ARCOPLAST
14 ft Free Standing Wall

Finite Element Model

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30 December 2013

Wall Model

- Three 4’ x 14’ wall panels
- 3/4” total panel thickness
- Chopped strand mat in MODAR resin
- Steel purloins 6” high with 1.5” flanges, 0.1” thick 16” centers, back to back at panel seams (48”)

Material Properties

- Chopped Strand Mat
  - Elastic Modulus $E_x = E_y = 1x10^6$ psi
  - Strength $\sigma_x = \sigma_y = 1x10^4$ psi
  - Strain to Failure = $\varepsilon = 0.01$ or 1%
- Steel $E_x = E_y = 3x10^7$ psi
  - Elastic Modulus $E_x = E_y = 3x10^7$ psi
  - Yield Strength $\sigma_x = \sigma_y = 5.3\ x10^4$ psi
  - Strain to Failure = $\varepsilon = 0.0017$ or 0.17%

Wall Model Constraints

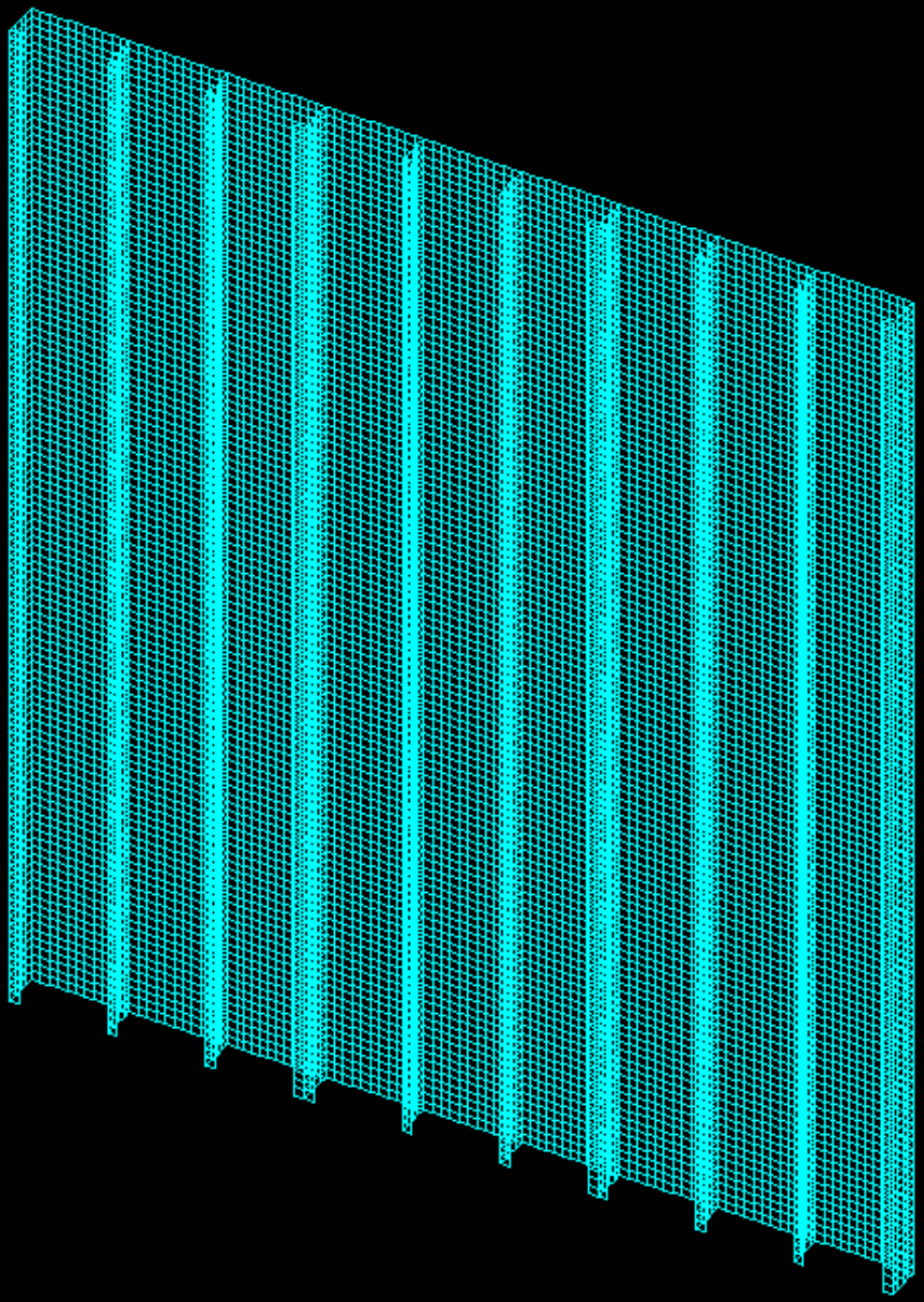
- Z displacement constrained to zero at top and bottom ends
- Y displacement constrained to zero at bottom end
- X displacement constrained to zero at one vertical edge

Load Cases

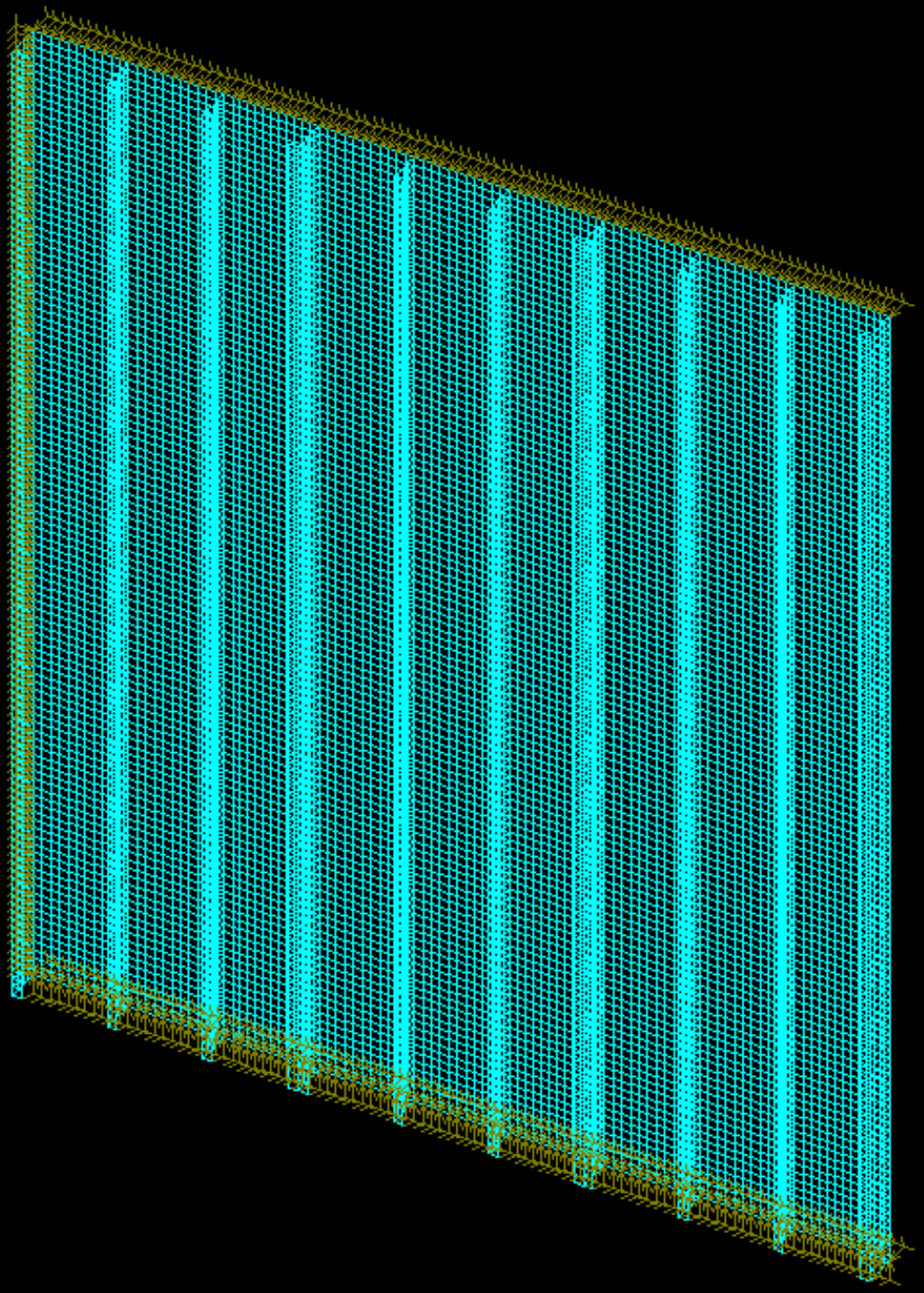
- Pressure load of 0.287 psi on panels for all load cases

- 2000 lb point load on frame 2 ft above floor (A)
- 2000 lb point load on frame 4 ft above floor (B)
- 2000 lb point load on frame 6 ft above floor (C)

- 2000 lb point load at panel middle 2 ft above floor (D)
- 2000 lb point load at panel middle 4 ft above floor (E)
- 2000 lb point load at panel middle 6 ft above floor (F)



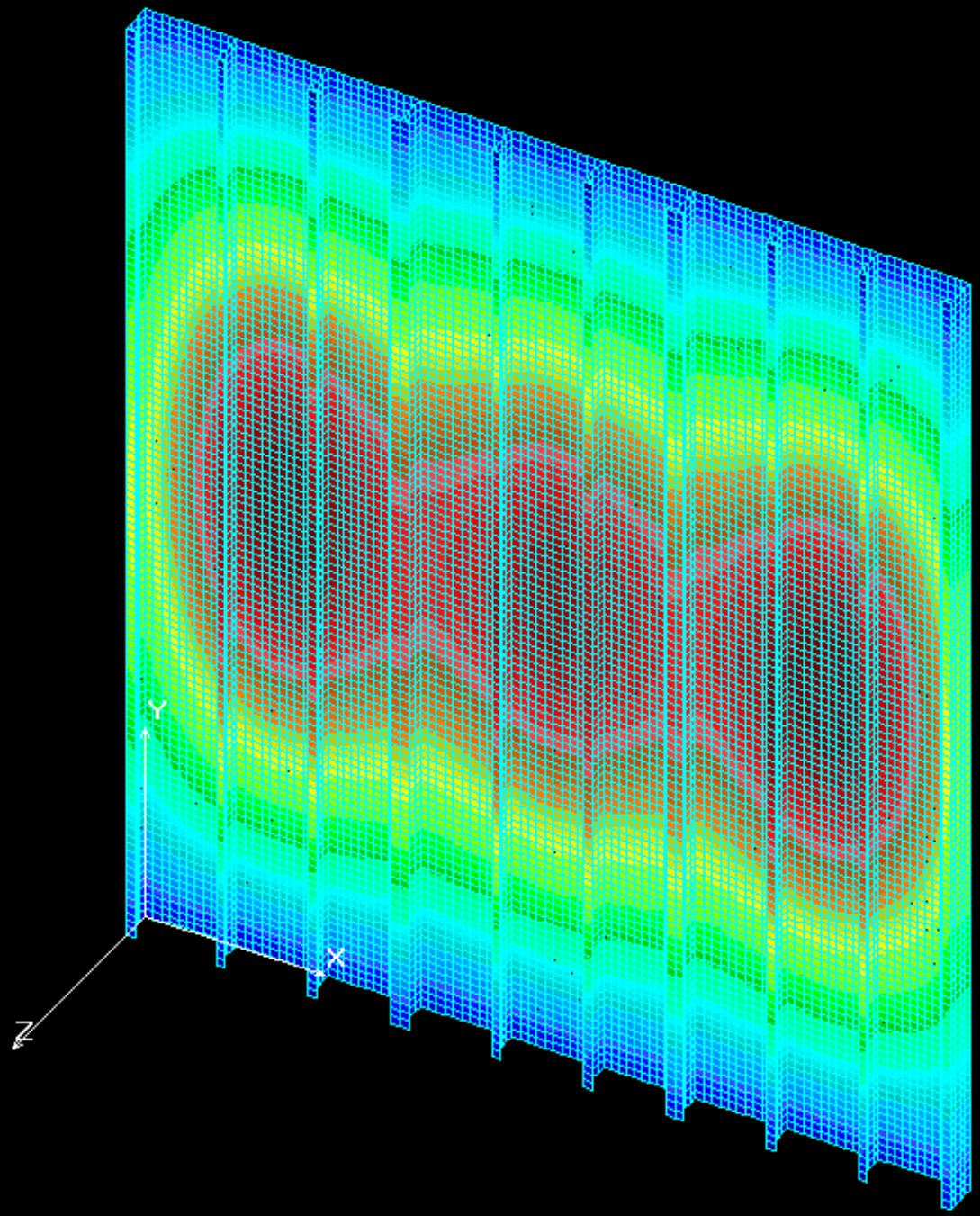
Finite Element Grid

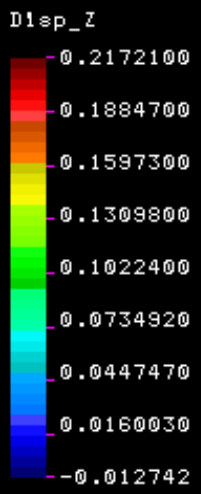


Constraints

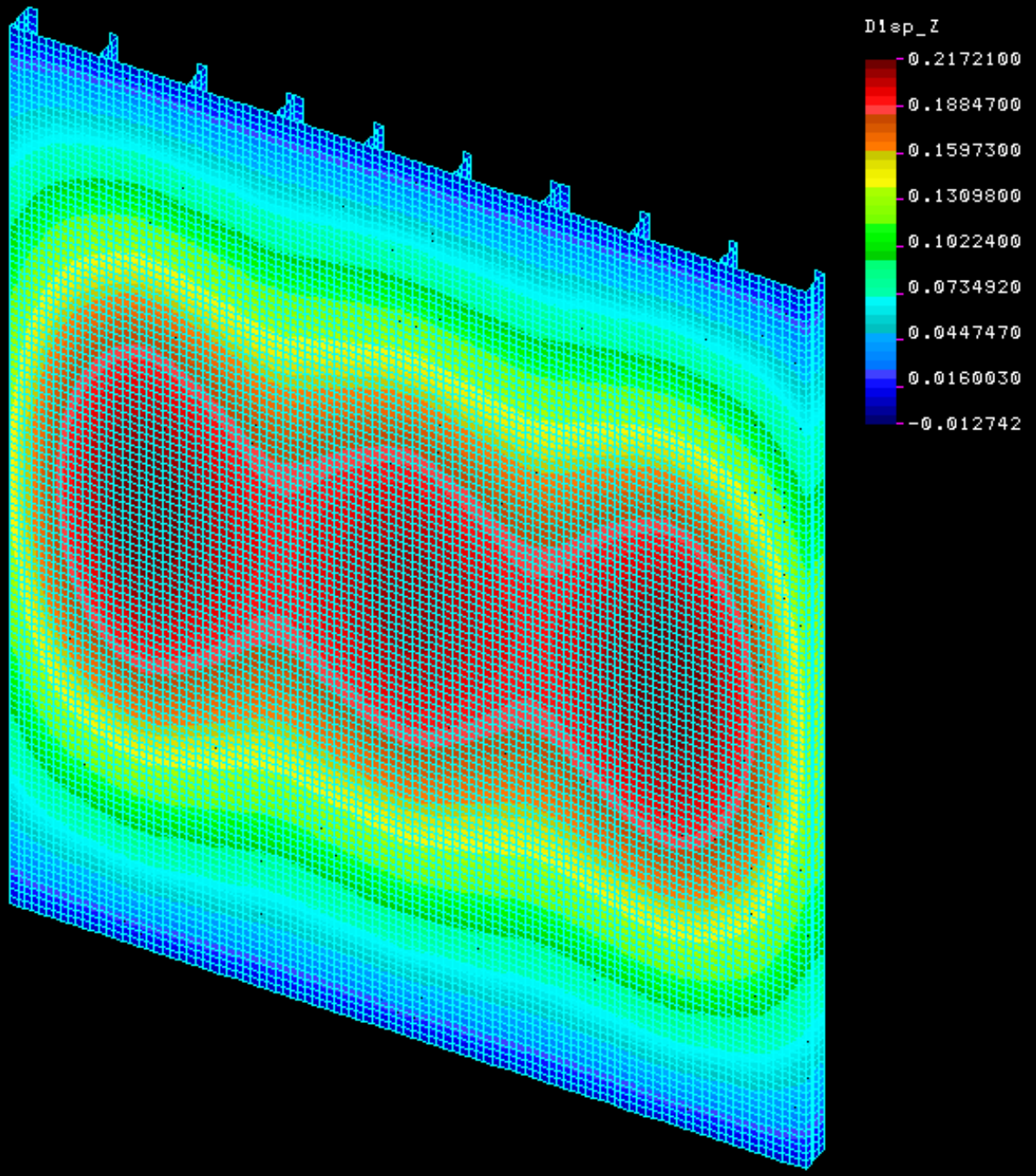
Pressure Load Only

- 0.287 psi on wall panels

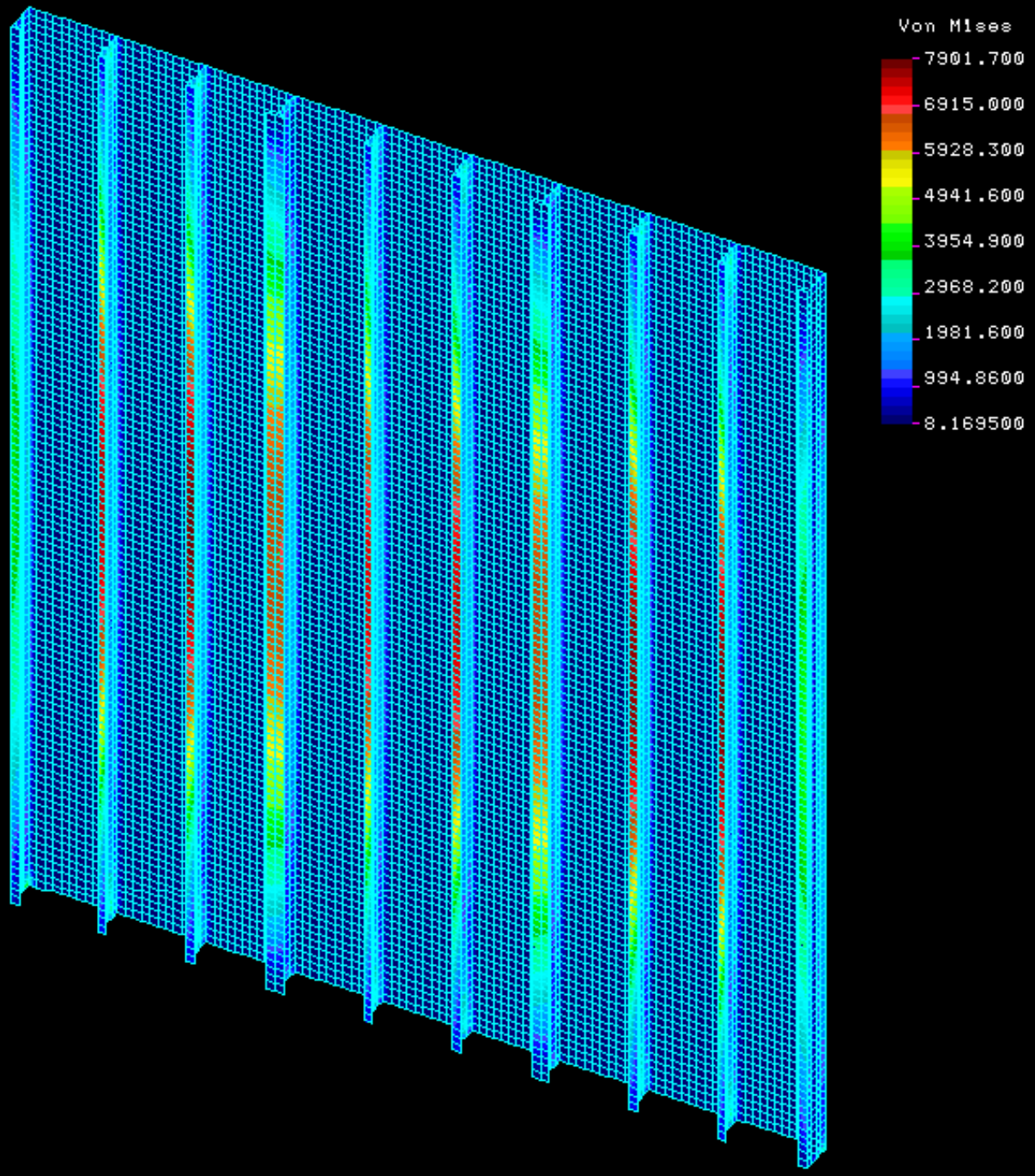




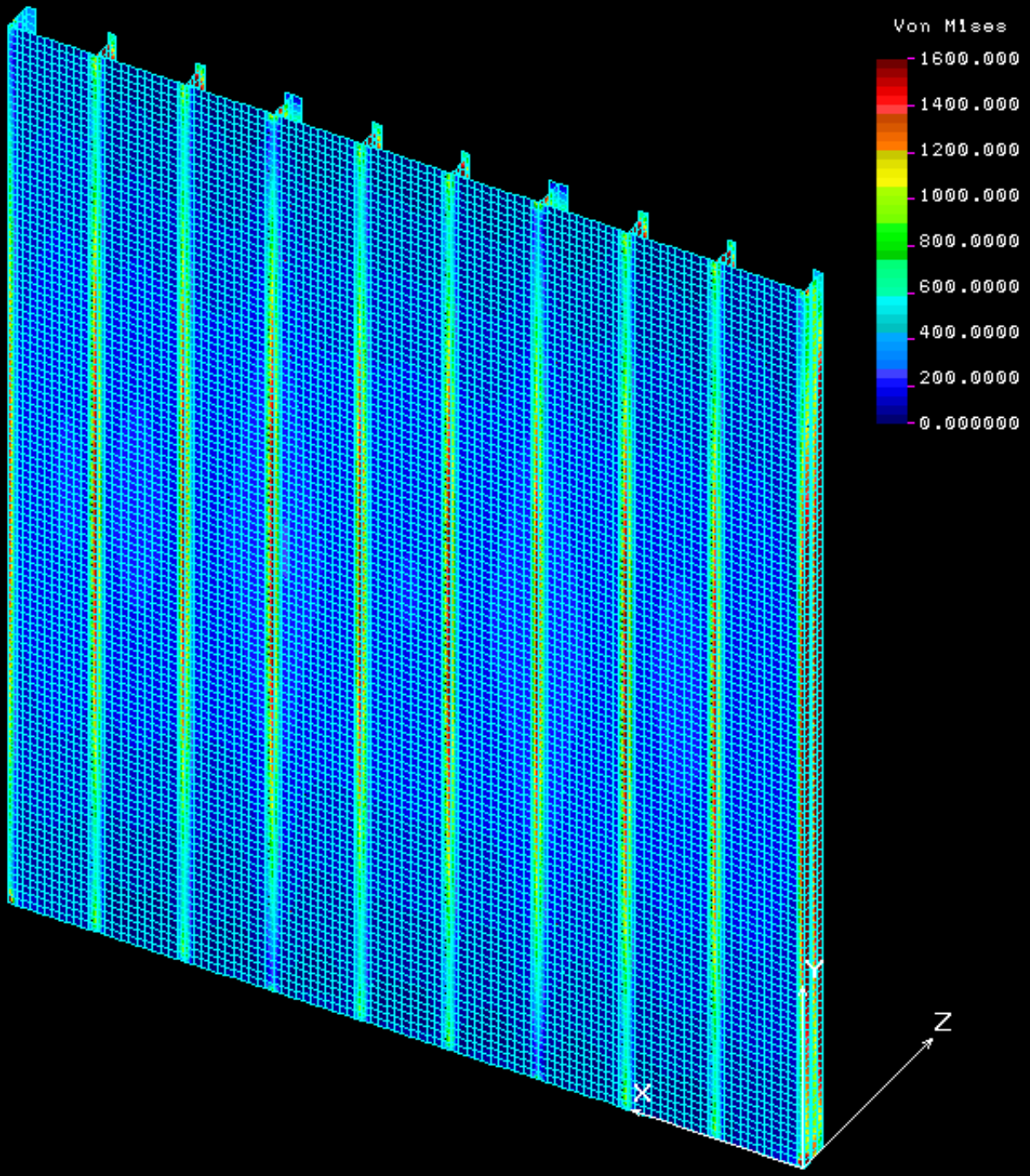
Pressure Load Only Z Deflection (in)



