ARCOPLAST
12 ft Free Standing Double Sided Wall

Finite Element Model

By

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Wall Model

- Three 4’ x 12’ 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 = ε = 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 = ε = 0.0017 or 0.17%

Wall Model Constraints

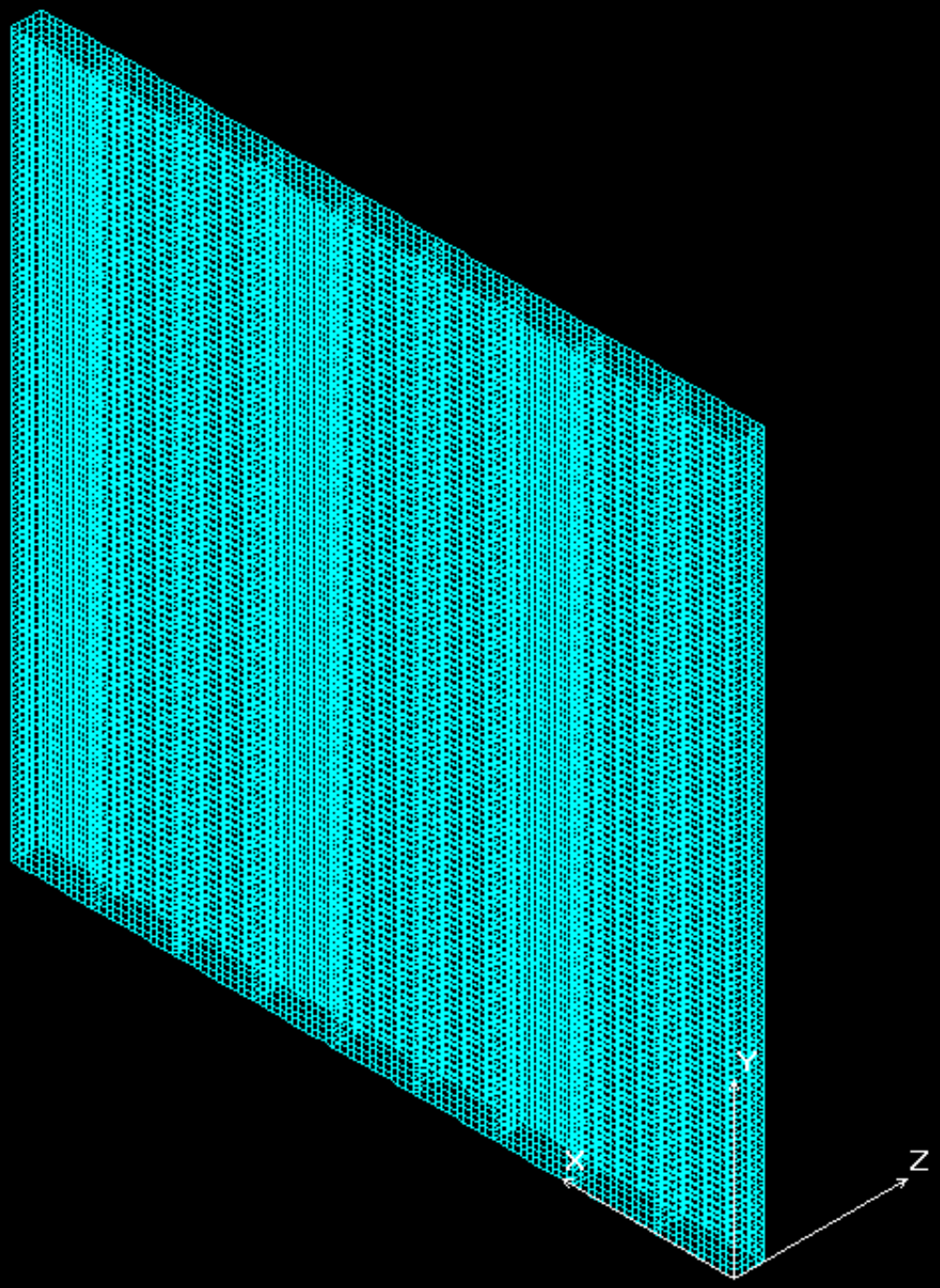
- Z displacement constrained to zero at top and bottom ends
- Y displacement constrained to zero at bottom end
- X displacement constrained to zero at one vertical edge

Load Cases

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

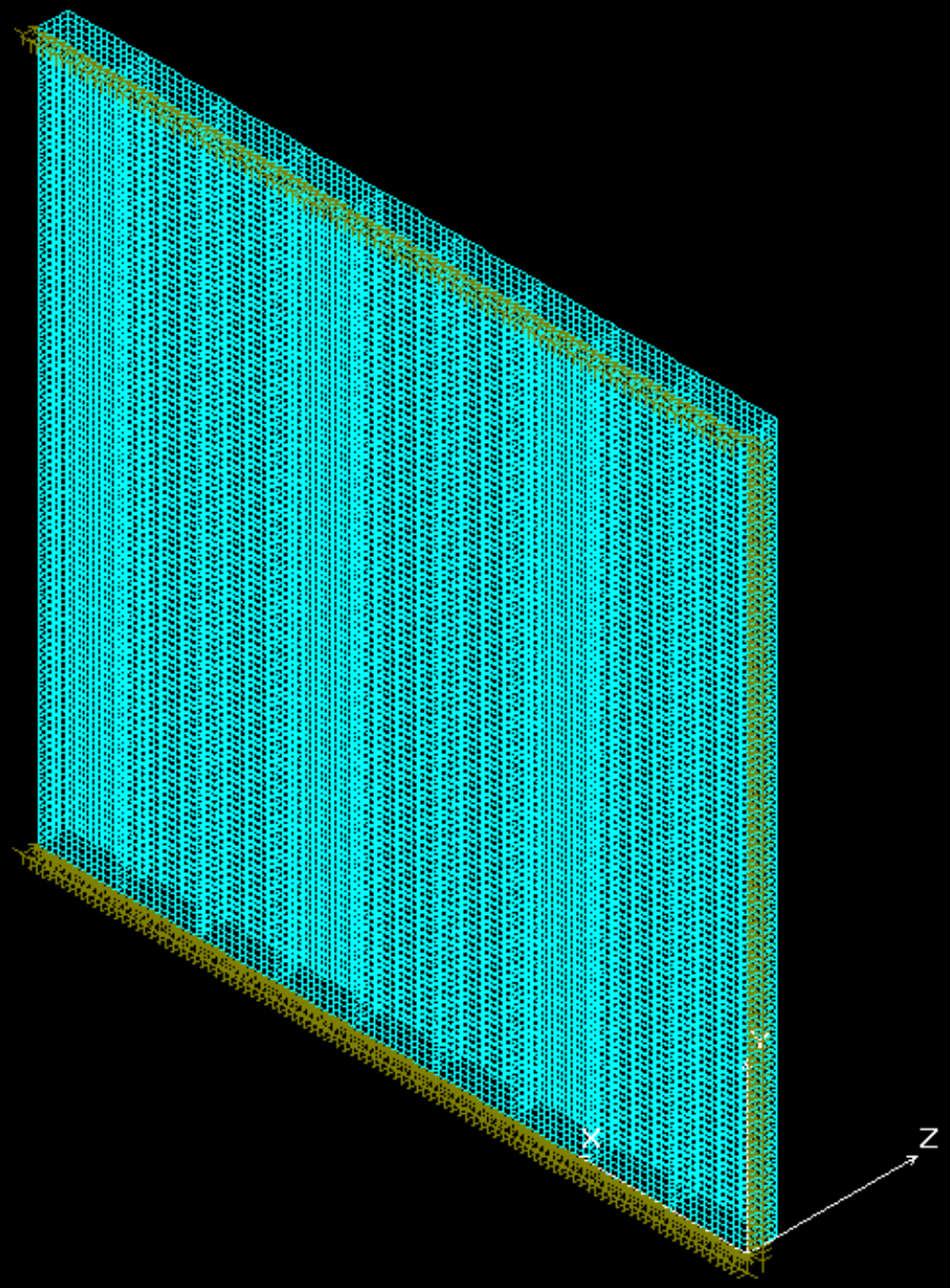
- 2000 lb point load on frame 2 ft above floor (A)
- 2000 lb point load on frame 4 ft above floor (B)
- 2000 lb point load on frame 6 ft above floor (C)

- 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)



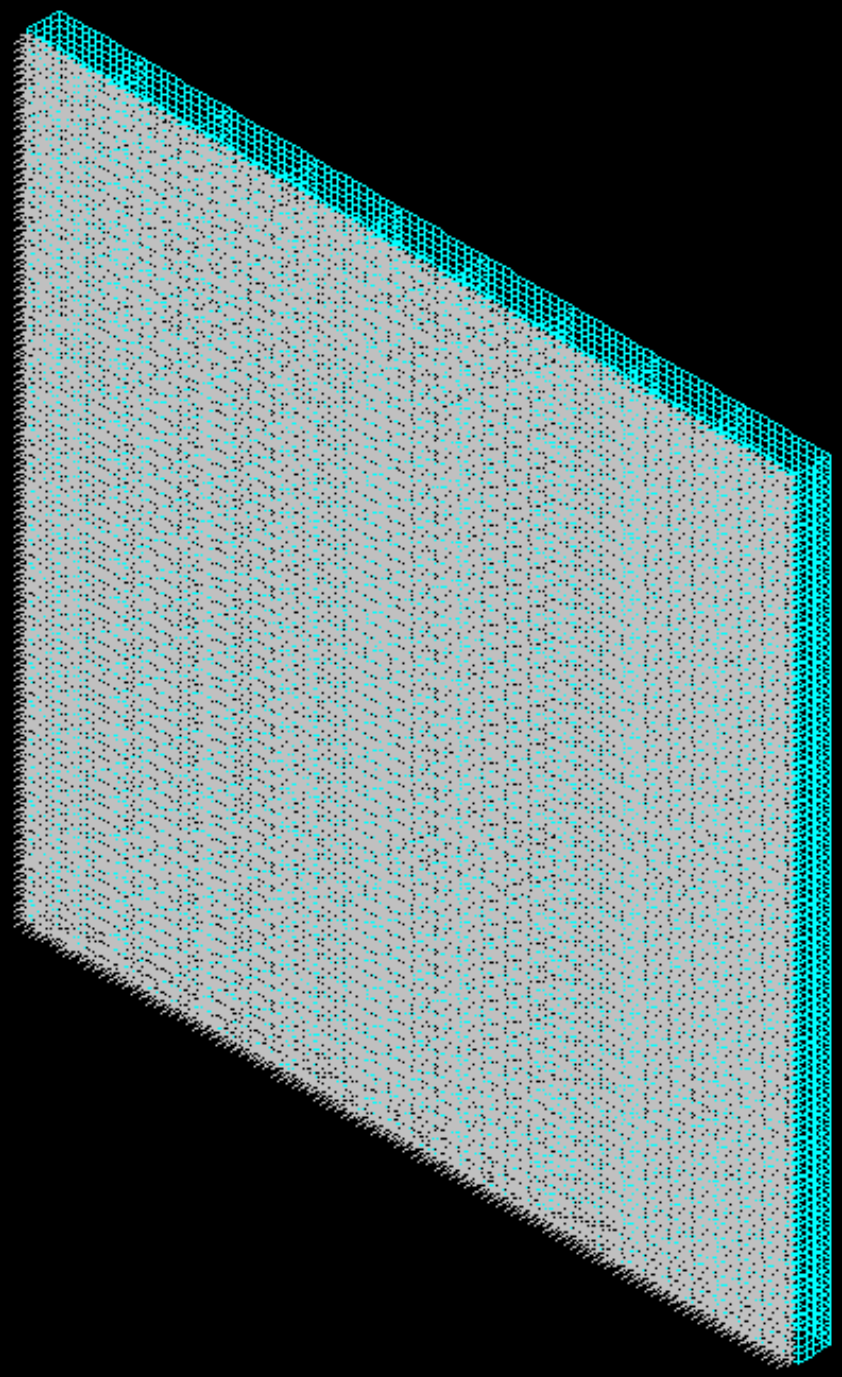
Finite Element Grid

Constraints

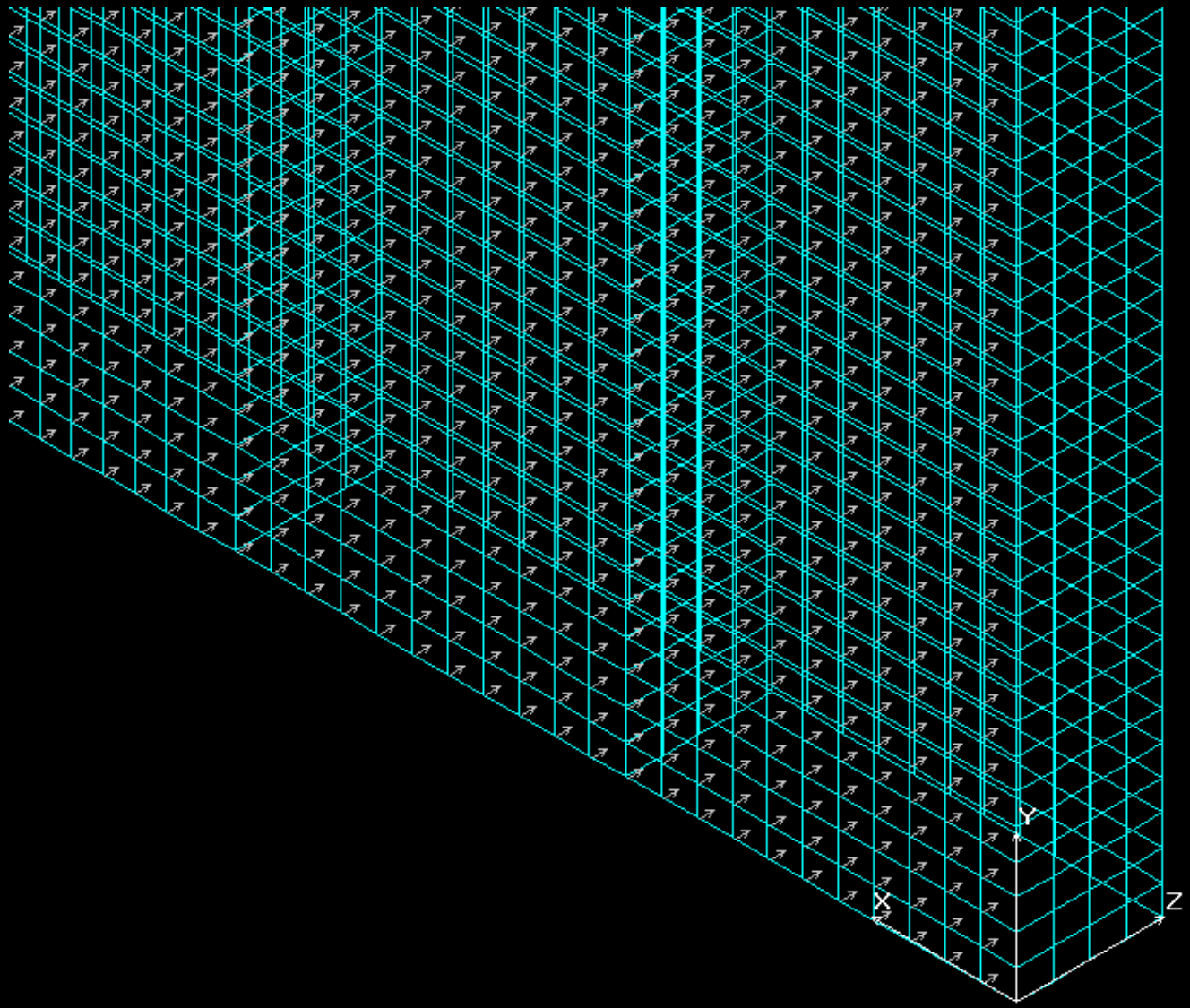


Pressure Load Only

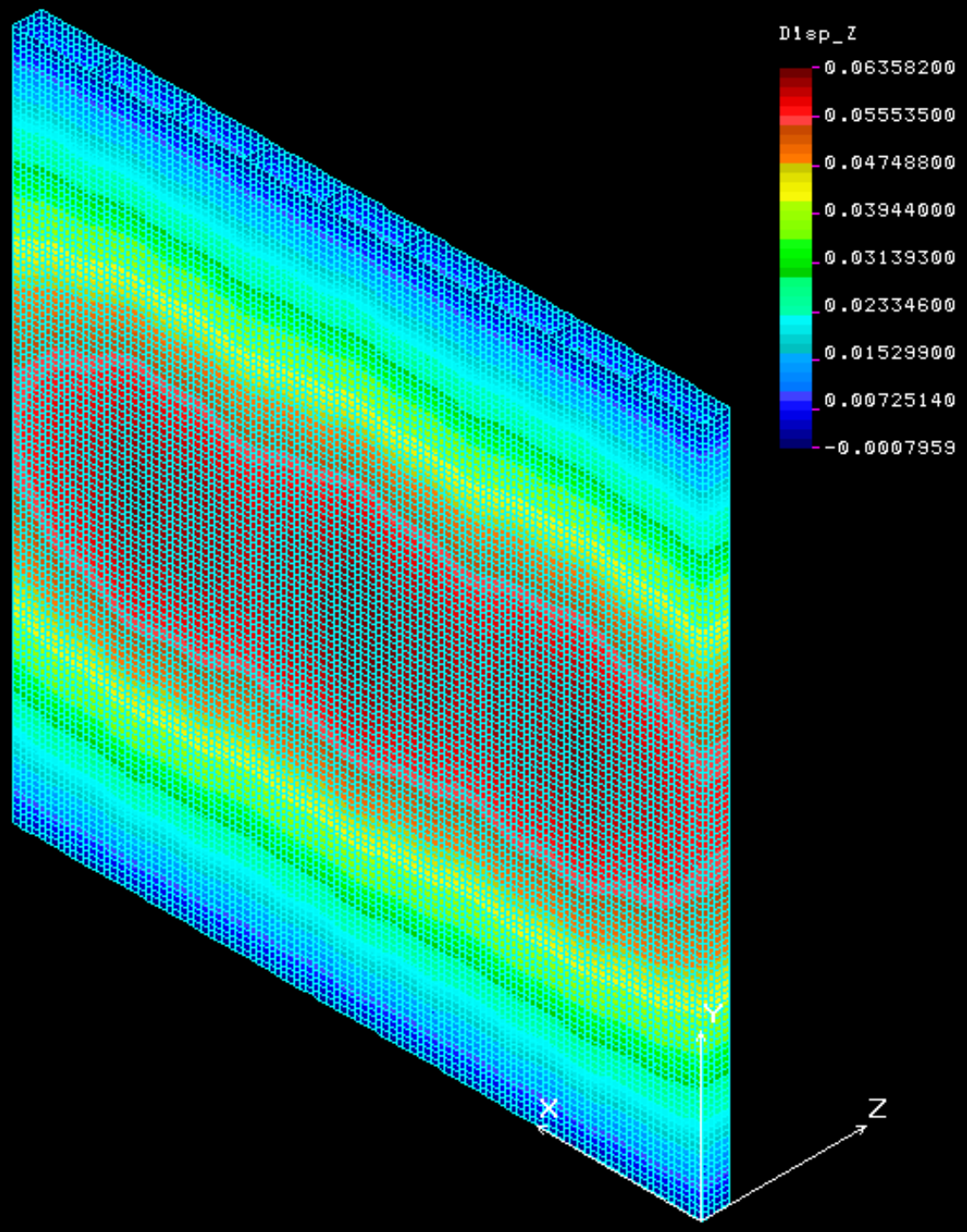
- 0.287 psi on wall panels



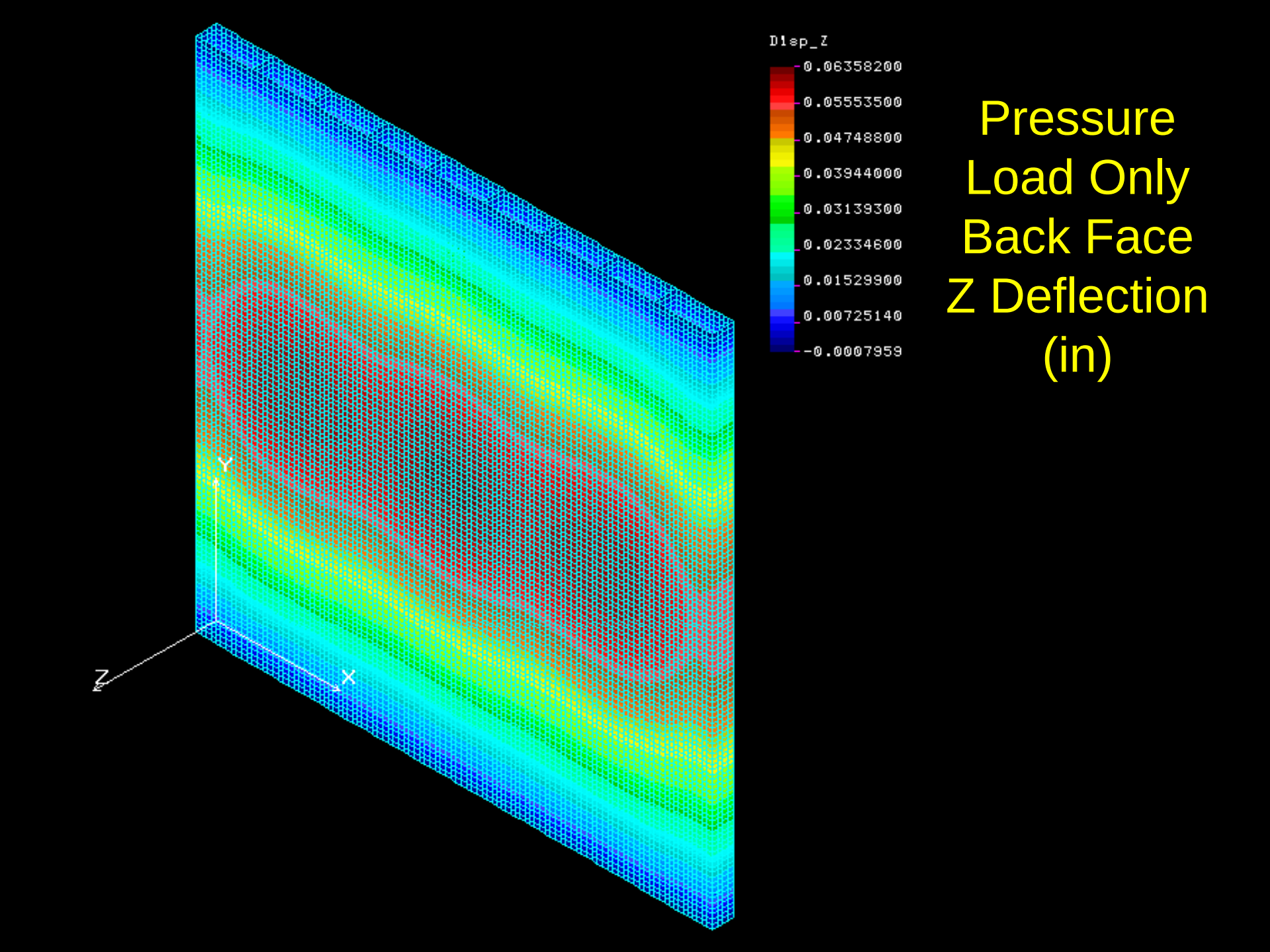
Pressure Load



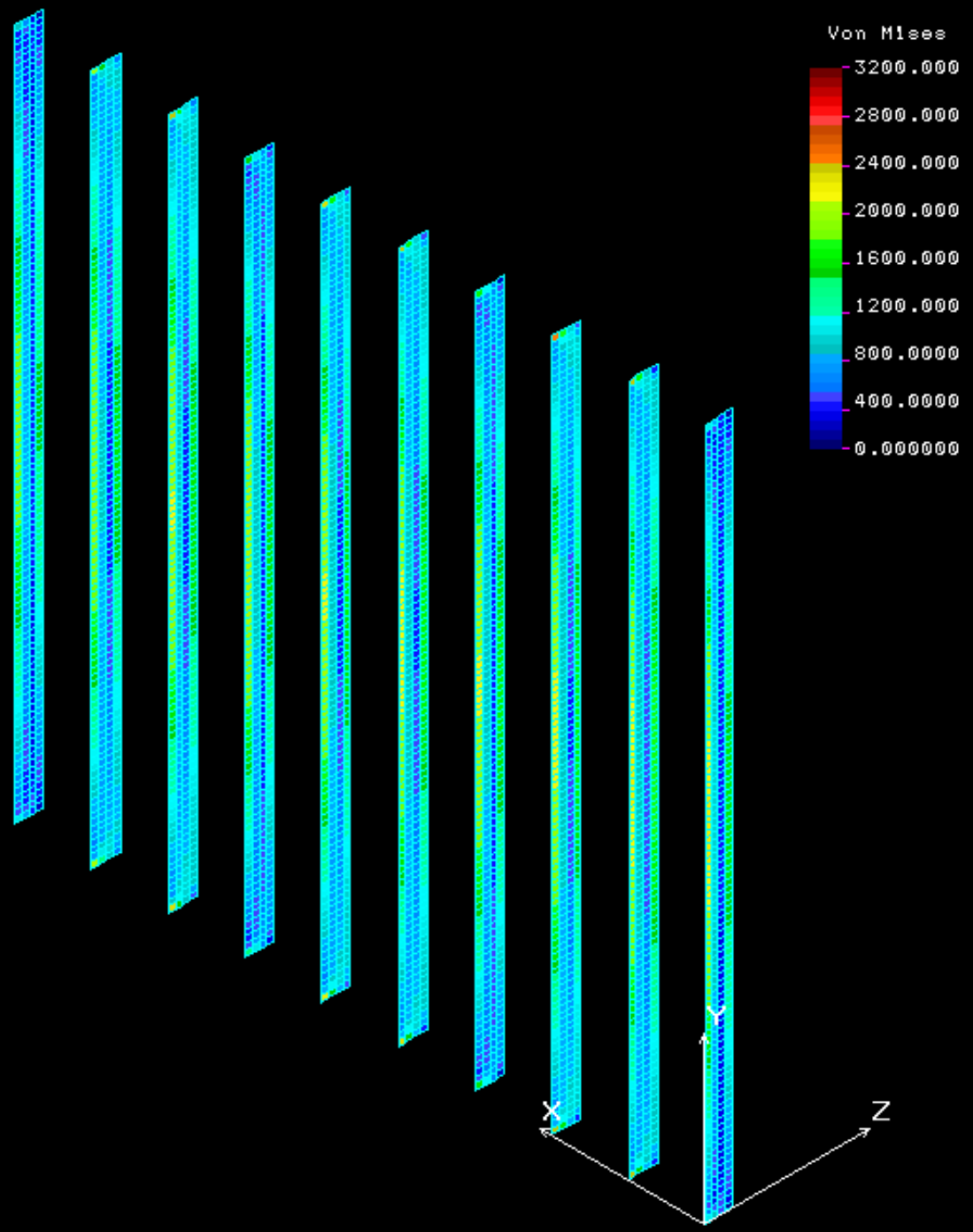
Pressure Load Closeup



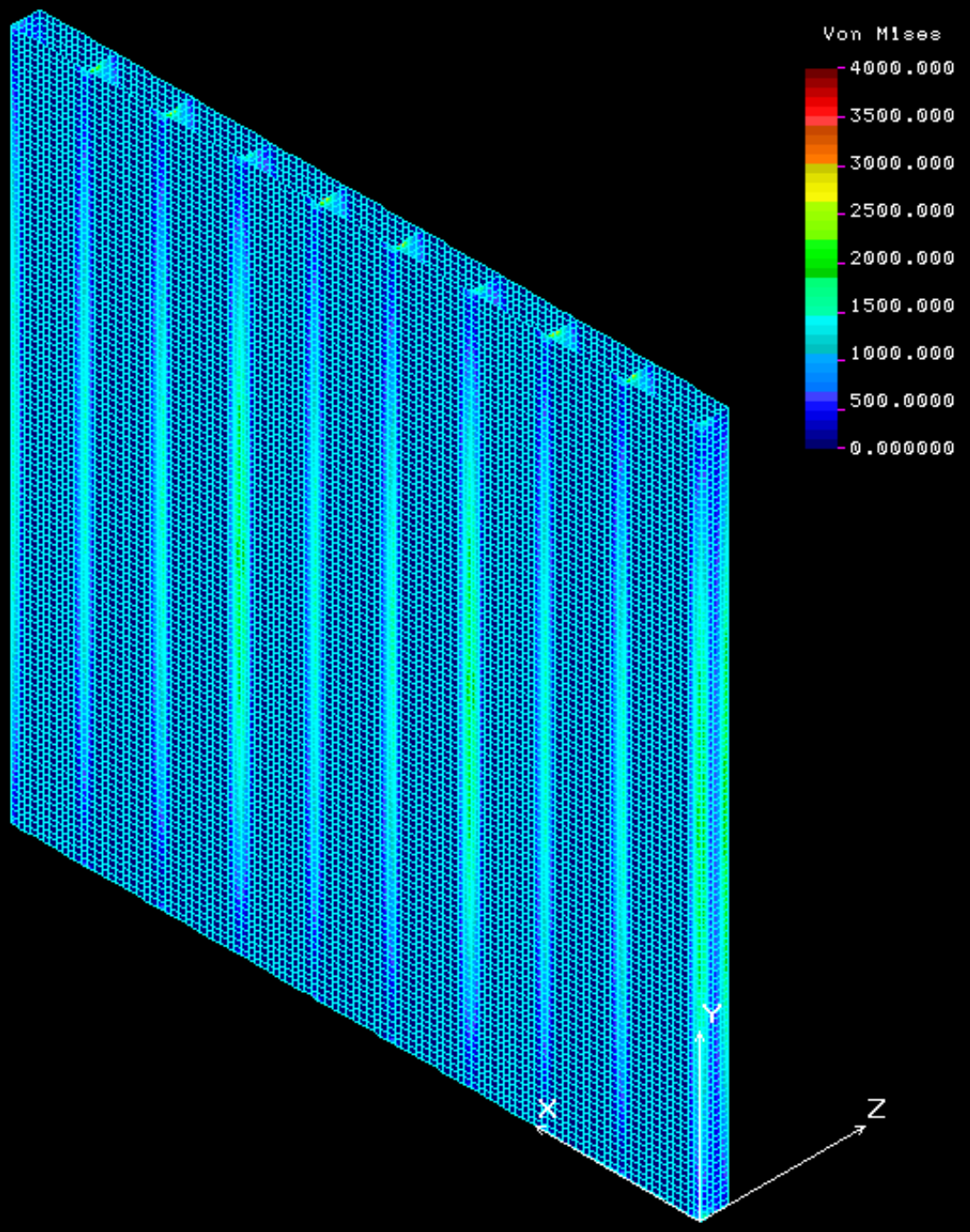
Pressure Load Only Front Face Z Deflection (in)



