

Tension Anchorage

Table 1.1: Simplified Tension Anchorage Solutions – Footing Width and Embedment Depth

| Column Size | Nominal Heights | Wind ^{1,3} | | | | Seismic (R≤3) ^{2,3} | | | |
|-------------|-----------------|---------------------|---------------------|------------------|---------------------|------------------------------|---------------------|------------------|---------------------|
| | | Uncracked Concrete | | Cracked Concrete | | Uncracked Concrete | | Cracked Concrete | |
| | | W (in) | d _e (in) | W (in) | d _e (in) | W (in) | d _e (in) | W (in) | d _e (in) |
| C6 | 8-ft | 14 | 6 | 16 | 6 | 27 | 9 | 32 | 10 |
| | 9 to 12-ft | 13 | 6 | 15 | 6 | 25 | 8 | 29 | 9 |
| | 14 to 19-ft | 12 | 6 | 12 | 6 | 18 | 6 | 20 | 6 |
| C9 | 8 to 10-ft | 19 | 6 | 22 | 7 | 40 | 13 | 45 | 15 |
| | 12 to 16-ft | 14 | 6 | 17 | 6 | 30 | 9 | 35 | 11 |
| | 18 to 19-ft | 12 | 6 | 12 | 6 | 22 | 7 | 26 | 8 |
| C12 | 8 to 9-ft | 24 | 7 | 28 | 9 | 49 | 16 | 56 | 18 |
| | 10 to 16-ft | 21 | 6 | 25 | 8 | 40 | 13 | 46 | 15 |
| | 18 to 19-ft | 15 | 6 | 17 | 6 | 32 | 10 | 37 | 12 |
| C15 | 8 to 9-ft | 27 | 8 | 32 | 10 | 55 | 18 | 63 | 20 |
| | 10-ft | 25 | 8 | 29 | 9 | 50 | 16 | 57 | 18 |
| | 12 to 16-ft | 23 | 7 | 26 | 8 | 40 | 13 | 46 | 15 |
| | 18 to 19-ft | 18 | 6 | 21 | 6 | 38 | 12 | 44 | 14 |

1. Wind includes Seismic Design Category A & B, and detached 1 and 2 family dwellings in SDC C.
2. Seismic denotes Seismic Design Category C with R ≤ 3.0. For designs based on R = 3.5, see Table 1.2. Detached 1 and 2 family dwellings in SDC C may use wind solutions.
3. Anchorage solutions are based on maximum tension reactions resulting from the tabulated allowable shear loads applied to the frame in combination with the gravity loads noted. For frames with an applied shear less than the allowable load or with additional uplift, see Table 1.2. See pages 40–44 for required anchorage assembly strength.
4. Seismic denotes Seismic Design Category C through F with R = 3.5 and R ≤ 3.0. Designs in Seismic Design Category A or B and detached 1 and 2 family dwellings in SDC C may use wind solutions.
5. See Maximum Column Reactions – Tension in allowable load tables for tension reactions, or see allowable load tables footnote 5 to calculate tension reactions. Allowable tension is minimum of anchorage capacity and frame uplift capacity.
6. Anchorage assembly strength shall be determined from the table below. Requirements are based on maximum shear and tension reactions, and include shear-tension interaction. Wind solutions also include 4,000 lbs. of additional uplift. Std.=Standard strength anchorage assembly (OMFSL_ _-KT or OMFAB_ _-KT). HS=high strength anchorage assembly (OMFSL_ _HS-KT or OMFAB_ _HS-KT).

