Examples:
Seismic Loading

Example 1

Example 5

The floor plan of a single story commercial building located in Seismic Zone 3 is shown in Fig. 5-22. The 14-foot high masonry shear walls are load bearing and have a weight of 70 pounds per square foot. The weight of the roof is 50 pounds per square foot and all other weights may be neglected. Determine the seismic base shear.

Solution

The relevant dead loads are given by:

Roof = $W_R = 0.05 \times 40 \times 20 = 40$ kips

North wall = $W_3 = 0.07 \times 12 \times 14 = 11.76$ kips

South wall = $W_1 = 11.76$ kips

East wall = $W_2 = 0.07 \times 10 \times 14 = 9.80$ kips

West wall = $W_4 = 9.80$ kips

Total seismic dead load is then

$W = W_R + W_1 + W_2 + W_3 + W_4$

$= 83.12$ kips.

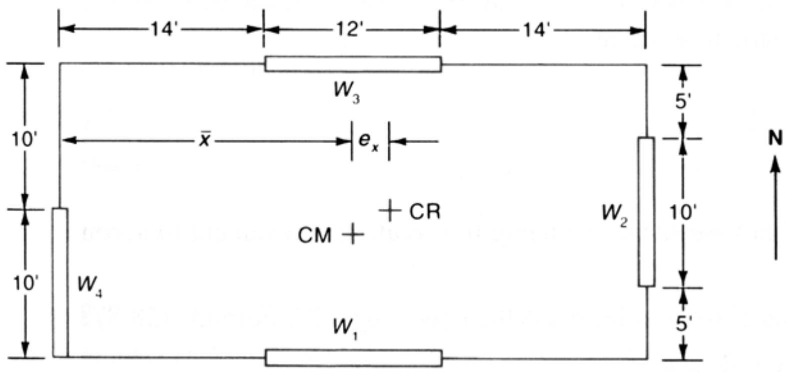

Fig. 5-22

The seismic base shear is given by Formula (28-1) as

$V = (ZIC/R_W)W$ where

$Z = 0.3$ for Zone 3 from Table 16-I

$I = 1.0$ for a standard occupancy structure as defined in Table 16-K

$C = 2.75$, the maximum value specified by UBC Section 1628.2.1

$R_W = 6$ from Table 16-N for a bearing wall system

$W = 83.12$ kips, as calculated

Then the seismic base shear is

$V = (0.3 \times 1 \times 2.75/6)W$

$= 0.1375\ W$

$= 11.43$ kips.

TABLE 1.1
Occupancy Category of Buildings and Other Structures

Nature of Occupancy	Category
Agriculture, temporary structures, storage	I
All buildings and structures except classified as I, III, and IV	II
Buildings and other structures that can cause a substantial economic impact and/or mass disruption of day-to-day civil lives, including the following:	III
More than 300 people congregation	
Day care with more than 150	
School with more than 250 and college with more than 500	
Resident health care with 50 or more	
Jail	
Power generation, water treatment, wastewater treatment, telecommunication centers	
Essential facilities, including the following:	IV
Hospitals	
Fire, police, ambulance	
Emergency shelters	
Facilities need in emergency	

Source: Courtesy of American Society of Civil Engineers, Reston, VA.

TABLE 5.5
Importance Factor for Seismic Coefficient

Occupancy Category	Importance Factor
I and II	1.0
III	1.25
IV	1.5

TABLE 5-13 SEISMIC ZONE FACTOR *Z* (*UBC TABLE 23-I*)

Zone	1	2A	2B	3	4
Z	0.075	0.15	0.20	0.30	0.40

The zone shall be determined from the seismic zone map in Figure No. 23-2.

TABLE 5-14 STRUCTURAL SYSTEMS (*UBC TABLE 23-O*)

Basic structural system[a]	Lateral load-resisting system description	R_w[b]	H[c]
A. Bearing-wall system	1. Light-framed walls with shear panels		
	a. Plywood walls for structures of three stories or less	8	65
	b. All other light-framed walls	6	65
	2. Shear walls		
	a. Concrete	6	160
	b. Masonry	6	160
	3. Light steel-framed bearing walls with tension-only bracing	4	65
	4. Braced frames where bracing carries gravity loads		
	a. Steel	6	160
	b. Concrete[d]	4	—
	c. Heavy timber	4	65
B. Building-frame system	1. Steel eccentrically braced frame (EBF)	10	240
	2. Light-framed walls with shear panels		
	a. Plywood walls for structures of three stories or less	9	65
	b. All other light-framed walls	7	65
	3. Shear walls		
	a. Concrete	8	240
	b. Masonry	8	160
	4. Concentrically braced frames		
	a. Steel	8	160
	b. Concrete[d]	8	—
	c. Heavy timber	8	65
C. Moment-resisting frame system	1. Special moment-resisting frames (SMRF)[f]		
	a. Steel	12	N.L.[e]
	b. Concrete	12	N.L.
	2. Concrete intermediate moment-resisting frames (IMRF)[f]	8	—
	3. Ordinary moment-resisting frames (OMRF)		
	a. Steel	6	160
	b. Concrete[g]	5	—
D. Dual systems	1. Shear walls		
	a. Concrete with SMRF	12	N.L.
	b. Concrete with steel OMRF	6	160
	c. Concrete with concrete IMRF[f]	9	160
	d. Masonry with SMRF	8	160
	e. Masonry with steel OMRF	6	160
	f. Masonry with concrete IMRF[d]	7	—
	2. Steel EBF		
	a. With steel SMRF	12	N.L.
	b. With steel OMRF	6	160
	3. Concentrically braced frames		
	a. Steel with steel SMRF	10	N.L.
	b. Steel with steel OMRF	6	160
	c. Concrete with concrete SMRF[d]	9	—
	d. Concrete with concrete IMRF[d]	6	—
E. Undefined systems	See Sections 2333(h)3 and 2333(i)2	—	—

