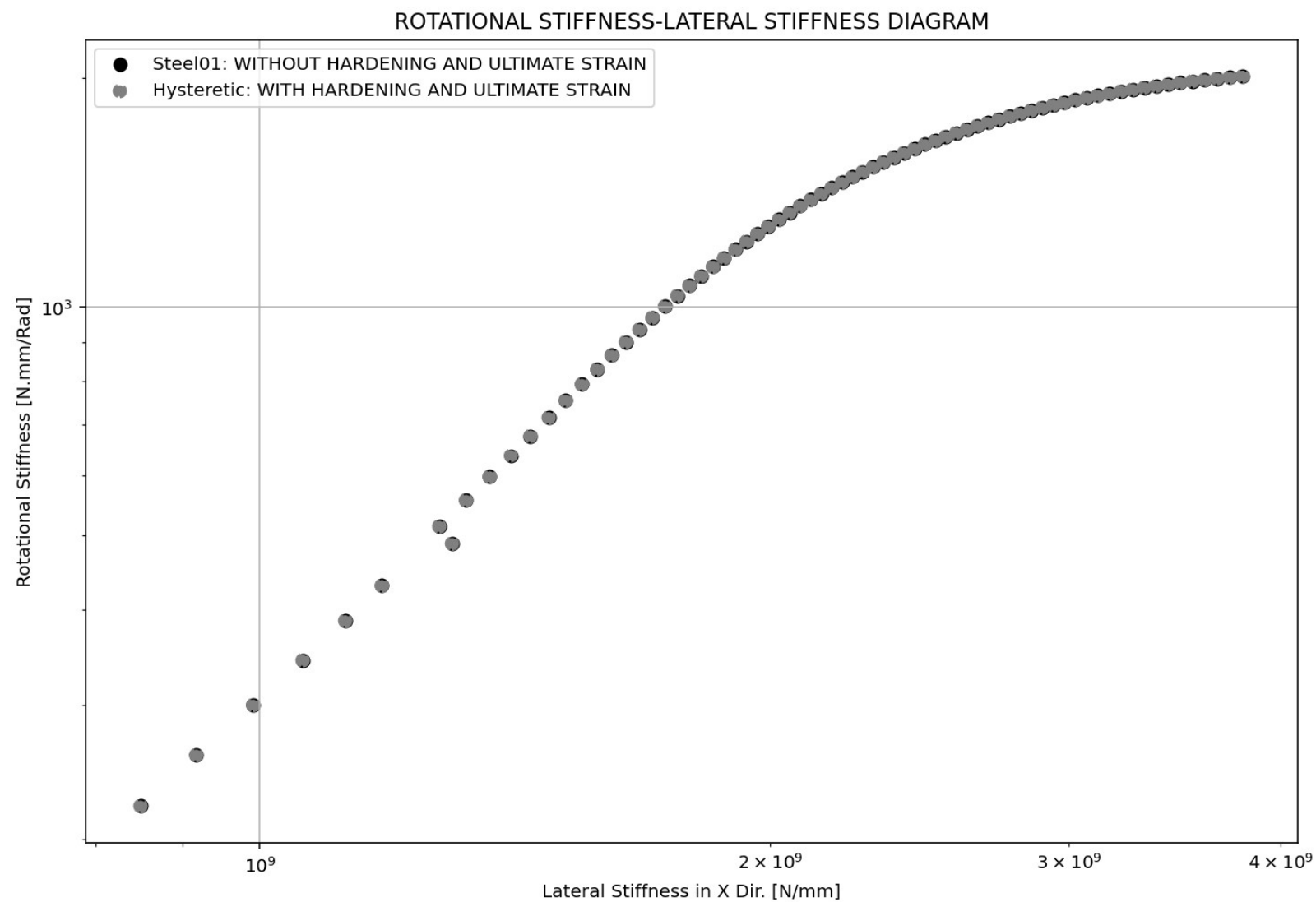




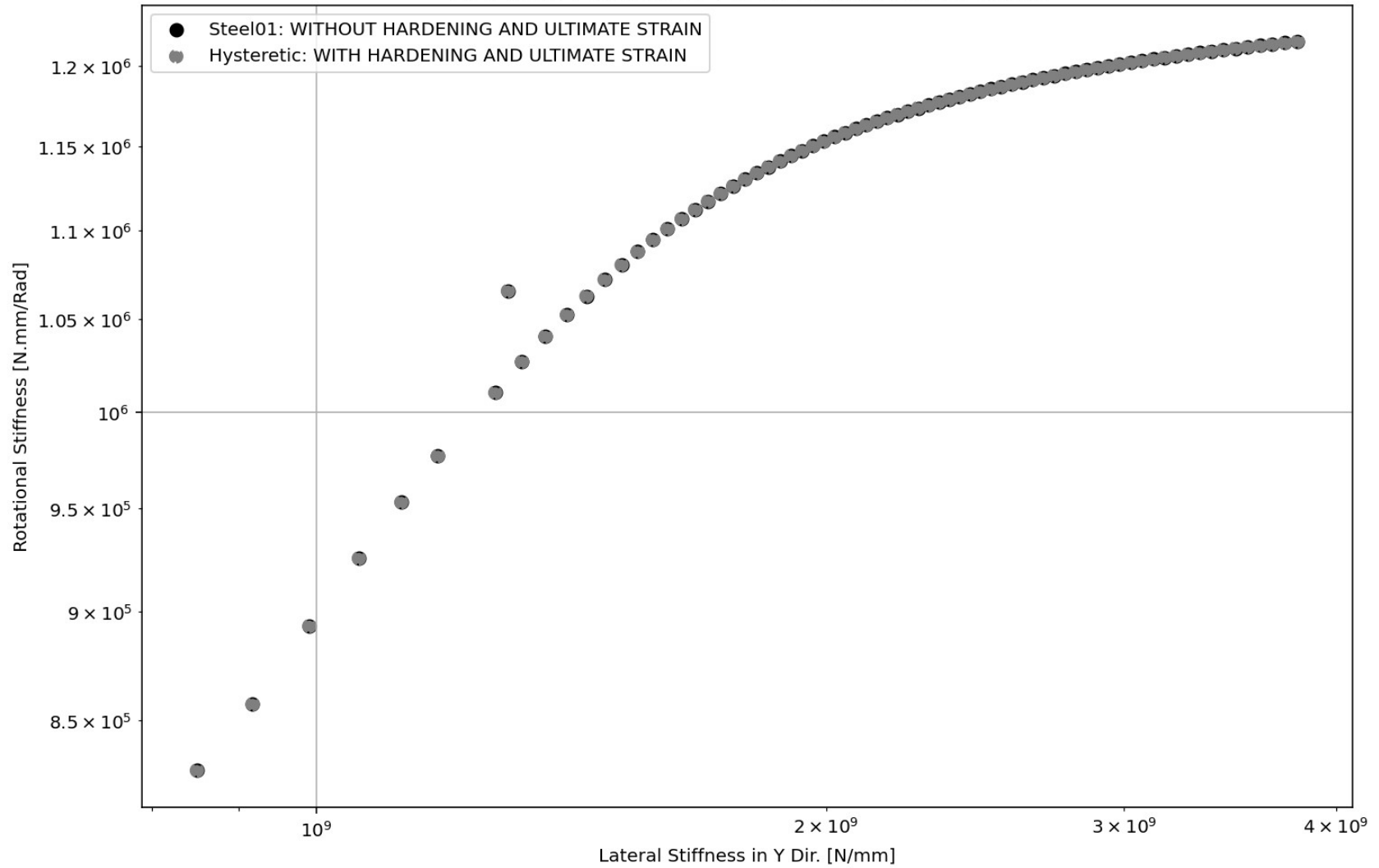