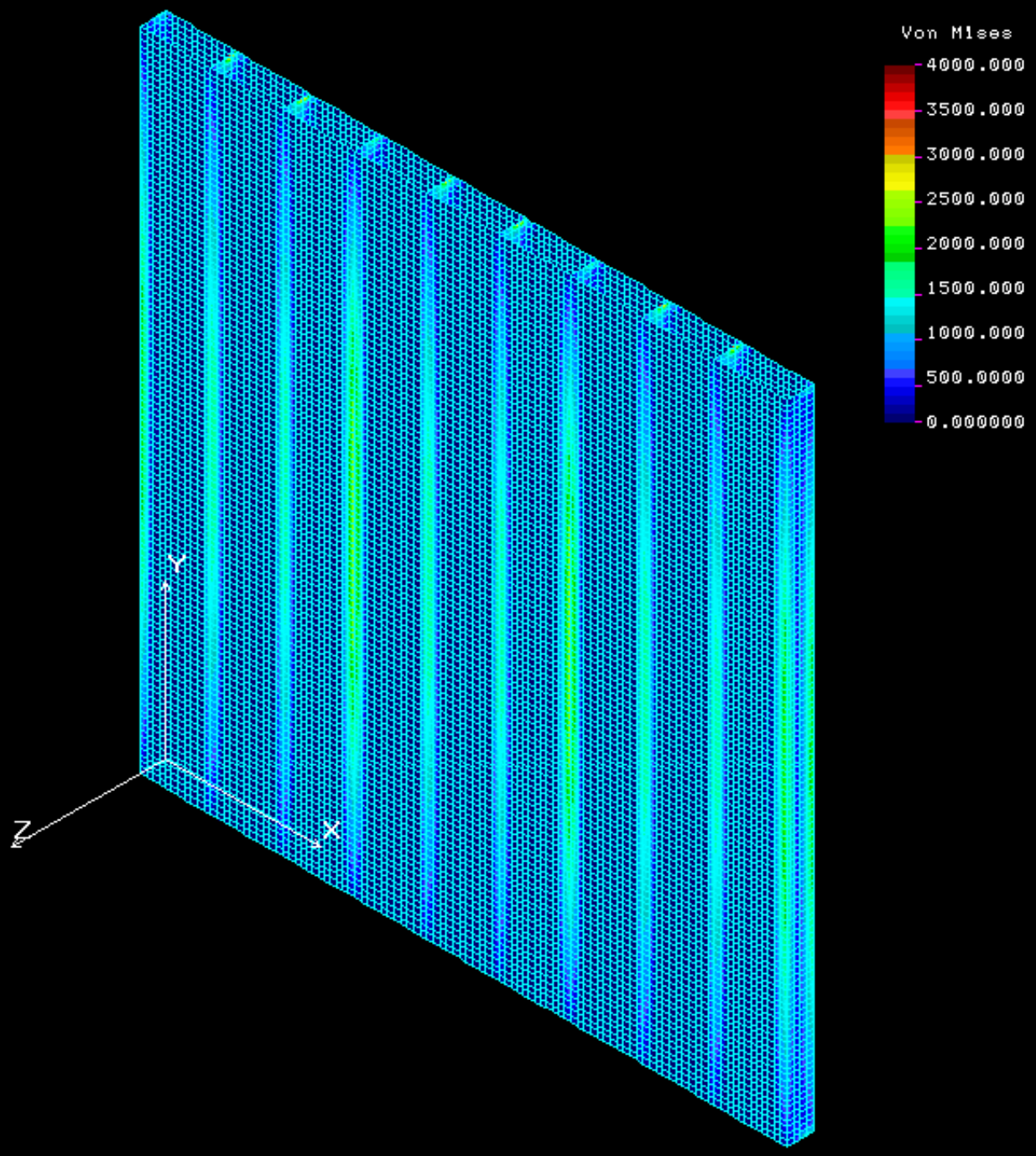
Pressure Load Only Back Face Z Deflection (in)



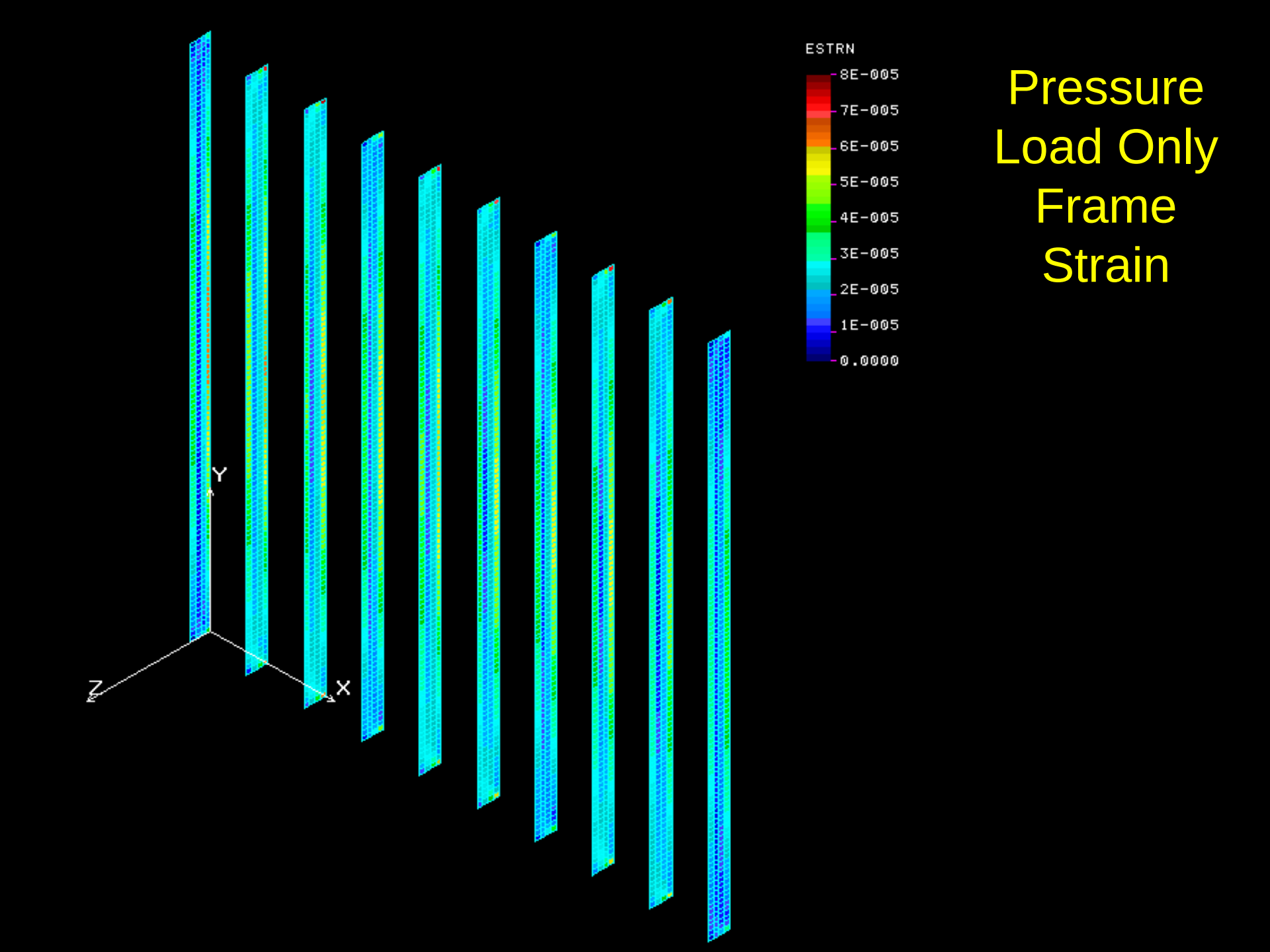
Pressure Load Only Frame Stress (psi)



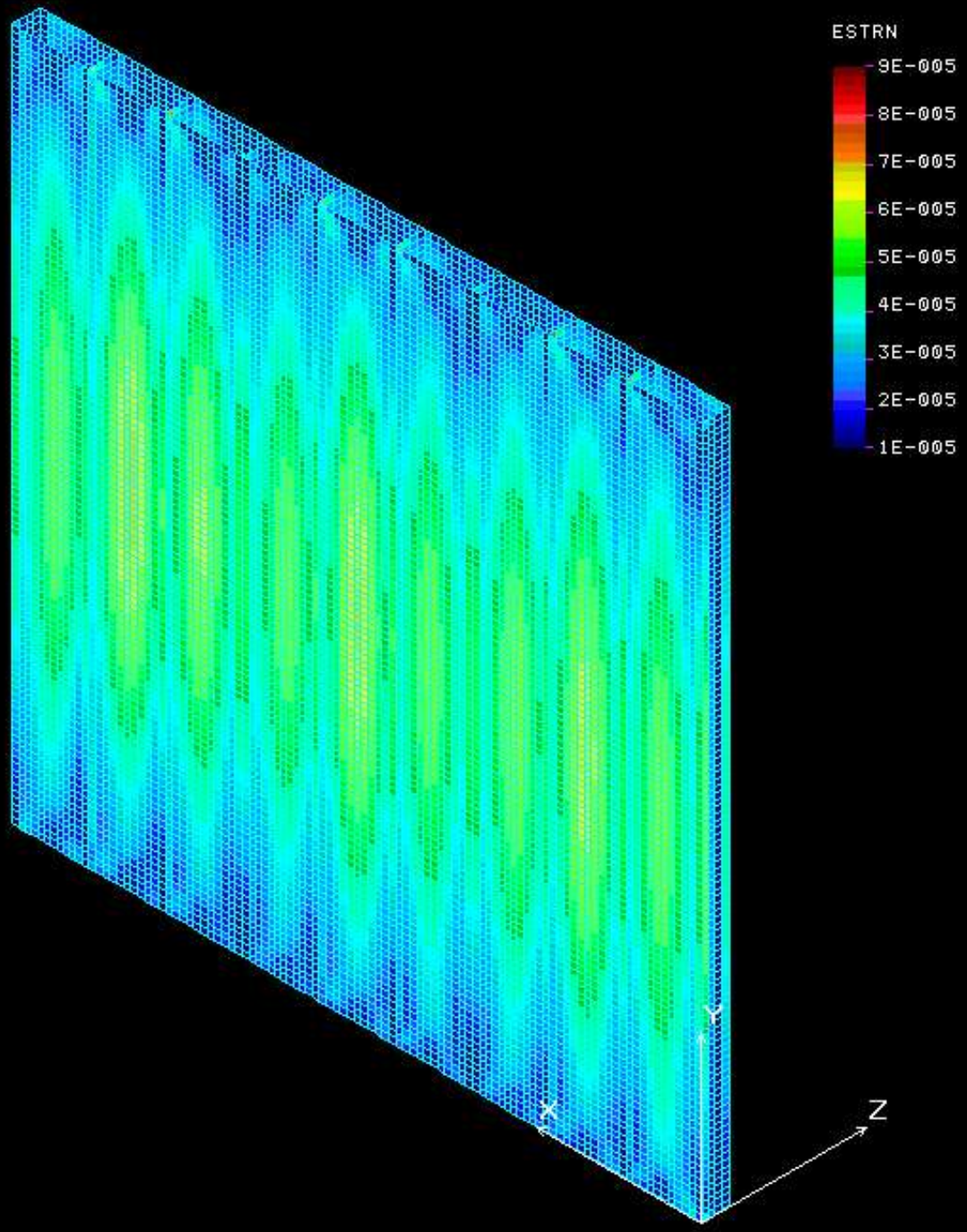
Pressure Load Only Front Panel Stress (psi)



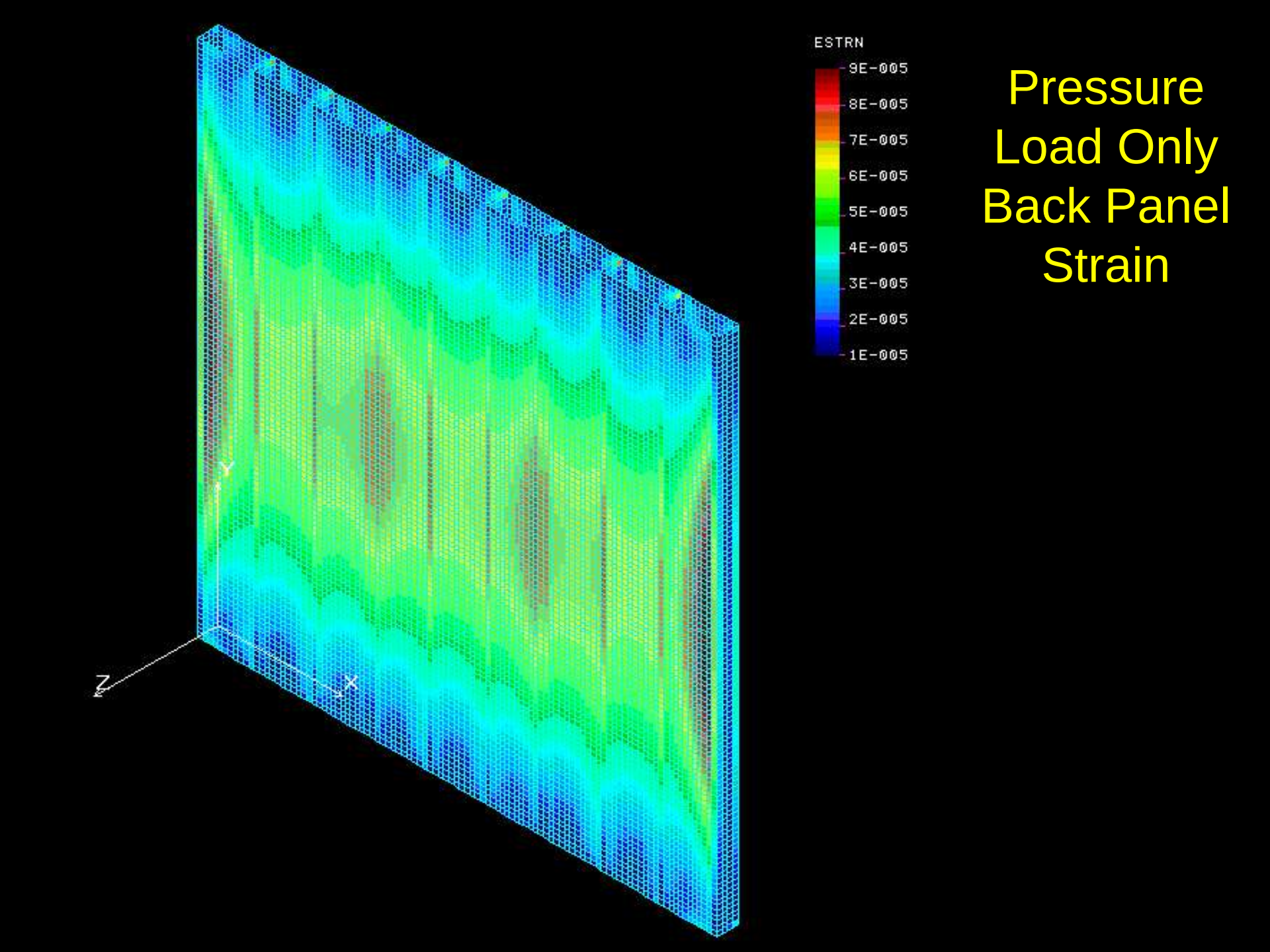
Pressure Load Only Back Panel Stress (psi)



Pressure Load Only Frame Strain



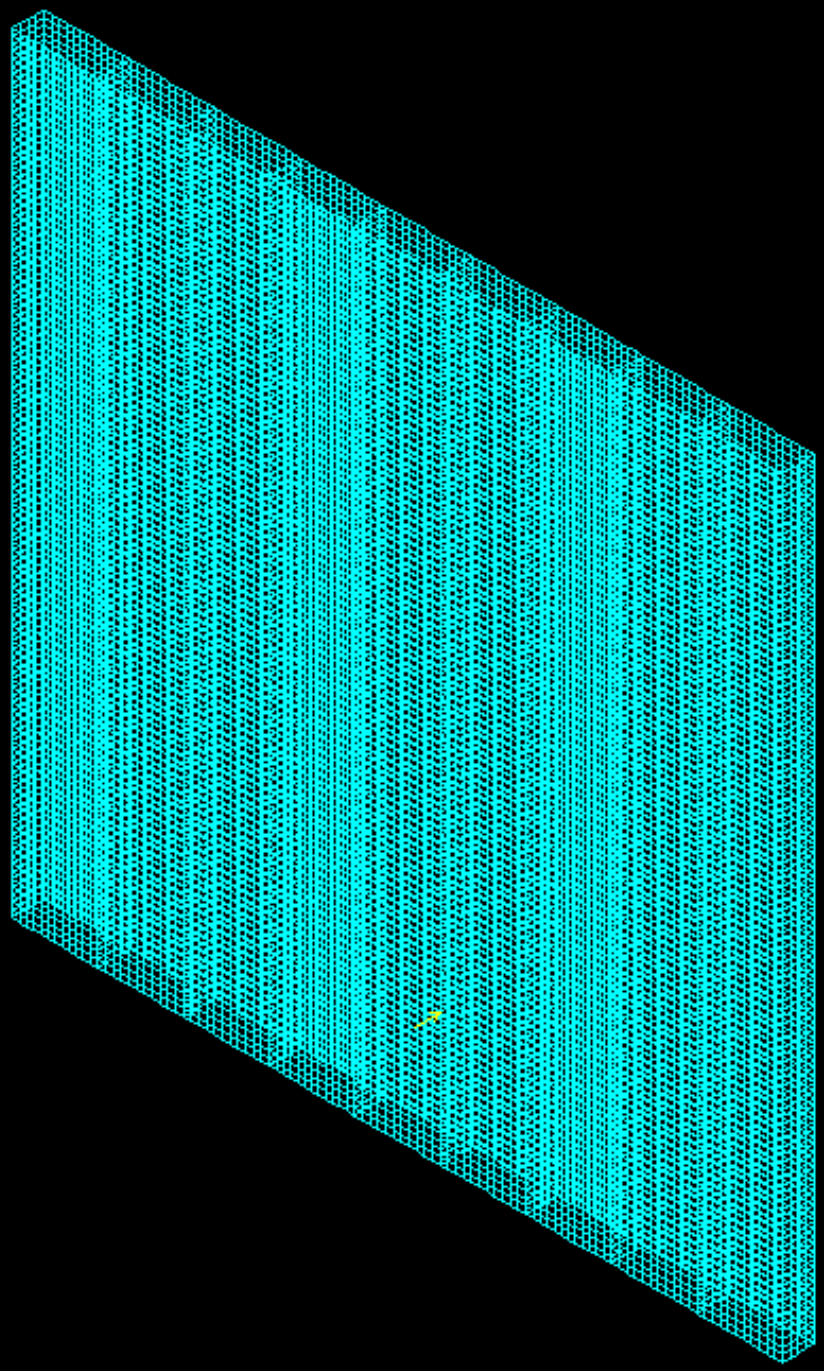
Pressure Load Only Front Panel Strain



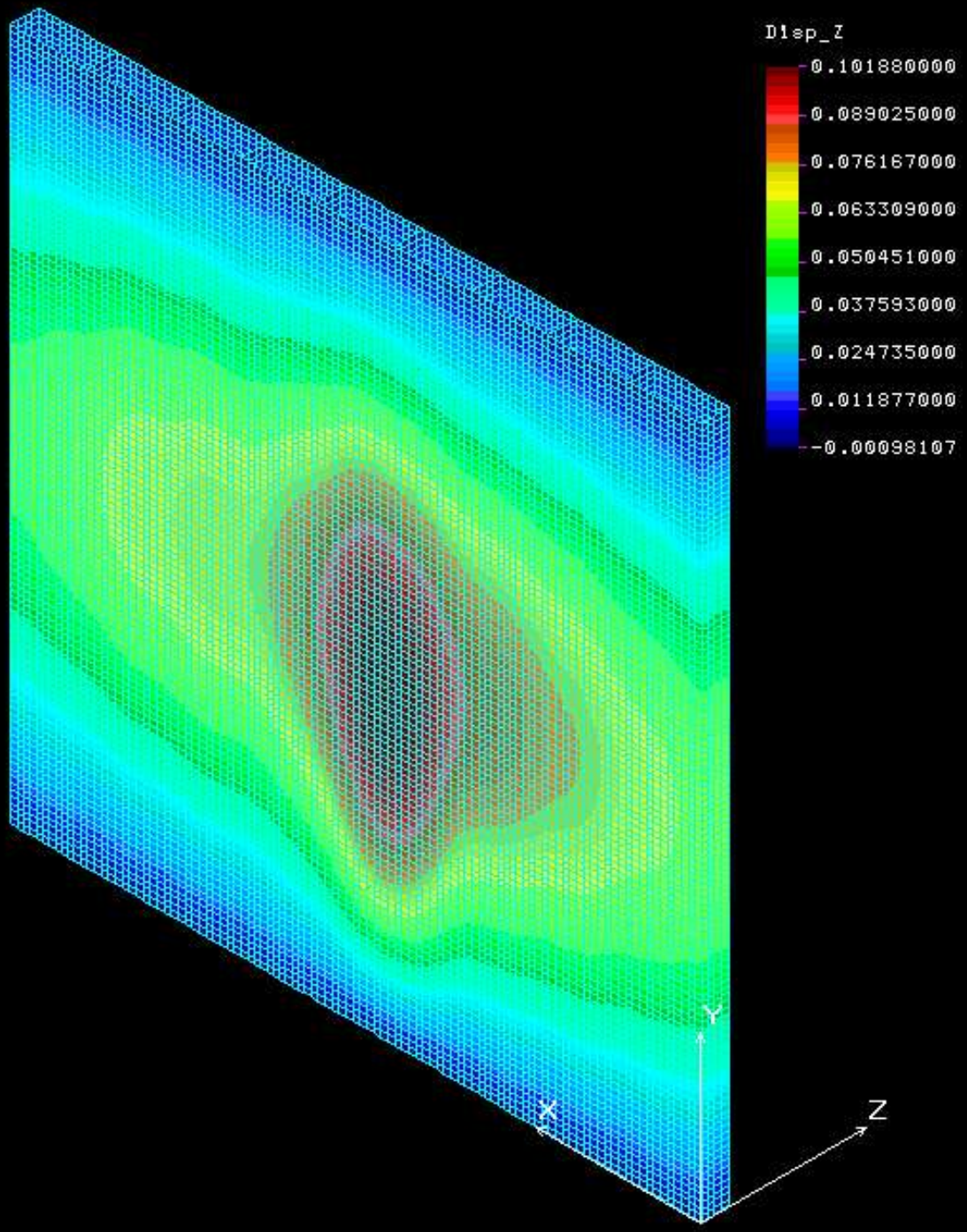
Pressure Load Only Back Panel Strain

Loading “A”

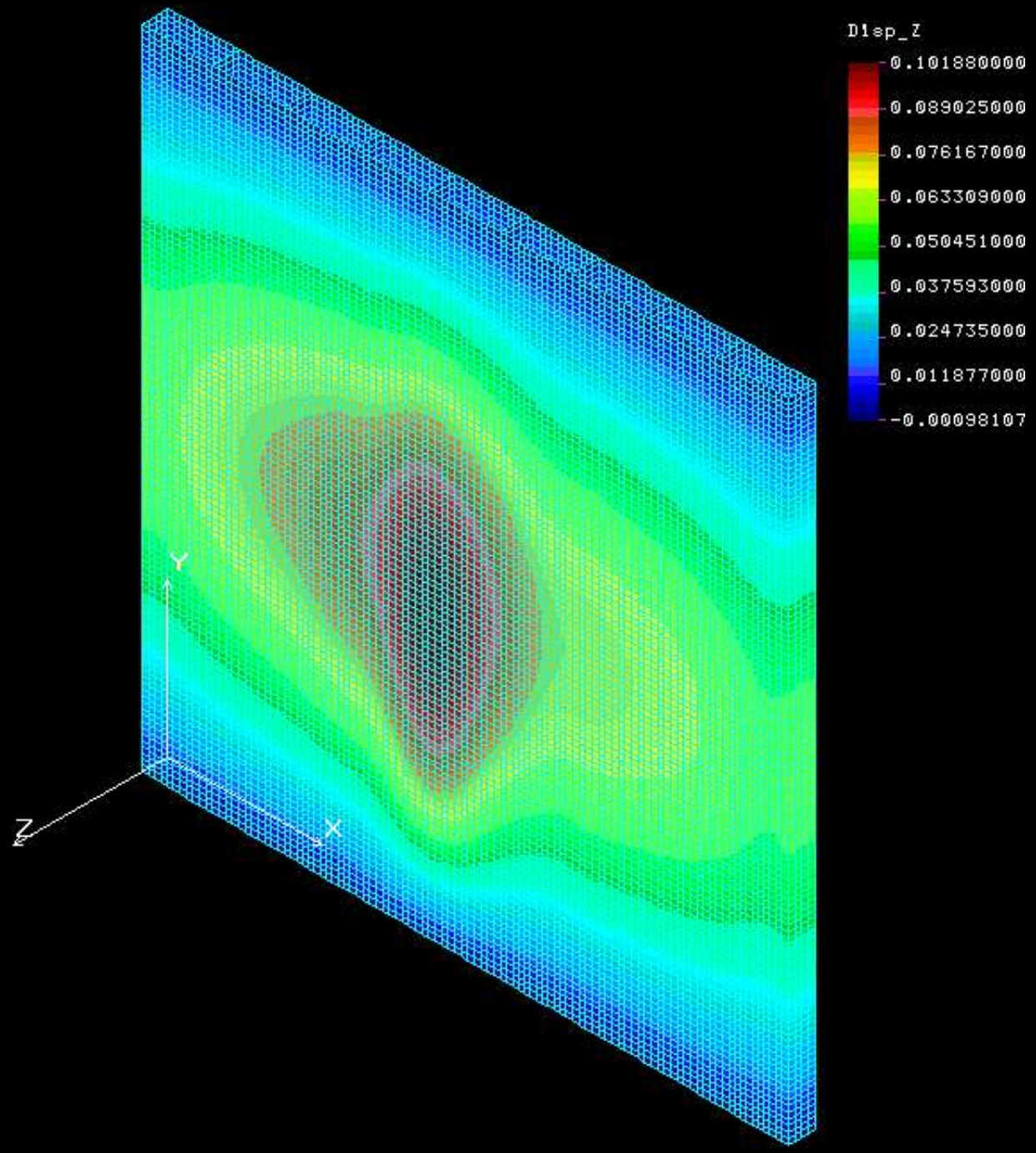
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 2 ft above floor



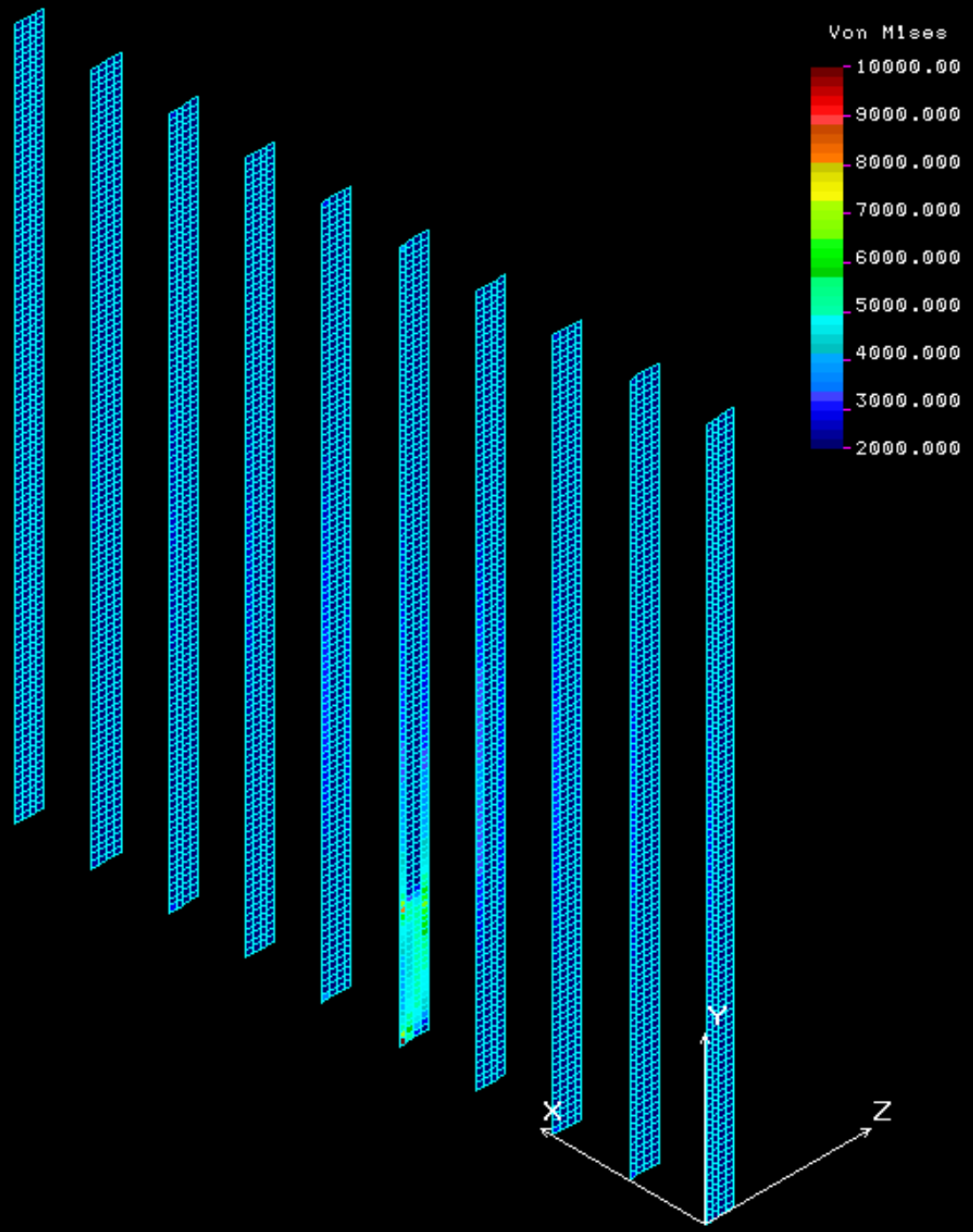
2000 lb point
force on frame
2 ft above floor



