# SECTION 1807
# FOUNDATION WALLS, RETAINING WALLS AND EMBEDDED POSTS AND POLES

### 1807.1 Foundation walls.

Foundation walls shall be designed and constructed in accordance with Sections 1807.1.1 through 1807.1.6. Foundation walls shall be supported by foundations designed in accordance with Section 1808.

### 1807.1.1 Design lateral soil loads.

Foundation walls shall be designed for the lateral soil *loads* set forth in Section 1610.

### 1807.1.2 Unbalanced backfill height.

Unbalanced backfill height is the difference in height between the exterior finish ground level and the lower of the top of the concrete footing that supports the foundation wall or the *interior finish* ground level. Where an interior concrete slab on grade is provided and is in contact with the interior surface of the foundation wall, the unbalanced backfill height shall be permitted to be measured from the exterior finish ground level to the top of the interior concrete slab.

### 1807.1.3 Rubble stone foundation walls.

Foundation walls of rough or random rubble stone shall be not less than 16 inches (406 mm) thick. Rubble stone shall not be used for foundation walls of structures assigned to *Seismic Design Category* C, D, E or F.

### 1807.1.4 Permanent wood foundation systems.

Permanent wood foundation systems shall be designed and installed in accordance with AWC PWF. Lumber and plywood shall be preservative treated in accordance with AWPA U1 (Commodity Specification A, Special Requirement 4.2) and shall be identified in accordance with Section 2303.1.9.1.

### 1807.1.5 Concrete and masonry foundation walls.

Concrete and masonry foundation walls shall be designed in accordance with Chapter 19 or 21, as applicable.

> **Exception:** Concrete and masonry foundation walls shall be permitted to be designed and constructed in accordance with Section 1807.1.6.

### 1807.1.6 Prescriptive design of concrete and masonry foundation walls.

Concrete and masonry foundation walls that are laterally supported at the top and bottom shall be permitted to be designed and constructed in accordance with this section.

### 1807.1.6.1 Foundation wall thickness.

The thickness of prescriptively designed foundation walls shall be not less than the thickness of the wall supported, except that foundation walls of not less than 8-inch (203 mm) nominal width shall be permitted to support brick-veneered frame walls and 10-inch-wide (254 mm) *cavity walls* provided that the requirements of Section 1807.1.6.2 or 1807.1.6.3 are met.

### 1807.1.6.2 Concrete foundation walls.

Concrete foundation walls shall comply with the following:

1. The thickness shall comply with the requirements of Table 1807.1.6.2.
2. The size and spacing of vertical reinforcement shown in Table 1807.1.6.2 are based on the use of reinforcement with a minimum yield strength of 60,000 pounds per square inch (psi) (414 MPa). Vertical reinforcement with a minimum yield strength of 40,000 psi (276 MPa) or 50,000 psi (345 MPa) shall be permitted, provided that the same size bar is used and the spacing shown in the table is reduced by multiplying the spacing by 0.67 or 0.83, respectively.
3. Vertical reinforcement, where required, shall be placed nearest the inside face of the wall a distance, d, from the outside face (soil face) of the wall. The distance, $d$, is equal to the wall thickness, $t$, minus 1.25 inches (32 mm) plus one-half the bar diameter, $d_b$, [$d = t - (1.25 + d_b/2)$]. The reinforcement shall be placed within a tolerance of $\pm 3/8$ inch (9.5 mm) where $d$ is less than or equal to 8 inches (203 mm) or $\pm 1/2$ inch (12.7 mm) where d is greater than 8 inches (203 mm).
4. In lieu of the reinforcement shown in Table 1807.1.6.2, smaller reinforcing bar sizes with closer spacings that provide an equivalent cross-sectional area of reinforcement per unit length shall be permitted.
5. Concrete cover for reinforcement measured from the inside face of the wall shall be not less than $3/4$ inch (19.1 mm). Concrete cover for reinforcement measured from the outside face of the wall shall be not less than $1\,1/2$ inches (38 mm) for No. 5 bars and smaller, and not less than 2 inches (51 mm) for larger bars.
6. Concrete shall have a specified compressive strength, $f'_c$, of not less than 2,500 psi (17.2 MPa).

