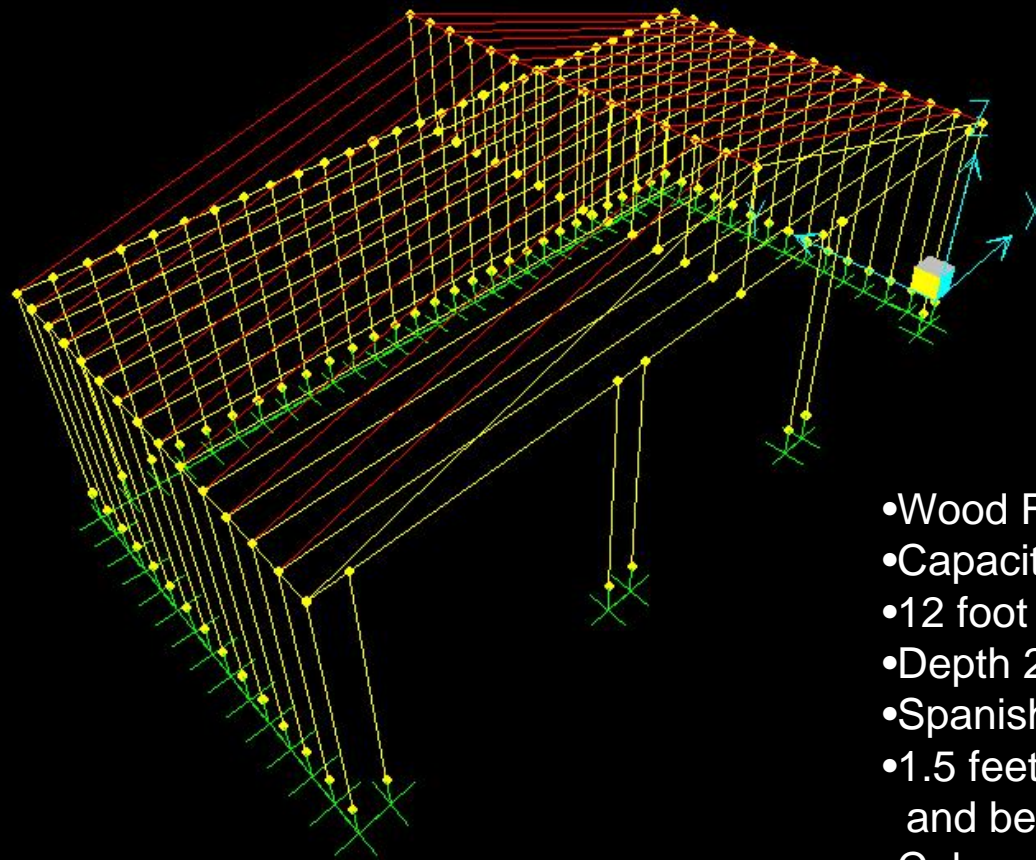


CE 409a Homework 7
Detached Three-Car Garage Design

George Zouein

Design of the Structure

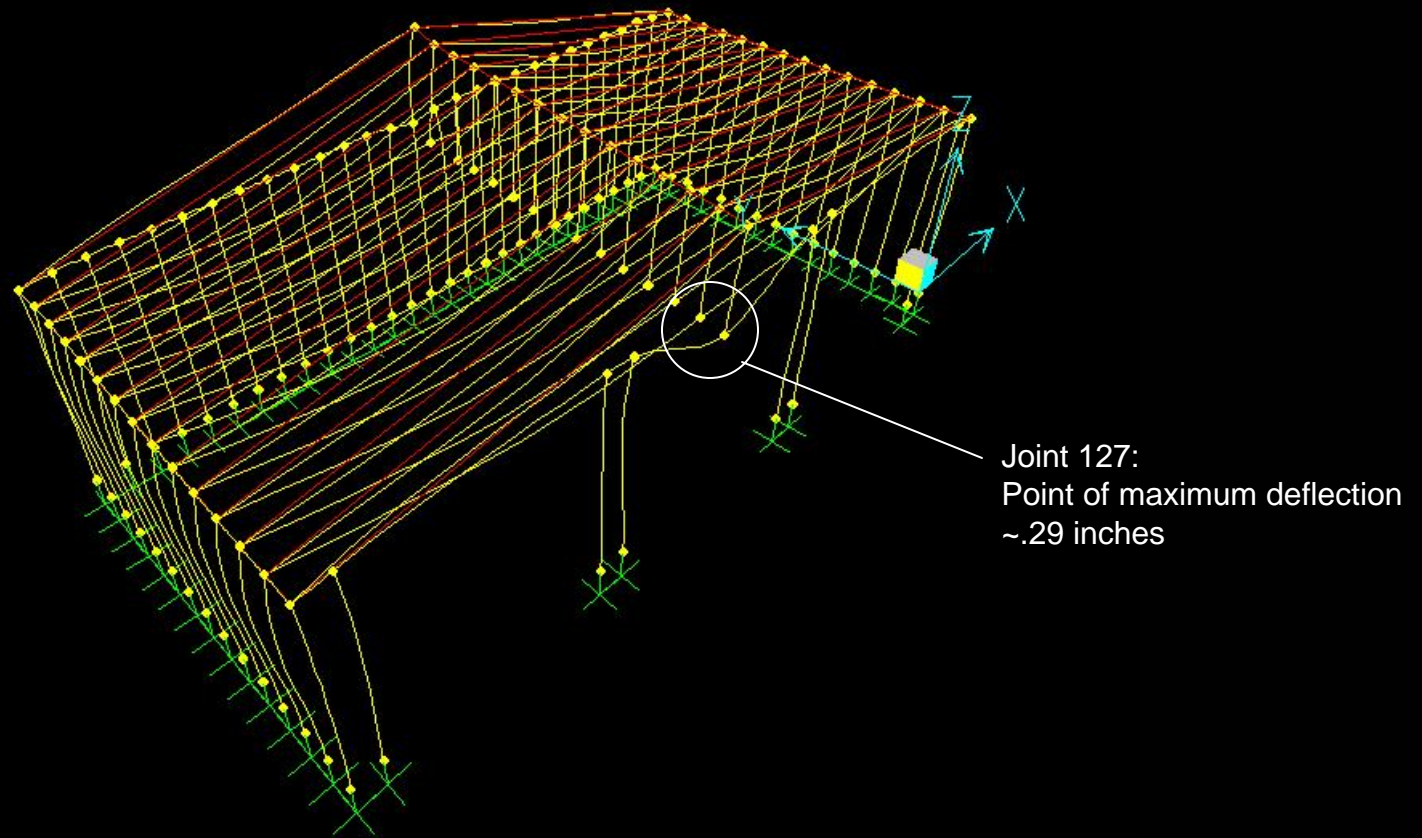


- Wood Framed
- Capacity: 3 cars
- 12 foot wide car spaces
- Depth 20 feet
- Spanish tile roof
- 1.5 feet between columns and beams
- Columns – 2 x 4 in.
- Beams – 2 x 6 in.