Table 1.2: Detailed Tension Anchorage – Allowable Loads

| Column Size | Load ^{1,4} | Concrete Condition | ASD Tension ⁵ (lbs) | Anchorage Assembly Strength ⁶ | Footing Dimensions (in) | | | |
|--------------|---------------------|--------------------|--------------------------------|--|-------------------------|----------------|----|---|
| | | | | | W | d _e | | |
| C6 | Wind | Uncracked | 4,550 | Std. or HS | 12 | 6 | | |
| | | | 5,125 | Std. or HS | 14 | 6 | | |
| | | | 3,650 | Std. or HS | 12 | 6 | | |
| | | Cracked | 4,725 | Std. or HS | 14 | 6 | | |
| | | | 5,125 | Std. or HS | 15 | 6 | | |
| | | | 1,525 | Std. or HS | 12 | 6 | | |
| | Seismic | Uncracked | 3,000 | Std. or HS | 18 | 6 | | |
| | | | 3,775 | Std. or HS | 21 | 6 | | |
| | | | 4,675 | Std. or HS | 24 | 7 | | |
| | | | 5,745 ⁷ | Std. | 27 | 8 | | |
| | | | 5,625 | HS | 27 | 8 | | |
| | | | 5,745 | HS | 28 | 9 | | |
| | | Cracked | 2,400 | Std. or HS | 18 | 6 | | |
| | | | 3,025 | Std. or HS | 21 | 6 | | |
| | | | 3,725 | Std. or HS | 24 | 7 | | |
| | | | 4,500 | Std. or HS | 27 | 8 | | |
| | | | 5,300 | Std. or HS | 30 | 9 | | |
| | | | 5,745 | Std. or HS | 32 | 10 | | |
| C9, C12, C15 | Wind | Uncracked | 6,050 | Std. or HS | 12 | 6 | | |
| | | | 7,475 | Std. or HS | 14 | 6 | | |
| | | | 8,975 | Std. or HS | 16 | 6 | | |
| | | | 10,575 | Std. or HS | 18 | 6 | | |
| | | | 12,250 | Std. or HS | 20 | 6 | | |
| | | | 14,025 | Std. or HS | 22 | 7 | | |
| | | | 16,360 | Std. or HS | 25 | 8 | | |
| | | | 4,850 | Std. or HS | 12 | 6 | | |
| | | | Cracked | 5,975 | Std. or HS | 14 | 6 | |
| | | 7,175 | | Std. or HS | 16 | 6 | | |
| | | 8,450 | | Std. or HS | 18 | 6 | | |
| | | 10,500 | | Std. or HS | 21 | 6 | | |
| | | 12,700 | | Std. or HS | 24 | 7 | | |
| | | 15,025 | | Std. or HS | 27 | 8 | | |
| | | 16,360 | | Std. or HS | 29 | 9 | | |
| | | Seismic | | Uncracked | 3,550 | Std. or HS | 18 | 6 |
| | | | | | 4,400 | Std. or HS | 21 | 6 |
| | | | 5,325 | | Std. or HS | 24 | 7 | |
| | 7,350 | | Std. or HS | | 30 | 9 | | |
| | 9,525 | | Std. or HS | | 36 | 11 | | |
| | 18,325 ⁷ | | Std. | | 42 | 13 | | |
| | 12,250 | | HS | | 48 | 15 | | |
| | 15,250 | | HS | | 54 | 17 | | |
| | 18,325 | | HS | | 54 | 17 | | |
| | Cracked | | 2,850 | Std. or HS | 18 | 6 | | |
| | | | 3,525 | Std. or HS | 21 | 6 | | |
| | | | 4,275 | Std. or HS | 24 | 7 | | |
| | | | 5,875 | Std. or HS | 30 | 9 | | |
| | | | 7,625 | Std. or HS | 36 | 11 | | |
| | | | 9,800 | Std. or HS | 42 | 13 | | |
| | | | 18,325 ⁷ | Std. | 48 | 15 | | |
| | | | 12,200 | HS | 54 | 17 | | |
| | | | 14,825 | HS | 54 | 17 | | |
| | 18,325 | HS | 62 | 20 | | | | |

| Column Size | Nominal Heights | Anchorage Assembly Strength | |
|-------------|-----------------|-----------------------------|---------|
| | | Wind | Seismic |
| C6 | 8-ft | HS | HS |
| | 9 to 10-ft | Std. | Std. |
| | 12 to 19-ft | | Std. |
| C9 | 8 to 9-ft | Std. | HS |
| | 10 to 19-ft | | Std. |
| | C12 | 8 to 9-ft | HS |
| 10 to 12-ft | | Std. | Std. |
| 14 to 19-ft | | | Std. |
| C15 | 8 to 10-ft | HS | HS |
| | 12 to 14-ft | Std. | Std. |
| | 16 to 19-ft | | Std. |

7. Allowable ASD tension capacity for anchorage assembly is based on anchor rod strength in tension. All other anchorage assembly capacities are based on concrete capacity divided by 2.5 per 2006 IBC Section 1908.1.16 and ACI 318-08 Section D.3.3.6.
8. Solutions are based on embedment in concrete with minimum f'c = 2,500 psi.
9. Footing dimensions are the minimum required for concrete anchorage requirements only. The Designer must determine required footing size and reinforcing for other design limits, such as foundation shear and bending, soil bearing, shear transfer, and frame stability/overturning.
10. Values for uncracked concrete include ν_{c,N} = 1.25 factor per ACI 318, Section D.5.2.6. Designer shall evaluate cracking at service load levels and select appropriate cracked or uncracked solution.
11. See pages 40 to 44 for shear anchorage solutions.
12. Footing width, W, and embedment depth, d_e are shown below:

