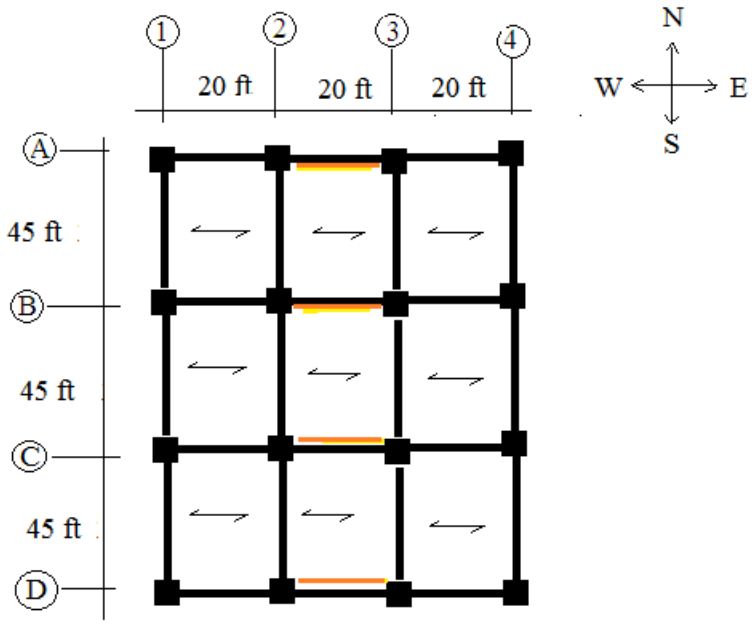
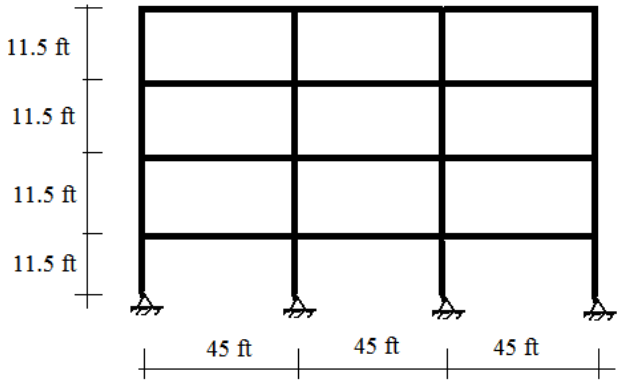
Take-home Exam #2:

Consider a four story steel frame building the plan and elevation views of which are shown below. The structure is considered to be a rigid frame in the N-S direction and a braced frame in the E-W direction.

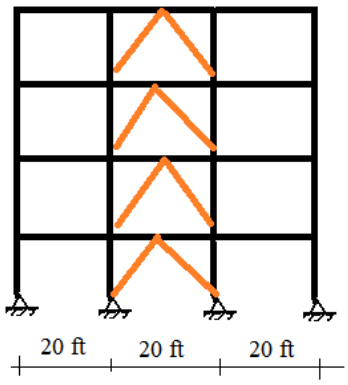
The rigid flooring system transmits the gravity load primarily to the floor beams oriented in the N-S direction (one-way action).