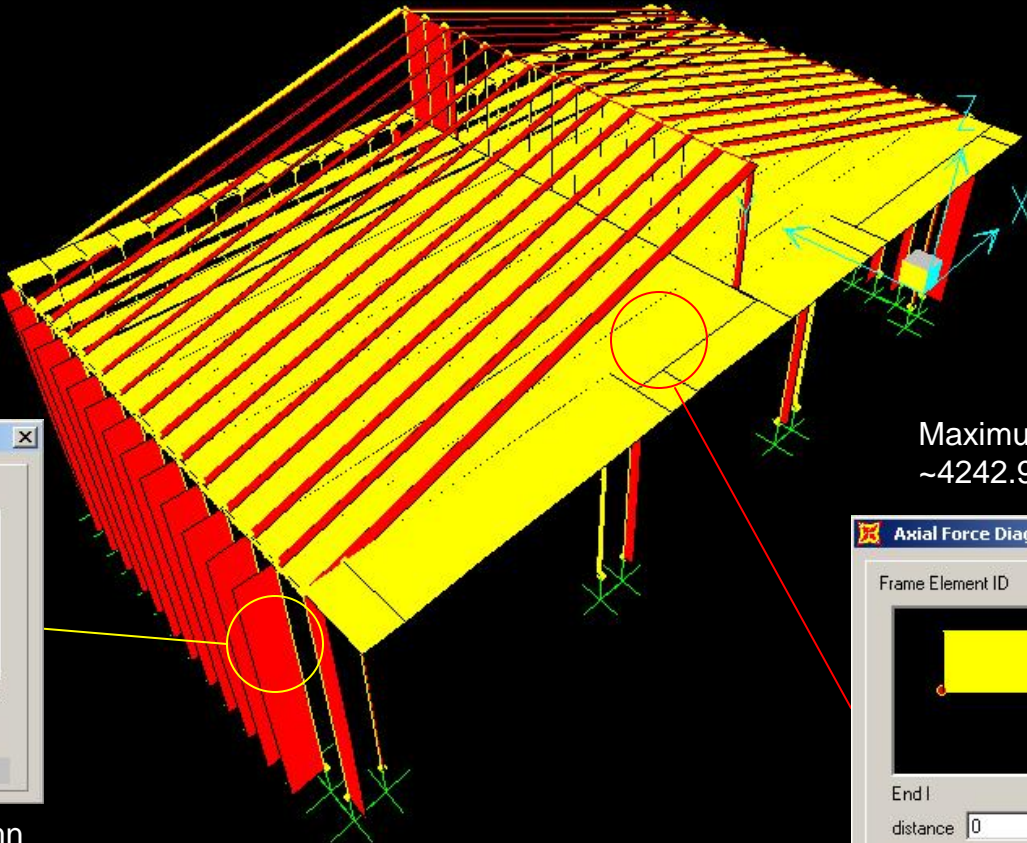
Properties of Douglas Fir

- Unit Weight = 0.018 pounds per cubic inch
- Ultimate Strength:
 - 7.4 ksi compression, 8.5 ksi shear
- Allowable Stress:
 - 1900 psi axial, 120 psi shear
- Young's Modulus = 1,760,000 psi
- 2 foot snow load estimated as 53 lb/ft²

