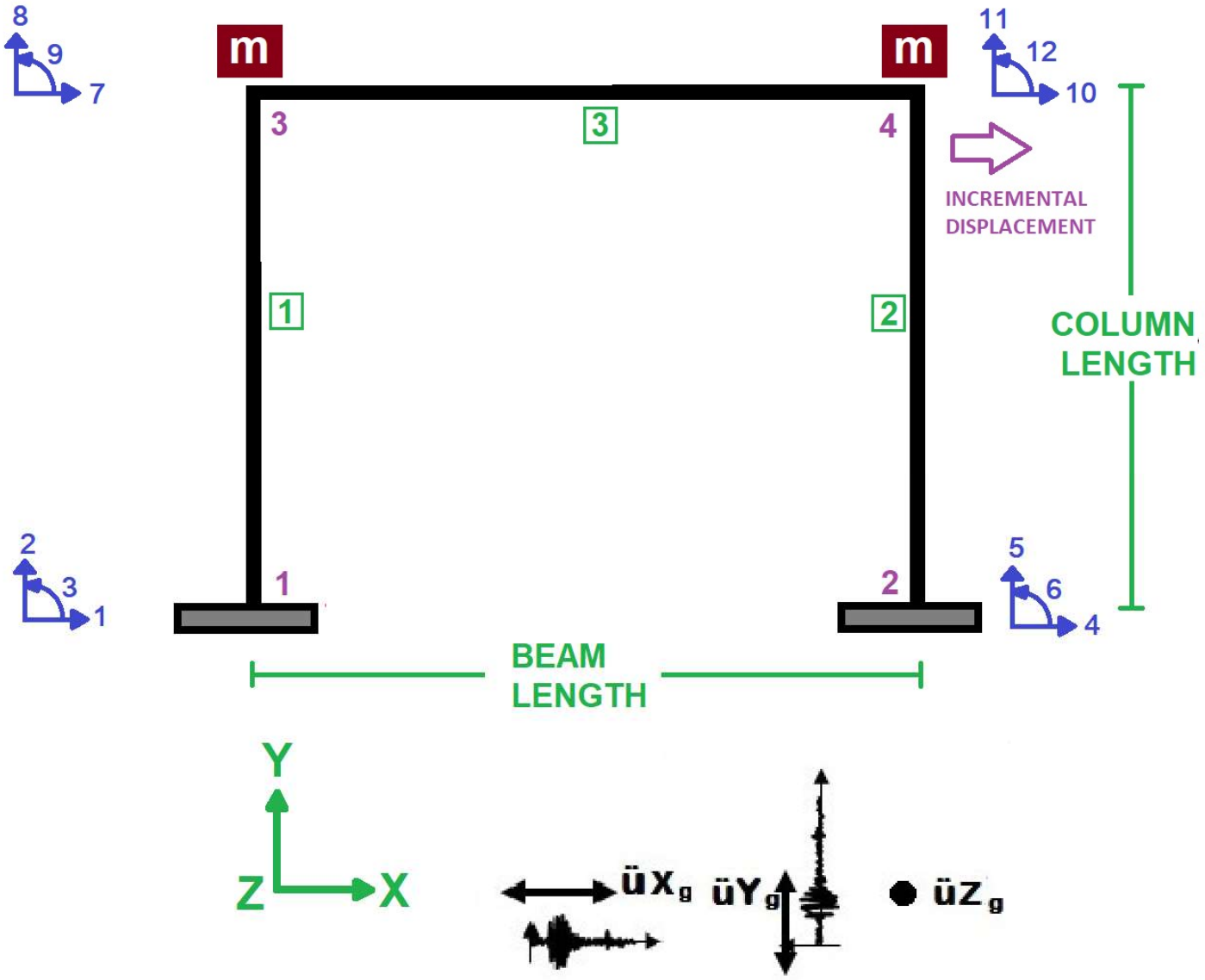
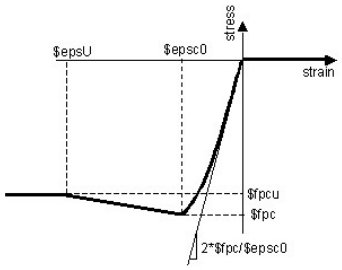
IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL

CONCRETE COLUMN SECTION REBAR OPTIMIZATION BASED ON DEMAND BASE-SHEAR REACTION.

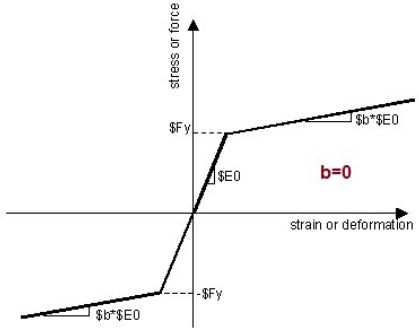
UTILIZING PARALLEL PROCESSING PROCEDURES FOR THE SIMULTANEOUS EXECUTION OF NONLINEAR STATIC AND DYNAMIC CONCRETE STRUCTURAL ANALYSIS, USING OPENSEES

WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)