7. The unfactored axial load per linear foot of wall shall not exceed $1.2tf'_c$ where $t$ is the specified wall thickness in inches.

**TABLE 1807.1.6.2**
**CONCRETE FOUNDATION WALLS[b,c]**

| MAXIMUM WALL HEIGHT (feet) | MAXIMUM UNBALANCED BACKFILL HEIGHT[e] (feet) | MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | Design lateral soil load[a] (psf per foot of depth) | | | | | | | | |
| | | 30[d] | | | 45[d] | | | 60 | | |
| | | Minimum wall thickness (inches) | | | | | | | | |
| | | 7.5 | 9.5 | 11.5 | 7.5 | 9.5 | 11.5 | 7.5 | 9.5 | 11.5 |
| 5 | 4 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 5 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| 6 | 4 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 5 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 6 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| 7 | 4 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 5 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 6 | PC | PC | PC | PC | PC | PC | #5 at 48 | PC | PC |
| | 7 | PC | PC | PC | #5 at 46 | PC | PC | #6 at 48 | PC | PC |
| 8 | 4 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 5 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 6 | PC | PC | PC | PC | PC | PC | #5 at 43 | PC | PC |
| | 7 | PC | PC | PC | #5 at 41 | PC | PC | #6 at 43 | PC | PC |
| | 8 | #5 at 47 | PC | PC | #6 at 43 | PC | PC | #6 at 32 | #6 at 44 | PC |
| 9 | 4 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 5 | PC | PC | PC | PC | PC | PC | PC | PC | PC |
| | 6 | PC | PC | PC | #5 at 37 | PC | PC | #5 at 39 | PC | PC |
| | 7 | PC | PC | PC | #6 at 38 | #5 at 37 | PC | #6 at 38 | #5 at 37 | PC |
| | 8 | #5 at 41 | PC | PC | #7 at 41 | #6 at 41 | PC | #7 at 39 | #6 at 39 | #4 at 48 |
| | 9[d] | #6 at 46 | PC | PC | | | | #7 at 31 | #7 at 41 | #6 at 39 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| 10 | 4<br>5<br>6<br>7<br>8<br>9[d]<br>10[d] | PC<br>PC<br>PC<br>PC<br>#5 at 38<br>#6 at 41<br>#7 at 45 | PC<br>PC<br>PC<br>PC<br>PC<br>#4 at 48<br>#6 at 45 | PC<br>PC<br>PC<br>PC<br>PC<br>PC<br>PC | PC<br>PC<br>PC<br>#6 at 48<br>#7 at 47<br>#7 at 37<br>#7 at 31 | PC<br>PC<br>PC<br>PC<br>#6 at 47<br>#7 at 48<br>#7 at 40 | PC<br>PC<br>PC<br>PC<br>PC<br>#4 at 48<br>#6 at 38 | PC<br>PC<br>#5 at 37<br>#6 at 35<br>#7 at 35<br>#6 at 22<br>#6 at 22 | PC<br>PC<br>PC<br>#6 at 48<br>#7 at 47<br>#7 at 37<br>#7 at 30 | PC<br>PC<br>PC<br>PC<br>#6 at 45<br>#7 at 47<br>#7 at 38 |

For SI:1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 0.157 kPa/m.

a. For design lateral soil loads, see Section 1610.

b. Provisions for this table are based on design and construction requirements specified in Section 1807.1.6.2.

c. PC = Plain Concrete.

d. Where unbalanced backfill height exceeds 8 feet and design lateral soil loads from Table 1610.1 are used, the requirements for 30 and 45 psf per foot of depth are not applicable (see Section 1610).

e. For height of unbalanced backfill, see Section 1807.1.2.

**1807.1.6.2.1 Seismic requirements.**

Based on the *seismic design category* assigned to the structure in accordance with Section 1613, concrete foundation walls designed using Table 1807.1.6.2 shall be subject to the following limitations:

1. *Seismic Design Categories* A and B. Not less than one No. 5 bar shall be provided around window, door and similar sized openings. The bar shall be anchored to develop $f_y$ in tension at the corners of openings.
2. *Seismic Design Categories* C, D, E and F. Tables shall not be used except as allowed for plain concrete members in Section 1905.1.7.