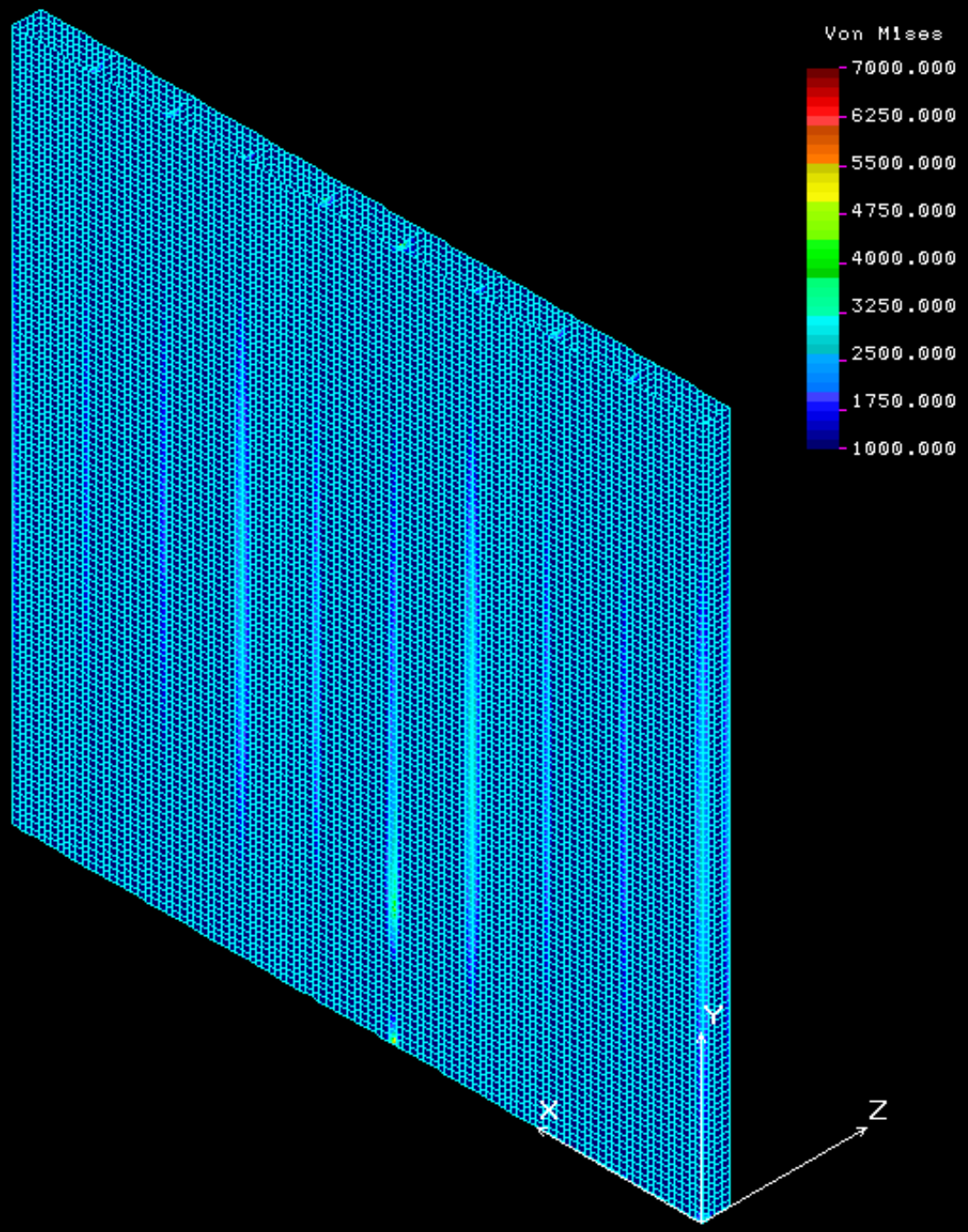
Load “A”
Front Face
Z Deflection
(in)



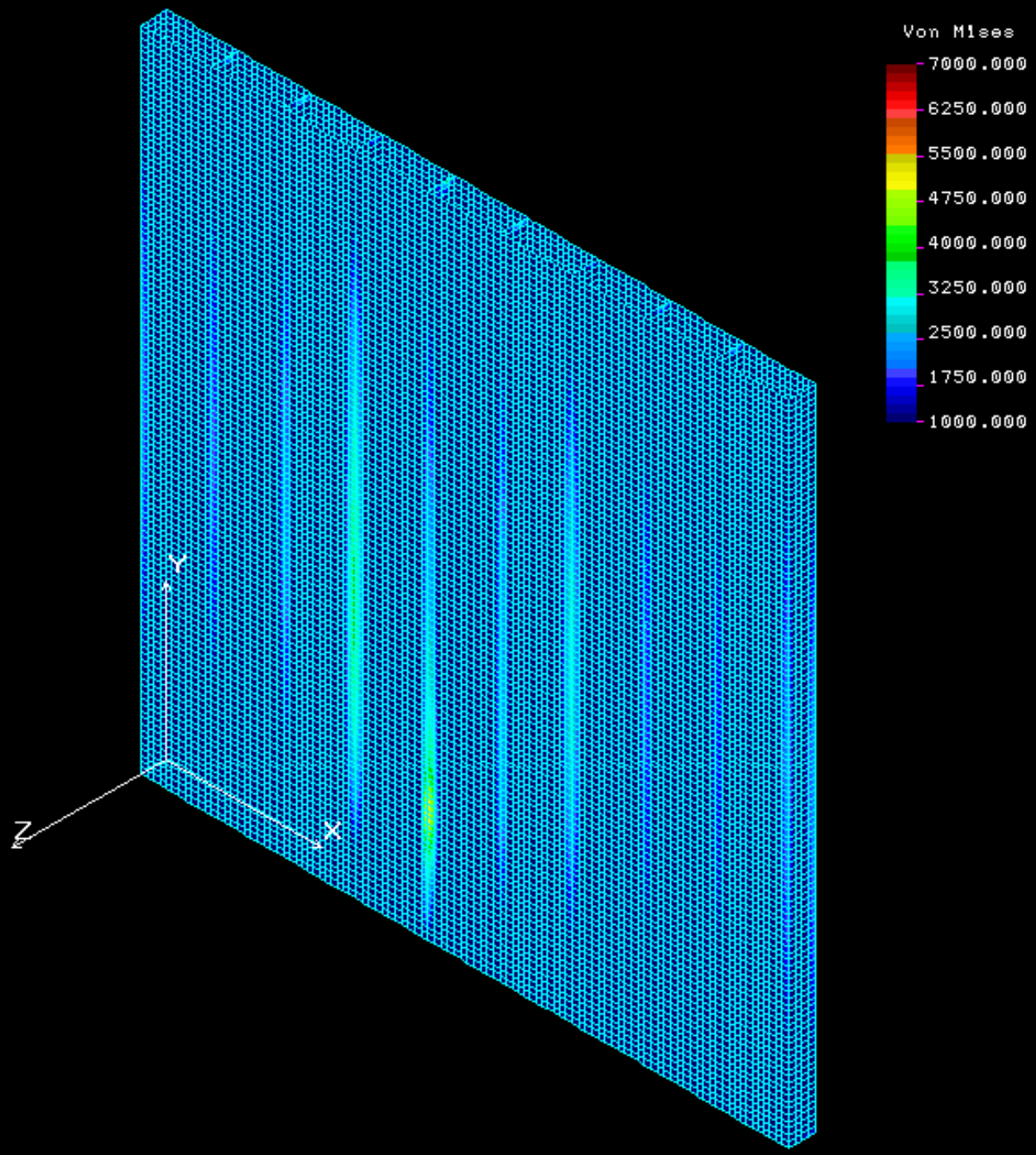
Load “A”
Back Face
Z Deflection
(in)



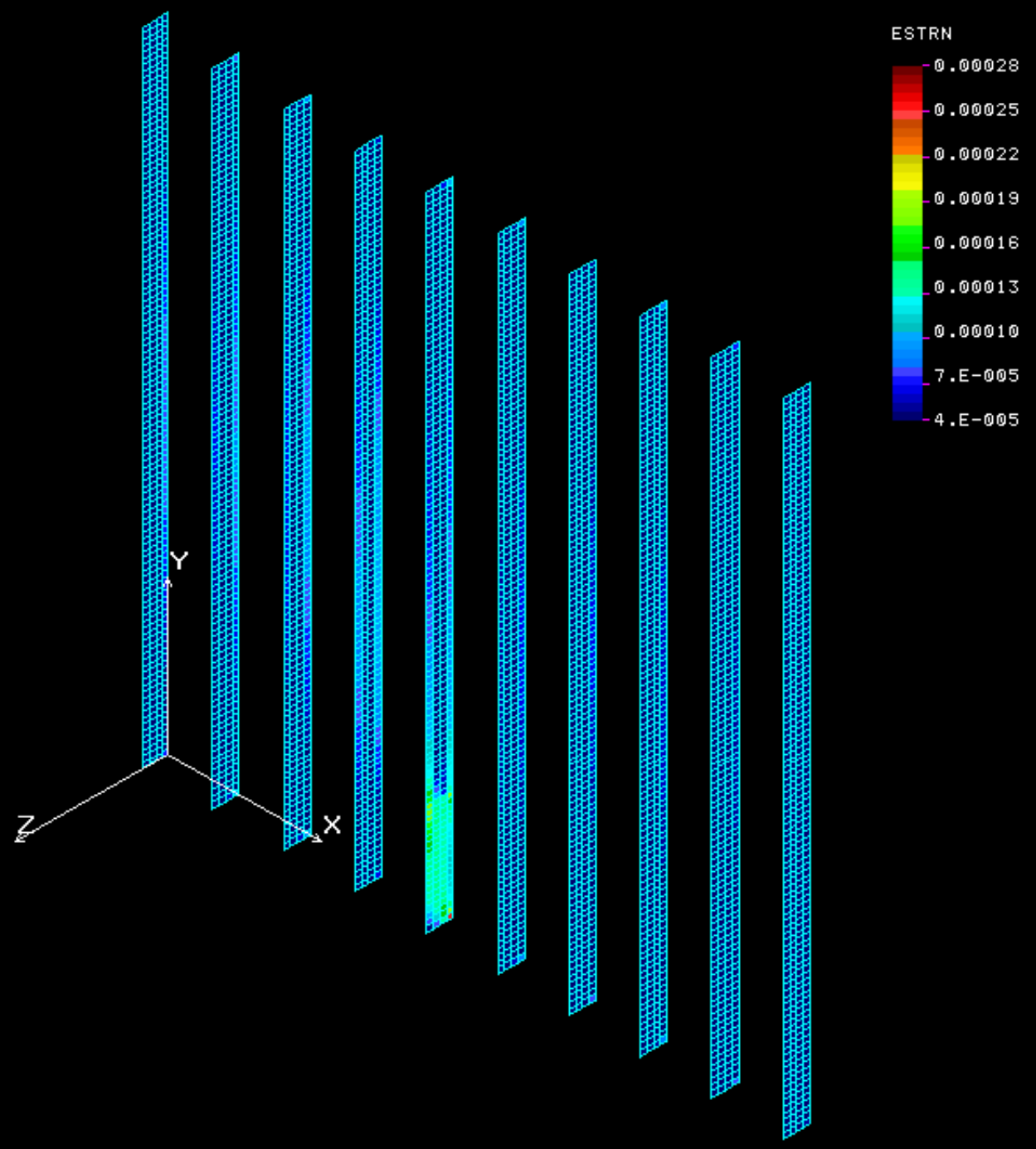
Load “A” Frame Stress (psi)



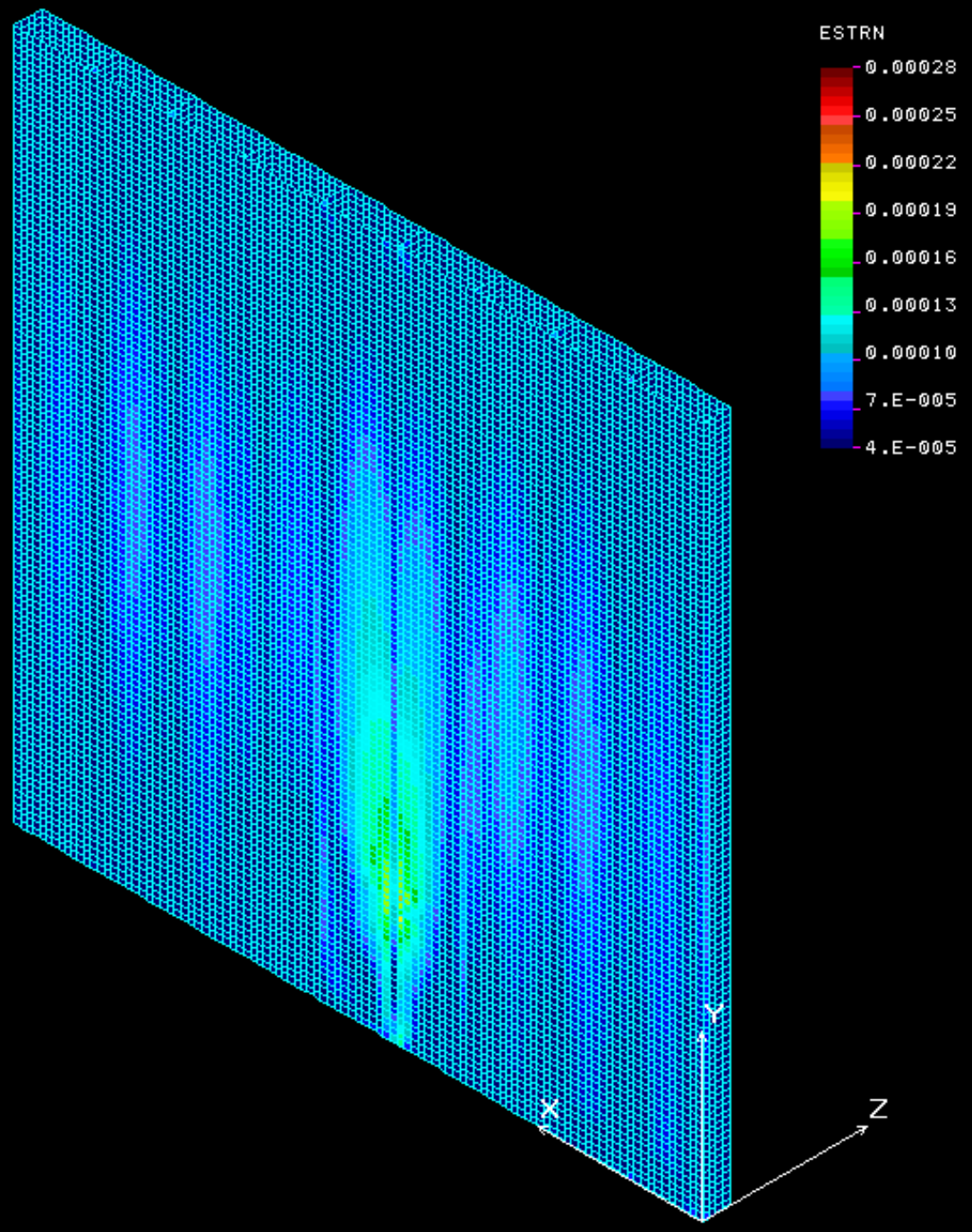
Load “A” Front Panel Stress (psi)



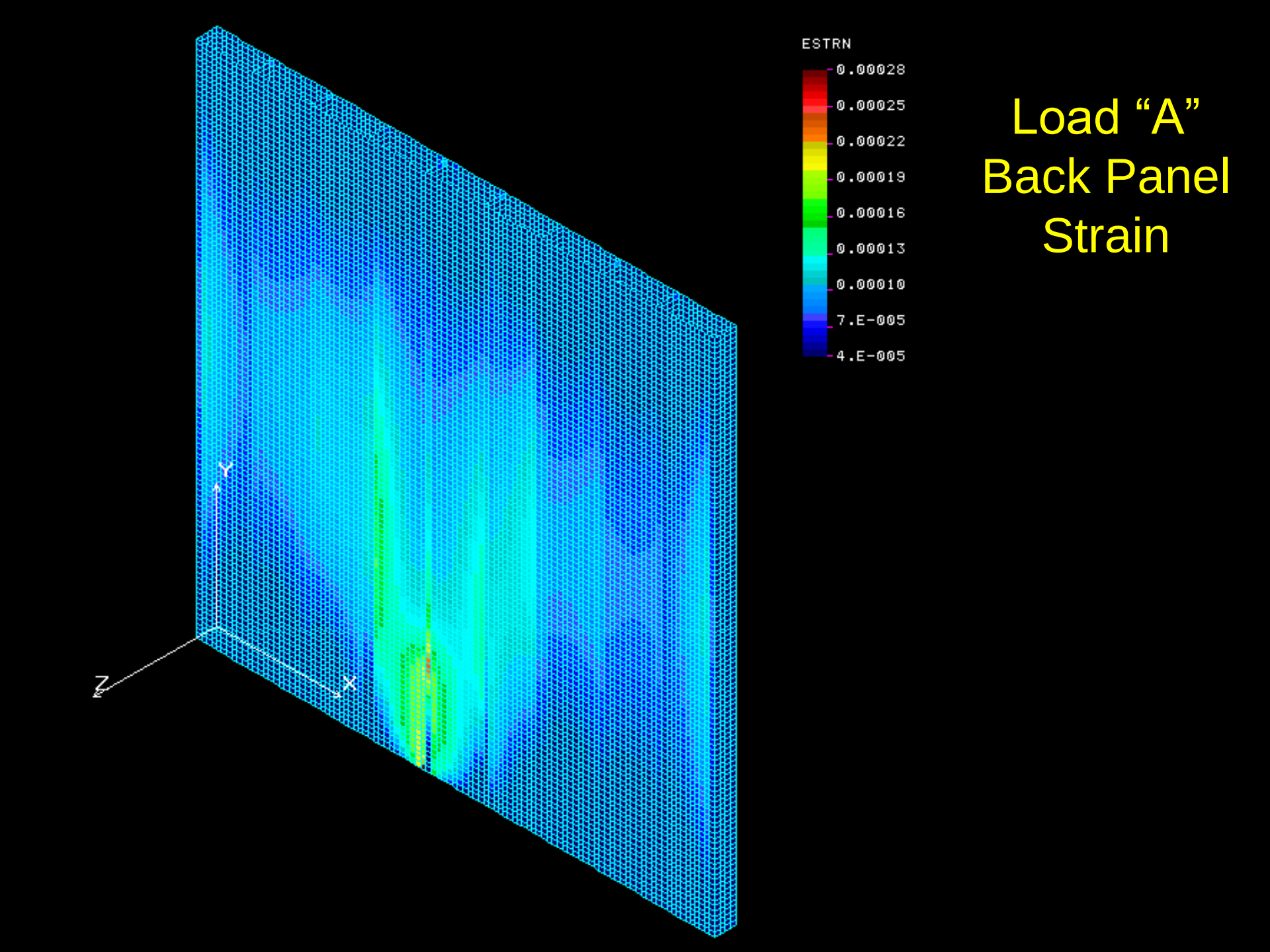
Load “A” Back Panel Stress (psi)



Load “A” Frame Strain



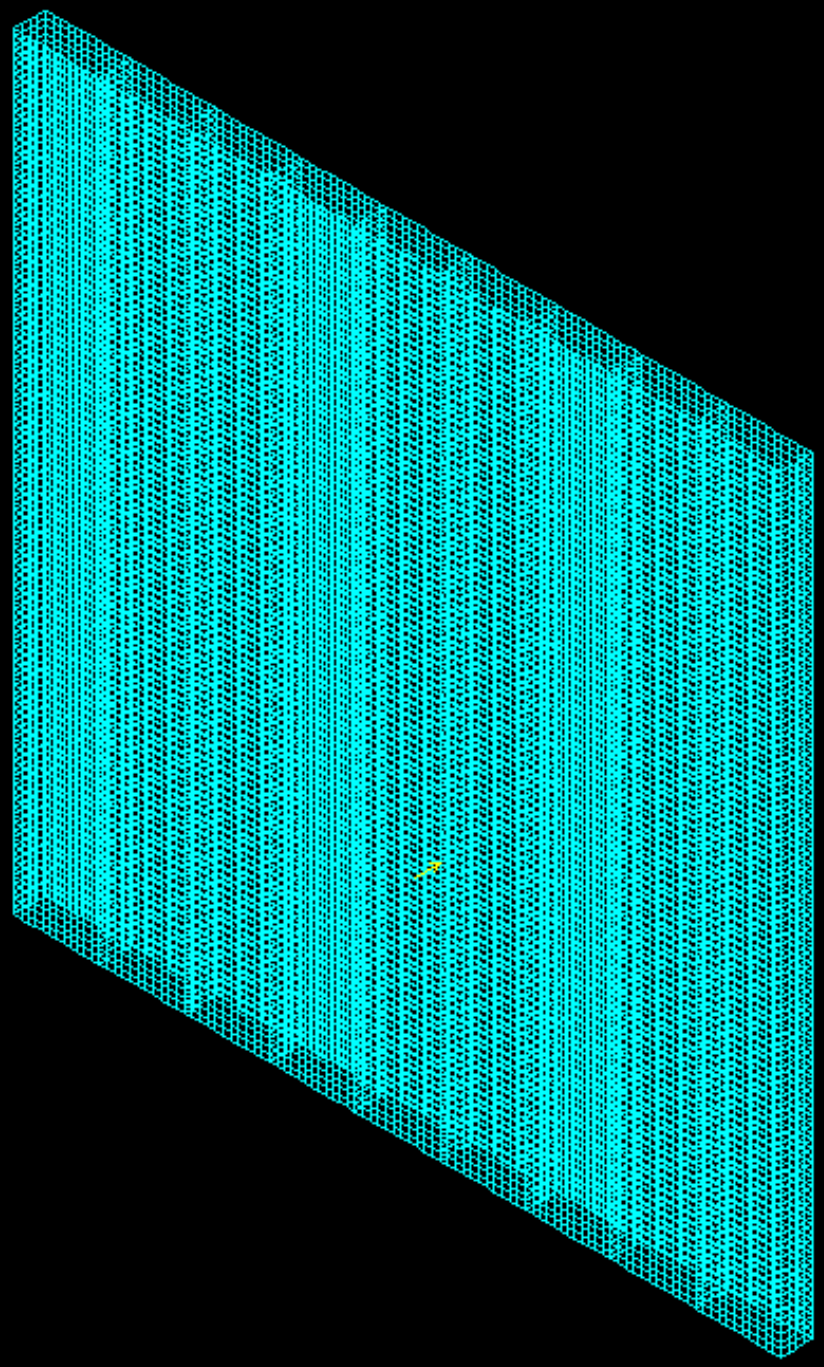
Load “A” Front Panel Strain



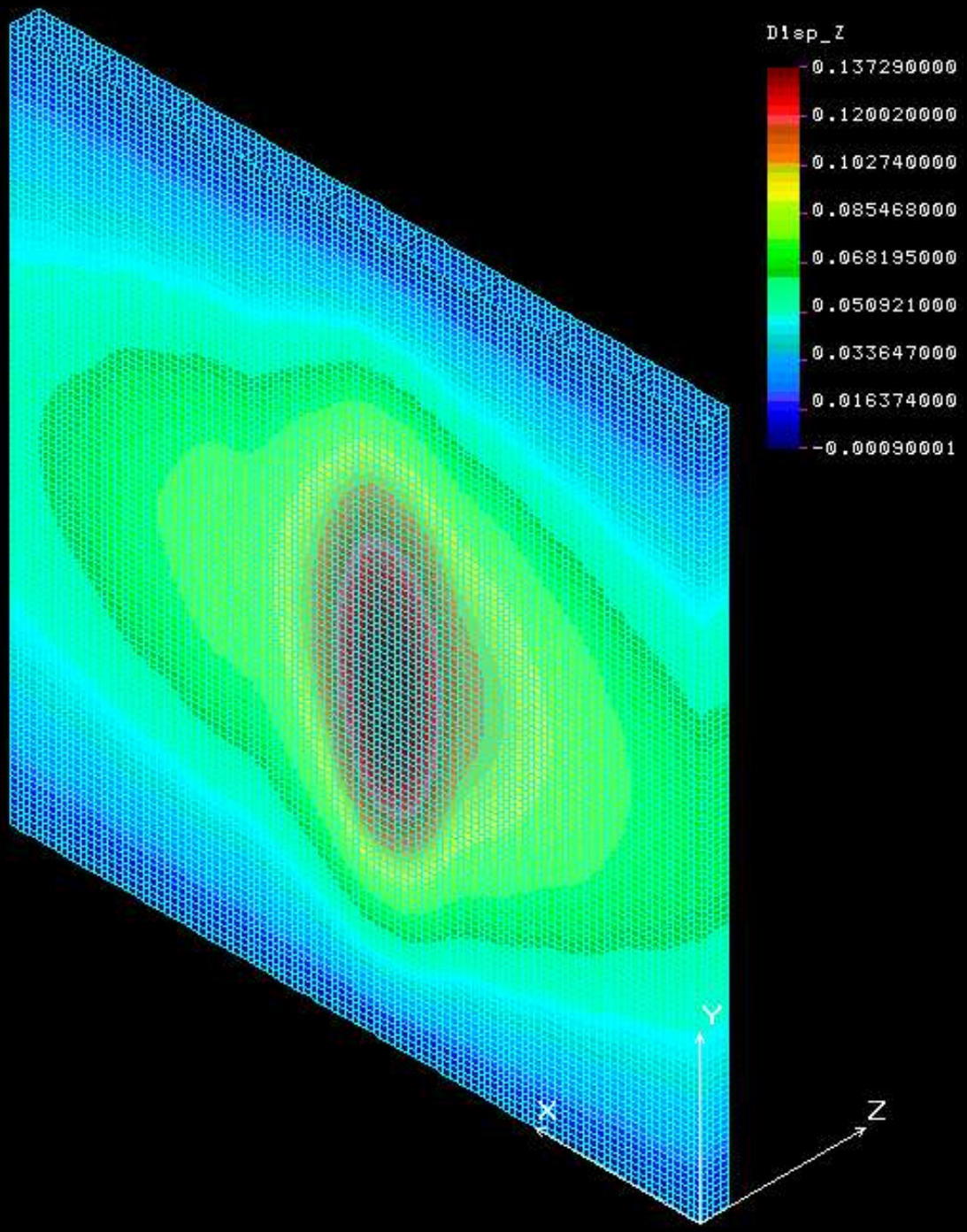
Load “A” Back Panel Strain

Loading “B”

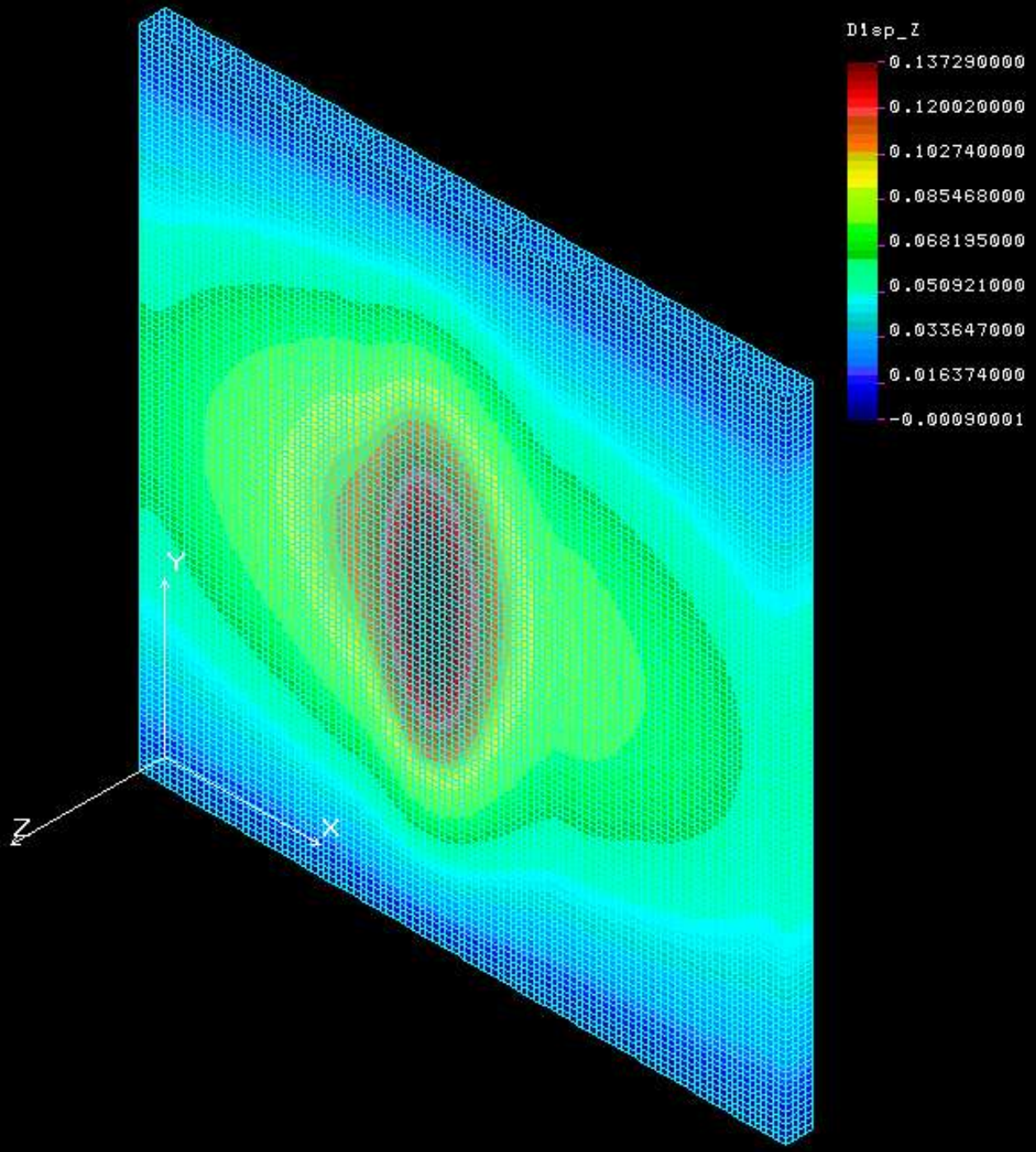
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 4 ft above floor



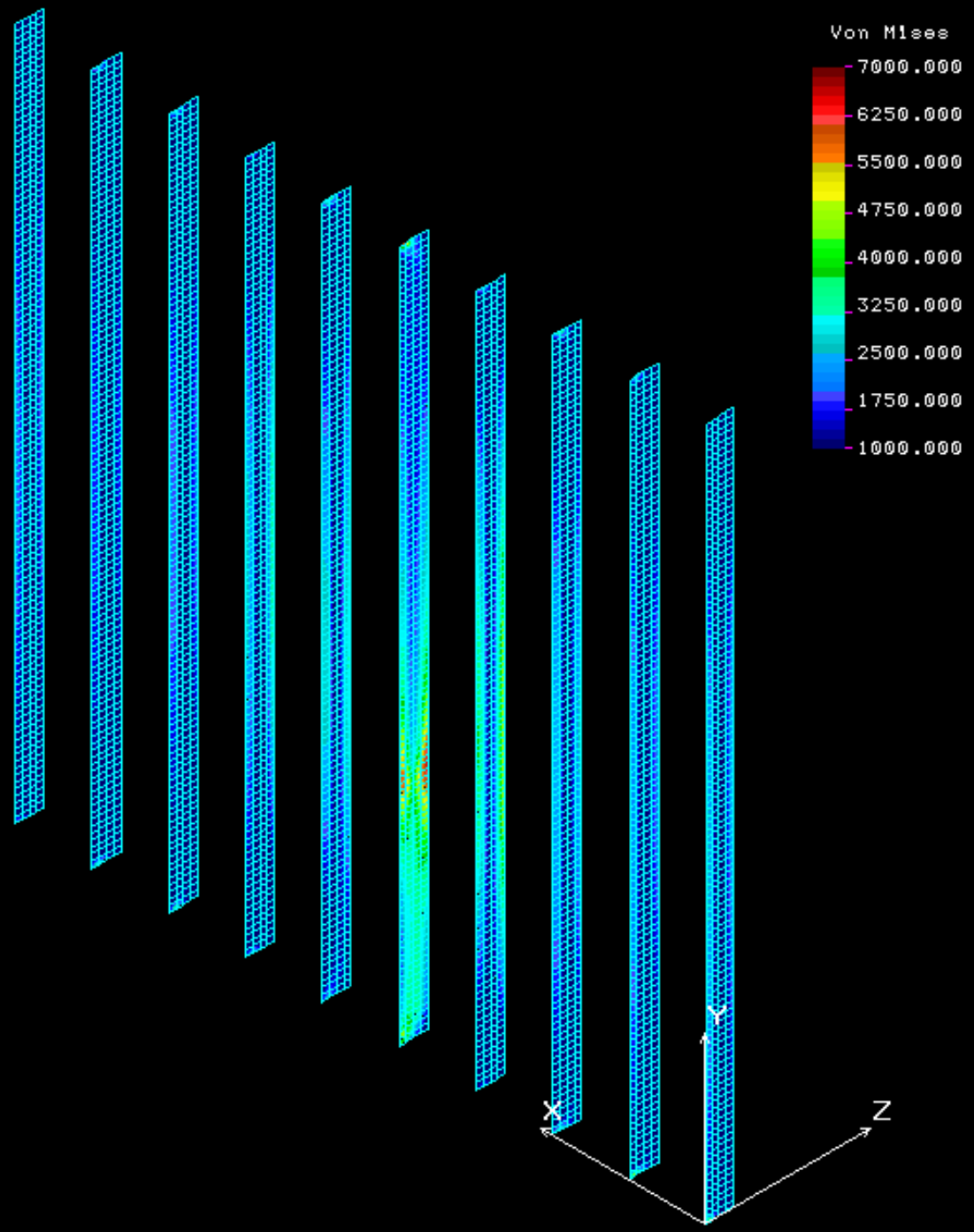
2000 lb point
force on frame
4 ft above floor