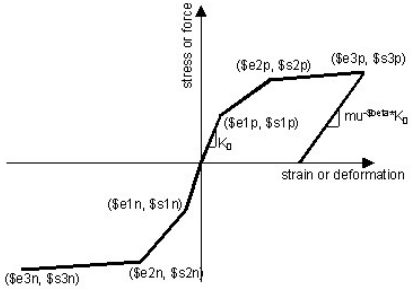

8
9
7
m
m
11
12
10
3
3
4
INCREMENTAL
DISPLACEMENT
1
2
COLUMN
LENGTH
2
3
1
1
2
5
6
4
BEAM
LENGTH
Y
Z
X
üX g
üY g
üZ g



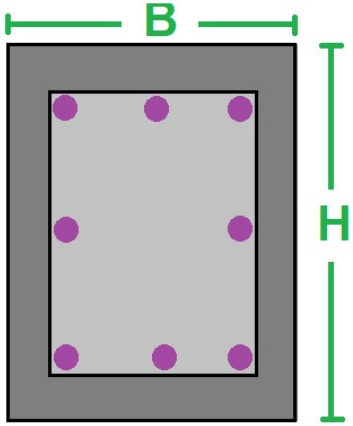
CORE AND COVER CONCRETE RELATION



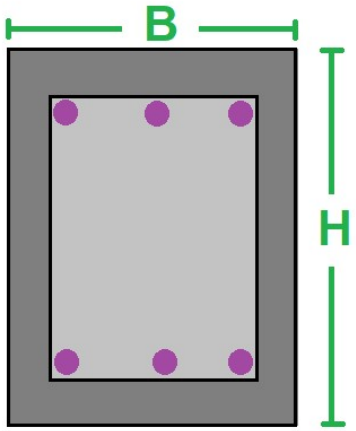
WITHOUT HARDENING AND ULTIMATE STRAIN



WITH HARDENING AND ULTIMATE STRAIN



COLUMN SECTION



BEAM SECTION

Spyder (Python 3.12)

File Edit Search Source Run Debug Consoles Projects Tools View Help

...CONCRETE_FRAME_EXAMPLES\PARALLEL_COMPUTING_&_OPTIMIZATION

C:\Users\Dell\Desktop\OPENSEES_FILES\CONCRETE_FRA...NCRETE_FRAME_PARALLEL_COMPUTING_&_OPTIMIZATION.py

CONCRETE_FRAME_PARALLEL_COMPUTING.py | CONCRETE_FRAME_PAR..._OPTIMIZATION.py

```
DR = 0.05        # Intial Guess for Damping ratio
duration = 15.0  # [s] Total simulation duration
dt = 0.01        # [s] Time step
MASS = 12000     # [kg] Mass on the each column

#%% DEFINE PARAMEETRS FOR NONLINEAR STATIC ANALYSIS
DMAX = 675       # [mm] Maximum Displacement
DINCR = 0.05     # [mm] Incremental Displacement

#%% DEFINE ANALYSIS PROPERTIES
MAX_ITERATIONS = 5000    # Convergence iteration for test
MAX_TOLERANCE = 1.0e-6   # Convergence tolerance for test
#STEEL_KIND: 1 -> WITHOUT HARDENING AND ULTIMATE STRAIN
#STEEL_KIND: 2 -> WITH HARDENING AND ULTIMATE STRAIN

#%%-------------------------------------------------------------------------
def PD_ANALYSIS(DIAc, STEEL_KIND, ANA_KIND):

    #DIAc = 25              # [mm] Column Rebar Size Diameter
    AsC = np.pi*(DIAc**2)/4  # [mm²] Column Area of Rebar

    DIAb = DIAc - 4          # [mm] Beam Rebar Size Diameter
    AsB = np.pi*(DIAb**2)/4  # [mm²] Beam Area of Rebar

    # Reset model
    ops.wipe()
    ops.model('basic', '-ndm', 2, '-ndf', 3)

    # CORNER NODES
    ops.node(1, 0.0, 0.0)
    ops.node(2, LENGTH_BM, 0.0)
    ops.node(3, 0.0, LENGTH_COL)
    ops.node(4, LENGTH_BM, LENGTH_COL)
```

100 %

No plots to show

Run plot-generating code in the Editor or IPython console to see your figures appear here. This pane only supports static images, so it can't display interactive plots like Bokeh, Plotly or Altair.

Help | Variable Explorer | Debugger | Plots | Files

Console 1/A

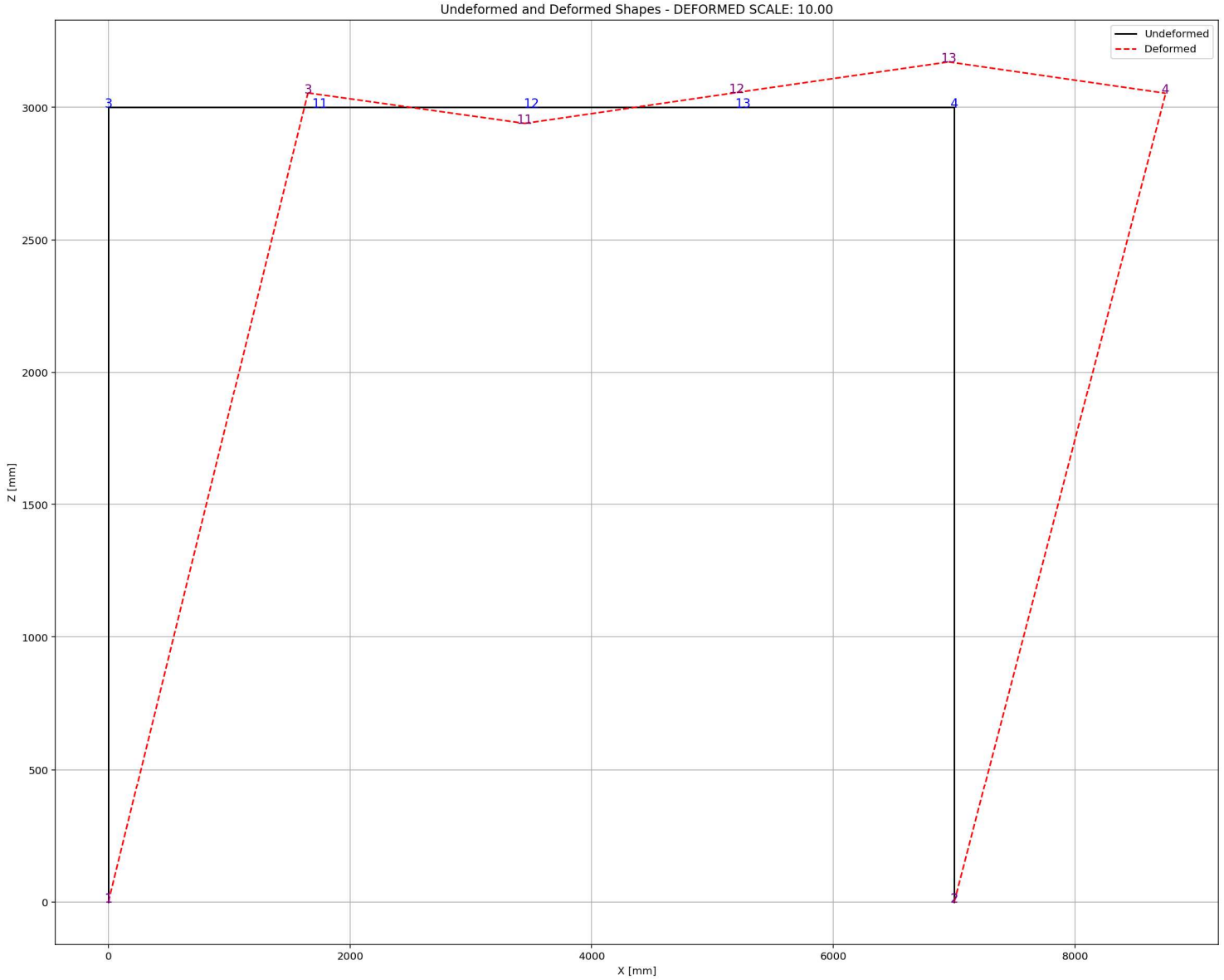
```
Nonlinear Static Analysis Done.

SUPPLY: 215532.37905
53208.63548428315
IT: 6 - RESIDUAL: 2.036359e-08 - COLUMN SECTION REBAR DIAMETER 8.588362e+00
        Optimum Section Rebar Diameter:   8.5884
        Iteration Counts:                 6
        Convergence Residual:             2.0363594501e-08
Finish time (HH:MM:SS): 16:43:28
```

