

Design Examples *Wind/Anchorage*

Example #1: Garage Front Wind Application

Given:

2006 IBC, wind design, 2500-psi concrete (uncracked)
 20' floor and 30' roof span tributary to frame
 Vertical Loads
 Floor: 15 psf dead, 40 psf live
 Roof: 20 psf dead, 20 psf live
 Wall weight = 12 psf
 Garage opening = 16'-0" wide x 7'-0" tall
 Total ASD $V_{frame} = 3000 + 5000 = 8000$ lbs

Step 1: Check vertical loading

$W_{DL} = 20 \text{ psf} \times 30'/2 + 15 \text{ psf} \times 20'/2 + 12 \text{ psf} \times 8' = 546 \text{ plf} < 800 \text{ plf}$ **OK**✓
 $W_{RLL} = 20 \text{ psf} \times 30'/2 = 300 \text{ plf} < 400 \text{ plf}$ **OK**✓
 $W_{FLL} = 40 \text{ psf} \times 20'/2 = 400 \text{ plf} = 400 \text{ plf}$ **OK**✓

Vertical loads less than frame design uniform load, use "maximum shear" values.

Step 2: Select ordinary moment frame size from catalog tables

For OMF912-16x8:

1. Allowable $V_{ASD} = 10200 \text{ lbs} > 8000 \text{ lbs}$ Shear **OK**✓
2. Clear opening width, $W_1 = 16'-4" > 16'-0"$ **OK**✓
3. Outside frame width, $W_2 = 18'-4" < 20\text{-ft}$ **OK**✓
4. Bottom nailer height, $6'-6\frac{3}{4}" + 6" \text{ curb} = 7'-0\frac{3}{4}" > 7'-0"$ **OK**✓

Step 3: Determine Anchorage Solution

Tension:

Page 22, C9 column 8' tall for wind 2500 psi concrete: $W = 18"$, $d_e = 6"$
 8" wide x 12" tall curb (above footing), required $l_e = d_e + 12" = 18"$
 Select OMFSL9-24-KT, $l_e = 18\frac{1}{2}"$ **OK**✓

Shear:

- Option 1: Design for maximum shear reaction published in table for OMF912-16x9
 $R_H = 8080 \text{ lbs}$ (for maximum shear case)
- Option 2: Calculate actual shear based on load using table reaction factor, X, and shear equation
 See example #3.

Note: Design for maximum shear reaction in tables (option 1) is simplest. Calculating reactions based on actual vertical and lateral loading may result in more economical anchorage solutions.

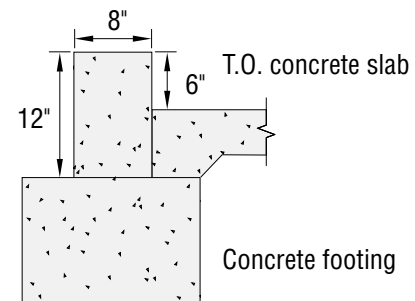
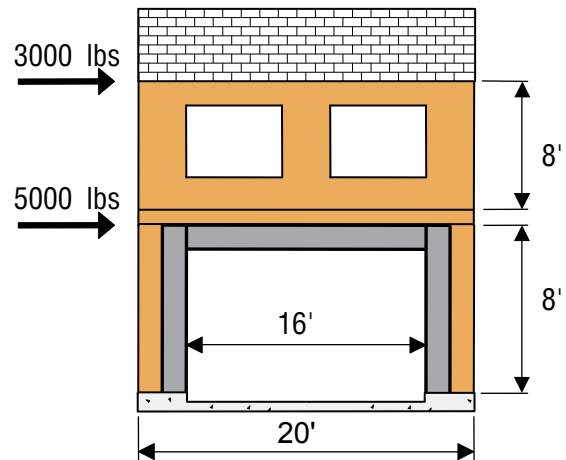
Select outside end distance for OMFSL from page 24 that meets required column shear reaction of 8080 lbs.
 8" curb, C9 column, $7\frac{1}{2}"$ end distance, allow shear = 8085 lbs $> 8080 \text{ lbs}$ **OK**✓