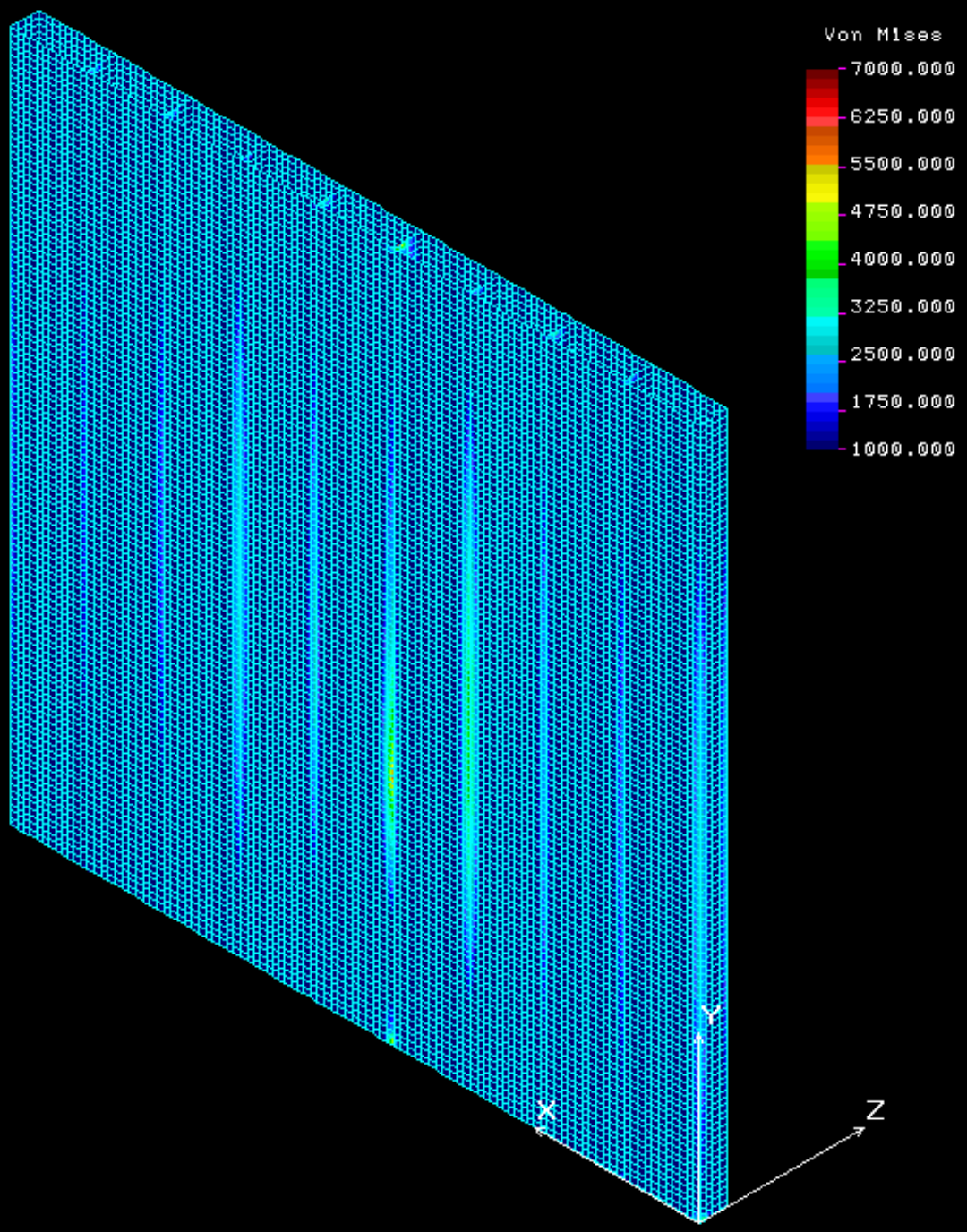
Load “B”
Front Face
Z Deflection
(in)



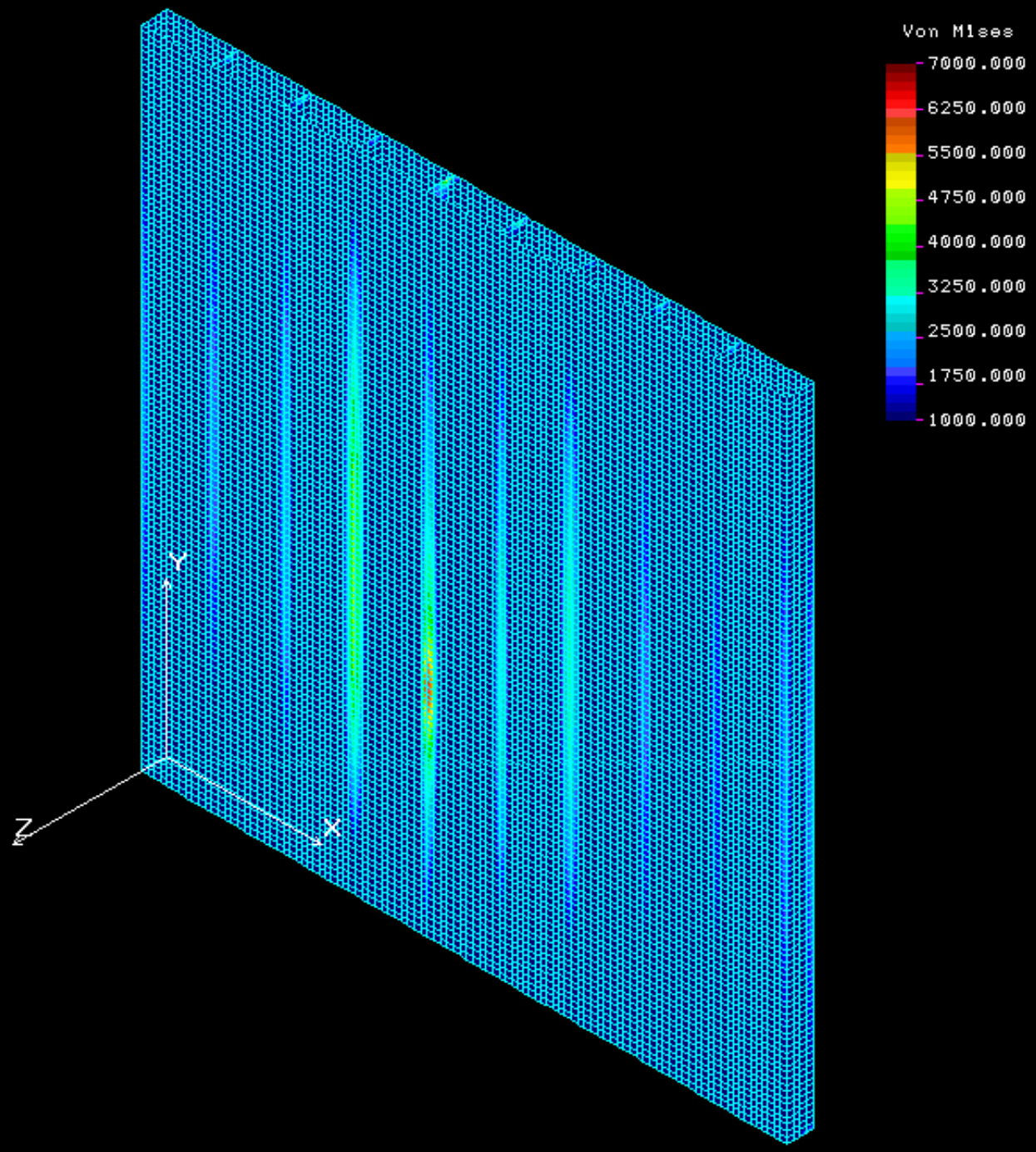
Load “B”
Back Face
Z Deflection
(in)



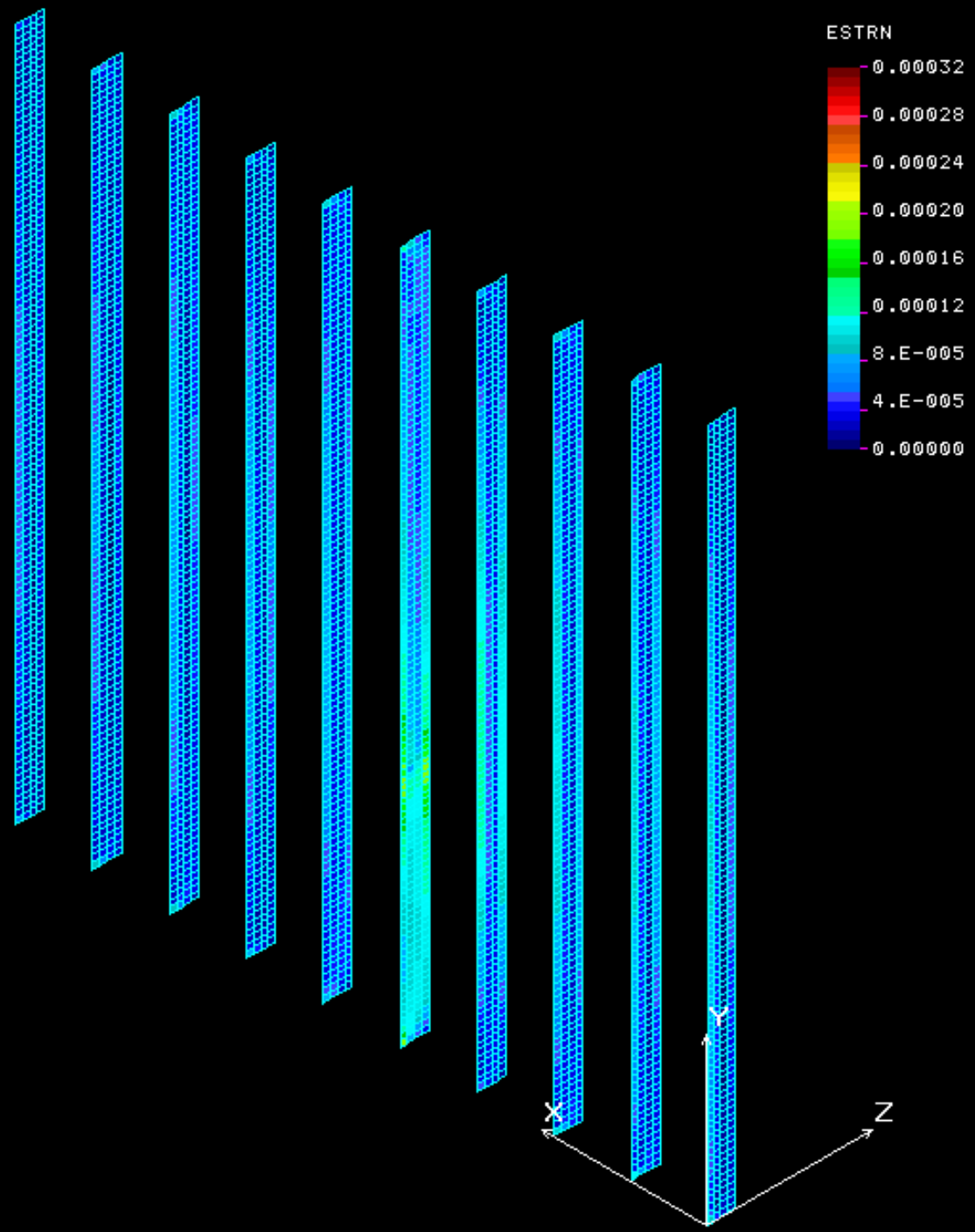
Load “B” Frame Stress (psi)



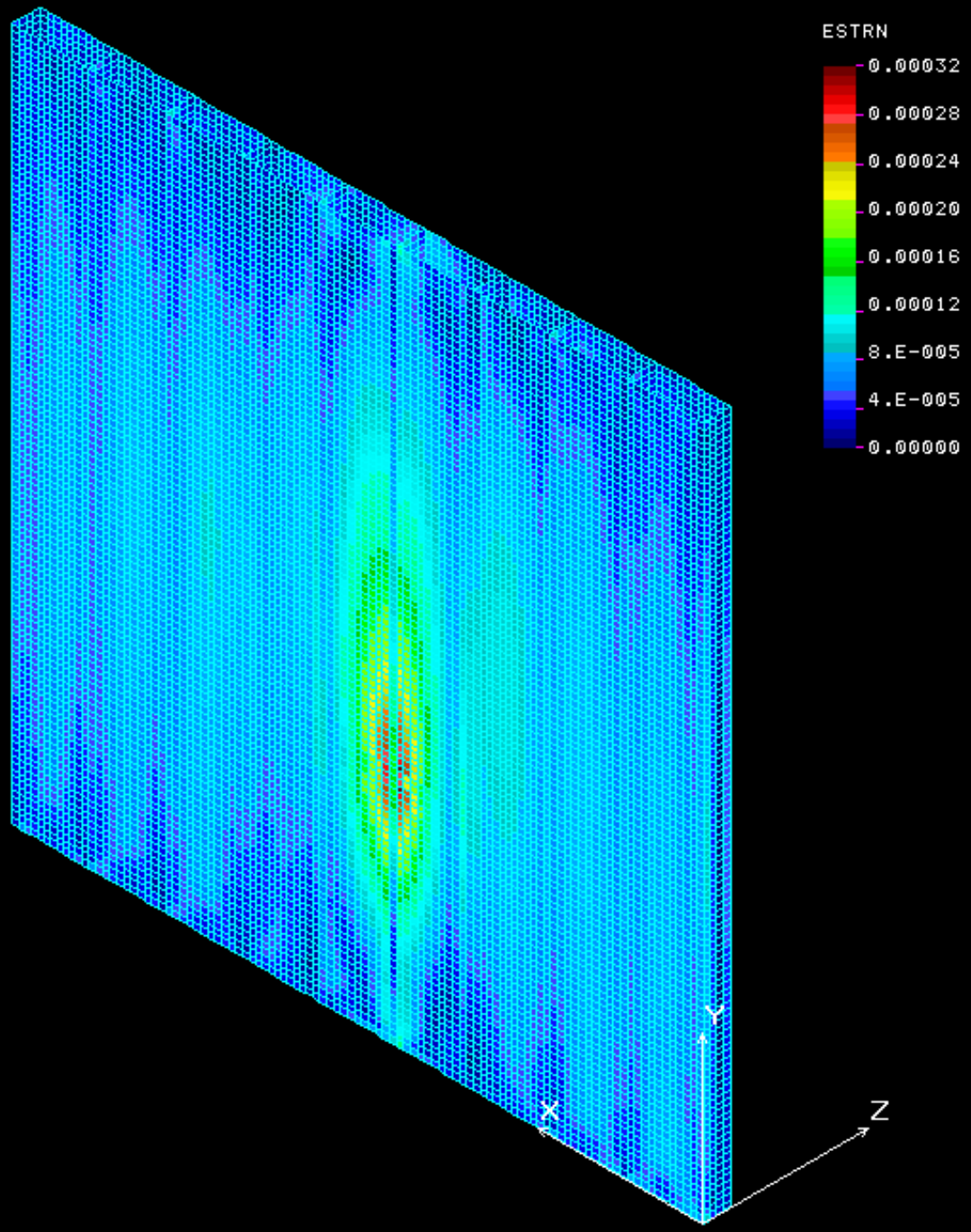
Load “B” Front Panel Stress (psi)



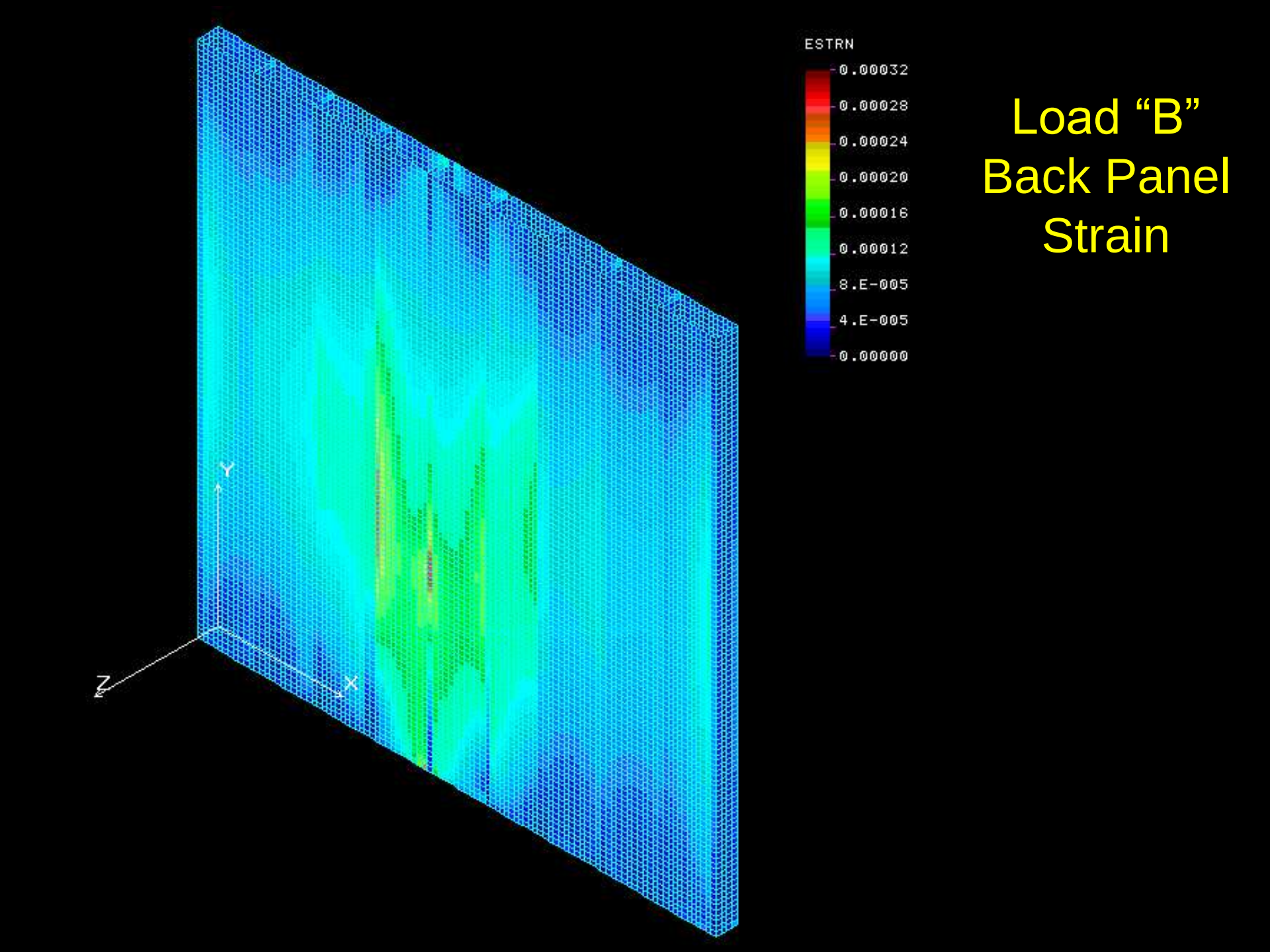
Load “B” Back Panel Stress (psi)



Load “B” Frame Strain



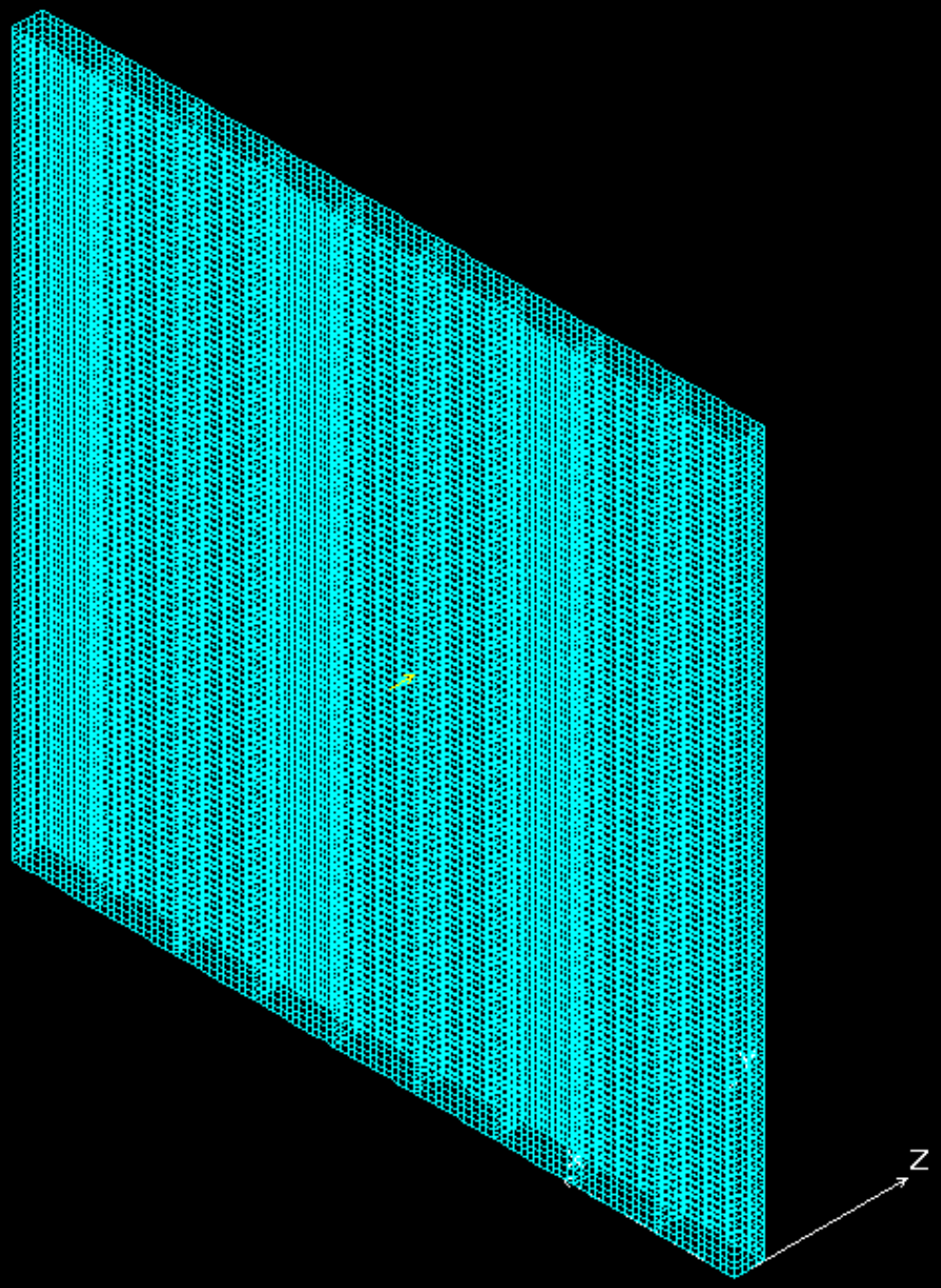
Load “B” Front Panel Strain



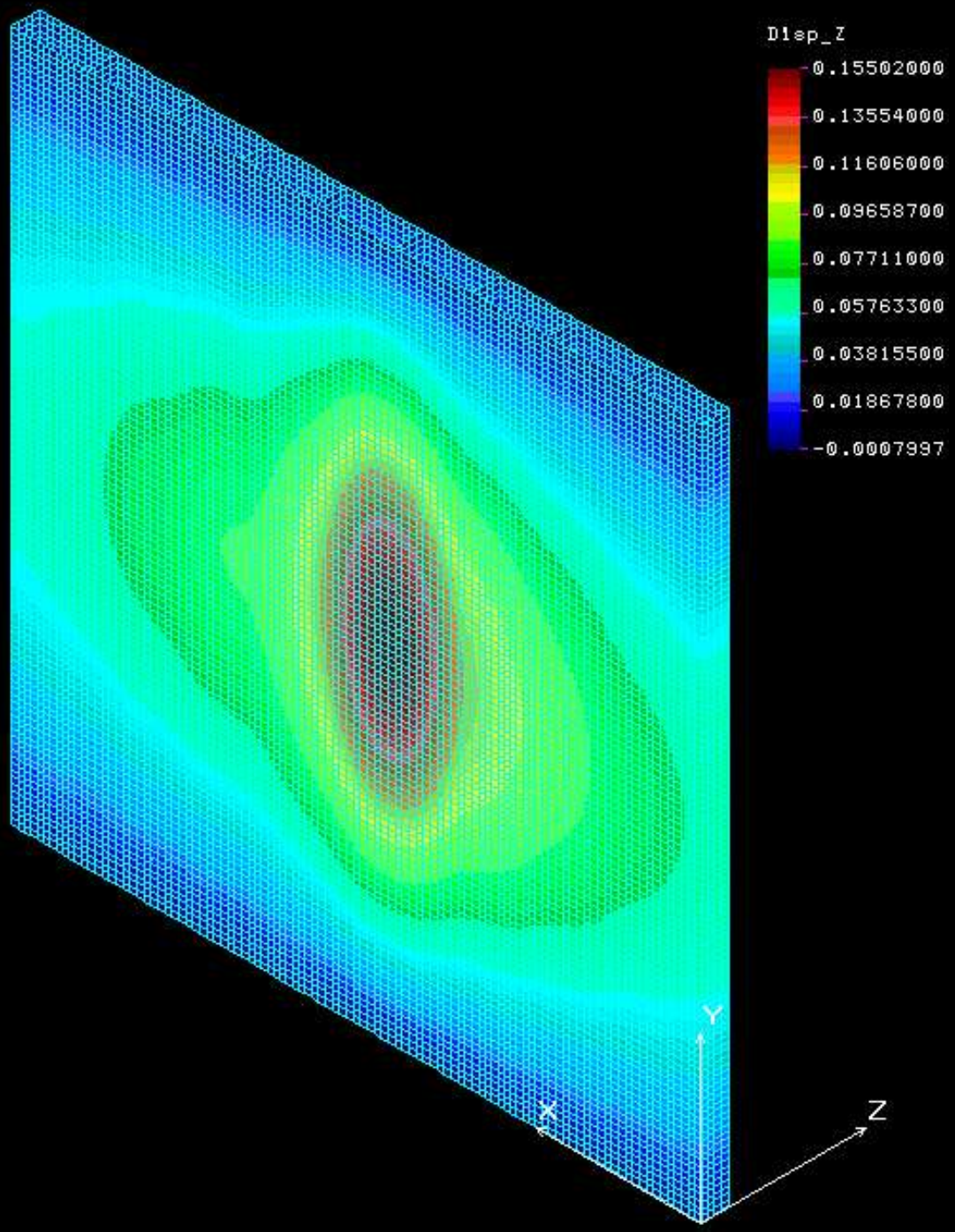
Load “B” Back Panel Strain

Loading “C”

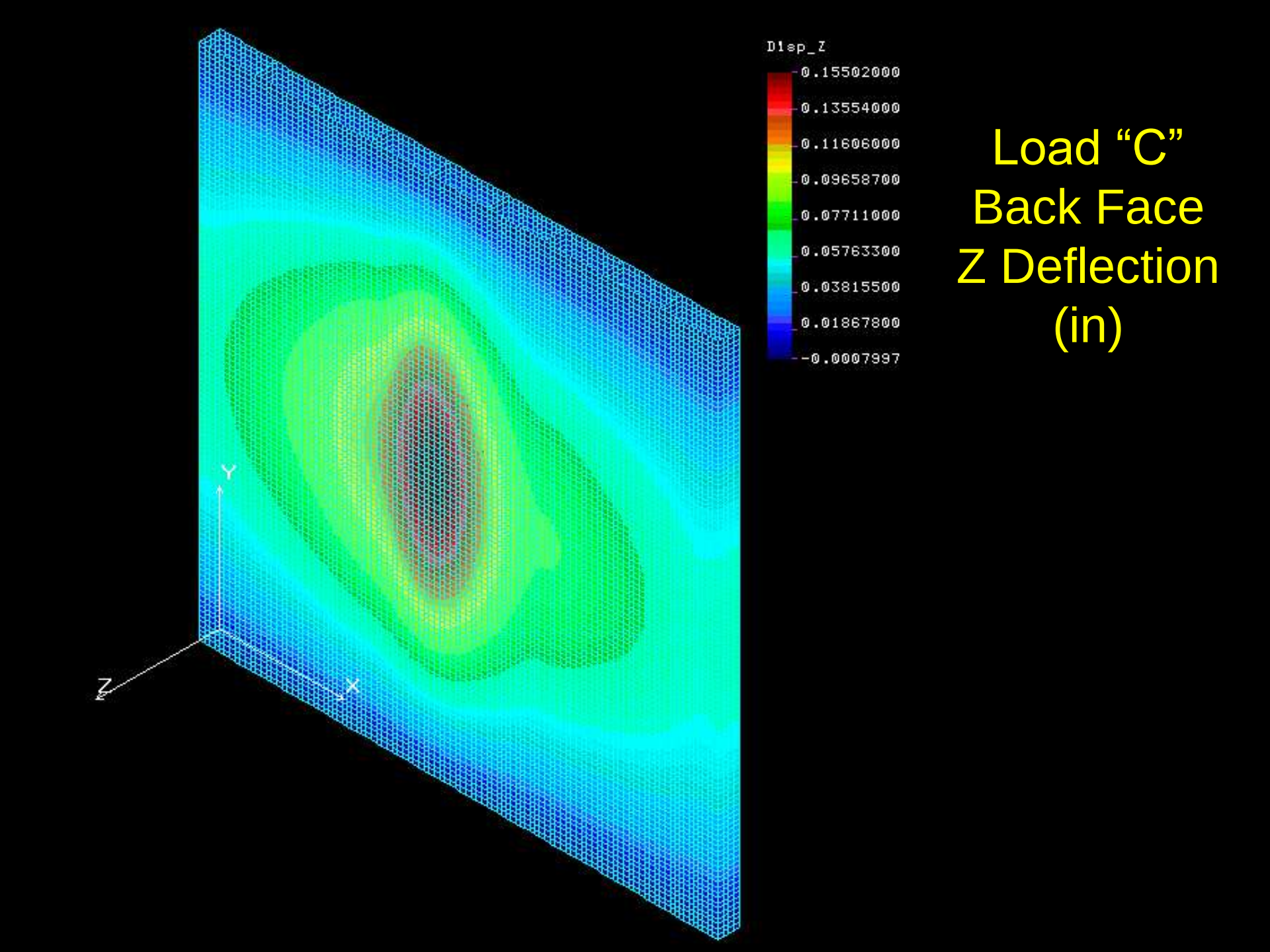
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 6 ft above floor