IPython Console | History

Inline | Conda: anaconda3 (Python 3.12.7) | LSP: Python | Line 414, Col 51 | UTF-8 | CRLF | RW

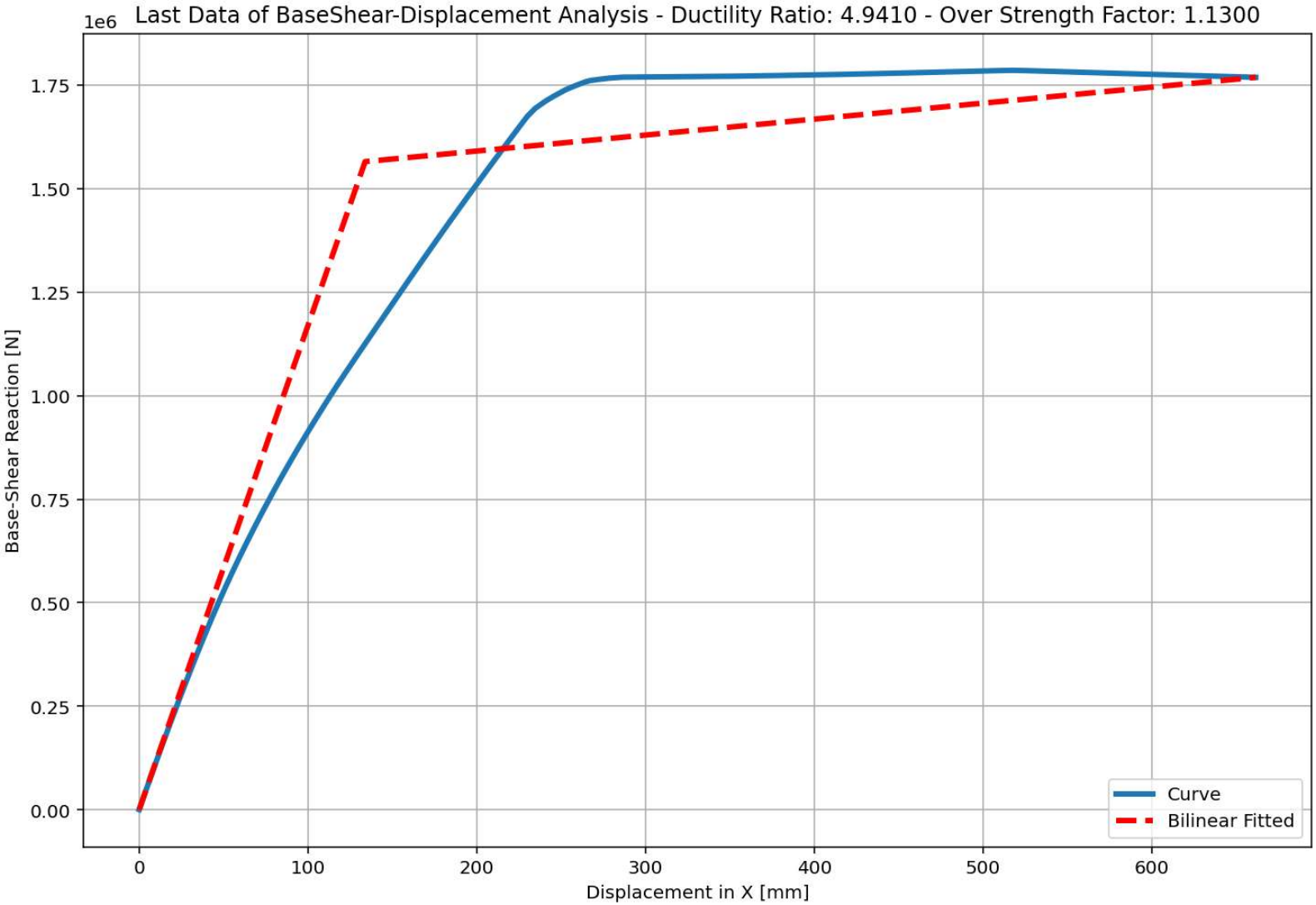
NONLINEAR STATIC ANALYSIS (PUSHOVER)