[a] Basic structural systems are defined in Section 2333(f).
[b] See Section 2334(c) for combination of structural system.
[c] Height limit applicable to seismic zones 3 and 4. See Section 2333(g).
[d] Prohibited in seismic zones 3 and 4.
[e] N.L., no limit.
[f] Prohibited in seismic zones 3 and 4, except as permitted in Section 2338(b).
[g] Prohibited in seismic zones 2, 3, and 4.

Example 2

Determine the base shear for the single story building shown with a wood roof system and masonry walls by ASCE-7 *equivalent lateral force procedure*. The building is located in Hayward, California (San Francisco bay), with S_S of 2.05*g*, Site Class D, and Seismic Design Category E. The walls are specially reinforced shearwalls for an *R*-factor of 5. W per unit width of longitudinal building is 1820 lb/ft. The design short-period spectral response has been determined to govern (S_{DS}). It is not considered an essential facility.

SOLUTION:

Base shear for strength (LRFD) is determined with

$V = C_sW$

C_S is defined as $\frac{S_{DS}}{R/I}$ but not greater than $\frac{S_{D1}}{T(R/I)}$.

S_{DS} has been determined to govern, so:

$S_{DS} = 2/3 \text{ x } S_{MS}$

$S_{MS} = S_S \text{ x } F_a$

where site coefficient F_a is 1.0 for Site Class D (IBC Table 1613.3.3.(1))

$S_{DS} = 2/3 \text{ x } (2.05g \text{ x } 1.0) = 1.37g$

The building is in occupancy category II because it has no specific occupancy type: *I* = 1.0.

$C_s = \frac{1.37g}{(5/1.0)} = 0.274g$

Finally,

$V_{(u)} = 0.274(1820 \text{ lb/ft}) = 499 \text{ lb/ft}$

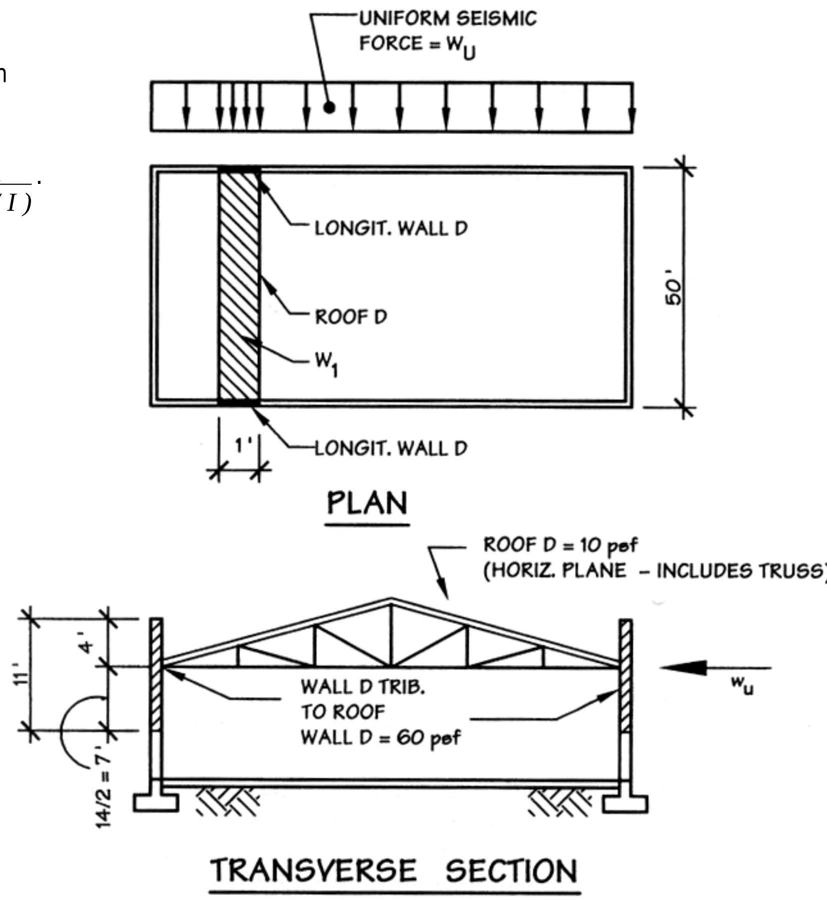

Figure 3.10 Plan view shows a typical 1-ft-wide strip of dead load D in transverse direction. Weight of this strip W_1 generates a uniform seismic force on the diaphragm. Section view has mass of walls tributary to roof level indicated by cross-hatching. Both views show the force acting on the diaphragm.