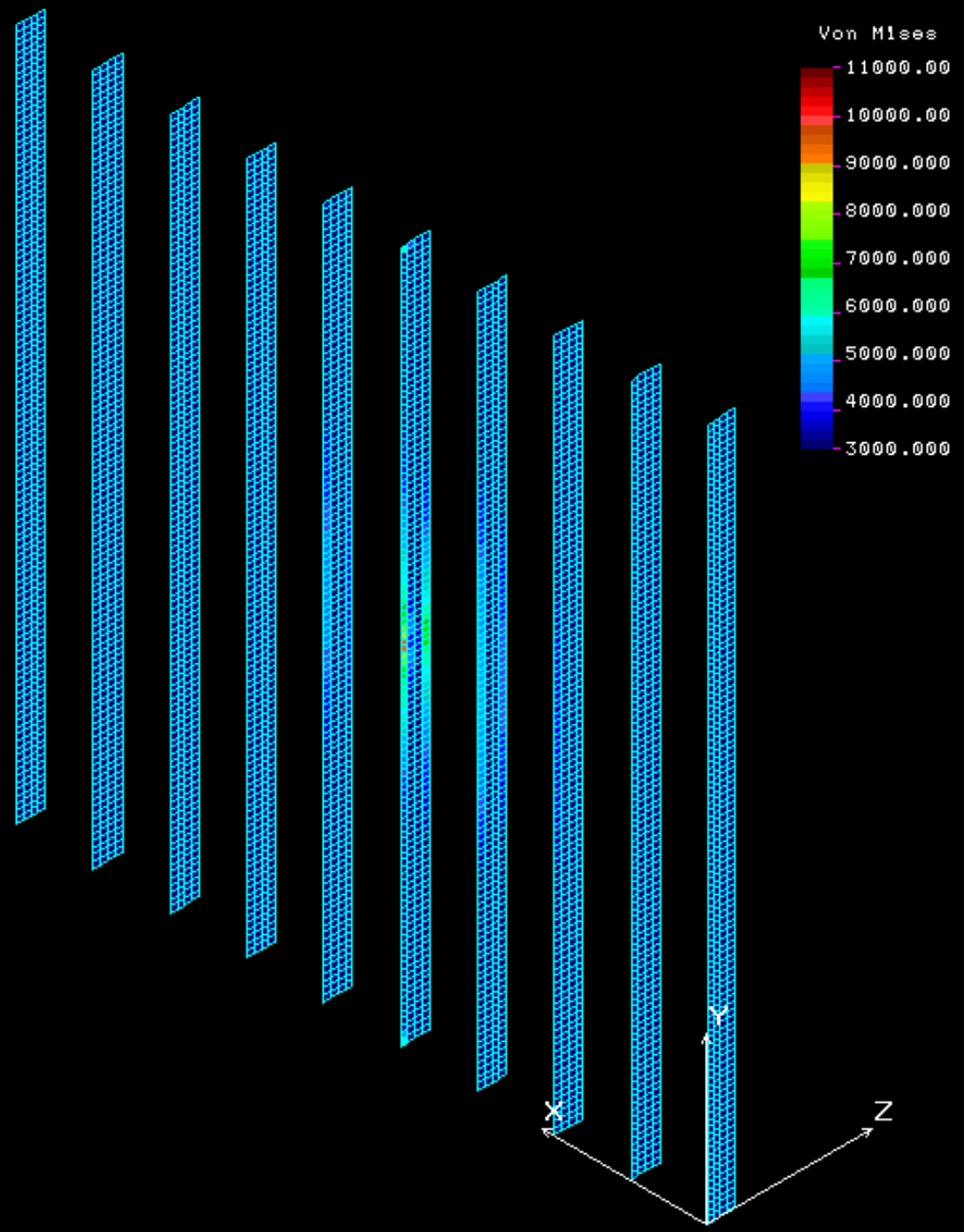
2000 lb point force on frame 6 ft above floor



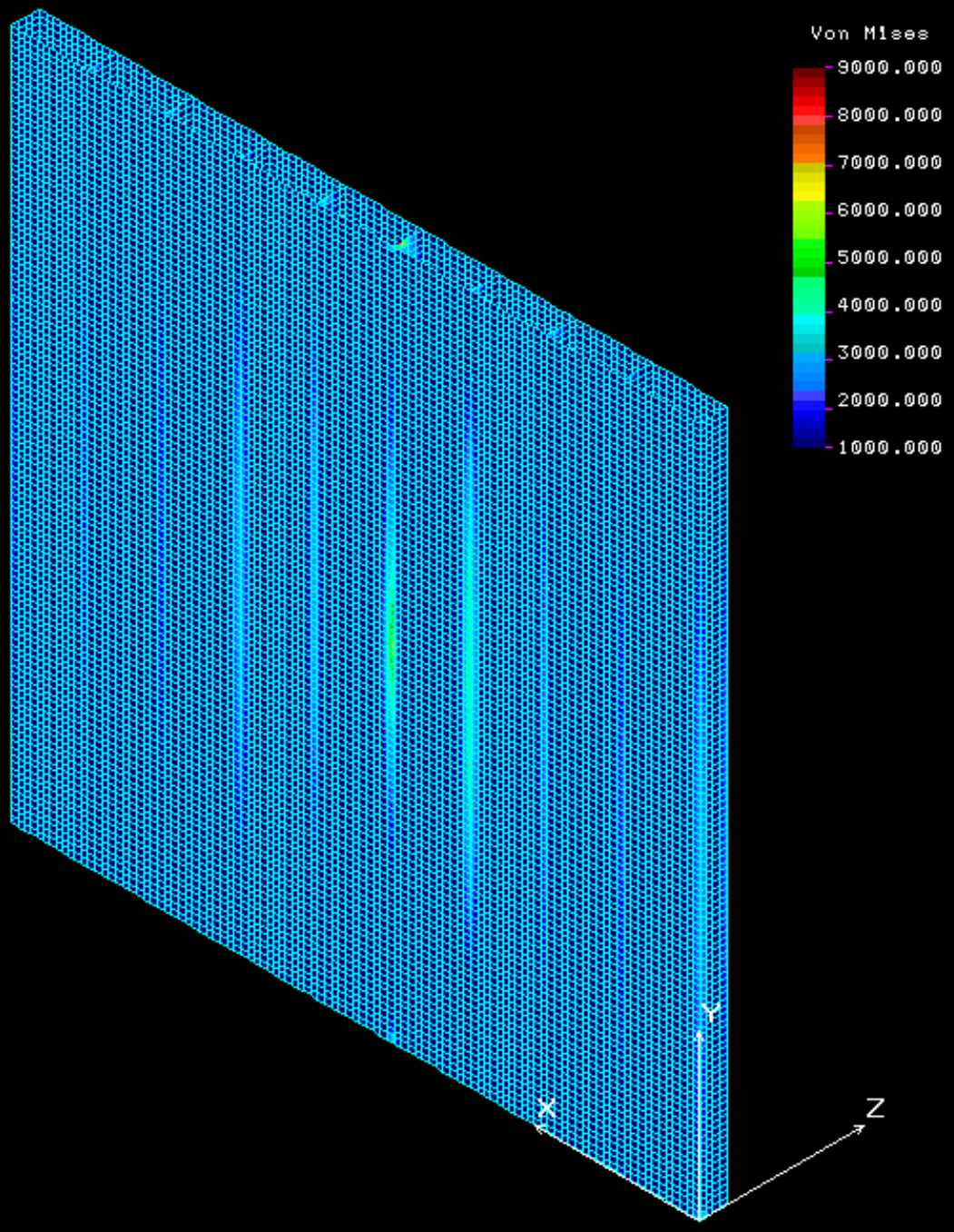
Load “C”
Front Face
Z Deflection
(in)



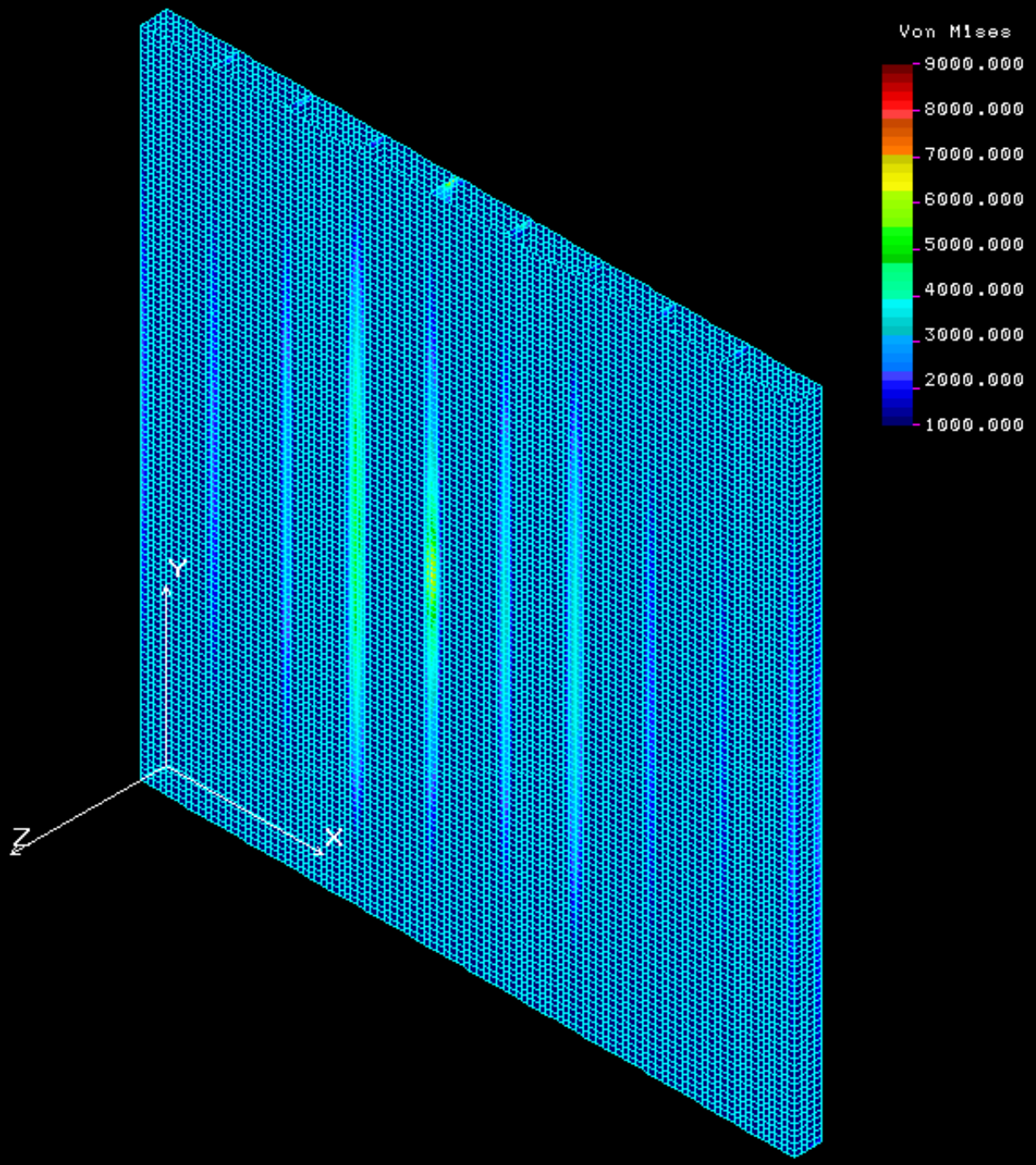
Load “C”
Back Face
Z Deflection
(in)



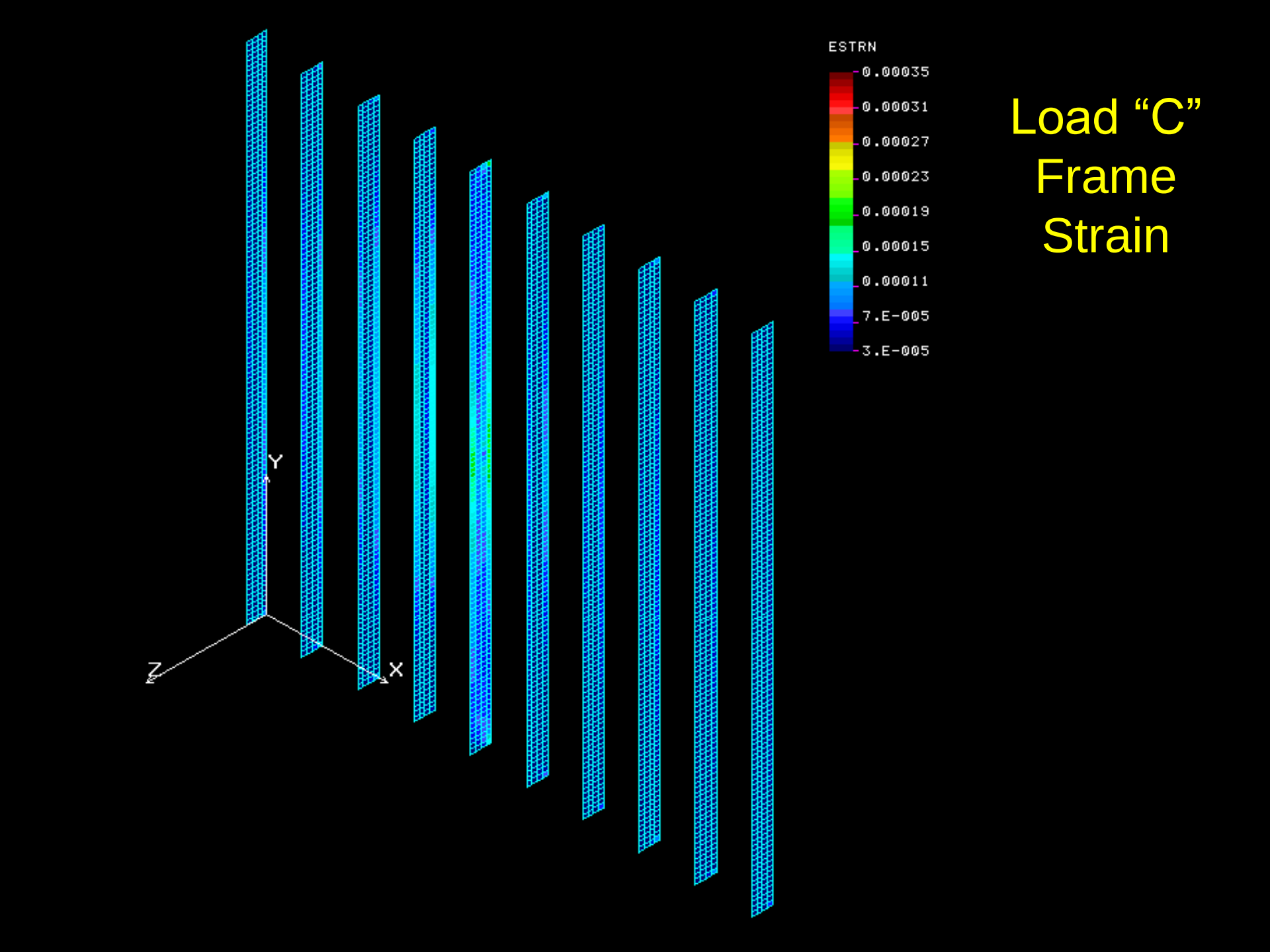
Load “C” Frame Stress (psi)



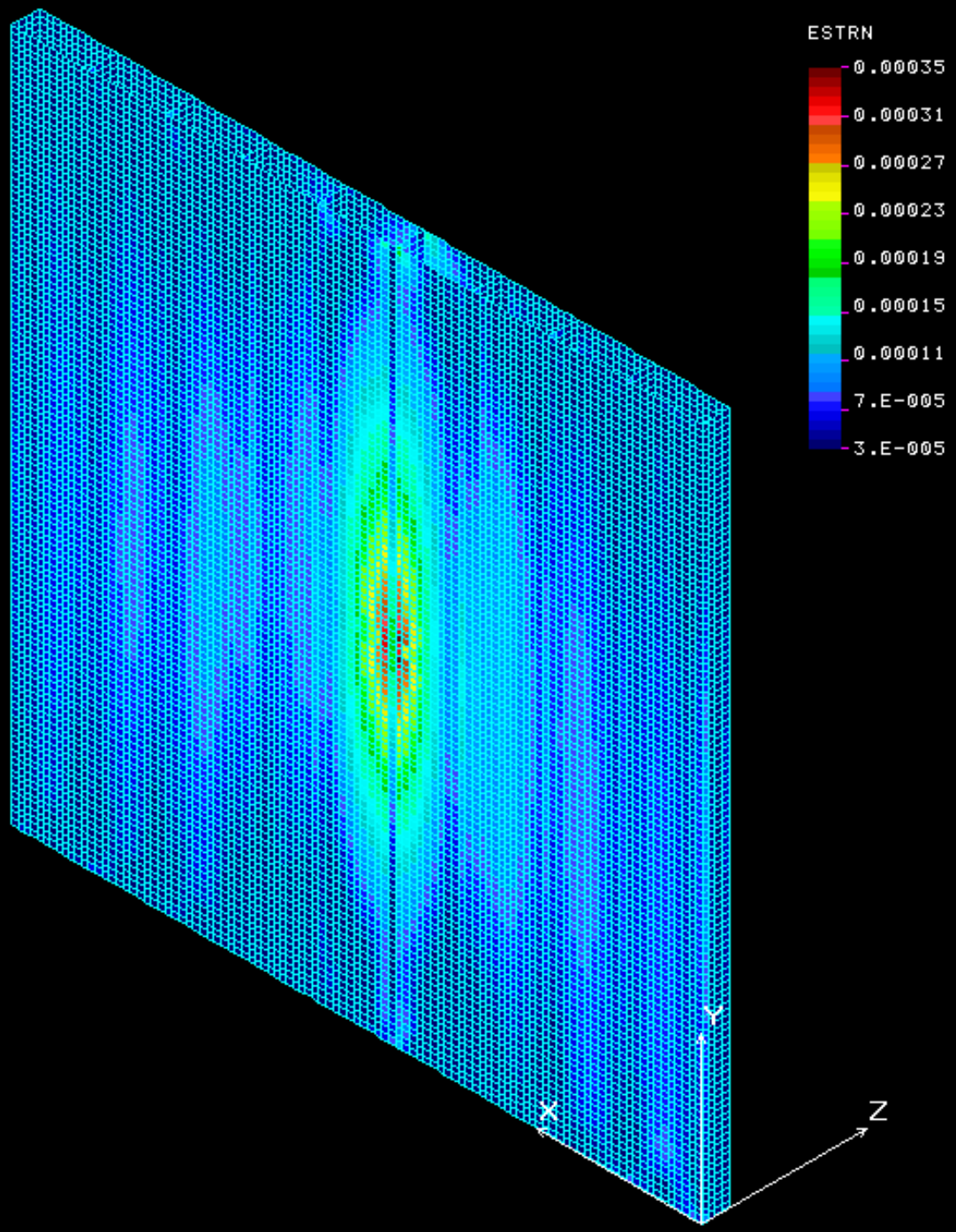
Load “C” Front Panel Stress (psi)



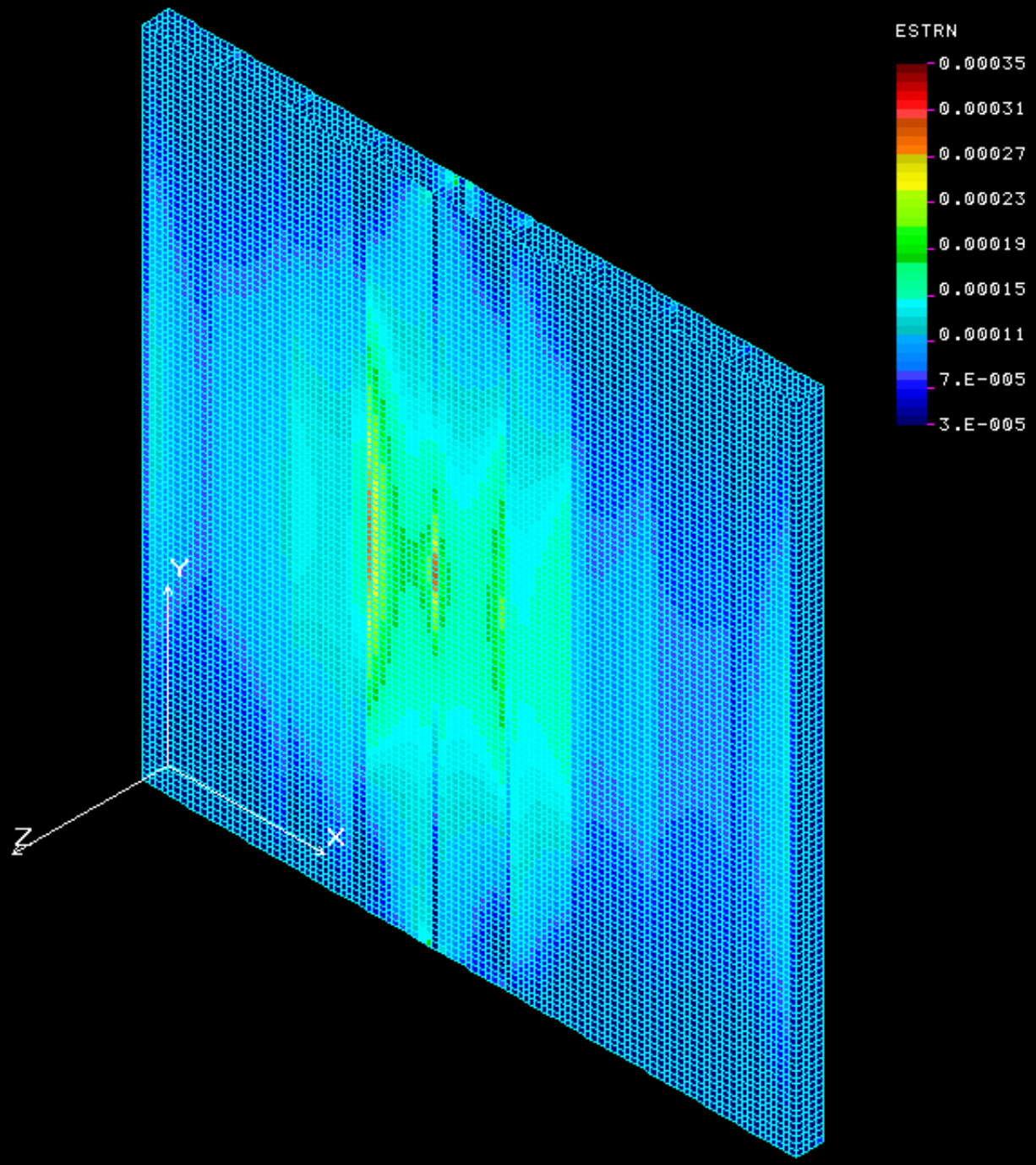
Load “C” Back Panel Stress (psi)



Load “C” Frame Strain



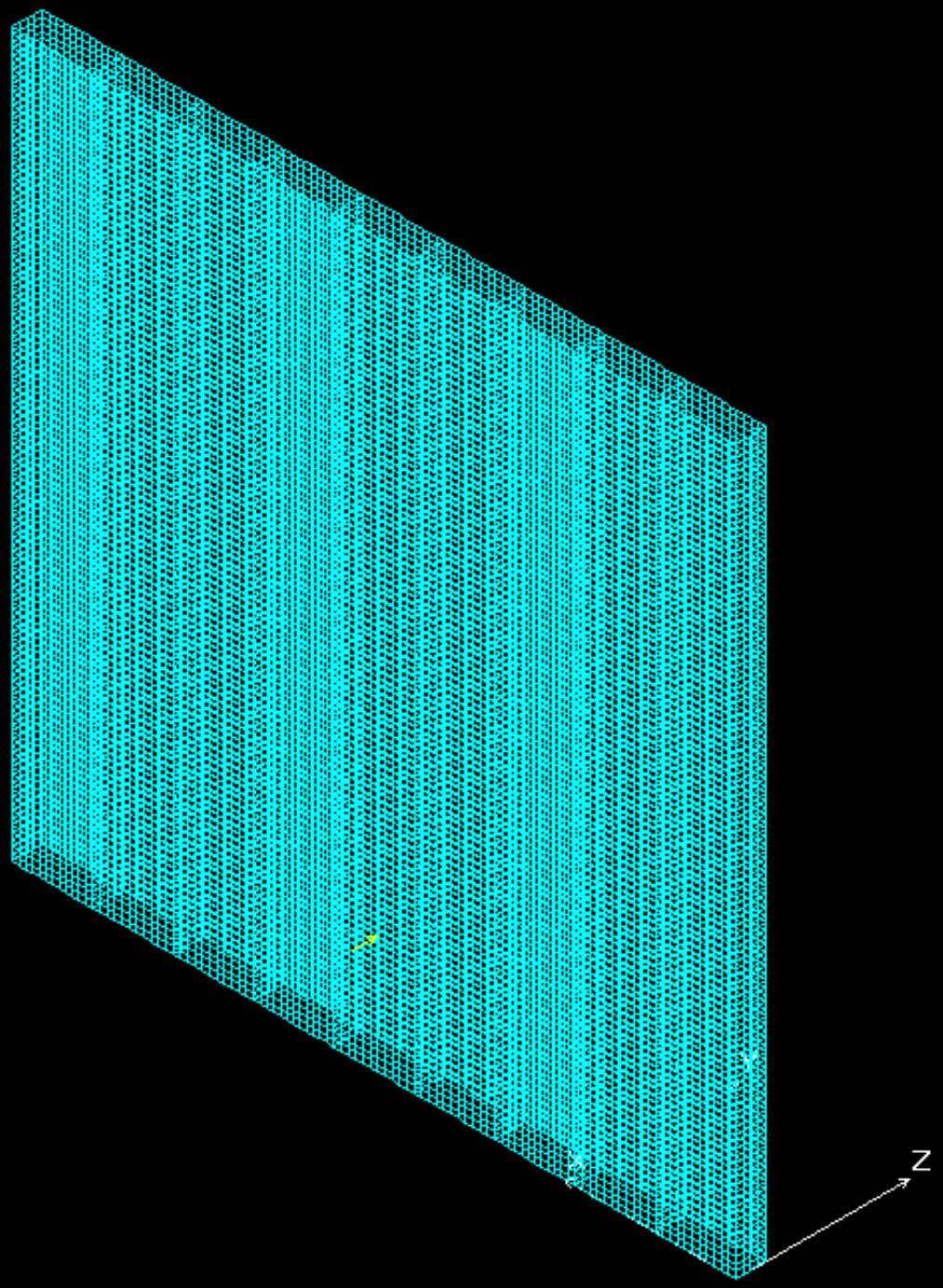
Load “C” Front Panel Strain



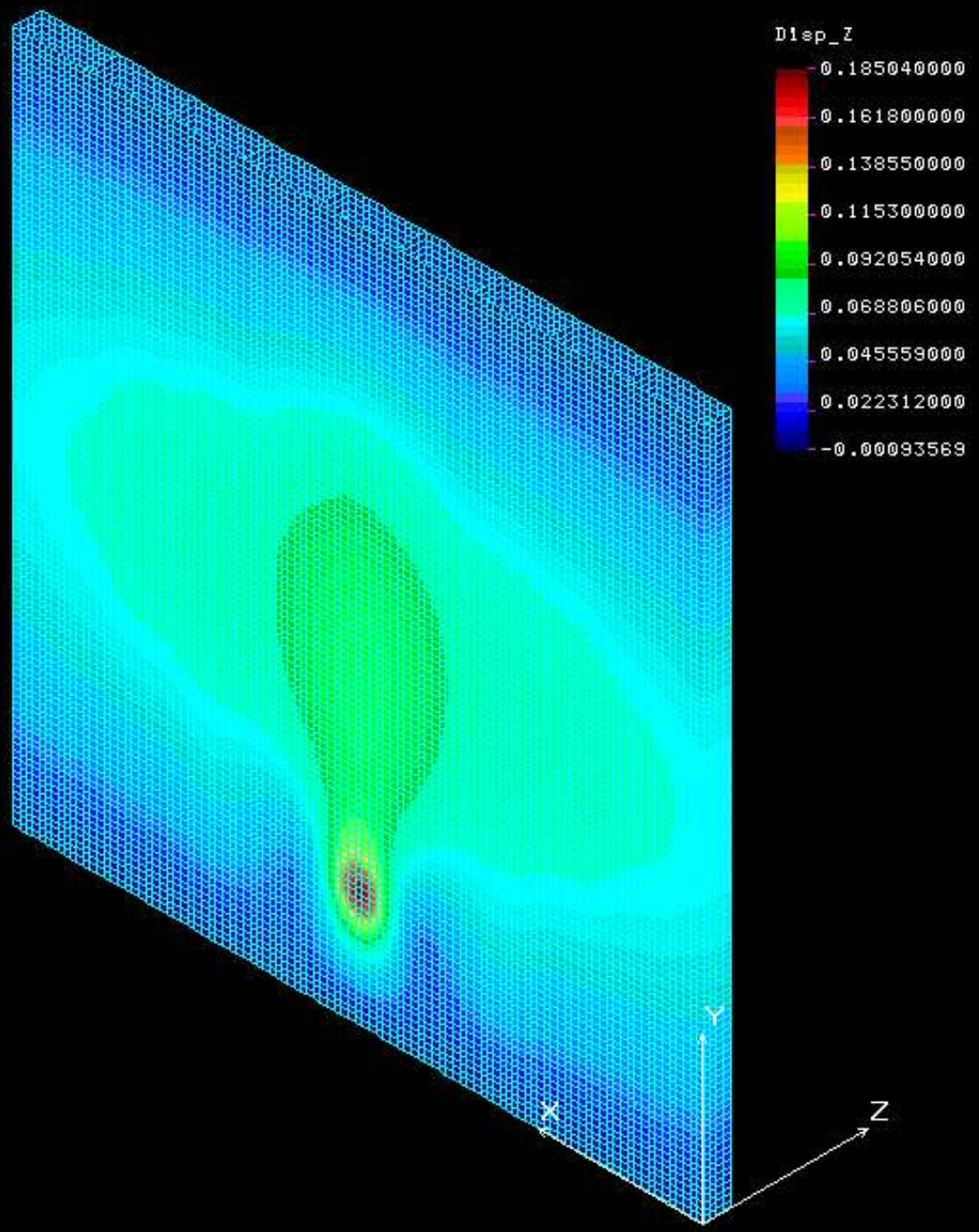
Load “C” Back Panel Strain

Loading “D”

