# **AT** Acrylic Adhesive



### Test Criteria

Anchors installed with AT adhesive have been tested in accordance with ICC-ES *Acceptance Criteria for Anchors in Unreinforced Masonry Elements* (AC60).

| Property | Test Method | Result* |
|---|---|---|
| Consistency | ASTM C881 | Non-sag/thixotropic paste |
| Heat deflection | ASTM D648 | 142°F (61°C) |
| Bond strength (moist cure, 60°F) | ASTM C882 | 2,960 psi (2 days)<br>3,567 psi (14 days) |
| Water absorption | ASTM D570 | 0.25% (24 hours) |
| Compressive yield strength (cured 60°F) | ASTM D695 | 10,930 psi (7 days) |
| Compressive modulus (cured 60°F) | ASTM D695 | 502,330 psi (7 days) |
| Shore D hardness | ASTM D2240 | 91 |
| Gel time | ASTM C881 | 5 minutes |
| VOC | ASTM D2369 | 25 g/L |
| Shrinkage coefficient | ASTM D2566 | 0.004 in./in. |

*Material and curing conditions: 73 ± 2°F, unless otherwise noted.

## AT Adhesive Cartridge Systems

| Model No. | Capacity (ounces) | Cartridge Type | Carton Quantity | Dispensing Tools | Mixing Nozzle |
|---|---|---|---|---|---|
| AT13[4] | 12.5 | Side-by-side | 10 | ADT813S | AMN19Q |
| AT30[4] | 30 | Side-by-side | 5 | ADT30S, ADTA30CKT ADTA30P | |

1. Cartridge estimation guidelines are available at **strongtie.com/apps**.
2. Detailed information on dispensing tools, mixing nozzles and other adhesive accessories is available at **strongtie.com**.
3. Use only Simpson Strong-Tie mixing nozzles in accordance with Simpson Strong-Tie instructions. Modification or improper use of mixing nozzle may impair AT adhesive performance.
4. One AMN19Q mixing nozzle and one nozzle extension are supplied with each cartridge.

## In-Service Temperature Sensitivity

| Base Material Temperature | | Percent Allowable Load for $TEMP_{inst}$ = 0°F | Percent Allowable Load for $TEMP_{inst}$ ≥ 70°F |
|---|---|---|---|
| °F | °C | | |
| 0 | -18 | 100% | 100% |
| 32 | 0 | 100% | 100% |
| 70 | 21 | 100% | 100% |
| 110 | 43 | 82% | 82% |
| 135 | 57 | 74% | 82% |
| 150 | 66 | 38% | 65% |
| 180 | 82 | 22% | 28% |

1. Refer to in-service temperature sensitivity chart for allowable bond strength reduction for in-service temperature. See p. 251.
2. $TEMP_{inst}$ is the base material temperature during installation and curing of the adhesive.
3. Percent allowable load for $TEMP_{inst}$ = 0°F (-18°C) is to be used for $TEMP_{inst}$ between 0°F (-18°C) and 70°F (21°C).
4. Percent allowable load may be linearly interpolated for intermediate base material in-service temperatures.
5. °C = (°F-32) / 1.8

## Cure Schedule

| Base Material Temperature | | Cure Time (hrs.) |
|---|---|---|
| °F | °C | |
| 0 | -18 | 24 |
| 25 | -4 | 8 |
| 40 | 4 | 4 |
| 60 | 16 | 1 |
| 70 | 21 | 30 min. |
| 100 | 38 | 20 min. |

# **AT** Design Information — Concrete



## AT Allowable Tension Loads for Threaded Rod Anchors in Normal-Weight Concrete (continued on next page)

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Tension Load Based on Bond Strength | | | Tension Load Based on Steel Strength | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq 2{,}000$ psi (13.8 MPa) Concrete | | | F1554 Grade 36 | A193 GR B7 | F593 304SS |
| | | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| ⅜ (9.5) | 7/16 | 1¾ (44) | 2⅝ (67) | 7 (178) | 3,362 (15.0) | 99 (0.4) | 840 (3.7) | 2,105 (9.4) | 4,535 (20.2) | 3,630 (16.1) |
| | | 3½ (89) | 5¼ (133) | 6⅛ (156) | 8,937 (39.8) | 314 (1.4) | 2,235 (9.9) | | | |
| | | 4½ (114) | 6¾ (171) | 18 (457) | 10,411 (46.3) | 525 (2.3) | 2,605 (11.6) | | | |
| ½ (12.7) | 9/16 | 2⅛ (54) | 3 3/16 (81) | 8½ (216) | 5,252 (23.4) | 501 (2.2) | 1,315 (5.8) | 3,750 (16.7) | 8,080 (35.9) | 6,470 (28.8) |
| | | 4¼ (108) | 6⅜ (162) | 7½ (191) | 16,668 (74.1) | 822 (3.7) | 4,165 (18.5) | | | |
| | | 6 (152) | 9 (229) | 24 (610) | 19,182 (85.3) | 331 (1.5) | 4,795 (21.3) | | | |
| ⅝ (15.9) | 11/16 | 2½ (64) | 3¾ (95) | 10 (254) | 8,495 (37.8) | 561 (2.5) | 2,125 (9.5) | 5,875 (26.1) | 12,660 (56.3) | 10,120 (45.0) |
| | | 4 (102) | 5⅝ (143) | 16 (406) | — | — | 4,315 (19.2) | | | |
| | | 5½ (140) | 7½ (191) | 9⅝ (244) | 26,025 (115.8) | 1,866 (8.3) | 6,505 (28.9) | | | |
| | | 7 7/16 (189) | 10⅞ (276) | 29¾ (756) | — | — | 7,215 (32.1) | | | |
| | | 9⅜ (238) | 14⅛ (359) | 37½ (953) | 31,683 (140.9) | 1,571 (7.0) | 7,920 (35.2) | | | |

See notes on next page.

¾"–1 ¼" diameters on next page →



* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Tension Loads for Threaded Rod Anchors in Normal-Weight Concrete (continued from previous page)