**1807.1.6.3 Masonry foundation walls.**

Masonry foundation walls shall comply with the following:

1. The thickness shall comply with the requirements of Table 1807.1.6.3(1) for *plain masonry* walls or Table 1807.1.6.3(2), 1807.1.6.3(3) or 1807.1.6.3(4) for masonry walls with reinforcement.
2. Vertical reinforcement shall have a minimum yield strength of 60,000 psi (414 MPa).
3. The specified location of the reinforcement shall equal or exceed the effective depth distance, *d*, noted in Tables 1807.1.6.3(2), 1807.1.6.3(3) and 1807.1.6.3(4) and shall be measured from the face of the exterior (soil) side of the wall to the center of the vertical reinforcement. The reinforcement shall be placed within the tolerances specified in TMS 602, Article 3.4.B.11, of the specified location.
4. Grout shall comply with Section 2103.3.
5. Concrete *masonry units* shall comply with ASTM C90.
6. Clay *masonry units* shall comply with ASTM C652 for hollow brick, except compliance with ASTM C62 or ASTM C216 shall be permitted where solid *masonry units* are installed in accordance with Table 1807.1.6.3(1) for *plain masonry*.
7. *Masonry units* shall be laid in *running bond* and installed with Type M or S mortar in accordance with Section 2103.2.1.
8. The unfactored axial load per linear foot of wall shall not exceed $1.2\ t\ f'_m$ where t is the specified wall thickness in inches and $f'_m$ is the *specified compressive strength of masonry* in pounds per square inch.
9. Not less than 4 inches (102 mm) of *solid masonry* shall be provided at girder supports at the top of hollow *masonry unit* foundation walls.

10. Corbeling of masonry shall be in accordance with Section 2104.1. Where an 8-inch (203 mm) wall is corbeled, the top corbel shall not extend higher than the bottom of the floor framing and shall be a full course of headers not less than 6 inches (152 mm) in length or the top course *bed joint* shall be tied to the vertical wall projection. The tie shall be W2.8 (4.8 mm) and spaced at a maximum horizontal distance of 36 inches (914 mm). The hollow space behind the corbelled masonry shall be filled with *mortar* or grout.

**TABLE 1807.1.6.3(1)**
**PLAIN MASONRY FOUNDATION WALLS[a, b, c]**

| MAXIMUM WALL HEIGHT (feet) | MAXIMUM UNBALANCED BACKFILL HEIGHT[e] (feet) | MINIMUM NOMINAL WALL THICKNESS (inches) | | |
|---|---|---|---|---|
| | | Design lateral soil load[a] (psf per foot of depth) | | |
| | | 30[f] | 45[f] | 60 |
| 7 | 4 (or less) | 8 | 8 | 8 |
| | 5 | 8 | 10 | 10 |
| | 6 | 10 | 12 | 10 (solid[c]) |
| | 7 | 12 | 10 (solid[c]) | 10 (solid[c]) |
| 8 | 4 (or less) | 8 | 8 | 8 |
| | 5 | 8 | 10 | 12 |
| | 6 | 10 | 12 | 12 (solid[c]) |
| | 7 | 12 | 12 (solid[c]) | Note d |
| | 8 | 10 (solid[c]) | 12 (solid[c]) | Note d |
| 9 | 4 (or less) | 8 | 8 | 8 |
| | 5 | 8 | 10 | 12 |
| | 6 | 12 | 12 | 12 (solid[c]) |
| | 7 | 12 (solid[c]) | 12 (solid[c]) | Note d |
| | 8 | 12 (solid[c]) | Note d | Note d |
| | 9[f] | Note d | Note d | Note d |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 0.157 kPa/m.

a. For design lateral soil loads, see Section 1610.

b. Provisions for this table are based on design and construction requirements specified in Section 1807.1.6.3.

c. Solid grouted hollow units or solid masonry units.

d. A design in compliance with Chapter 21 or reinforcement in accordance with Table 1807.1.6.3(2) is required.

e. For height of unbalanced backfill, see Section 1807.1.2.

f. Where unbalanced backfill height exceeds 8 feet and design lateral soil loads from Table 1610.1 are used, the requirements for 30 and 45 psf per foot of depth are not applicable (see Section 1610).

