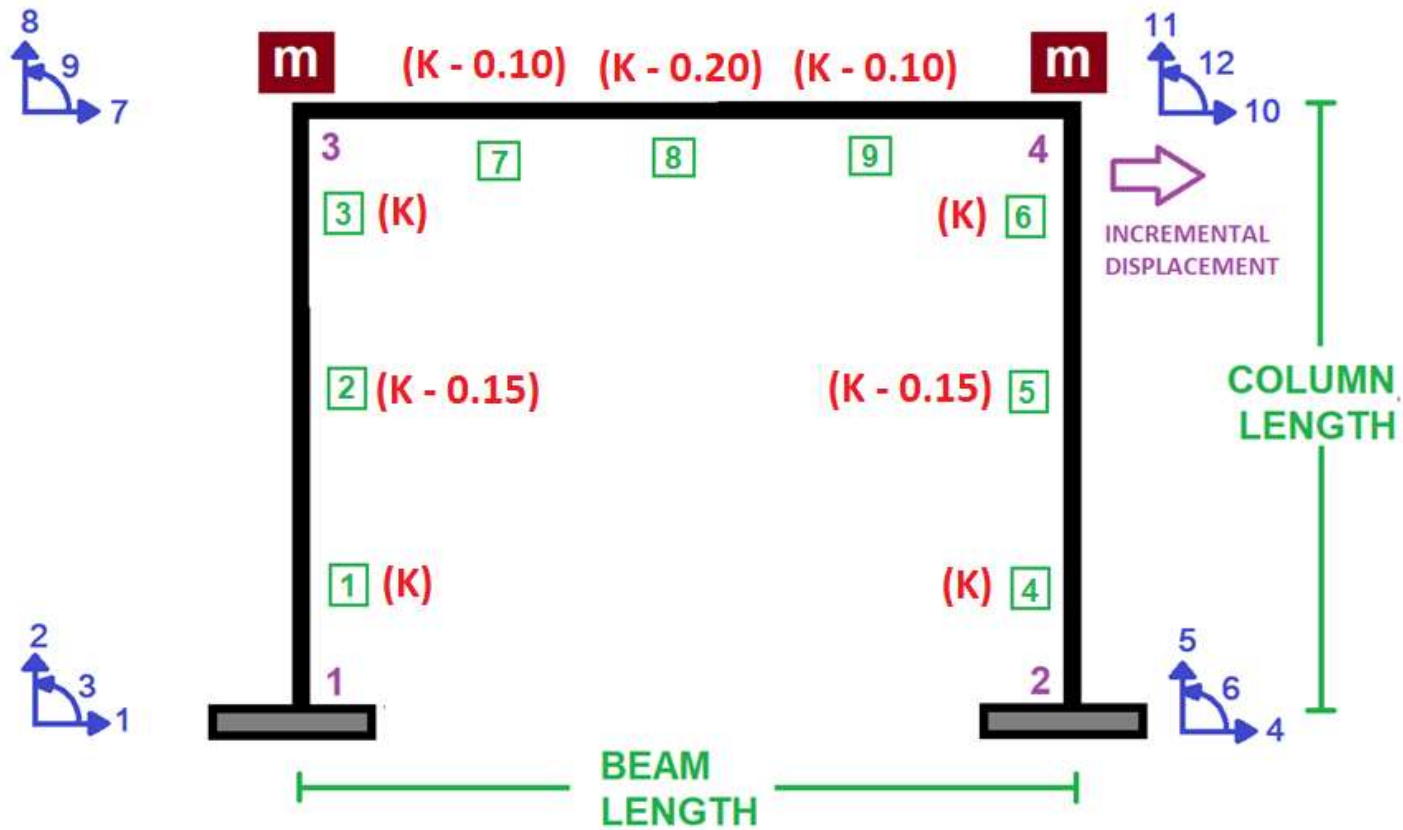


>> IN THE NAME OF ALLAH, THE MOST GRACIOUS, THE MOST MERCIFUL <<

SENSITIVITY ANALYSIS OF CONCRETE FRAME BY CHANGING COLUMN REBAR DIAMETER AND SECTION DEPTH AND CONFINEMENT ENHANCEMENT RATIO. USING OPENSEES

WRITTEN BY SALAR DELAVAR GHASHGHAEI (QASHQAI)

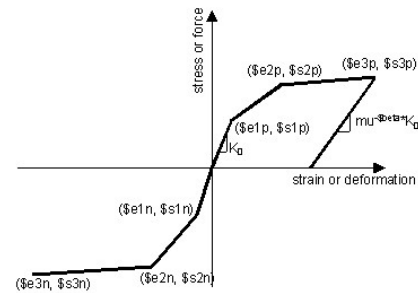




CORE AND COVER CONCRETE RELATION



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 <<
#   SENSITIVITY ANALYSIS OF A CONCRETE FRAME BY VARYING COLUMN REBAR DIAMETER, SECTION DEPTH, AND CONFINEMENT
#   ENHANCEMENT RATIO USING OPENSEES
#
#   -----
#   FREE VIBRATION ANALYSIS USING INITIAL DISPLACEMENT, VELOCITY, AND ACCELERATION
#   -----
#
#   PROGRAM DEVELOPED BY SALAR DELAVAR GHASHGHAEI (QASHQAI)
#   CONTACT: salar.d.ghashghaei@gmail.com
#####

"""
1. Objective:
This code performs a sensitivity analysis on a 2D reinforced concrete frame under free-vibration
conditions. It evaluates the effects of varying column rebar diameters, section depths,
and confinement enhancement ratios on structural behavior coefficients using OpenSees.

2. Model Setup:
A nonlinear 2D frame is modeled with columns and beams using distributed plasticity elements.
Corotational transformation is applied to account for geometric nonlinearity due to large displacements.

3. Material Modeling:
Confined and unconfined concrete are modeled using the Modified Kent-Scott-Park formulation.
Steel reinforcement behavior follows either a bilinear or strain hardening model, depending
on input parameters.

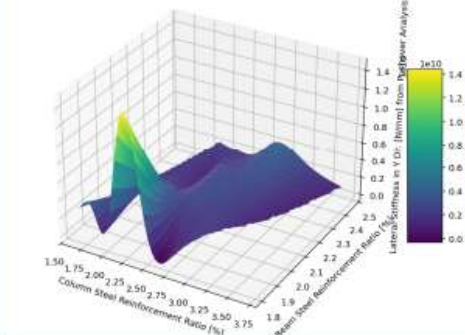
4. Analysis Types:
Both static (pushover) and dynamic (free-vibration) analyses are supported. Rayleigh damping
is calibrated based on modal frequencies for dynamic analysis.

5. Key Outputs:
The model outputs base shear, top displacement, initial and tangent stiffness, ductility ratios
, overstrength factors, and seismic response modification coefficients (R-factors).
```

INEMENT_ENHANCEMENT_RATIO_&_REBAR_&_Cdepth_FREE_VIBRATION

29 %

3D Contour Plot of Lateral Stiffness in Y Dir. [N/mm] from Pushover Analysis



Help Variable Explorer Debugger Plots Files

Console 1/A

STEP: 18 PUSHOVER DONE.

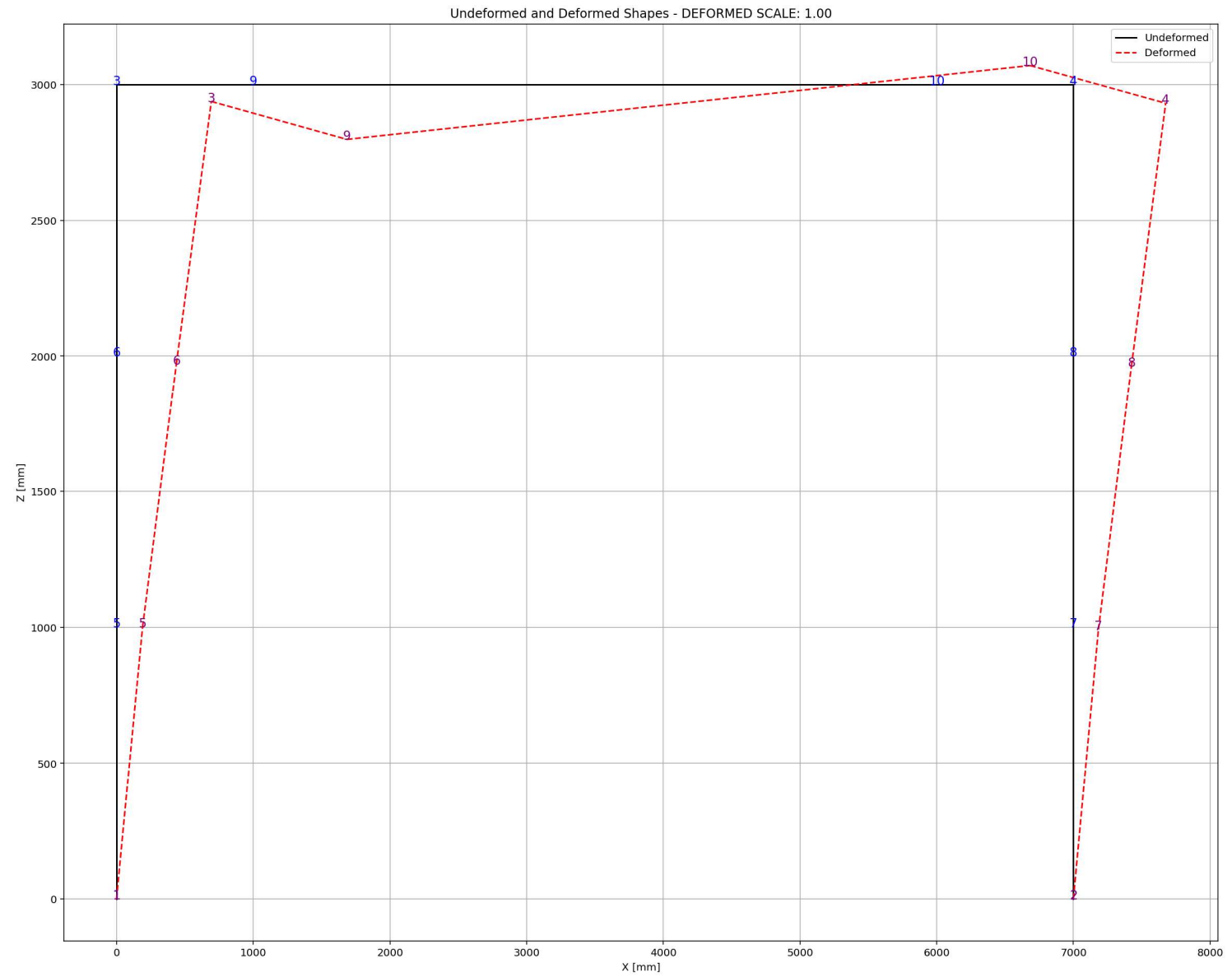
Structure First Period: 2.1477754106050386
Structure Second Period: 5.9556297605924415

STEP: 18 DYNAMIC DONE.

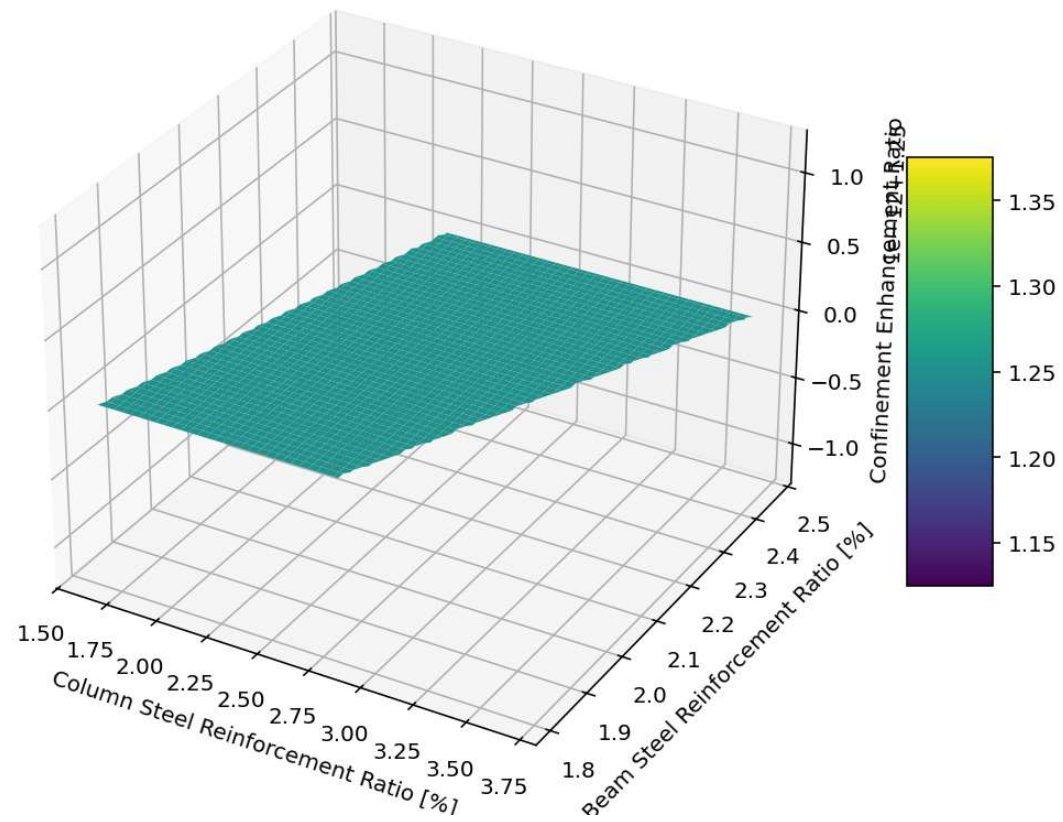
Current time (HH:MM:SS): 12:43:45

IPython Console History

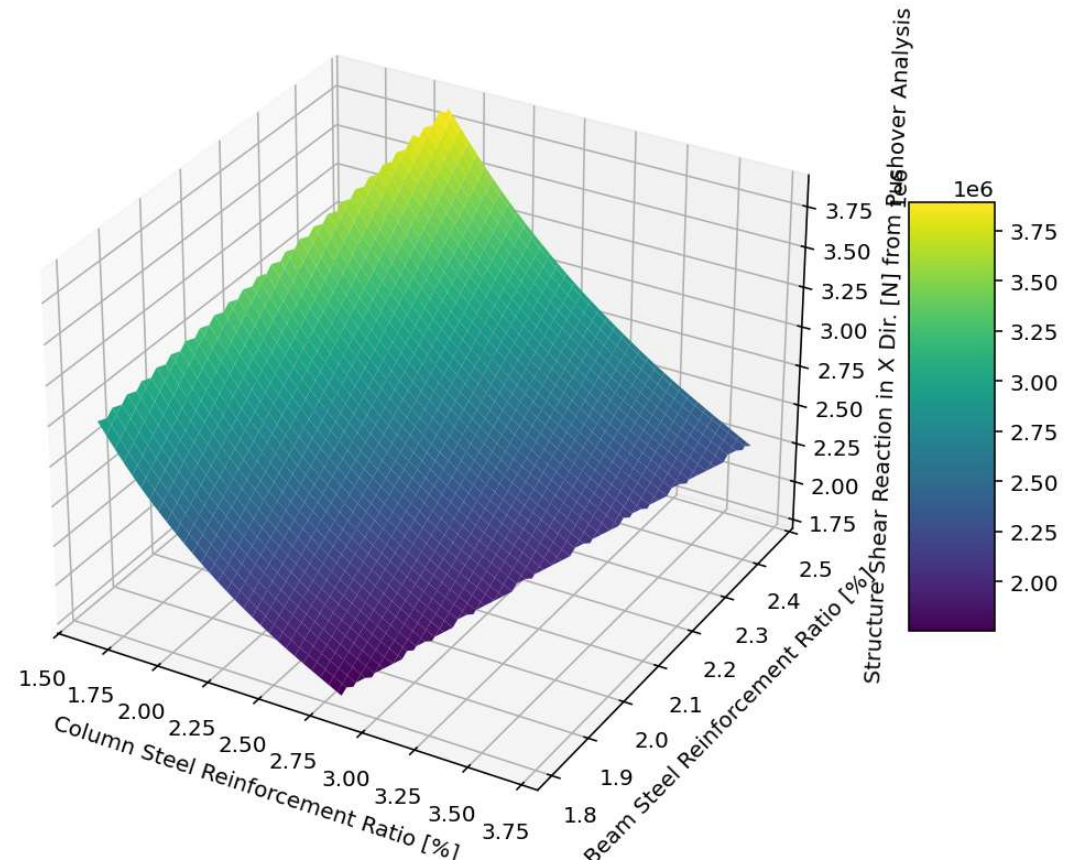
Inline Conda: anaconda3 (Python 3.12.7) ✓ LSP: Python Line 60, Col 1 UTF-8 CRLF RW Mem 42%



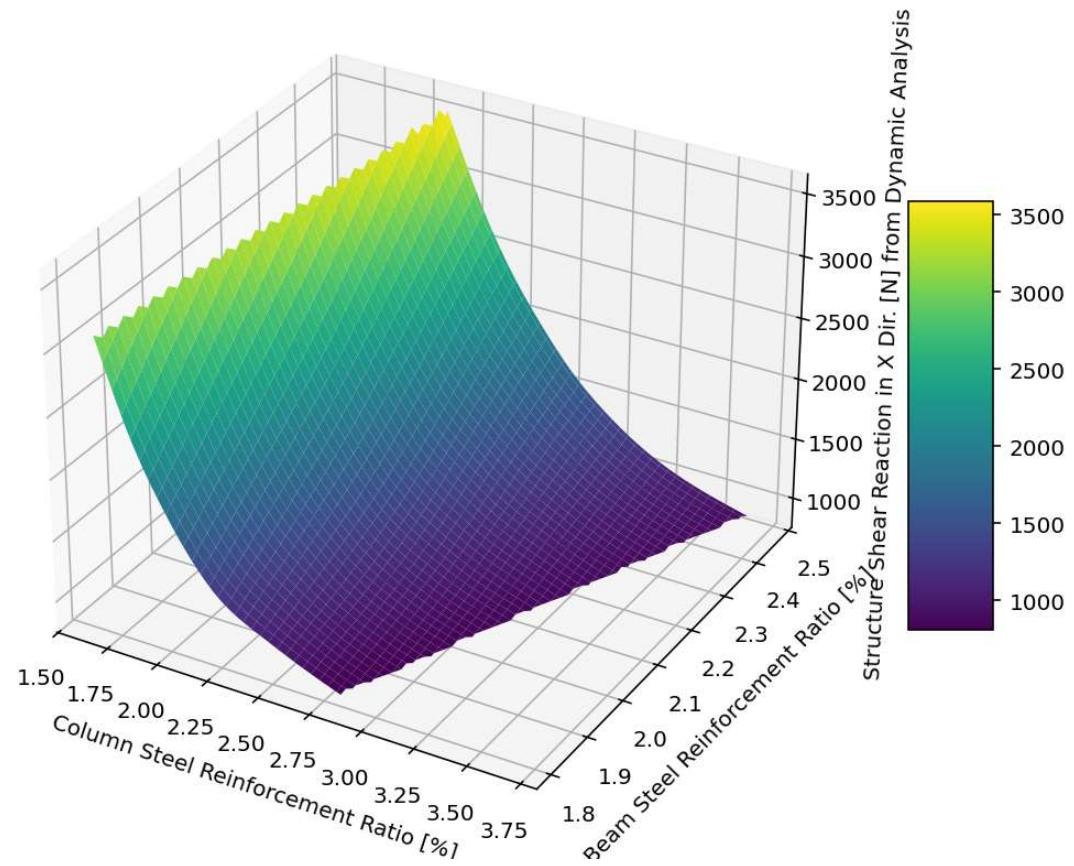
3D Contour Plot of Confinement Enhancement Ratio



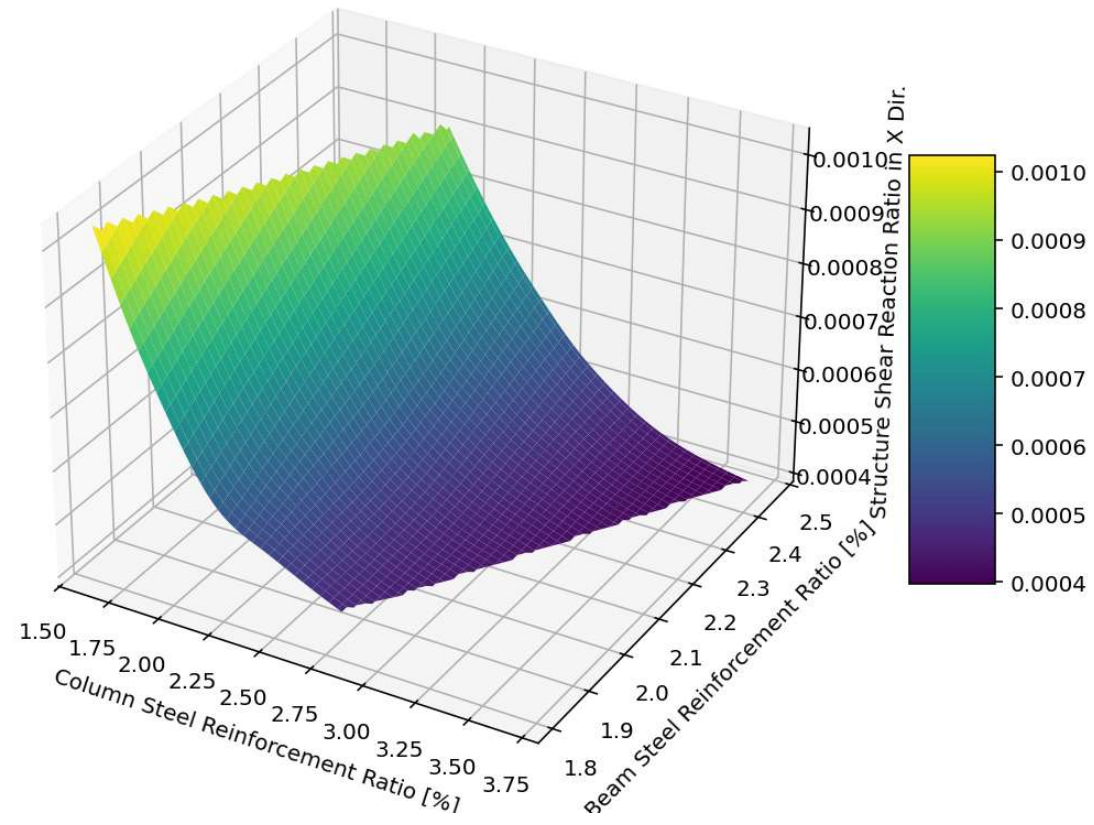
3D Contour Plot of Structure Shear Reaction in X Dir. [N] from Pushover Analysis



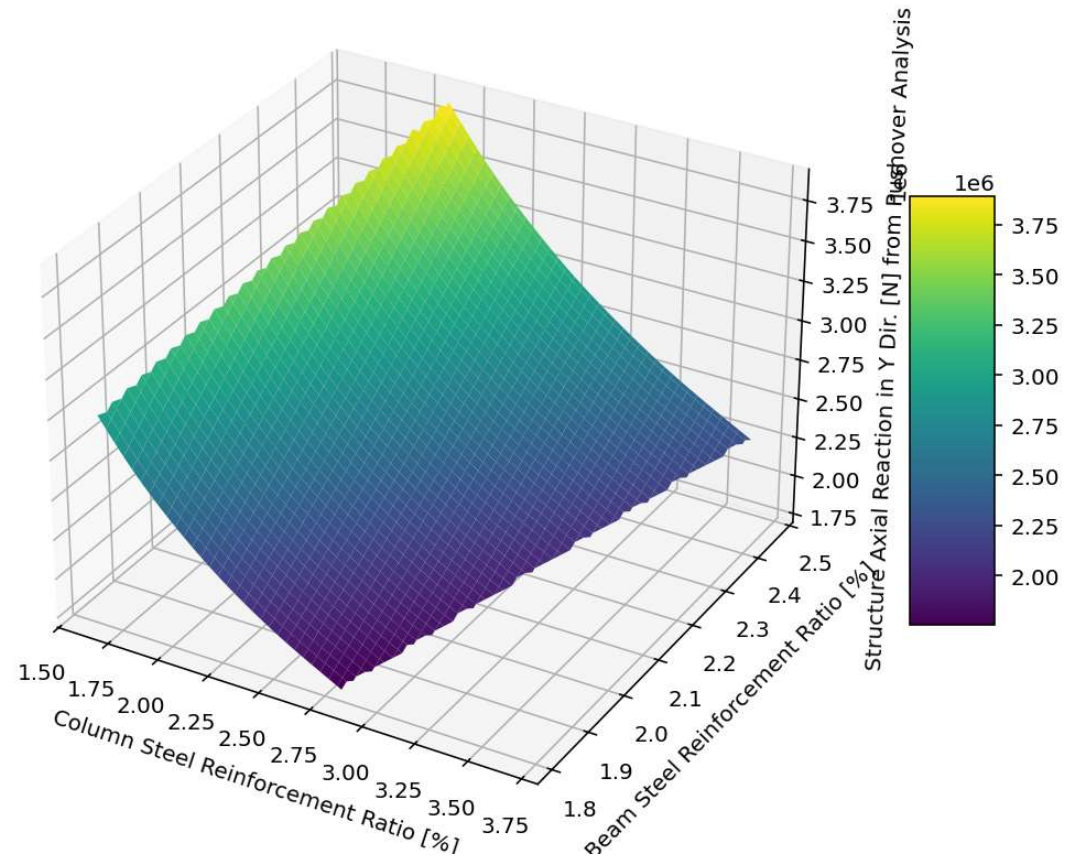
3D Contour Plot of Structure Shear Reaction in X Dir. [N] from Dynamic Analysis



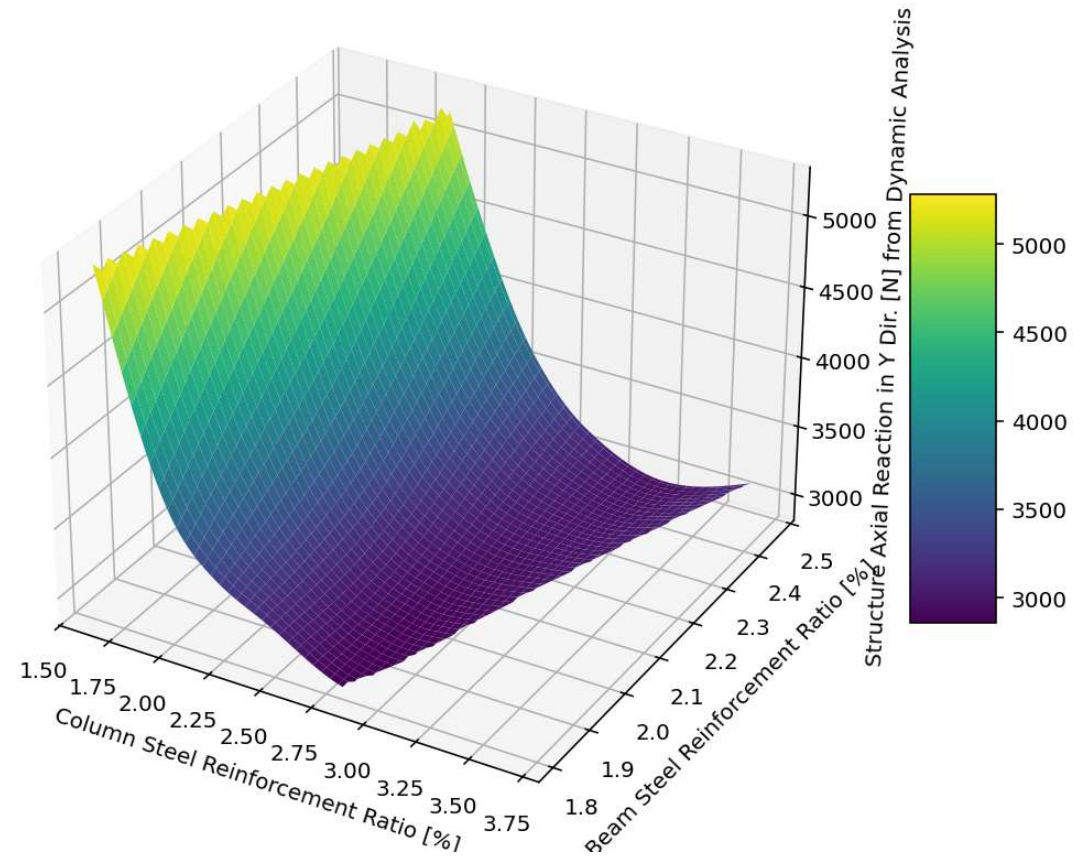
3D Contour Plot of Structure Shear Reaction Ratio in X Dir.



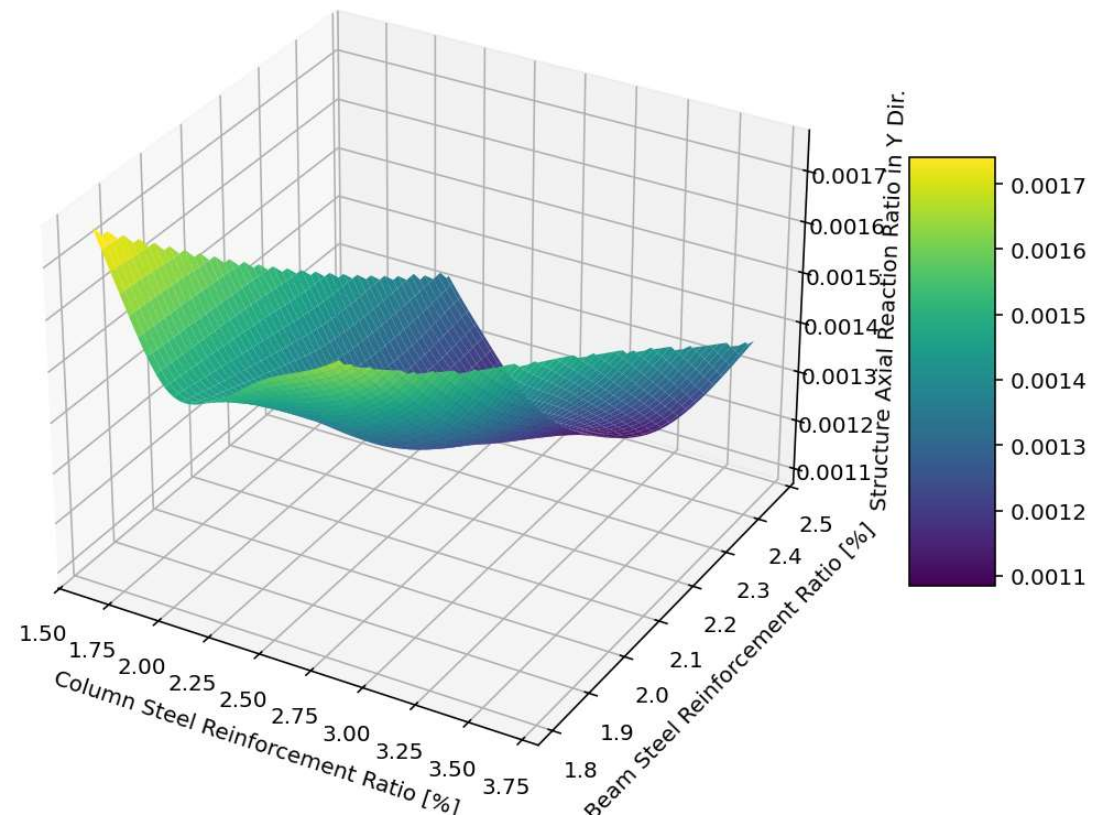
3D Contour Plot of Structure Axial Reaction in Y Dir. [N] from Pushover Analysis



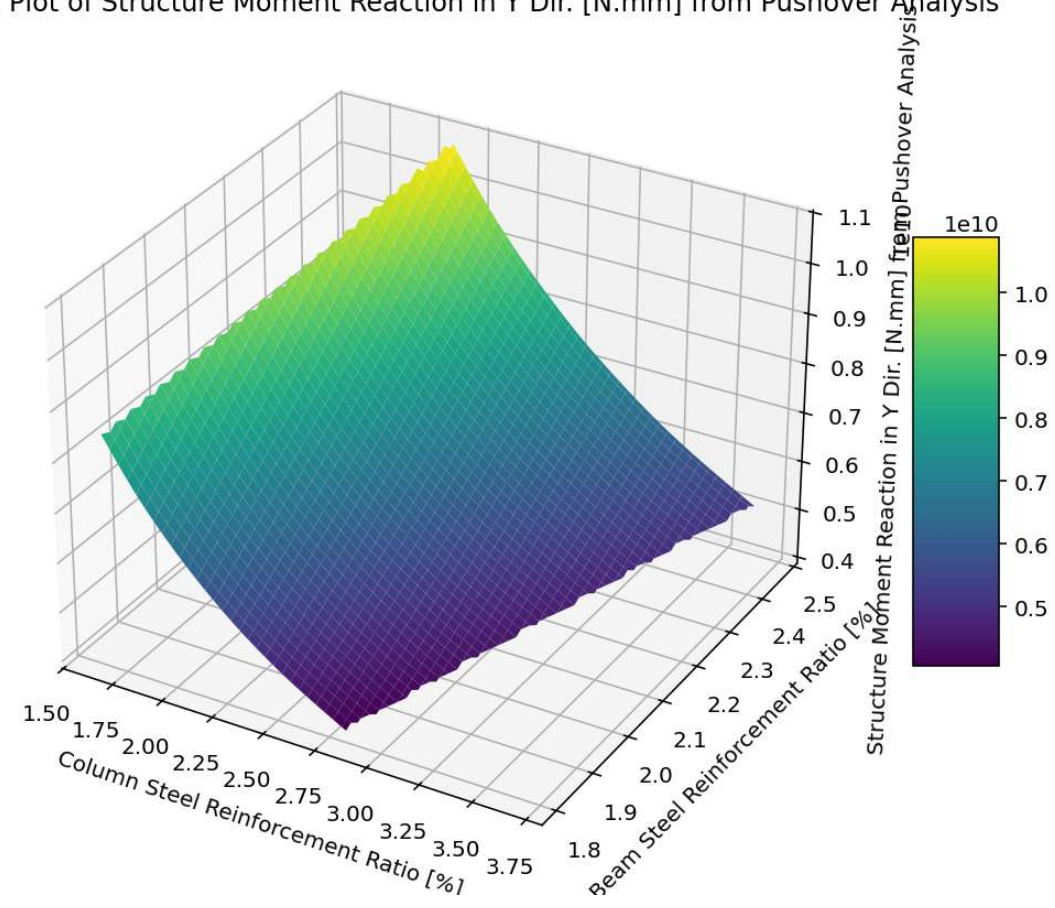
3D Contour Plot of Structure Axial Reaction in Y Dir. [N] from Dynamic Analysis



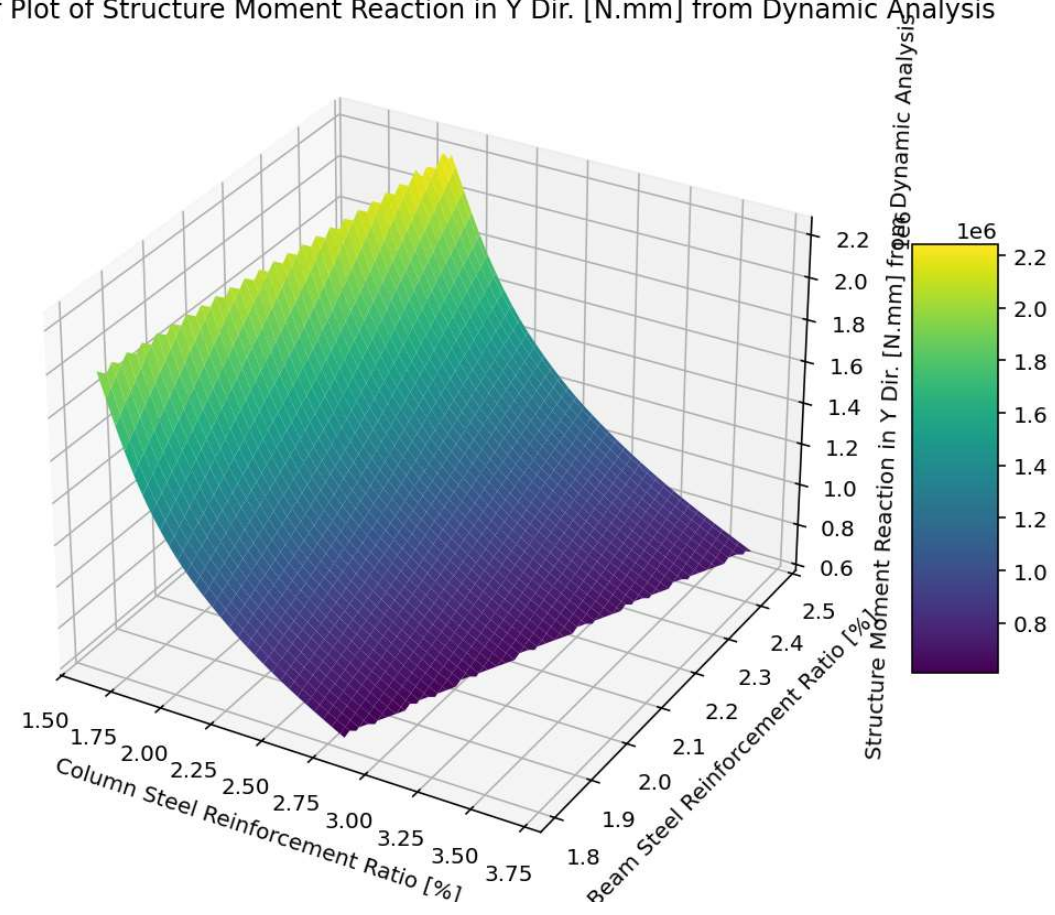
3D Contour Plot of Structure Axial Reaction Ratio in Y Dir.



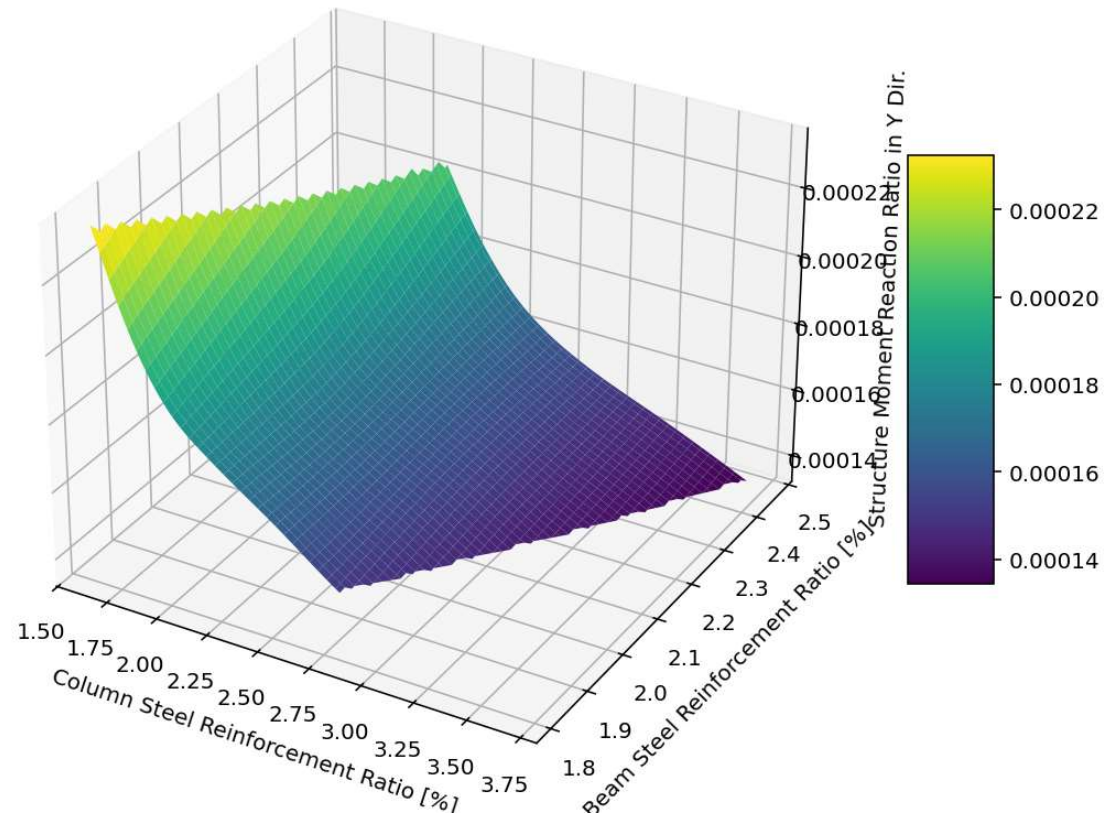
3D Contour Plot of Structure Moment Reaction in Y Dir. [N.mm] from Pushover Analysis



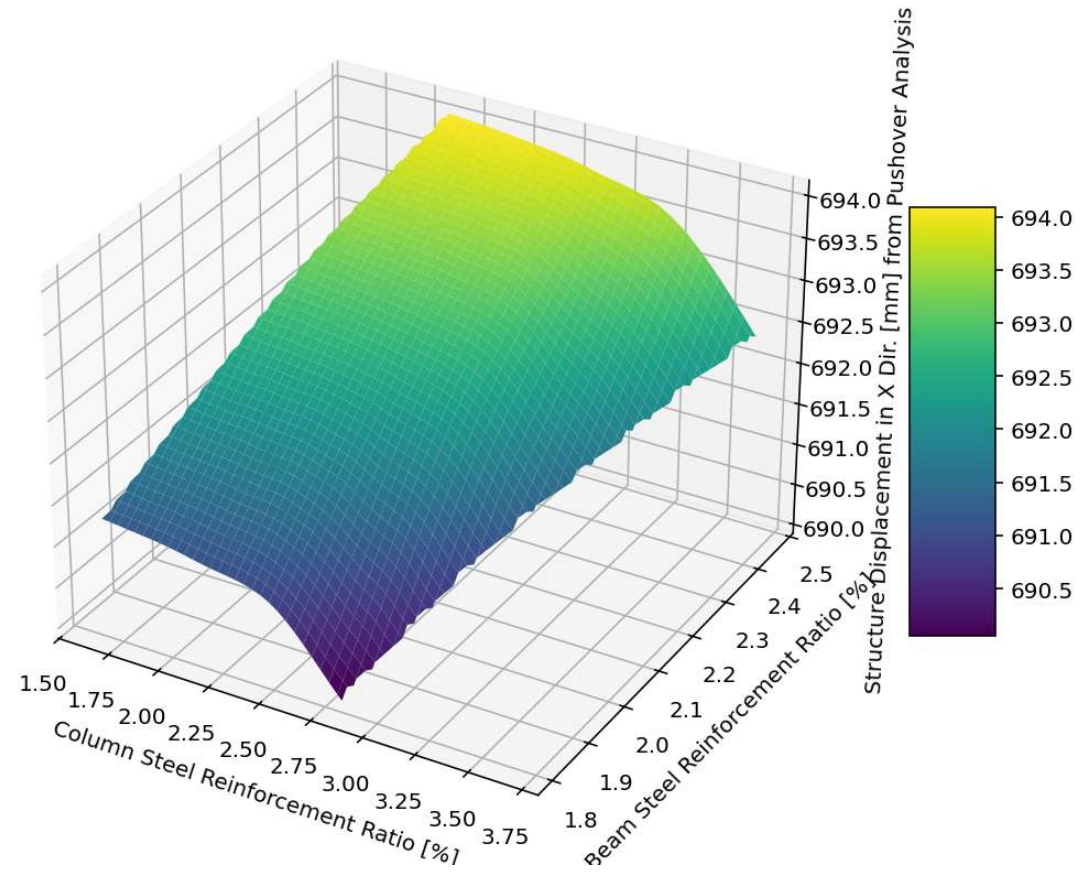
3D Contour Plot of Structure Moment Reaction in Y Dir. [N.mm] from Dynamic Analysis



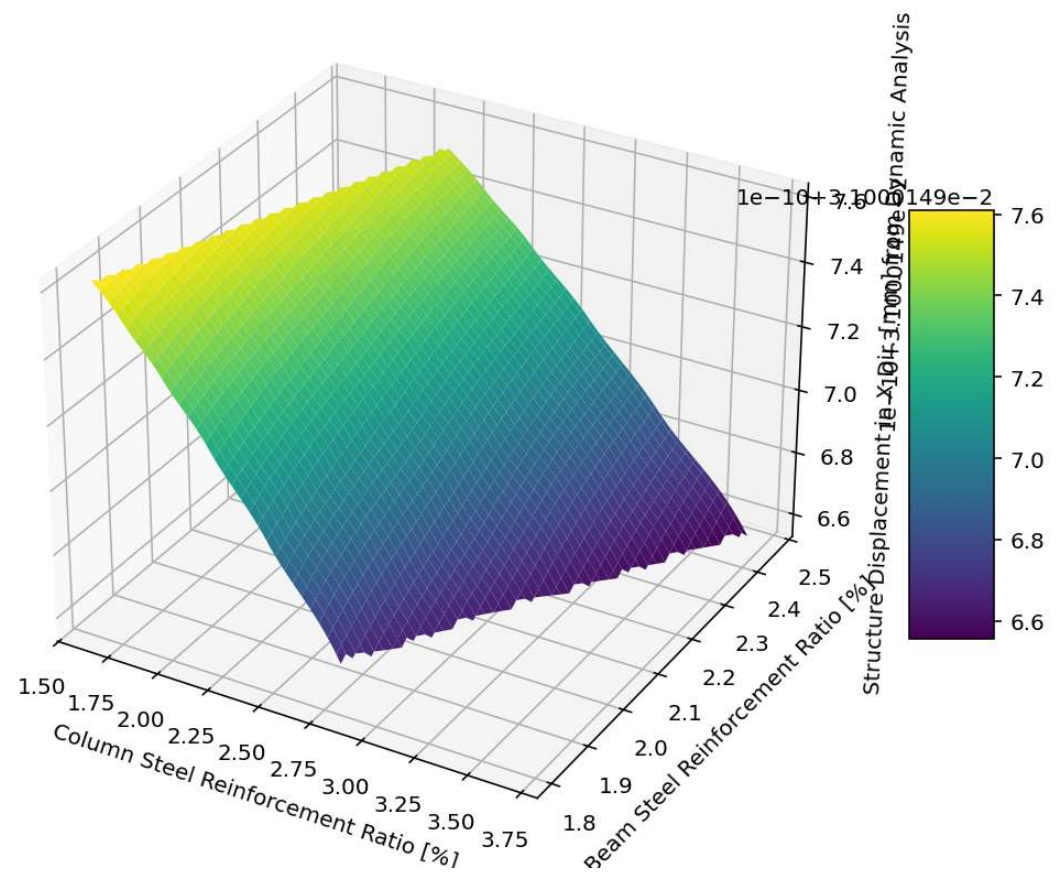
3D Contour Plot of Structure Moment Reaction Ratio in Y Dir.



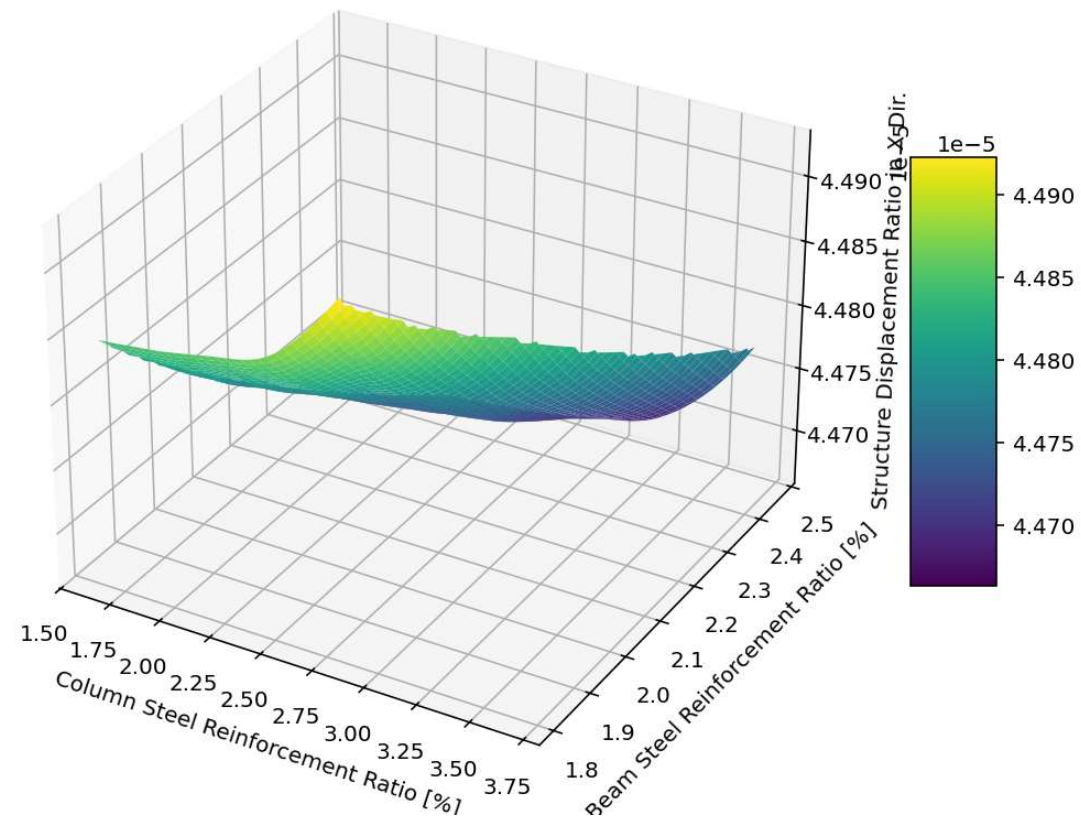
3D Contour Plot of Structure Displacement in X Dir. [mm] from Pushover Analysis



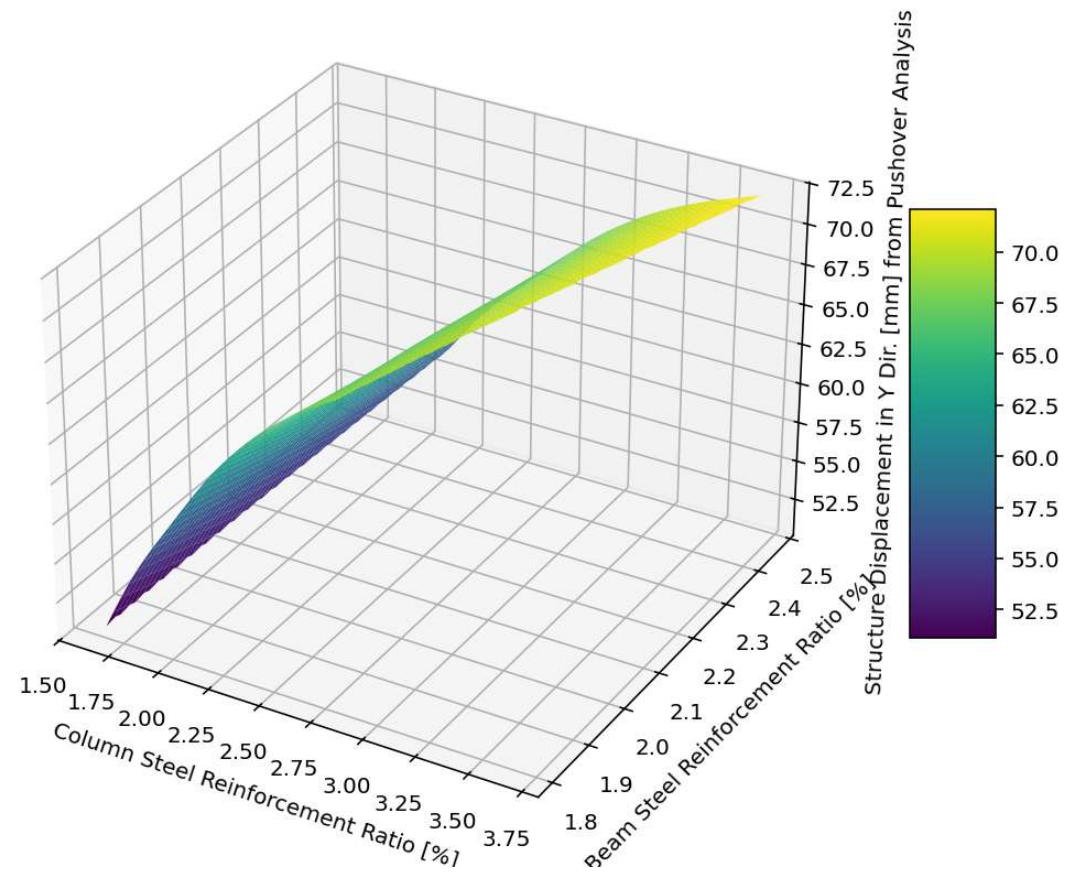
3D Contour Plot of Structure Displacement in X Dir. [mm] from Dynamic Analysis



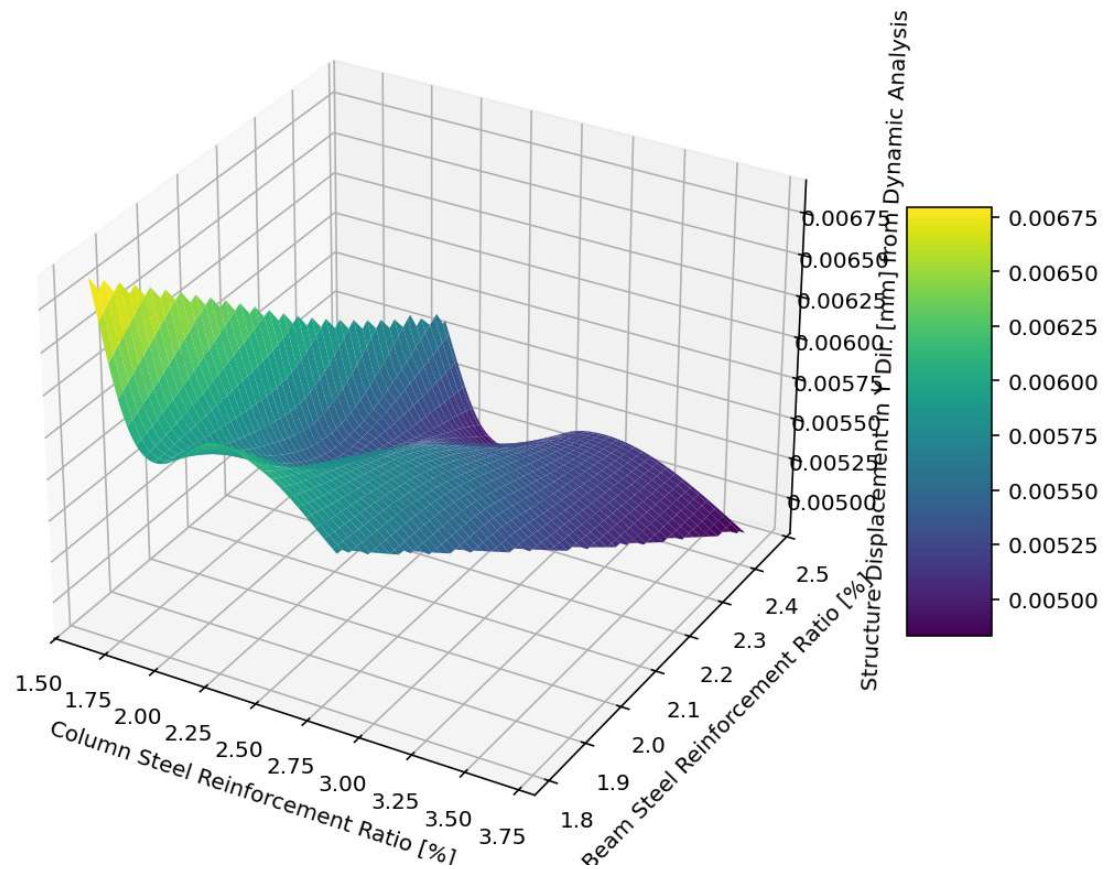
3D Contour Plot of Structure Displacement Ratio in X Dir.



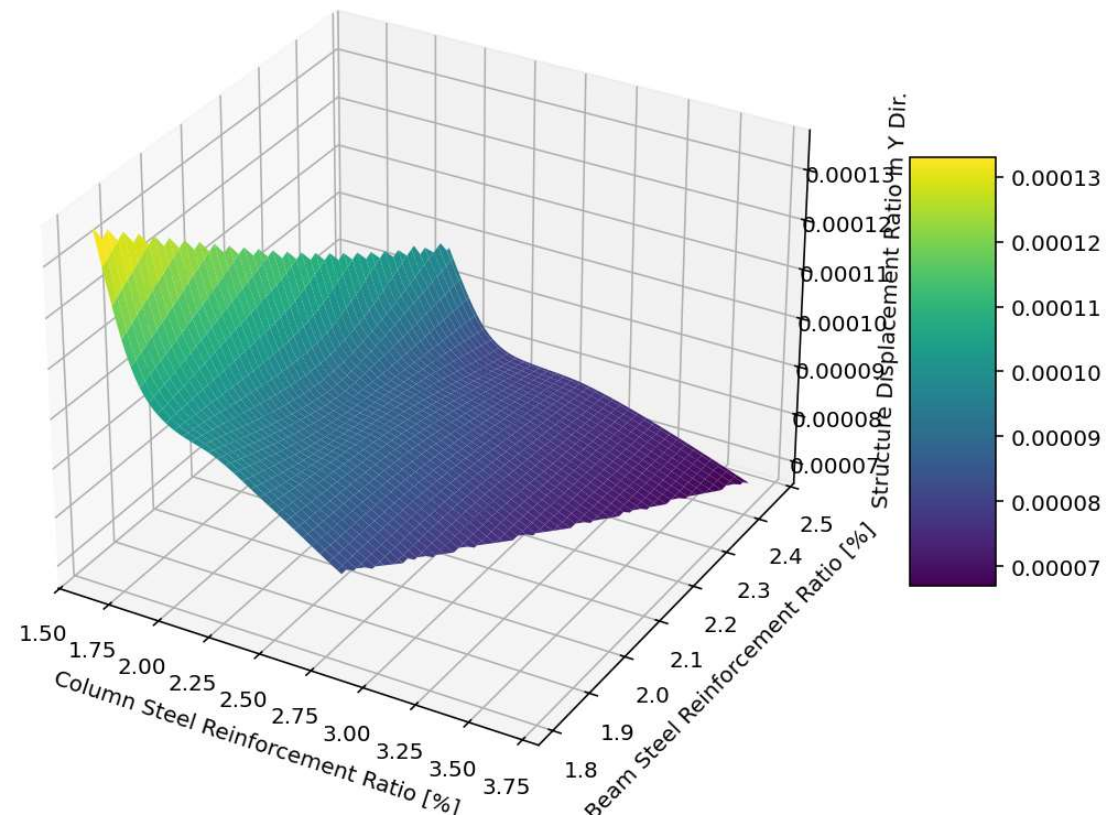
3D Contour Plot of Structure Displacement in Y Dir. [mm] from Pushover Analysis



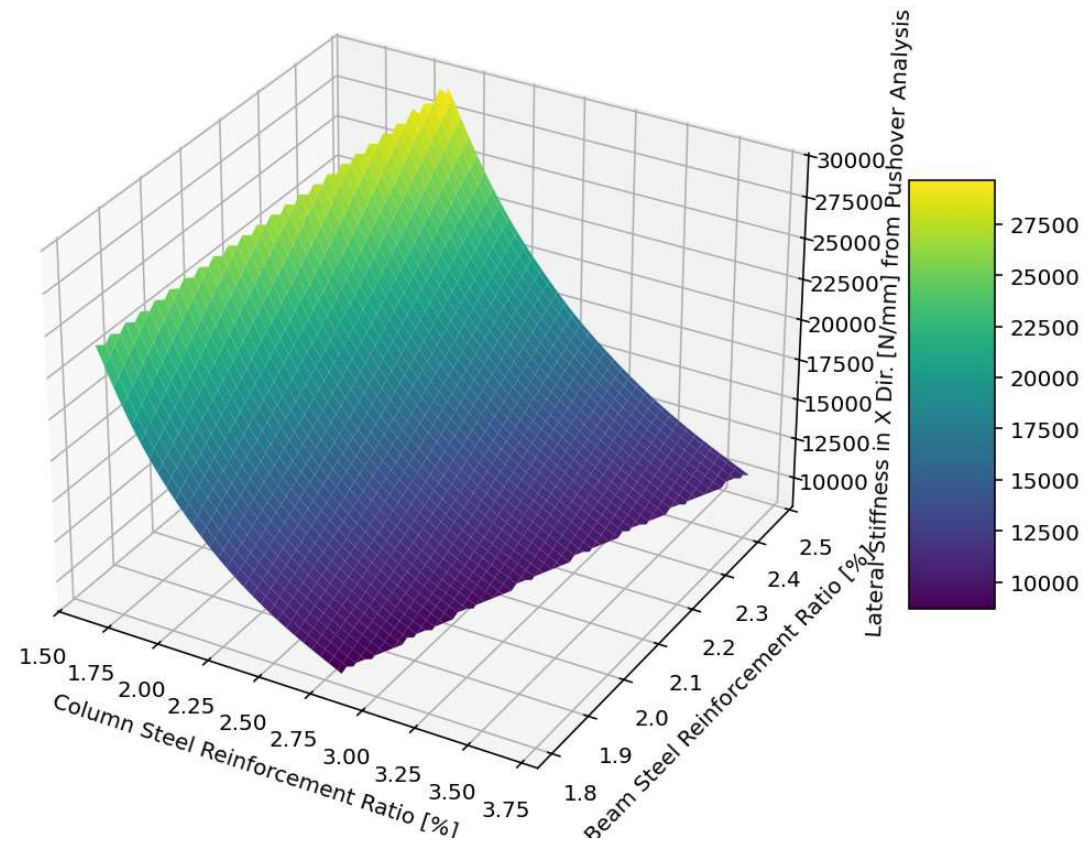
3D Contour Plot of Structure Displacement in Y Dir. [mm] from Dynamic Analysis



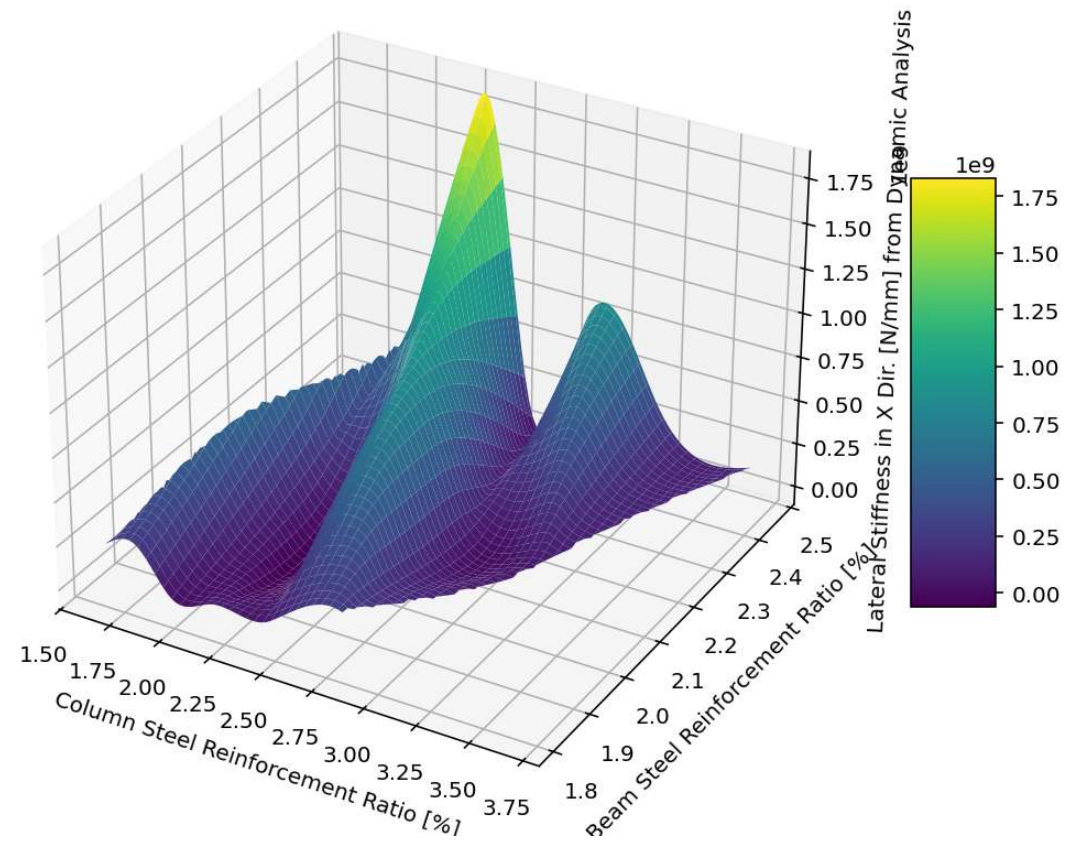
3D Contour Plot of Structure Displacement Ratio in Y Dir.



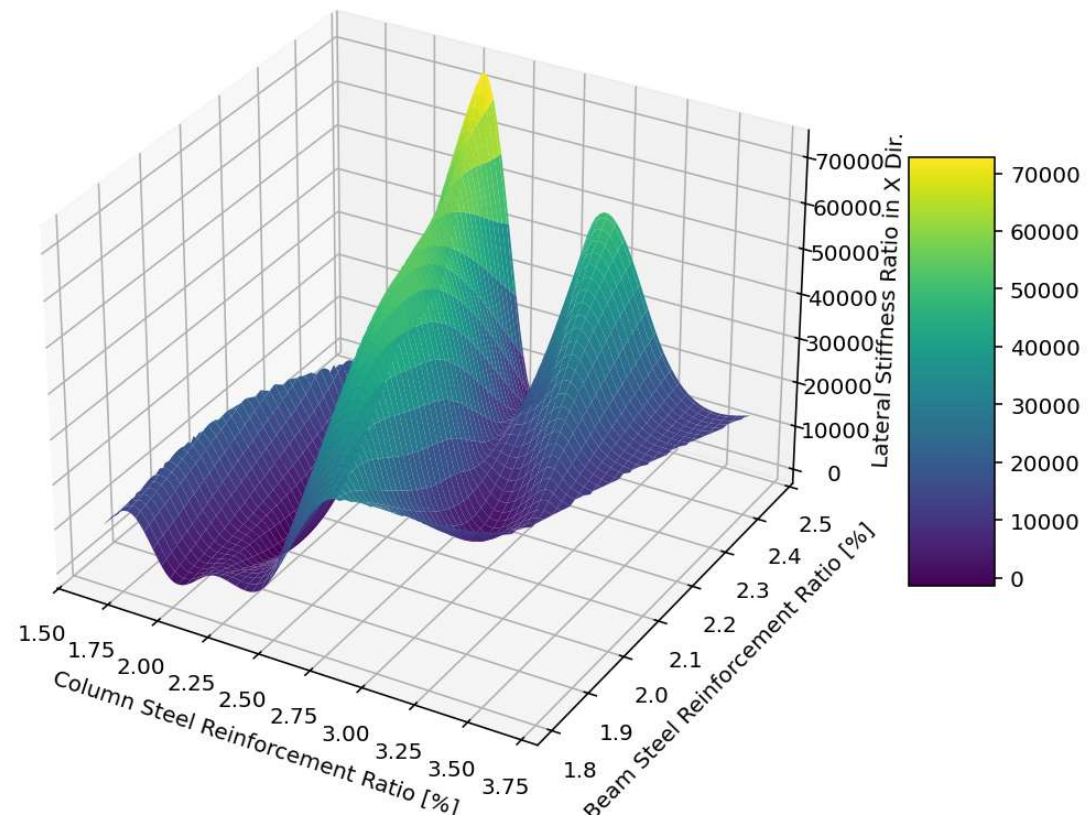
3D Contour Plot of Lateral Stiffness in X Dir. [N/mm] from Pushover Analysis



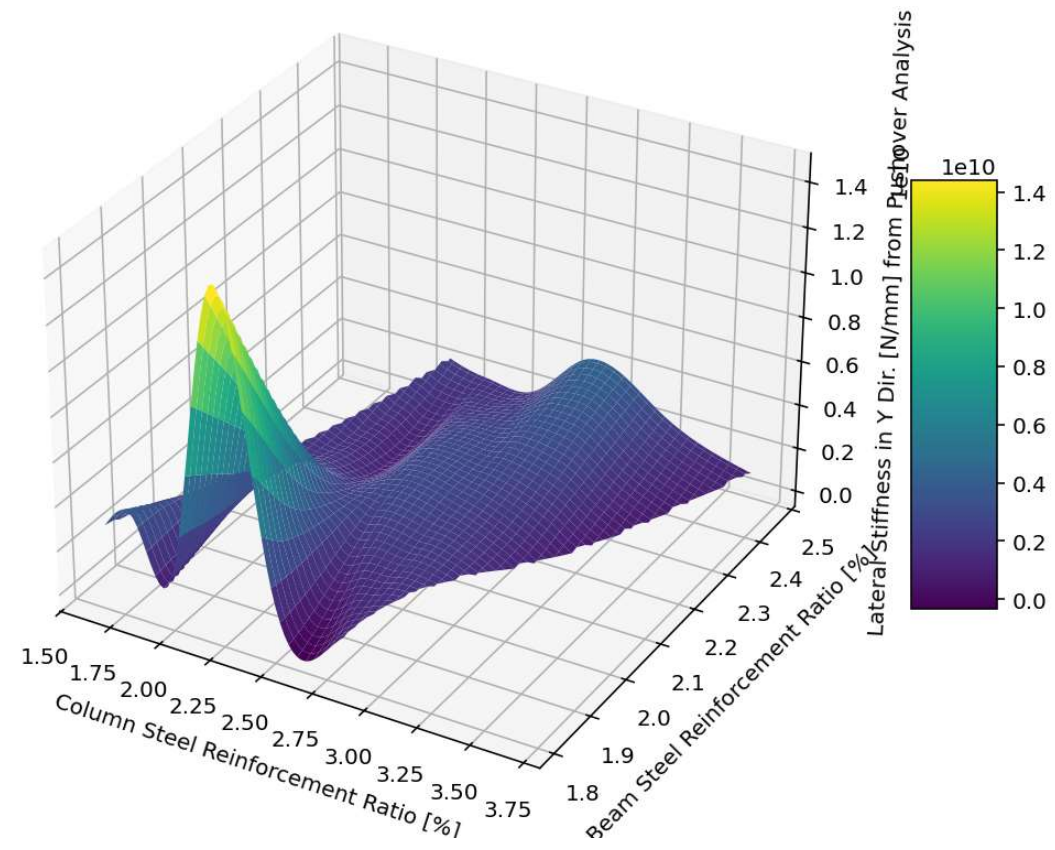
3D Contour Plot of Lateral Stiffness in X Dir. [N/mm] from Dynamic Analysis



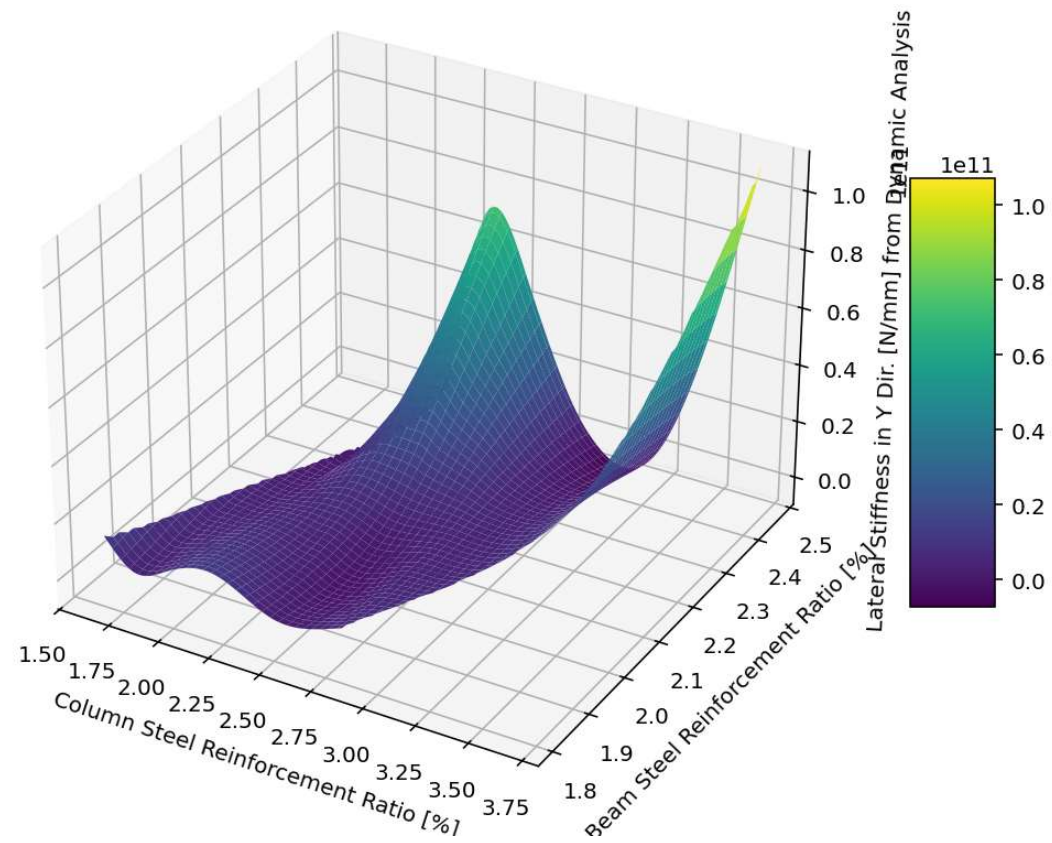
3D Contour Plot of Lateral Stiffness Ratio in X Dir.