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Tension Load Based on Bond Strength, $f'_c \geq 2{,}000$ psi (13.8 MPa) Concrete: Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Tension Load Based on Steel Strength: F1554 Grade 36 Allowable lb. (kN) | A193 GR B7 Allowable lb. (kN) | F593 304SS Allowable lb. (kN) |
|---|---|---|---|---|---|---|---|---|---|---|
| ¾ (19.1) | 13/16 | 3⅜ (86) | 5 1/16 (129) | 13½ (343) | 12,991 (57.8) | 725 (3.2) | 3,250 (14.5) | 8,460 (37.6) | 18,230 (81.1) | 12,400 (55.2) |
| | | 5 1/16 (129) | 7⅝ (194) | 20¼ (514) | — | — | 6,330 (28.2) | | | |
| | | 6¾ (171) | 10⅛ (257) | 11⅞ (302) | 37,616 (167.3) | 1,817 (8.1) | 9,405 (41.8) | | | |
| | | 9 (229) | 13½ (343) | 36 (914) | — | — | 10,000 (44.5) | | | |
| | | 11¼ (286) | 16⅞ (429) | 45 (1,143) | 42,381 (188.5) | 683 (3.0) | 10,595 (47.1) | | | |
| ⅞ (22.2) | 1 | 3⅞ (98) | 5 13/16 (148) | 15½ (394) | 14,206 (63.2) | 457 (2.0) | 3,550 (15.8) | 11,500 (51.2) | 24,785 (110.2) | 16,860 (75.0) |
| | | 5 13/16 (148) | 8¾ (222) | 23¼ (591) | — | — | 7,130 (31.7) | | | |
| | | 7¾ (197) | 11⅝ (295) | 13⅝ (346) | 42,848 (190.6) | 3,155 (14.0) | 10,710 (47.6) | | | |
| | | 10 7/16 (265) | 15⅝ (397) | 41¾ (1,060) | — | — | 12,250 (54.5) | | | |
| | | 13⅛ (333) | 19⅝ (498) | 52½ (1,334) | 55,148 (245.3) | 5,673 (25.2) | 13,785 (61.3) | | | |
| 1 (25.4) | 1 1/16 | 4½ (114) | 6¾ (171) | 18 (457) | 20,797 (92.5) | 1,763 (7.8) | 5,200 (23.1) | 15,025 (66.8) | 32,380 (144.0) | 22,020 (97.9) |
| | | 6¾ (171) | 10⅛ (257) | 27 (686) | — | — | 10,165 (45.2) | | | |
| | | 9 (229) | 13½ (343) | 15¾ (400) | 60,504 (269.1) | 2,065 (9.2) | 15,125 (67.3) | | | |
| | | 12 (305) | 18 (457) | 48 (1,219) | — | — | 17,880 (79.5) | | | |
| | | 15 (381) | 22½ (572) | 60 (1,524) | 82,529 (367.1) | 5,146 (22.9) | 20,630 (91.8) | | | |
| 1⅛ (28.6) | 1 3/16 | 5⅛ (130) | 7¾ (197) | 20½ (521) | 26,600 (118.3) | — | 6,650 (29.6) | 19,025 (84.6) | 41,000 (182.4) | 27,880 (124.0) |
| | | 7⅝ (194) | 11½ (292) | 30½ (775) | — | — | 11,780 (52.4) | | | |
| | | 10⅛ (257) | 15¼ (387) | 17¾ (451) | 67,600 (300.7) | — | 16,900 (75.2) | | | |
| | | 13½ (343) | 20¼ (514) | 54 (1,372) | — | — | 21,385 (95.1) | | | |
| | | 16⅞ (429) | 25⅜ (645) | 67½ (1,715) | 103,460 (460.2) | — | 25,865 (115.1) | | | |
| 1¼ (31.8) | 1 5/16 | 5⅝ (143) | 8 7/16 (214) | 22½ (572) | 32,368 (144.0) | 2,054 (9.1) | 8,090 (36.0) | 23,490 (104.5) | 50,620 (225.2) | 34,420 (153.1) |
| | | 8 7/16 (214) | 12¾ (324) | 33¾ (857) | — | — | 13,090 (58.2) | | | |
| | | 11¼ (286) | 16⅞ (429) | 19¾ (502) | 72,363 (321.9) | 7,457 (33.2) | 18,090 (80.5) | | | |
| | | 15 (381) | 22½ (572) | 60 (1,524) | — | — | 24,860 (110.6) | | | |
| | | 18¾ (476) | 28⅛ (714) | 75 (1,905) | 126,500 (562.7) | 15,813 (70.3) | 31,625 (140.7) | | | |

1. Reference p. 250 for oversize holes.
2. Allowable load must be the lesser of the bond or steel strength.
3. The allowable loads listed under allowable bond are based on a safety factor of 4.0.
4. Refer to allowable load-adjustment factors for spacing and edge distance on pp. 95, 97 and 98.
5. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
6. Anchors are permitted to be used within fire-resistive construction, provided the anchors resist wind or seismic loads only. For use in fire-resistive construction, the anchors can also be permitted to be used to resist gravity loads, provided special consideration has been given to fire-exposure conditions.
7. Anchors are not permitted to resist tension forces in overhead or wall installations unless proper consideration is given to fire-exposure and elevated-temperature conditions.

* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Shear Loads for Threaded Rod Anchors in Normal-Weight Concrete

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Shear Load Based on Concrete Edge Distance | | | Shear Load Based on Steel Strength | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq 2{,}000$ psi (13.8 MPa) Concrete | | | F1554 Grade 36 | A193 GR B7 | F593 304SS |
| | | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| ⅜ (9.5) | 7/16 | 1¾ (44) | 5¼ (133) | 2⅝ (67) | 4,869 (21.7) | 369 (1.6) | 1,215 (5.4) | 1,085 (4.8) | 2,340 (10.4) | 1,870 (8.3) |
| | | 3½ (89) | | 5¼ (133) | 5,540 (24.6) | 620 (2.8) | 1,385 (6.2) | | | |
| | | 4½ (114) | | 5¼ (133) | — | — | 1,385 (6.2) | | | |
| ½ (12.7) | 9/16 | 2⅛ (54) | 6⅜ (162) | 3¼ (83) | 8,318 (37.0) | 643 (2.9) | 2,080 (9.3) | 1,930 (8.6) | 4,160 (18.5) | 3,330 (14.8) |
| | | 4¼ (108) | | 6⅜ (162) | 9,998 (44.5) | 522 (2.3) | 2,500 (11.1) | | | |
| | | 6 (152) | | 6⅜ (162) | — | — | 2,500 (11.1) | | | |
| ⅝ (15.9) | 11/16 | 2½ (64) | 7½ (191) | 3¾ (95) | 14,806 (65.9) | 728 (3.2) | 3,700 (16.5) | 3,025 (13.5) | 6,520 (29.0) | 5,220 (23.2) |
| | | 5½ (140) | | 8¼ (210) | 15,692 (69.8) | 305 (1.4) | 3,925 (17.5) | | | |
| | | 9⅜ (238) | | 8¼ (210) | — | — | 3,925 (17.5) | | | |
| ¾ (19.1) | 13/16 | 3⅜ (86) | 10⅛ (257) | 5⅛ (130) | 20,350 (90.5) | — | 5,090 (22.6) | 4,360 (19.4) | 9,390 (41.8) | 6,385 (28.4) |
| | | 6¾ (171) | | 10⅛ (257) | 20,350 (90.5) | 1,521 (6.8) | 5,090 (22.6) | | | |
| | | 11¼ (286) | | 10⅛ (257) | — | — | 5,090 (22.6) | | | |
| ⅞ (22.2) | 1 | 3⅞ (98) | 11⅝ (295) | 5⅞ (149) | 27,475 (122.2) | 1,655 (7.4) | 6,870 (30.6) | 5,925 (26.4) | 12,770 (56.8) | 8,685 (38.6) |
| | | 7¾ (197) | | 11⅝ (295) | 30,876 (137.3) | 1,714 (7.6) | 7,720 (34.3) | | | |
| | | 13⅛ (333) | | 11⅝ (295) | — | — | 7,720 (34.3) | | | |
| 1 (25.4) | 1 1/16 | 4½ (114) | 13½ (343) | 6¾ (171) | 32,687 (145.4) | 2,287 (10.2) | 8,170 (36.3) | 7,740 (34.4) | 16,680 (74.2) | 11,345 (50.5) |
| | | 9 (229) | | 13½ (343) | 33,858 (150.6) | 2,035 (9.1) | 8,465 (37.7) | | | |
| | | 15 (381) | | 13½ (343) | — | — | 8,465 (37.7) | | | |
| 1⅛ (28.6) | 1 3/16 | 5⅛ (130) | 15¼ (387) | 7¾ (197) | 41,536 (184.8) | — | 10,385 (46.2) | 9,800 (43.6) | 21,125 (94.0) | 14,365 (63.9) |
| | | 10⅛ (257) | | 15¼ (387) | 49,812 (221.6) | — | 12,455 (55.4) | | | |
| | | 16⅞ (429) | | 15¼ (387) | — | — | 12,455 (55.4) | | | |
| 1¼ (31.8) | 1 5/16 | 5⅝ (143) | 16⅞ (429) | 8½ (216) | 50,385 (224.1) | 1,090 (4.8) | 12,595 (56.0) | 12,100 (53.8) | 26,075 (116.0) | 17,730 (78.9) |
| | | 11¼ (286) | | 16⅞ (429) | 65,765 (292.5) | 4,636 (20.6) | 16,440 (73.1) | | | |
| | | 18¾ (476) | | 16⅞ (429) | — | — | 16,440 (73.1) | | | |

1. Allowable load must be the lesser of the load based on concrete edge distance or steel strength.
2. The allowable loads based on concrete edge distance are based on a safety factor of 4.0.
3. Refer to allowable load-adjustment factors for spacing and edge distance on pp. 96 and 98.
4. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
5. Anchors are permitted to be used within fire-resistive construction, provided the anchors resist wind or seismic loads only. For use in fire-resistive construction, the anchors can also be permitted to be used to resist gravity loads, provided special consideration has been given to fire-exposure conditions.

* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Tension Loads for Rebar Dowels in Normal-Weight Concrete

| Rebar Size No. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Tension Load Based on Bond Strength | | | | | | Tension Load Based on Steel Strength |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq 2{,}000$ psi (13.8 MPa) Concrete | | | $f'_c \geq 4{,}000$ psi (27.6 MPa) Concrete | | | ASTM A615 Grade 60 Rebar |
| | | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| #3 (9.5) | ½ | 3½ (89) | 5¼ (133) | 6⅛ (156) | 8,245 (36.7) | 849 (3.8) | 2,060 (9.2) | — | — | 2,060 (9.2) | 2,640 (11.7) |
| | | 4½ (114) | 5¼ (133) | 6⅛ (156) | — | — | 2,060 (9.2) | — | — | 2,060 (9.2) | |
| #4 (12.7) | 9⁄16 | 4¼ (108) | 6⅜ (162) | 7½ (191) | 12,743 (56.7) | 1,760 (7.8) | 3,185 (14.2) | — | — | 3,185 (14.2) | 4,800 (21.4) |
| | | 5⅞ (149) | 8⅞ (225) | 23½ (597) | — | — | 3,185 (14.2) | — | — | 3,985 (17.7) | |
| | | 7½ (191) | 11¼ (286) | 30 (762) | — | — | 3,185 (14.2) | 19,124 (85.1) | 854 (3.8) | 4,780 (21.3) | |
| #5 (15.9) | ¾ | 5½ (140) | 7½ (191) | 9⅝ (244) | 20,396 (90.7) | 1,412 (6.3) | 5,100 (22.7) | — | — | 5,100 (22.7) | 7,440 (33.1) |
| | | 7¼ (184) | 10⅞ (276) | 29 (737) | — | — | 5,100 (22.7) | — | — | 6,095 (27.1) | |
| | | 9⅜ (191) | 14⅛ (359) | 37½ (953) | — | — | 5,100 (22.7) | 28,115 (125.1) | 1,496 (6.7) | 7,030 (31.3) | |
| #6 (19.1) | ⅞ | 6¾ (171) | 10⅛ (257) | 11⅞ (302) | 31,839 (141.6) | 1,454 (6.5) | 7,960 (35.4) | — | — | 7,960 (35.4) | 10,560 (47.0) |
| | | 9 (229) | 13½ (343) | 36 (914) | — | — | 7,960 (35.4) | — | — | 8,730 (38.8) | |
| | | 11¼ (286) | 16⅞ (429) | 45 (1,143) | — | — | 7,960 (35.4) | 37,992 (169.0) | 1,999 (8.9) | 9,500 (42.3) | |
| #7 (22.2) | 1 | 7¾ (197) | 11⅝ (295) | 13⅝ (346) | 35,250 (156.8) | 2,693 (12.0) | 8,815 (39.2) | — | — | 8,815 (39.2) | 14,400 (64.1) |
| | | 10½ (267) | 15¾ (400) | 42 (1,067) | — | — | 8,815 (39.2) | — | — | 10,815 (48.1) | |
| | | 13⅛ (333) | 19⅝ (498) | 52½ (1,334) | — | — | 8,815 (39.2) | 50,889 (226.4) | 3,717 (16.5) | 12,720 (56.6) | |
| #8 (25.4) | 1⅛ | 9 (229) | 13½ (343) | 15¾ (400) | 49,973 (222.3) | 5,023 (22.3) | 12,495 (55.6) | — | — | 12,495 (55.6) | 18,960 (84.3) |
| | | 12 (305) | 18 (457) | 48 (1,219) | — | — | 12,495 (55.6) | — | — | 16,325 (72.6) | |
| | | 15 (381) | 22½ (572) | 60 (1,524) | — | — | 12,495 (55.6) | 80,598 (358.5) | 2,195 (9.8) | 20,150 (89.6) | |
| #9 (28.6) | 1¼ | 16⅞ (429) | 25⅜ (645) | 67½ (1,715) | — | — | — | 96,096 (427.5) | 489 (2.2) | 24,025 (106.9) | 24,000 (106.8) |
| #10 (31.8) | 1⅜ | 18¾ (476) | 28⅛ (714) | 75 (1,905) | — | — | — | 124,031 (551.7) | 2,447 (10.9) | 31,010 (137.9) | 30,480 (135.6) |
| #11 (34.9) | 1⅝ | 20⅝ (524) | 31 (787) | 82½ (2,096) | — | — | — | 166,059 (738.7) | 4,222 (18.8) | 41,515 (184.7) | 37,440 (166.5) |

1. Allowable load must be the lesser of the bond or steel strength.
2. The allowable loads listed under allowable bond are based on a safety factor of 4.0.
3. Refer to allowable load-adjustment factors for spacing and edge distance on pp. 95, 97 and 98.
4. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
5. Anchors are permitted to be used within fire-resistive construction, provided the anchors resist wind or seismic loads only. For use in fire-resistive construction, the anchors can also be permitted to be used to resist gravity loads, provided special consideration has been given to fire-exposure conditions.
6. Anchors are not permitted to resist tension forces in overhead or wall installations unless proper consideration is given to fire-exposure and elevated-temperature conditions.



* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Shear Loads for Rebar Dowels in Normal-Weight Concrete

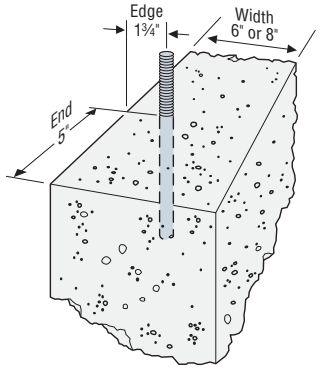
| Rebar Size No. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Shear Load Based on Concrete Edge Distance, $f'_c \geq 2{,}000$ psi (13.8 MPa) Concrete: Ultimate lb. (kN) | Shear Load Based on Concrete Edge Distance, $f'_c \geq 2{,}000$ psi (13.8 MPa) Concrete: Std. Dev. lb. (kN) | Shear Load Based on Concrete Edge Distance, $f'_c \geq 2{,}000$ psi (13.8 MPa) Concrete: Allowable lb. (kN) | Shear Load Based on Steel Strength, ASTM A615 Grade 60 Rebar: Allowable lb. (kN) |
|---|---|---|---|---|---|---|---|---|
| #3 (9.5) | ½ | 3½ (89) | 6 (152) | 5¼ (133) | 8,294 (36.9) | 515 (2.3) | 2,075 (9.2) | 1,680 (7.5) |
| | | 4½ (114) | | | — | — | 2,075 (9.2) | |
| #4 (12.7) | 9/16 | 4¼ (108) | 8 (203) | 6⅜ (162) | 11,012 (49.0) | 383 (1.7) | 2,755 (12.3) | 3,060 (13.6) |
| | | 7½ (191) | | | — | — | 2,755 (12.3) | |
| #5 (15.9) | ¾ | 5½ (140) | 10 (254) | 8¼ (210) | 15,758 (70.1) | 1,154 (5.1) | 3,940 (17.5) | 4,740 (21.1) |
| | | 9⅜ (238) | | | — | — | 3,940 (17.5) | |
| #6 (19.1) | ⅞ | 6¾ (171) | 12 (305) | 10⅛ (257) | 23,314 (103.7) | 1,494 (6.6) | 5,830 (25.9) | 6,730 (29.9) |
| | | 11¼ (286) | | | — | — | 5,830 (25.9) | |
| #7 (22.2) | 1 | 7¾ (197) | 14 (356) | 11⅝ (295) | 32,662 (145.3) | 5,588 (24.9) | 8,165 (36.3) | 9,180 (40.8) |
| | | 13⅛ (333) | | | — | — | 8,165 (36.3) | |
| #8 (25.4) | 1⅛ | 9 (229) | 16 (406) | 13½ (343) | 33,428 (148.7) | 2,319 (10.3) | 8,360 (37.2) | 12,085 (53.8) |
| | | 15 (381) | | | — | — | 8,360 (37.2) | |

1. Allowable load must be the lesser of the load based on concrete edge distance or steel strength.
2. The allowable loads based on concrete edge distance are based on a safety factor of 4.0.
3. Refer to allowable load-adjustment factors for spacing and edge distance on pp. 96 and 98.
4. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
5. Anchors are permitted to be used within fire-resistive construction, provided the anchors resist wind or seismic loads only. For use in fire-resistive construction, the anchors can also be permitted to be used to resist gravity loads, provided special consideration has been given to fire-exposure conditions.

