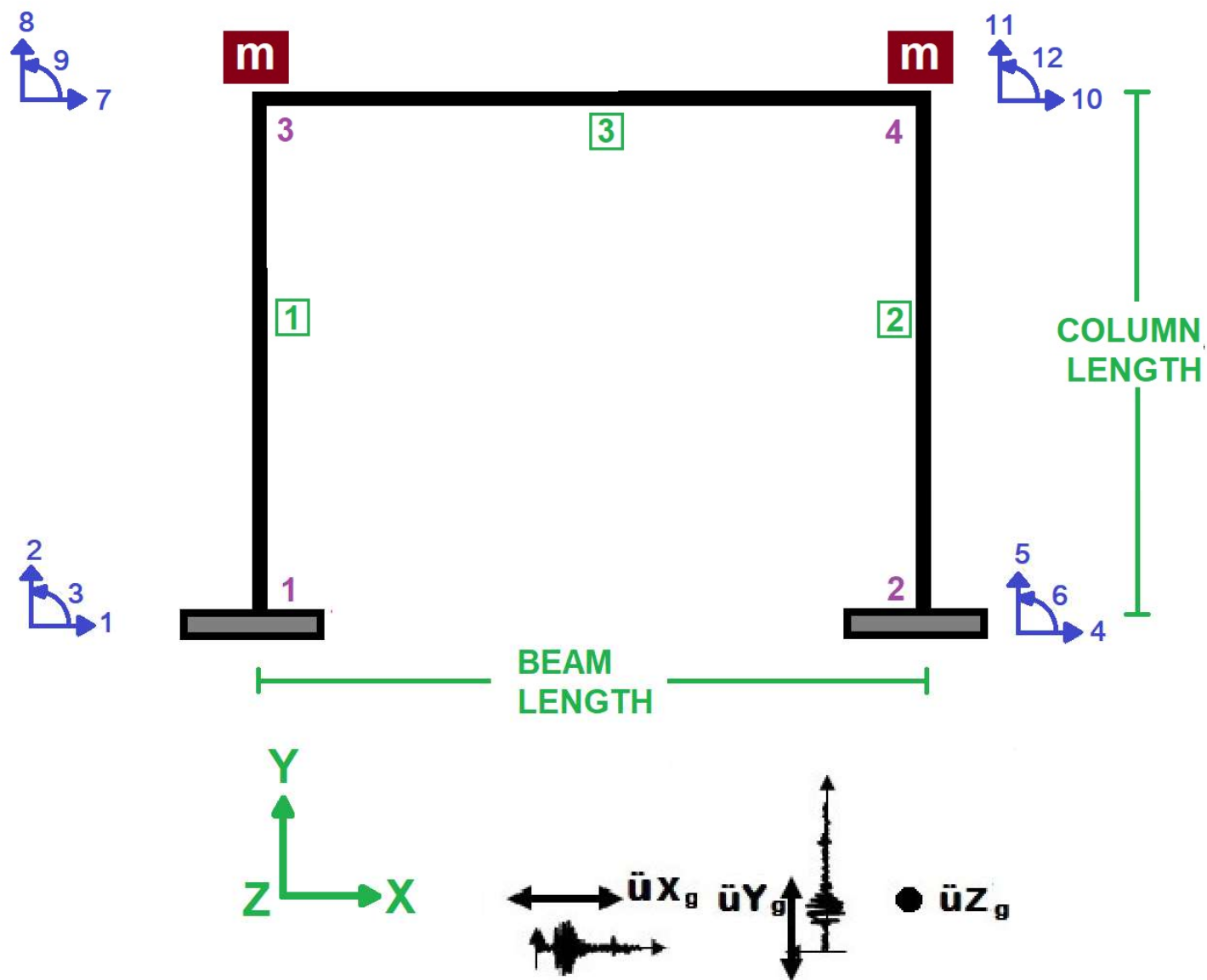


>> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<

# **SENSITIVITY ANALYSIS OF CONCRETE FRAME BY CHANGING COLUMN REBAR DIAMETER AND CONFINEMENT ENHANCEMENT RATIO. USING OPENSEES FOR STRUCTURAL BEHAVIOR COEFFICIENT CALCULATION**

WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)