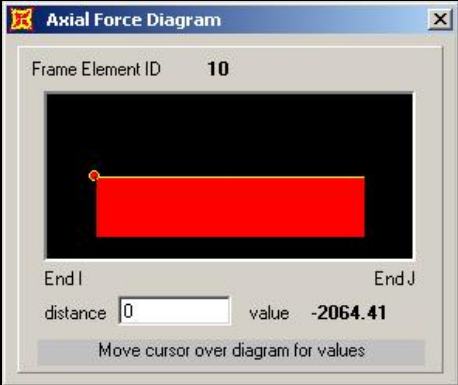
Loaded Structure



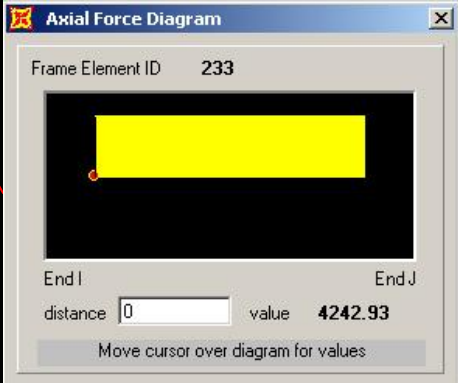
Axial Force



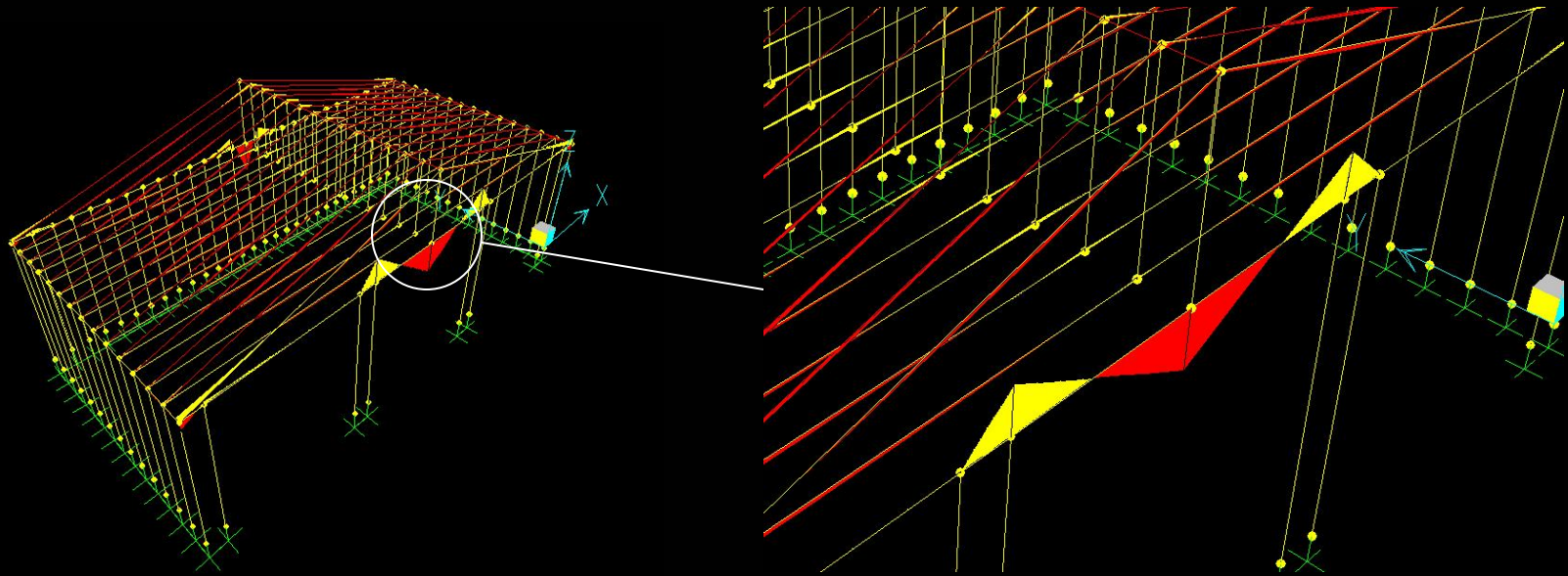
Maximum Beam
~4242.93 lbs (tension)



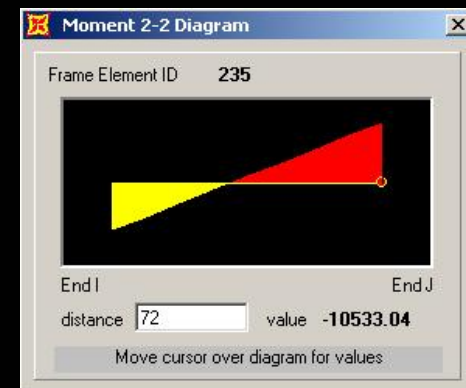
Maximum Column
~2064.41 lbs (compression)