Select inside end distance. For shear loaded toward inside end distance (tension column),
 $R_H = V/2 = 8000/2 = 4000 \text{ lbs}$. 8" curb, C9 column, $4\frac{1}{2}"$ end distance, allow shear = 5565 lbs > 4000 **OK**✓

Note: Check of inside end distance only required for 8' and 9' tall OMF912, OMF1212 and OMF1512 models.
 All other ordinary moment frame models achieve full allowable load when installed with nailer flush with inside end of curb.

>>> OMF912-16x8

OMFSL9-24-KT anchorage assembly, outside end distance = $7\frac{1}{2}"$, inside end distance = $4\frac{1}{2}"$.
 Minimum footing width for anchorage: $18" \times 18"$, minimum depth = $18\frac{1}{2}" - 12" \text{ step} + 4" = 10\frac{1}{2}"$.
 Note: Actual footing/grade beam size and reinforcing must be determined by Designer based on project specific geometry and allowable soil bearing pressures.



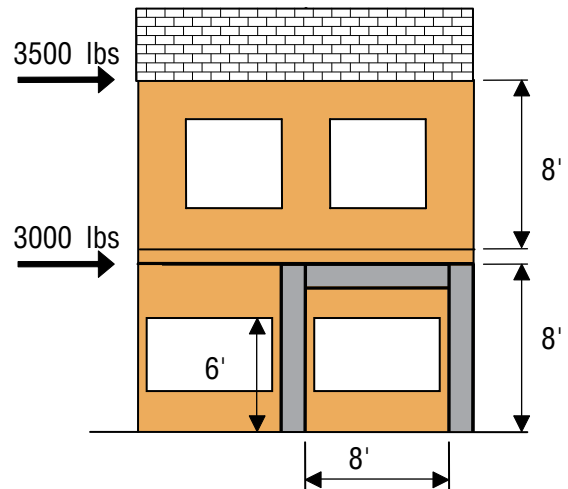
Section at Column

Design Examples

Example #2: 1st of 2-Story Seismic Application

Given:

2006 IBC, seismic design $R = 6.5$ ($S_{DS} = 0.9g$), 3000-psi concrete (cracked)
 30' floor and 40' roof span tributary to frame
 Light frame construction, detached 1 and 2 family home
 Vertical loads
 Floor: 15 psf dead, 40 psf live
 Roof: 20 psf dead, 20 psf live
 Wall weight = 12 psf
 Window opening 4'-0" x 8'-0"
 Total ASD force to frame = 3500 + 3000 = 6500 lbs



Step 1: Check vertical loading

$W_{DL} = 20 \text{ psf} \times 40'/2 + 15 \text{ psf} \times 30'/2 + 12 \text{ psf} \times 8' = 721 \text{ plf} < 800 \text{ plf}$ **OK**✓
 $W_{RLL} = 20 \text{ psf} \times 40'/2 = 400 \text{ plf} = 400 \text{ plf}$ **OK**✓
 $W_{FLL} = 40 \text{ psf} \times 30'/2 = 600 \text{ plf} > 400 \text{ plf}$

Uniform vertical loads exceed frame design uniform load for maximum shear.
 Therefore use minimum shear values to select frame. Total applied vertical load:

$W_{Total} = W_{DL} + 0.75 (W_{RLL} + W_{FLL}) = 721 + 0.75 (400 + 600) = 1471 \text{ plf} \times 8' = 11768 \text{ lbs}$
 (IBC EQ 16-13 governs)

Note: Designer shall determine governing load combination per applicable building code.

Step 2: Select ordinary moment frame size from catalog tables

Seismic loads calculated based on $R = 6.5$. For combination of lateral systems (shearwalls $R = 6.5$, OMF $R = 3.5$) construction type meets exceptions of ASCE 7-05 sections 12.2.3.1 and 12.2.3.2, so shearwalls in structure may be designed for $R = 6.5$ forces, ordinary moment frame designed for $R = 3.5$ force levels.