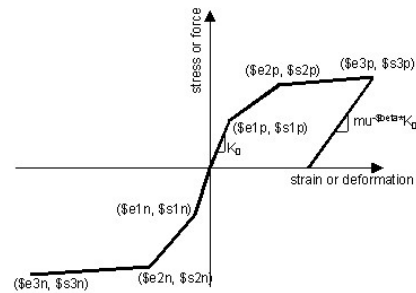




CORE AND COVER CONCRETE RELATION



WITHOUT HARDENING AND ULTIMATE STRAIN



WITH HARDENING AND ULTIMATE STRAIN



COLUMN SECTION



BEAM SECTION

C:\Users\ DELL\Desktop\OPENSEES\_FILES\CONCRETE\_FRA...SITIVITY\_CONFINEMENT\_ENHANCEMENT\_RATIO\_&\_REBAR.py

SENSITIVITY\_CONFIN...T\_RATIO\_REBAR.py

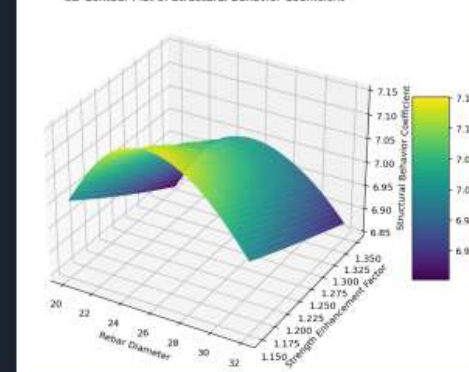
```

1 #####
2 #                               >> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<
3 # SENSITIVITY ANALYSIS OF CONCRETE FRAME BY CHANGING COLUMN REBAR DIAMETER AND CONFINEMENT ENHANCEMENT
4 # USING OPENSEES FOR STRUCTURAL BEHAVIOR COEFFICIENT CALCULATION
5 #-----
6 # THIS PROGRAM WRITTEN BY SALAR DELAVAR GHASHGHAEE (QASHQAI)
7 # EMAIL: salar.d.ghashghaei@gmail.com
8 #####
9 """
10 1. Objective: The code performs a sensitivity analysis on a 2D reinforced concrete frame by varying
11 diameter and confinement enhancement ratios to evaluate structural behavior coefficients using Open.
12
13 2. Model Setup: A nonlinear 2D frame model is created with columns, beams, and distributed plasticity
14 incorporating geometric transformations (Corotational) for large displacements.
15
16 3. Material Modeling: Confined and unconfined concrete behaviors are modeled using modified Kent-Scott
17 formulations, while steel reinforcement follows bilinear or hardening models.
18
19 4. Analysis Types: Both pushover (static) and dynamic analyses are supported, with Rayleigh damping
20
21 5. Key Outputs: The code extracts base shear, displacement, stiffness, ductility ratios, overstrength
22 factors, and structural behavior coefficients (R).
23
24 6. Sensitivity Parameters: Rebar diameters (20-32 mm) and confinement enhancement ratios (1.15-1.35)
25 are systematically varied to assess their impact on performance.
26
27 7. Bilinear Fitting: Pushover curves are post-processed to derive elastic/plastic stiffness, ductility
28 and R factors using a bilinear approximation algorithm.
29
30 8. Visualization: 3D contour plots and 2D graphs illustrate relationships between rebar, confinement
31 and structural responses (e.g., stiffness, R-factors).
32
33 9. Validation: Eigenvalue analysis ensures realistic dynamic properties (periods/damping), while
34 convergence checks enhance numerical robustness.