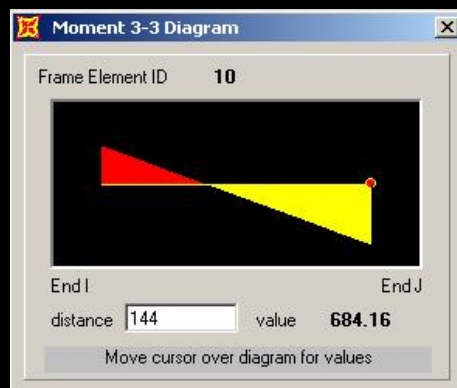
X axis Moment



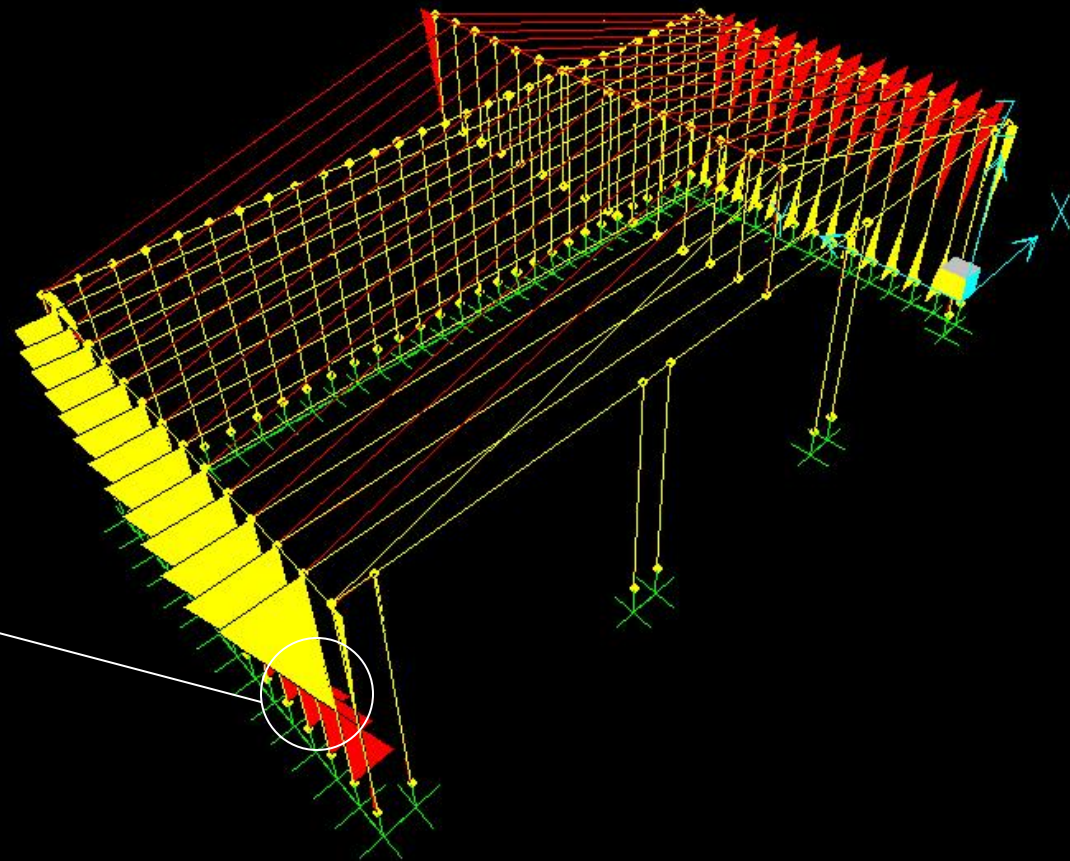
Maximum Beam
~ -10533.04 lbs*in



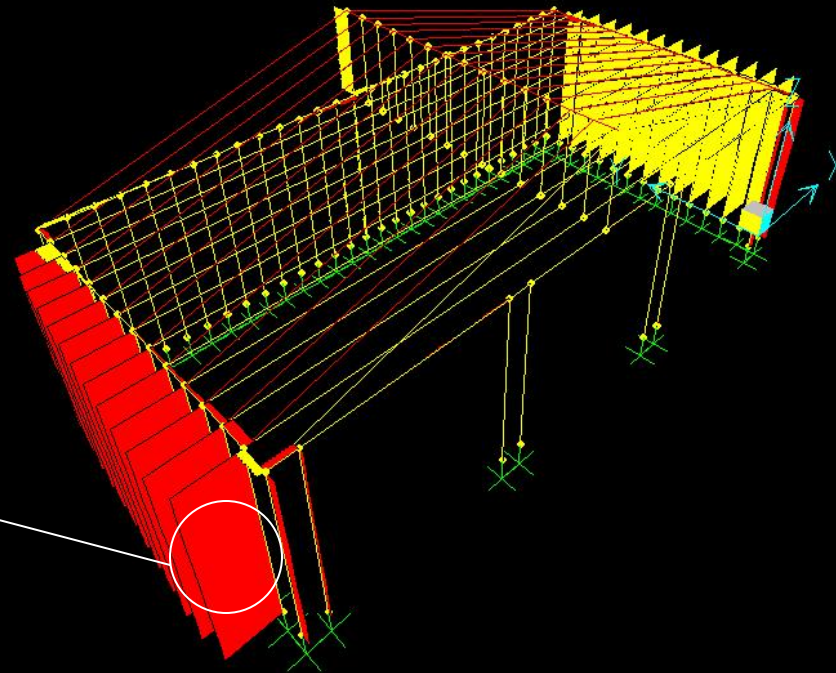
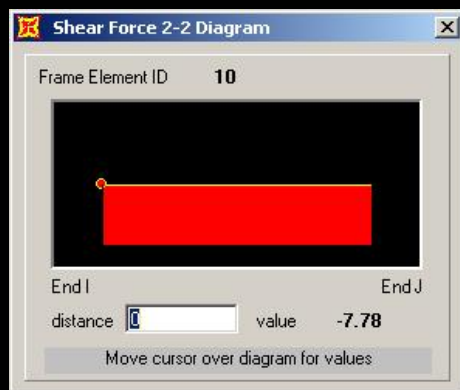
Z axis Moment