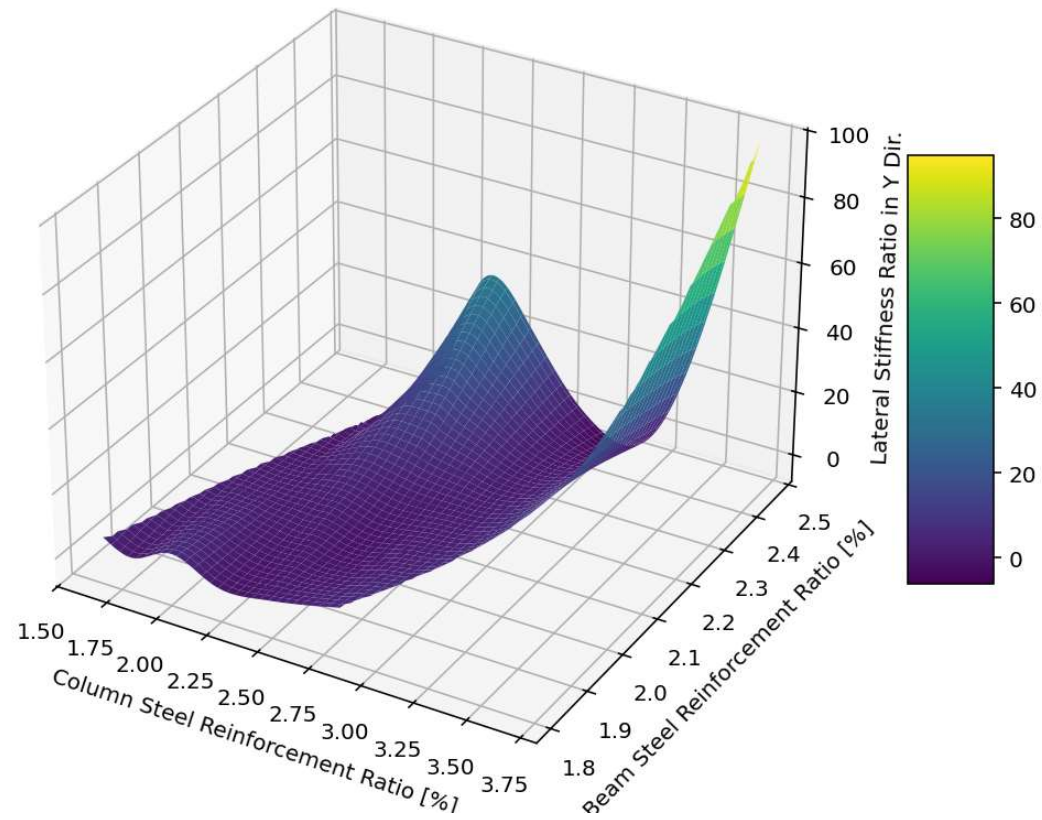
3D Contour Plot of Lateral Stiffness in Y Dir. [N/mm] from Pushover Analysis



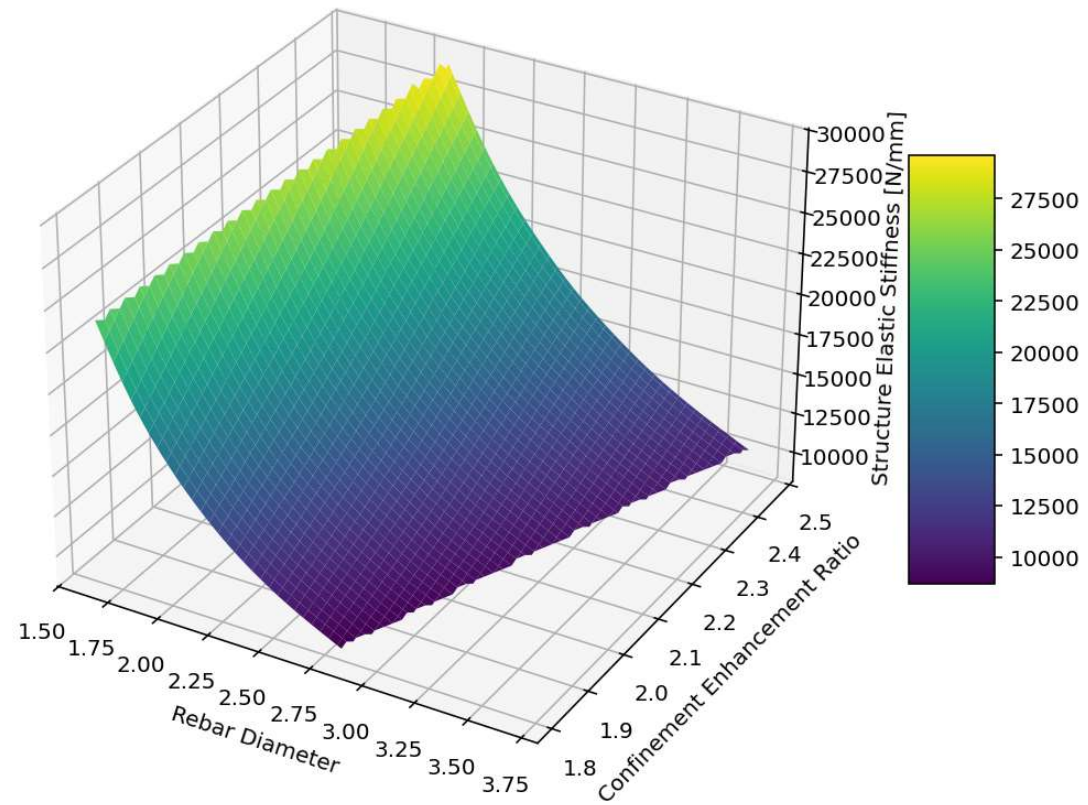
3D Contour Plot of Lateral Stiffness in Y Dir. [N/mm] from Dynamic Analysis



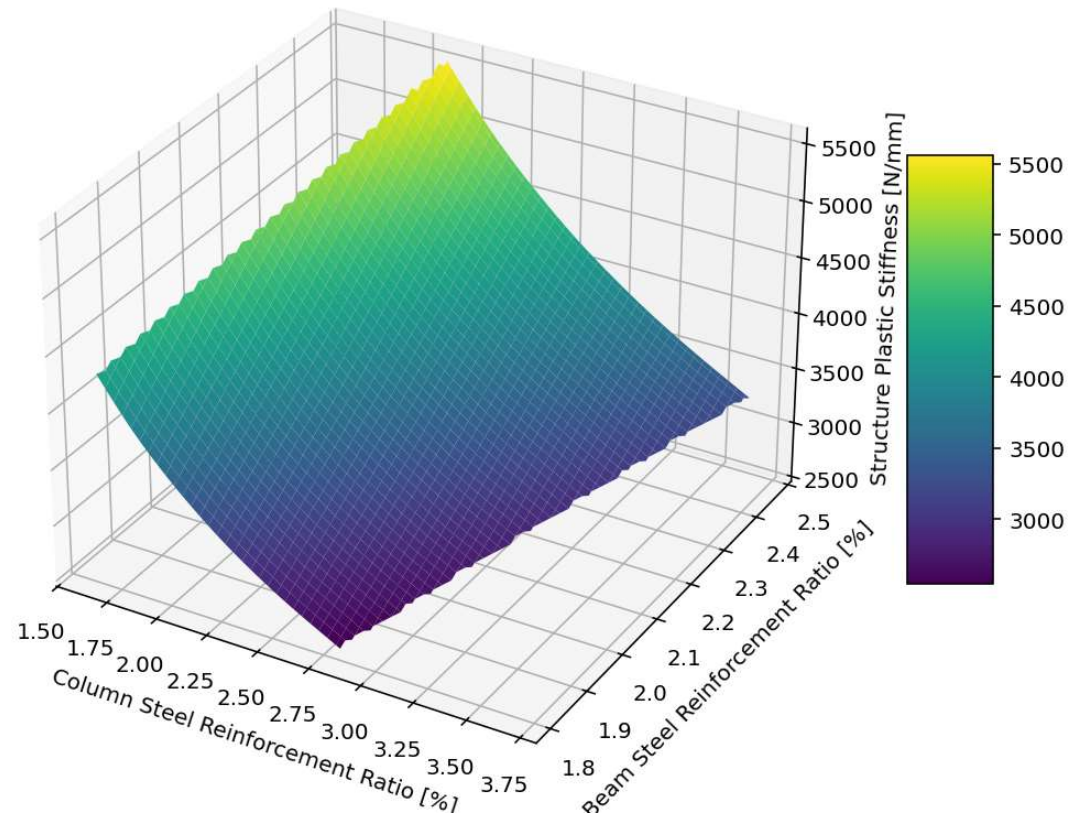
3D Contour Plot of Lateral Stiffness Ratio in Y Dir.



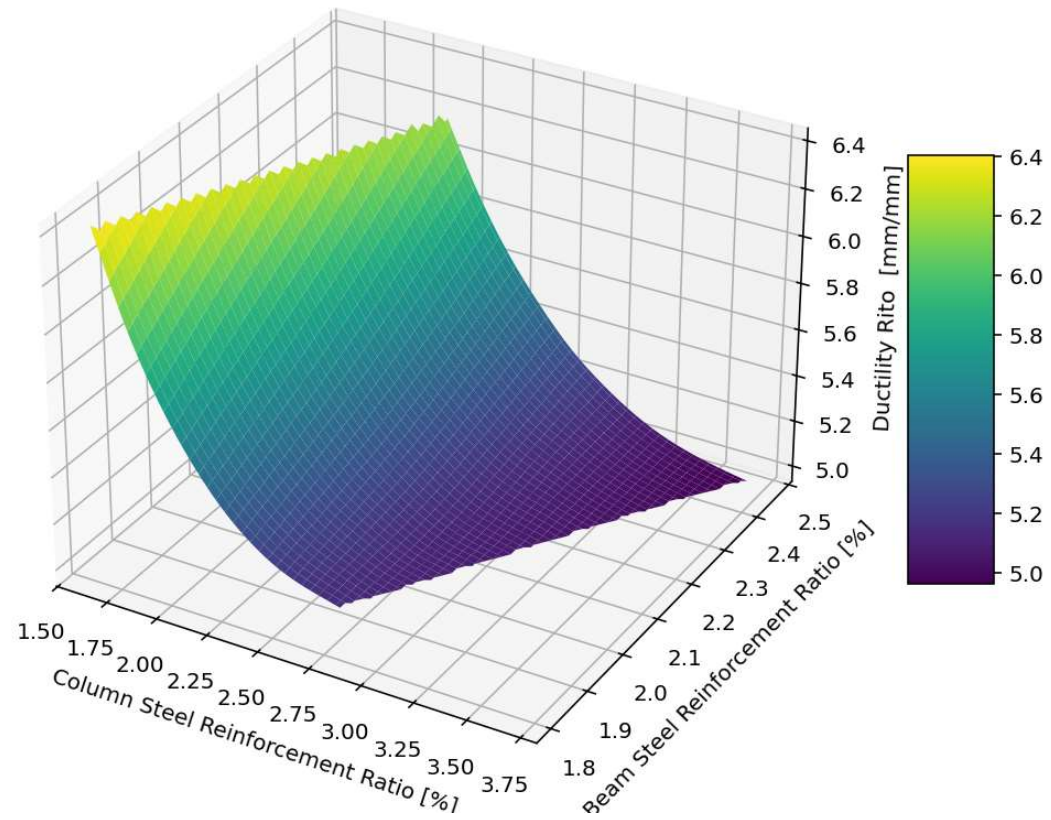
3D Contour Plot of Structure Elastic Stiffness [N/mm]



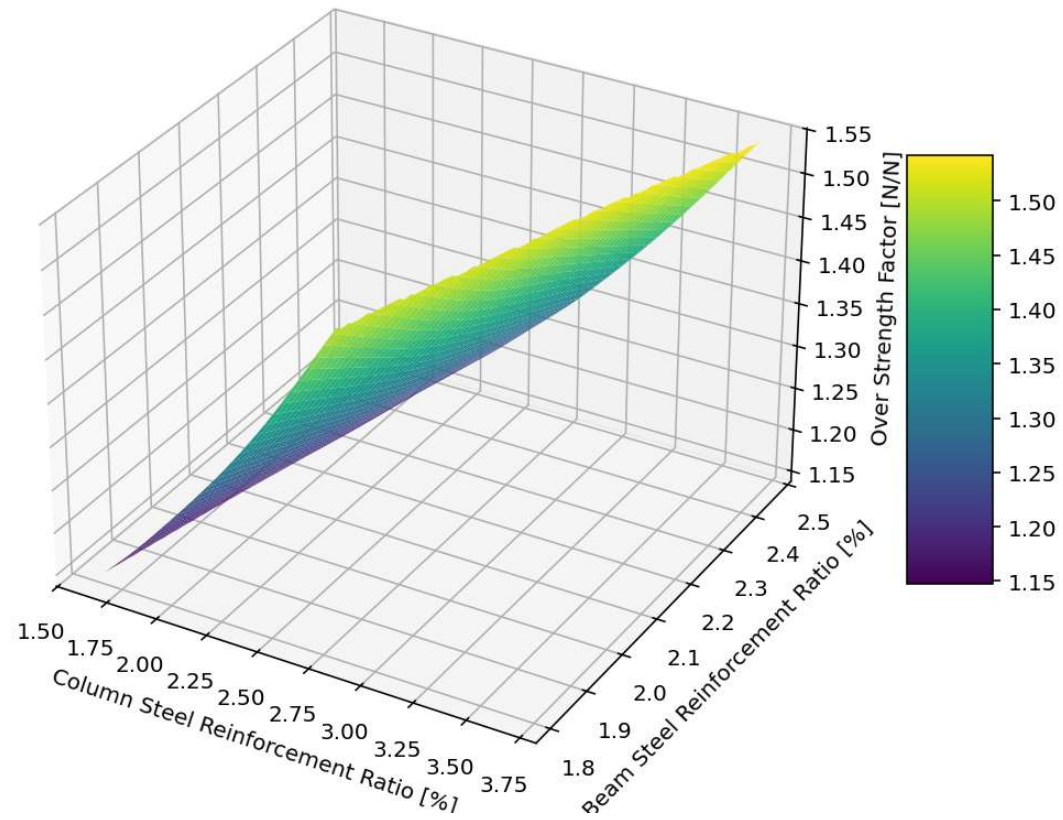
3D Contour Plot of Structure Plastic Stiffness [N/mm]