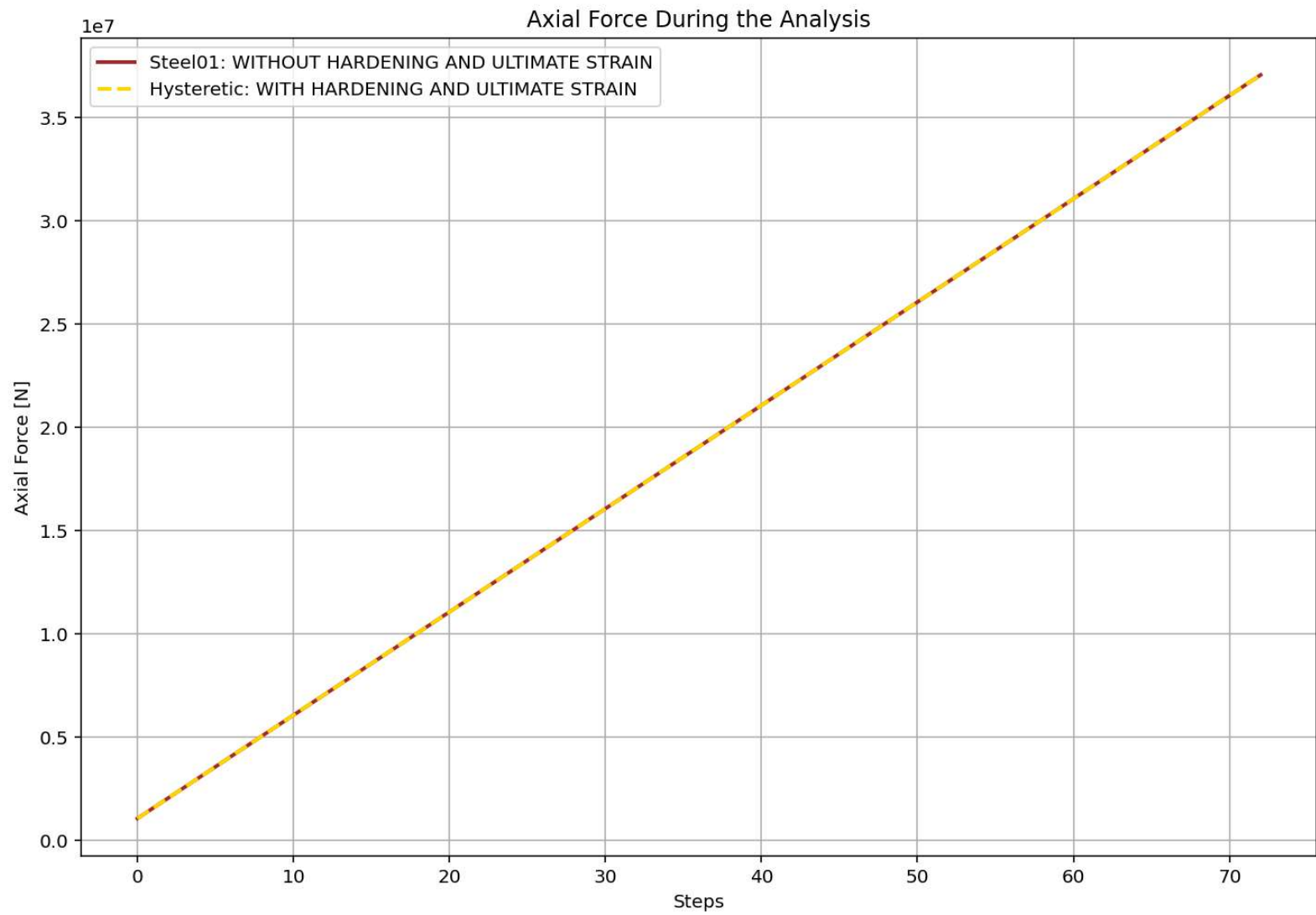