```

...HANCEMENT\_RATIO\SENSITIVITY\_CONFINEMENT\_ENHANCEMENT\_RATIO

3D Contour Plot of Structural Behavior Coefficient



Help Variable Explorer Debugger Plots Files

Console 1/A

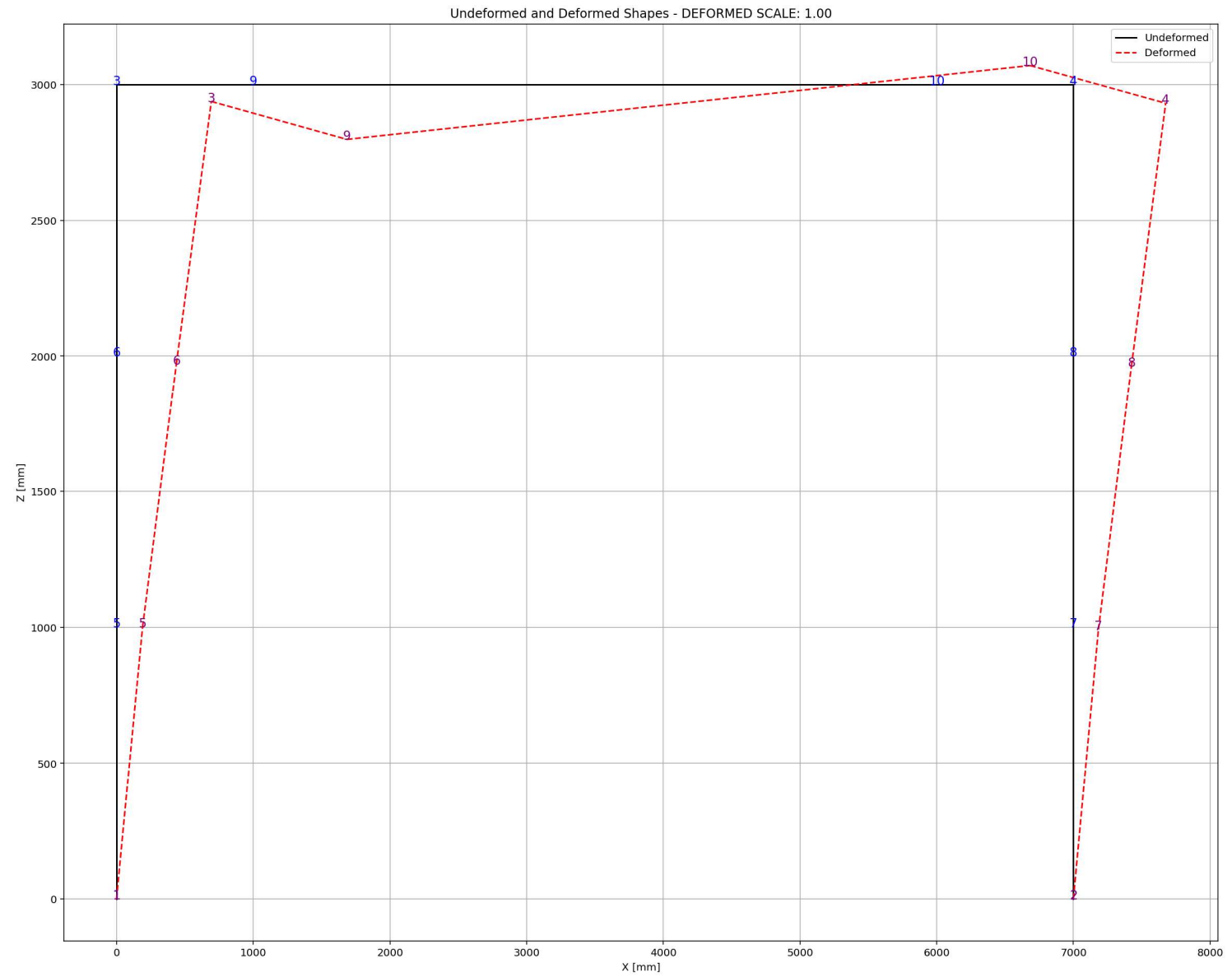
them also appear inline in the console, you need to uncheck "Mute inline plotting" under the options menu of Plots.