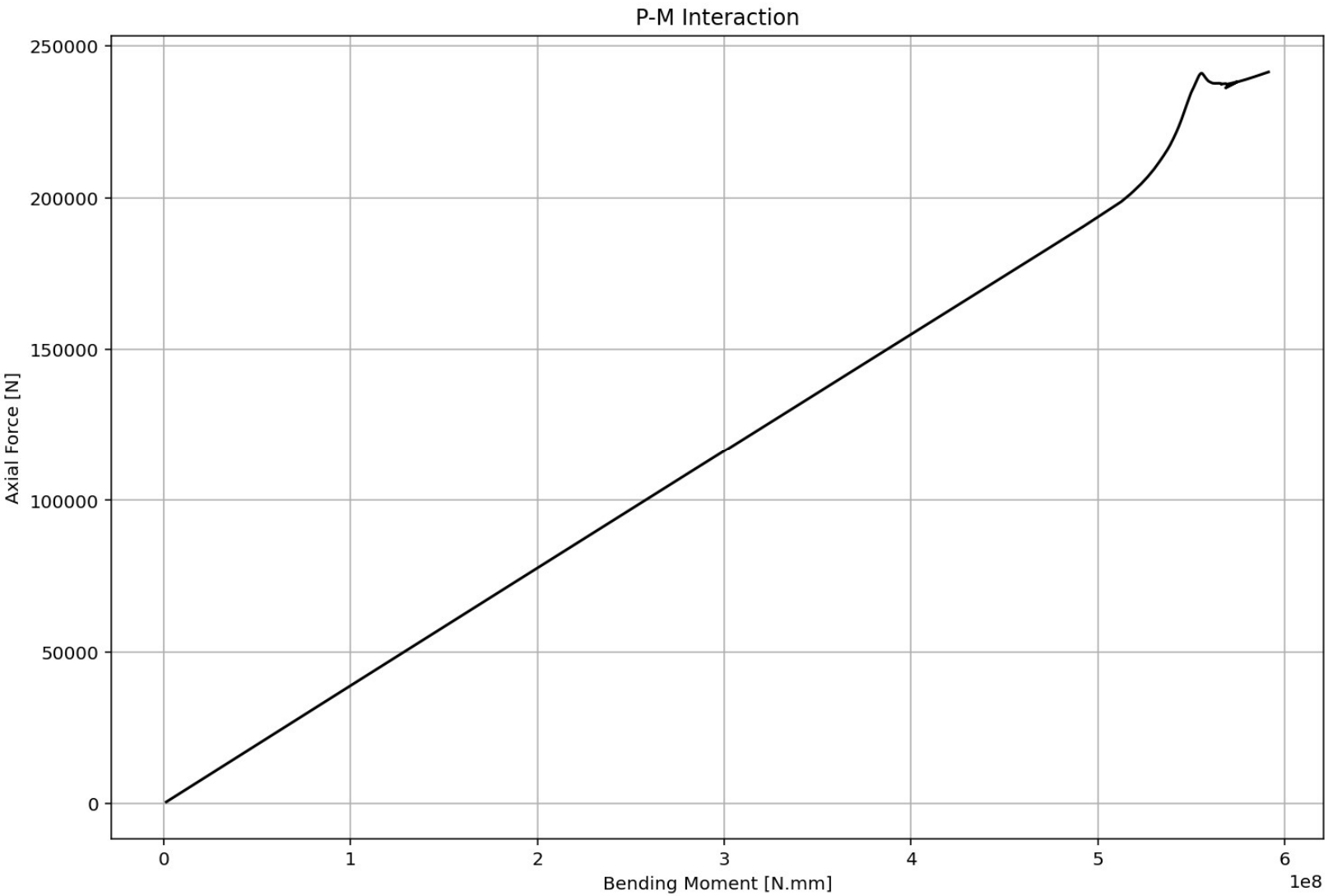

Undeformed and Deformed Shapes - DEFORMED SCALE: 10.00
Undeformed
Deformed
Z [mm]
X [mm]
0
500
1000
1500
2000
2500
3000
0
2000
4000
6000
8000
1
2
3
4
11
12
13