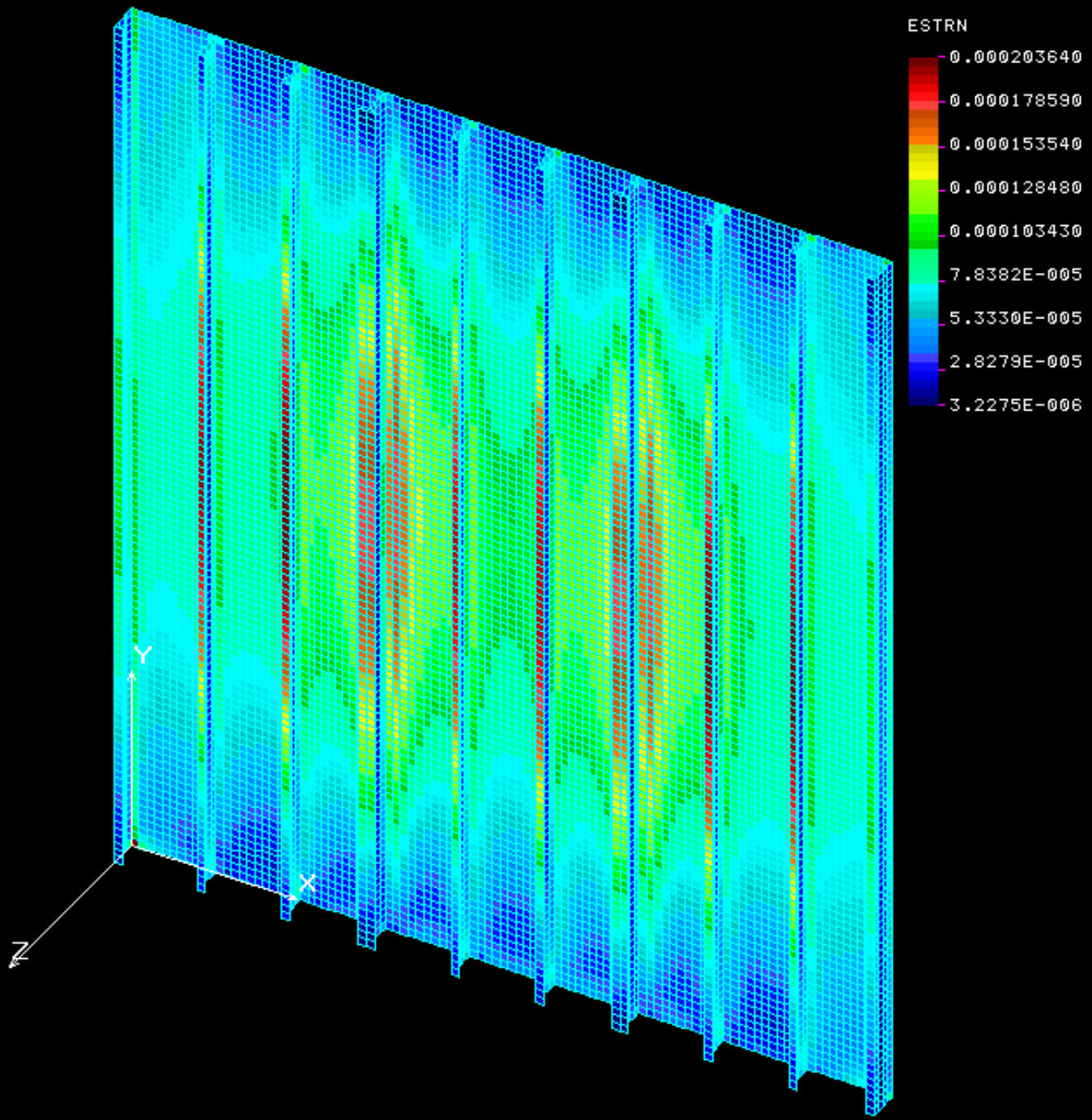
Pressure Load Only Z Deflection (in)



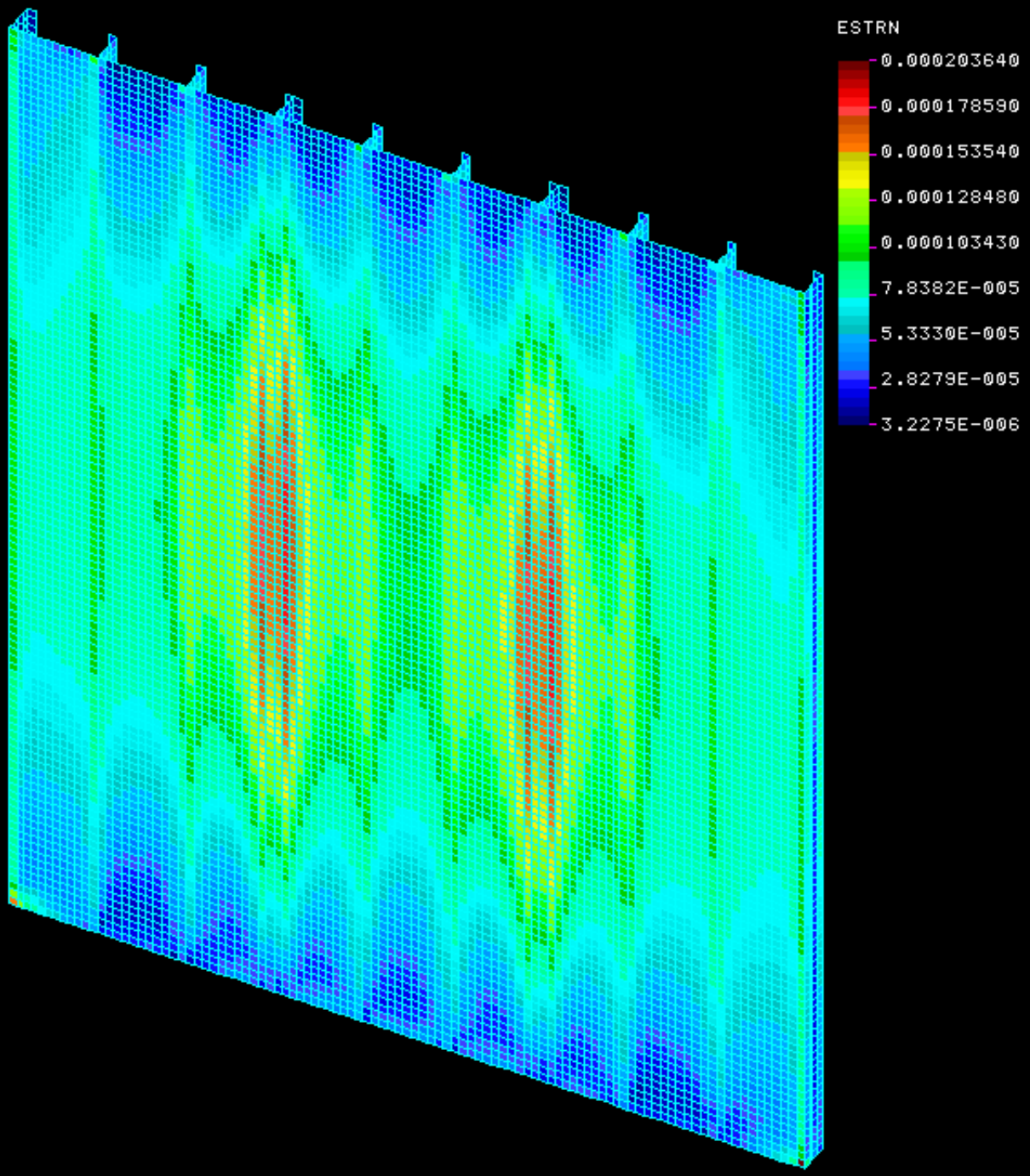
Pressure Load Only Frame Stress (psi)



Pressure Load Only Panel Stress (psi)



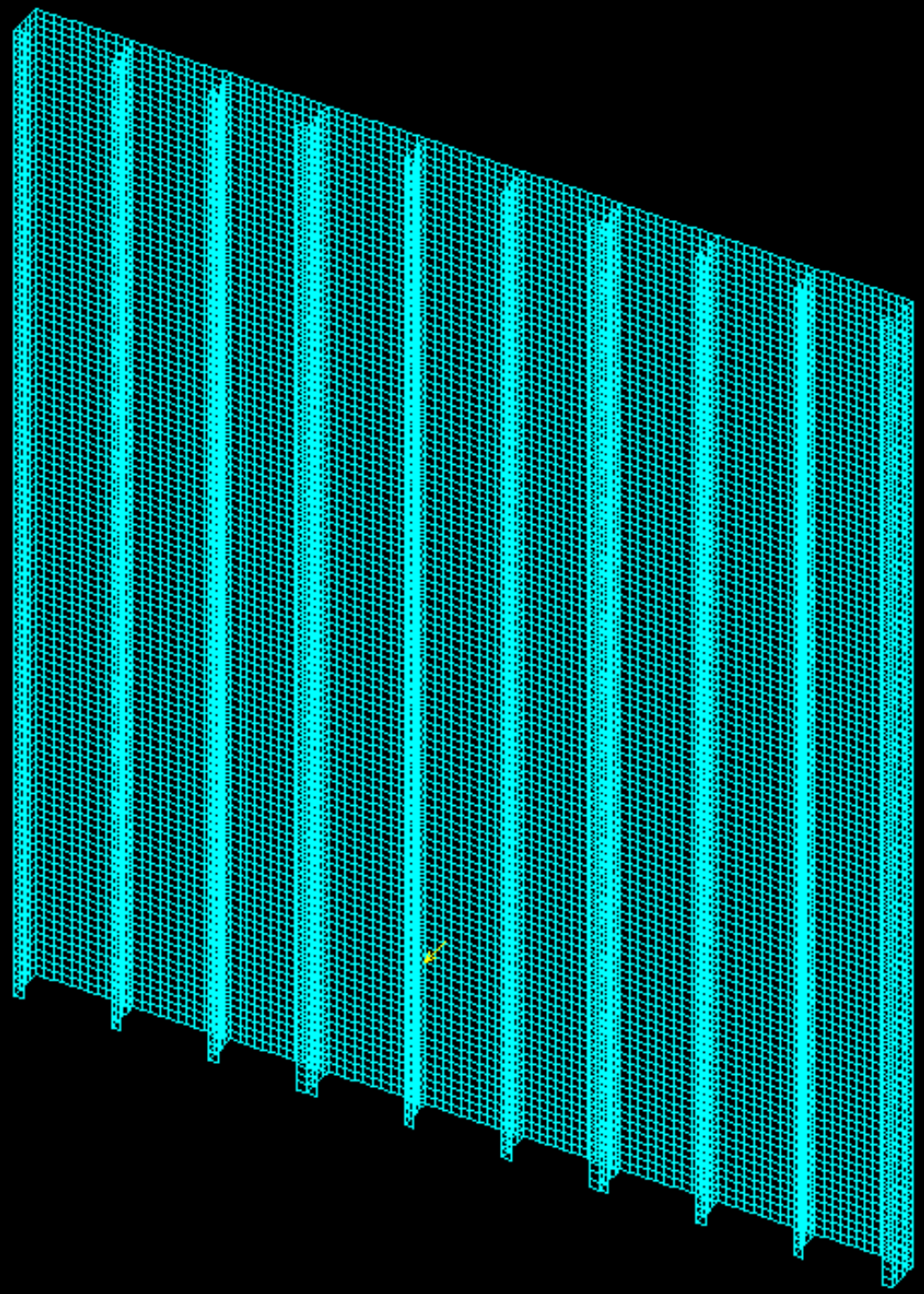
Pressure Load Only Frame Strain



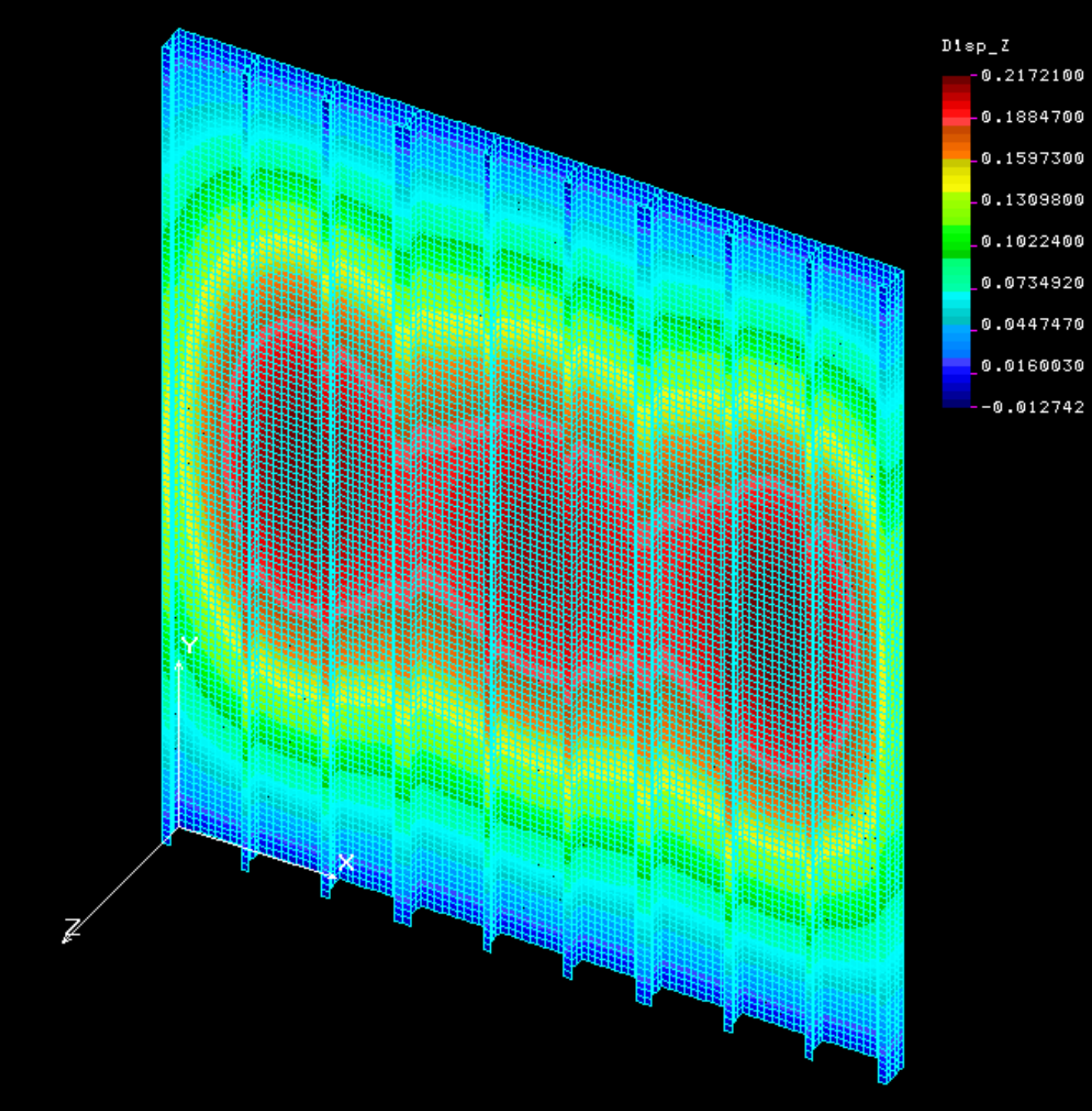
Pressure Load Only Panel Strain

Loading “A”

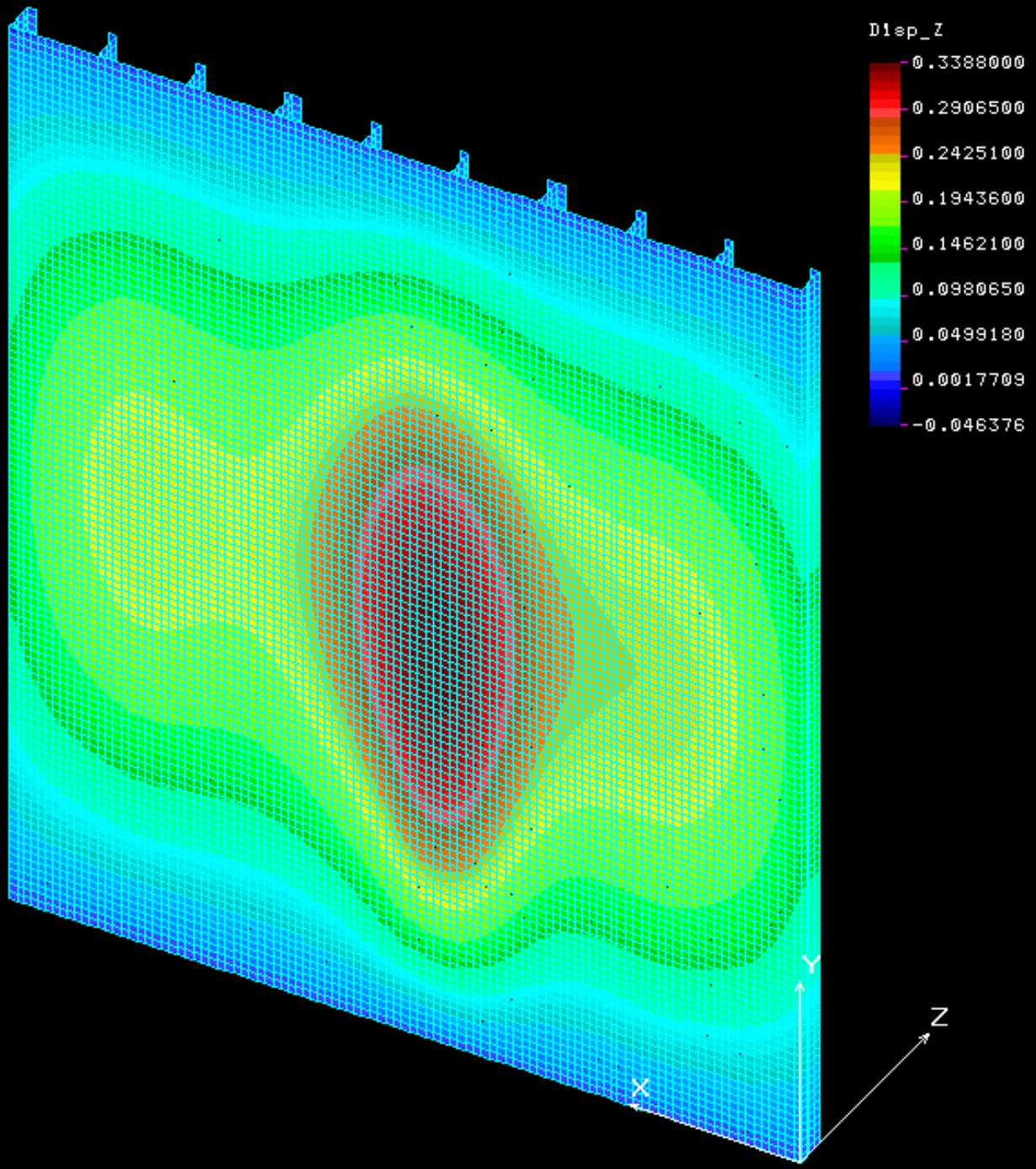
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 2 ft above floor



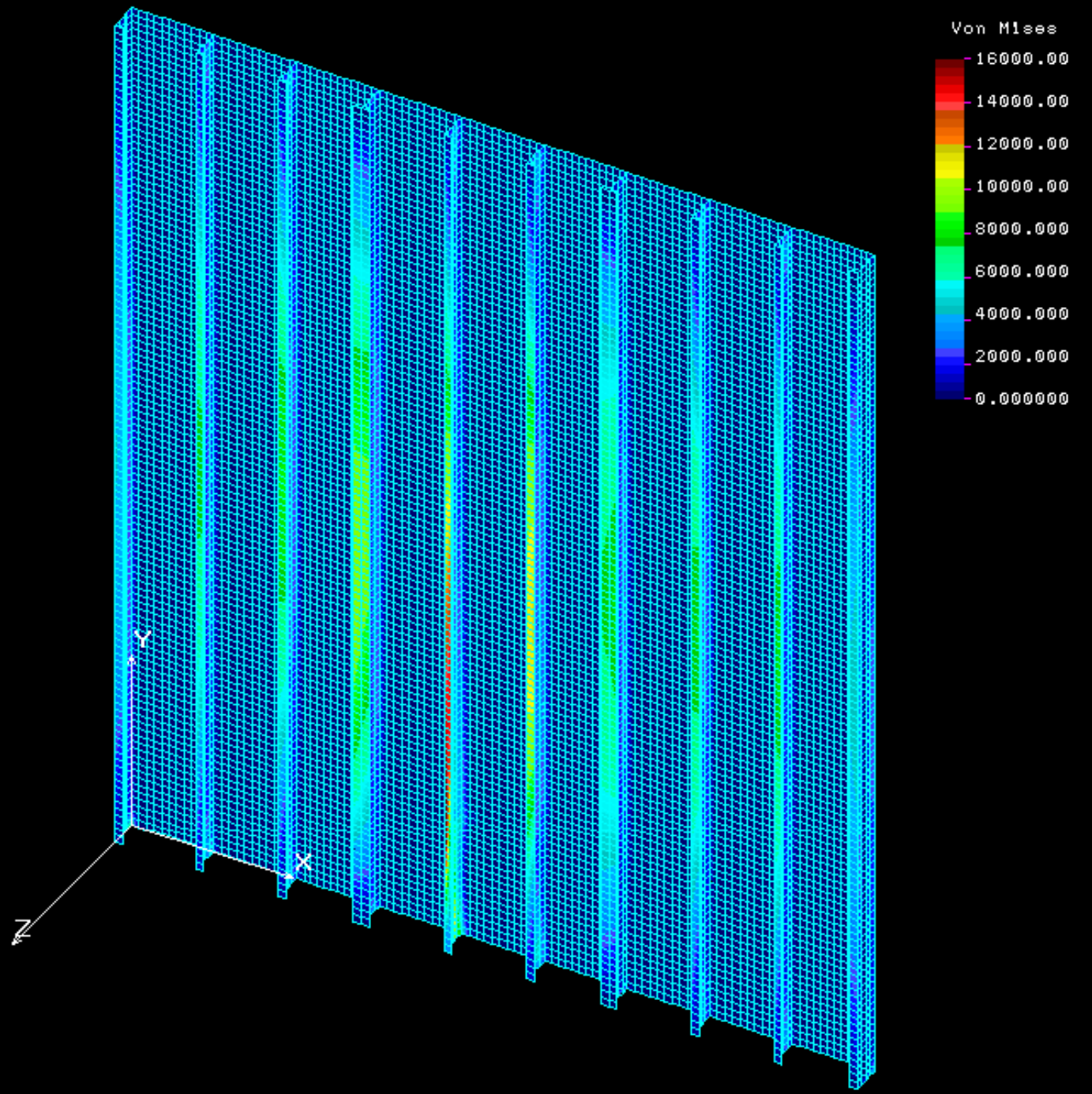
2000 lb point
force on frame
2 ft above floor



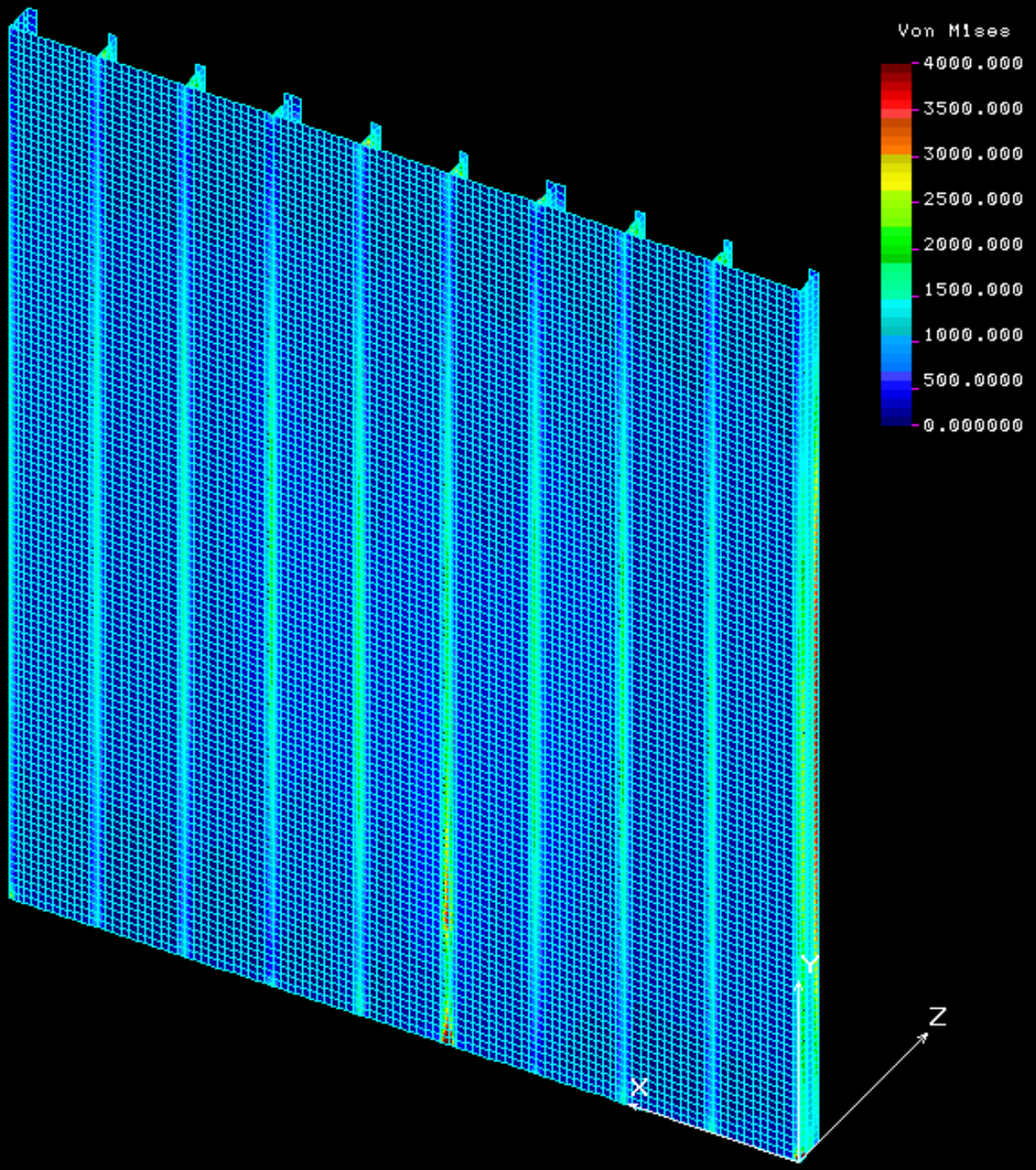
Load “A” Frame Side Z Deflection (in)



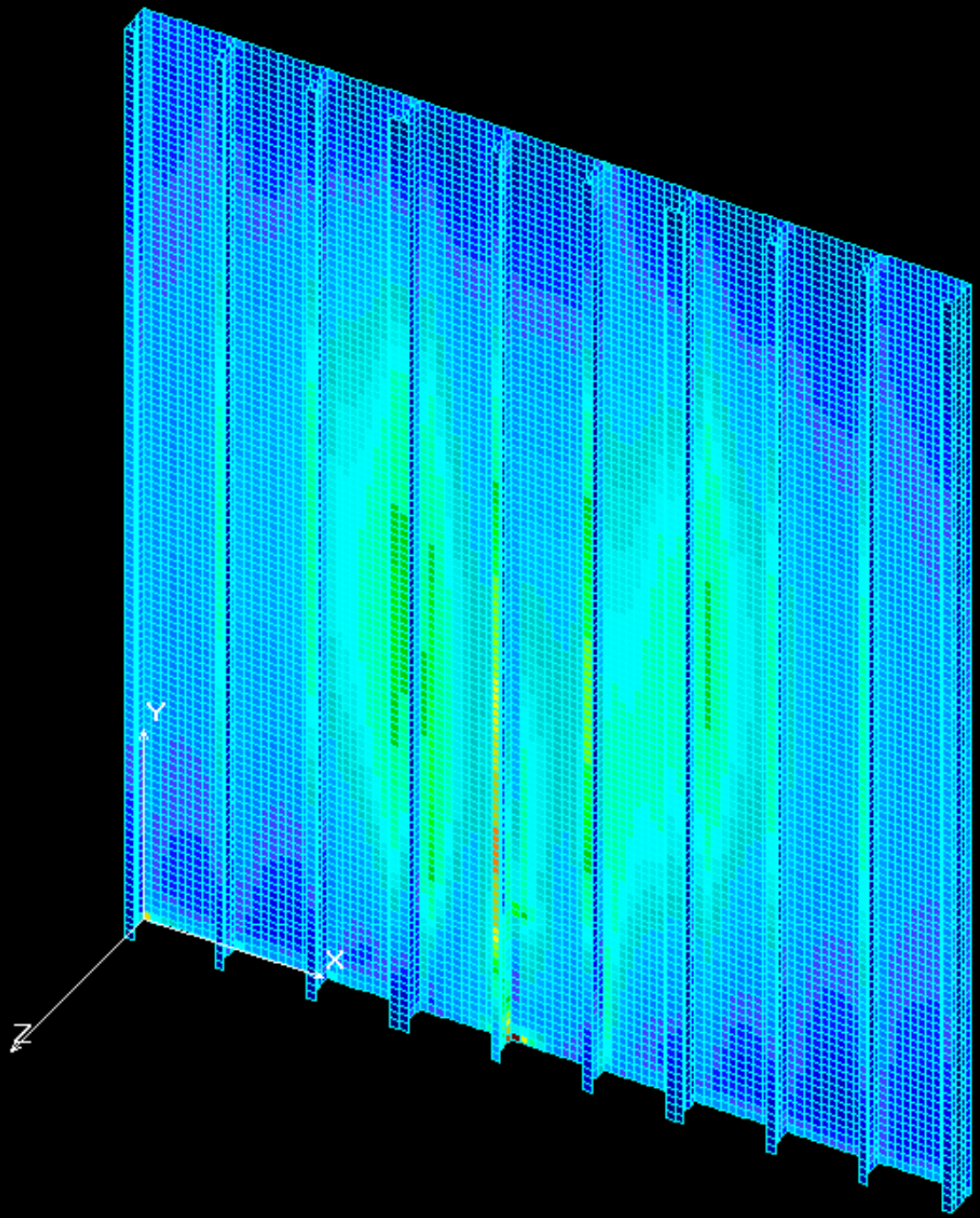
Load “A” Front Face Z Deflection (in)



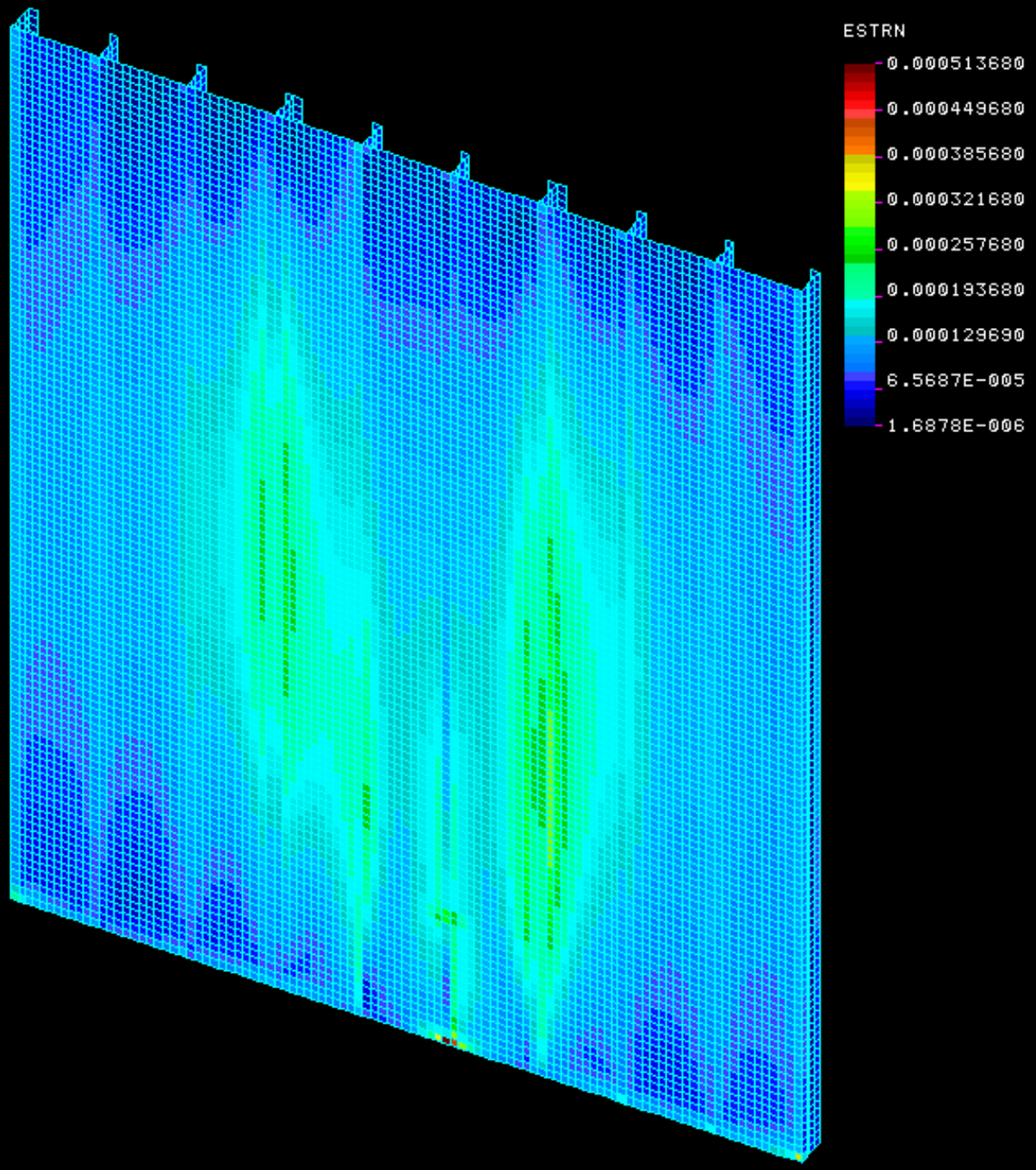
Load “A” Frame Stress (psi)



Load “A” Panel Stress (psi)



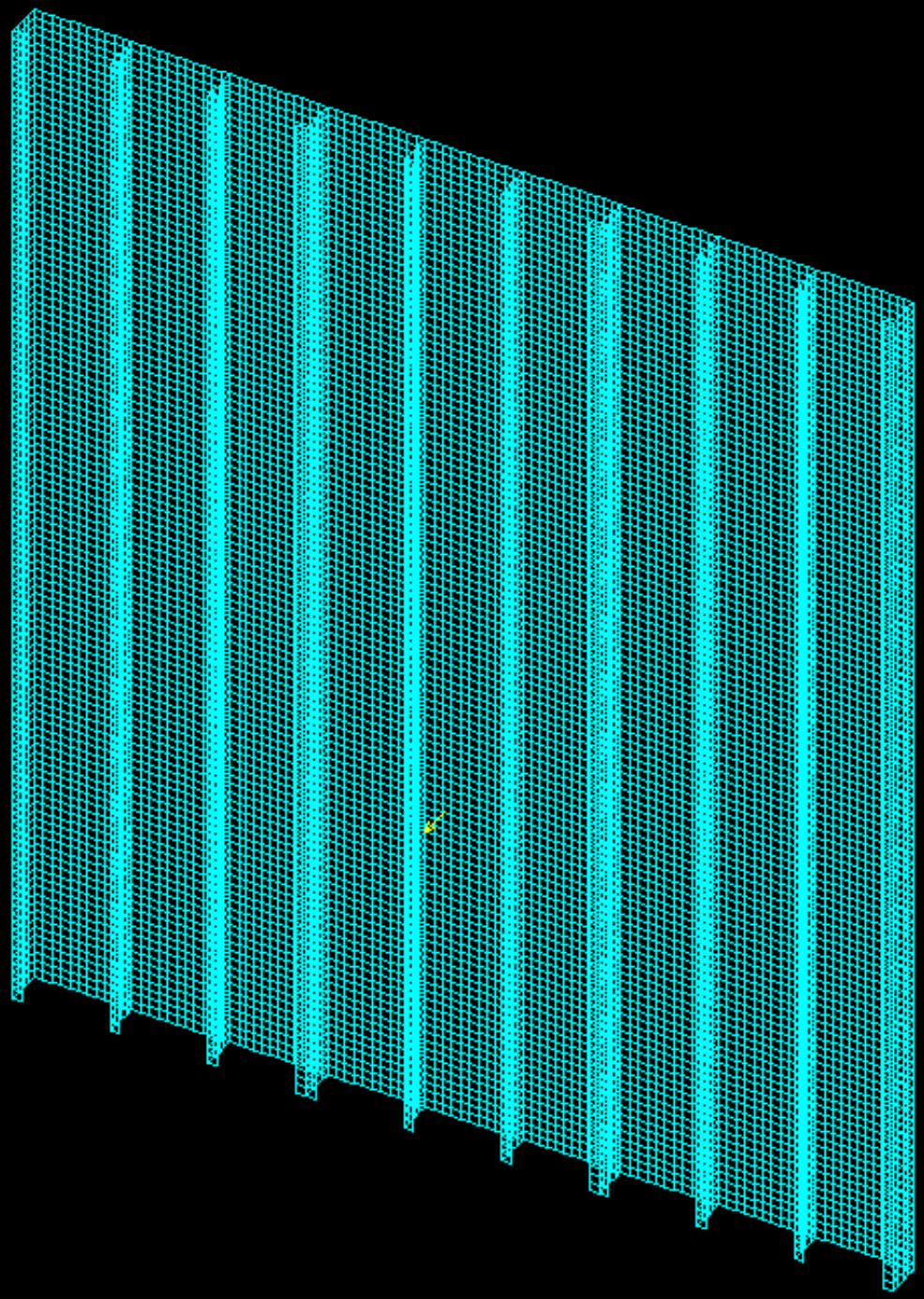
Load “A” Frame Strain



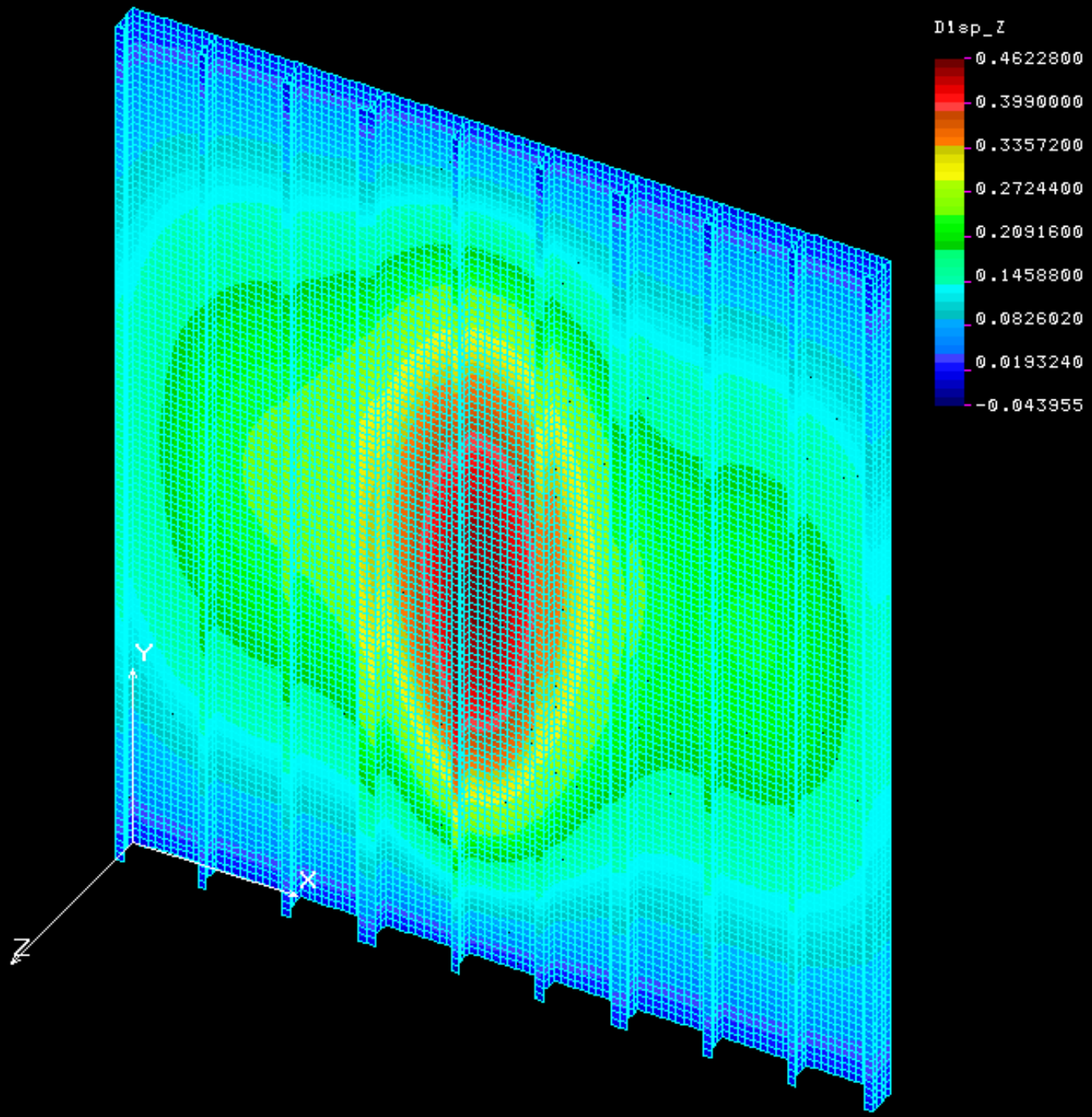
Load “A” Panel Strain

Loading “B”

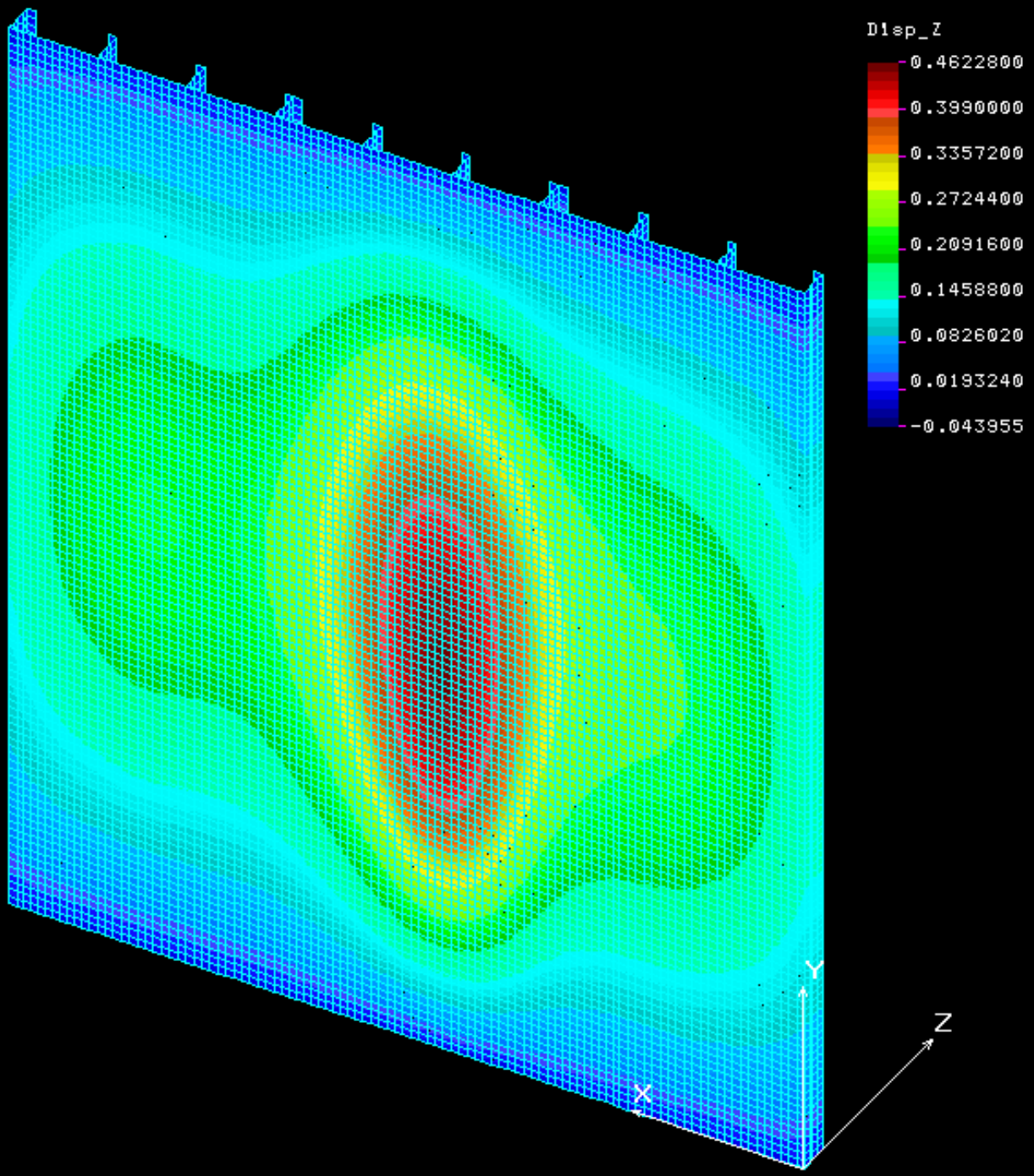
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 4 ft above floor



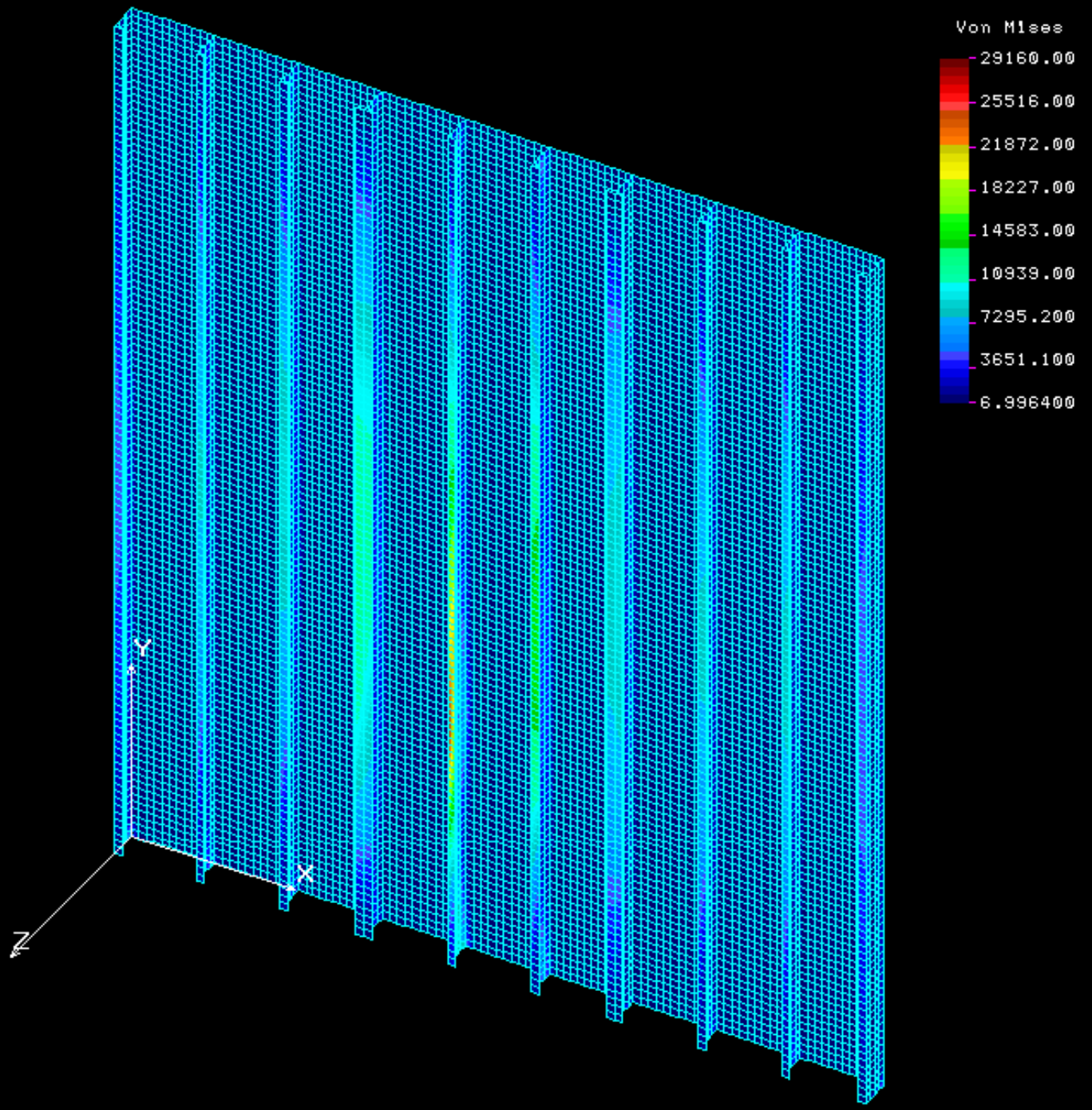
2000 lb point
force on frame
4 ft above floor



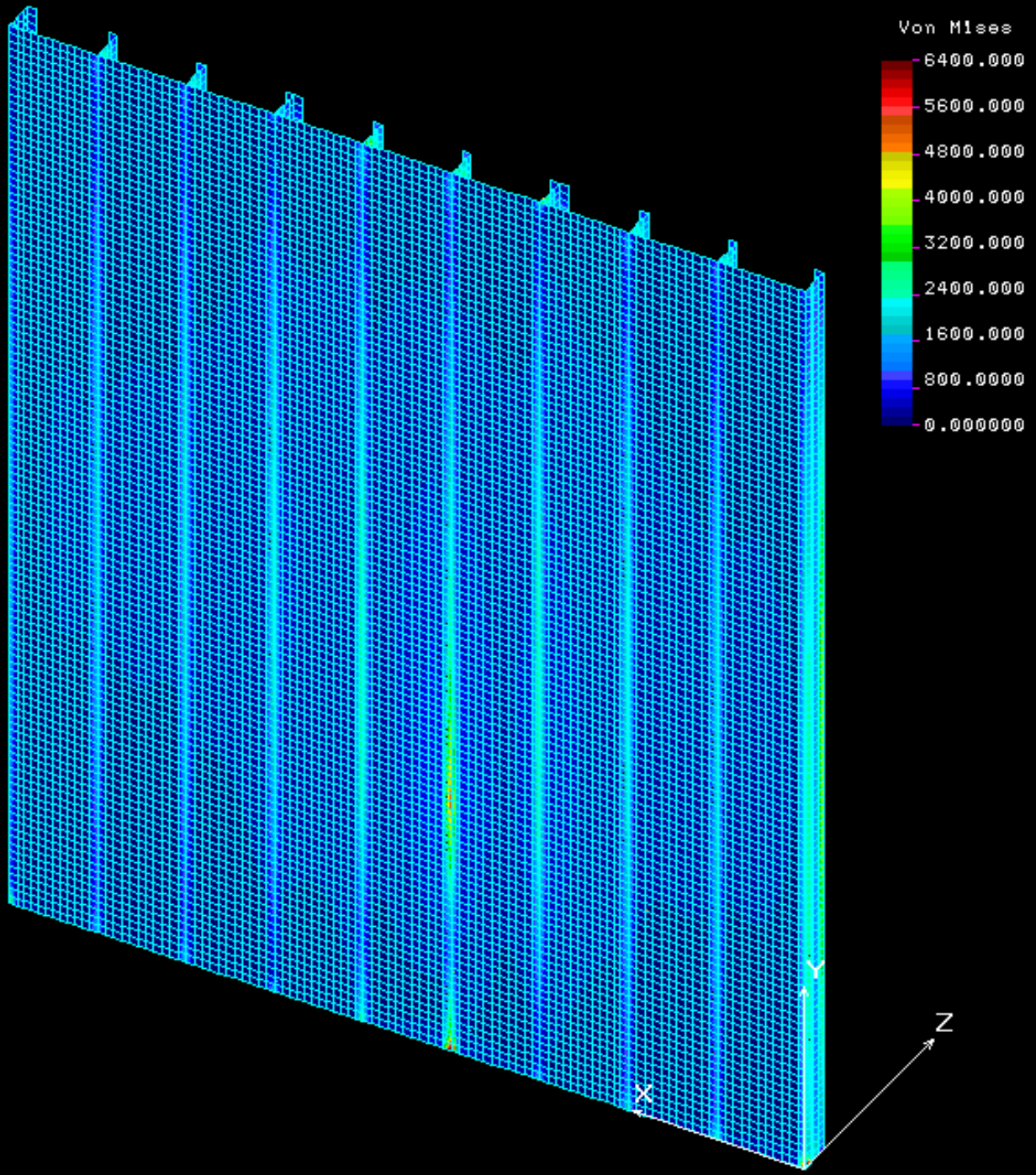
Load “B” Frame Side Z Deflection (in)



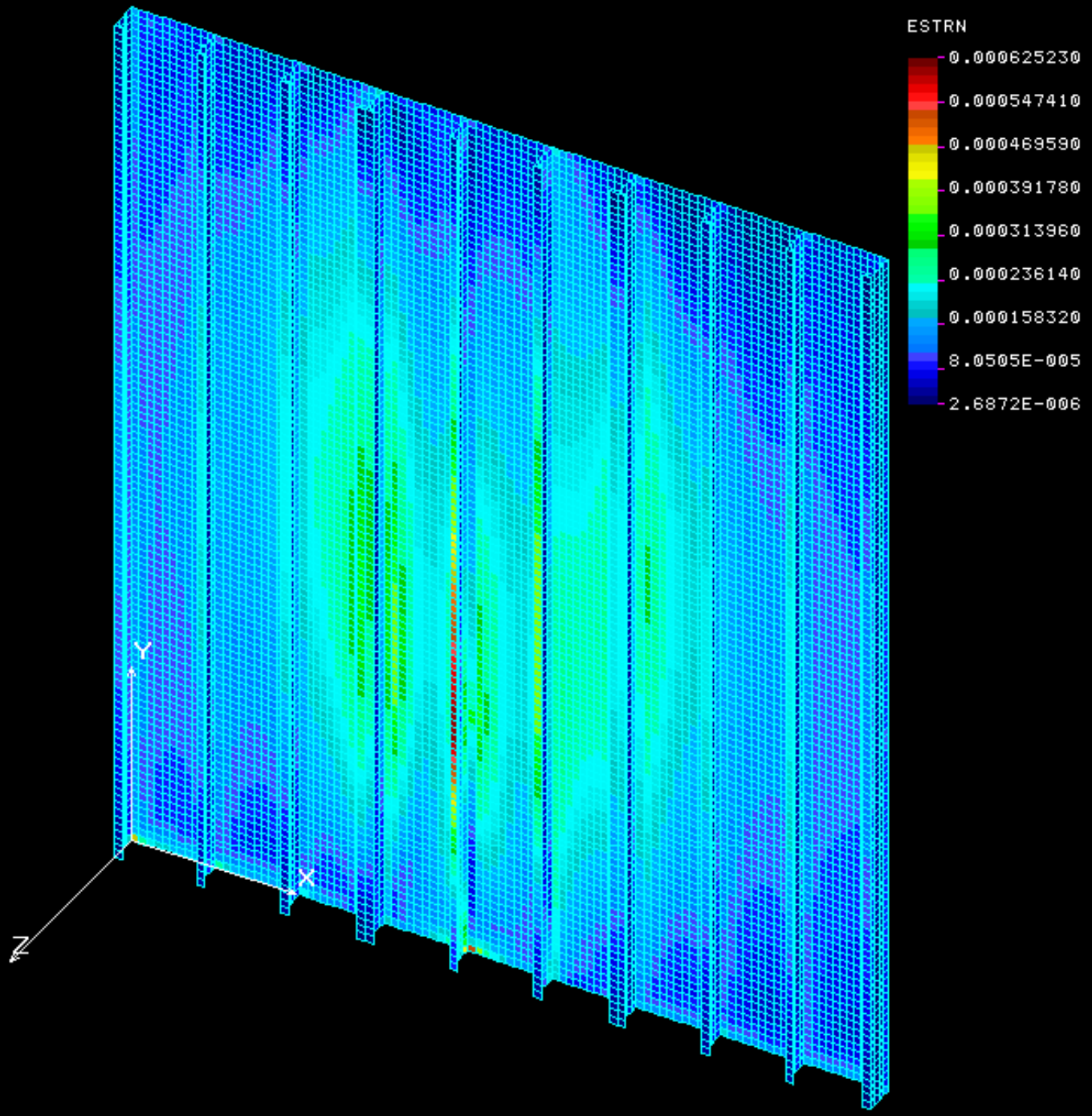
Load “B” Front Face Z Deflection (in)



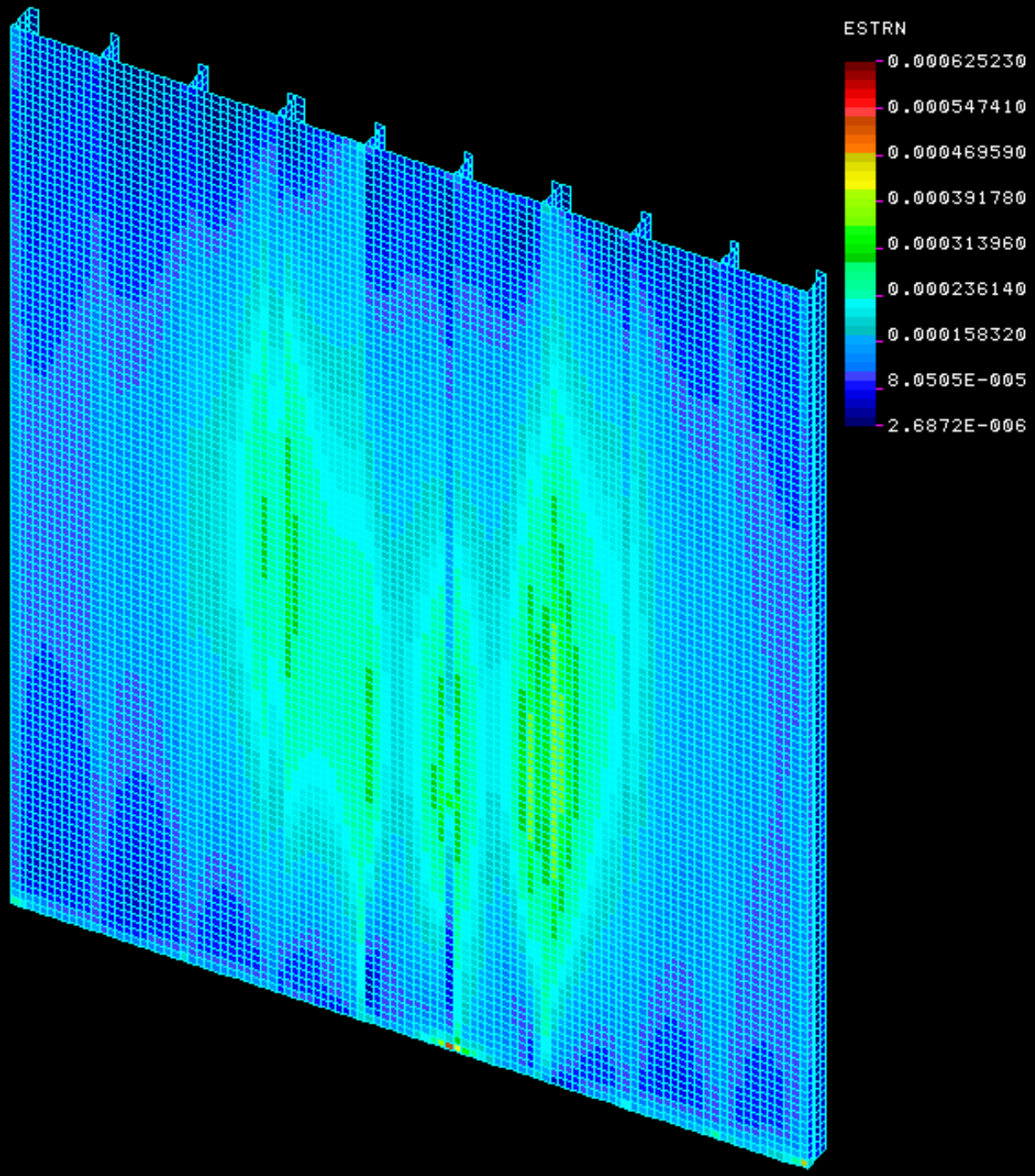
Load “B” Frame Stress (psi)



Load “B” Panel Stress (psi)



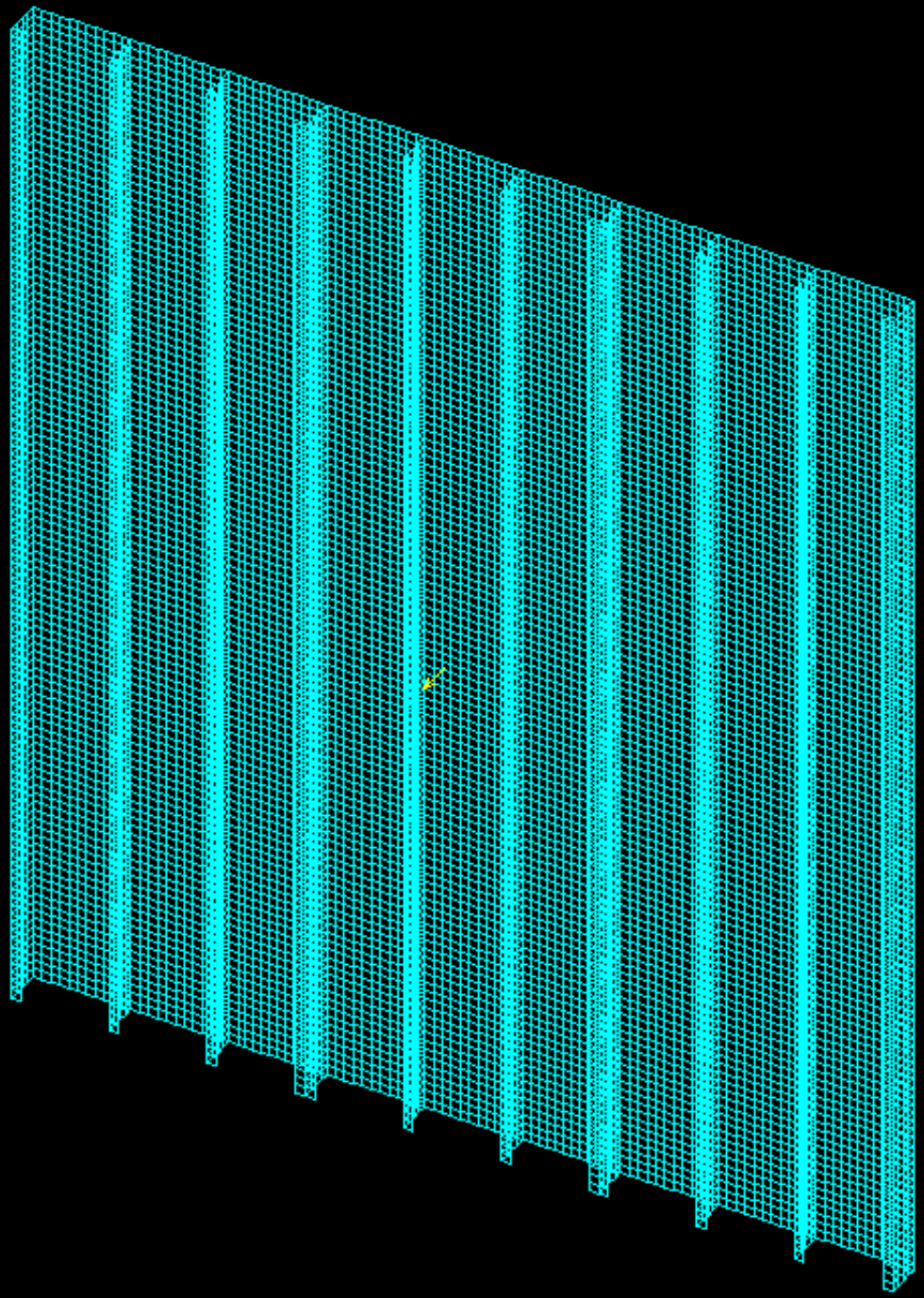
Load “B” Frame Strain



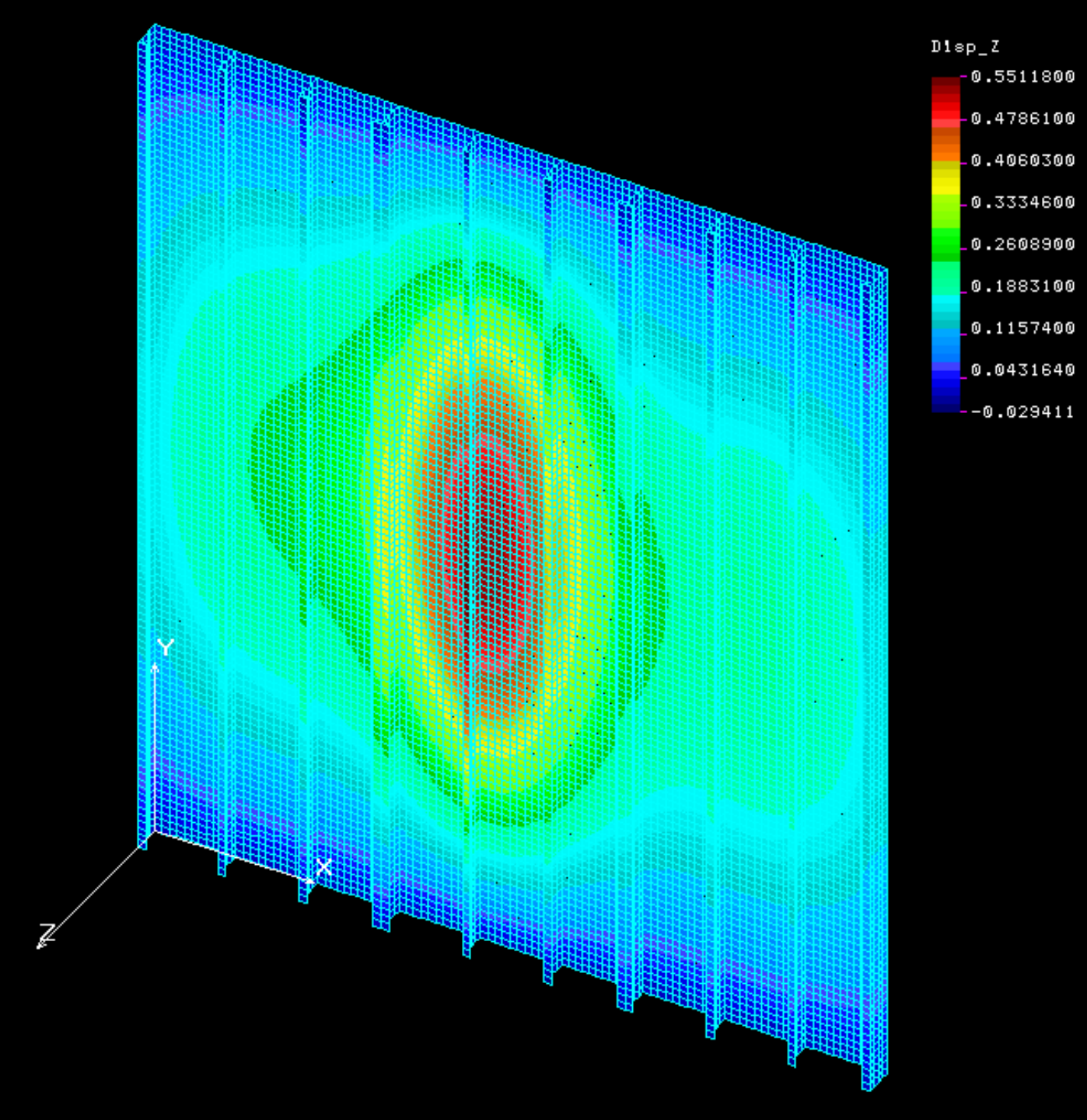
Load “B” Panel Strain

Loading “C”

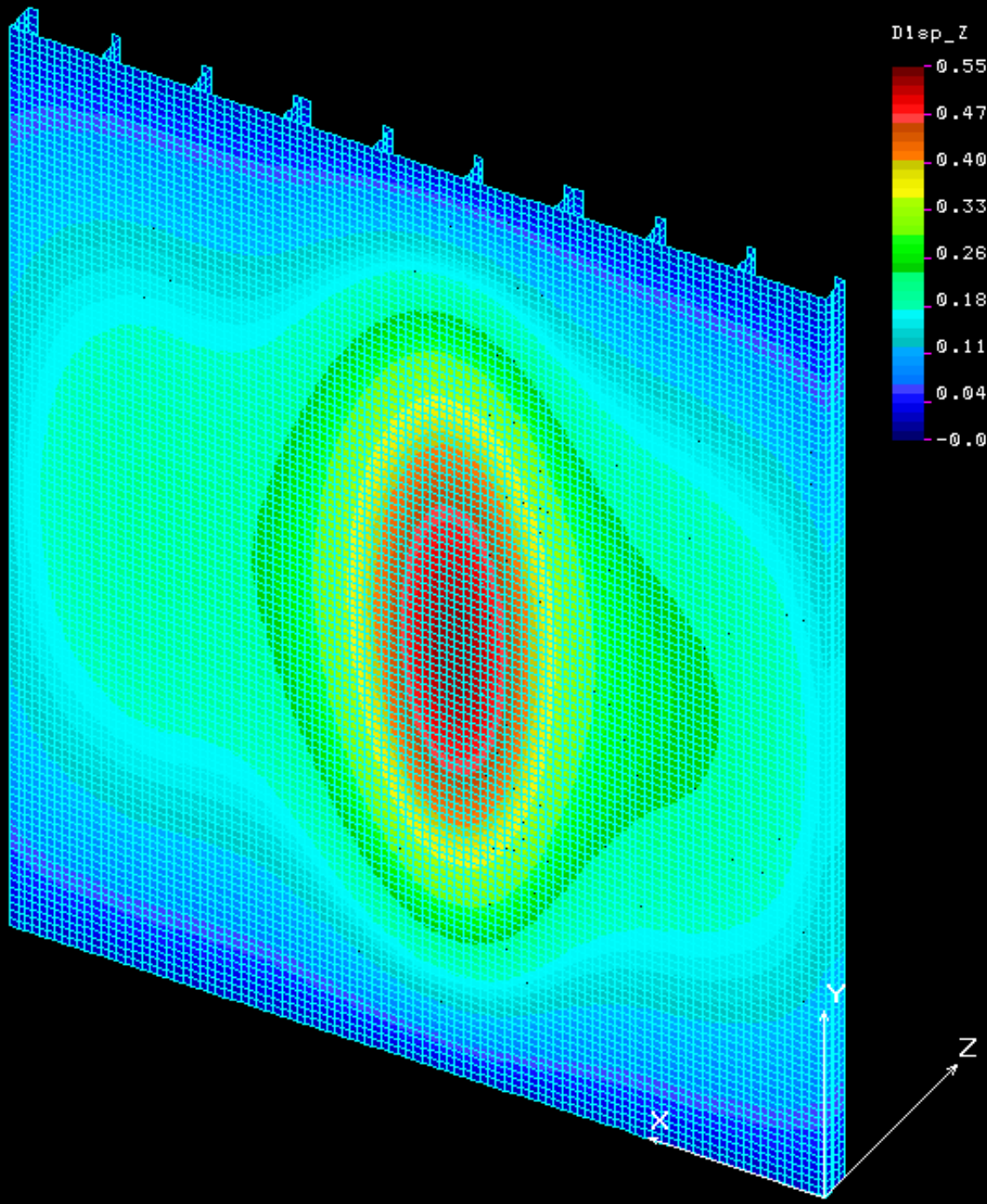
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 6 ft above floor



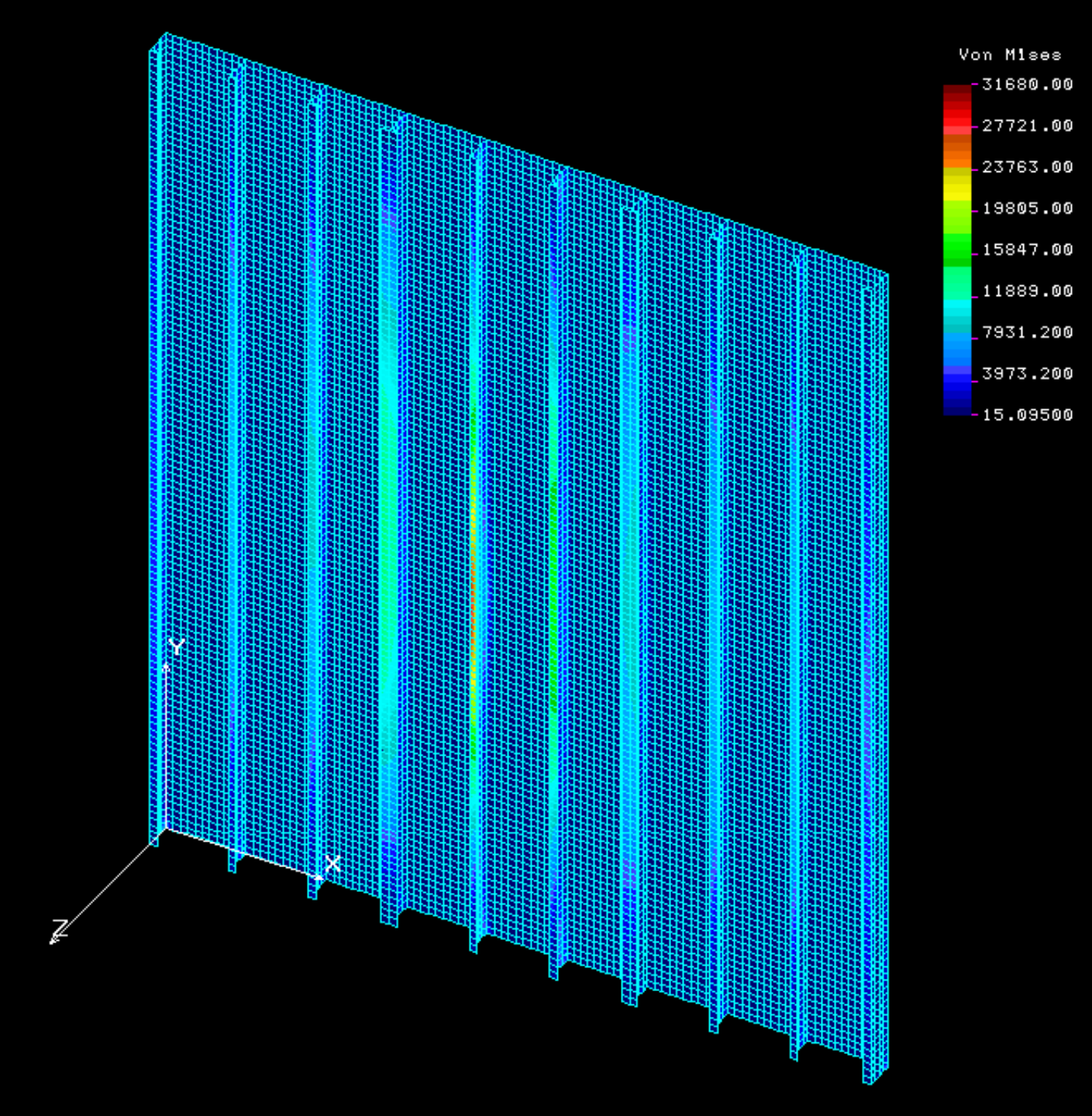
2000 lb point force on frame 6 ft above floor



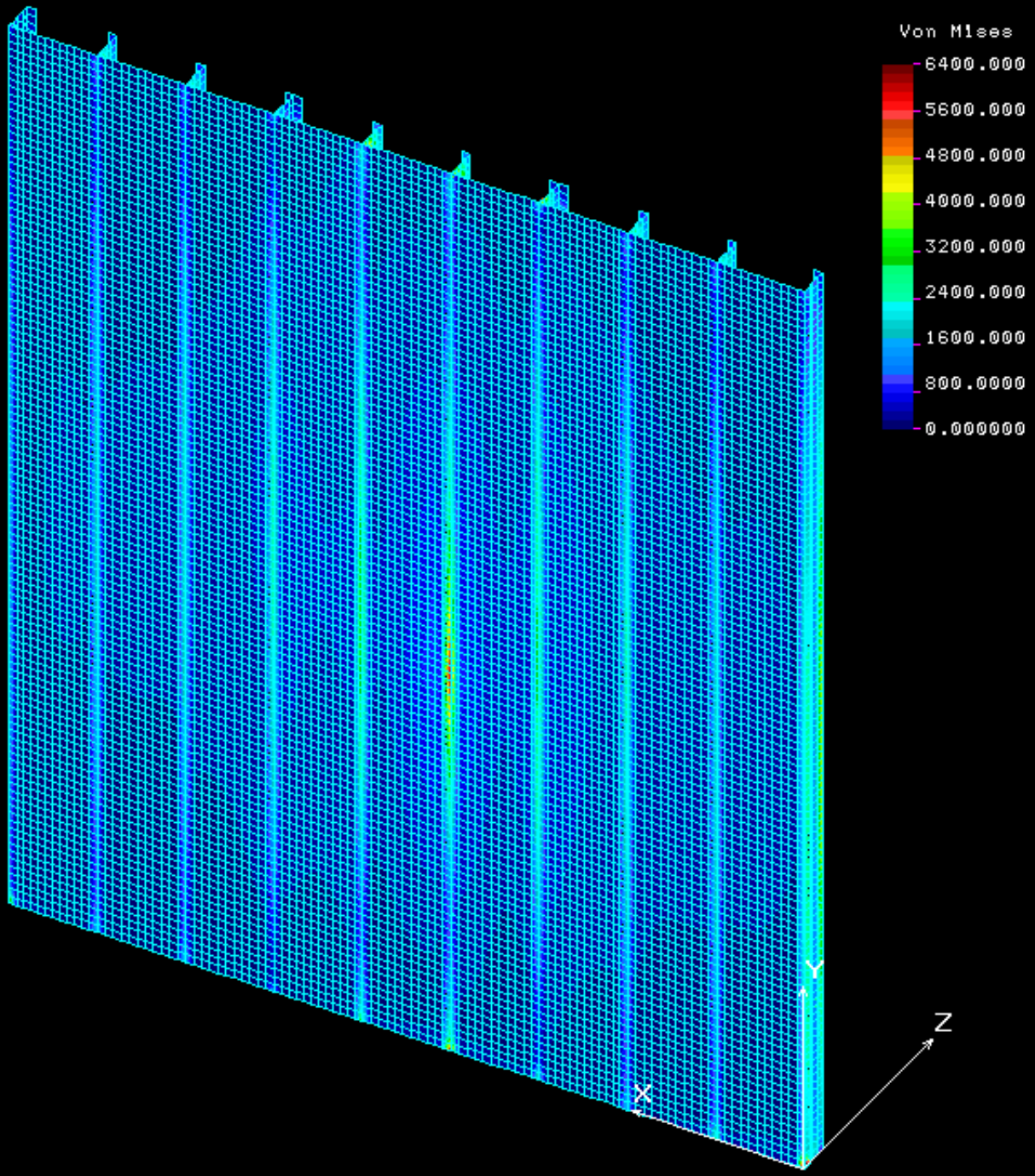
Load “C” Frame Side Z Deflection (in)



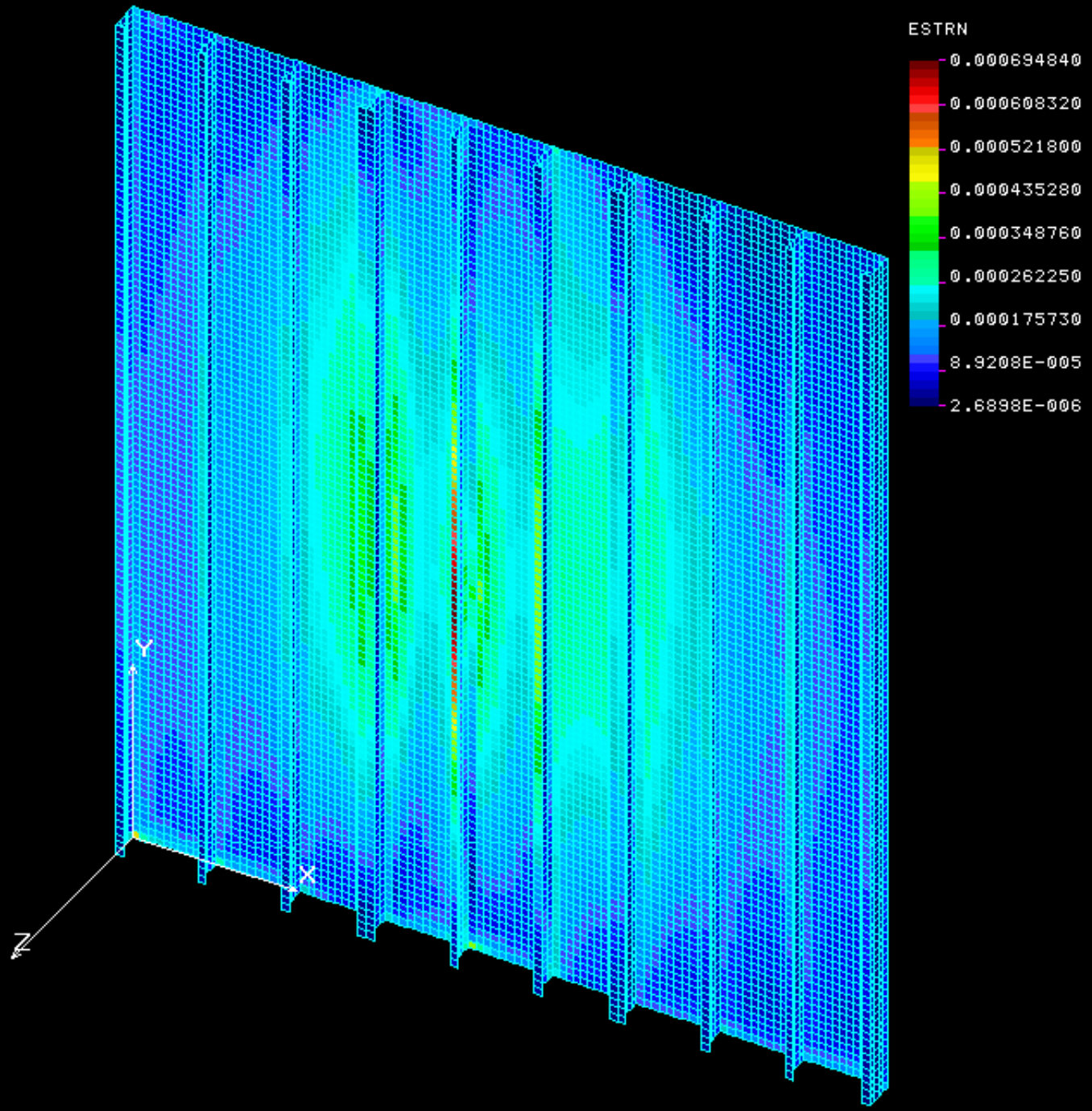
Load “C” Front Face Z Deflection (in)



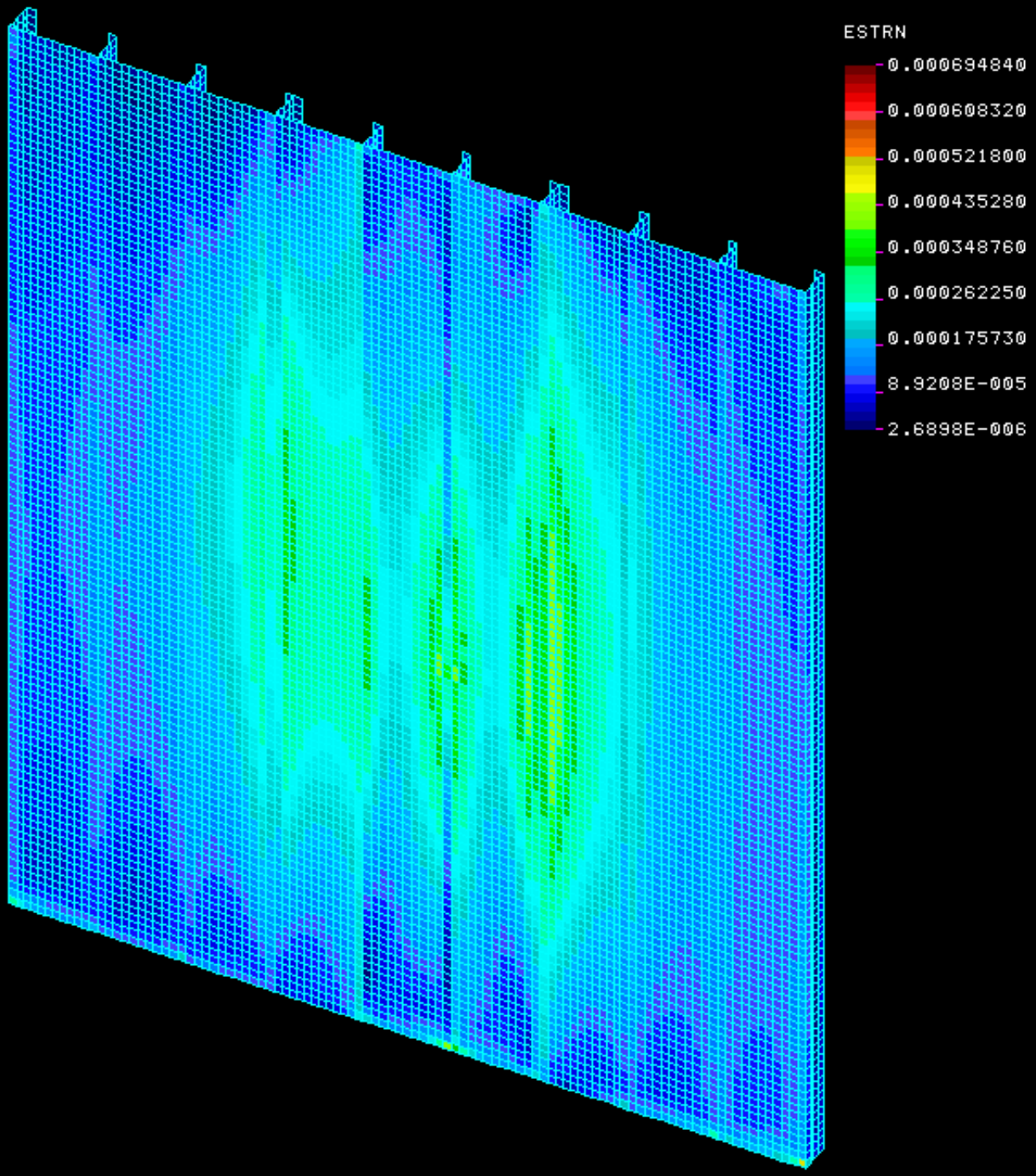
Load “C” Frame Stress (psi)



Load “C” Panel Stress (psi)



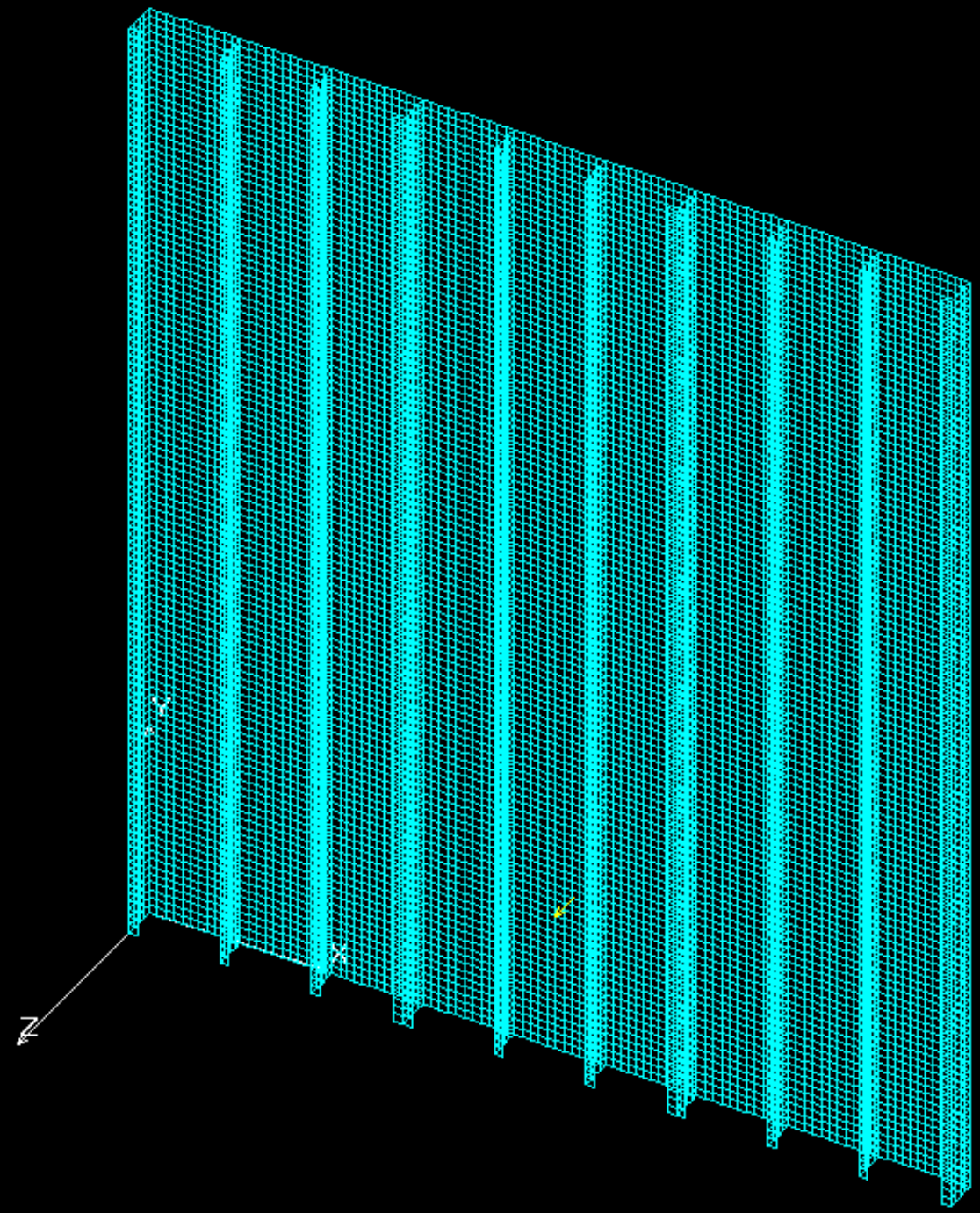
Load “C” Frame Strain



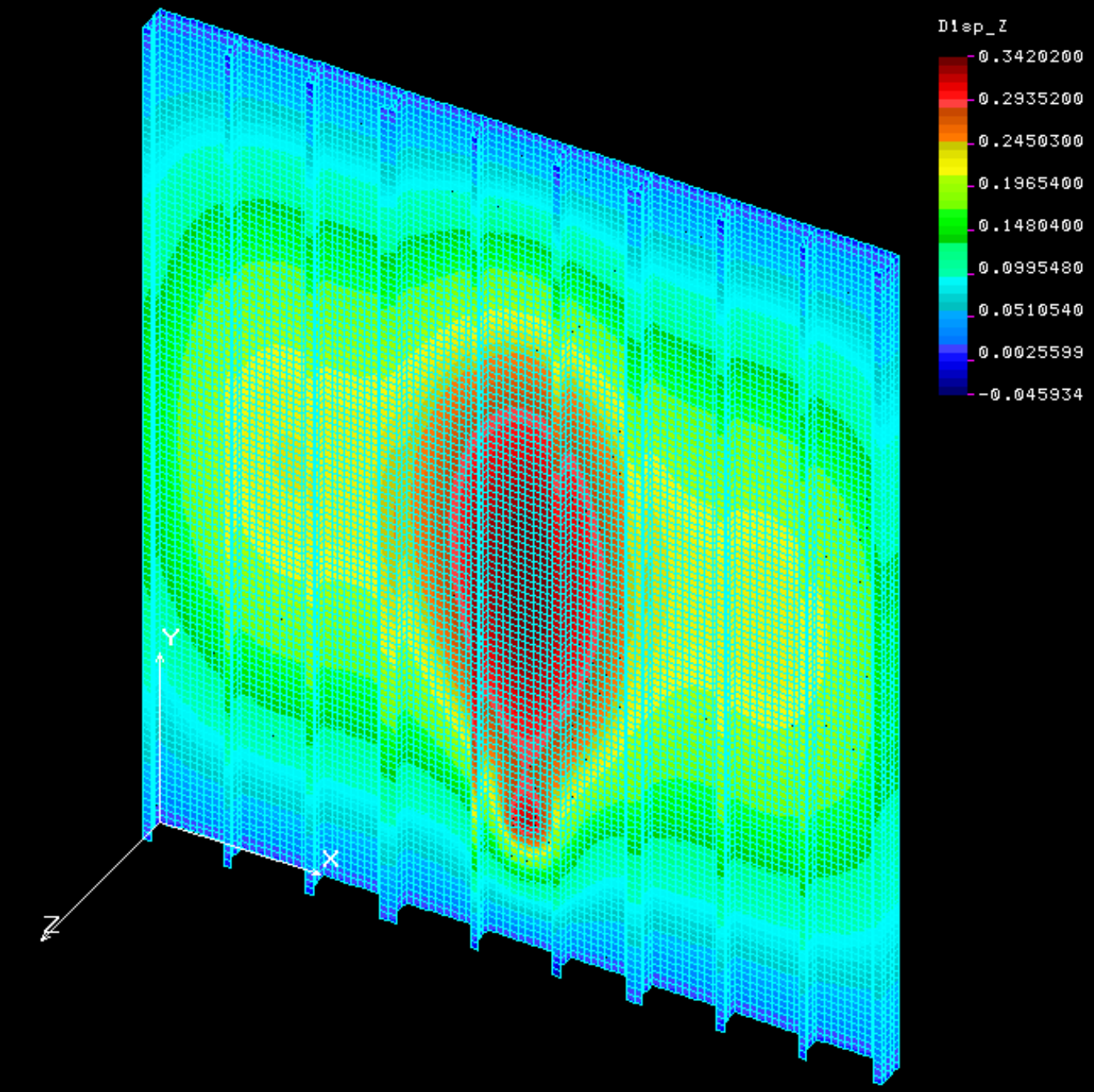
Load “C” Panel Strain

Loading “D”

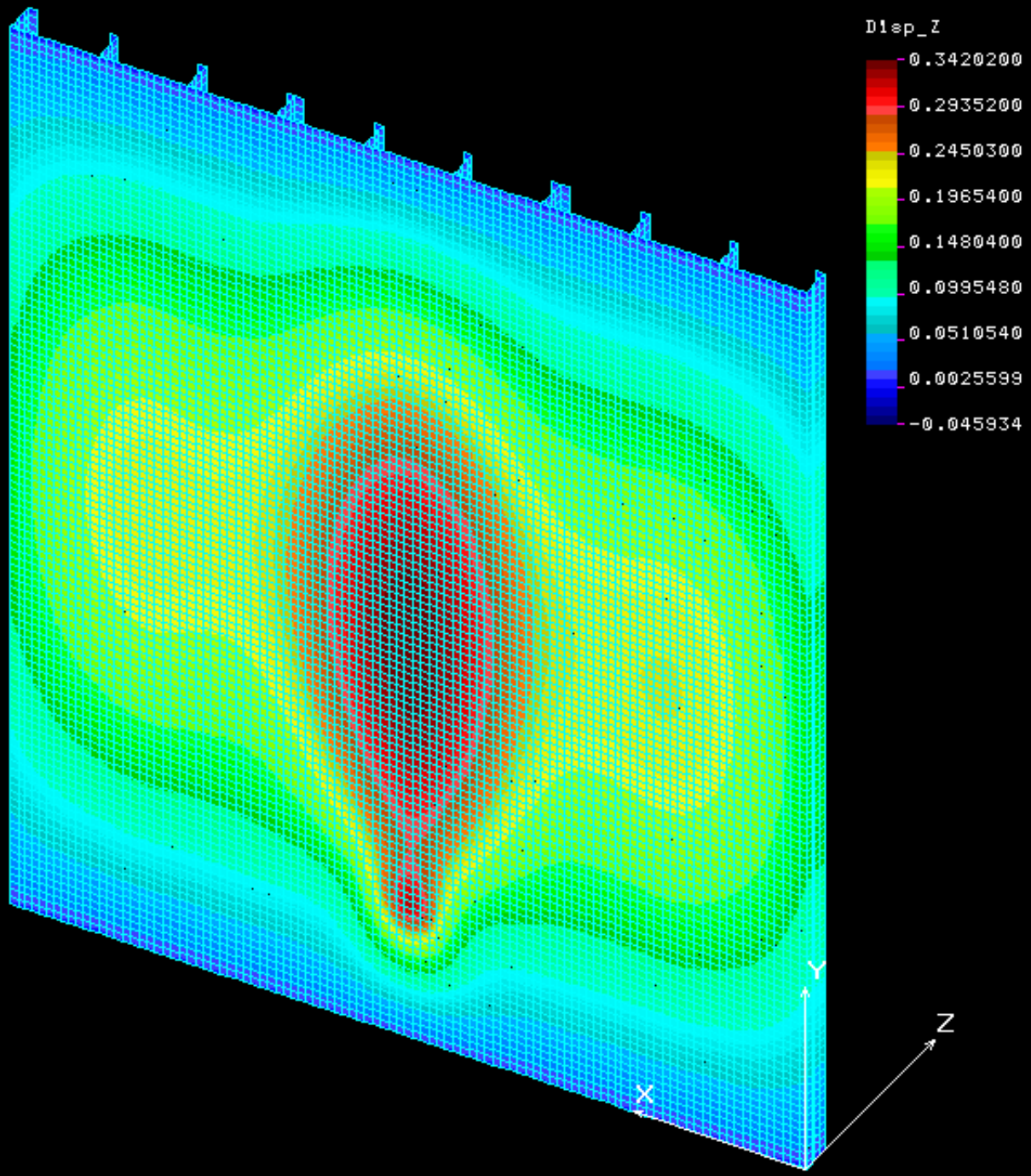
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load between frames 2 ft above floor



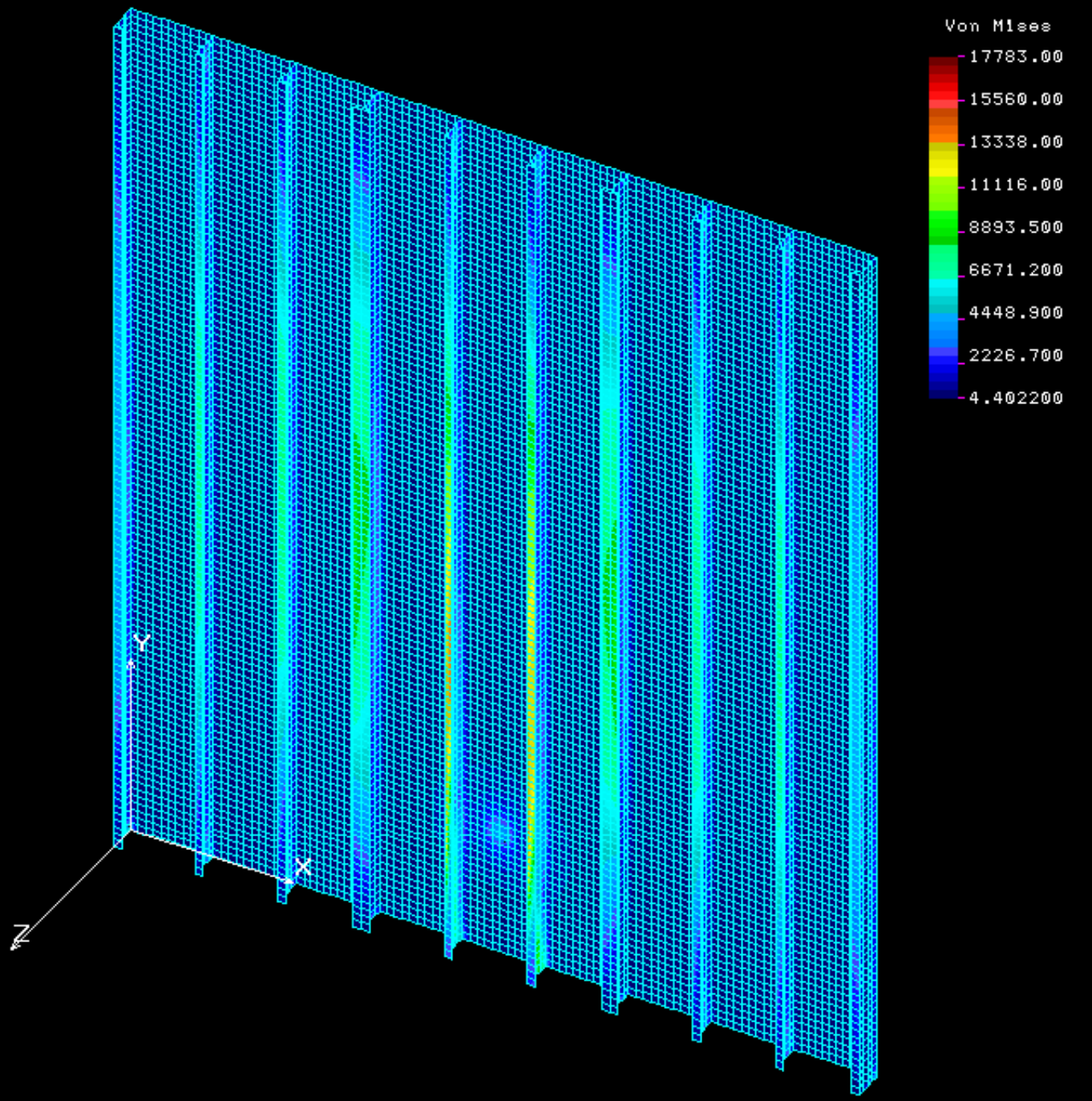
2000 lb point
force on panel
2 ft above floor



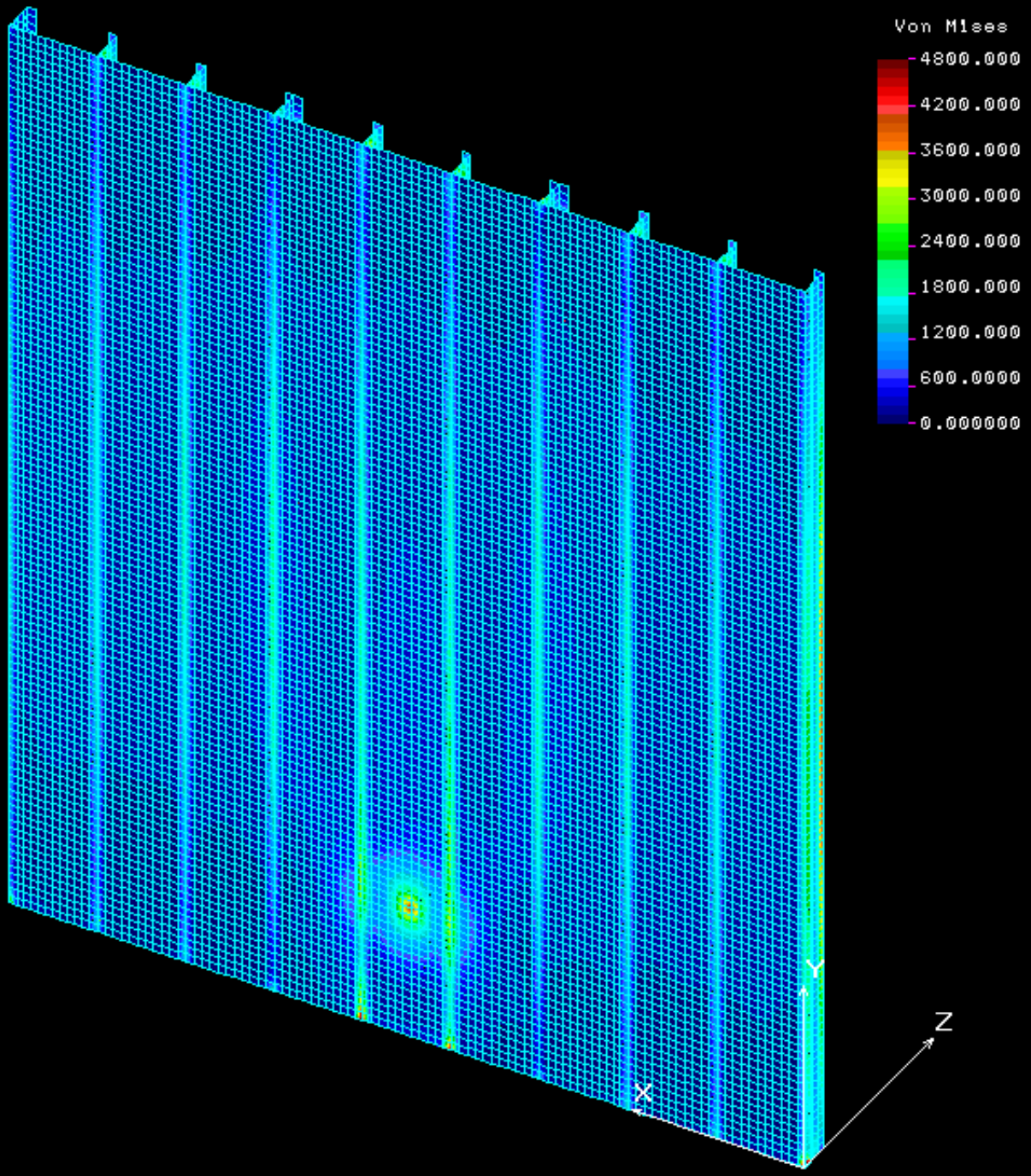
Load “D” Frame Side Z Deflection (in)



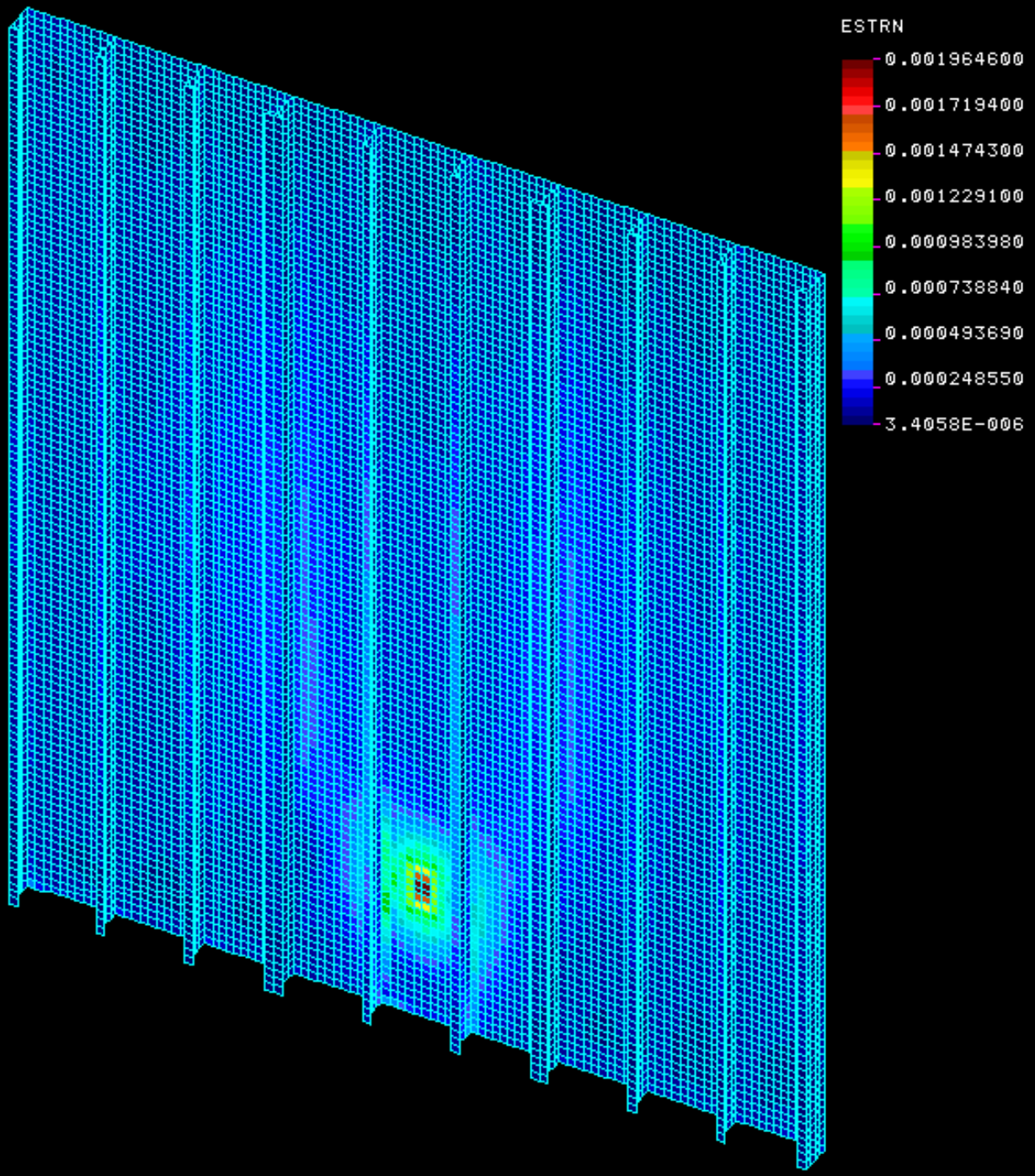
Load “D” Front Face Z Deflection (in)



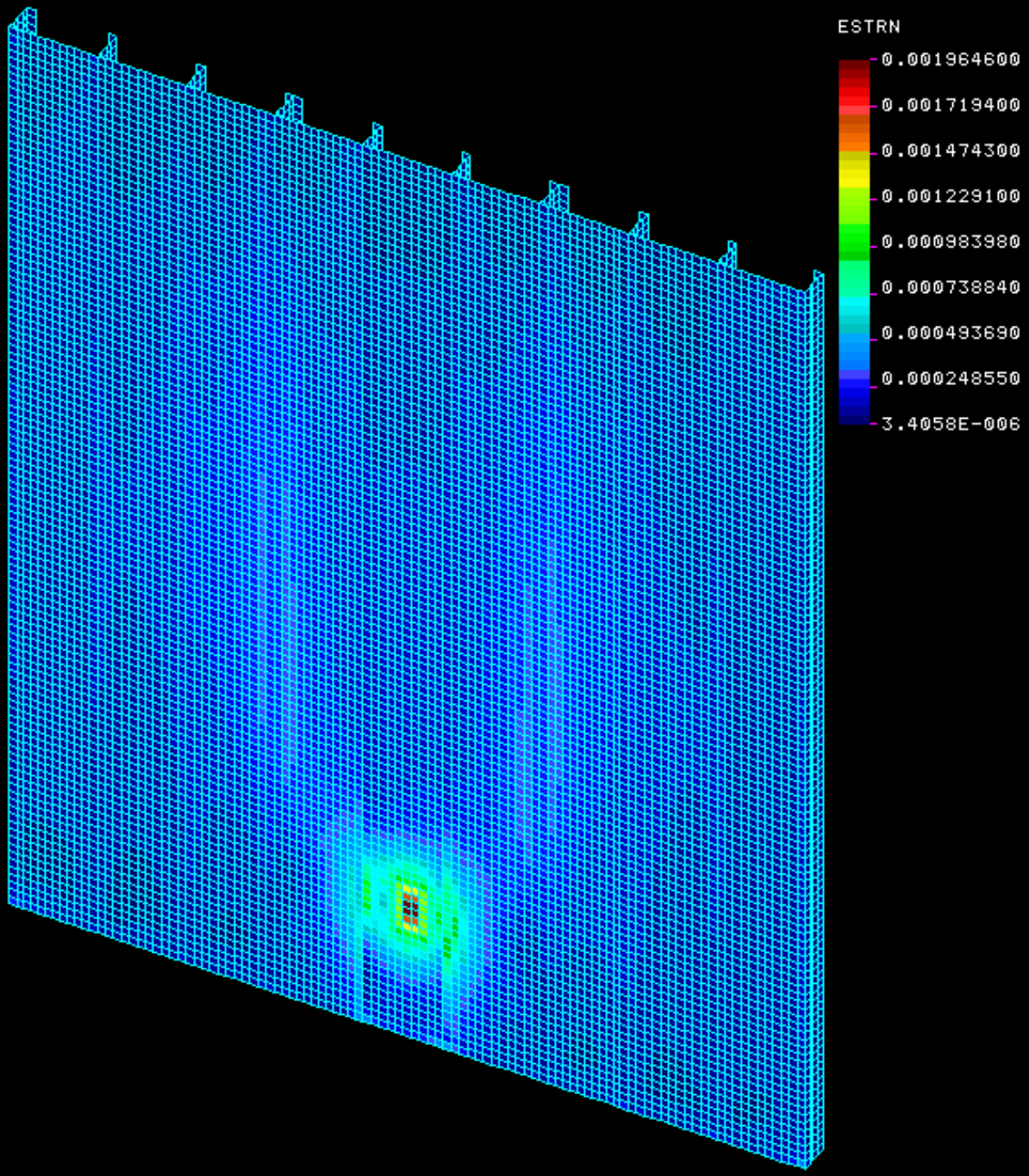
Load “D” Frame Stress (psi)



Load “D” Panel Stress (psi)



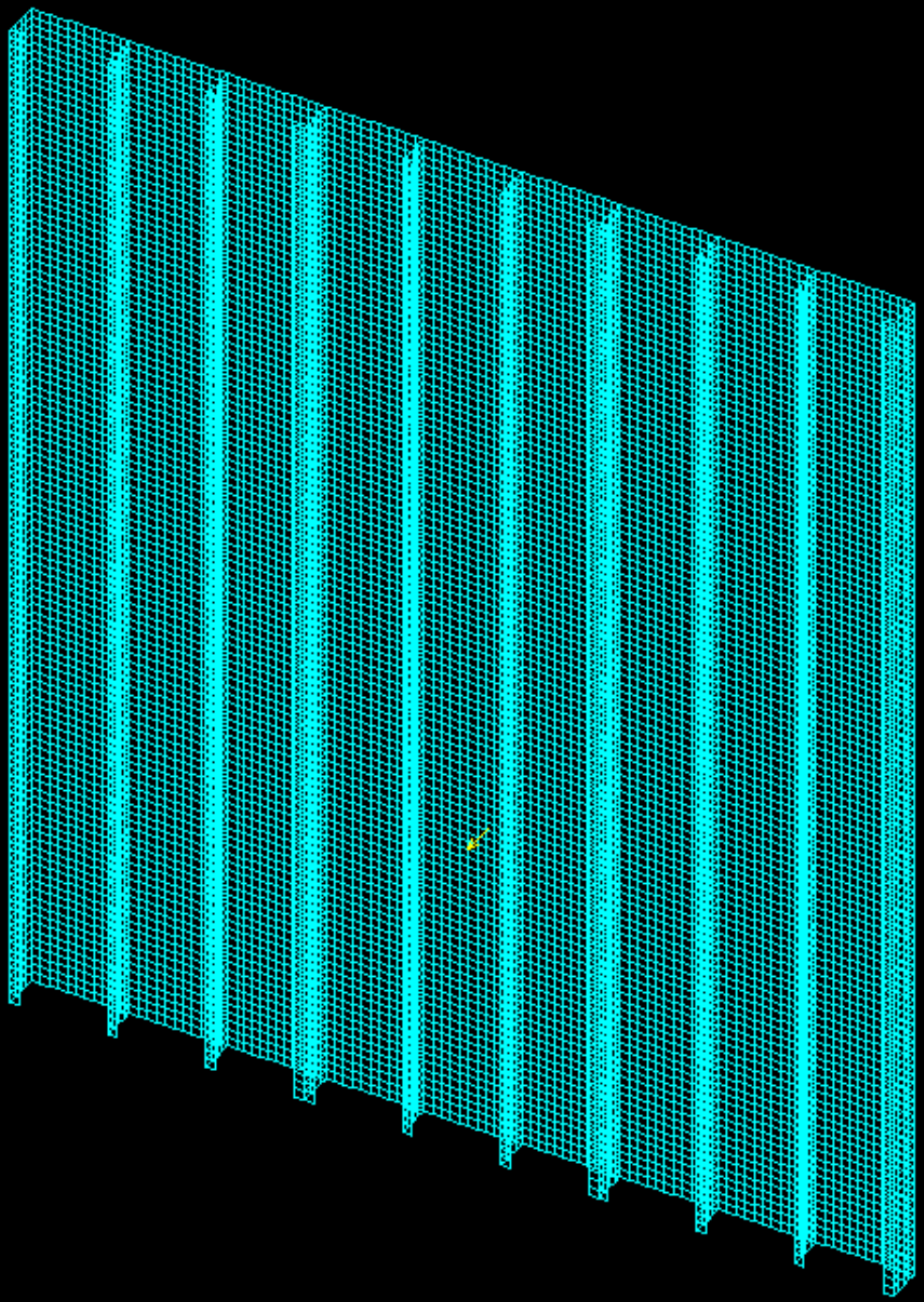
Load “D” Frame Strain



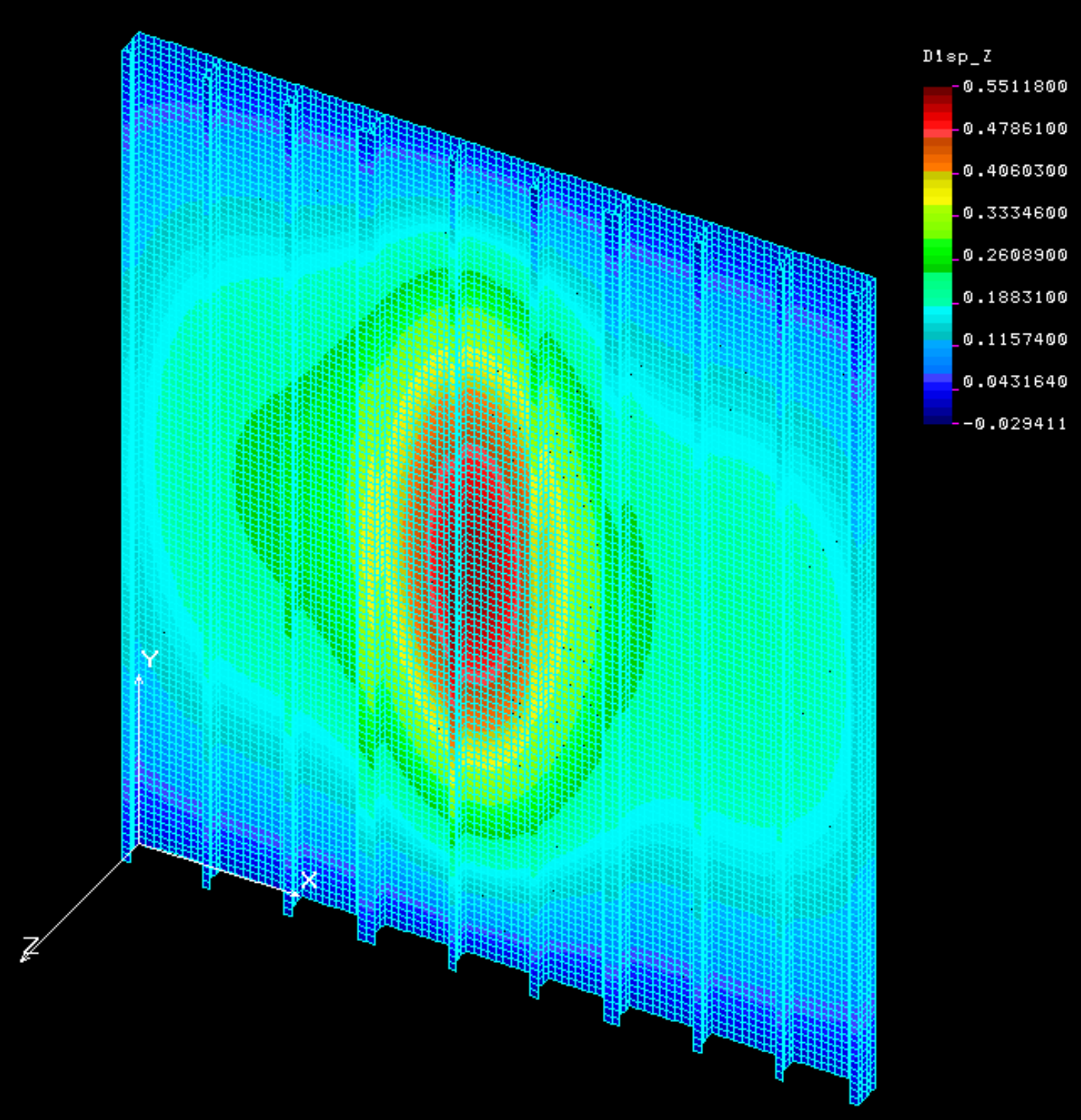
Load “D” Panel Strain

Loading “E”

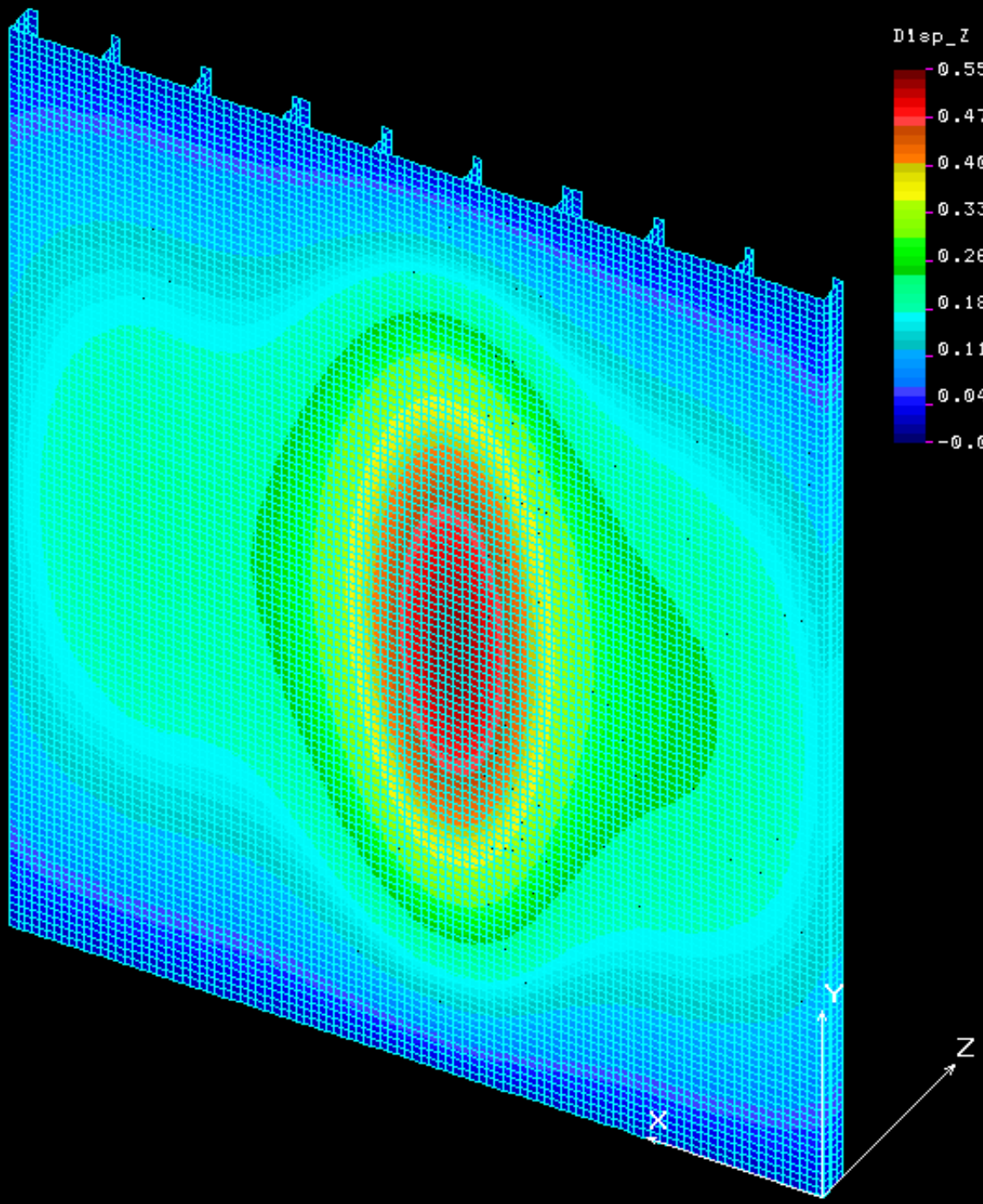
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 4 ft above floor



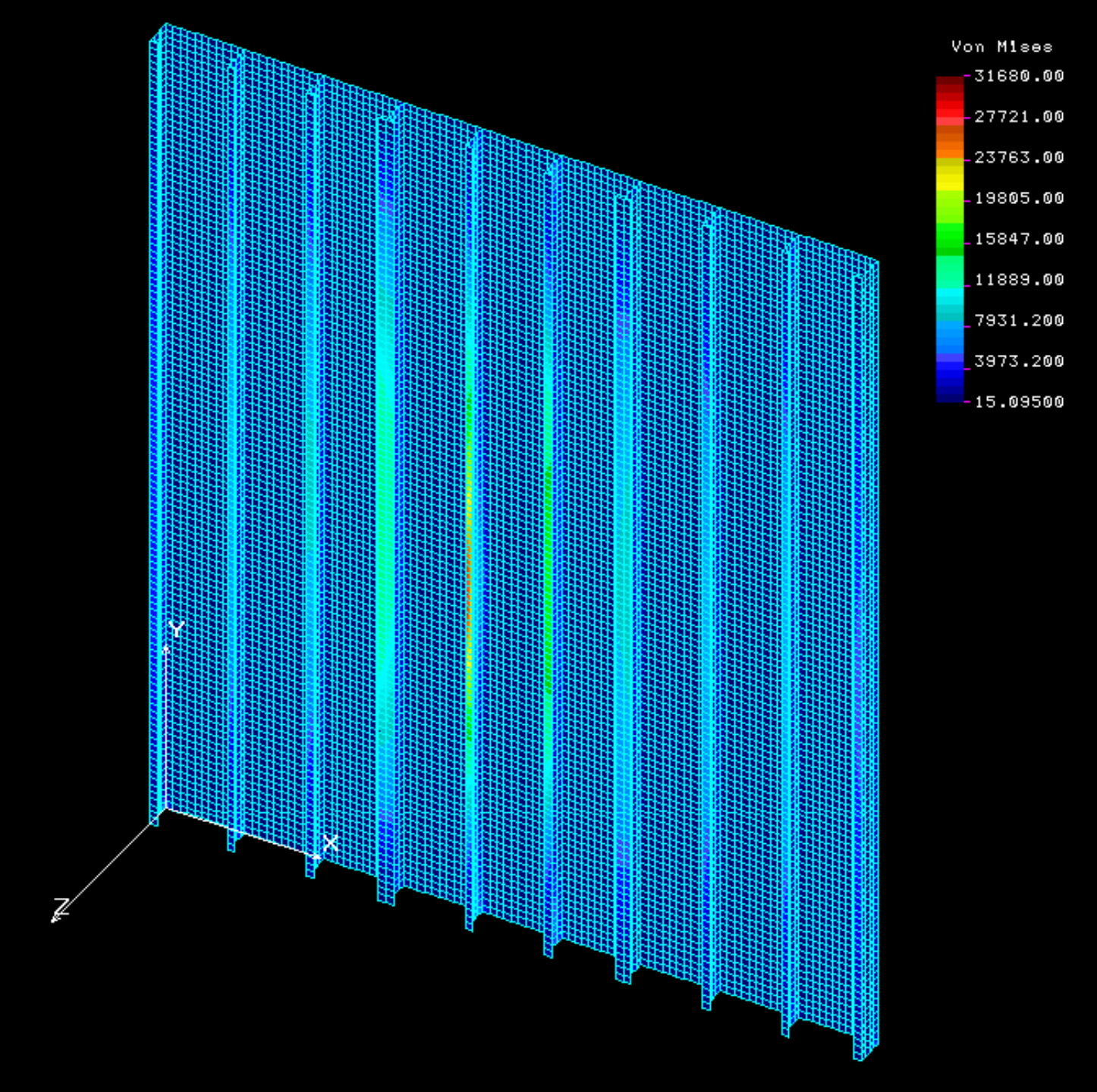
2000 lb point force on frame 4 ft above floor



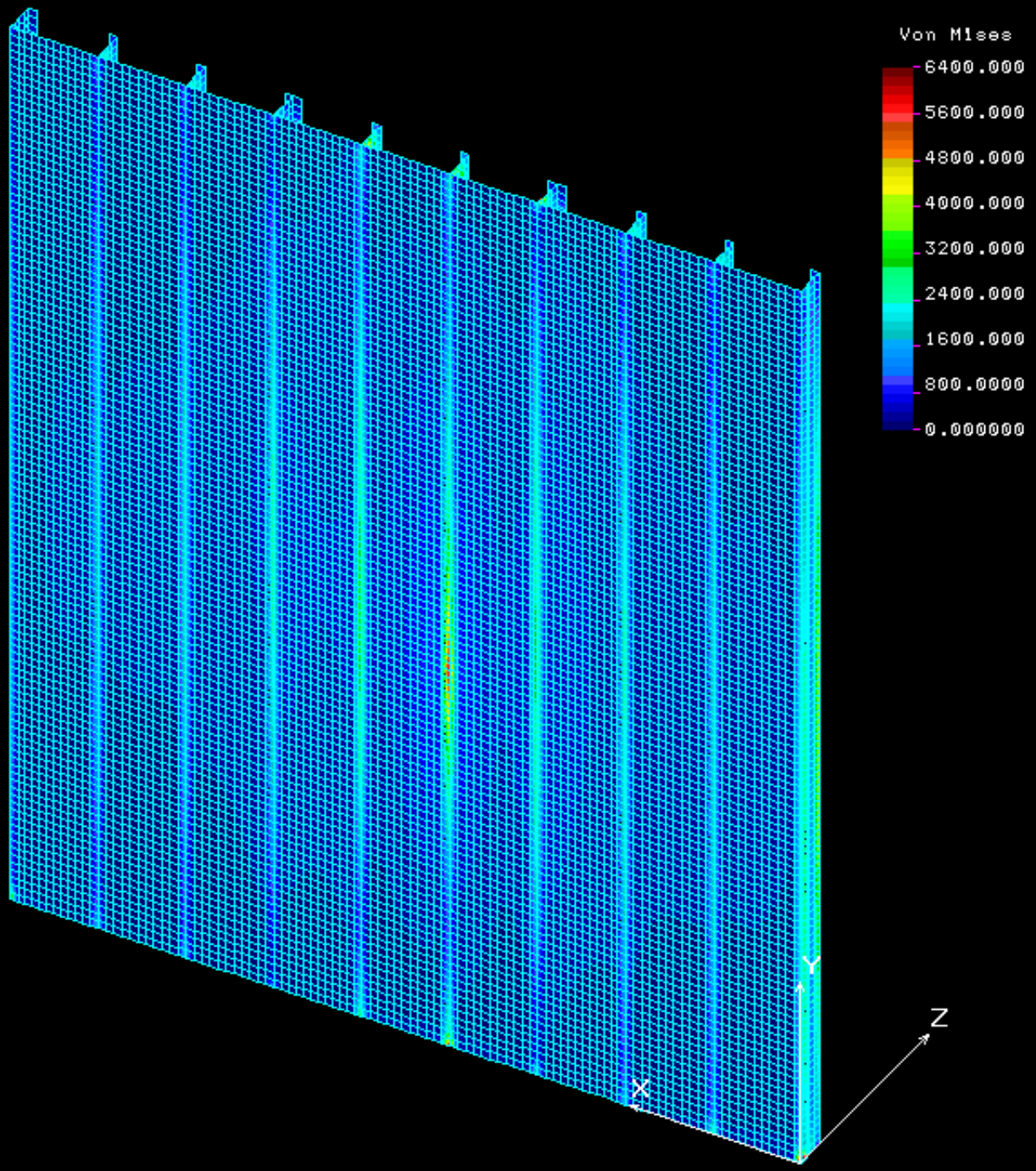
Load “E” Frame Side Z Deflection (in)



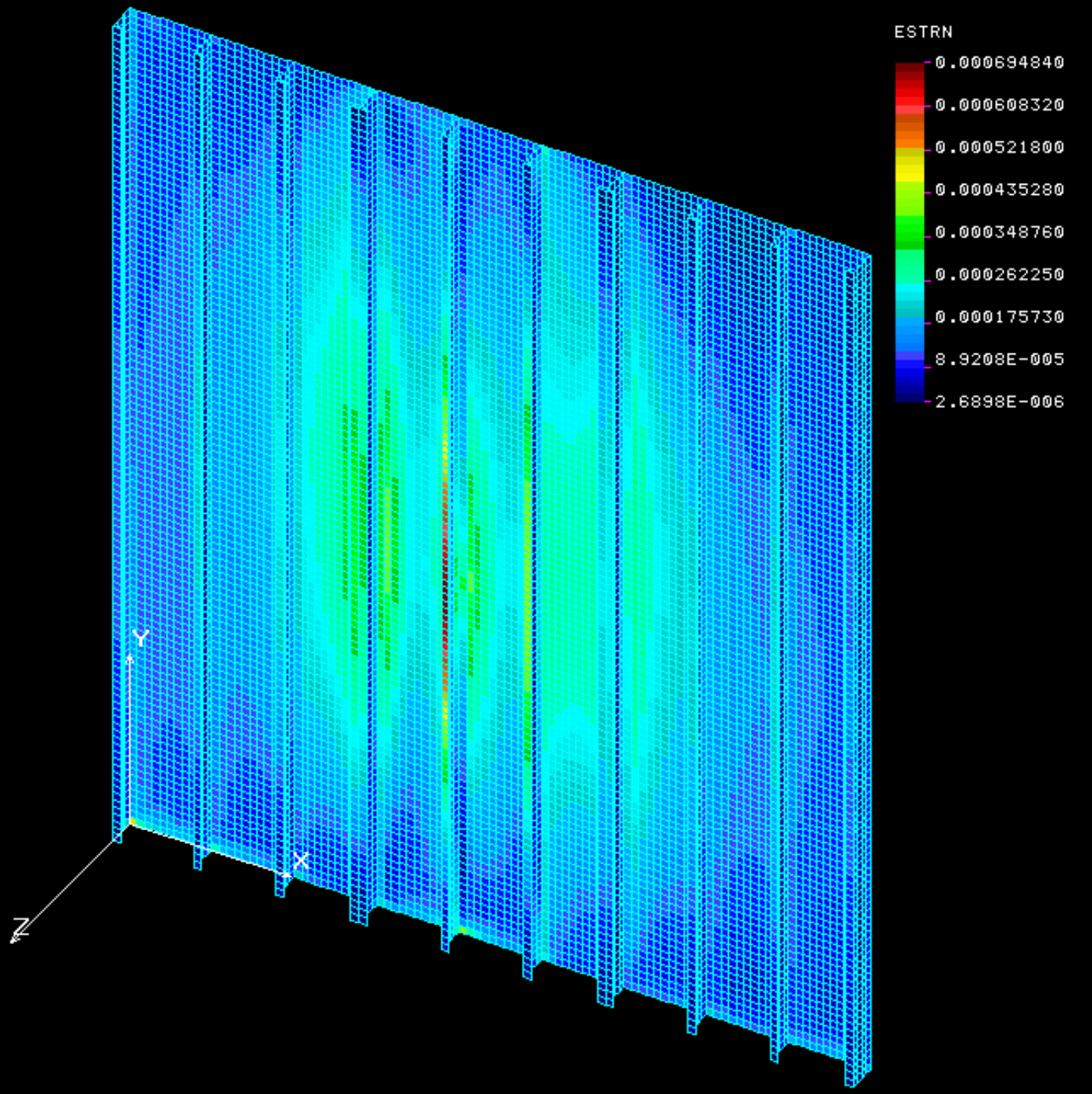
Load “E” Front Face Z Deflection (in)



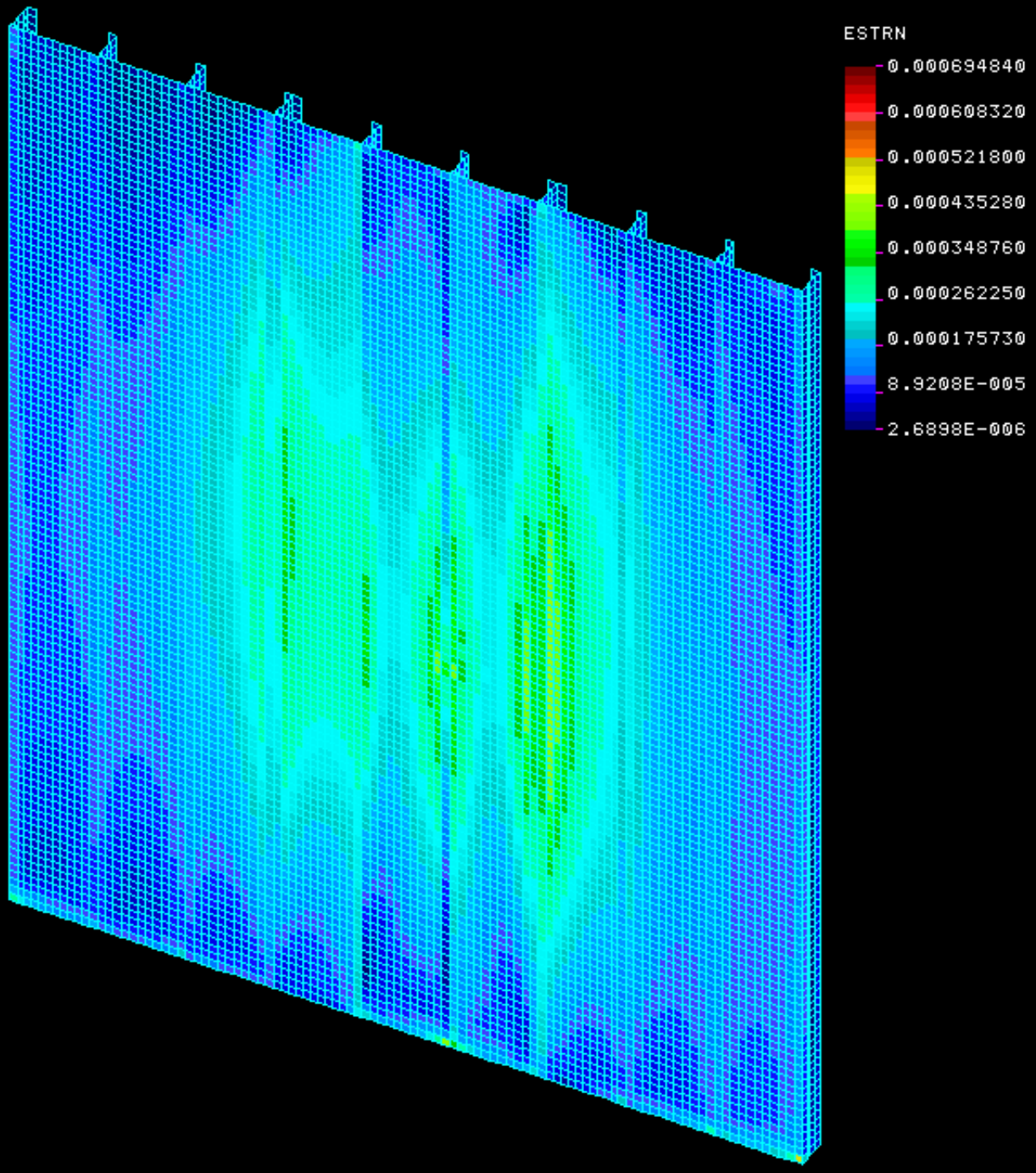
Load “E” Frame Stress (psi)



Load “E” Panel Stress (psi)