```

+=====+
= Analysis curve fitted =
= Disp Base Shear
-----
[[0.00000000e+00 0.00000000e+00]
 [1.25736042e+02 2.61065850e+06]
 [6.93434250e+02 3.25359115e+06]]

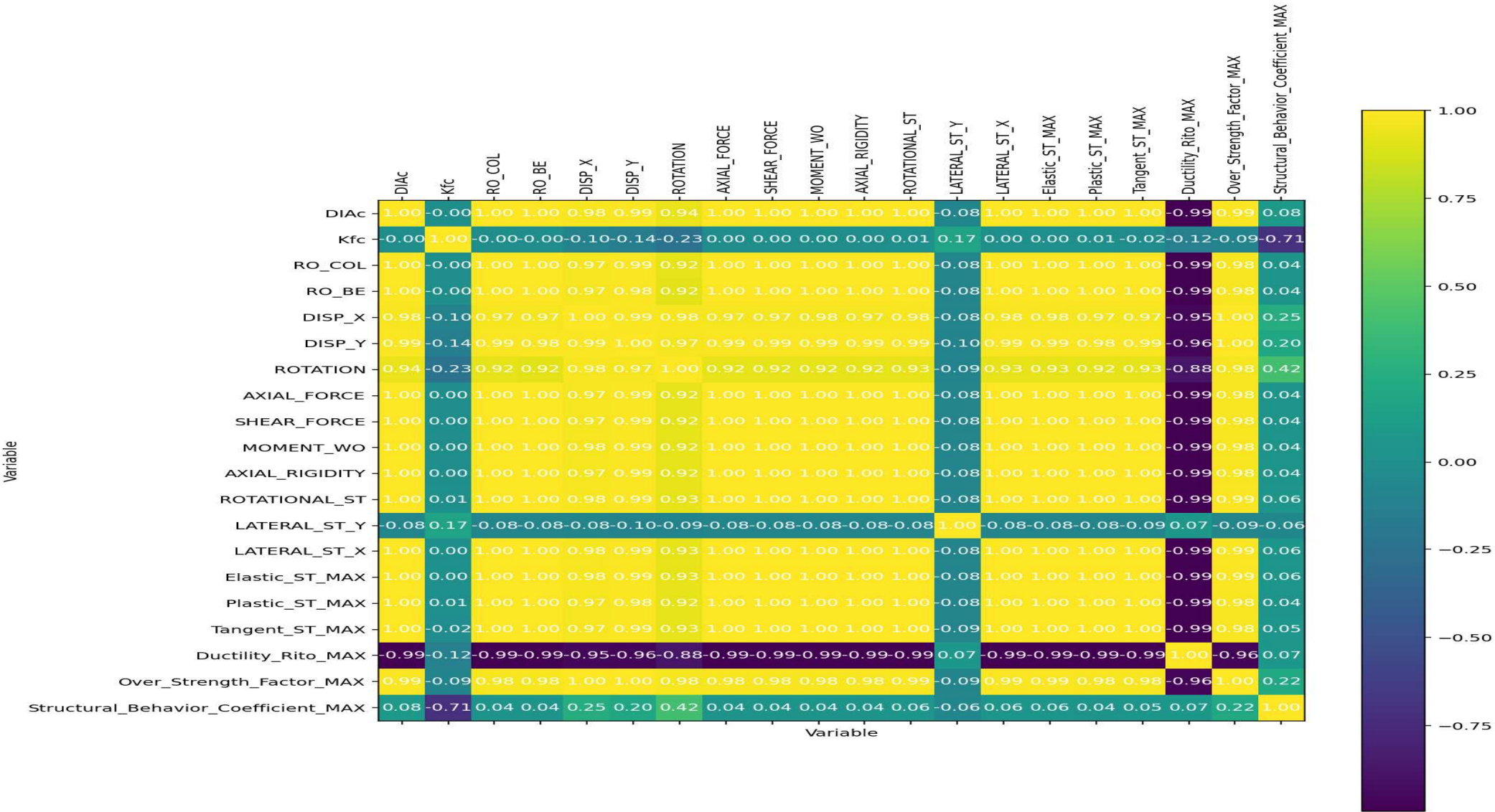
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IPython Console History