## AT Allowable Tension Loads for Threaded Rod Anchors in Normal-Weight Concrete Stemwall

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Stemwall Width in. (mm) | Min. Edge Dist. in. (mm) | Min. End Dist. in. (mm) | Tension Load Based on Bond Strength, $f'_c \geq 2{,}500$ psi (17.2 MPa) Concrete: Ultimate lb. (kN) | Tension Load Based on Bond Strength, $f'_c \geq 2{,}500$ psi (17.2 MPa) Concrete: Allowable lb. (kN) | Tension Load Based on Steel Strength, F1554 Grade 36: Allowable lb. (kN) |
|---|---|---|---|---|---|---|---|---|
| ⅝ (15.9) | 11/16 | 10 (254.0) | 6 (152.4) | 1¾ (44.5) | 5 (127.0) | 12,913 (57.4) | 3,230 (14.4) | 5,875 (26.1) |
| ⅞ (22.2) | 1 | 15 (381.0) | 8 (203.2) | 1¾ (44.5) | 5 (127.0) | 21,838 (97.1) | 5,460 (24.3) | 11,500 (51.2) |

1. Allowable load must be the lesser of the bond or steel strength.
2. The allowable loads listed under allowable bond are based on a safety factor of 4.0.
3. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
4. Anchors are permitted to be used within fire-resistive construction, provided the anchors resist wind or seismic loads only. For use in fire-resistive construction, the anchors can also be permitted to be used to resist gravity loads, provided special consideration has been given to fire-exposure conditions.




Edge and End Distances for Threaded Rod in Concrete Foundation Stemwall Corner Installation

* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Tension Loads for Threaded Rod Anchors in Sand-Lightweight Concrete

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Tension Load Based on Bond Strength | | | Tension Load Based on Steel Strength | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq 3{,}000$ psi (20.7 MPa) Lightweight Concrete | | | F1554 Grade 36 | A193 GR B7 | F593 304SS |
| | | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| 3/8 (9.5) | 7/16 | 1 3/4 (44) | 2 5/8 (67) | 3 1/2 (89) | 2,842 (12.6) | 226 (1.0) | 710 (3.2) | 2,105 (9.4) | 4,535 (20.2) | 3,630 (16.1) |
| | | 3 1/2 (89) | 5 1/4 (133) | 7 (178) | 5,132 (22.8) | 762 (3.4) | 1,280 (5.7) | | | |
| 1/2 (12.7) | 9/16 | 2 1/8 (54) | 3 1/8 (79) | 4 1/4 (108) | 4,415 (19.6) | 454 (2.0) | 1,100 (4.9) | 3,750 (16.7) | 8,080 (35.9) | 6,470 (28.8) |
| | | 4 1/4 (108) | 6 3/8 (162) | 8 1/2 (216) | 6,709 (29.8) | 1,002 (4.5) | 1,675 (7.5) | | | |
| 5/8 (15.9) | 11/16 | 2 1/2 (64) | 3 3/4 (95) | 5 (127) | 5,568 (24.8) | 498 (2.2) | 1,390 (6.2) | 5,875 (26.1) | 12,660 (56.3) | 10,120 (45.0) |
| | | 5 (127) | 7 1/2 (191) | 10 (254) | 6,298 (28.0) | 1,155 (5.1) | 1,575 (7.0) | | | |

1. Allowable load must be the lesser of the bond or steel strength.
2. 100% of the allowable load is permitted at critical spacing. No reduction in spacing is allowed.
3. Refer to allowable load-adjustment factors for edge distance on p. 99.
4. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
5. Anchors are permitted to be used within fire-resistive construction, provided the anchors resist wind or seismic loads only. For use in fire-resistive construction, the anchors can also be permitted to be used to resist gravity loads, provided special consideration has been given to fire-exposure conditions.
6. Anchors are not permitted to resist tension forces in overhead or wall installations unless proper consideration is given to fire-exposure and elevated-temperature conditions.
7. The allowable loads listed under allowable bond are based on a safety factor of 4.0.

## AT Allowable Shear Loads for Threaded Rod Anchors in Sand-Lightweight Concrete

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Critical Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | Shear Load Based on Concrete Edge Distance | | | Shear Load Based on Steel Strength | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | $f'_c \geq 3{,}000$ psi (20.7 MPa) Lightweight Concrete | | | F1554 Grade 36 | A193 GR B7 | F593 304SS |
| | | | | | Ultimate lb. (kN) | Std. Dev. lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| 3/8 (9.5) | 7/16 | 1 3/4 (44) | 2 5/8 (67) | 3 1/2 (89) | 3,042 (13.5) | 249 (1.1) | 760 (3.4) | 1,085 (4.8) | 2,340 (10.4) | 1,870 (8.3) |
| | | 3 1/2 (89) | 5 1/4 (133) | 7 (178) | 5,320 (23.7) | 187 (0.8) | 1,330 (5.9) | | | |
| 1/2 (12.7) | 9/16 | 2 1/8 (54) | 3 1/8 (79) | 4 1/4 (108) | 4,076 (18.1) | 458 (2.0) | 1,020 (4.5) | 1,930 (8.6) | 4,160 (18.5) | 3,330 (14.8) |
| | | 4 1/4 (108) | 6 3/8 (162) | 8 1/2 (216) | 9,838 (43.8) | 625 (2.8) | 2,460 (10.9) | | | |
| 5/8 (15.9) | 11/16 | 2 1/2 (64) | 3 3/4 (95) | 5 (127) | 5,360 (23.8) | 351 (1.6) | 1,340 (6.0) | 3,025 (13.5) | 6,520 (29.0) | 5,220 (23.2) |
| | | 5 (127) | 7 1/2 (191) | 10 (254) | 12,430 (55.3) | 518 (2.3) | 3,105 (13.8) | | | |

1. Allowable load must be the lesser of the load based on concrete edge distance or steel strength.
2. The allowable loads based on concrete edge distance are based on a safety factor of 4.0.
3. Refer to allowable load-adjustment factors for edge distance on p. 99.
4. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
5. Anchors are permitted to be used within fire-resistive construction, provided the anchors resist wind or seismic loads only. For use in fire-resistive construction, the anchors can also be permitted to be used to resist gravity loads, provided special consideration has been given to fire-exposure conditions.
6. 100% of the allowable load is permitted at critical spacing. No reduction in spacing is allowed.

* See p. 13 for an explanation of the load table icons.