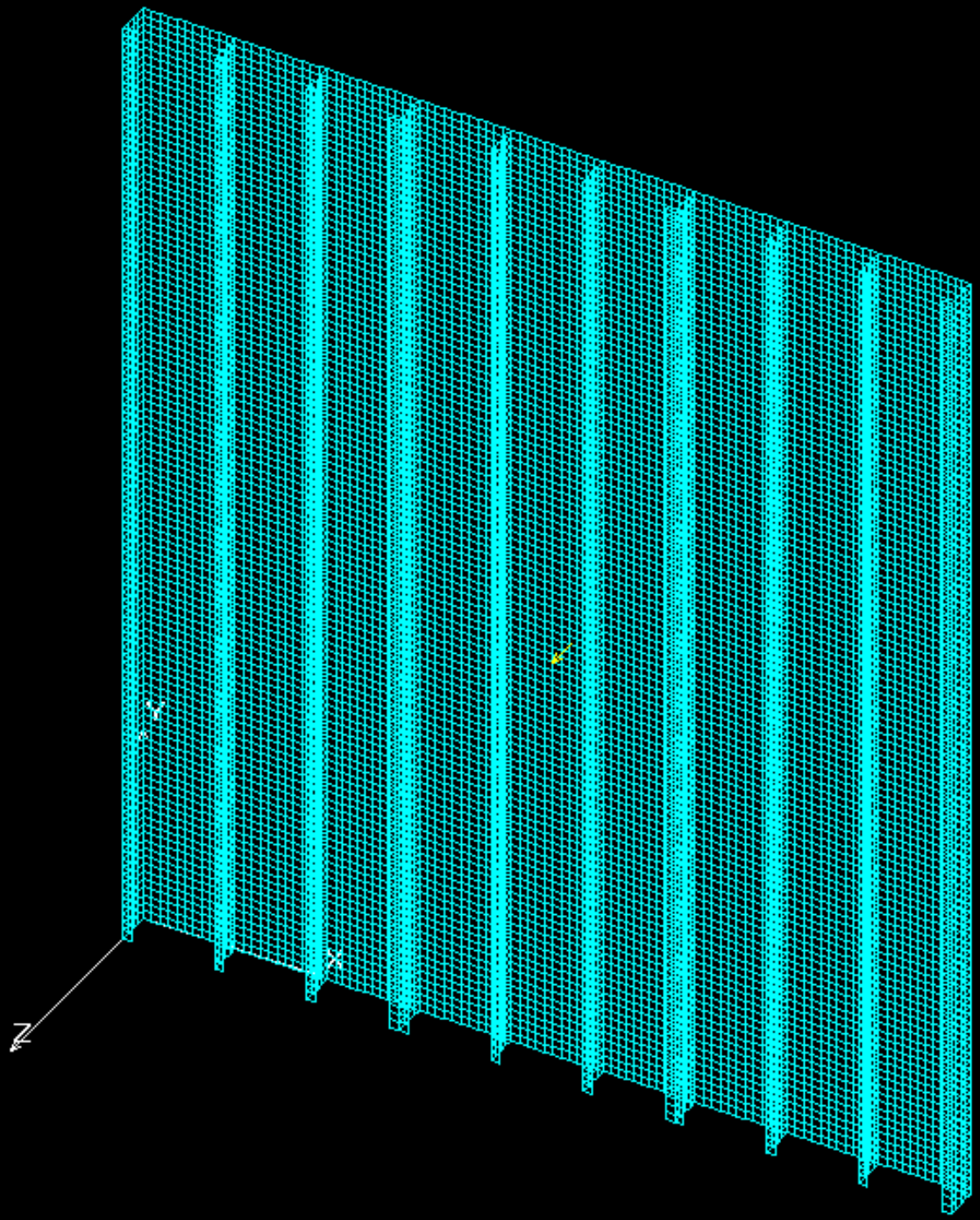
Load “E” Frame Strain



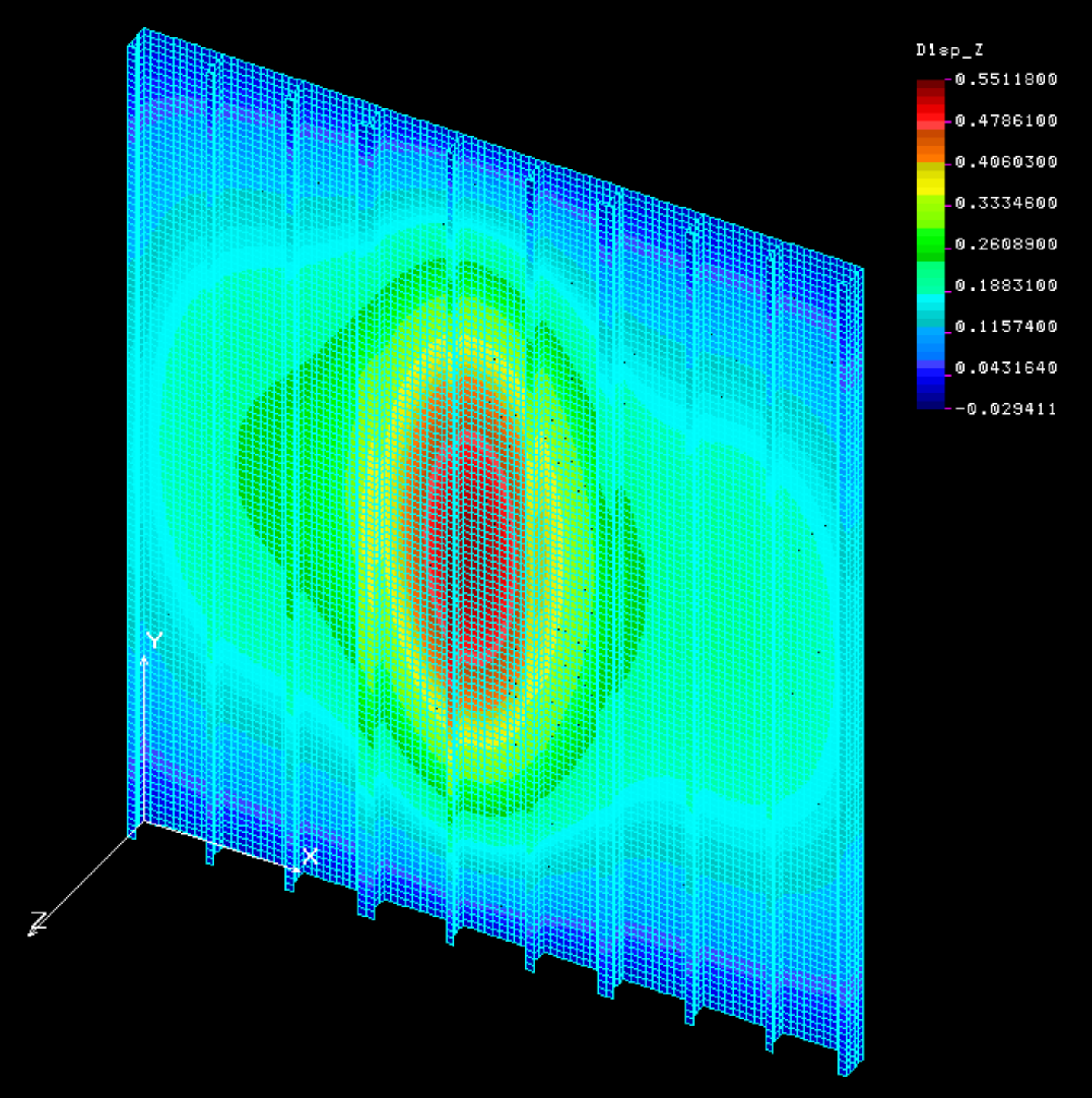
Load “E” Panel Strain

Loading “F”

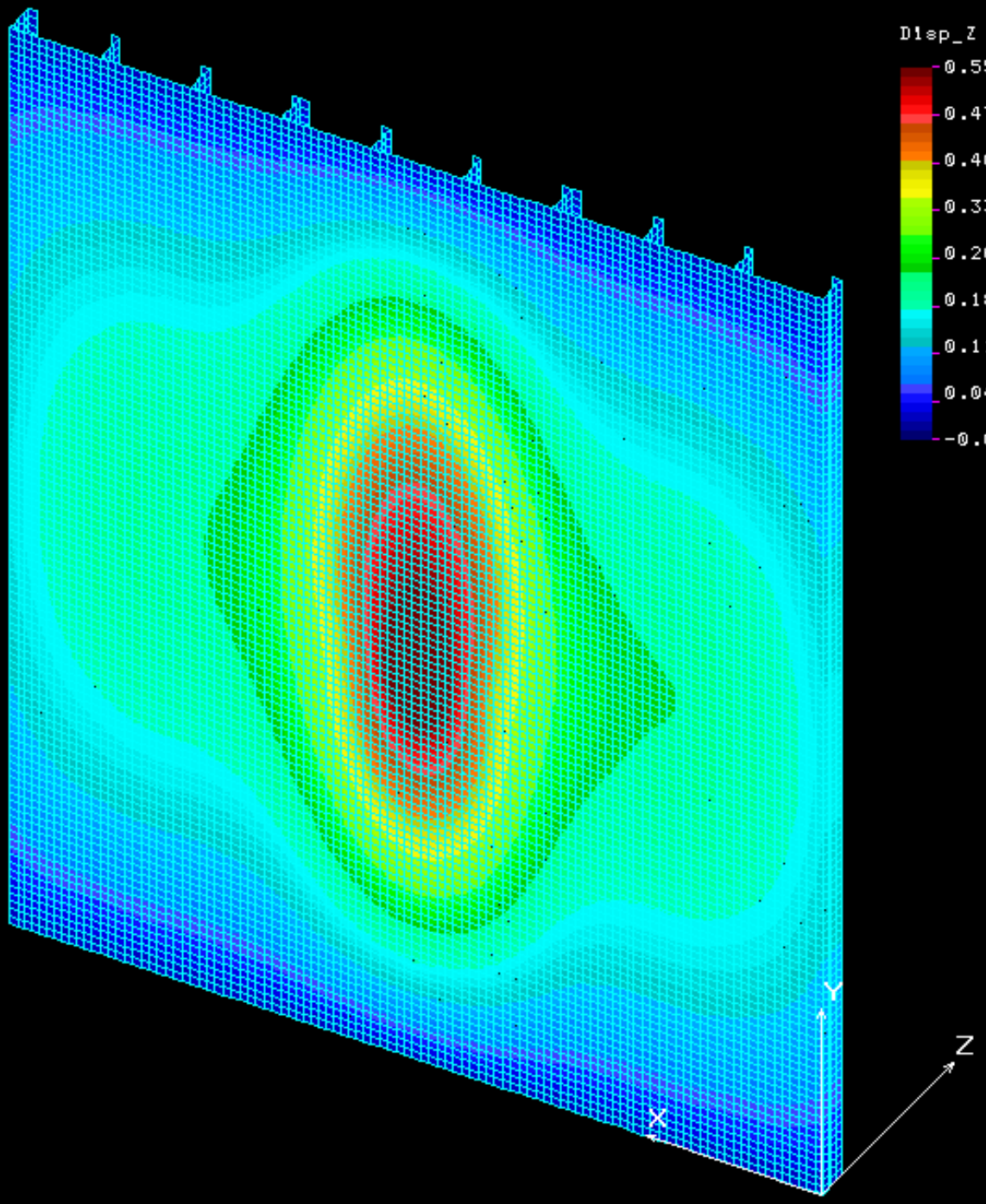
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 2 ft above floor



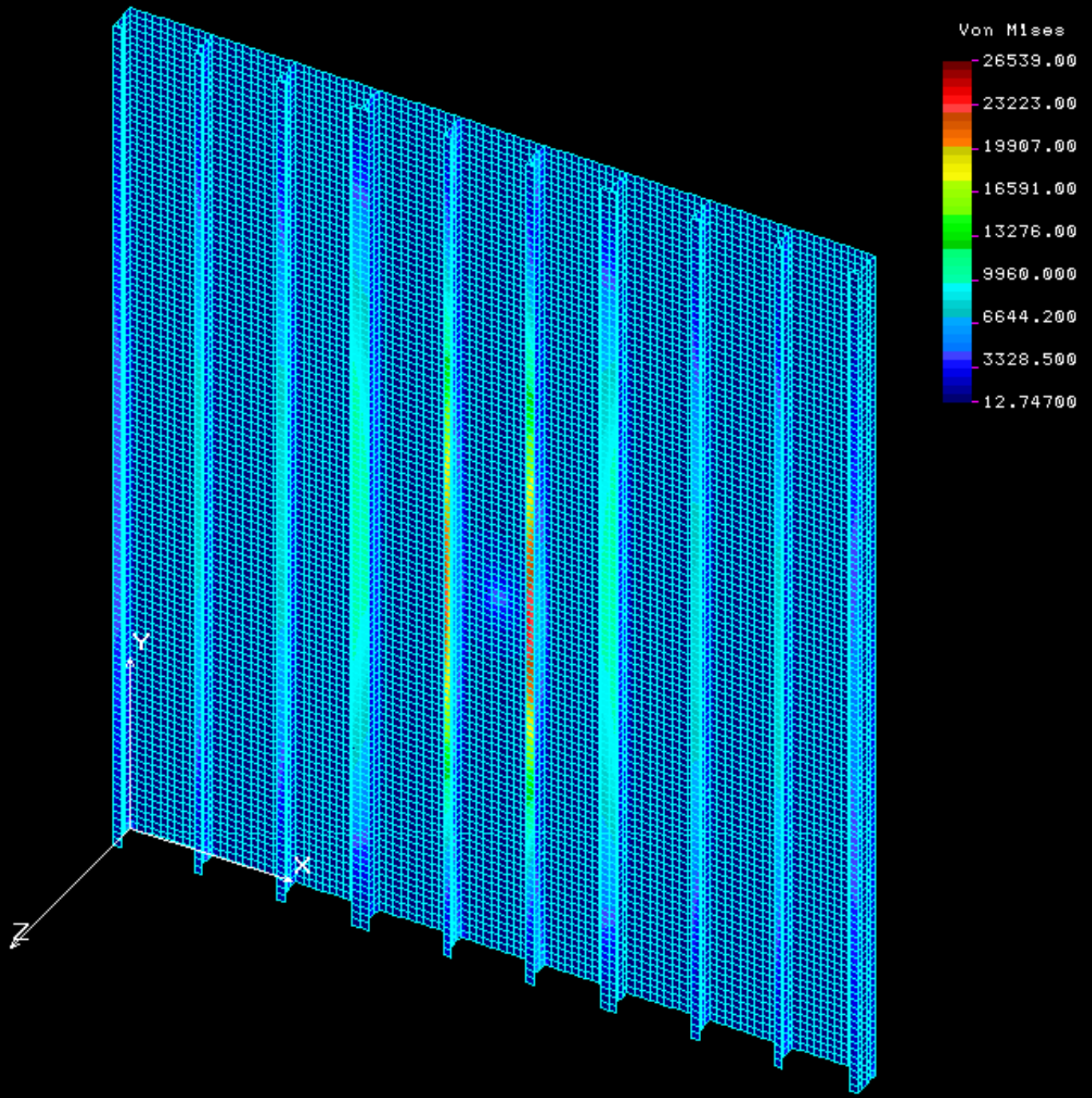
2000 lb point force on frame 6 ft above floor



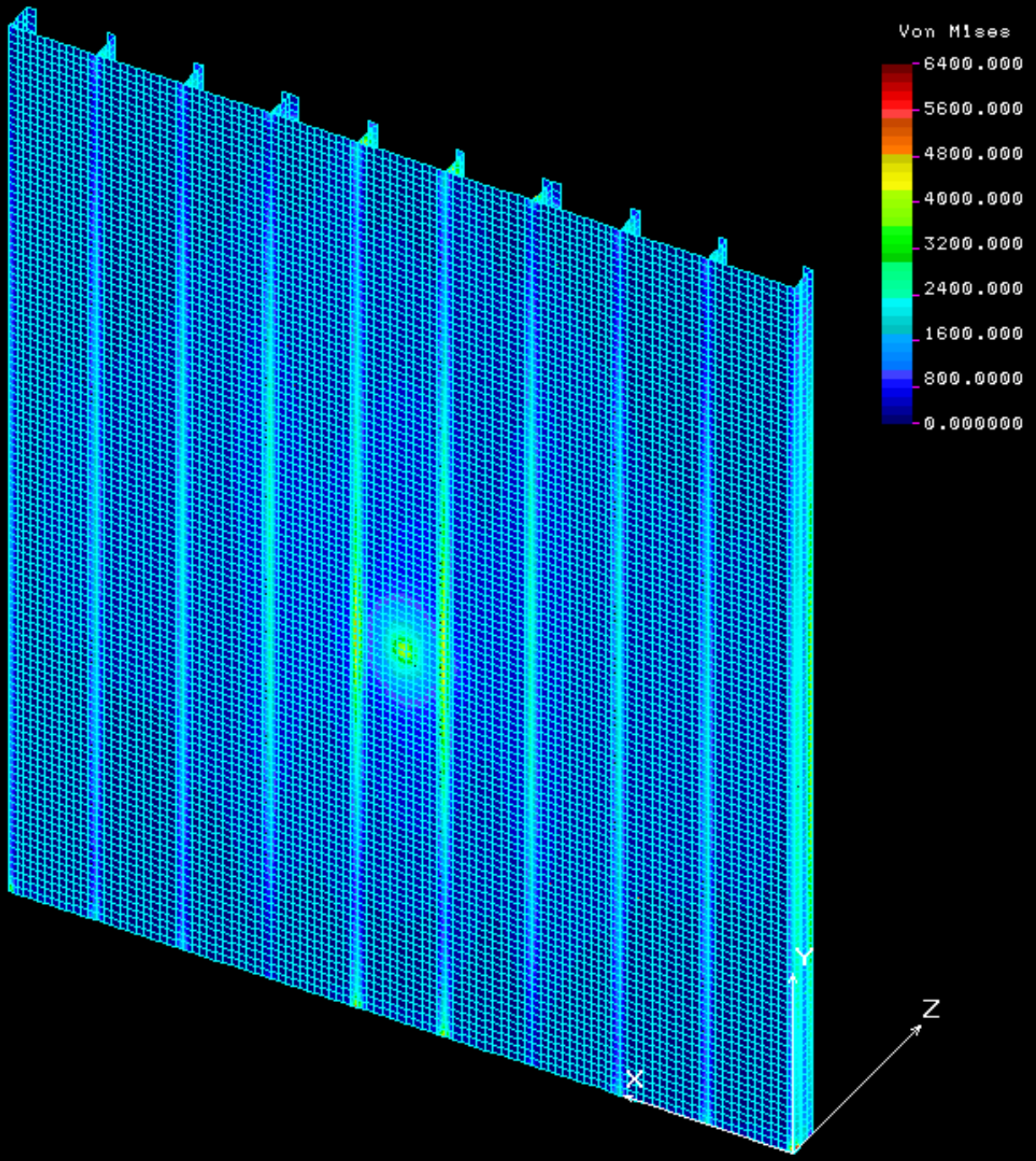
Load “F” Frame Side Z Deflection (in)



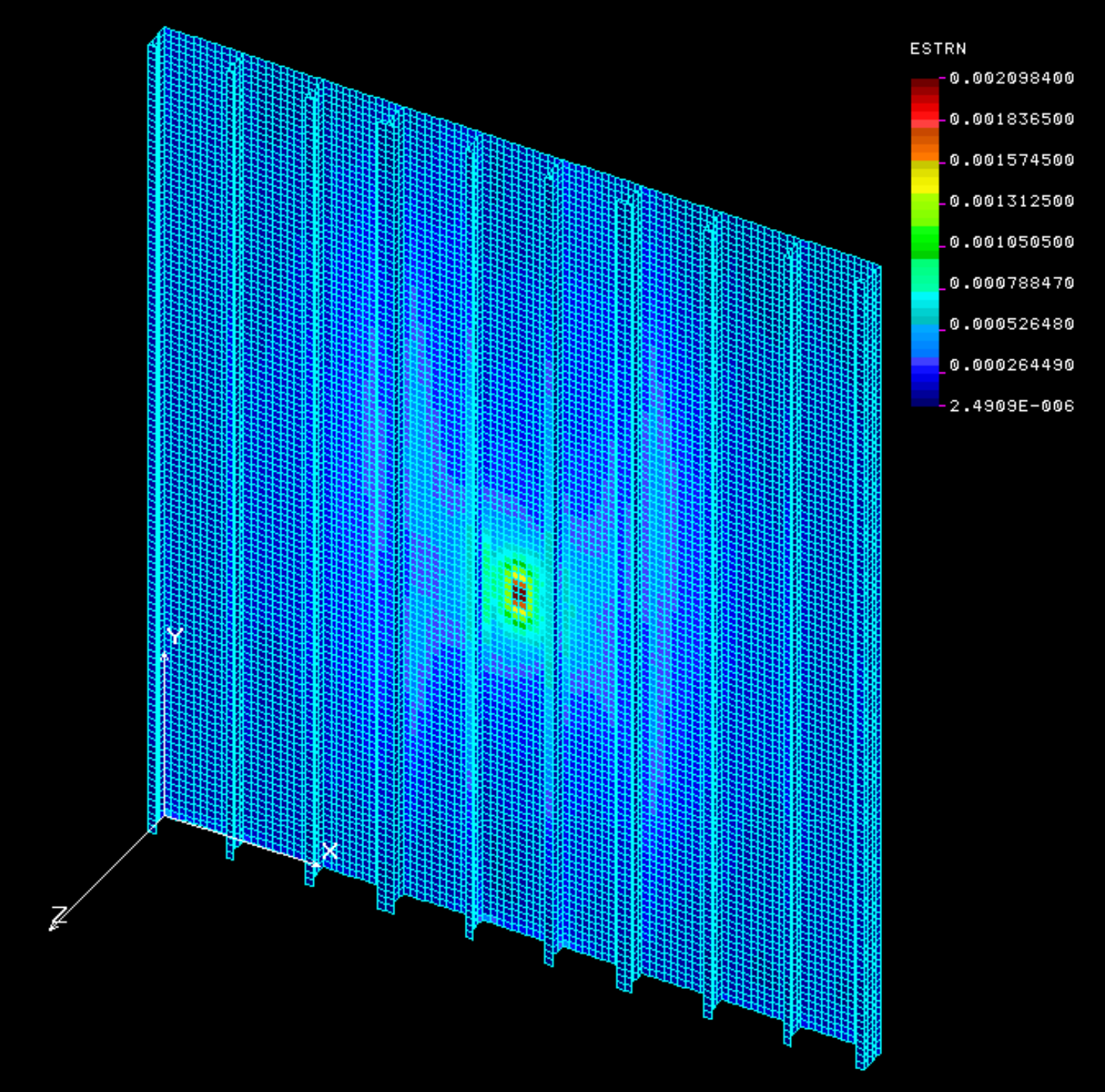
Load “F”
Front Face
Z Deflection
(in)



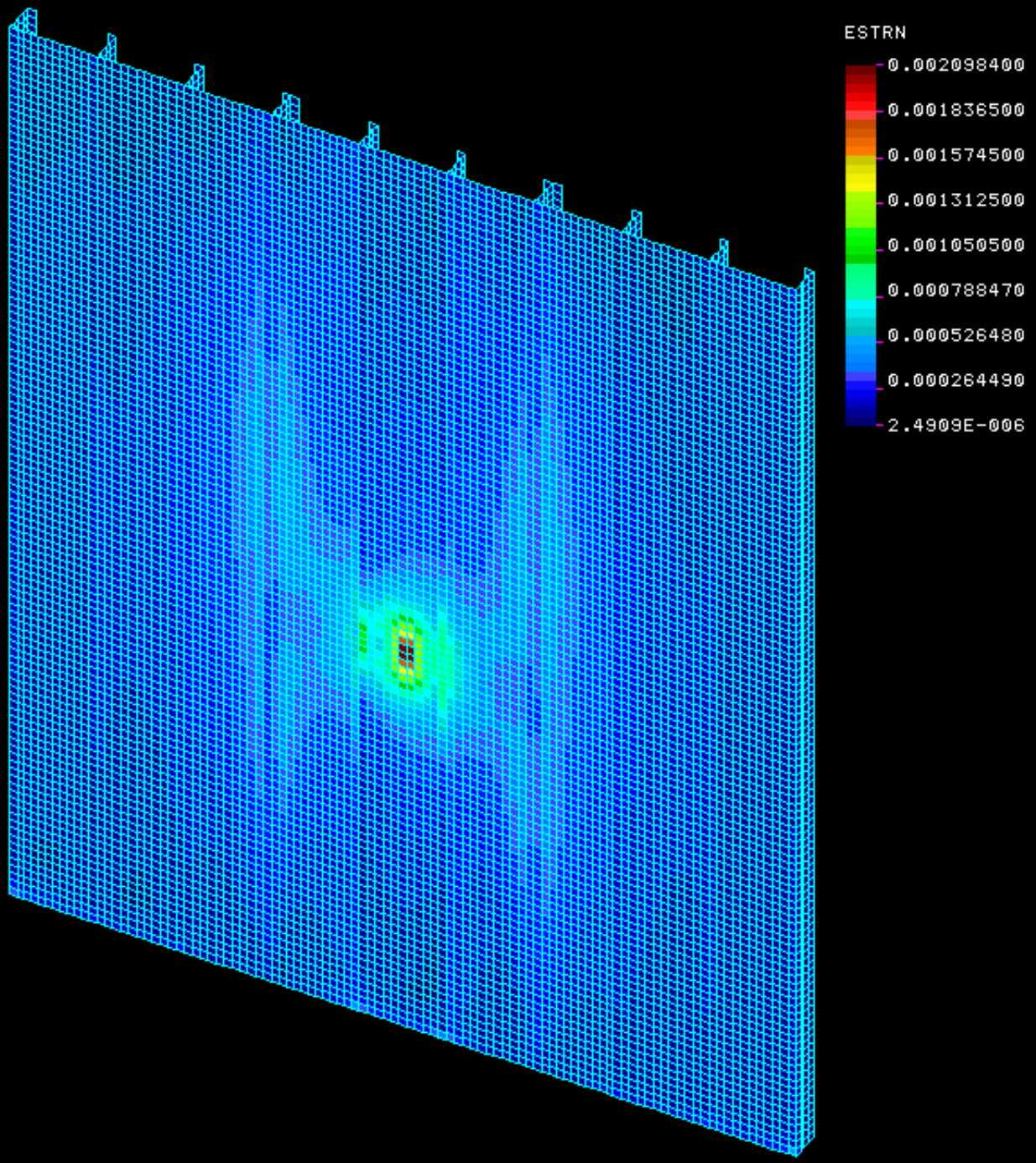
Load “F” Frame Stress (psi)



Load “F” Panel Stress (psi)



Load “F” Frame Strain



Load “F” Panel Strain

Summary

- The lowest safety factor for the steel frames is 1.6, for load case “C”.
- The lowest safety factor for the GRP panels is 2, for load cases “E & F”.
- The current design is marginal for up to a 2000 lb point load for 14 ft high walls.
- Recommend Increase in steel frame thickness or height of 25%.