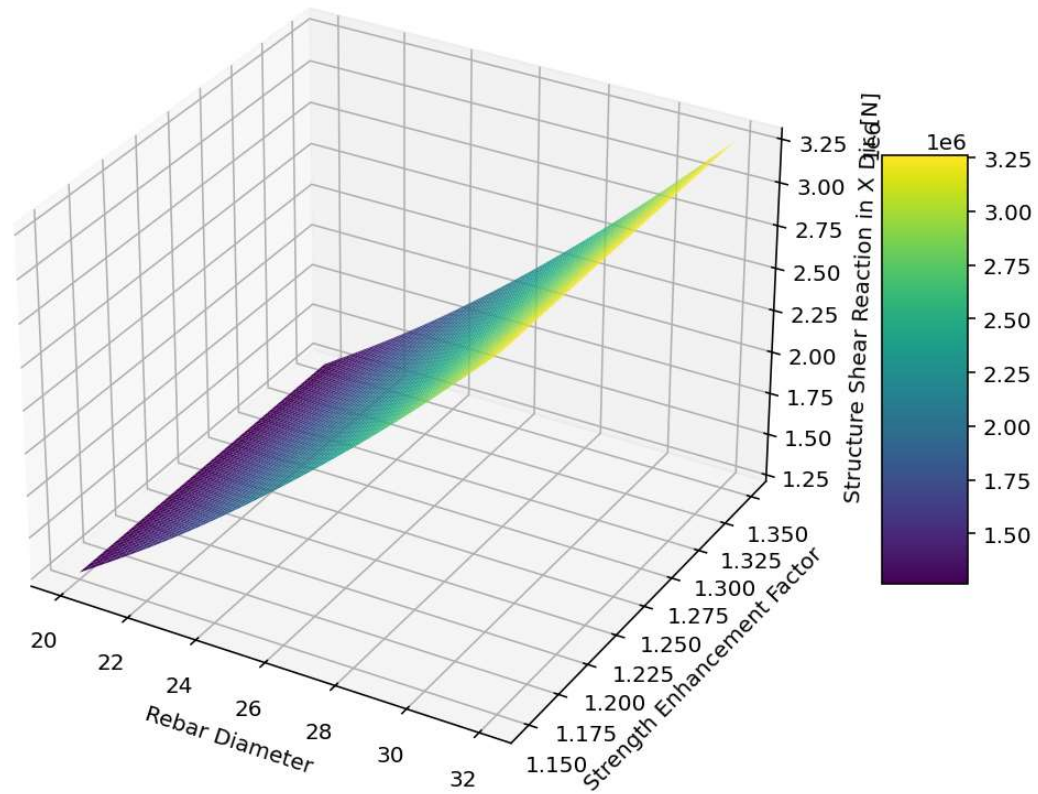




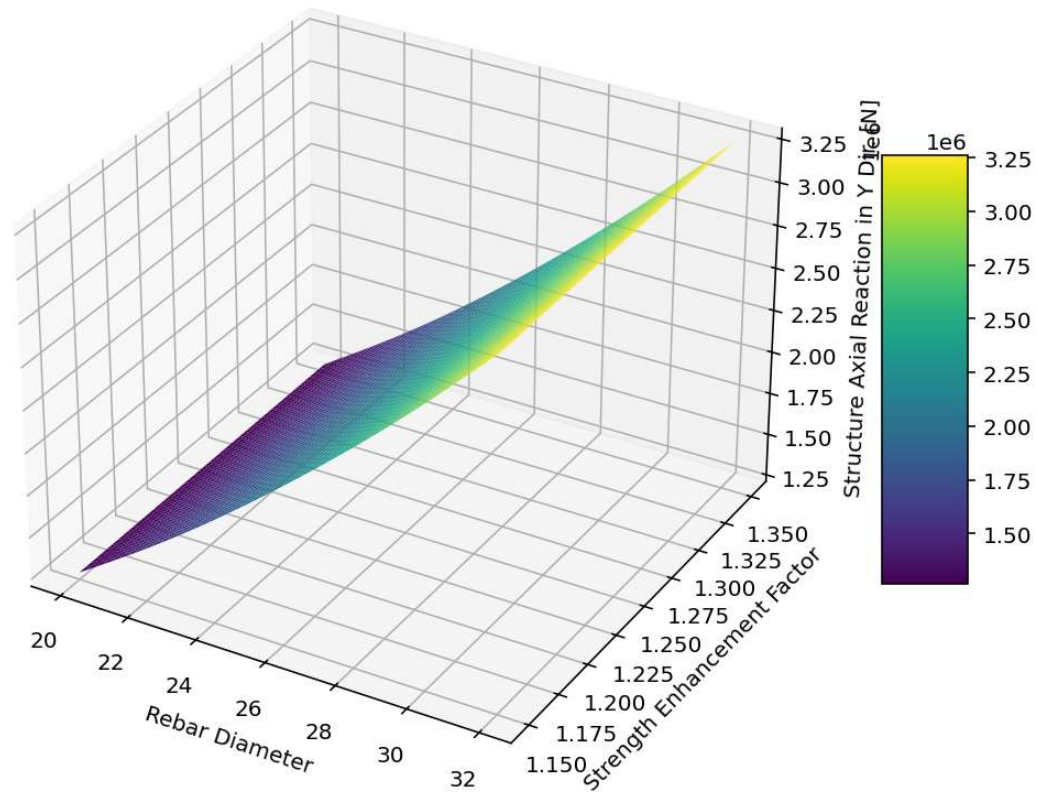
Correlation Heatmap



3D Contour Plot of Structure Shear Reaction in X Dir. [N]

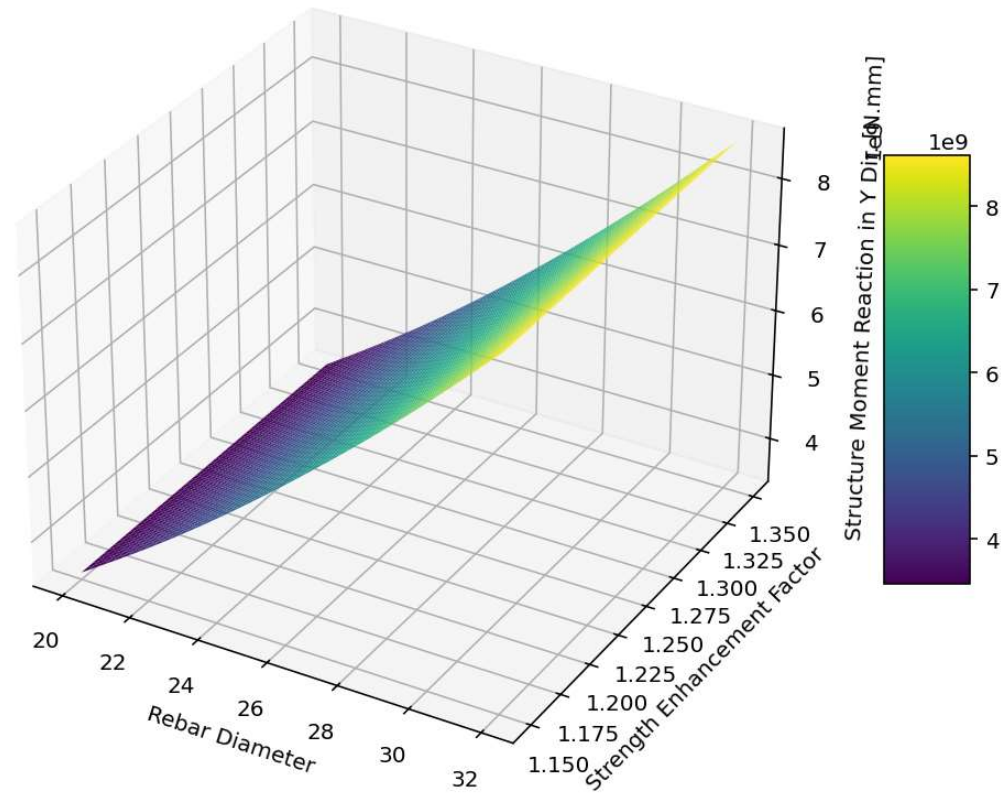


3D Contour Plot of Structure Axial Reaction in Y Dir. [N]