Therefore, convert $R = 6.5$ based forces to $R = 3.5$ forces for OMF selection:

$V_{frame \text{ design}} = 6500 \text{ lbs} \times (6.5/3.5) = 12070 \text{ lbs}$ ($R = 3.5$ based force)

For OMF129-8x8:

1. Allowable $V_{ASD} = 12260 \text{ lbs} > 12070 \text{ lbs}$, shear **OK**✓
2. $W_{Max} = 24,000 \text{ lbs} > 11768 \text{ lbs}$, vertical load **OK**✓
3. Clear opening width, $W_1 = 8'-2" > 8'-0"$ **OK**✓
4. Bottom nailer height, $6'-10\frac{1}{4}" (H3) > 6'-0"$ **OK**✓

Step 3: Determine anchorage solutions

Tension:

Page 22, C12 column 8' tall for seismic, 3000 psi concrete: $W = 53"$, $d_e = 17"$, HS rods

Slab on grade, 12" step height, required $l_e = d_e + 12" = 29"$.

Select OMFSL9-36HS-KT, $l_e = 30\frac{1}{2}"$ **OK**✓

Shear:

Option 1: Design for maximum shear published in table for OMF129-8x8

$R_H = 9345 \text{ lbs}$ (for $W_{Max} + V$ case)

Option 2: Calculate actual shear based on load using table reaction factor, X, and shear equation. See example #3.

Select end distance for OMFSL from page 25 that meets required column shear reaction of 9345 lbs.

Slab on grade, 6" end distance, allow shear = 15750 lbs $> 9345 \text{ lbs}$ **OK**✓

>>>

Use OMF129-8x8

OMFSL9-36HS-KT anchorage assembly, 6" end distance

Minimum footing width for anchorage: $53" \times 53"$, minimum depth = $30\frac{1}{2}" - 12" (\text{step}) + 4" = 22\frac{1}{2}"$

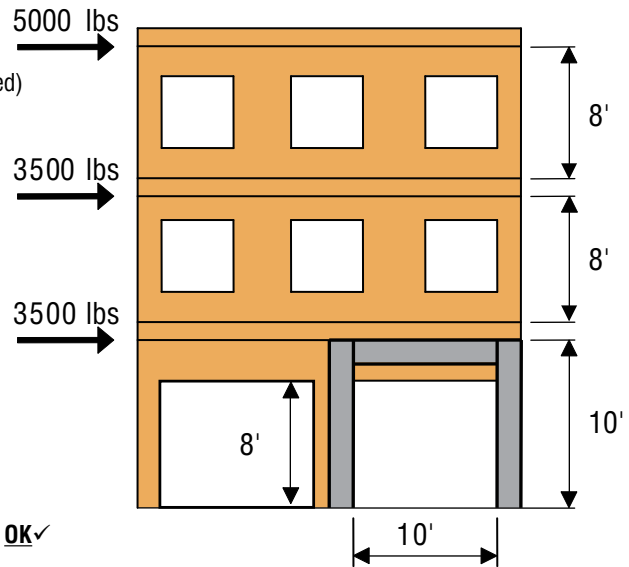
Note: Actual footing/grade beam size and reinforcing must be determined by Designer based on project specific geometry and allowable soil bearing pressures.

Design Examples *General*

Example #3: 1st of 3-Story Seismic Application

Given:

2006 IBC, seismic design $R = 3.5$ ($S_{DS} = 1.50g$), 3000-psi concrete (cracked)
 20' floor and 20' roof span tributary to frame
 Apartment building
 Vertical loads
 Floor: 15 psf dead, 40 psf live
 Roof: 16 psf dead, 20 psf live
 Wall weight = 12 psf
 Opening 10'-0" x 8'-0"
 3-Story structure less than 35' height, ordinary moment
 frame OK for seismic design loads based on $R = 3.5$
 Total ASD force to frame = 5000 + 3500 + 3500 = 12000 lbs