Typical Plan



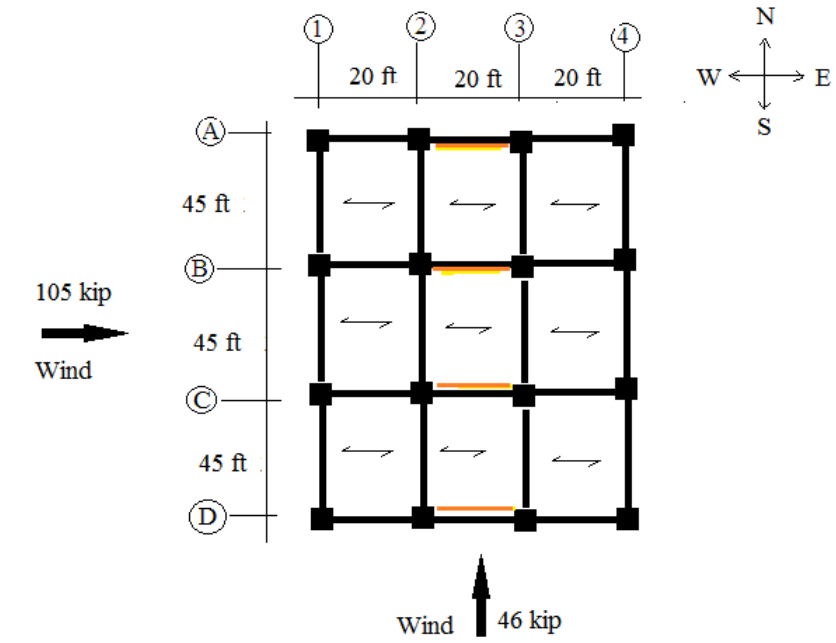
Elevation N-S

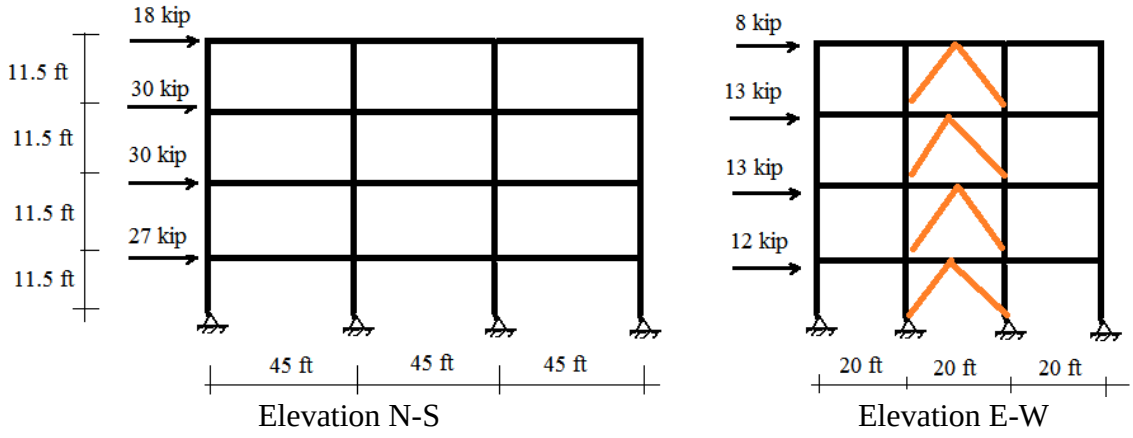


Elevation E-W

- Floor /roof dead load = 70 psf
- Floor /roof live load = 80 psf

- The building is subjected to an earthquake acting in both the N-S and E-W directions. Assume s_a =0.12g.
- The global wind loads (N-S and E-W directions) are defined in the figures below.





Elevation N-S

Elevation E-W

Assume:
All the roof /floor beams in the N-S direction are of the same size.

All the floor/roof beams in the E-W direction are of the same size. Assume that the only gravity load which the beams in the E-W direction carry is a dead load of 0.6 kip/ft.

All the columns are of the same size.

All the braces are of the same size.

1- Determine the earthquake forces for the typical interior frame.

2- Estimate the forces (axial, shear and moment) of the beams and columns.

3- Estimate the maximum axial force of the k-brace.

4- Determine the critical loading patterns for the gravity live loading using the Müller-Breslau Principle.

5- Use computer software to determine the maximum axial/moment in the beams and the columns.

6- Select the lightest W21 shape for a typical floor beam in N-S direction. Limit the beam deflection to $\frac{L_{beam}}{240}$.

7- Select the lightest W10 shape for a typical column. Limit the building drift to $\frac{H_{building}}{300}$.

8- Summarize your findings.