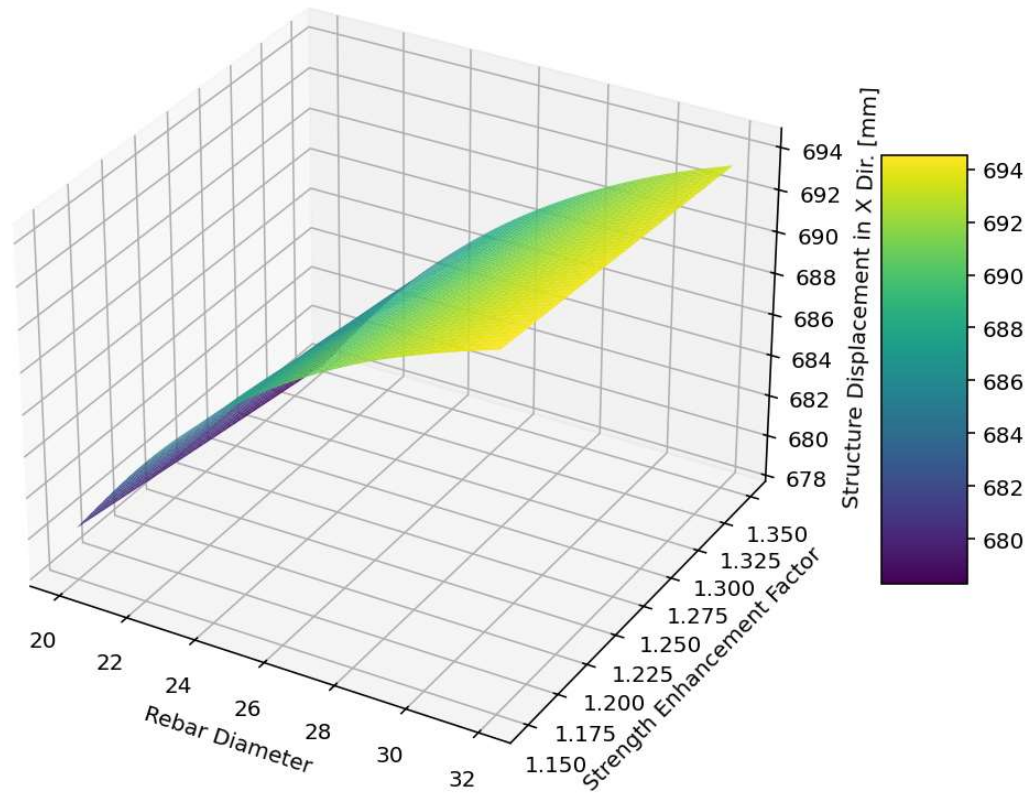




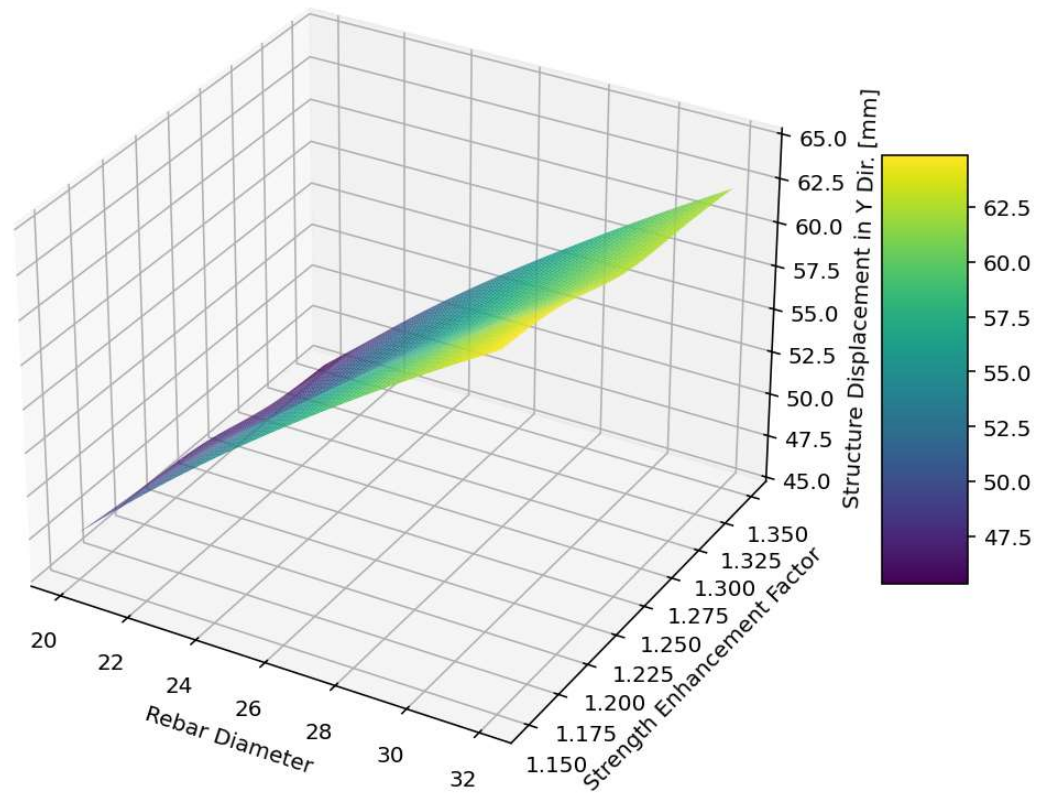
3D Contour Plot of Structure Moment Reaction in Y Dir. [N.mm]



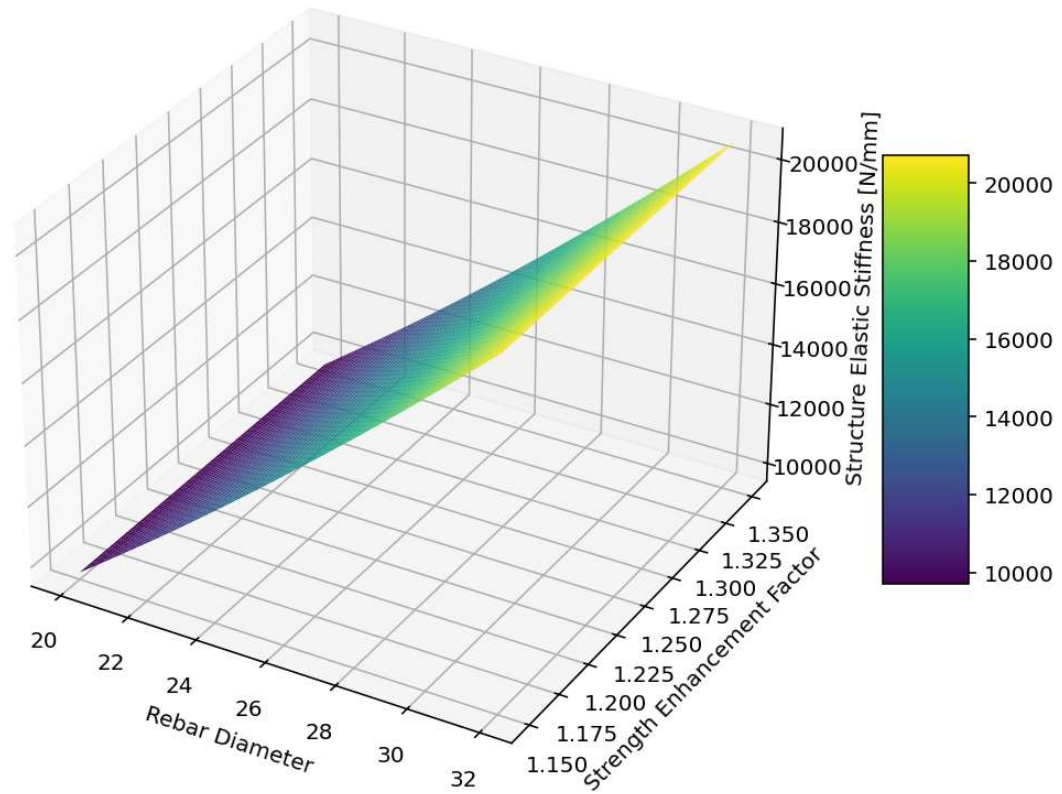
3D Contour Plot of Structure Displacement in X Dir. [mm]



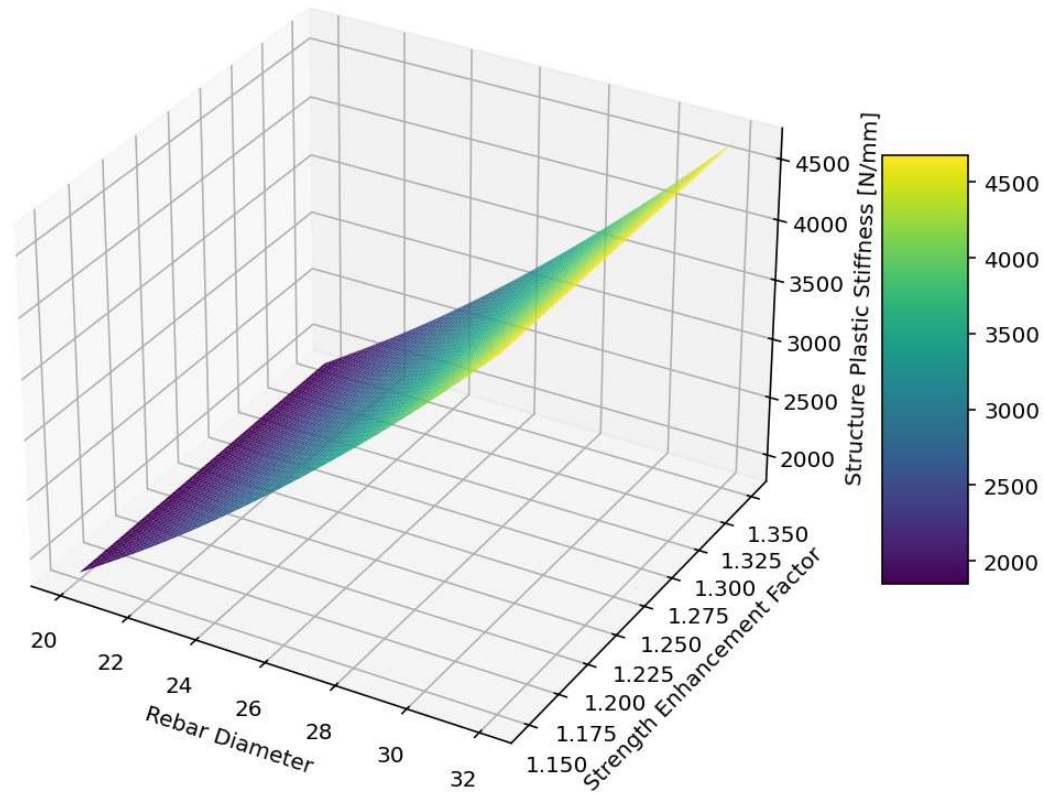