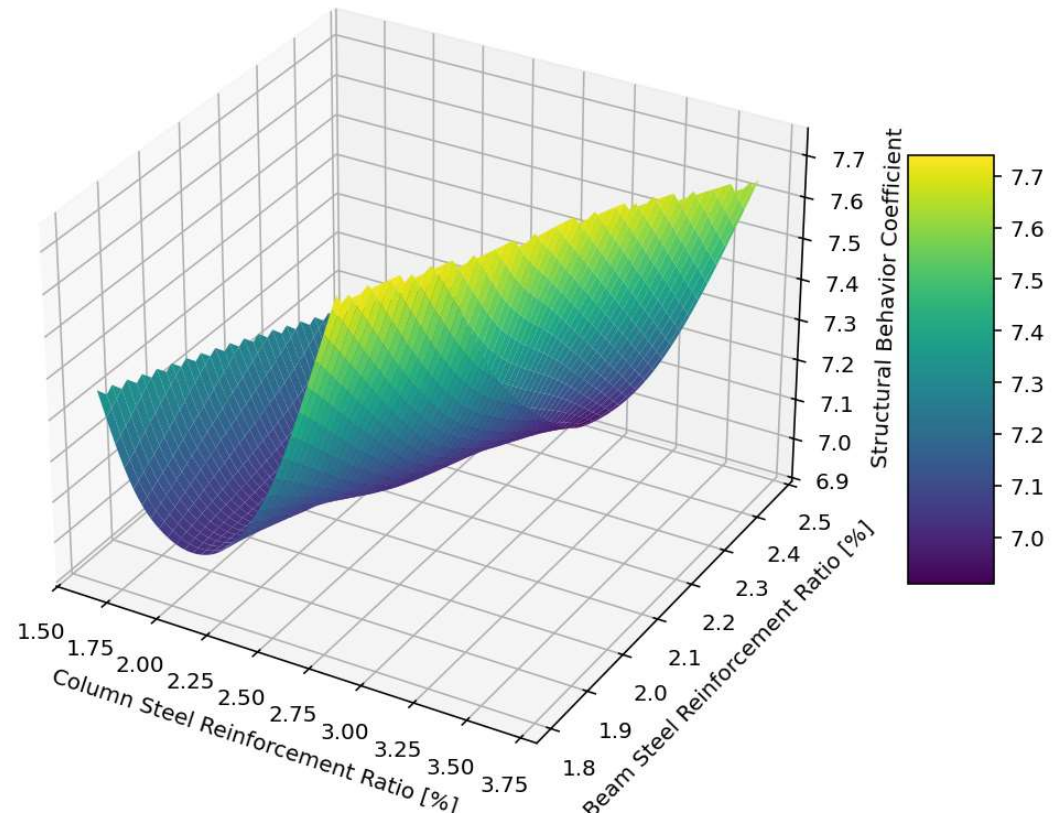
3D Contour Plot of Ductility Rito [mm/mm]



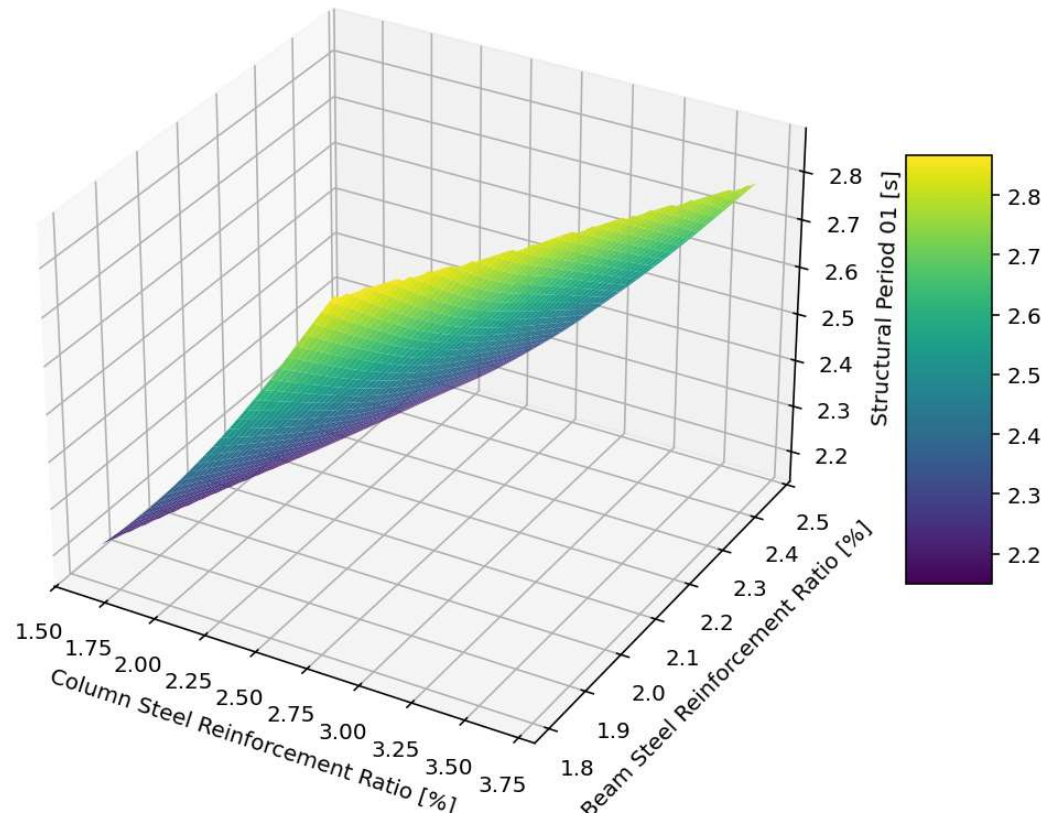
3D Contour Plot of Over Strength Factor [N/N]



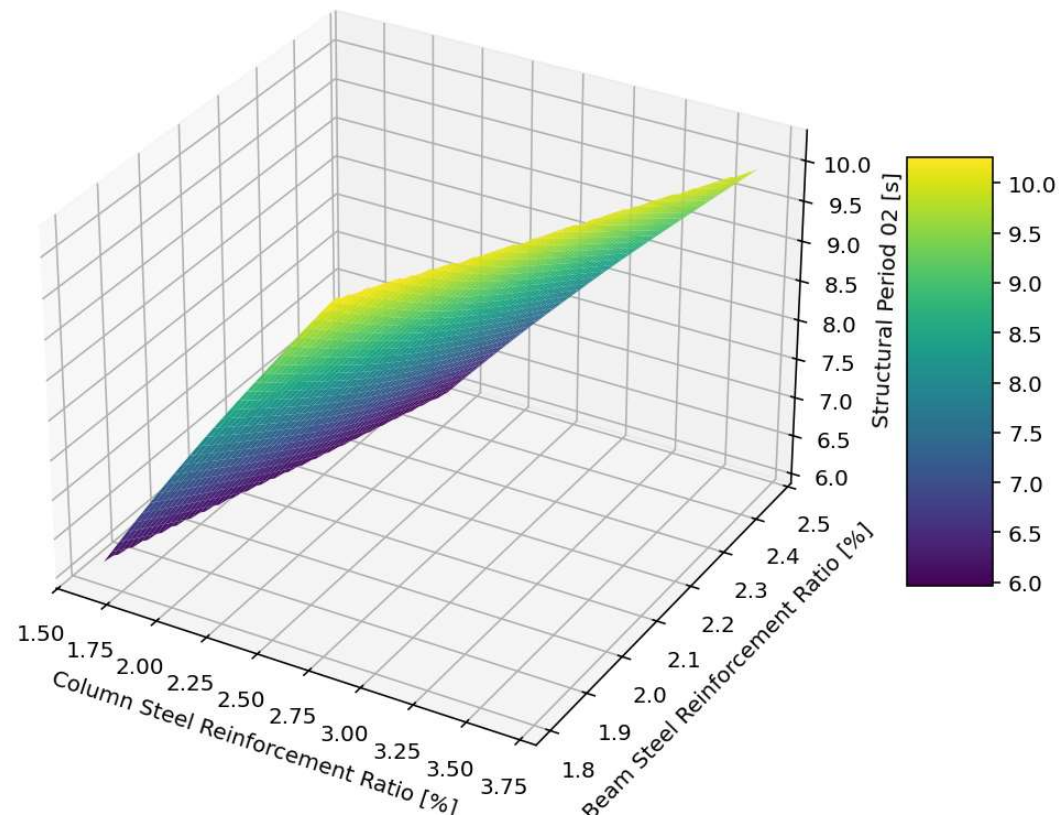
3D Contour Plot of Structural Behavior Coefficient



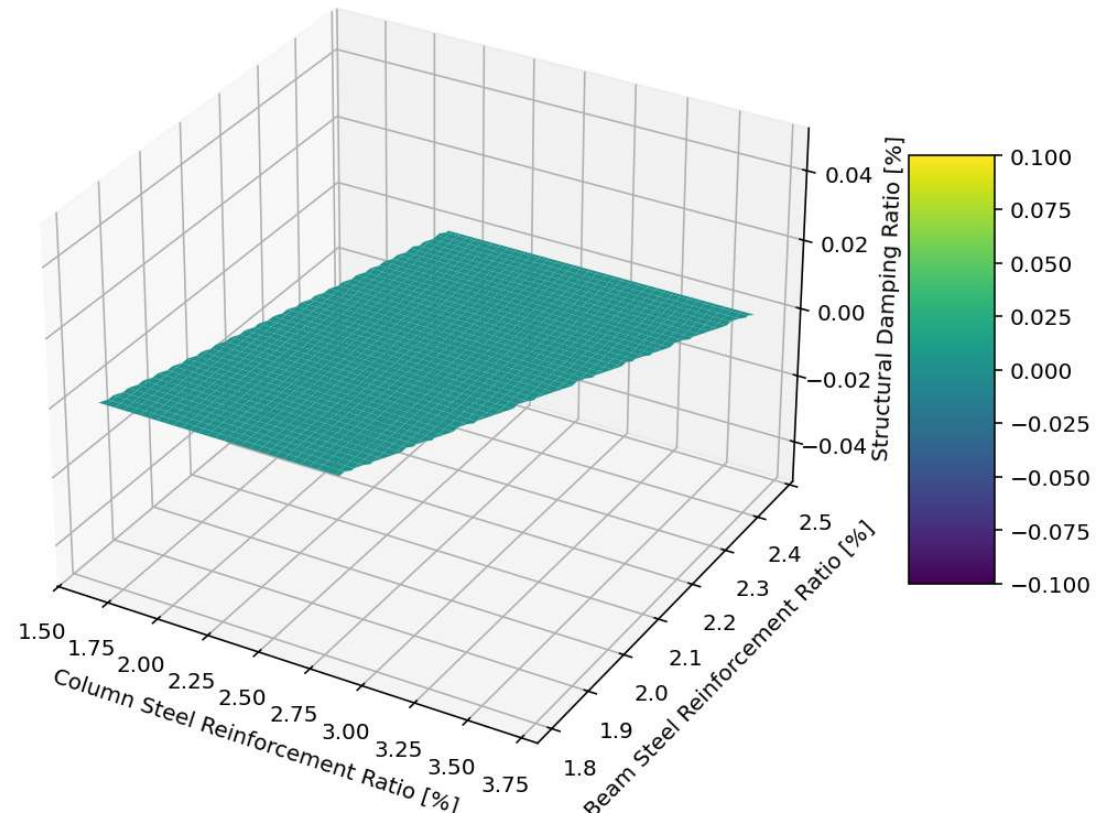
3D Contour Plot of Structural Period 01 [s]



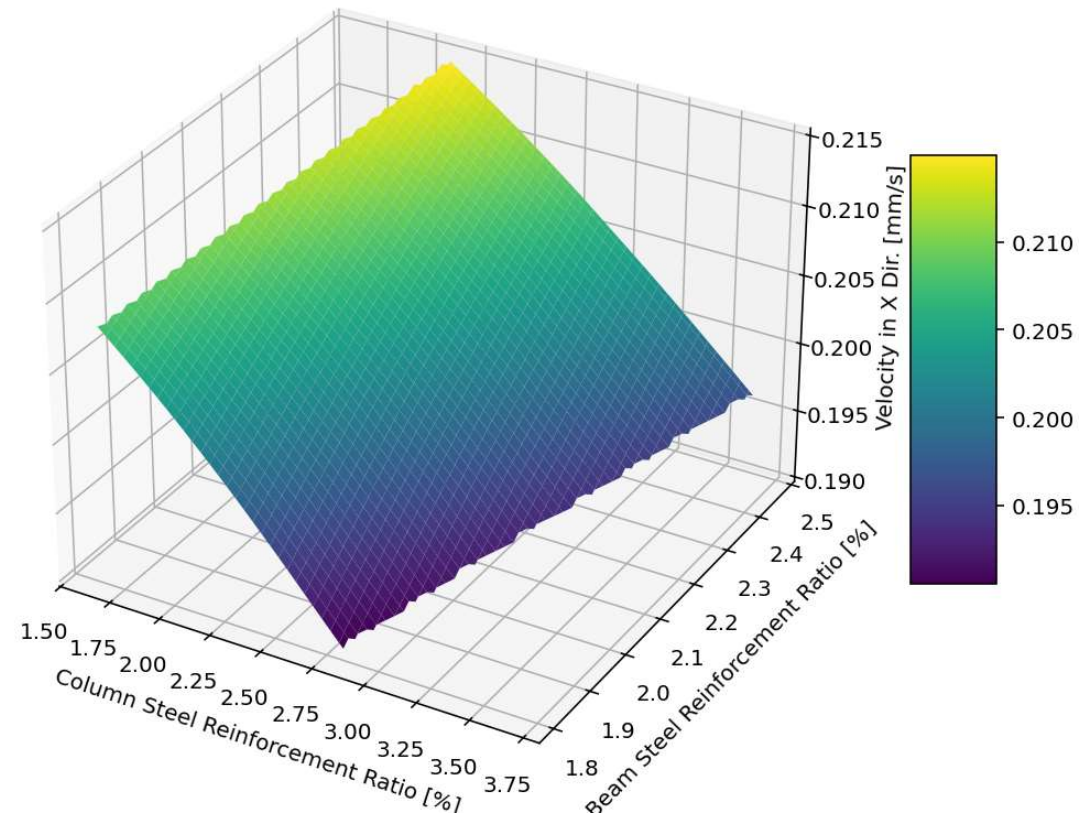
3D Contour Plot of Structural Period 02 [s]



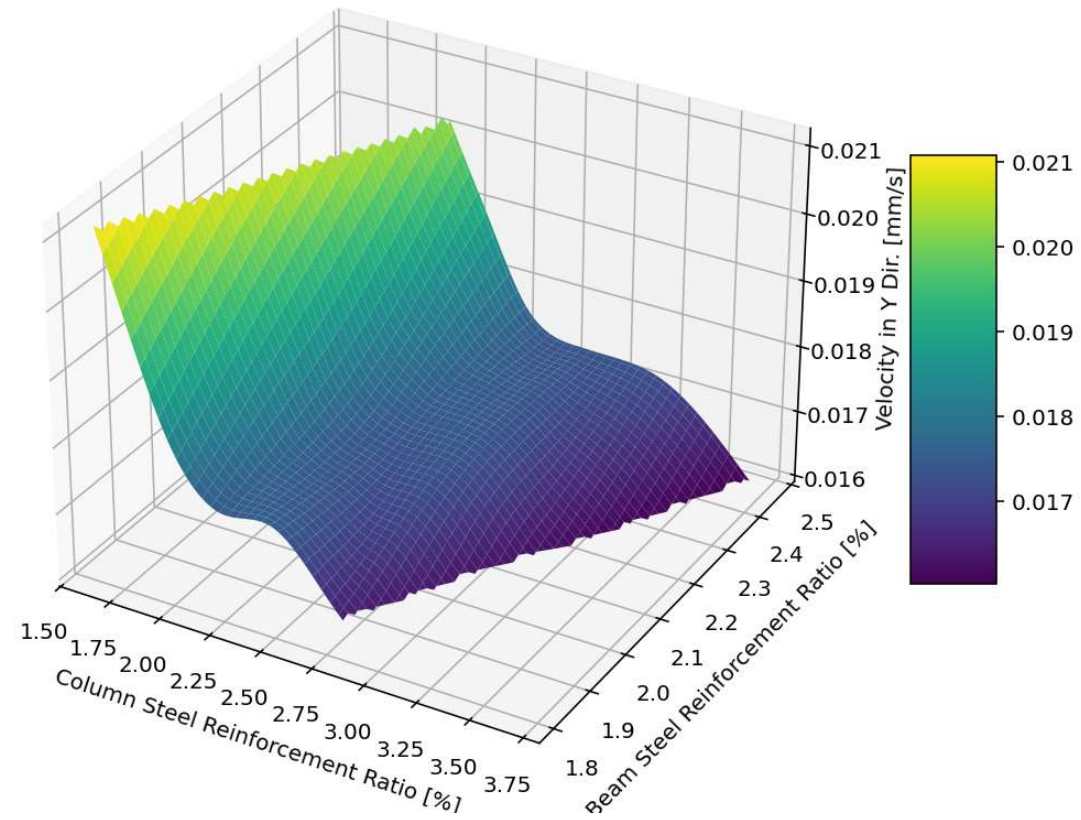
3D Contour Plot of Structural Damping Ratio [%]



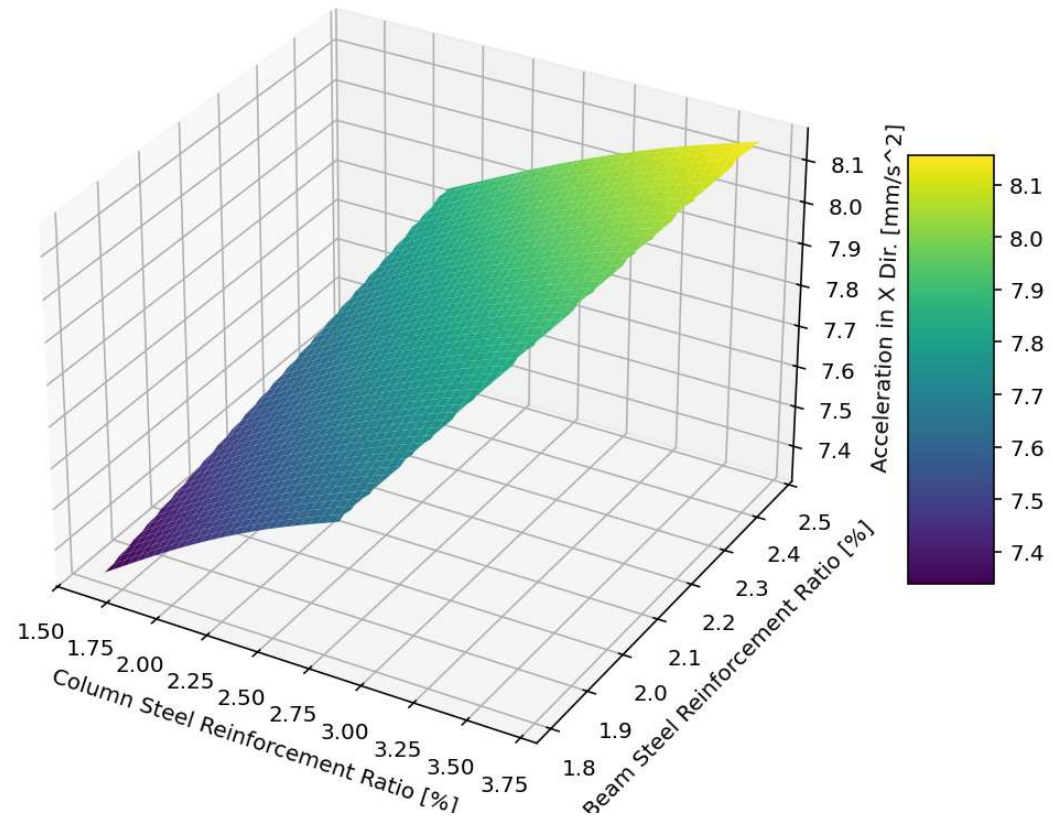