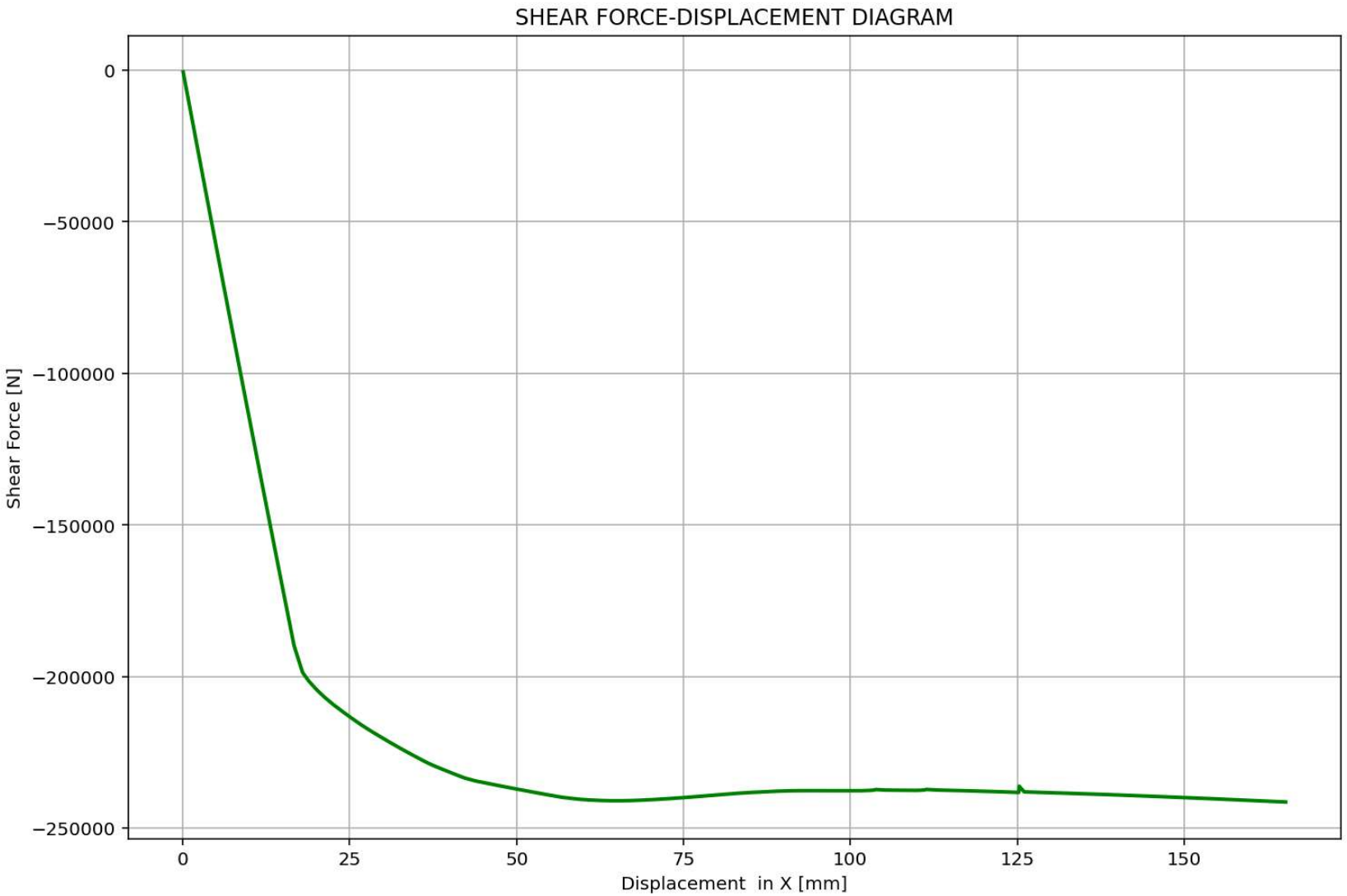
Start time (HH:MM:SS): 16:38:29

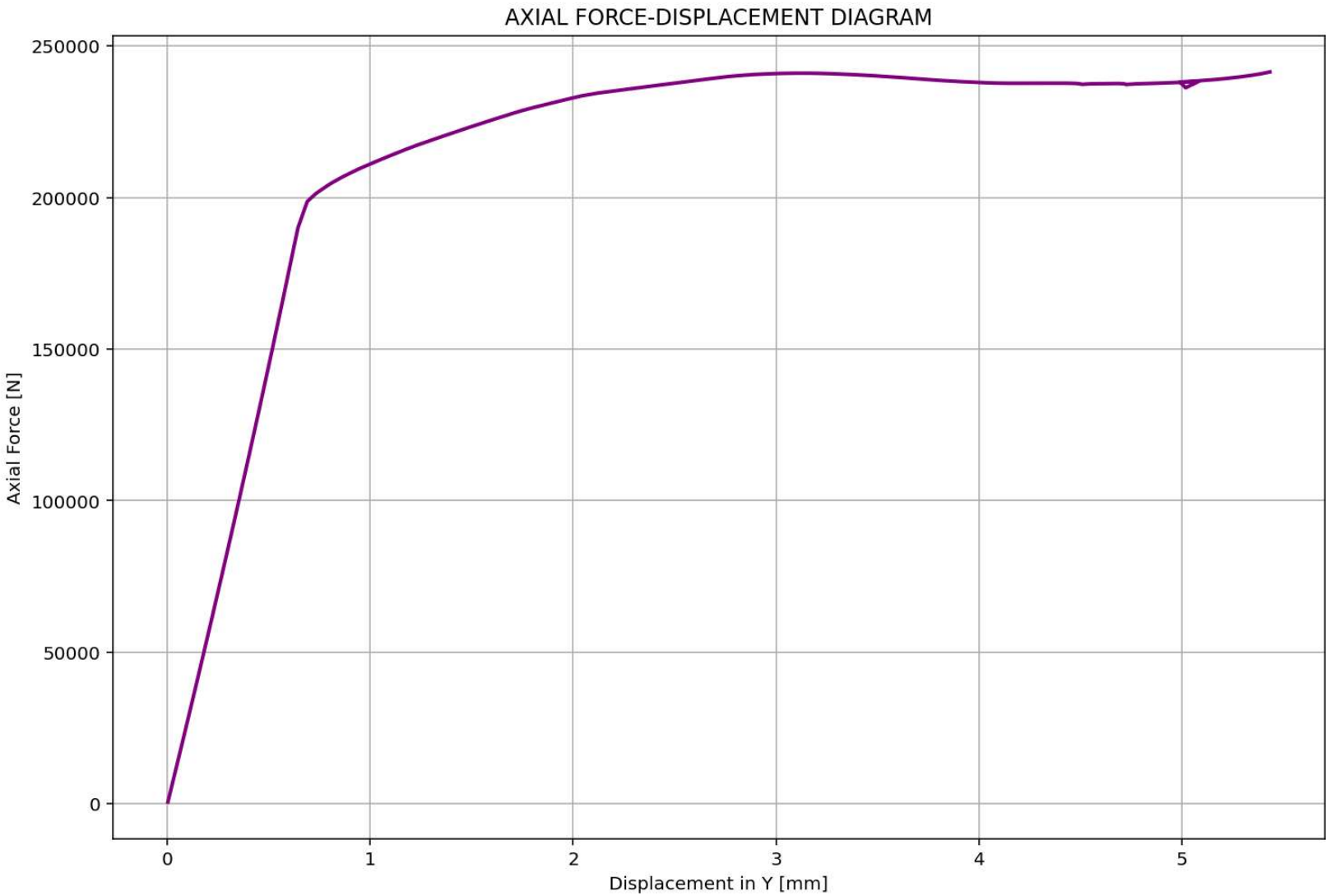
SUPPLY: 215532.37905
53208.63548428315
IT: 6 - RESIDUAL: 2.036359e-08 - COLUMN SECTION REBAR DIAMETER 8.588362e+00
Optimum Section Rebar Diameter: 8.5884
Iteration Counts: 6
Convergence Residual: 2.0363594501e-08