Step 1: Check vertical loading

Since $S_{DS} > 1.0$, add $E_v = 0.14S_{DS}$ DL to account for vertical acceleration effects due to seismic load.

$$W_{DL} = (2 \times 15 \text{ psf} + 16 \text{ psf}) \times 20' / 2 + 12 \text{ psf} \times 8' \times 2 = 652 \text{ plf} < 800 \text{ plf} \text{ OK} \checkmark$$

$$W_{RLL} = 20 \text{ psf} \times 20' / 2 = 200 \text{ plf} < 400 \text{ plf} \text{ OK} \checkmark$$

$$W_{FLL} = 2 \times 40 \text{ psf} \times 20' / 2 = 800 \text{ plf} > 400 \text{ plf}$$

Uniform vertical loads exceed frame design uniform load for maximum shear.

Therefore, use minimum shear values to select frame. Total applied vertical load:

$$\begin{aligned} W_{TOTAL} &= W_{DL} + W_{FLL} = (652 + 800) \times 10' = 1452 \text{ plf} \times 10' = 14520 \text{ lbs (IBC EQ 16-9)} \\ &= W_{DL} + 0.75 (E_v + W_{FLL} + W_{RLL}) = (652 + 0.75 (0.14 \times 1.5 \times 652 + 800 + 400)) \times 10' \\ &= 1655 \text{ plf} \times 10' = 16550 \text{ lbs (IBC EQ 16-13 governs)} \end{aligned}$$

Note: Designer shall determine governing load combination per applicable building code.

Step 2: Select ordinary moment frame size from catalog tables

For OMF1512-10x10:

1. Allowable $V_{ASD} = 14620 \text{ lbs} > 12000 \text{ lbs}$, Shear **OK** ✓
2. $W_{MAX} = 24500 \text{ lbs} > 16550 \text{ lbs}$, Vertical Load **OK** ✓
3. Clear opening width, $W_1 = 10'-2" > 10'-0"$ **OK** ✓
4. Bottom nailer height, $8'-6\frac{3}{4}" (H3) > 8'-0"$ **OK** ✓

Step 3: Determine anchorage solutions

Tension:

Page 25, C15 Column 10' tall for seismic, 3000 psi concrete: $W = 46"$, $d_e = 15"$

Slab on grade, 10" step height, required $l_e = d_e + 10" = 25"$.

Select OMFAB9-30, $l_e = 24\frac{1}{2}"$ Say **OK** ✓

Shear:

Option 1: Design for maximum shear published in table for OMF1512-10x10

$$R_H = 10325 \text{ lbs (for } W_{MAX} + V \text{ case)}$$

Option 2: Calculate actual shear based on load using table reaction factor, X, and shear equation

$$R_H = V/2 + X(2/3 wL) \text{ for uniform loads}$$

$$w = W_{DL} (1 + 0.14S_{DS}) = 652 (1 + 0.14 \times 1.5) = 789 \text{ plf}$$

$$X = 0.123, \text{ reaction factor from load tables.}$$

$$L = 10'-2" + 18" = 11'-8" \text{ (centerline column dimension)}$$

$$R_H = 12000/2 + 0.123(2/3 \times 789 \text{ plf} \times 11'-8") = 6755 \text{ lbs (IBC EQ 16-12 governs)}$$

Note: Designer shall determine governing load combination per applicable building code.

Select end distance for OMFAB9 from page 25 that meets required column shear reaction of 6755 lbs.

Slab on grade, C15, 2 - #3 hairpin ties, allow shear = 11450 lbs > 6755 lbs **OK** ✓

>>> Use OMF1512-10x10

OMFAB9-30-KT anchorage assembly, 2 - #3 hairpin ties

Minimum footing width for anchorage: $46" \times 46"$, minimum depth = $24\frac{1}{2}" - 10" + 4" = 18\frac{1}{2}"$

Note: Actual footing/grade beam size and reinforcing must be determined by Designer based on project specific geometry and allowable soil bearing pressures.