3D Contour Plot of Velocity in X Dir. [mm/s]



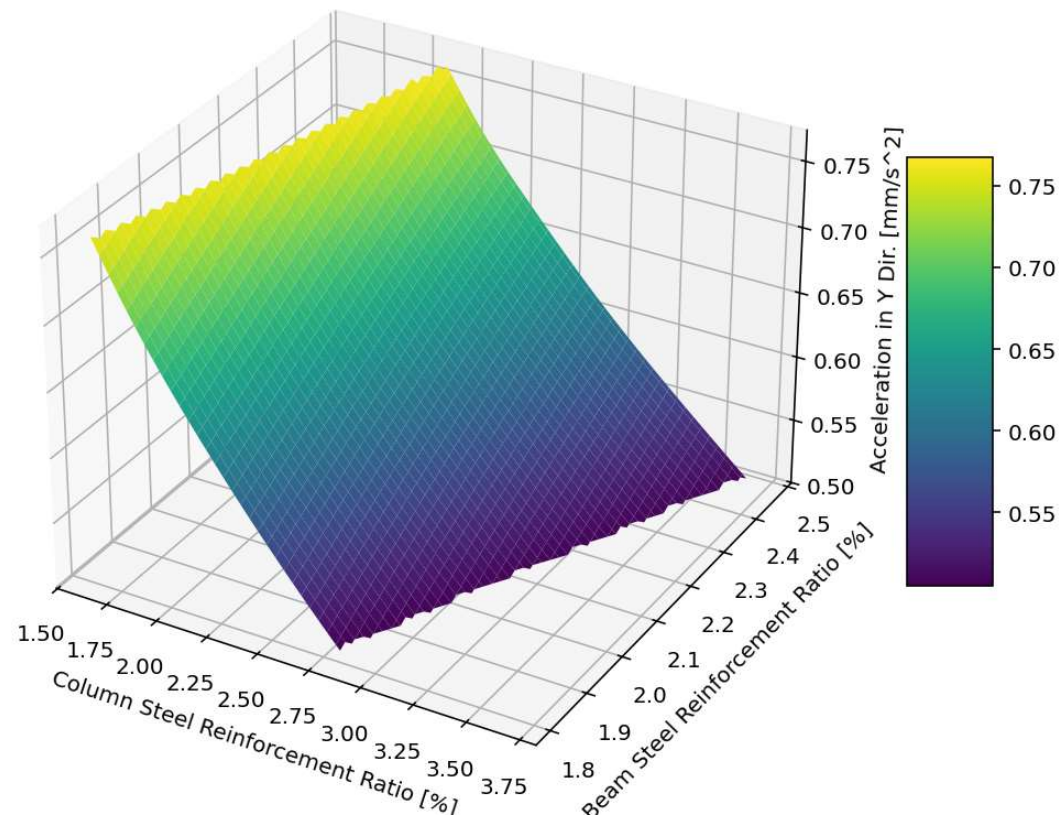
3D Contour Plot of Velocity in Y Dir. [mm/s]



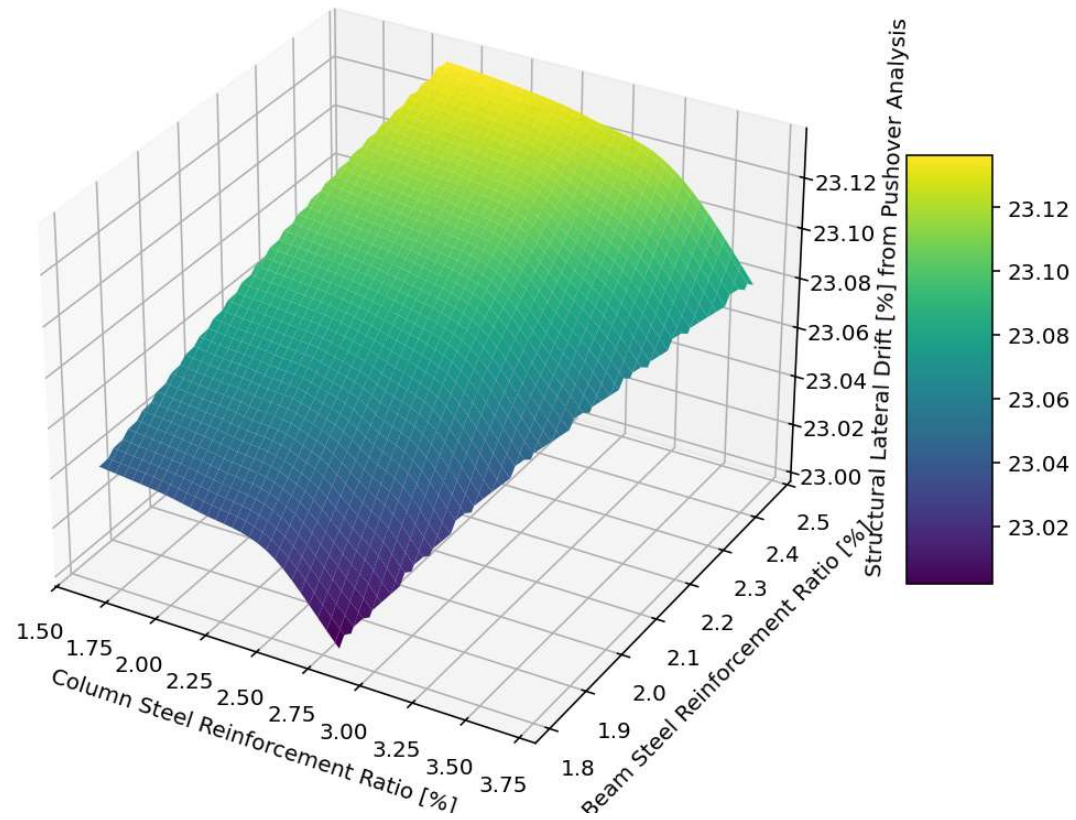
3D Contour Plot of Acceleration in X Dir. [mm/s²]



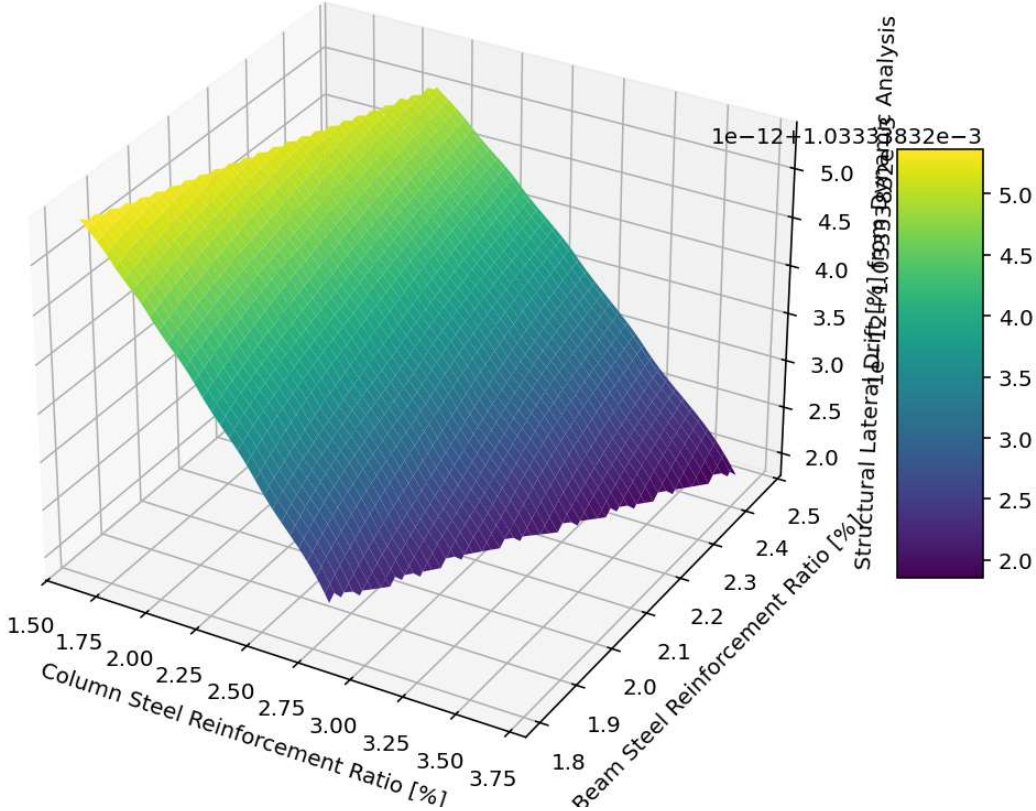
3D Contour Plot of Acceleration in Y Dir. [mm/s²]



3D Contour Plot of Structural Lateral Drift [%] from Pushover Analysis



3D Contour Plot of Structural Lateral Drift [%] from Dynamic Analysis



3D Contour Plot of Structural Lateral Drift [%] Ratio in X Dir.