## AT Allowable Tension and Shear Loads for Threaded Rod Anchors in 6- and 8-Inch Normal-Weight Grout-Filled CMU

IBC *

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Min. Edge Dist. in. (mm) | Min. End Dist. in. (mm) | Min. Spacing Dist. in. (mm) | 6-Inch Grout-Filled CMU Allowable Loads Based on CMU Strength | | 8-Inch Grout-Filled CMU Allowable Loads Based on CMU Strength | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension | Shear | Tension | Shear |
| | | | | | | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in Face Shell (See Figure 1)** | | | | | | | | | |
| ½ (12.7) | 9/16 | 4¼ (108) | 12 (305) | 12 (305) | 17 (432) | 770 (3.4) | 1,325 (5.9) | 770 (3.4) | 1,325 (5.9) |
| ¾ (19.1) | 13/16 | 6¾ (171) | 12 (305) | 4 (102) | 27 (686) | — | — | 1,375 (6.1) | — |
| | | | | 12 (305) | 27 (686) | — | — | — | 2,670 (11.9) |
| **Anchor Installed in Mortar "T" Joint (See Figure 2)** | | | | | | | | | |
| ¾ (19.1) | 13/16 | 6¾ (171) | 16 (406) | 8 (203) | 27 (686) | — | — | — | 1,030 (4.6) |

See notes 1–7 below.

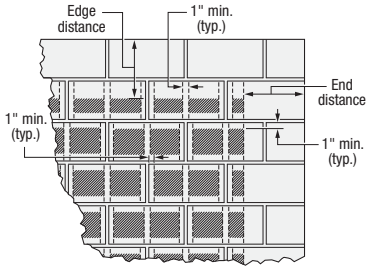



**Figure 1.** Allowable Anchor Placement in Grouted CMU Face Shell

## AT Allowable Tension and Shear Loads for Threaded Rod Anchors in 6- and 8-Inch Normal-Weight Grout-Filled CMU

IBC *

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Min. Edge Dist. in. (mm) | Min. End Dist. in. (mm) | Min. Spacing Dist. in. (mm) | 6- and 8-Inch Grout-Filled CMU Allowable Loads Based on CMU Strength | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | | Tension | Shear Perpendicular[8] | Shear Parallel[9] |
| | | | | | | Allowable lb. (kN) | Allowable lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in Cell Opening (Top-of-Wall) (See Figure 3)** | | | | | | | | |
| ½ (12.7) | 9/16 | 4¼ (108) | 1¾ (44) | 11 (279) | 17 (432) | 650 (2.9) | 285 (1.3) | 705 (3.1) |
| ⅝ (15.9) | 11/16 | 5 (127) | 1¾ (44) | 11 (279) | 20 (508) | 815 3.6 | 330 (1.5) | 755 (3.4) |
| | | 12 (305) | 1¾ (44) | 11 (279) | 48 (1,219) | 1,120 (5.0) | 410 (1.8) | 815 (3.6) |
| ⅞ (22.2) | 1 | 12 (305) | 1¾ (44) | 11 (279) | 48 (1,219) | 1,385 (6.2) | 290 (1.3) | 1,030 (4.6) |

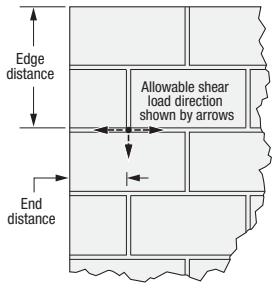



**Figure 2.** Anchor Placement in Grouted CMU Mortar "T" Joint

1. Threaded rods must comply with ASTM F1554 Grade 36 minimum.
2. Values for 6- and 8-inch wide concrete masonry units (CMU) with a minimum specified compressive strength of masonry, $f'_m$, at 28 days is 1,500 psi.
3. Embedment depth is measured from the outside face of the concrete masonry unit for installations through a face shell.
4. Allowable loads may be increased 33⅓% for short-term loading due to wind or seismic forces where permitted by code.
5. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.
6. The tabulated allowable loads are based on a safety factor of 5.0.
7. Anchors must be spaced a minimum distance of four times the anchor embedment.
8. Shear load applied perpendicular to edge of CMU wall.
9. Shear load applied parallel to edge of CMU wall.

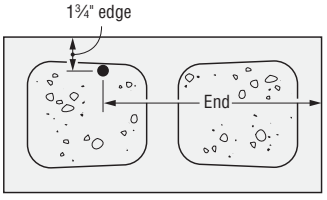



**Figure 3.** Anchor Installed in Cell Opening (Top of Wall)

## AT Allowable Tension and Shear Loads for Threaded Rod Anchors in Lightweight, Medium-Weight and Normal-Weight Hollow CMU

IBC *

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Min. Edge Dist. in. (mm) | Min. End Dist. in. (mm) | 6- and 8-Inch Hollow CMU Allowable Loads Based on CMU Strength | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | Tension | | Shear | |
| | | | | | Ultimate lb. (kN) | Allowable lb. (kN) | Ultimate lb. (kN) | Allowable lb. (kN) |
| **Anchor Installed in Face Shell with Simpson Stong-Tie® Stainless-Steel Screen Tube (See Figure 4)** | | | | | | | | |
| ⅜ (9.5) | 9/16 | 3½ (88.9) | 4 (101.6) | 4⅝ (117.5) | 1,400 (6.2) | 280 (1.2) | 1,326 (5.9) | 265 (1.2) |
| ½ (12.7) | 11/16 | 3½ (88.9) | 4 (101.6) | 4⅝ (117.5) | — | 280 (1.2) | — | 265 (1.2) |
| ⅝ (15.9) | ⅞ | 3 (76.2) | 4 (101.6) | 4⅝ (117.5) | — | 280 (1.2) | — | 265 (1.2) |

1. See notes 1, 2, 3, 5, 6, 7 above.
2. Set drill to rotation-only mode when drilling into hollow CMU.

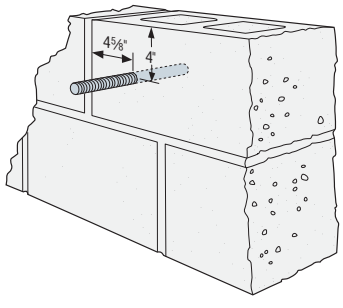



**Figure 4.** Anchor Installed in Face Shell with Screen Tube in Hollow Cell

* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Masonry

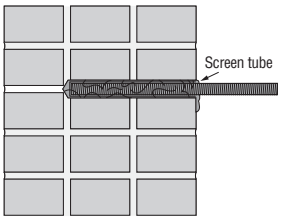


## AT Allowable Tension and Shear Loads for Installations in Unreinforced Brick Masonry Walls — Minimum URM Wall Thickness is 13" (3 wythes thick)

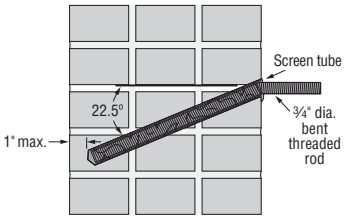
IBC *

| Rod/Rebar Dia./Size in. (mm) | Drill Bit Dia. in. | Embed. Depth in. (mm) | Min. Edge/End Dist. in. (mm) | Min. Vertical Spacing Dist. in. (mm) | Min. Horiz. Spacing Dist. in. (mm) | Tension Load Based on URM Strength<br>Minimum Net Mortar Strength = 50 psi<br>Allowable lb. (kN) | Shear Load Based on URM Strength<br>Minimum Net Mortar Strength = 50 psi<br>Allowable lb. (kN) |
|---|---|---|---|---|---|---|---|
| **Configuration A (Simpson Strong-Tie® ATS Screen Tube Required)** | | | | | | | |
| ¾ (19.1) | 1 | 8 (203) | 24 (610) | 18 (457) | 18 (457) | — | 1,000 (4.4) |
| #5 (15.9) | 1 | 8 (203) | 24 (610) | 18 (457) | 18 (457) | — | 750 (3.3) |
| #6 (19.1) | 1 | 8 (203) | 24 (610) | 18 (457) | 18 (457) | — | 1,000 (4.4) |
| **Configuration B (Simpson Strong-Tie ATS Screen Tube Required)** | | | | | | | |
| ¾ (19.1) | 1 | 13 (330) | 16 (406) | 18 (457) | 24 (610) | 1,200 (5.3) | 1,000 (4.4) |
| **Configuration C (Simpson Strong-Tie ATS Screen Tube and AST Steel Sleeve Required)** | | | | | | | |
| ⅝ (15.9) | 1 | ** | 24 (610) | 18 (457) | 18 (457) | 1,200 (5.3) | 750 (3.3) |

