HW wk-06 | due 03.05.2019 | Lateral Forces

A rectangular steel frame building experiences the wind pressure loading shown below. The building is 72' long as shown, and has two 24' bays totaling 48' wide in the other direction (plan diagram shown on next page).

Similar to Project 2 this building is clad with a curtain wall on all sides.

1. What is the tributary height (equivalent to tributary width working in plan) of the curtain wall for lateral wind pressure loads to the roof diaphragm?

   **Trb. height to roof is 14'-0" (0.5) = 7'-0"**

2. What are the tributary distances of the curtain wall for lateral wind pressure loads to the second floor diaphragm? (hint: 2nd floor receives pressure loads from walls above and walls below)

   Trib from above = 14'-0" (0.5) = 7'-0"; Trib from below = 16'-0" (0.5) = 8'-0"

3. From the applied pressures on the given schematic section diagram above and the tributary distance calculated in question 1 above determine the line load acting horizontally upon the roof diaphragm. (be careful about units!)

   Roof Line Load = Trib Ht. to Roof (Wind Load A 30 psf)
   
   Roof Line Load = 7ft (30 psf) = 210 lbs/ft or 210 PLF

4. From the applied pressures diagrammed above and the tributary distances calculated in question 2 determine the line load acting horizontally at the 2nd Floor diaphragm. (units!)

   Floor Line Load = Trib Ht. to Roof (Wind Load A) + Trib Ht. to Floor (Wind Load B)
   
   Floor Line Load = 7ft (30 psf) + 8ft (15 psf)
   
   Floor Line Load = 210 PLF + 120 PLF
   
   **Floor Line Load = 330 PLF**

5. Determine the resultants that are equal to the total wind load (in kips) pushing eastward acting at both the middle of the roof diaphragm and the floor diaphragm. (hint: equivalent resultant for line load distributed on beam—look at building in plan and rotate 90 degrees clockwise)(Units!)

   \[ \text{Res}_{\text{Roof}} = 210 \text{ PLF (48'-0")} = 10080 \text{ lbs} \]

   \[ \text{Res}_{\text{2nd floor}} = 330 \text{ PLF (48'-0")} = 15840 \text{ lbs} \]
6. Diagrammatic Plan view below shows three identical moment frames along grid lines A, B and C. Determine the wind load distribution to one of the moment frames (based on relative rigidity) and show the loading for your chosen moment frame on the elevation drawing below. (Check your units!)

Assumed
Rigidity for Individual Single Bay Moment Frame is ‘1’
Total Rigidity of the system is all the rigidities added together
1 + 1 + 1 = 3

Relative Rigidity of a Frame = Individual Moment Frame Rigidity / Total Rigidity of the system

Relative Rigidity Frame = 1/3 = 0.3333
Roof Load: 0.333(10080 lbs) = 3357 lbs
Floor Load 0.333(15840 lbs) = 5275 lbs