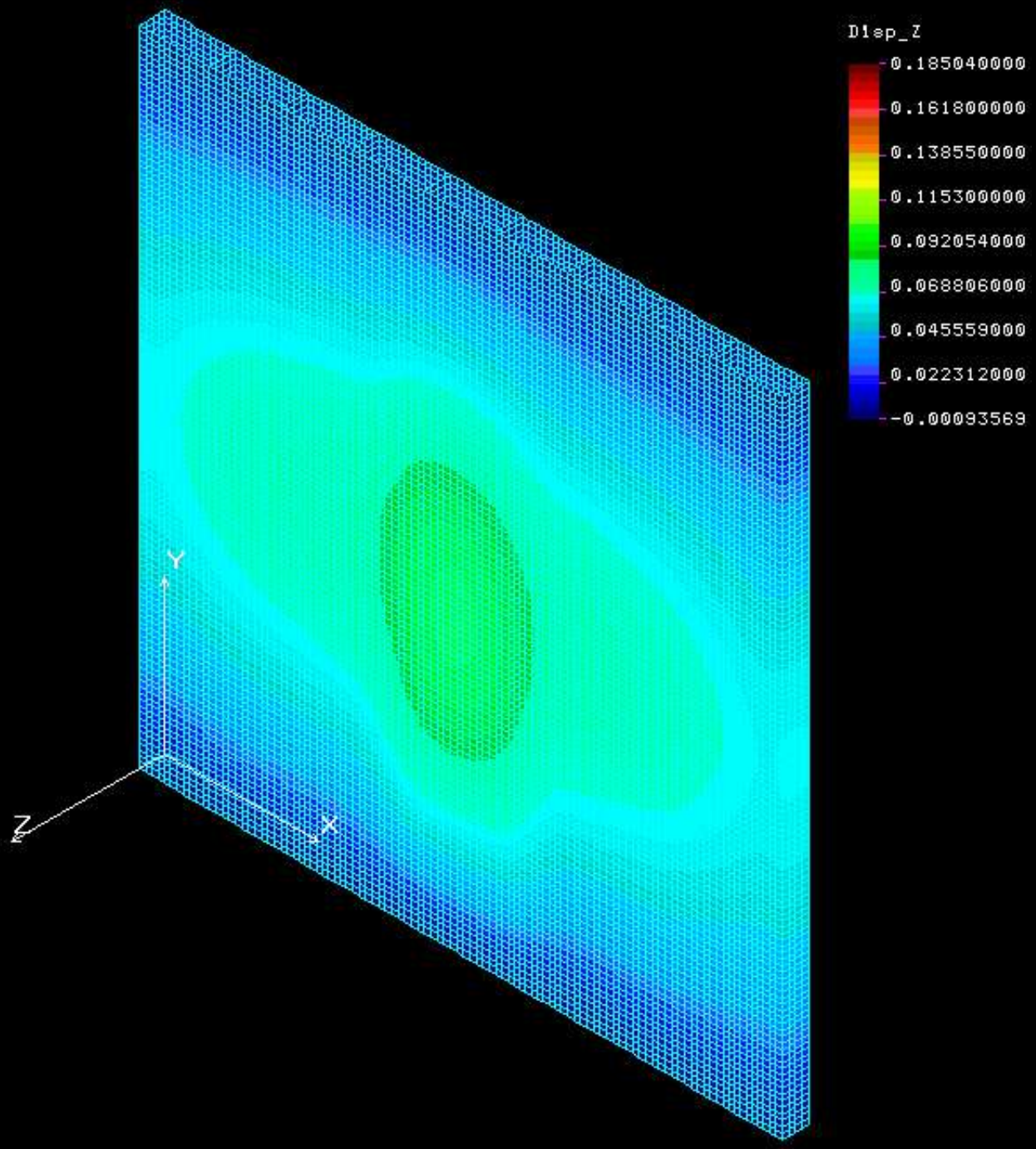
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load between frames 2 ft above floor



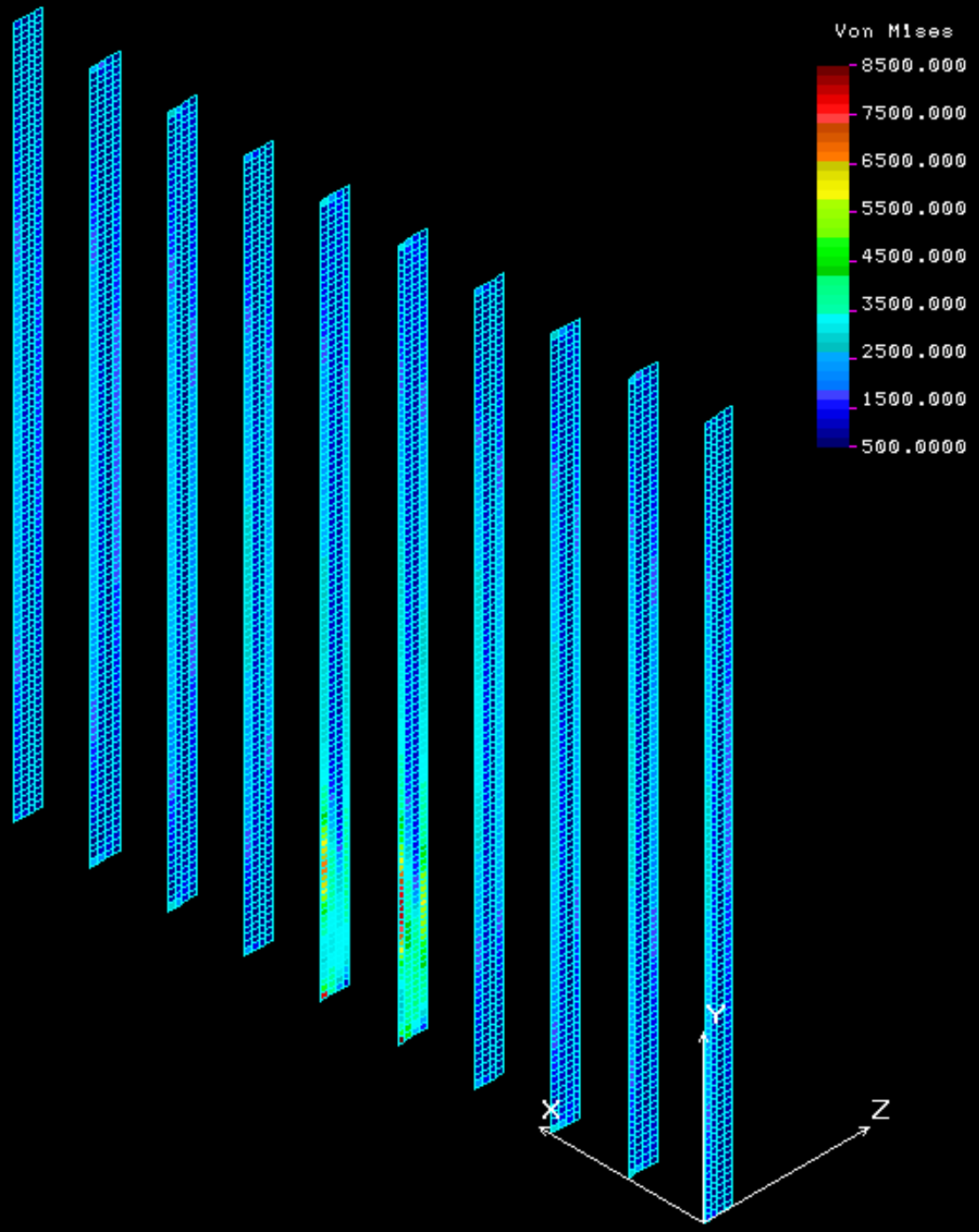
2000 lb point force on panel 2 ft above floor



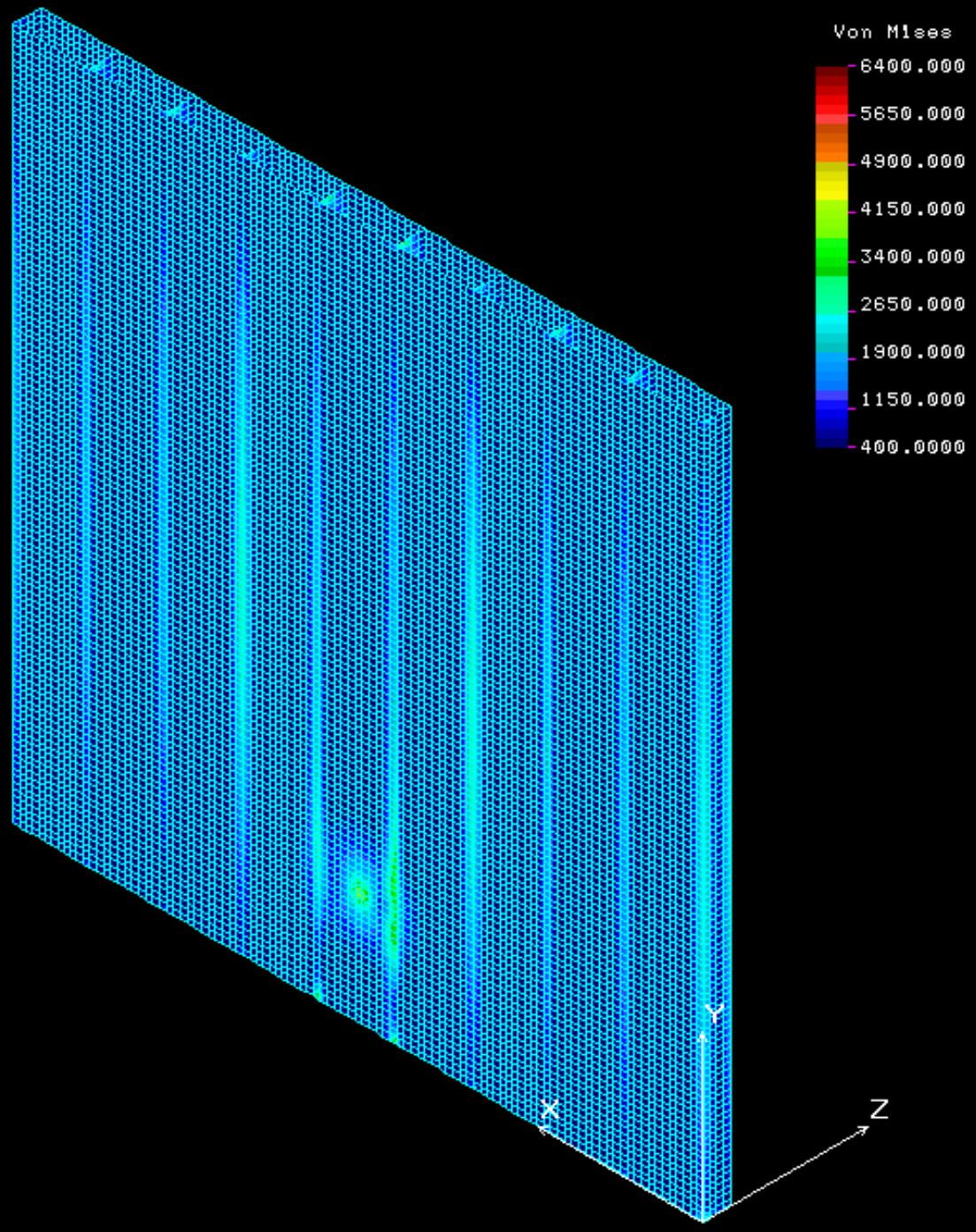
Load “D”
Front Face
Z Deflection
(in)



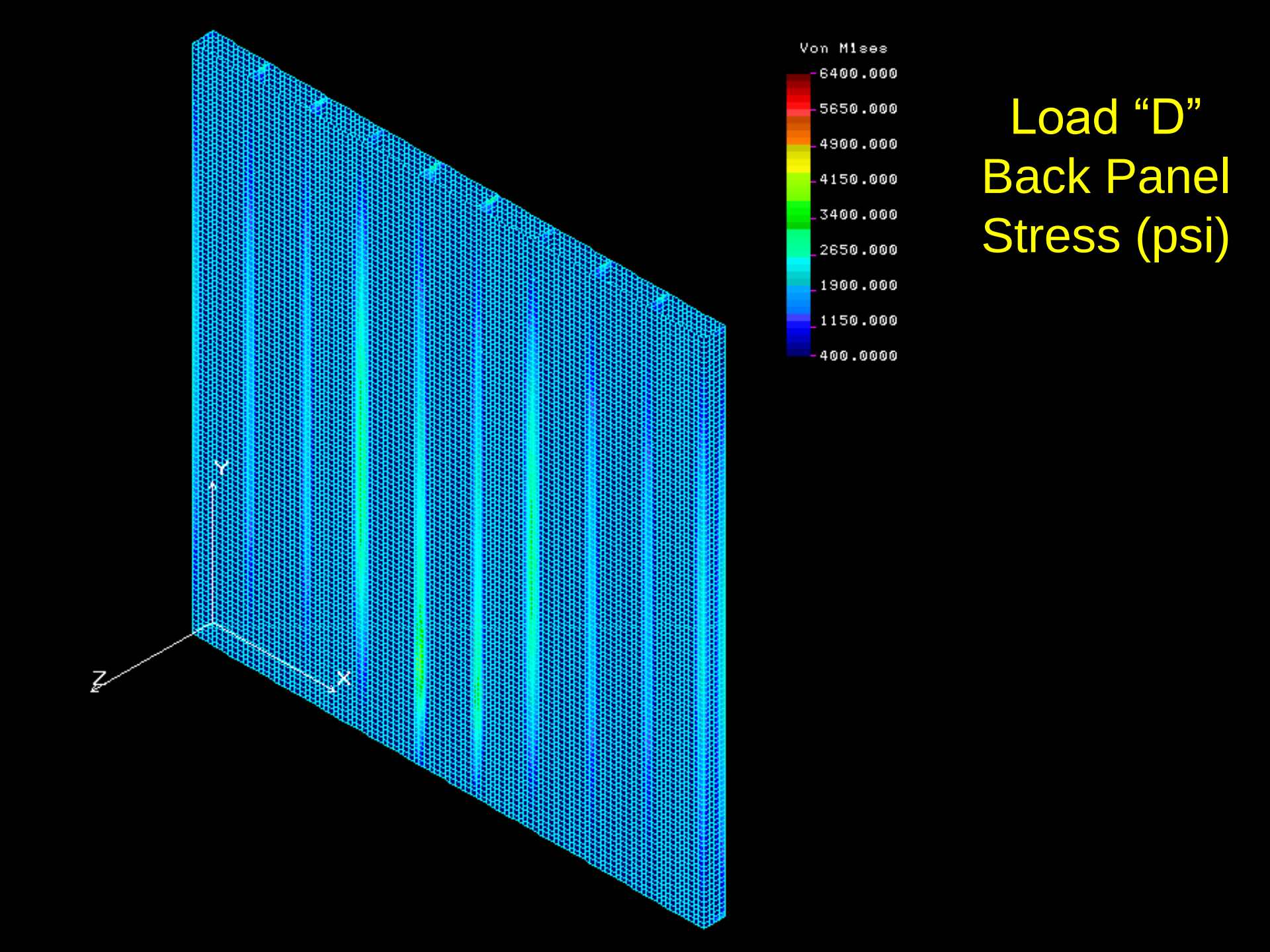
Load “D”
Back Face
Z Deflection
(in)



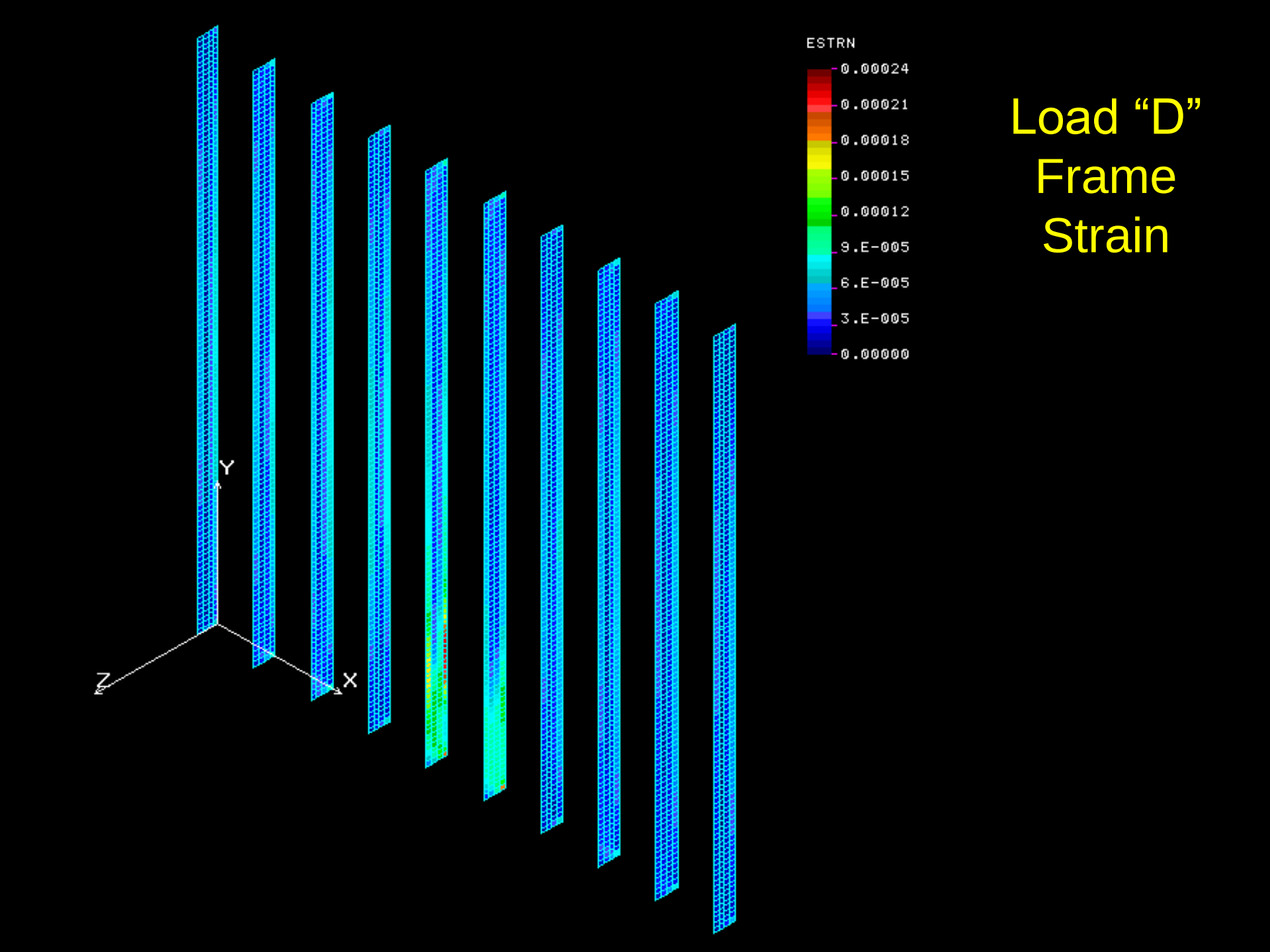
Load “D” Frame Stress (psi)



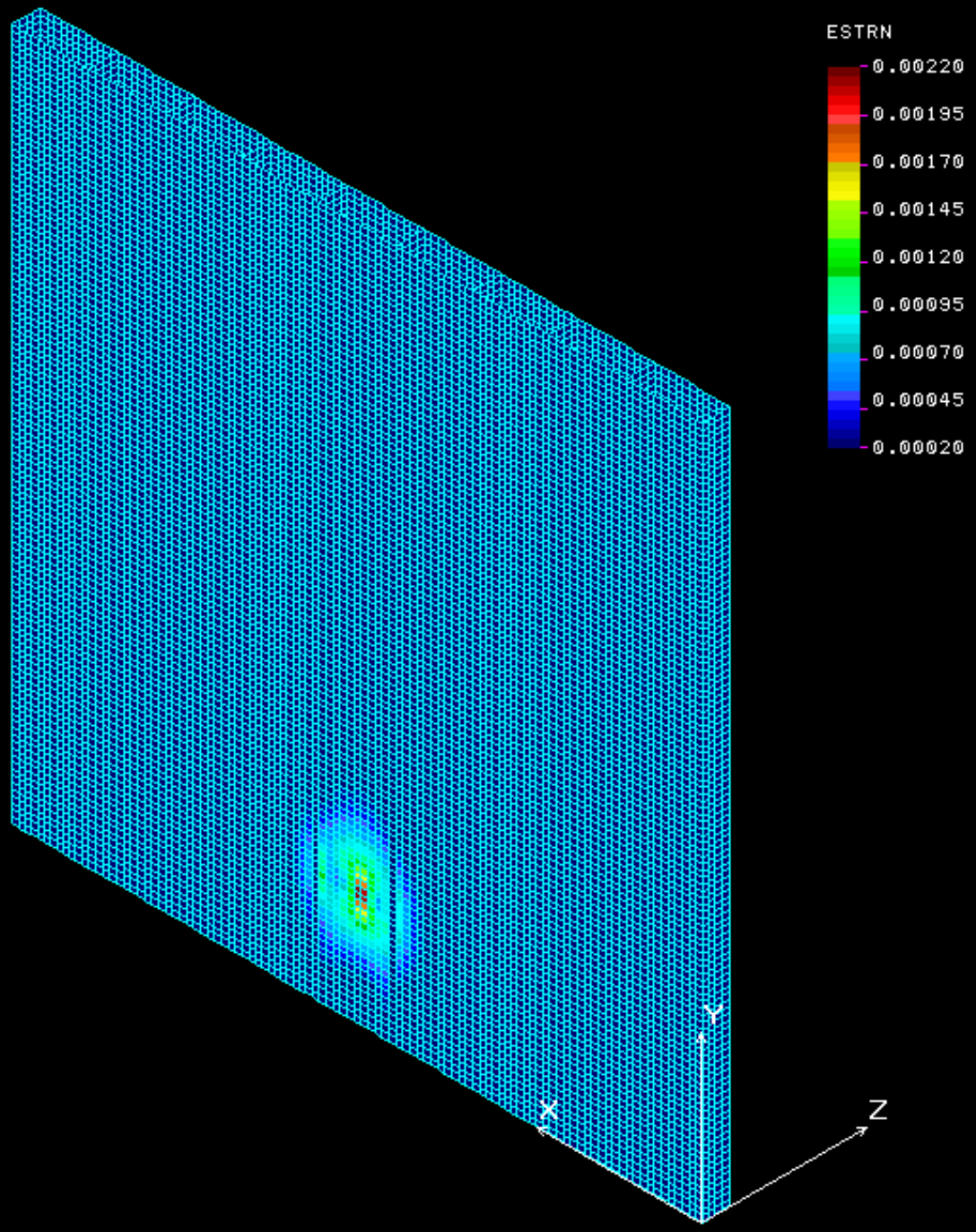
Load “D” Front Panel Stress (psi)



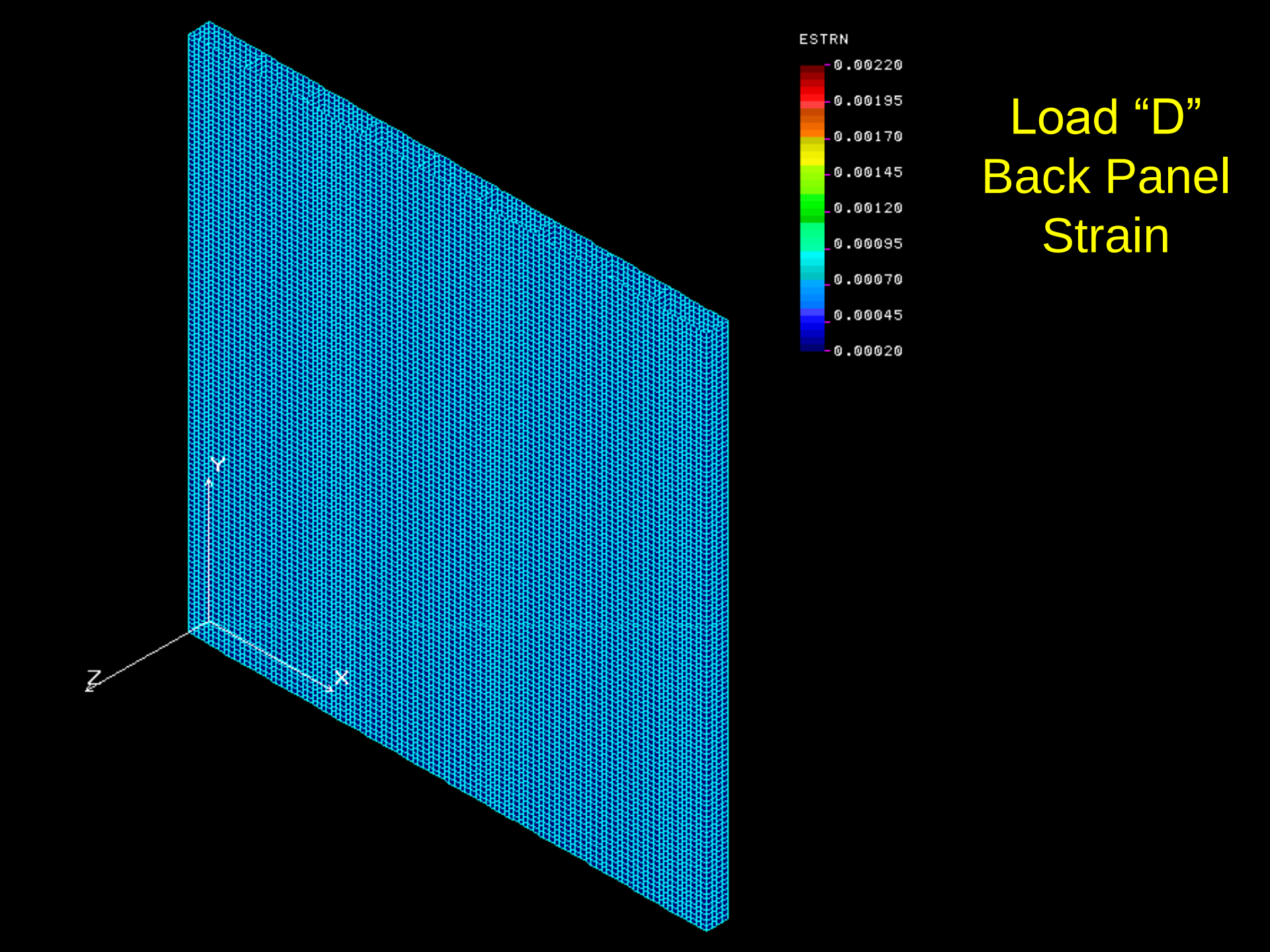
Load “D”
Back Panel
Stress (psi)



Load “D” Frame Strain



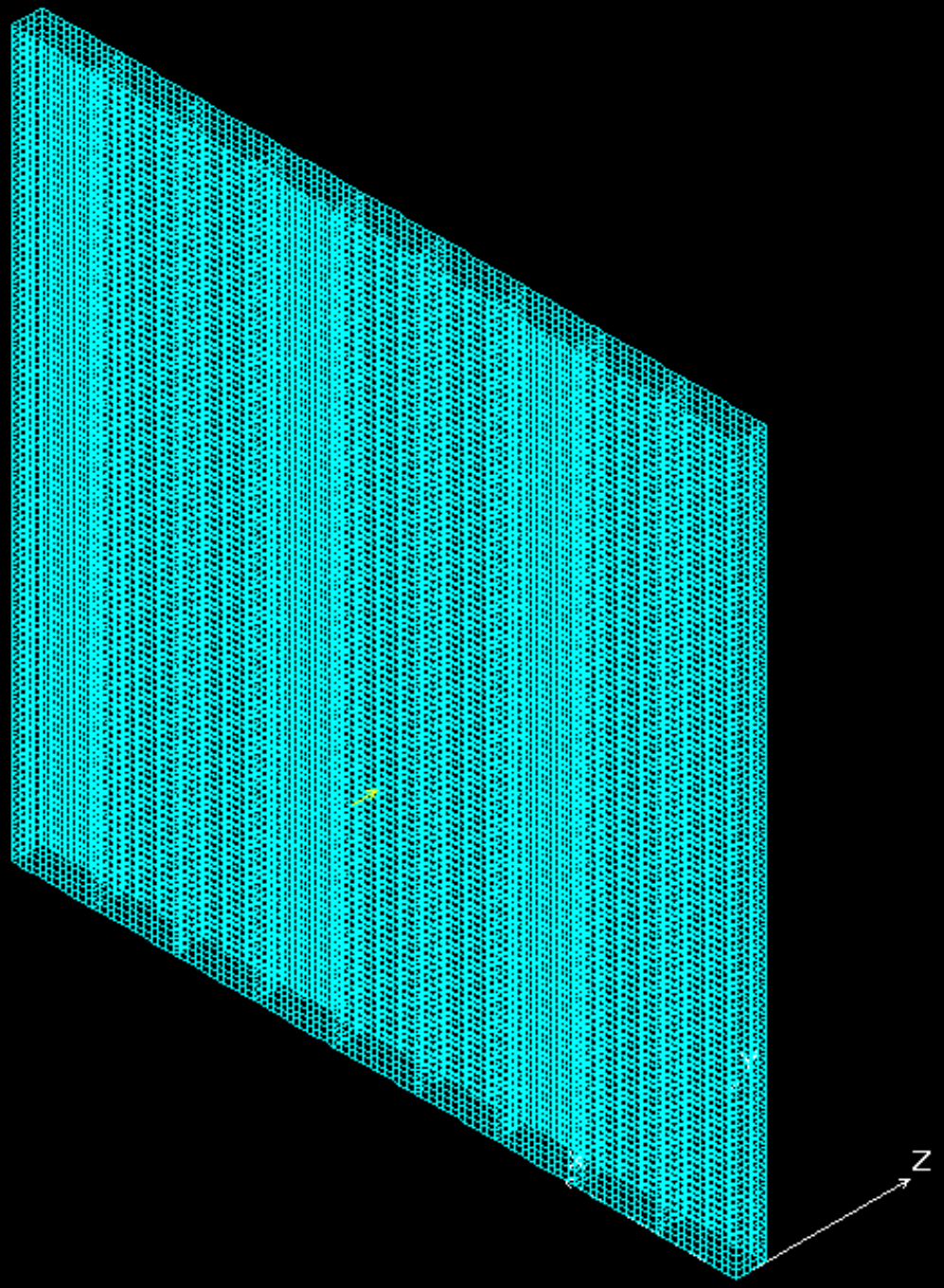
Load “D” Front Panel Strain



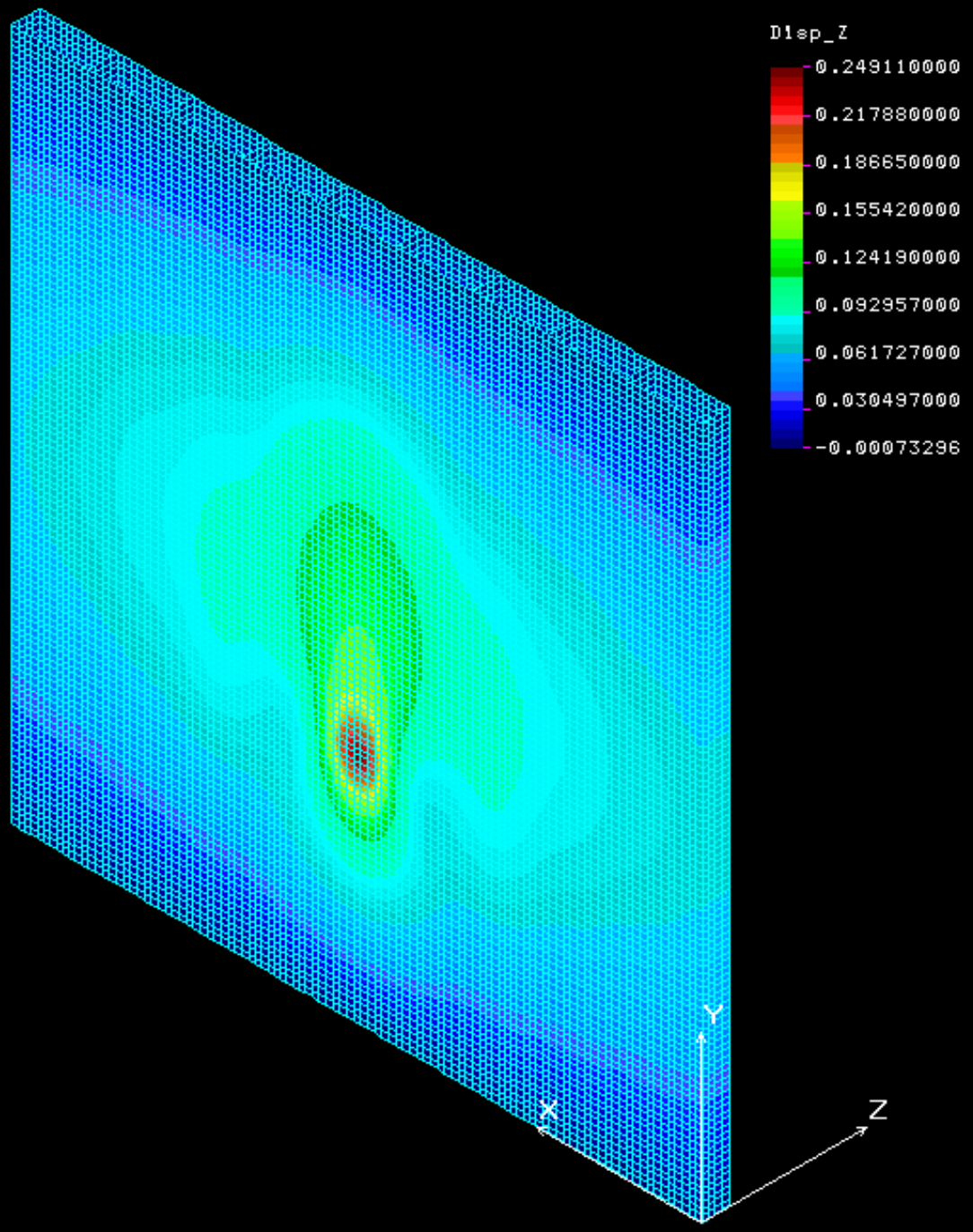
Load “D”
Back Panel
Strain

Loading “E”