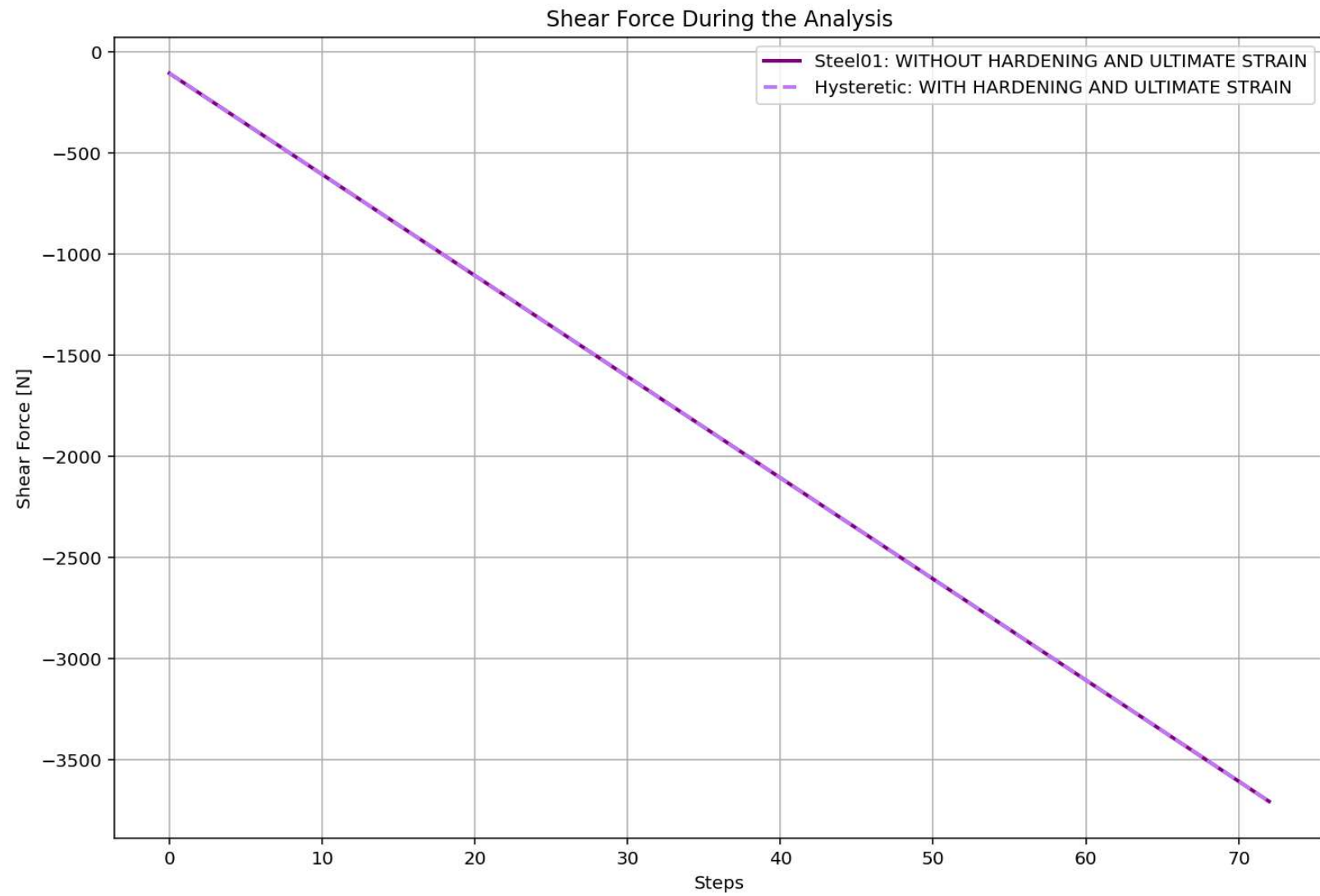


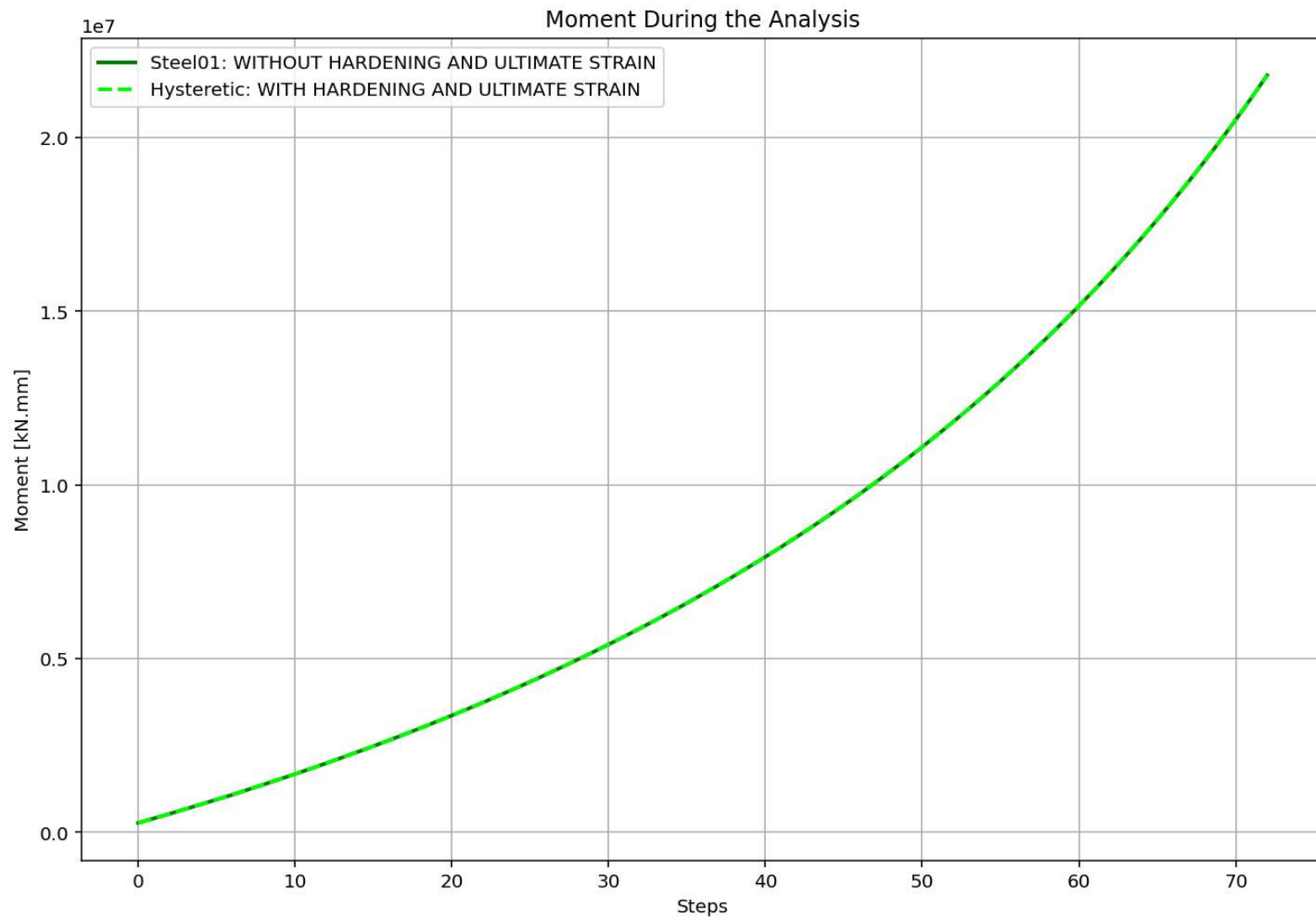