3D Contour Plot of Structure Displacement in Y Dir. [mm]



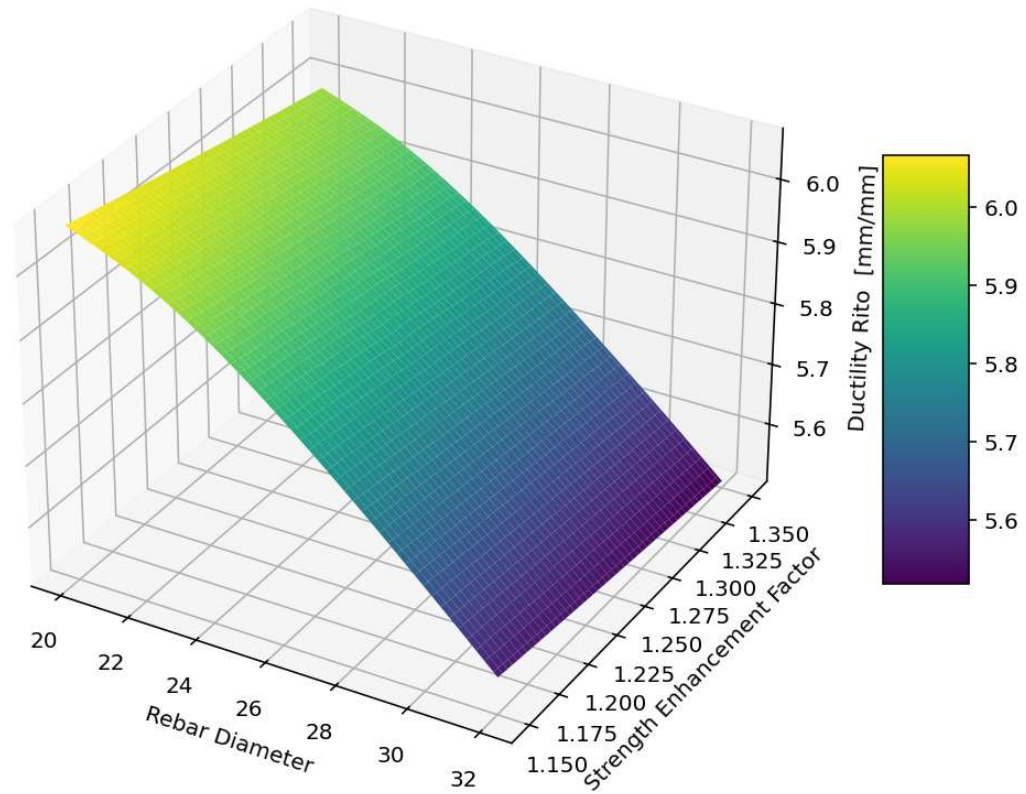
3D Contour Plot of Structure Elastic Stiffness [N/mm]



3D Contour Plot of Structure Plastic Stiffness [N/mm]

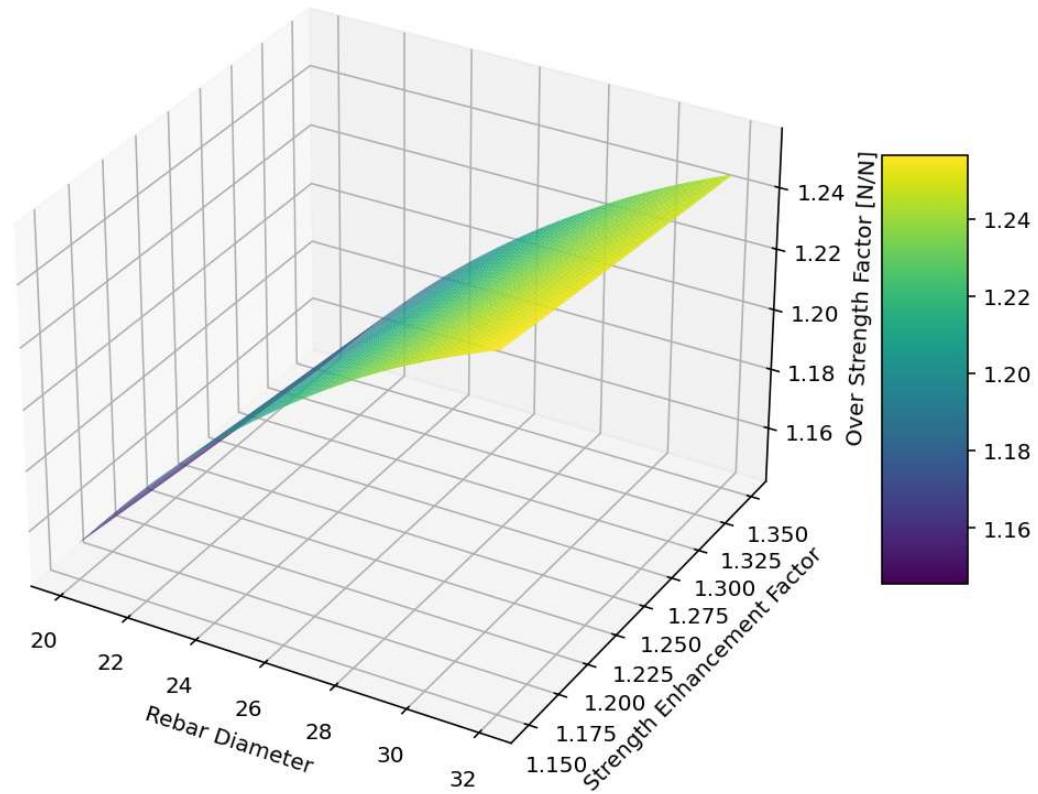


3D Contour Plot of Ductility Rito [mm/mm]