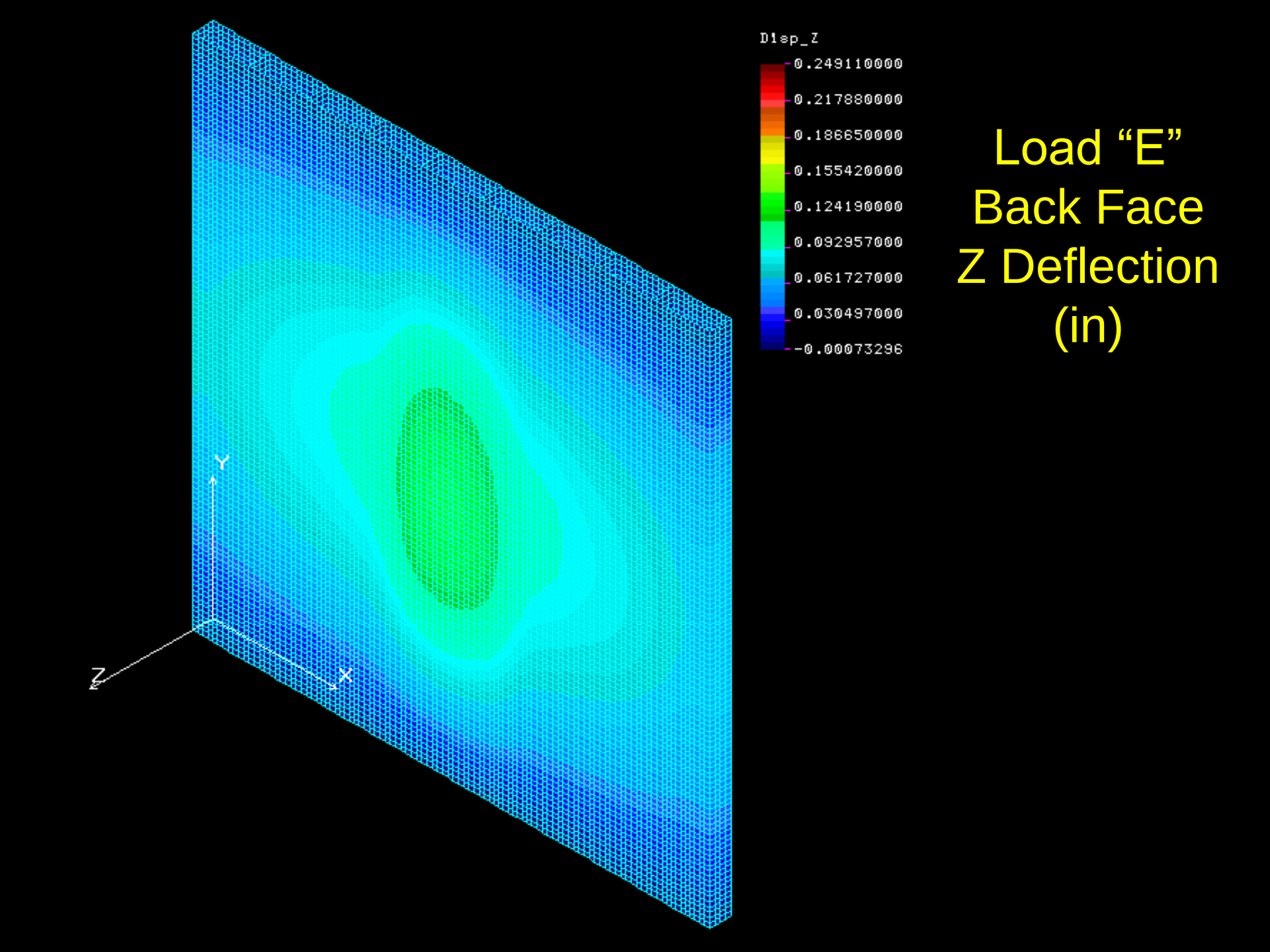
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 4 ft above floor



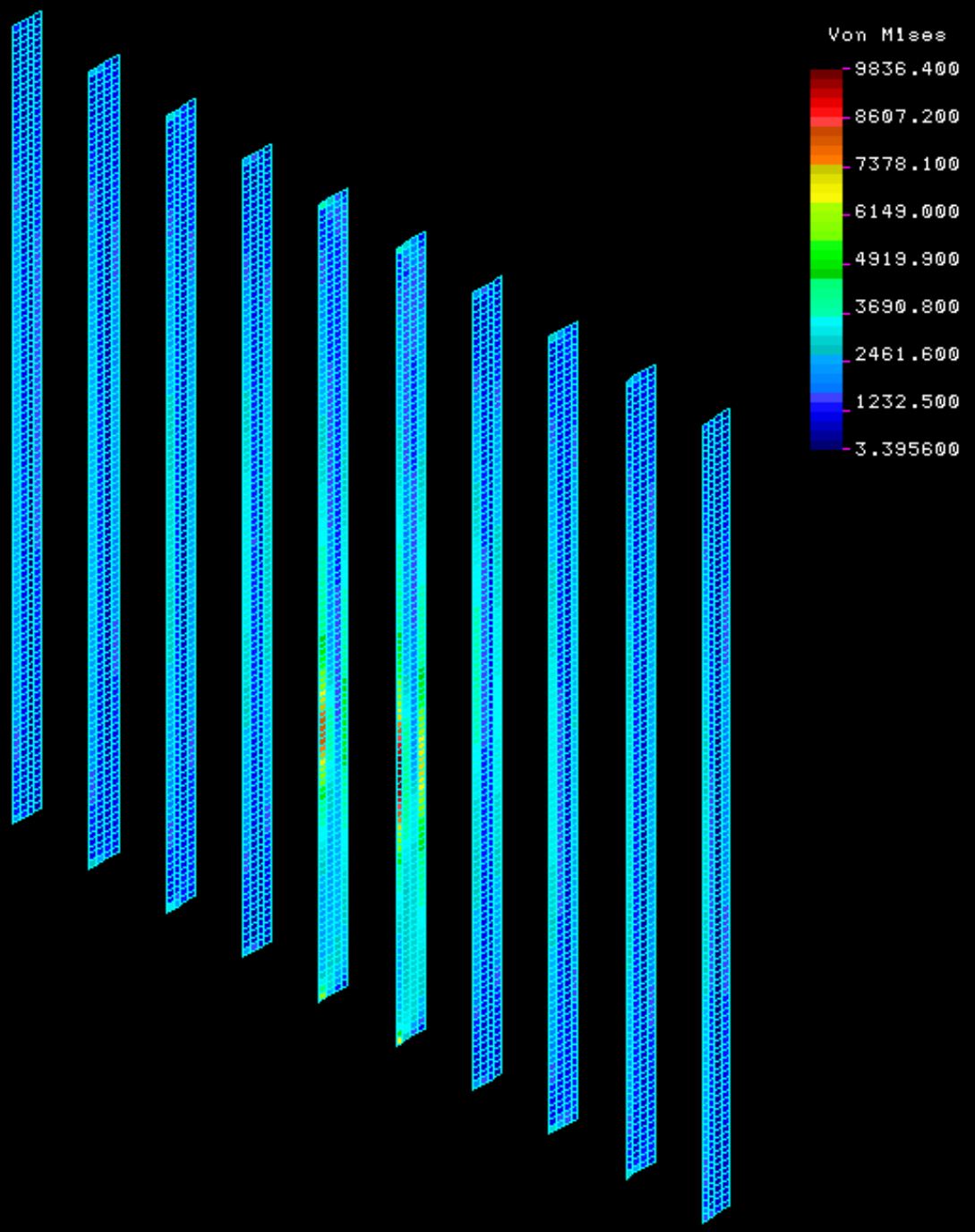
2000 lb point force on frame 4 ft above floor



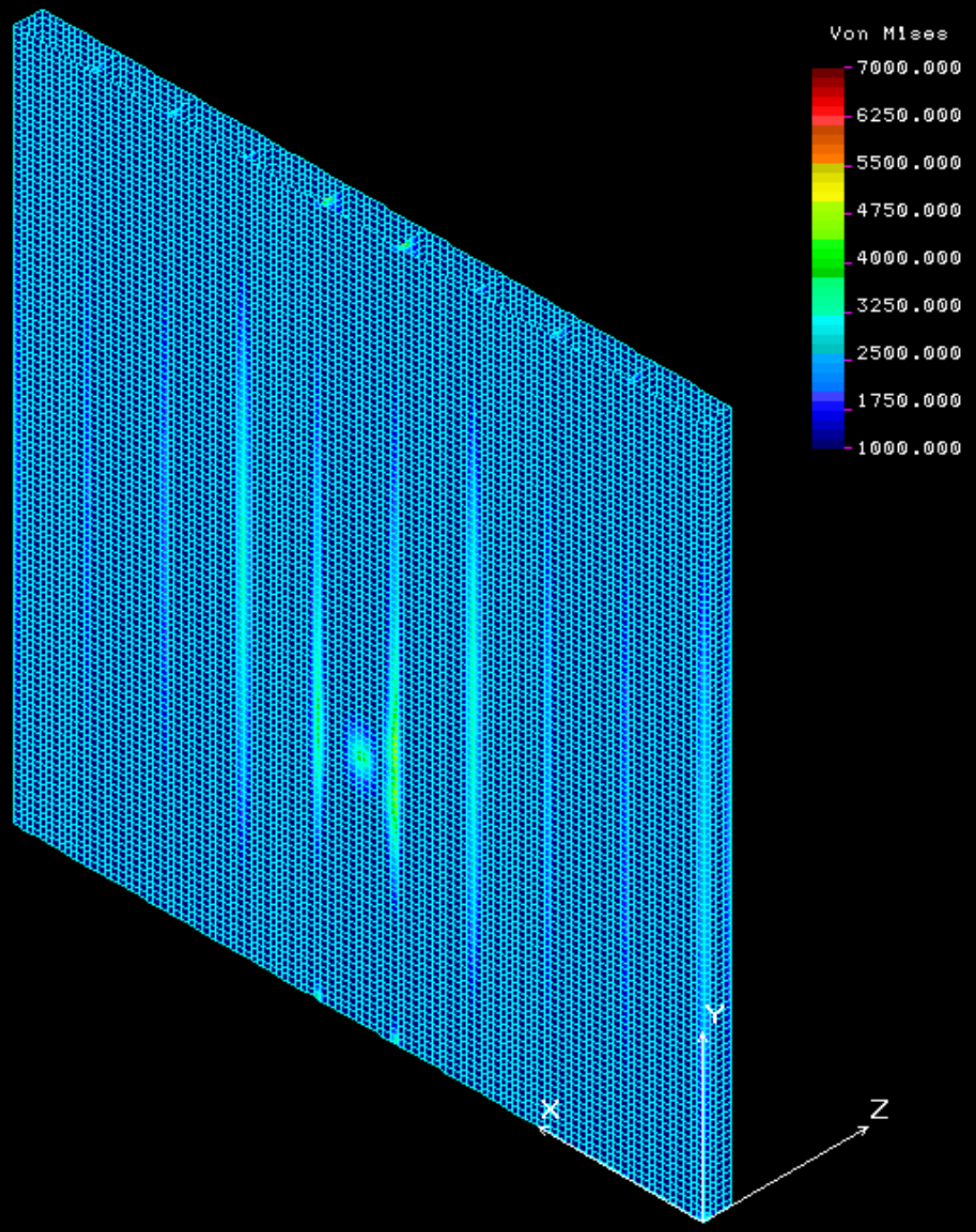
Load “E”
Front Face
Z Deflection
(in)



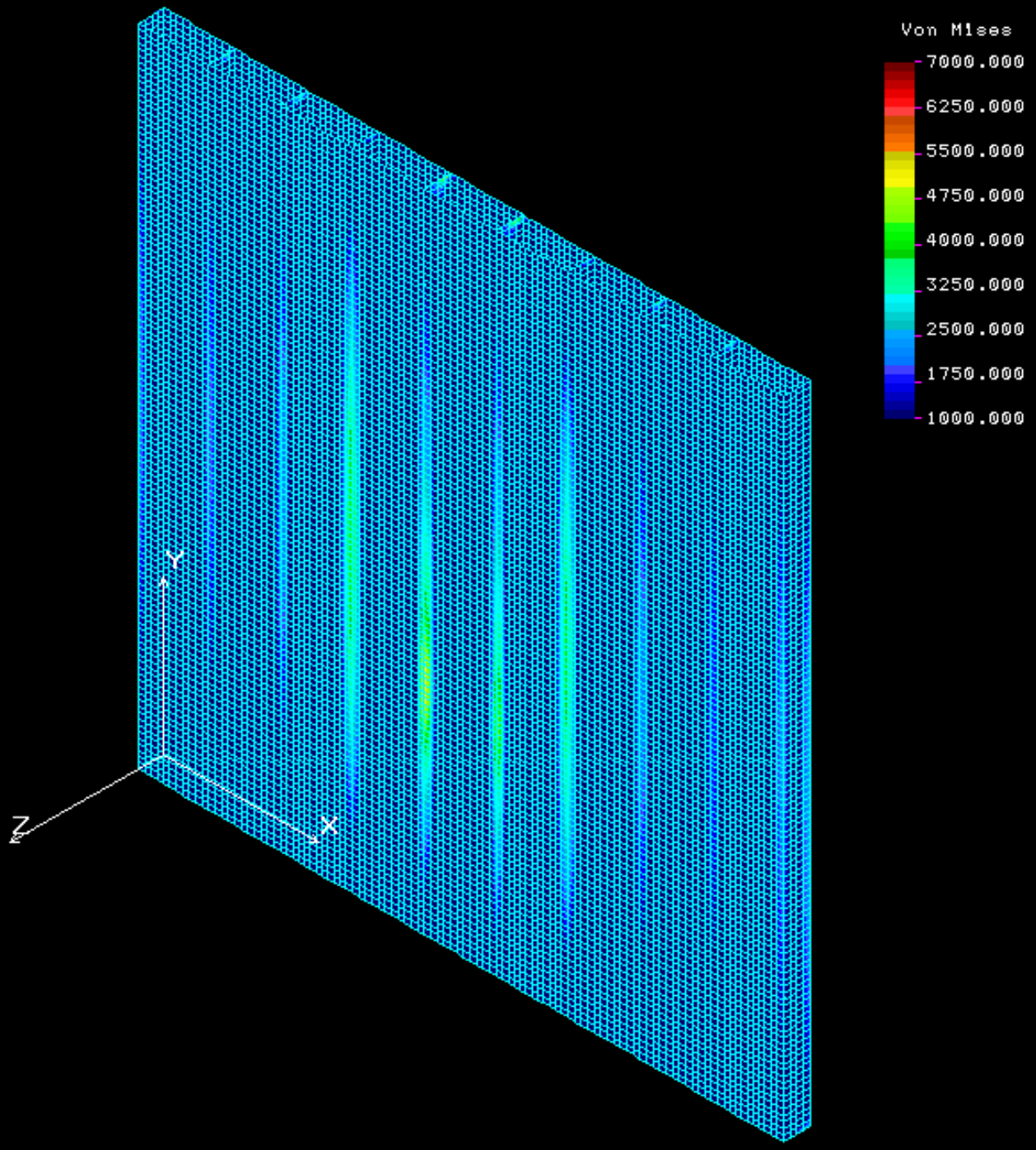
Load “E”
Back Face
Z Deflection
(in)



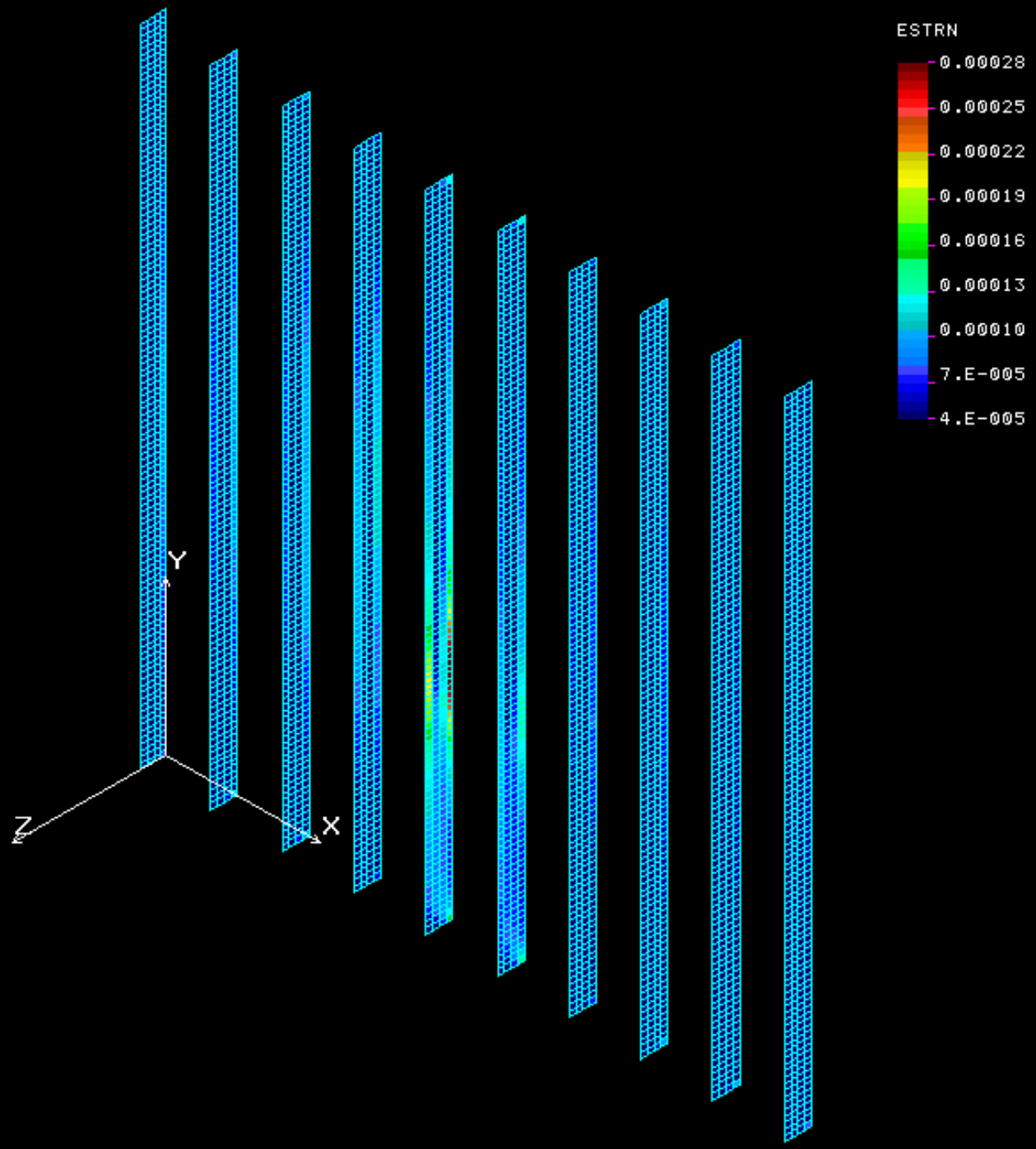
Load “E” Frame Stress (psi)



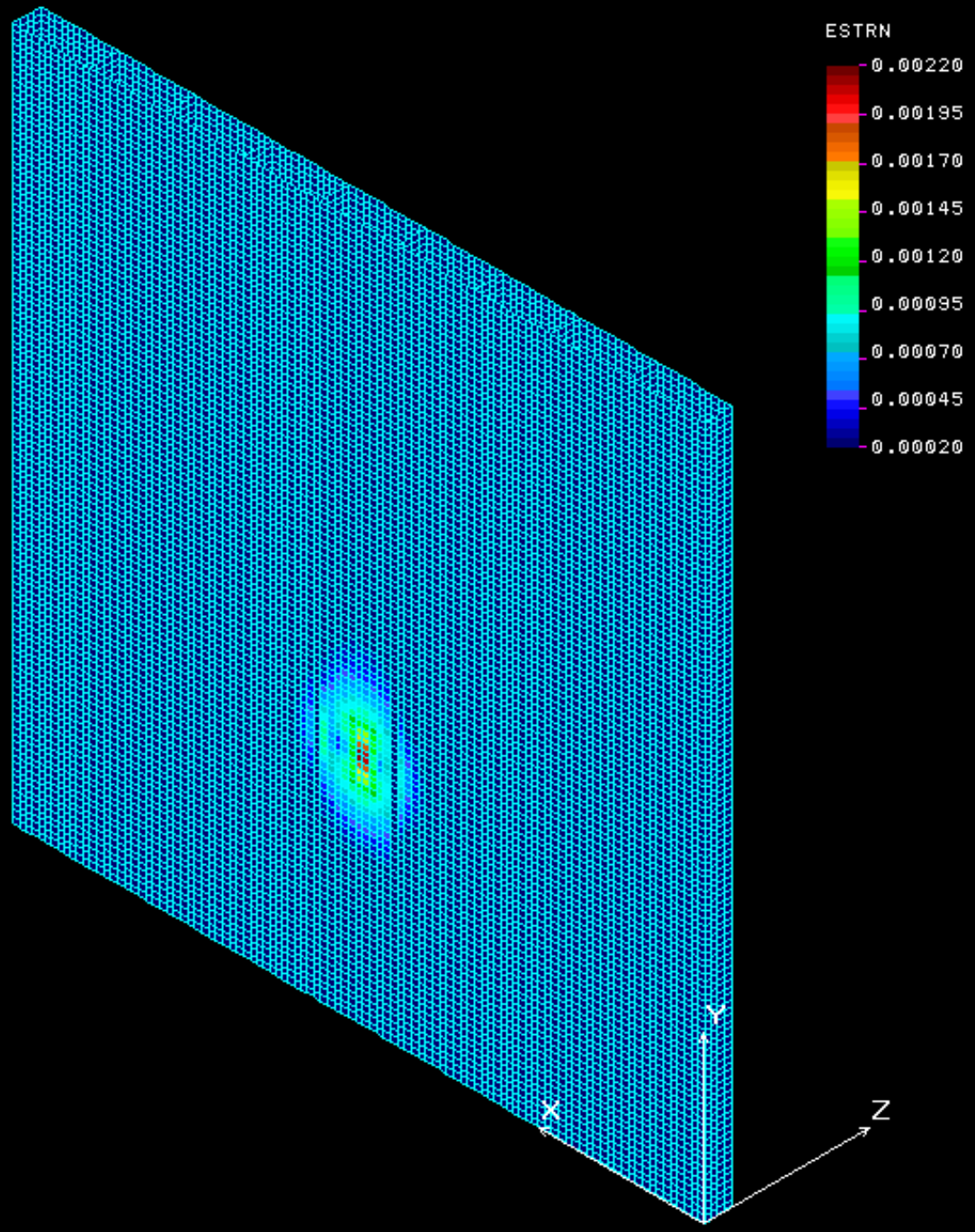
Load “E” Front Panel Stress (psi)



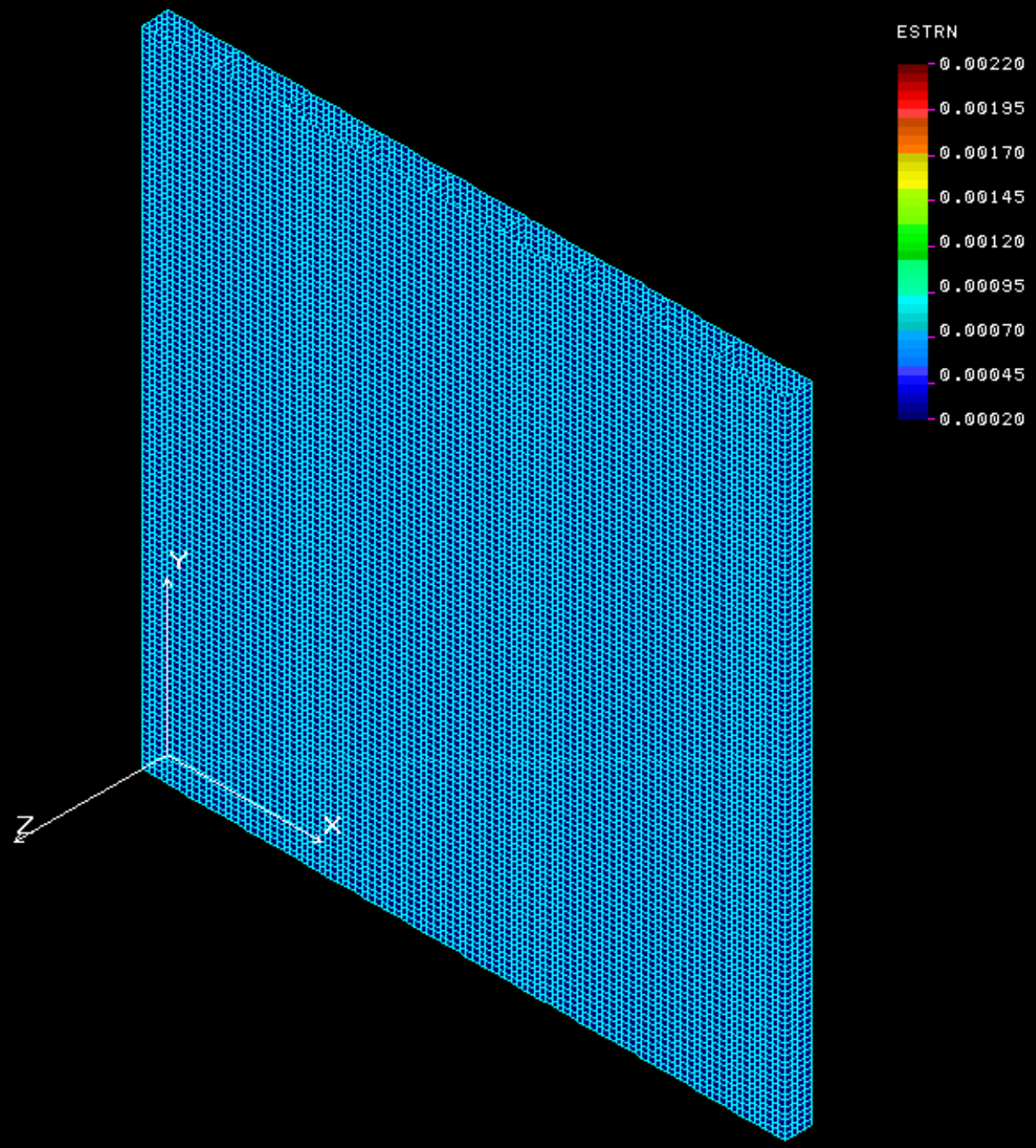
Load “E” Back Panel Stress (psi)