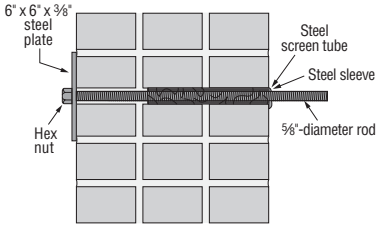
1. Threaded rods must comply with ASTM F1554 Grade 36 minimum.
2. All holes are drilled with a 1" diameter carbide-tipped drill bit with the drill set in the rotation-only mode.
3. The unreinforced brick walls must have a minimum thickness of 13 inches (three wythes of brick).
4. The allowable load is applicable only where in-place shear tests indicate minimum net mortar strength of 50 psi.
5. The allowable load for Configuration B and C anchors subjected to a combined tension and shear load is determined by assuming a straight-line relationship between allowable tension and shear.
6. The anchors installed in unreinforced brick walls are limited to resisting seismic or wind forces only.
7. Configuration A has a straight threaded rod or rebar embedded 8 inches into the wall with a 31/32" diameter by 8-inch long screen tube (part # ATS758). This configuration is designed to resist shear loads only.
8. Configuration B has a ¾" threaded rod bent and installed at a 22.5-degree angle and installed 13 inches into the wall, to within 1-inch (maximum) of the exterior wall surface. This configuration is designed to resist tension and shear loads. The pre-bent threaded rod is installed with a 31/32" diameter by 13-inch long screen tube (part # ATS7513).
9. Configuration C is designed to resist tension and shear forces. It consists of a ⅝" diameter, ASTM F1554 Grade 36 threaded rod and an 8" long steel sleeve (part # AST800) and a 31/32" diameter by 8-inch long screen tube (part # ATS758). The steel sleeve has a plastic plug in one end. A 6" by 6" by ⅜" thick ASTM A 36 steel plate is located on the back face of the wall.
10. Special inspection requirements are determined by local jurisdiction and must be confirmed by the local building official.
11. Refer to in-service temperature sensitivity chart for allowable load adjustment for temperature.




**Configuration A (Shear)**




**Configuration B (Tension and Shear)**




**Configuration C (Tension and Shear)**

### Installation Instructions for Configuration C

1. Drill hole perpendicular to the wall to a depth of 8" with a 1"-diameter carbide-tipped drill bit (rotation only mode).
2. Clean hole with oil-free compressed air and a nylon brush.
3. Fill 8" steel screen tube with mixed adhesive and insert into hole.
4. Insert steel sleeve slowly into screen tube (adhesive will displace).
5. Allow adhesive to cure (see cure schedule).
6. Drill through plastic plug in (inside) end of steel sleeve with ⅝" bit.
7. Drill completely through the wall with ⅝" carbide tipped concrete drill bit (rotation mode only).
8. Insert ⅝" rod through hole and attach metal plate and nut.

* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Masonry

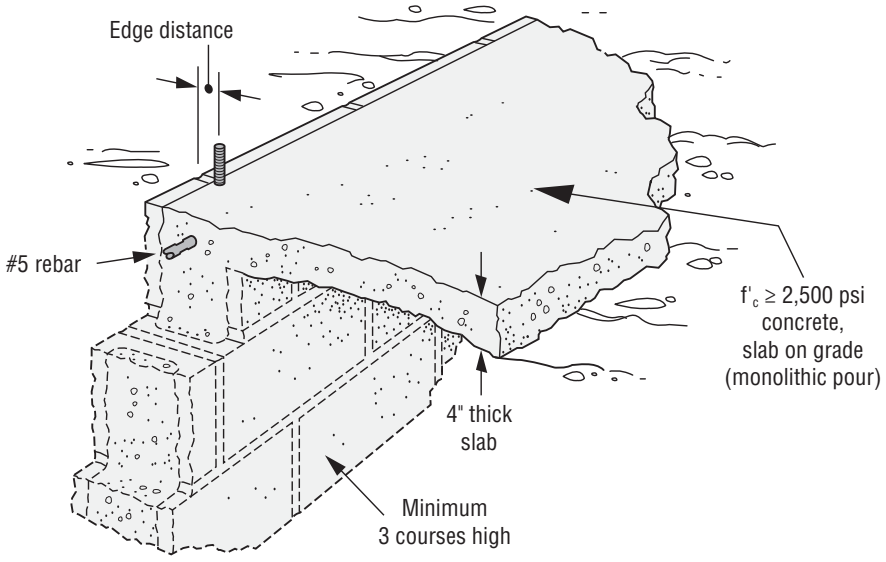


## AT Allowable Tension Loads for Threaded Rod Anchors in 8-inch Lightweight, Medium-Weight and Normal-Weight CMU Chair Blocks Filled with Normal-Weight Concrete

IBC *

| Rod Dia. in. (mm) | Drill Bit Dia. in. | Min. Embed. Depth in. (mm) | Min. Edge Dist. in. (mm) | Critical Spacing Dist. in. (mm) | 8-inch Concrete-Filled CMU Chair Block | |
|---|---|---|---|---|---|---|
| | | | | | Allowable Tension Loads Based on CMU Strength | |
| | | | | | Ultimate lb. (kN) | Allowable lb. (kN) |
| ½ (12.7) | 9/16 | **4½** (114) | **1¾** (44.5) | **18** (457) | **3,540** (15.7) | **710** (3.2) |
| | | **7** (178) | **1¾** (44.5) | **28** (711) | **6,285** (28.0) | **1,255** (5.6) |
| | | **12** (305) | **1¾** (44.5) | **48** (1,220) | **18,950** (84.3) | **3,750** (16.7) |
| ⅝ (15.9) | 11/16 | **4½** (114) | **1¾** (44.5) | **18** (457) | **4,775** (21.2) | **955** (4.2) |
| | | **7** (178) | **1¾** (44.5) | **28** (711) | **7,960** (35.4) | **1,590** (7.1) |
| | | **12** (305) | **1¾** (44.5) | **48** (1,219) | — | **3,400** (15.1) |
| | | **15** (381) | **1¾** (44.5) | **60** (1,524) | **22,425** (99.8) | **4,485** (20.0) |

1. Threaded rods must comply with ASTM F1554 Grade 36 minimum.
2. Values are for 8-inch wide concrete masonry units CMU filled with concrete with minimum compressive strength of 2,500 psi and poured monolithically with the floor slab.
3. Center #5 rebar in CMU cell and concrete slab as shown.
4. The tabulated allowable loads are based on a safety factor of 5.0.






* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Load Adjustment Factors in Normal-Weight Concrete: Edge Distance, Tension Load

### How to use these charts

1. The following tables are for reduced edge distance.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) at which the anchor is to be installed.
5. The load-adjustment factor ($f_c$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load-adjustment factor.
7. Reduction factors for multiple edges are multiplied together.
8. Adjustment factors do not apply to allowable steel strength values.
9. Adjustment factors are to be applied to allowable tension load based on bond strength values only.