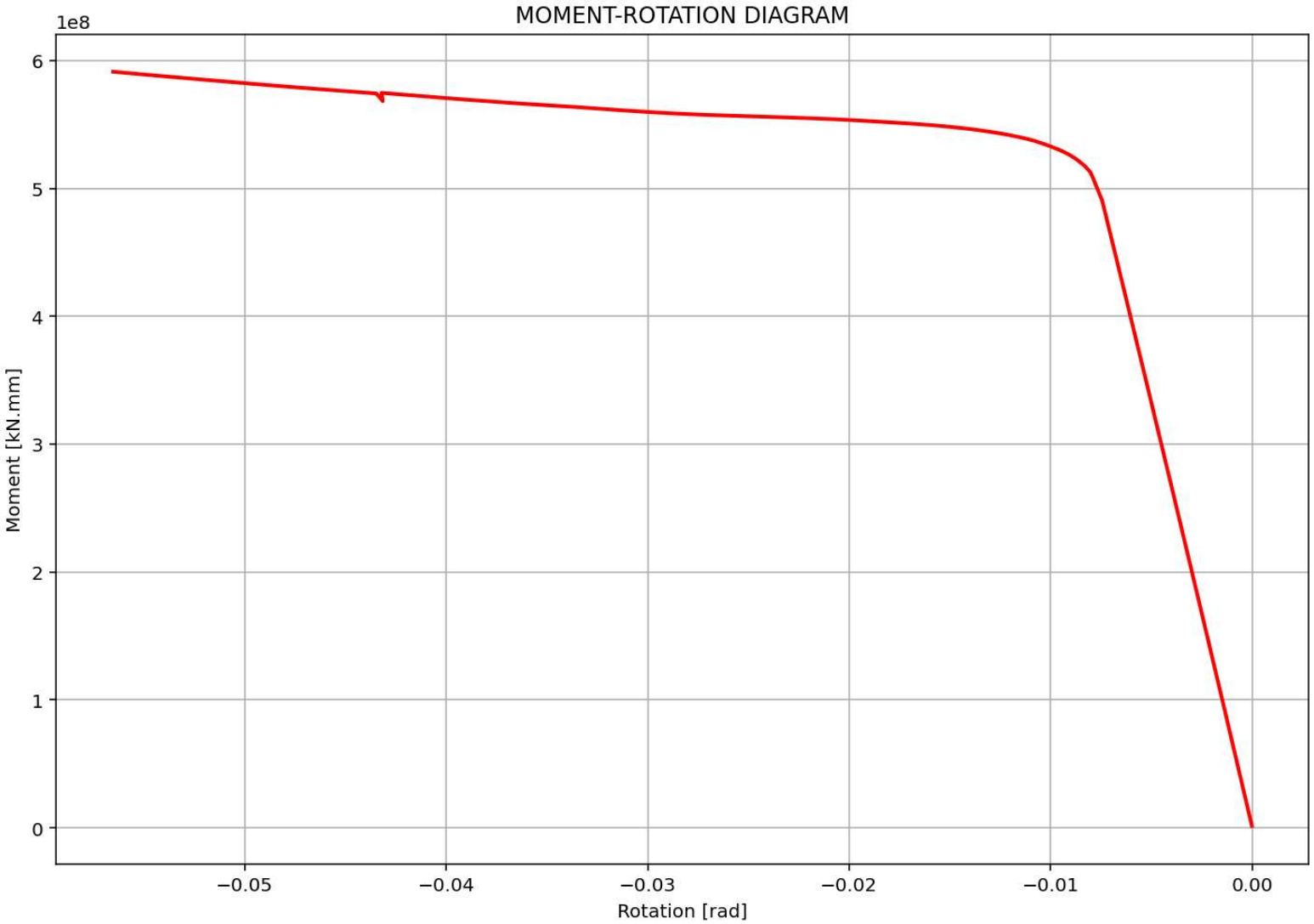
Finish time (HH:MM:SS): 16:43:28

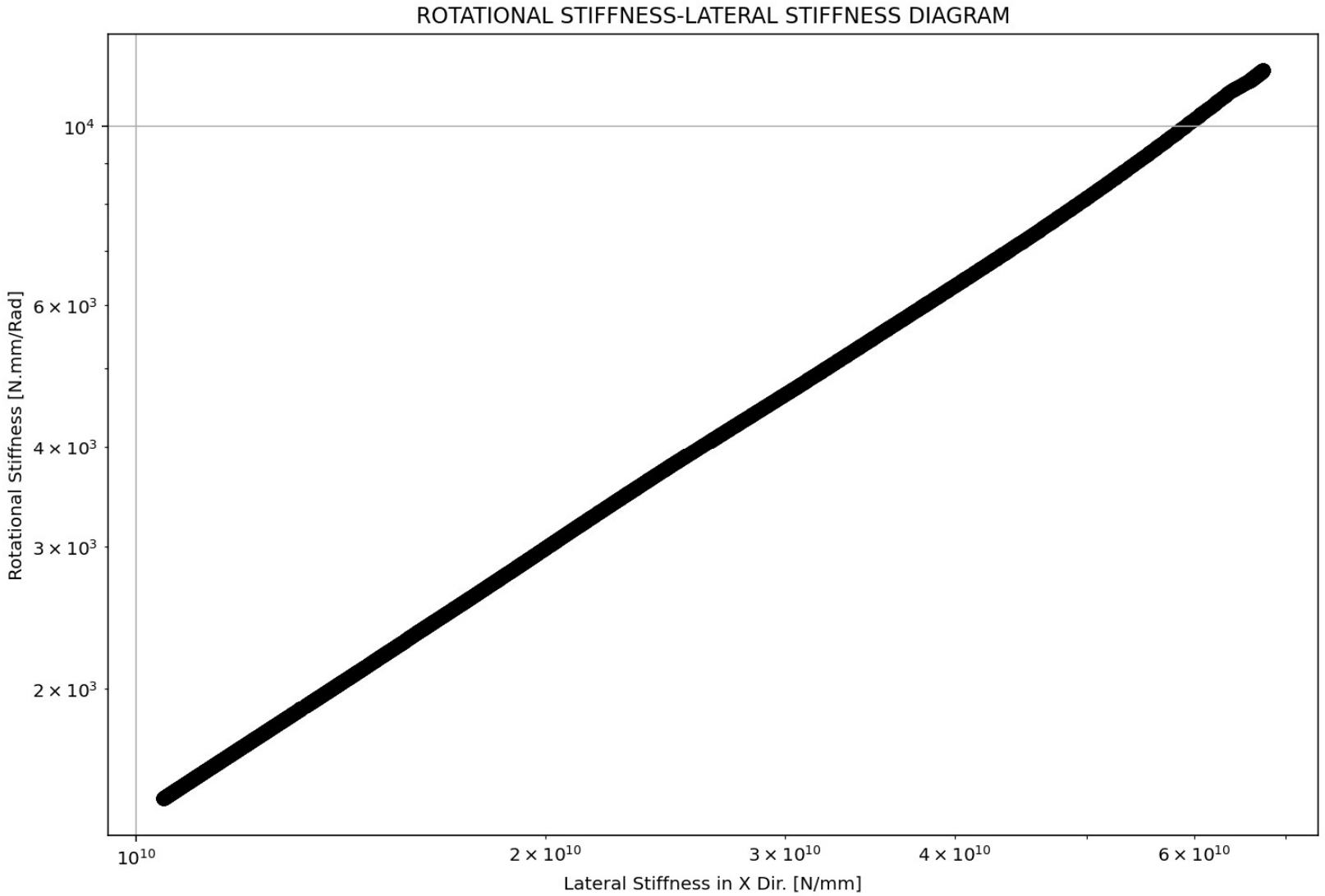

Last Data of BaseShear-Displacement Analysis - Ductility Ratio: 4.9410 - Over Strength Factor: 1.1300
1e6