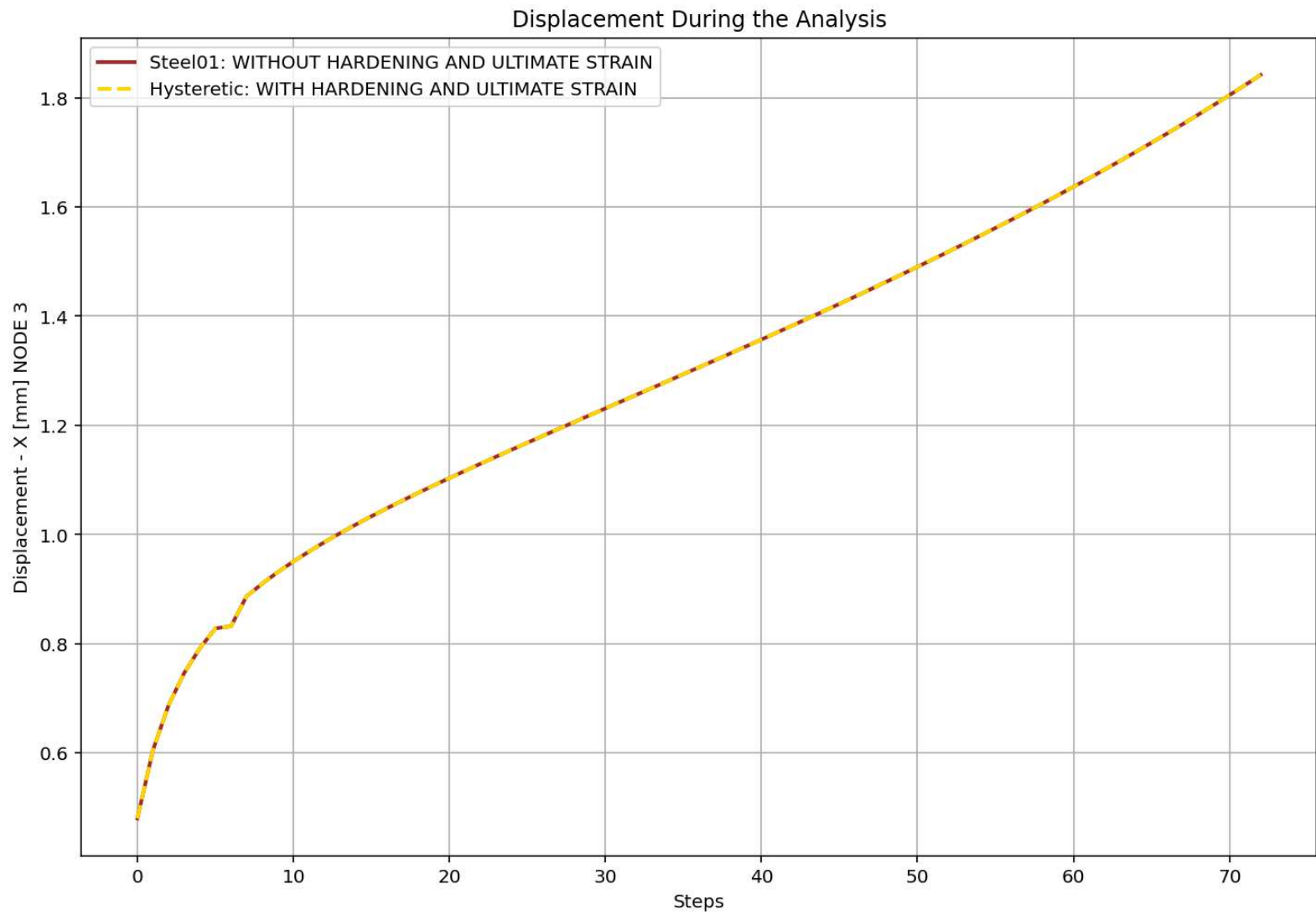
ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM

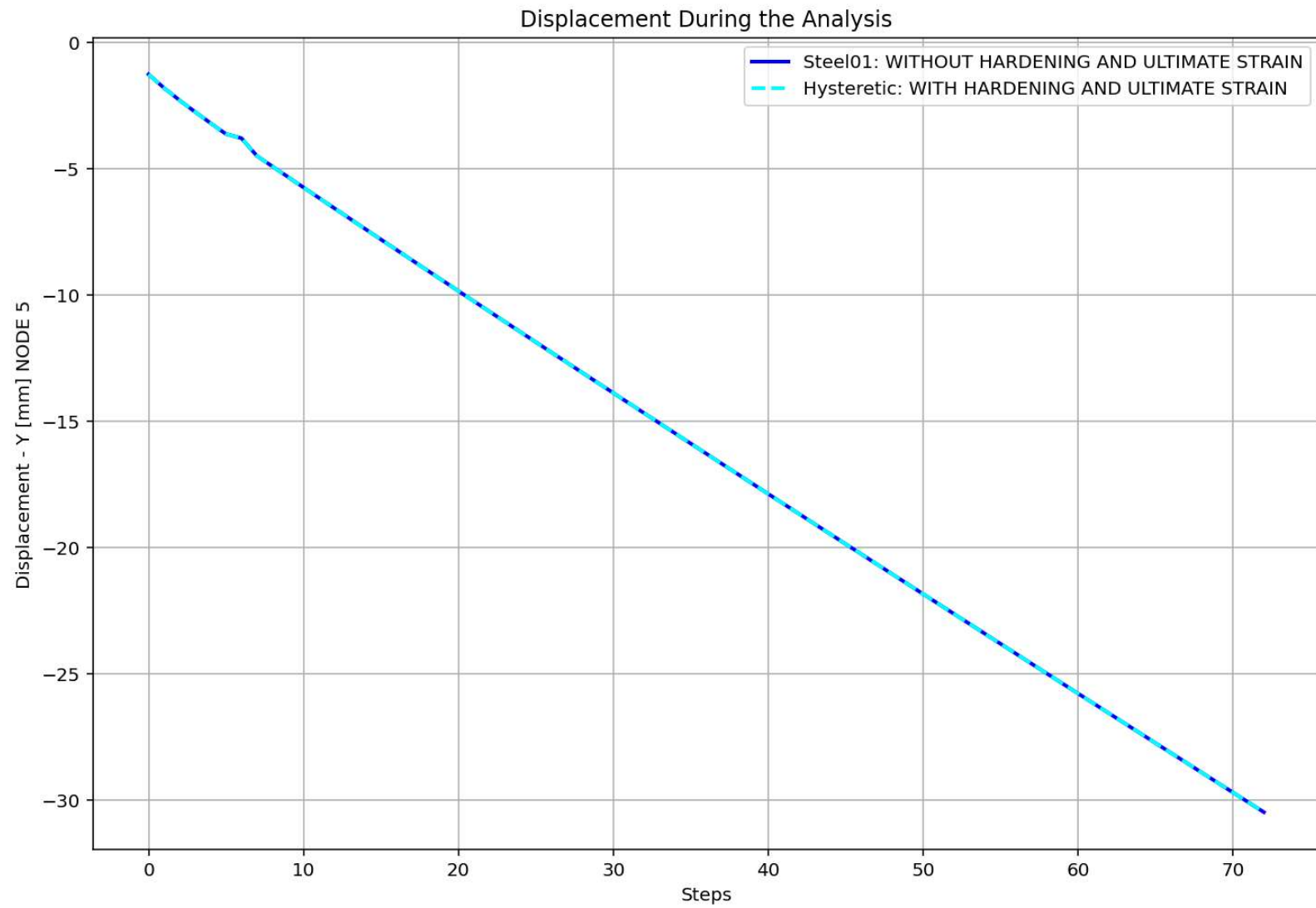












Last Data of BaseShear-Displacement Analysis - Ductility Ratio: 1.7728 - Over Strength Factor: 5.5951