### Edge Distance Tension ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Dia. | ⅜ | | | ½ | | | | ⅝ | | | ¾ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rebar | | #3 | | | #4 | | #4 | | #5 | | | #6 | |
| | E | 1¾ | 3½ | 4½ | 2⅛ | 4¼ | 6 | 7½ | 2½ | 5½ | 9⅜ | 3⅜ | 6¾ | 11¼ |
| | $c_{cr}$ | 2⅝ | 5¼ | 6¾ | 3³⁄₁₆ | 6⅜ | 9 | 11¼ | 3¾ | 7½ | 14⅛ | 5¹⁄₁₆ | 10⅛ | 16⅞ |
| | $c_{min}$ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ |
| | $f_{cmin}$ | **0.59** | **0.59** | **0.65** | **0.50** | **0.50** | **0.65** | **0.65** | **0.50** | **0.50** | **0.61** | **0.50** | **0.50** | **0.56** |
| 1¾ | | 0.59 | 0.59 | 0.65 | 0.50 | 0.50 | 0.65 | 0.65 | 0.50 | 0.50 | 0.61 | 0.50 | 0.50 | 0.56 |
| 2 | | 0.71 | 0.62 | 0.67 | 0.59 | 0.53 | 0.66 | 0.66 | 0.56 | 0.52 | 0.62 | 0.54 | 0.51 | 0.57 |
| 3 | | 1.00 | 0.74 | 0.74 | 0.93 | 0.64 | 0.71 | 0.70 | 0.81 | 0.61 | 0.65 | 0.69 | 0.57 | 0.60 |
| 4 | | | 0.85 | 0.81 | 1.00 | 0.74 | 0.76 | 0.73 | 1.00 | 0.70 | 0.68 | 0.84 | 0.63 | 0.63 |
| 5 | | | 0.97 | 0.88 | | 0.85 | 0.81 | 0.77 | | 0.78 | 0.71 | 0.99 | 0.69 | 0.65 |
| 6 | | | 1.00 | 0.95 | | 0.96 | 0.86 | 0.81 | | 0.87 | 0.74 | 1.00 | 0.75 | 0.68 |
| 7 | | | | 1.00 | | 1.00 | 0.90 | 0.84 | | 0.96 | 0.78 | | 0.81 | 0.71 |
| 8 | | | | | | | 0.95 | 0.88 | | 1.00 | 0.81 | | 0.87 | 0.74 |
| 9 | | | | | | | 1.00 | 0.92 | | | 0.84 | | 0.93 | 0.77 |
| 10 | | | | | | | | 0.95 | | | 0.87 | | 0.99 | 0.80 |
| 11 | | | | | | | | 0.99 | | | 0.90 | | 1.00 | 0.83 |
| 12 | | | | | | | | 1.00 | | | 0.93 | | | 0.86 |
| 13 | | | | | | | | | | | 0.96 | | | 0.89 |
| 14 | | | | | | | | | | | 1.00 | | | 0.92 |
| 15 | | | | | | | | | | | | | | 0.95 |
| 16 | | | | | | | | | | | | | | 0.97 |
| 17 | | | | | | | | | | | | | | 1.00 |

See notes below.

### Edge Distance Tension ($f_c$) (continued)

| Edge Dist. $c_{act}$ (in.) | Dia. | ⅞ | | | 1 | | | 1⅛ | | | 1¼ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rebar | | #7 | | | #8 | | | | #9 | | | #10 | #11 |
| | E | 3⅞ | 7¾ | 13⅛ | 4½ | 9 | 15 | 5⅛ | 10⅛ | 16⅞ | 5⅝ | 11¼ | 18¾ | 20⅝ |
| | $c_{cr}$ | 5¹³⁄₁₆ | 11⅝ | 19⅝ | 6¾ | 13½ | 22½ | 7¾ | 15¼ | 25⅜ | 8⁷⁄₁₆ | 16⅞ | 28⅛ | 31 |
| | $c_{min}$ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 2¾ | 2¾ | 2¾ | 2¾ | 2¾ | 2¾ | 2¾ |
| | $f_{cmin}$ | **0.49** | **0.49** | **0.52** | **0.44** | **0.44** | **0.39** | **0.47** | **0.47** | **0.43** | **0.47** | **0.47** | **0.43** | **0.43** |
| 1¾ | | 0.49 | 0.49 | 0.52 | 0.44 | 0.44 | 0.39 | | | | | | | |
| 2¾ | | 0.62 | 0.54 | 0.55 | 0.55 | 0.49 | 0.42 | 0.47 | 0.47 | 0.43 | 0.47 | 0.47 | 0.43 | 0.43 |
| 4 | | 0.77 | 0.61 | 0.58 | 0.69 | 0.55 | 0.46 | 0.60 | 0.52 | 0.46 | 0.59 | 0.52 | 0.46 | 0.46 |
| 6 | | 1.00 | 0.71 | 0.63 | 0.92 | 0.64 | 0.51 | 0.81 | 0.61 | 0.51 | 0.77 | 0.59 | 0.50 | 0.50 |
| 8 | | | 0.81 | 0.69 | 1.00 | 0.74 | 0.57 | 1.00 | 0.69 | 0.56 | 0.96 | 0.67 | 0.55 | 0.54 |
| 10 | | | 0.92 | 0.74 | | 0.83 | 0.63 | | 0.78 | 0.61 | 1.00 | 0.74 | 0.59 | 0.58 |
| 12 | | | 1.00 | 0.80 | | 0.93 | 0.69 | | 0.86 | 0.66 | | 0.82 | 0.64 | 0.62 |
| 14 | | | | 0.85 | | 1.00 | 0.75 | | 0.95 | 0.71 | | 0.89 | 0.68 | 0.66 |
| 16 | | | | 0.90 | | | 0.81 | | 1.00 | 0.76 | | 0.97 | 0.73 | 0.70 |
| 18 | | | | 0.96 | | | 0.87 | | | 0.81 | | 1.00 | 0.77 | 0.74 |
| 20 | | | | 1.00 | | | 0.93 | | | 0.86 | | | 0.82 | 0.78 |
| 22 | | | | | | | 0.99 | | | 0.91 | | | 0.86 | 0.82 |
| 24 | | | | | | | 1.00 | | | 0.97 | | | 0.91 | 0.86 |
| 26 | | | | | | | | | | 1.00 | | | 0.95 | 0.90 |
| 28 | | | | | | | | | | | | | 1.00 | 0.94 |
| 30 | | | | | | | | | | | | | | 0.98 |
| 32 | | | | | | | | | | | | | | 1.00 |

1. E = Embedment depth (inches).
2. $c_{act}$ = actual edge distance at which anchor is installed (inches).
3. $c_{cr}$ = critical edge distance for 100% load (inches).
4. $c_{min}$ = minimum edge distance for reduced load (inches).
5. $f_c$ = adjustment factor for allowable load at actual edge distance.
6. $f_{ccr}$ = adjustment factor for allowable load at critical edge distance. $f_{ccr}$ is always = 1.00.
7. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
8. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Load Adjustment Factors in Normal-Weight Concrete: Edge Distance, Shear Load

### How to use these charts

1. The following tables are for reduced edge distance.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) at which the anchor is to be installed.
5. The load-adjustment factor ($f_c$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load-adjustment factor.
7. Reduction factors for multiple edges are multiplied together.
8. Adjustment factors do not apply to allowable steel strength values.
9. Adjustment factors are to be applied to allowable shear load based on concrete edge distance values only.