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Base-Shear Reaction [N]
0
100
200
300
400
500
600
Displacement in X [mm]
Curve
Bilinear Fitted

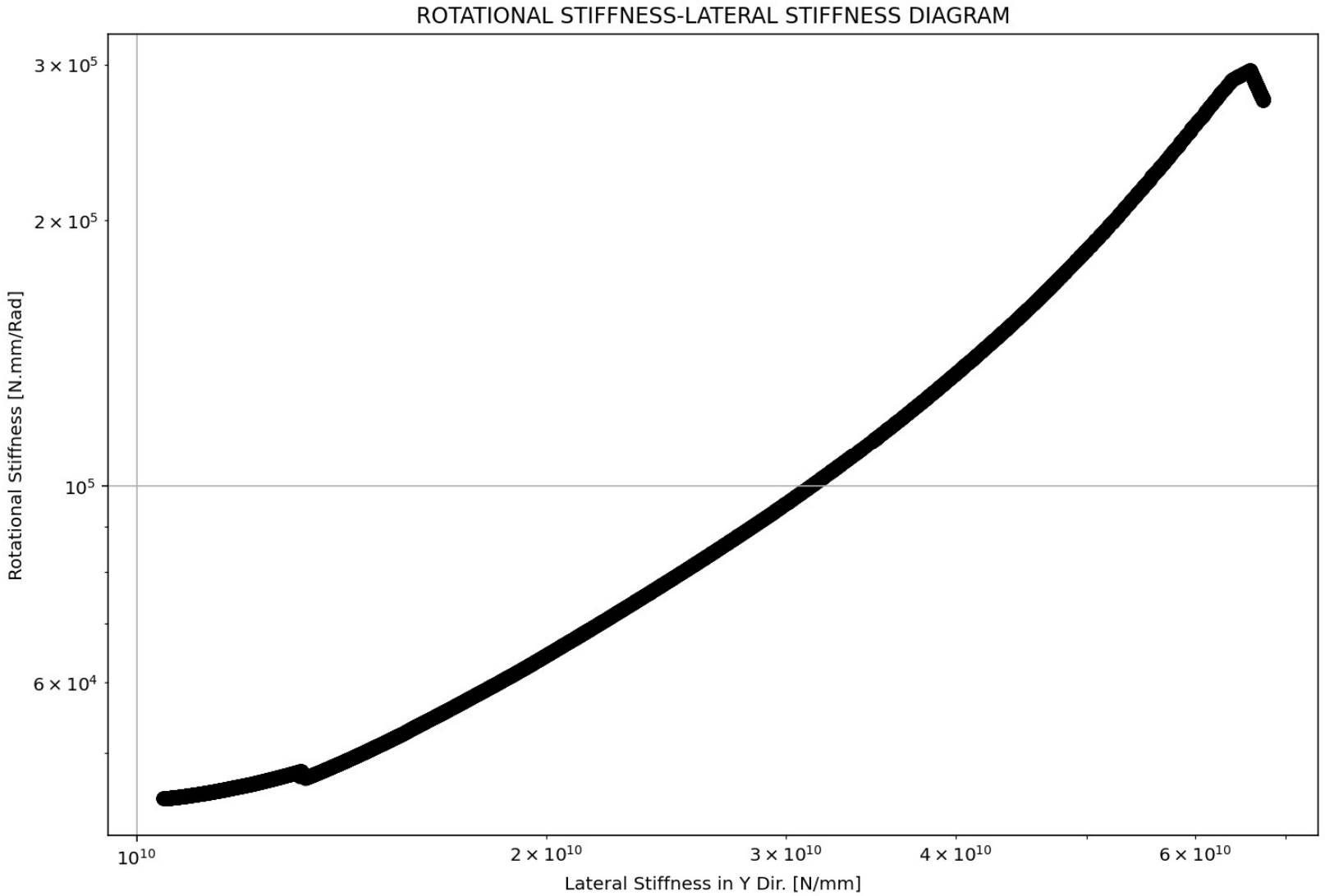

P-M Interaction
250000
200000
150000
100000
50000
0
Axial Force [N]
0
1
2
3
4
5
6
1e8
Bending Moment [N.mm]

