

# Foundation Calculation Report: «1750 OX Residences - 1750 N Oxford Ave. - Eau Claire, WI»

XC structural engineering

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### 1 Building codes

The following building and material codes were used for the design:

- Building code

- International Building Code, 2018 Edition (IBC 2018) with reference to Minimum Design Loads for Buildings and Other Structures by the American Society of Civil Engineers, 2016 Edition (ASCE 7).
- Material codes
  - Reinforced Concrete: Building Code Requirements for Structural Concrete and Commentary by the American Concrete Institute, 2019 Edition (ACI 318).
  - Masonry: Building Code Requirements and Specification for Masonry Structures and Companion Commentaries, 2013 Edition (ACI 530/530).

## 2 Loading criteria

A summary of the project-specific loading criteria follows (see appendix A for a detailed list of load values).

### 2.1 Gravity loading

The gravity loads listed in Table 1 are in addition to the self weight of the structure. The minimum loading requirements were taken from ASCE 7 as well as the loading criteria supplied by the engineer of record. Loads are given in pounds per square foot (psf).

Use	Live Loading	Superimposed Dead Loading
Parking Garage	40	3
Storage/HVAC	125	28
Stairways, exits	100	28
Level 1 residential	40	28
Level 1 corridors	100	28
Level 1 office, recreational	100	28
Level 1 courtyard (footprint)	150	150
Elevated levels residential	40	28
Elevated levels corridors	40	28
Cornices	60	-
Balconies	40	28
Roof	20	28

Table 1: Gravity Loads

In addition to these uniform slab loads, a perimeter dead load of 12 psf was applied to the structure to account for the weight of the cladding system.

### 2.2 Wind design criteria

Wind loading is in accordance with the IBC and ASCE 7 requirements as shown in Table 2.

### 2.3 Snow loading

Wind loading is in accordance with the ASCE 7 requirements as shown in Table 3.

Parameter	Value
Basic Wind Speed, 3-second gust (ultimate)	115 mph
Basic Wind Speed, 3-second gust (nominal)	90 mph
Exposure	B
Occupancy Category	II
Importance Factor ( $I_w$ )	1.0
Topographic Factor ( $K_{zt}$ )	1.0
Enclosure Classification	Enclosed
Mean Roof Height (h)	33'

Table 2: Wind Design Criteria

Parameter	Value
Ground snow load $p_g$	60 psf
Terrain category	B
Exposure factor $C_e$	1.0
Thermal factor $C_t$	1.0
Occupancy Category	II
Snow load importance factor $I_s$	1.0
Snow load flat roof	42 psf

Table 3: Snow Design Criteria

### 3 Seismic design criteria

Seismic loads are in accordance with the IBC requirements as shown in Table 4.

Parameter	Value
Building Latitude/Longitude	44°49'01.8"N 91°30'34.8"W
Occupancy Category	II
Importance Factor $I_e$	1.0
Mapped Spectral Acceleration	$S_s = 0.045$ ; $S_1 = 0.038$
Site Class	B
Site Class Coefficients	$F_a = 1.0$ ; $F_v = 1.0$
Spectral Response Coefficients	$S_{DS} = 0.03$ ; $S_{D1} = 0.025$
Seismic Design Category	A

Table 4: Snow Design Criteria

## 4 Dead loads

### Materials

Wood structural panel	36.0 pcf = $5655 \frac{\text{newton}}{\text{meter}^3}$
Concrete reinforced stone (including gravel)	150.0 pcf = $23563 \frac{\text{newton}}{\text{meter}^3}$
Steel	489.0 pcf = $76816 \frac{\text{newton}}{\text{meter}^3}$
Gypsum crete	115.0 pcf = $18065 \frac{\text{newton}}{\text{meter}^3}$
Gypsum,loose	70.0 pcf = $10996 \frac{\text{newton}}{\text{meter}^3}$
Earth (not submerged) sand and gravel (wet)	120.0 pcf = $18850 \frac{\text{newton}}{\text{meter}^3}$
Water	62.4 pcf = $9802 \frac{\text{newton}}{\text{meter}^3}$

### Frame partitions

Wood or steel studs, $\frac{1}{2}$ in gypsum board inside	8 psf = 383 pascal
Wood studs, 2x4 unplastered	4 psf = 192 pascal
Wood studs, 2x4 plastered one side	12 psf = 575 pascal
Wood studs, 2x4 plastered two sides	20 psf = 958 pascal
Movable steel partitions	4 psf = 192 pascal

### Frame walls

Exterior stud wall 2x4 @ 16in, $\frac{5}{8}$ gypsum insulated, $\frac{3}{8}$ in siding	11 psf = 526 pascal
Exterior stud wall 2x6 @ 16in, $\frac{5}{8}$ gypsum insulated, $\frac{3}{8}$ in siding	12 psf = 575 pascal
Exterior stud wall with brick veneer	48 psf = 2298 pascal
CMU wall 8in	60 psf = 9425 pascal
Window, glass, frame and sash	8 psf = 383 pascal

### Cladding

Fiber cement panels, large format 38.4in $\times$ 102in	3.2 psf = 153 pascal
Fiber cement panels, small scale 9.6in $\times$ 102in	3.2 psf = 153 pascal
Perforated metal panel at exterior HVAC location	

### Floor truss

Single chord @ 24in o.c. spacing	3.2 psf = 153 pascal
Double chord @ 24in o.c. spacing	4.25 psf = 203 pascal

### Sheating

Roof sheating	3.5 psf = 167 pascal
Floor sheating	2.5 psf = 120 pascal
Ceilings	2.5 psf = 120 pascal
Deck composite sleepers (3in)	9.00 psf = 431 pascal