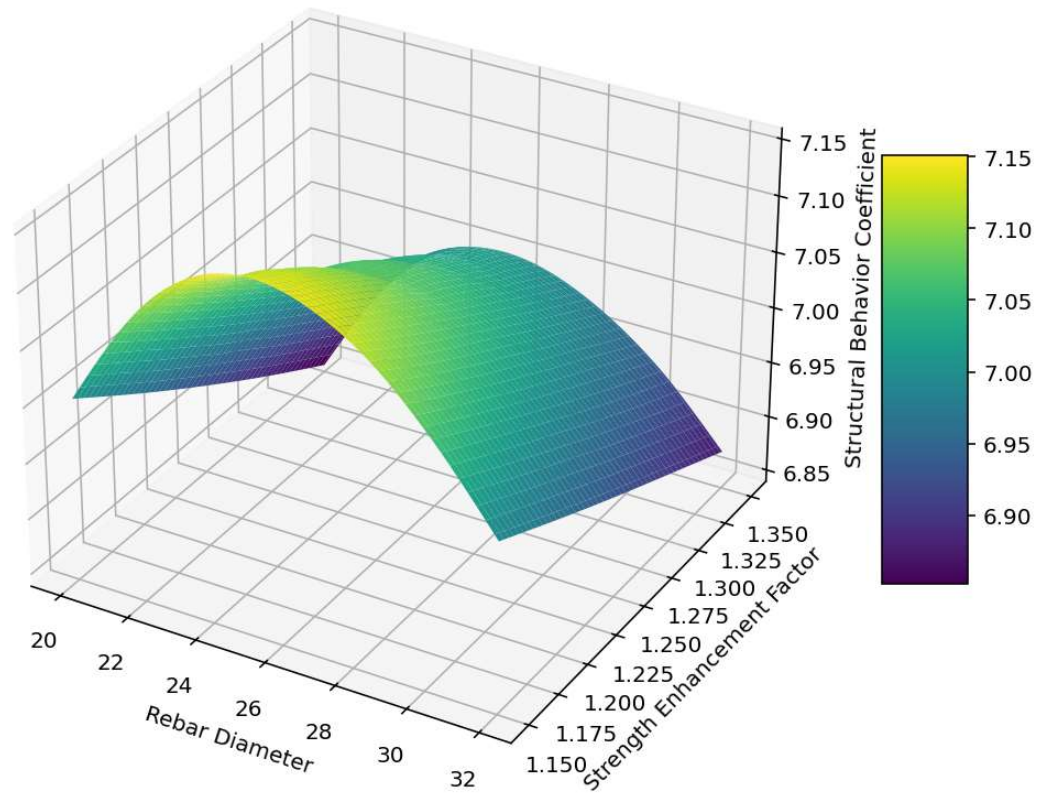




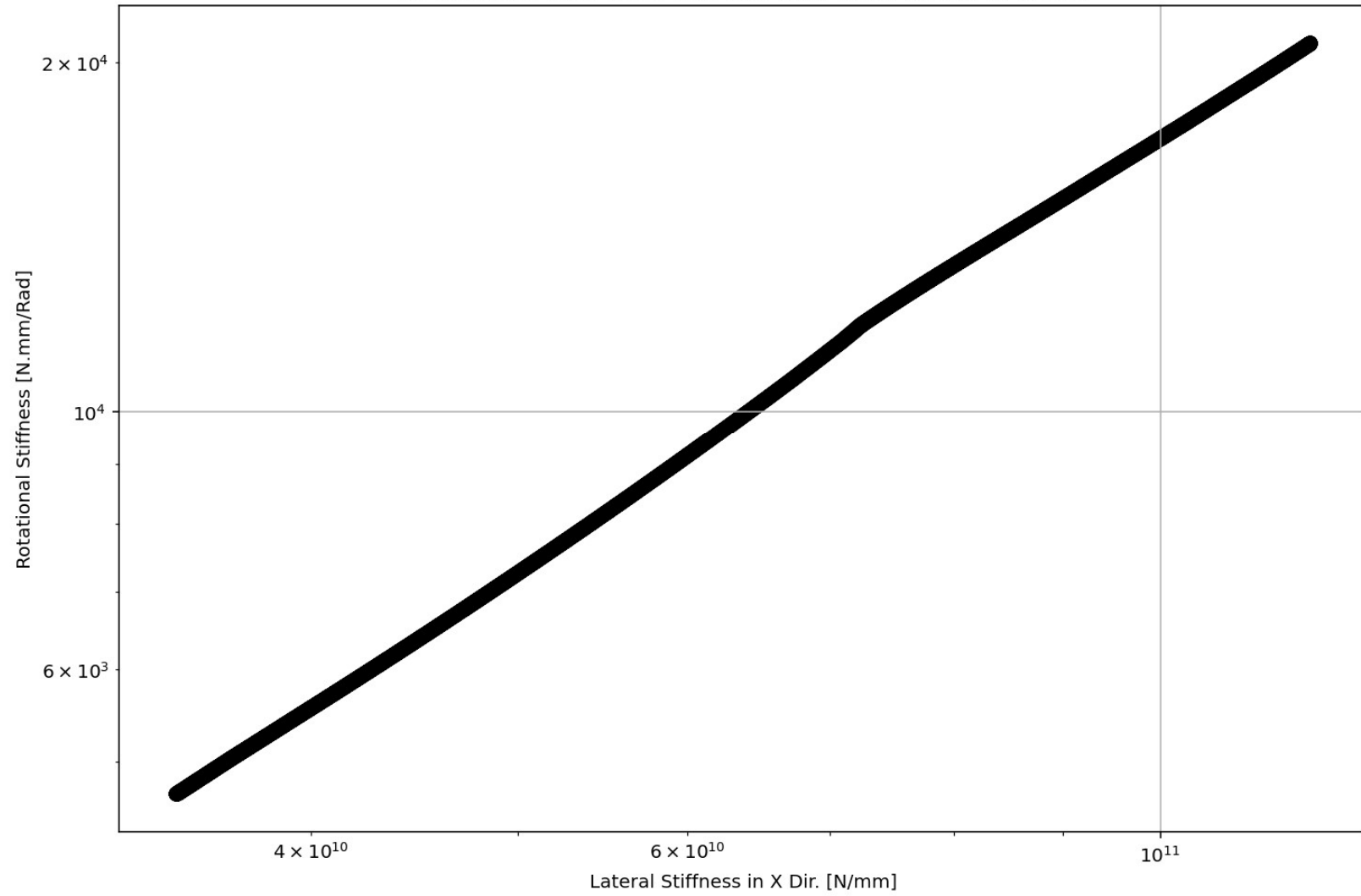
3D Contour Plot of Over Strength Factor [N/N]



3D Contour Plot of Structural Behavior Coefficient



ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM (X Dir)



ROTATIONAL STIFFNESS-LATERAL STIFFNESS DIAGRAM (Y Dir)