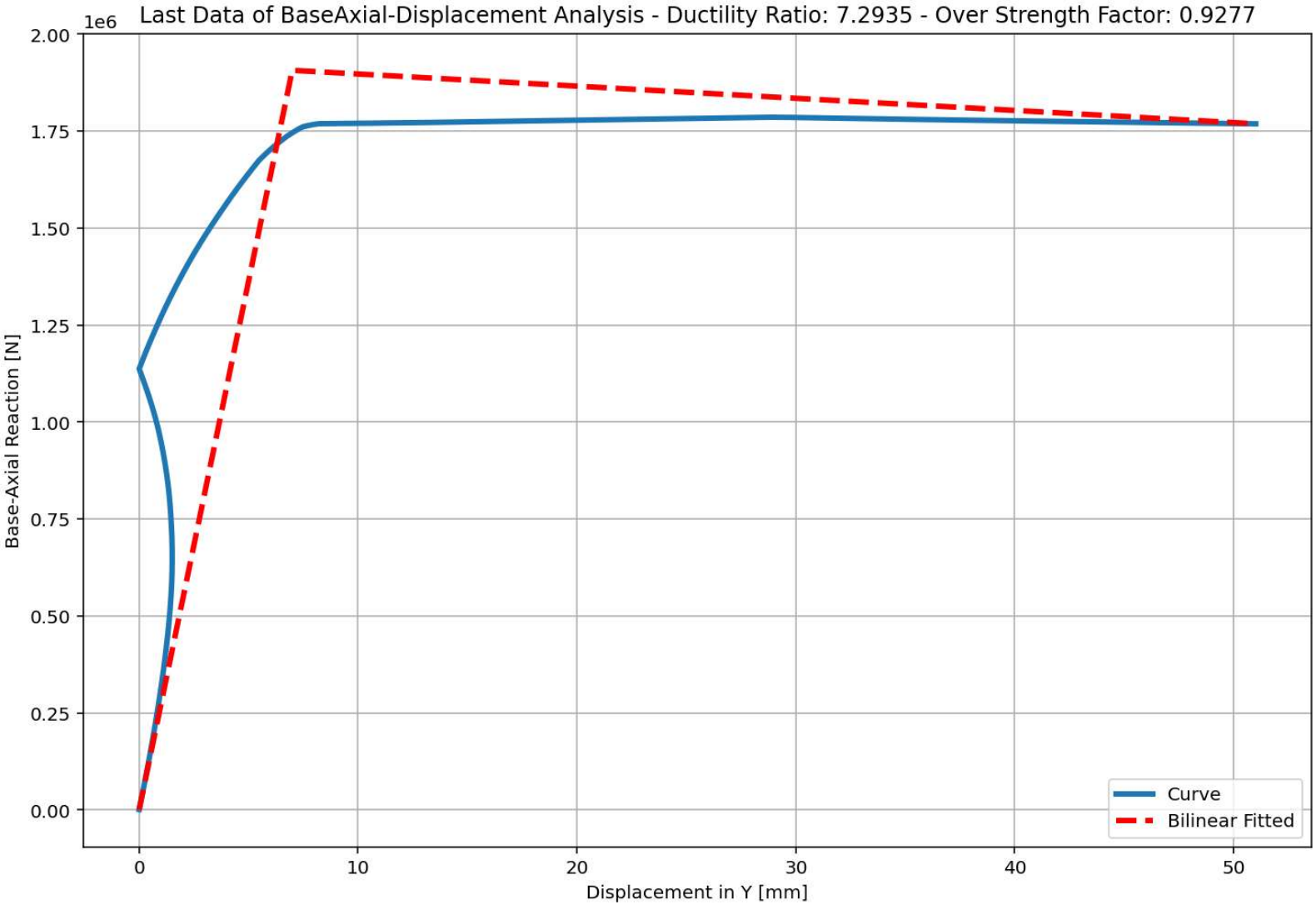

SHEAR FORCE-DISPLACEMENT DIAGRAM
Shear Force [N]
0
−50000
−100000
−150000
−200000
−250000
0
25
50
75
100
125
150
Displacement in X [mm]


AXIAL FORCE-DISPLACEMENT DIAGRAM
250000
200000
150000
100000
50000
0
Axial Force [N]
0
1
2
3
4
5
Displacement in Y [mm]


MOMENT-ROTATION DIAGRAM
1e8
6
5
4
3
2
1
0
Moment [kN.mm]
−0.05
−0.04
−0.03
−0.02
−0.01
0.00
Rotation [rad]


ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM
Rotational Stiffness [N.mm/Rad]
10^4
6×10^3
4×10^3
3×10^3
2×10^3
10^{10}
2×10^{10}
3×10^{10}
4×10^{10}
6×10^{10}
Lateral Stiffness in X Dir. [N/mm]


ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM
Rotational Stiffness [N.mm/Rad]
3×10^5
2×10^5
10^5
6×10^4
10^{10}
2×10^{10}
3×10^{10}
4×10^{10}
6×10^{10}
Lateral Stiffness in Y Dir. [N/mm]


Last Data of BaseAxial-Displacement Analysis - Ductility Ratio: 7.2935 - Over Strength Factor: 0.9277
1e6
2.00
1.75
1.50
1.25
1.00
0.75
0.50
0.25
0.00
Base-Axial Reaction [N]
0
10
20
30
40
50
Displacement in Y [mm]
Curve
Bilinear Fitted