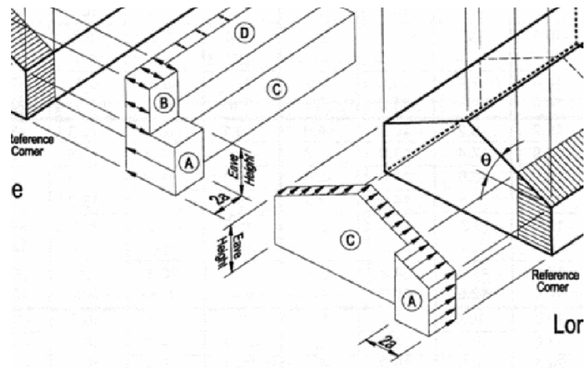
Examples:
Wind Loading

Example 1

Given the structure with three shear walls and rigid roof diaphragm, determine the horizontal shear distributed to the walls (and piers) with a static wind pressure and the overturning moment on each wall. The basic wind speed for the College Station area is 115 mph from ASCE-7.



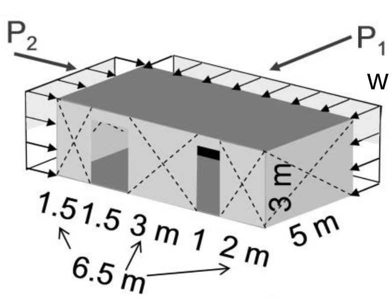
Wind Pressure:
Flat roof (0°)
Zone A: 10% of 5 m = 0.5 m
Zone C (~10 ft height)
for simplicity use C
p_{s30} = 13.9 psf
x 0.0479 kN/m^2/psf
= 0.67 kN/m^2 (KPa)

Simplified Design Wind Pressure , p_{S30} (psf) *(Expo*

Basic Wind Speed (mph)	Roof Angle (degrees)	Load Case	Zones: Horizontal Pressures A	B	C	D	Vert E	F
115	0 to 5°	1	21.0	-10.9	13.9	-6.5	-25.2	-1
	10°	1	23.7	-9.8	15.7	-5.7	-25.2	-1
	15°	1	26.3	-8.7	17.5	-5.0	-25.2	-1
	20°	1	29.0	-7.7	19.4	-4.2	-25.2	-1
	25°	1	26.3	4.2	19.1	4.3	-11.7	-1
		2	-------	------	-------	-------	-4.4	-8
	30 to 45	1	23.6	16.1	18.8	12.9	1.8	-1
		2	23.6	16.1	18.8	12.9	9.1	-7

(Found in Note Set 15.2)

SOLUTION:
The wind pressure needs to be turned into a static force by multiplying by the tributary area, which is half way from other "support" to "support" or top of parapet:



w = 0.67 kPa

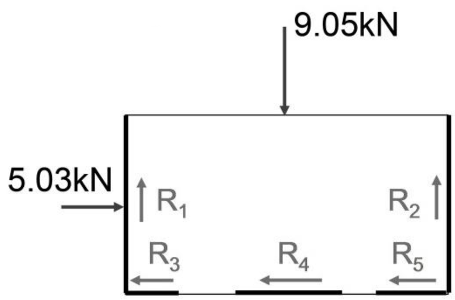
$$P_1 = w \cdot \frac{h}{2} \cdot l = 0.67 \cdot 1.5 \cdot 9 = 9.05kN$$

$$P_2 = w \cdot \frac{h}{2} \cdot d = 0.67 \cdot 1.5 \cdot 5 = 5.03kN$$

Example 1 (*continued*)

The force along the wide length, P_1, can be evenly resisted (split) by the end shear walls because they are the same size and stiffness.

In the long direction, the force P_2 must be resisted by the piers on one side only. The force should be distributed to each pier based on their stiffnesses (a function of h/L), but the calculation is laborious. This example splits the force proportionally by length.



$$R_1 = R_2 = {}^{9.05}\!/_{2} = 4.53kN$$

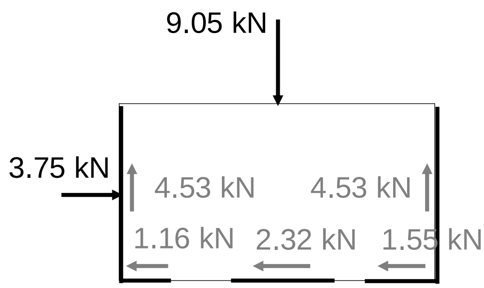
symmetry

$$R_3 = 5.03kN \cdot {}^{1.5}\!/_{6.5} = 1.16kN$$

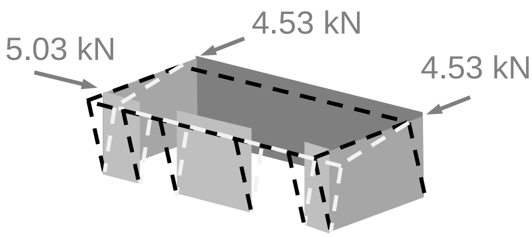
$$R_4 = 5.03kN \cdot {}^{3}\!/_{6.5} = 2.32kN$$