**TABLE 1807.1.6.3(2)**
**8-INCH MASONRY FOUNDATION WALLS WITH REINFORCEMENT WHERE d ≥ 5 INCHES[a, b, c]**

| MAXIMUM WALL HEIGHT (feet-inches) | MAXIMUM UNBALANCED BACKFILL HEIGHT[d] (feet-inches) | MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches) | | |
|---|---|---|---|---|
| | | Design lateral soil load[a] (psf per foot of depth) | | |
| | | 30[e] | 45[e] | 60 |
| 7-4 | 4-0 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5-0 | #4 at 48 | #4 at 48 | #4 at 48 |
| | 6-0 | #4 at 48 | #5 at 48 | #5 at 48 |
| | 7-4 | #5 at 48 | #6 at 48 | #7 at 48 |
| 8-0 | 4-0 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5-0 | #4 at 48 | #4 at 48 | #4 at 48 |

| | | | | |
|---|---|---|---|---|
| 8-0 | 6-0 | #4 at 48 | #5 at 48 | #5 at 48 |
| | 7-0 | #5 at 48 | #6 at 48 | #7 at 48 |
| | 8-0 | #5 at 48 | #6 at 48 | #7 at 48 |
| 8-8 | 4-0 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5-0 | #4 at 48 | #4 at 48 | #5 at 48 |
| | 6-0 | #4 at 48 | #5 at 48 | #6 at 48 |
| | 7-0 | #5 at 48 | #6 at 48 | #7 at 48 |
| | 8-8[e] | #6 at 48 | #7 at 48 | #8 at 48 |
| 9-4 | 4-0 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5-0 | #4 at 48 | #4 at 48 | #5 at 48 |
| | 6-0 | #4 at 48 | #5 at 48 | #6 at 48 |
| | 7-0 | #5 at 48 | #6 at 48 | #7 at 48 |
| | 8-0 | #6 at 48 | #7 at 48 | #8 at 48 |
| | 9-4[e] | #7 at 48 | #8 at 48 | #9 at 48 |
| 10-0 | 4-0 (or less) | #4 at 48 | #4 at 48 | #4 at 48 |
| | 5-0 | #4 at 48 | #4 at 48 | #5 at 48 |
| | 6-0 | #4 at 48 | #5 at 48 | #6 at 48 |
| | 7-0 | #5 at 48 | #6 at 48 | #7 at 48 |
| | 8-0 | #6 at 48 | #7 at 48 | #8 at 48 |
| | 9-0[e] | #7 at 48 | #8 at 48 | #9 at 48 |
| | 10-10[e] | #7 at 48 | #9 at 48 | #9 at 48 |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 0.157 kPa/m.

a. For design lateral soil loads, see Section 1610.

b. Provisions for this table are based on design and construction requirements specified in Section 1807.1.6.3.

c. For alternative reinforcement, see Section 1807.1.6.3.1.

d. For height of unbalanced backfill, see Section 1807.1.2.

e. Where unbalanced backfill height exceeds 8 feet and design lateral soil loads from Table 1610.1 are used, the requirements for 30 and 45 psf per foot of depth are not applicable. See Section 1610.