Maximum Column
~684.16 lbs*in

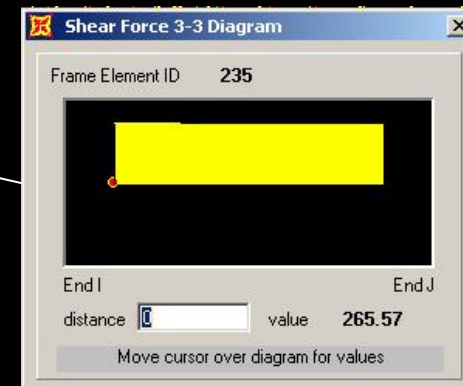
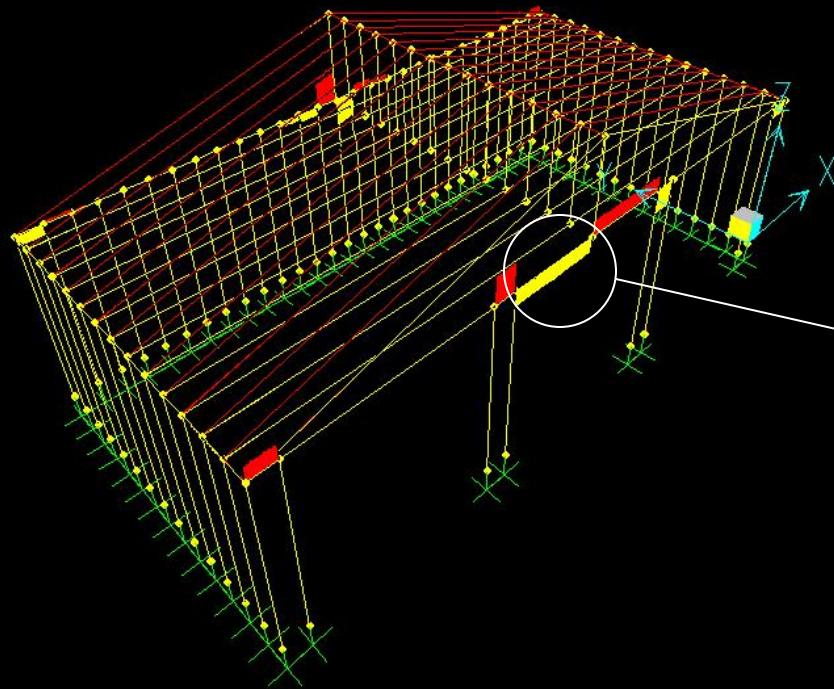


Shear in X axis



Maximum Column
~ -7.78 lbs

Shear in Z axis



Maximum Beam
~265.57 lbs

Safety of the Design

- Applying the equations for the axial and shear stresses for the critical beam and column of the design results in values of:
 - Beam:
 - Axial Stress: 353.6 psi
 - Shear Stress: 49.8 psi
 - Column:
 - Axial Stress: 172.0 psi
 - Shear Stress: 1.5 psi
- Conclusion: Since for both the critical beam and column, the values for the axial stress and shear stress are less than the allowable values of 1900 psi (axial) and 120 psi (shear), the design is concluded to be safe for use.