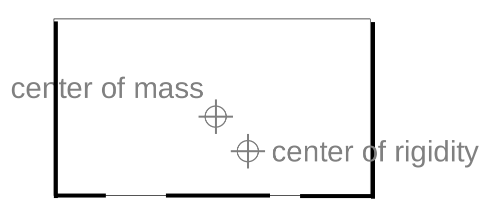
$$R_3 = 5.03kN \cdot {}^{2}\!/_{6.5} = 1.55kN$$

simplified stiffness



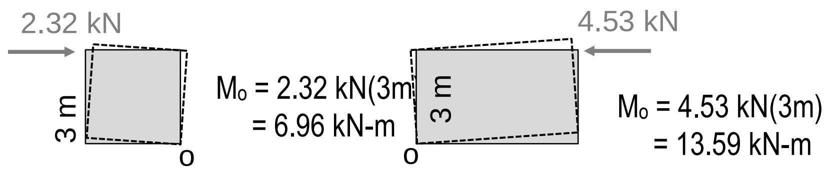
Would this want to twist? A torsional moment will result if the **center of rigidity**, which is the resulting location of the moments of the wall rigidities, does not coincide with the **center of mass** determined from the moments of the wall weight. There is, in effect, an eccentricity.





Example 1 (*continued*)

The overturning moments from the lateral forces at the top of the walls and piers about their bases (or toe) can be calculated.



Example 2

EXAMPLE 9.7 Header Acting as a Chord

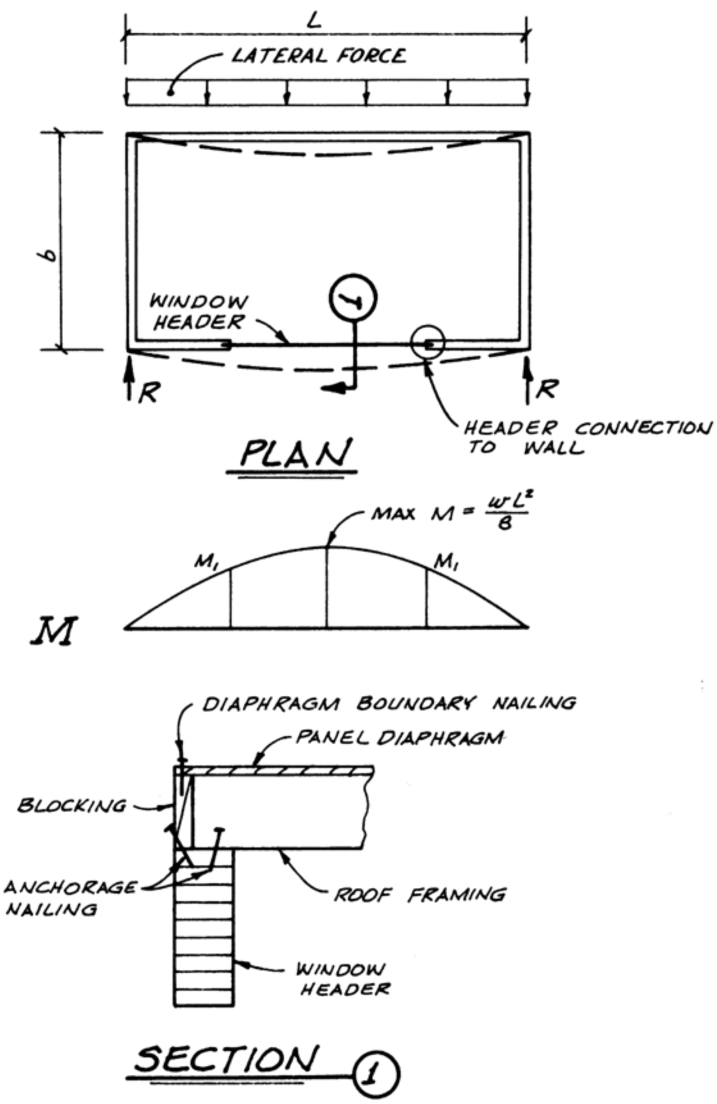


Figure 9.9 The header over an opening in a wall may be used as horizontal diaphragm chord.

Example 2 (*continued*)

Over the window the header serves as the chord. It must be capable of resisting the maximum chord force in addition to gravity loads. The maximum chord force is

$$T = C = \frac{\text{max. } M}{\text{b}}$$

The connection of the header to the wall must be designed for the chord force at that point:

$$T_1 = C_1 = \frac{M_1}{b}$$

NOTE: For simplicity, the examples in this book determine the chord forces using the dimension b as the width of the building. Theoretically b is the dimension between the centroids of the diaphragm chords, and the designer may choose to use this smaller, more conservative dimension.