## 5 Live loads

Occupancy or use	Uniform	Concentrated	Notes
Private rooms and corridors serving them in multifamily dwelling	40.0 psf = 1915 pascal	-	<i>IBC-2018 Table 1607.1</i>
Stairs and exits	100.0 psf = 4788 pascal	300 pound = 1334 newton	<i>IBC-2018 Table 1607.1. Concentrated load on stair treads applied on an area of 2 inches by 2 inches</i> <i>IBC-2018 Table 1607.1</i>
Balconies and decks	same as occupancy served	-	<i>IBC-2018 Table 1607.1</i>
Garages (passenger vehicles only)	40.0 psf = 1915 pascal	-	<i>IBC-2018 Table 1607.1</i>
Cornices	60.0 psf = 2873 pascal	-	<i>IBC-2018 Table 1607.1</i>
Elevator machine room and control room grating	-	300 pound = 1334 newton	<i>IBC-2018 Table 1607.1. Concentrated load applied on an area of 2 inches by 2 inches</i>
Flat roof (not occupiable) + maintenace	20.0 psf = 958 pascal	300 pound = 1334 newton	<i>IBC-2018 Table 1607.1</i>
Yards and terraces, pedestrians	100.0 psf = 4788 pascal	-	<i>IBC-2018 Table 1607.1</i>
Sidewalks, vehicular driveways and yards, subject to trucking	250.0 psf = 11970 pascal	8000 pound = 35586 newton	<i>IBC-2018 Table 1607.1</i>
Corridors first floor	100.0 psf = 4788 pascal	-	<i>IBC-2018 Table 1607.1</i>
Store first floor	100.0 psf = 4788 pascal	-	<i>IBC-2018 Table 1607.1</i>

## 6 Snow loads

Ground snow load	$p_g = 60.0 \text{ psf} = 2873 \text{ pascal}$	<i>ASCE 7. Figure 7.1</i>
Exposure factor	$C_e = 1.0$	<i>ASCE 7. Table 7-2. Terrain category B, roof partially exposed</i>
Thermal factor	$C_t = 1.0$	<i>ASCE 7. Table 7-3.</i>
Snow load importance factor	$I_s = 1.0$	<i>ASCE 7. Table 7-4. Structure risk category II</i>
<b>Snow load flat roof</b>	$p_f = 0.7 \times C_e \times C_t \times I_s \times p_g = 0.7 \times 1.0 \times 1.0 \times 1.0 \times 60.0 = 42.0 \text{ psf} = 2873 \text{ pascal}$	<i>ASCE 7. Sect. 7.3</i>

## 7 Wind loads

Alternate all-heights method.

Ultimate design wind speed	$V_{ult} = 115 \frac{\text{miles}}{\text{hour}} = 51 \frac{\text{meters}}{\text{second}}$
Velocity pressure exposure coefficient	$K_z = 0.72$
Topographic factor	$K_{zt} = 1.0$

IBC-2018, sect. 1609.6. Regularly shaped building, less than 75 feet in height, not sensitive to dynamic effects, not channeling effects or buffeting, simple diaphragm building

IBC-2018, figure 1609.3(1). Risk category II building

ASCE 7, table 27.3.1. Exposure B, height above ground level  $z \approx 33$  feet

ASCE 7, sect. 26.8

**Net pressure coefficients**  $C_{net}$ . Main windforce-resisting frames and systems

Description	$C_{net} + \text{Internal pressure}$	$C_{net} - \text{Internal pressure}$
Windward wall	0.43	0.73
Leeward wall	-0.51	-0.21
Sidewall	-0.66	-0.35
Parapet windward wall		1.28
Parapet leeward wall		-0.85
Flat roof	-1.09	-0.79

IBC-2018, Table 1609.6.2, enclosed

**Design wind pressures**  $P_{net}$ . Main windforce-resisting frames and systems

$$P_{net} = 0.00256 \times V^2 \times K_z \times C_{net} \times K_{zt}$$

Description	$P_{net} + \text{Internal pressure}$	$P_{net} - \text{Internal pressure}$
Windward wall	10.5 psf = 501 pascal	17.8 psf = 852 pascal
Leeward wall	-12.4 psf = -595 pascal	-5.1 psf = -245 pascal
Sidewall	-16.1 psf = -770 pascal	-8.5 psf = -409 pascal
Parapet windward wall		31.2 psf = 1494 pascal
Parapet leeward wall		-20.7 psf = -992 pascal
Flat roof	-26.6 psf = -1272 pascal	-19.3 psf = -992 pascal

IBC-2018, sect. 1609.6.3

## 8 Earthquake loads

Parameter 0.2-second spectral response acceleration	$S_s = 0.045$	<i>IBC-2018, figure 1613.3.1(1). Site class B</i>
Parameter 1-second spectral response acceleration	$S_1 = 0.038$	<i>IBC-2018, figure 1613.3.1(2). Site class B</i>
Seismic design category	$S_1 \leq 0.04$ and $S_s \leq 0.15 \rightarrow$ SDS A	<i>IBC-2018, sect. 1613.3.1</i>
Site coefficients	$F_a = 1.0, F_v = 1.0$	<i>IBC-2018, tables 1613.3.3(1) and 1613.3.3(2). Site class B</i>
Maximum considered earthquake spectral response acceleration for short periods	$S_{MS} = F_a \cdot S_s = 0.045$	<i>IBC-2018, sect. 163.3.3</i>
	$S_{M1} = F_a \cdot S_1 = 0.038$	<i>IBC-2018, sect. 163.3.3</i>
Design spectral response acceleration parameters	$S_{DS} = \frac{2}{3} S_{MS} = 0.03$	<i>IBC-2018, sect. 163.3.4</i>
	$S_{D1} = \frac{2}{3} S_{M1} = 0.025$	<i>IBC-2018, sect. 163.3.4</i>