Load “E” Frame Strain



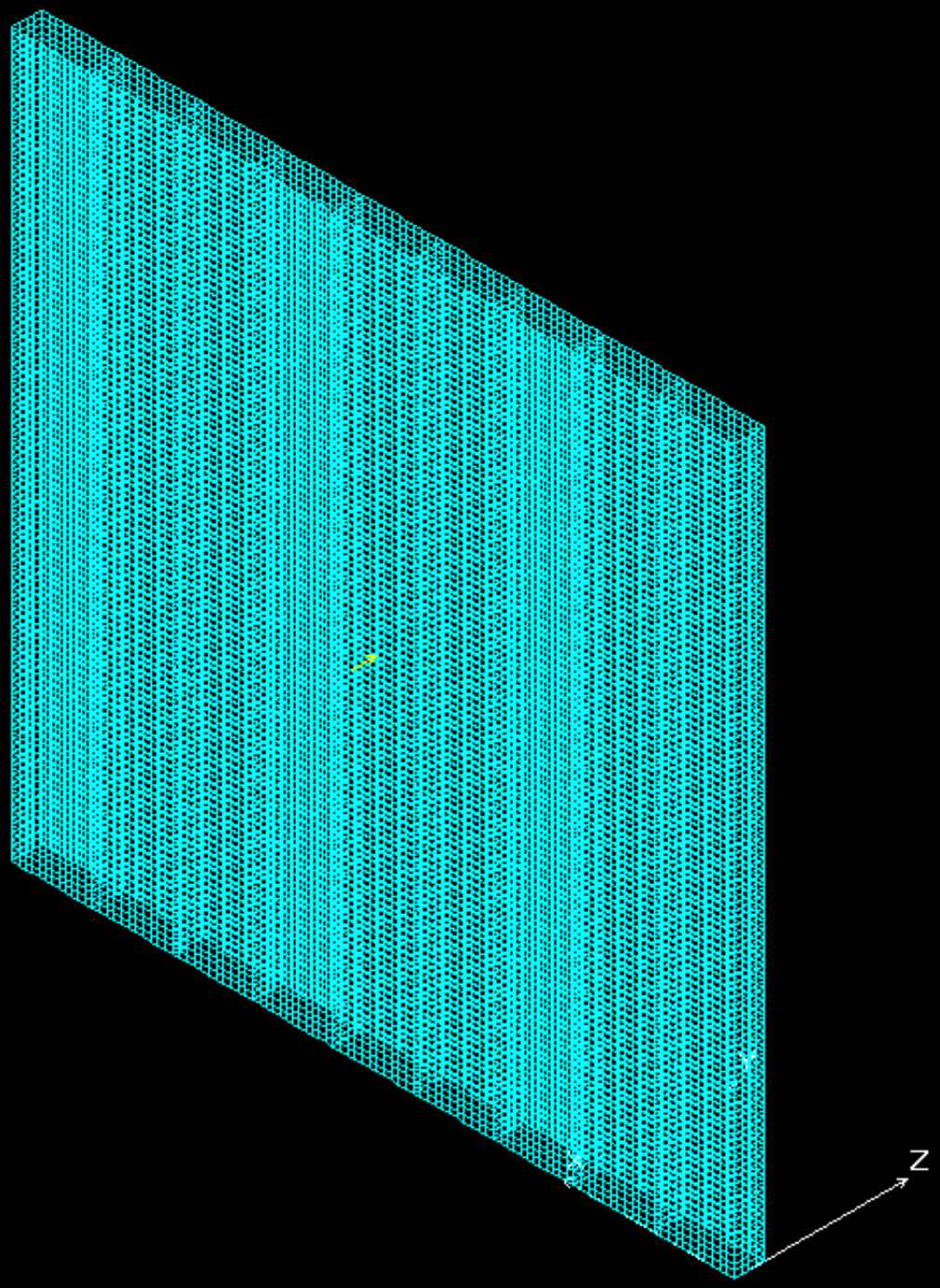
Load “E” Front Panel Strain



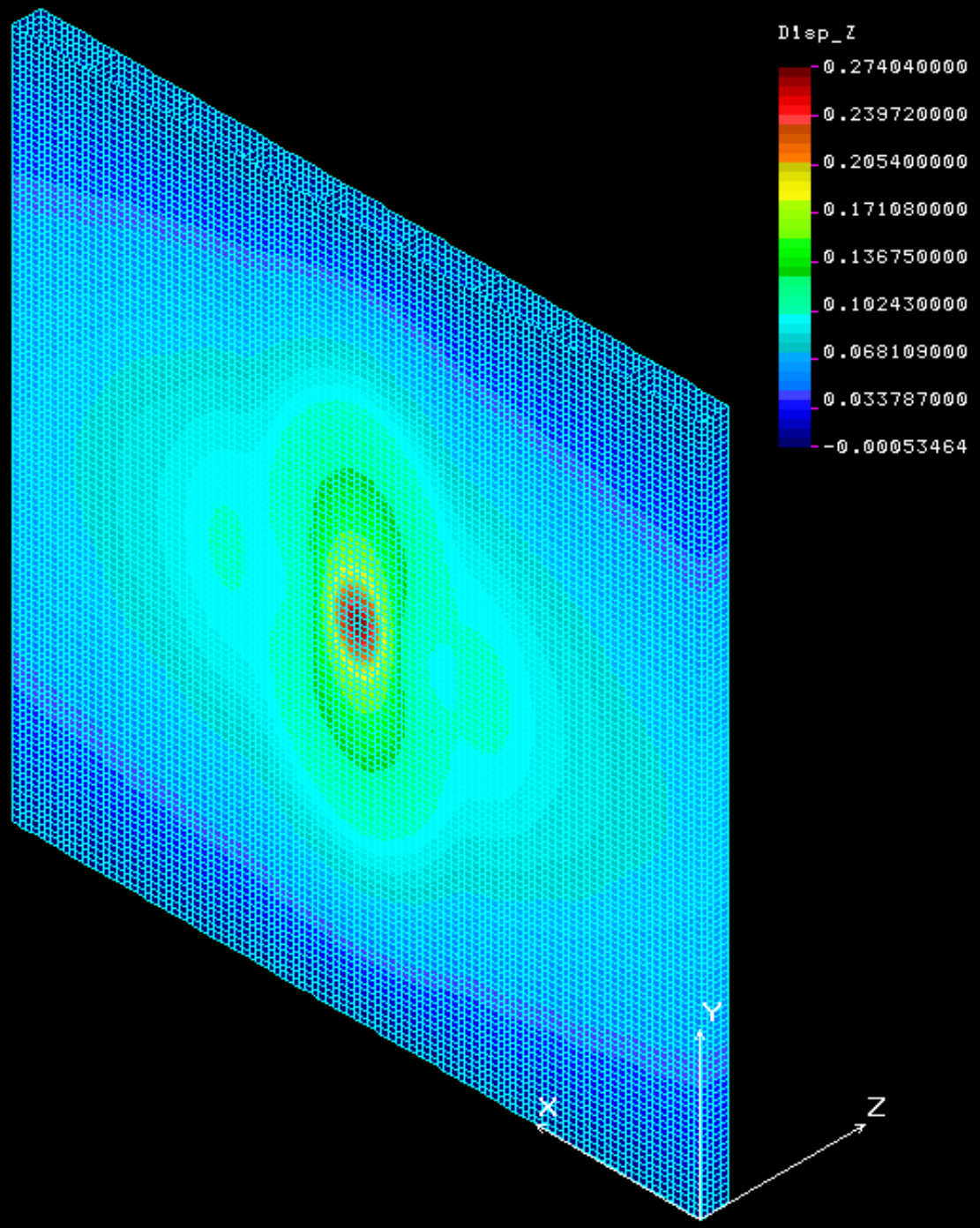
Load “E” Back Panel Strain

Loading “F”

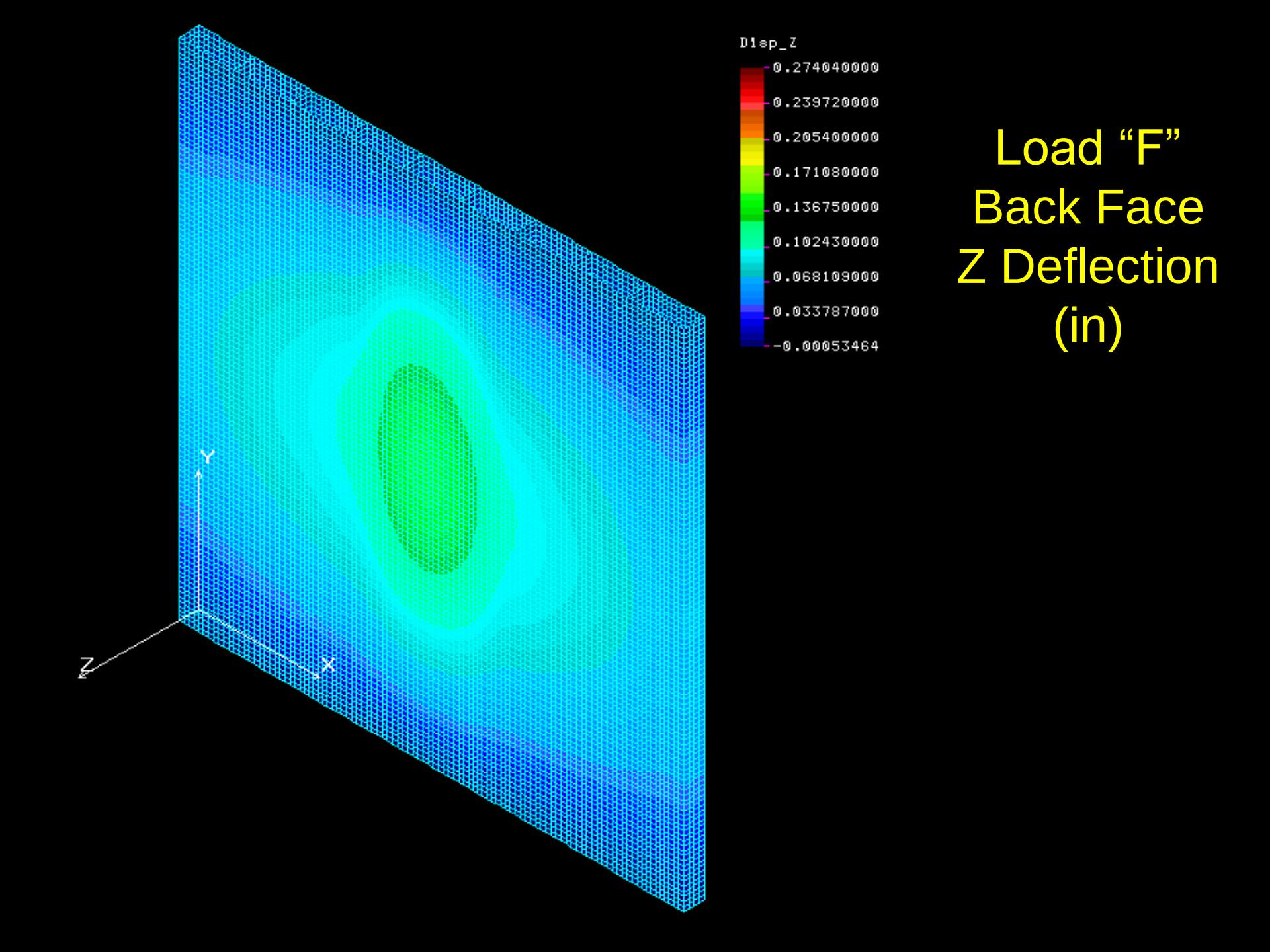
- Pressure load of 0.287 psi on wall panels
- 2000 lb point load on frame 2 ft above floor



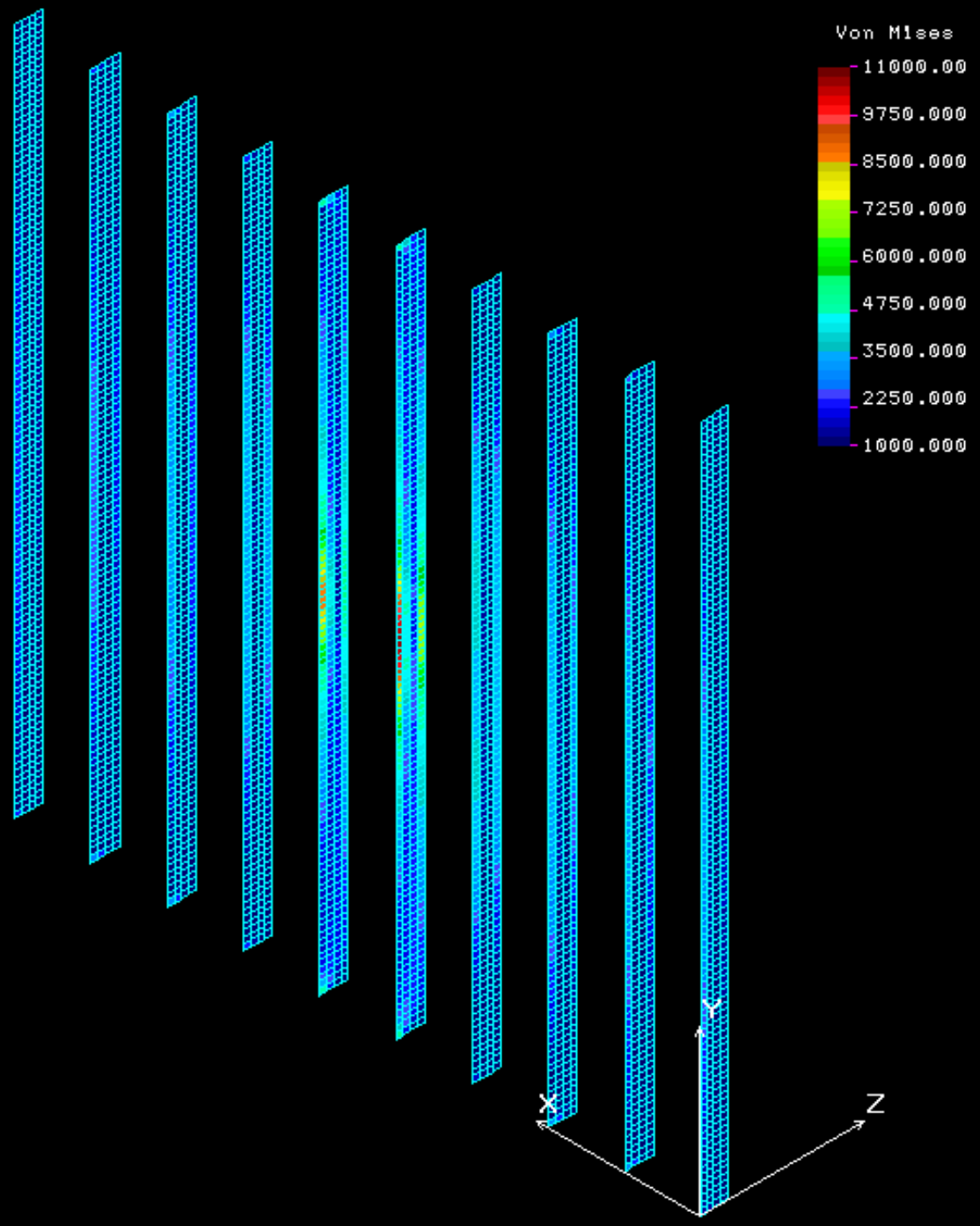
2000 lb point force on frame 6 ft above floor



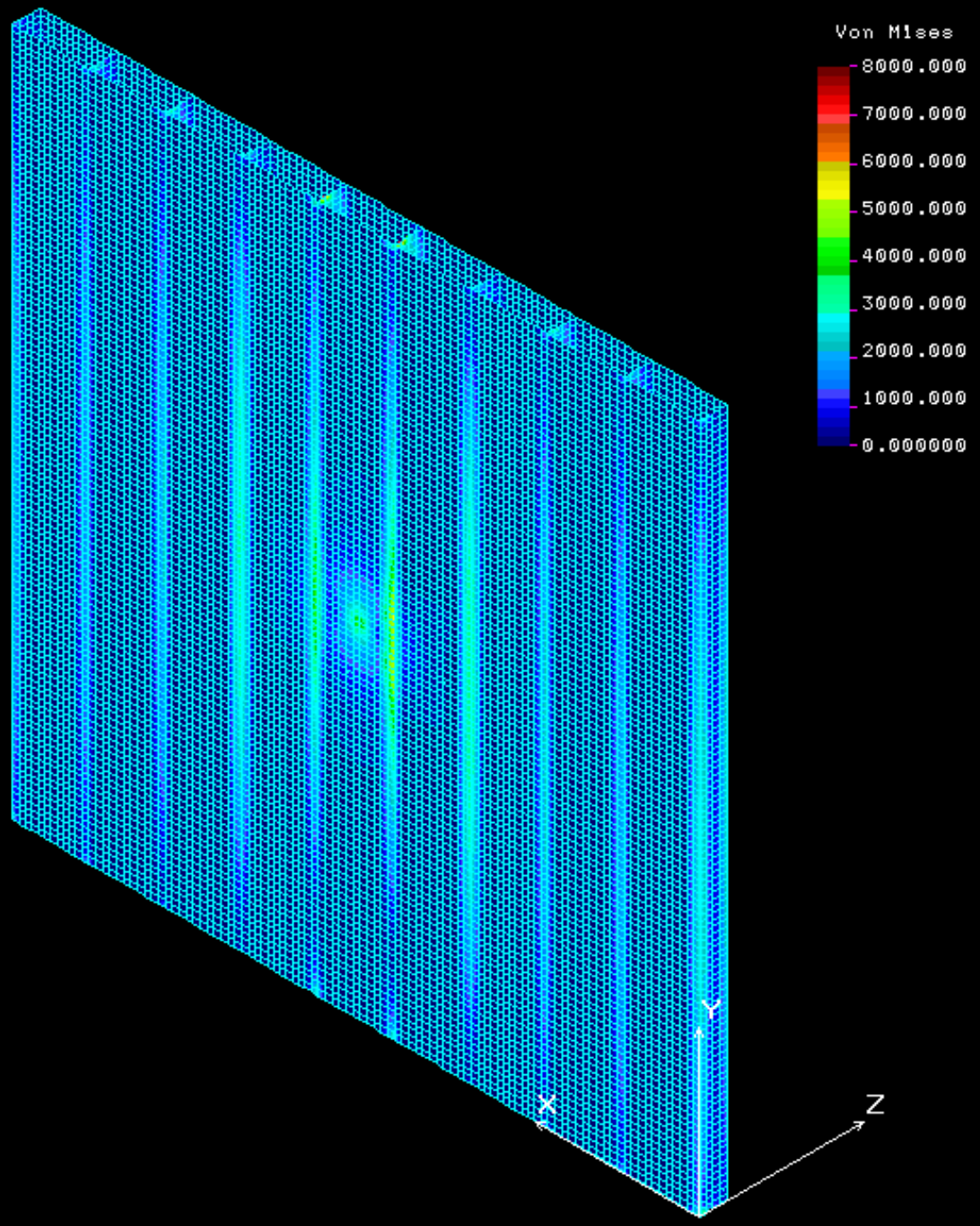
Load “F”
Front Face
Z Deflection
(in)



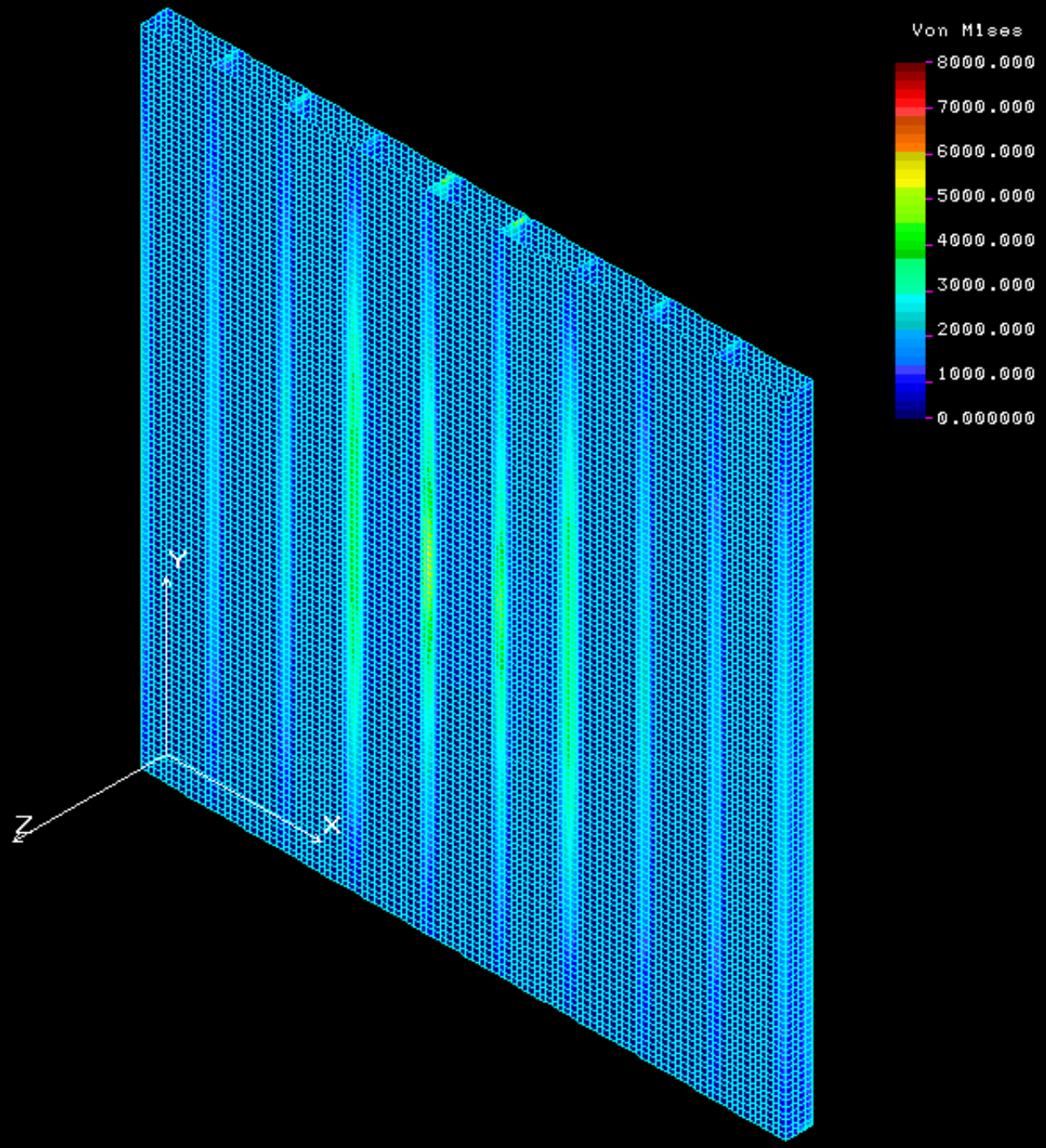
Load “F”
Back Face
Z Deflection
(in)



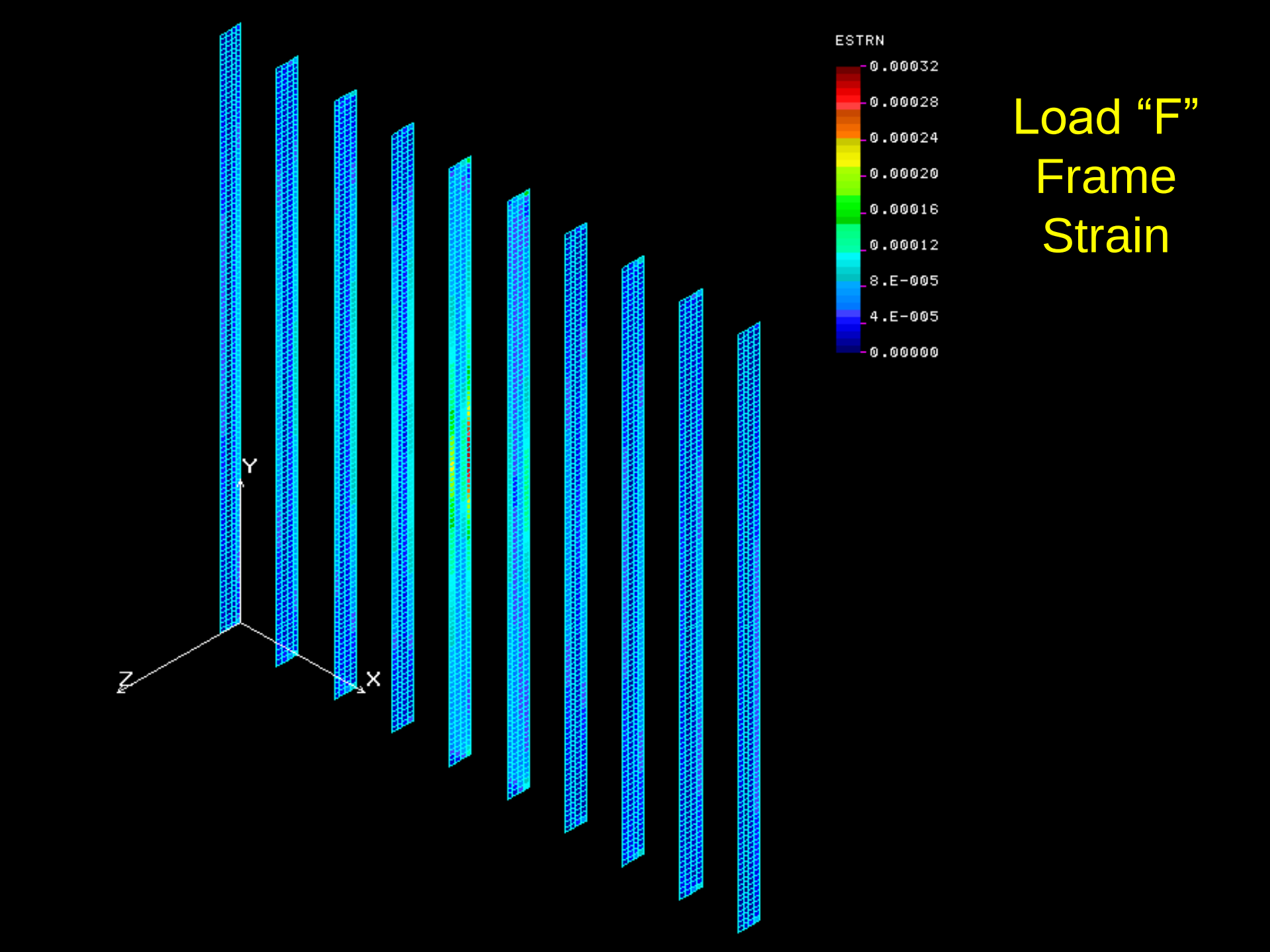
Load “F” Frame Stress (psi)



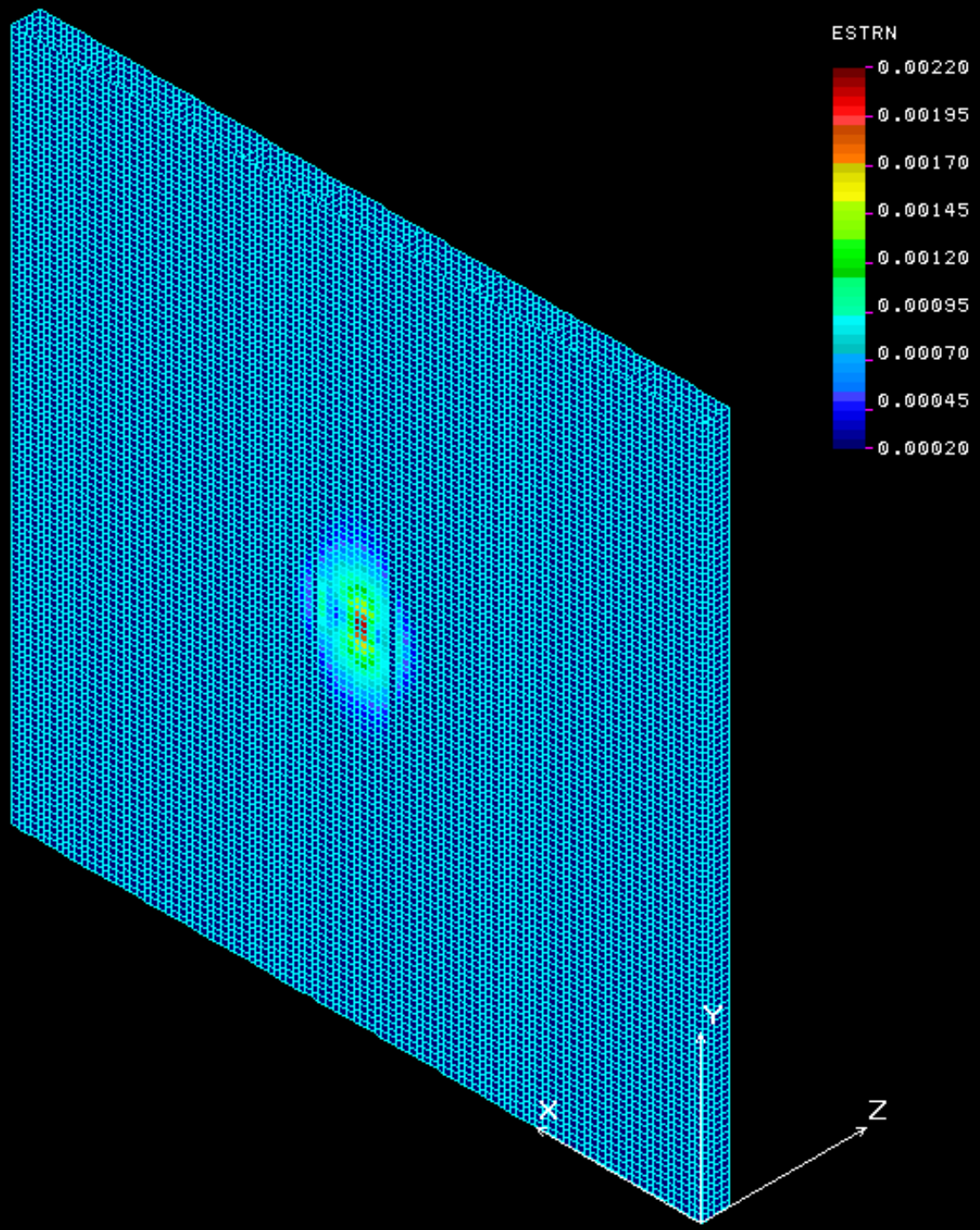
Load “F” Front Panel Stress (psi)



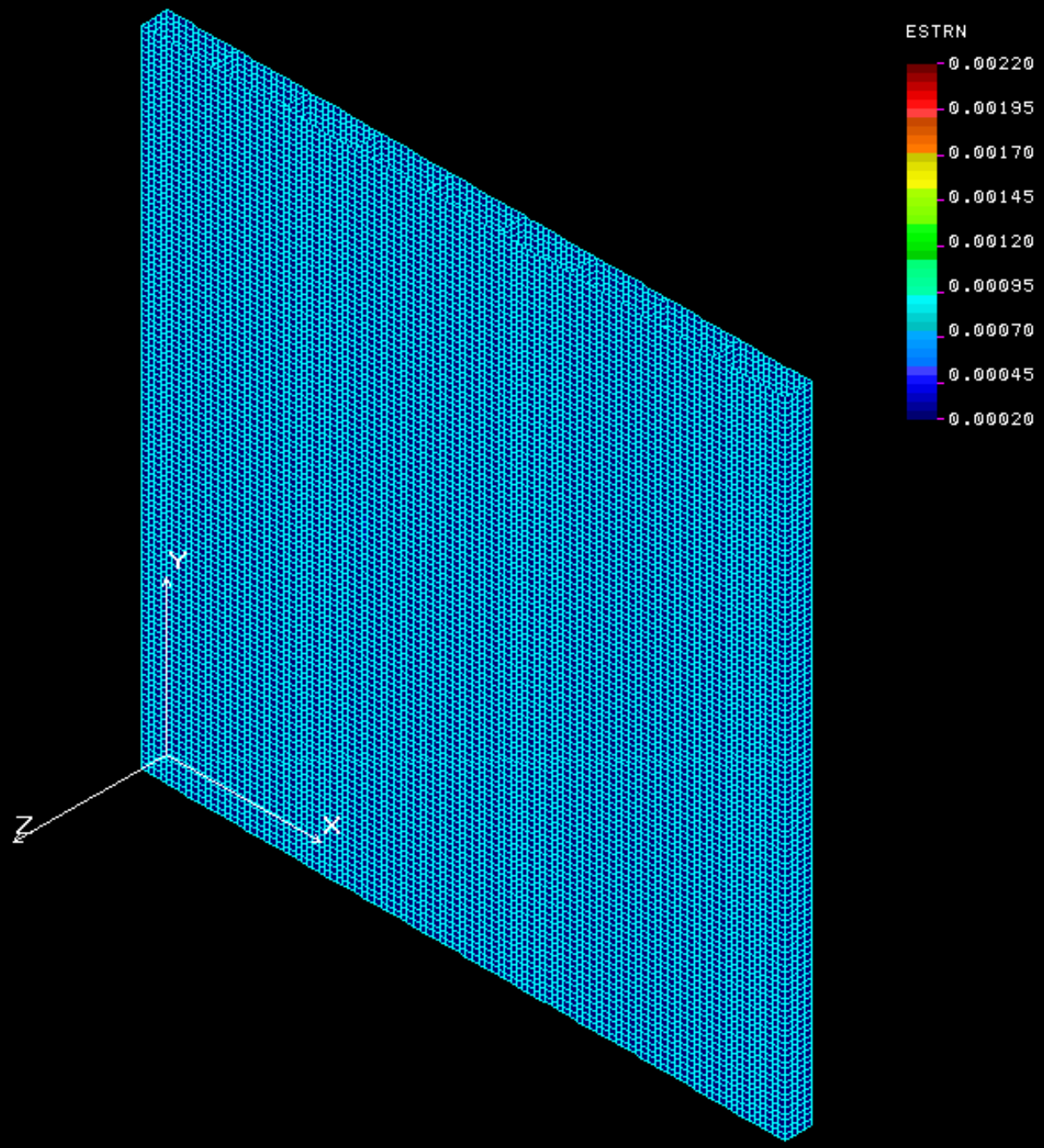
Load “F” Back Panel Stress (psi)



Load “F” Frame Strain



Load “F” Front Panel Strain



Load “F” Back Panel Strain

Summary

- The lowest safety factor for the steel frames is 4.8, for load case “C”.
- The lowest safety factor for the GRP panels is 1.8, for load case “F”.
- The current design is adequate for up to a 2000 lb point load for 12 ft high walls
- Higher loading will require thicker panels.