**TABLE 1807.1.6.3(3)**
**10-INCH MASONRY FOUNDATION WALLS WITH REINFORCEMENT WHERE d ≥ 6.75 INCHES[a, b, c]**

| MAXIMUM WALL HEIGHT (feet-inches) | MAXIMUM UNBALANCED BACKFILL HEIGHT[d] (feet-inches) | MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches) | | |
|---|---|---|---|---|
| | | Design lateral soil load[a] (psf per foot of depth) | | |
| | | 30[e] | 45[e] | 60 |
| 7-4 | 4-0 (or less) | #4 at 56 | #4 at 56 | #4 at 56 |
| | 5-0 | #4 at 56 | #4 at 56 | #4 at 56 |
| | 6-0 | #4 at 56 | #4 at 56 | #5 at 56 |
| | 7-4 | #4 at 56 | #5 at 56 | #6 at 56 |
| 8-0 | 4-0 (or less) | #4 at 56 | #4 at 56 | #4 at 56 |
| | 5-0 | #4 at 56 | #4 at 56 | #4 at 56 |
| | 6-0 | #4 at 56 | #4 at 56 | #5 at 56 |
| | 7-0 | #4 at 56 | #5 at 56 | #6 at 56 |
| | 8-0 | #5 at 56 | #6 at 56 | #7 at 56 |
| 8-8 | 4-0 (or less) | #4 at 56 | #4 at 56 | #4 at 56 |
| | 5-0 | #4 at 56 | #4 at 56 | #4 at 56 |
| | 6-0 | #4 at 56 | #4 at 56 | #5 at 56 |
| | 7-0 | #4 at 56 | #5 at 56 | #6 at 56 |

| | | | | |
|---|---|---|---|---|
| | 8-8[e] | #5 at 56 | #7 at 56 | #8 at 56 |
| 9-4 | 4-0 (or less) | #4 at 56 | #4 at 56 | #4 at 56 |
| | 5-0 | #4 at 56 | #4 at 56 | #4 at 56 |
| | 6-0 | #4 at 56 | #5 at 56 | #5 at 56 |
| | 7-0 | #4 at 56 | #5 at 56 | #6 at 56 |
| | 8-0 | #5 at 56 | #6 at 56 | #7 at 56 |
| | 9-4[e] | #6 at 56 | #7 at 56 | #7 at 56 |
| 10-0 | 4-0 (or less) | #4 at 56 | #4 at 56 | #4 at 56 |
| | 5-0 | #4 at 56 | #4 at 56 | #4 at 56 |
| | 6-0 | #4 at 56 | #5 at 56 | #5 at 56 |
| | 7-0 | #5 at 56 | #6 at 56 | #7 at 56 |
| | 8-0 | #5 at 56 | #7 at 56 | #8 at 56 |
| | 9-0[e] | #6 at 56 | #7 at 56 | #9 at 56 |
| | 10-0[e] | #7 at 56 | #8 at 56 | #9 at 56 |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 1.157 kPa/m.

a. For design lateral soil loads, see Section 1610.

b. Provisions for this table are based on design and construction requirements specified in Section 1807.1.6.3.

c. For alternative reinforcement, see Section 1807.1.6.3.1.

d. For height of unbalanced backfill, see Section 1807.1.2.

e. Where unbalanced backfill height exceeds 8 feet and design lateral soil loads from Table 1610.1 are used, the requirements for 30 and 45 psf per foot of depth are not applicable. See Section 1610.

**TABLE 1807.1.6.3(4)**
**12-INCH MASONRY FOUNDATION WALLS WITH REINFORCEMENT WHERE d ≥ 8.75 INCHES[a, b, c]**

| MAXIMUM WALL HEIGHT (feet-inches) | MAXIMUM UNBALANCED BACKFILL HEIGHT[d] (feet-inches) | MINIMUM VERTICAL REINFORCEMENT-BAR SIZE AND SPACING (inches) | | |
|---|---|---|---|---|
| | | Design lateral soil load[a] (psf per foot of depth) | | |
| | | 30[e] | 45[e] | 60 |
| 7-4 | 4 (or less) | #4 at 72 | #4 at 72 | #4 at 72 |
| | 5-0 | #4 at 72 | #4 at 72 | #4 at 72 |
| | 6-0 | #4 at 72 | #4 at 72 | #5 at 72 |
| | 7-4 | #4 at 72 | #5 at 72 | #6 at 72 |
| 8-0 | 4 (or less) | #4 at 72 | #4 at 72 | #4 at 72 |
| | 5-0 | #4 at 72 | #4 at 72 | #4 at 72 |
| | 6-0 | #4 at 72 | #4 at 72 | #5 at 72 |
| | 7-0 | #4 at 72 | #5 at 72 | #6 at 72 |
| | 8-0 | #5 at 72 | #6 at 72 | #8 at 72 |
| 8-8 | 4 (or less) | #4 at 72 | #4 at 72 | #4 at 72 |
| | 5-0 | #4 at 72 | #4 at 72 | #4 at 72 |
| | 6-0 | #4 at 72 | #4 at 72 | #5 at 72 |
| | 7-0 | #4 at 72 | #5 at 72 | #6 at 72 |
| | 8-8[e] | #5 at 72 | #7 at 72 | #8 at 72 |
| 9-4 | 4 (or less) | #4 at 72 | #4 at 72 | #4 at 72 |
| | 5-0 | #4 at 72 | #4 at 72 | #4 at 72 |
| | 6-0 | #4 at 72 | #5 at 72 | #5 at 72 |
| | 7-0 | #4 at 72 | #5 at 72 | #6 at 72 |
| | 8-0 | #5 at 72 | #6 at 72 | #7 at 72 |
| | 9-4[e] | #6 at 72 | #7 at 72 | #8 at 72 |

| | | | | |
|---|---|---|---|---|
| 10-0 | 4 (or less) | #4 at 72 | #4 at 72 | #4 at 72 |
| | 5-0 | #4 at 72 | #4 at 72 | #4 at 72 |
| | 6-0 | #4 at 72 | #5 at 72 | #5 at 72 |
| | 7-0 | #4 at 72 | #6 at 72 | #6 at 72 |
| | 8-0 | #5 at 72 | #6 at 72 | #7 at 72 |
| | 9-0[e] | #6 at 72 | #7 at 72 | #8 at 72 |
| | 10-0[e] | #7 at 72 | #8 at 72 | #9 at 72 |

For SI: 1 inch = 25.4 mm, 1 foot = 304.8 mm, 1 pound per square foot per foot = 0.157 kPa/m.

a. For design lateral soil loads, see Section 1610.

b. Provisions for this table are based on design and construction requirements specified in Section 1807.1.6.3.

c. For alternative reinforcement, see Section 1807.1.6.3.1.

d. For height of unbalanced backfill, see Section 1807.1.2.

e. Where unbalanced backfill height exceeds 8 feet and design lateral soil loads from Table 1610.1 are used, the requirements for 30 and 45 psf per foot of depth are not applicable. See Section 1610.

**1807.1.6.3.1 Alternative foundation wall reinforcement.**

In lieu of the reinforcement provisions for masonry foundation walls in Table 1807.1.6.3(2), 1807.1.6.3(3) or 1807.1.6.3(4), alternative reinforcing bar sizes and spacings having an equivalent cross-sectional area of reinforcement per linear foot (mm) of wall shall be permitted to be used, provided that the spacing of reinforcement does not exceed 72 inches (1829 mm) and reinforcing bar sizes do not exceed No. 11.

**1807.1.6.3.2 Seismic requirements.**

Based on the *seismic design category* assigned to the structure in accordance with Section 1613, masonry foundation walls designed using Tables 1807.1.6.3(1) through 1807.1.6.3(4) shall be subject to the following limitations:

1. *Seismic Design Categories* A and B. No additional seismic requirements.
2. *Seismic Design Category* C. A design using Tables 1807.1.6.3(1) through 1807.1.6.3(4) is subject to the seismic requirements of Section 7.4.3 of TMS 402.
3. *Seismic Design Category* D. A design using Tables 1807.1.6.3(2) through 1807.1.6.3(4) is subject to the seismic requirements of Section 7.4.4 of TMS 402.
4. *Seismic Design Categories* E and F. A design using Tables 1807.1.6.3(2) through 1807.1.6.3(4) is subject to the seismic requirements of Section 7.4.5 of TMS 402.

**1807.2 Retaining walls.**

Retaining walls shall be designed in accordance with Sections 1807.2.1 through 1807.2.4.

**1807.2.1 General.**

Retaining walls shall be designed to ensure stability against overturning, sliding, excessive foundation pressure and water uplift.

**1807.2.2 Design lateral soil loads.**

Retaining walls shall be designed for the lateral soil *loads* set forth in Section 1610. For structures assigned to *Seismic Design Category* D, E, or F, the design of retaining walls supporting more than 6 feet (1829 mm) of backfill height shall incorporate the additional seismic lateral earth pressure in accordance with the geotechnical investigation where required in Section 1803.2.

**1807.2.3 Safety factor.**

Retaining walls shall be designed to resist the lateral action of soil to produce sliding and overturning with a minimum safety factor of 1.5 in each case. The load combinations of Section 1605 shall not apply to this requirement. Instead, design shall be based on 0.7 times nominal earthquake *loads*, 1.0 times other *nominal loads*, and investigation with one or more of the variable *loads* set to zero. The safety factor against lateral sliding shall be taken as the available soil resistance at the base of the retaining wall foundation divided by the net lateral force applied to the retaining wall.

**Exception:** Where earthquake loads are included, the minimum safety factor for retaining wall sliding and overturning shall be 1.1.

**1807.2.4 Segmental retaining walls.**

Dry-cast concrete units used in the construction of segmental retaining walls shall comply with ASTM C1372.

**1807.3 Embedded posts and poles.**

Designs to resist both axial and lateral *loads* employing posts or poles as columns embedded in earth or in concrete footings in earth shall be in accordance with Sections 1807.3.1 through 1807.3.3.

**1807.3.1 Limitations.**

The design procedures outlined in this section are subject to the following limitations:

1. The frictional resistance for structural walls and slabs on silts and clays shall be limited to one-half of the normal force imposed on the soil by the weight of the footing or slab.
2. Posts embedded in earth shall not be used to provide lateral support for structural or nonstructural materials such as plaster, masonry or concrete unless bracing is provided that develops the limited deflection required.

Wood poles shall be treated in accordance with AWPA U1 for sawn timber posts (Commodity Specification A, Use Category 4B) and for round timber posts (Commodity Specification B, Use Category 4B).

**1807.3.2 Design criteria.**

The depth to resist lateral *loads* shall be determined using the design criteria established in Sections 1807.3.2.1 through 1807.3.2.3, or by other methods *approved* by the *building official*.

**1807.3.2.1 Nonconstrained.**

The following formula shall be used in determining the depth of embedment required to resist lateral *loads* where lateral constraint is not provided at the ground surface, such as by a rigid floor or rigid ground surface pavement, and where lateral constraint is not provided above the ground surface, such as by a structural *diaphragm*.

$$d = 0.5A\{1 + [1 + (4.36h/A)]^{1/2}\}$$

*where:* **(Equation 18-1)**

$A = 2.34\,P/(S_1 b)$.

$b$ = Diameter of round post or footing or diagonal dimension of square post or footing, feet (m).

$d$ = Depth of embedment in earth in feet (m) but not over 12 feet (3658 mm) for purpose of computing lateral pressure.

$h$ = Distance in feet (m) from ground surface to point of application of "P."

$P$ = Applied lateral force in pounds (kN).

$S_1$ = Allowable lateral soil-bearing pressure as set forth in Section 1806.2 based on a depth of one-third the depth of embedment in pounds per square foot (psf) (kPa).

**1807.3.2.2 Constrained.**

The following formula shall be used to determine the depth of embedment required to resist lateral *loads* where lateral constraint is provided at the ground surface, such as by a rigid floor or pavement.

$$d = \sqrt{\frac{4.25Ph}{S_3 b}}$$

or alternatively **(Equation 18-2)**

$$d = \sqrt{\frac{4.25M_g}{S_3 b}}$$

where: **(Equation 18-3)**

$M_g$ = Moment in the post at grade, in foot-pounds (kN-m).

$S_3$ = Allowable lateral soil-bearing pressure as set forth in Section 1806.2 based on a depth equal to the depth of embedment in pounds per square foot (kPa).

**1807.3.2.3 Vertical load.**

The resistance to vertical *loads* shall be determined using the vertical foundation pressure set forth in Table 1806.2.

**1807.3.3 Backfill.**

The backfill in the *annular space* around columns not embedded in poured footings shall be by one of the following methods:

1. Backfill shall be of concrete with a specified compressive strength of not less than 2,000 psi (13.8 MPa). The hole shall be not less than 4 inches (102 mm) larger than the diameter of the column at its bottom or 4 inches (102 mm) larger than the diagonal dimension of a square or rectangular column.

2. Backfill shall be of clean sand. The sand shall be thoroughly compacted by tamping in layers not more than 8 inches (203 mm) in depth.
3. Backfill shall be of *controlled low-strength material (CLSM)*.