### Edge Distance Shear ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Dia. | ⅜ | | | | | ½ | | | | | | ⅝ | | | | | ¾ | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rebar | | | | #3 | | | | | #4 | | | | | | #5 | | | | | | #6 | |
| | E | 1¾ | 3½ | 4½ | 3½ | 4½ | 2⅛ | 4¼ | 6 | 4¼ | 7½ | 2½ | 5½ | 9⅜ | 5½ | 9⅜ | 3⅜ | 6¾ | 11¼ | 6¾ | 11¼ |
| | $c_{cr}$ | 5¼ | 5¼ | 5¼ | 6 | 6 | 6⅜ | 6⅜ | 6⅜ | 8 | 8 | 7½ | 7½ | 7½ | 10 | 10 | 10⅛ | 10⅛ | 10⅛ | 12 | 12 |
| | $c_{min}$ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ |
| | $f_{cmin}$ | **0.40** | **0.35** | **0.39** | **0.19** | **0.39** | **0.18** | **0.15** | **0.25** | **0.16** | **0.25** | **0.12** | **0.11** | **0.14** | **0.10** | **0.14** | **0.10** | **0.11** | **0.14** | **0.10** | **0.14** |
| 1¾ | | 0.40 | 0.35 | 0.39 | 0.19 | 0.39 | 0.18 | 0.15 | 0.25 | 0.16 | 0.25 | 0.12 | 0.11 | 0.14 | 0.10 | 0.14 | 0.10 | 0.11 | 0.14 | 0.10 | 0.14 |
| 2¾ | | 0.57 | 0.54 | 0.56 | 0.38 | 0.53 | 0.36 | 0.33 | 0.41 | 0.29 | 0.37 | 0.27 | 0.26 | 0.29 | 0.21 | 0.24 | 0.21 | 0.22 | 0.24 | 0.19 | 0.22 |
| 3 | | 0.61 | 0.58 | 0.61 | 0.43 | 0.57 | 0.40 | 0.38 | 0.45 | 0.33 | 0.40 | 0.31 | 0.30 | 0.33 | 0.24 | 0.27 | 0.23 | 0.24 | 0.27 | 0.21 | 0.24 |
| 3½ | | 0.70 | 0.68 | 0.70 | 0.52 | 0.64 | 0.49 | 0.47 | 0.53 | 0.40 | 0.46 | 0.39 | 0.38 | 0.40 | 0.29 | 0.32 | 0.29 | 0.30 | 0.32 | 0.25 | 0.29 |
| 4 | | 0.79 | 0.77 | 0.78 | 0.62 | 0.71 | 0.58 | 0.56 | 0.61 | 0.46 | 0.52 | 0.46 | 0.46 | 0.48 | 0.35 | 0.37 | 0.34 | 0.35 | 0.37 | 0.30 | 0.33 |
| 4½ | | 0.87 | 0.86 | 0.87 | 0.71 | 0.78 | 0.67 | 0.66 | 0.70 | 0.53 | 0.58 | 0.54 | 0.54 | 0.55 | 0.40 | 0.43 | 0.40 | 0.40 | 0.42 | 0.34 | 0.37 |
| 5 | | 0.96 | 0.95 | 0.96 | 0.81 | 0.86 | 0.76 | 0.75 | 0.78 | 0.60 | 0.64 | 0.62 | 0.61 | 0.63 | 0.45 | 0.48 | 0.45 | 0.46 | 0.47 | 0.39 | 0.41 |
| 5½ | | 1.00 | 1.00 | 1.00 | 0.90 | 0.93 | 0.84 | 0.84 | 0.86 | 0.66 | 0.70 | 0.69 | 0.69 | 0.70 | 0.51 | 0.53 | 0.50 | 0.51 | 0.53 | 0.43 | 0.45 |
| 6 | | | | | 1.00 | 1.00 | 0.93 | 0.93 | 0.94 | 0.73 | 0.76 | 0.77 | 0.77 | 0.78 | 0.56 | 0.58 | 0.56 | 0.56 | 0.58 | 0.47 | 0.50 |
| 6½ | | | | | | | 1.00 | 1.00 | 1.00 | 0.80 | 0.82 | 0.85 | 0.85 | 0.85 | 0.62 | 0.64 | 0.61 | 0.61 | 0.63 | 0.52 | 0.54 |
| 7 | | | | | | | | | | 0.87 | 0.88 | 0.92 | 0.92 | 0.93 | 0.67 | 0.69 | 0.66 | 0.67 | 0.68 | 0.56 | 0.58 |
| 7½ | | | | | | | | | | 0.93 | 0.94 | 1.00 | 1.00 | 1.00 | 0.73 | 0.74 | 0.72 | 0.72 | 0.73 | 0.60 | 0.62 |
| 8 | | | | | | | | | | 1.00 | 1.00 | | | | 0.78 | 0.79 | 0.77 | 0.77 | 0.78 | 0.65 | 0.66 |
| 8½ | | | | | | | | | | | | | | | 0.84 | 0.84 | 0.83 | 0.83 | 0.83 | 0.69 | 0.71 |
| 9 | | | | | | | | | | | | | | | 0.89 | 0.90 | 0.88 | 0.88 | 0.88 | 0.74 | 0.75 |
| 9½ | | | | | | | | | | | | | | | 0.95 | 0.95 | 0.93 | 0.93 | 0.94 | 0.78 | 0.79 |
| 10 | | | | | | | | | | | | | | | 1.00 | 1.00 | 0.99 | 0.99 | 0.99 | 0.82 | 0.83 |
| 10½ | | | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 | 0.87 | 0.87 |
| 11 | | | | | | | | | | | | | | | | | | | | 0.91 | 0.92 |
| 11½ | | | | | | | | | | | | | | | | | | | | 0.96 | 0.96 |
| 12 | | | | | | | | | | | | | | | | | | | | 1.00 | 1.00 |

See notes below.

### Edge Distance Shear ($f_c$) (continued)

| Edge Dist. $c_{act}$ (in.) | Dia. | ⅞ | | | | | 1 | | | | | 1⅛ | | | 1¼ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rebar | | | | #7 | | | | | #8 | | | | | | | |
| | E | 3⅞ | 7¾ | 13⅛ | 7¾ | 13⅛ | 4½ | 9 | 15 | 9 | 15 | 5⅛ | 10⅛ | 16⅞ | 5⅝ | 11¼ | 18¾ |
| | $c_{cr}$ | 11⅝ | 11⅝ | 11⅝ | 14 | 14 | 13½ | 13½ | 13½ | 16 | 16 | 15¼ | 15¼ | 15¼ | 16⅞ | 16⅞ | 16⅞ |
| | $c_{min}$ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 2¾ | 2¾ | 2¾ | 2¾ | 2¾ | 2¾ |
| | $f_{cmin}$ | **0.09** | **0.08** | **0.09** | **0.09** | **0.09** | **0.08** | **0.08** | **0.09** | **0.08** | **0.09** | **0.14** | **0.12** | **0.12** | **0.14** | **0.12** | **0.12** |
| 1¾ | | 0.09 | 0.08 | 0.09 | 0.09 | 0.09 | 0.08 | 0.08 | 0.09 | 0.08 | 0.09 | | | | | | |
| 2¾ | | 0.18 | 0.17 | 0.18 | 0.16 | 0.16 | 0.16 | 0.16 | 0.17 | 0.14 | 0.15 | 0.14 | 0.12 | 0.12 | 0.14 | 0.12 | 0.12 |
| 3 | | 0.21 | 0.20 | 0.21 | 0.18 | 0.18 | 0.18 | 0.18 | 0.19 | 0.16 | 0.17 | 0.16 | 0.14 | 0.14 | 0.16 | 0.14 | 0.14 |
| 4 | | 0.30 | 0.29 | 0.30 | 0.26 | 0.26 | 0.26 | 0.26 | 0.26 | 0.23 | 0.23 | 0.23 | 0.21 | 0.21 | 0.22 | 0.20 | 0.20 |
| 5 | | 0.39 | 0.38 | 0.39 | 0.33 | 0.33 | 0.33 | 0.33 | 0.34 | 0.29 | 0.30 | 0.29 | 0.28 | 0.28 | 0.28 | 0.26 | 0.26 |
| 6 | | 0.48 | 0.48 | 0.48 | 0.41 | 0.41 | 0.41 | 0.41 | 0.42 | 0.35 | 0.36 | 0.36 | 0.35 | 0.35 | 0.34 | 0.32 | 0.32 |
| 7 | | 0.57 | 0.57 | 0.57 | 0.48 | 0.48 | 0.49 | 0.49 | 0.50 | 0.42 | 0.43 | 0.43 | 0.42 | 0.42 | 0.40 | 0.38 | 0.38 |
| 8 | | 0.67 | 0.66 | 0.67 | 0.55 | 0.55 | 0.57 | 0.57 | 0.57 | 0.48 | 0.49 | 0.50 | 0.49 | 0.49 | 0.46 | 0.45 | 0.45 |
| 9 | | 0.76 | 0.76 | 0.76 | 0.63 | 0.63 | 0.65 | 0.65 | 0.65 | 0.55 | 0.55 | 0.57 | 0.56 | 0.56 | 0.52 | 0.51 | 0.51 |
| 10 | | 0.85 | 0.85 | 0.85 | 0.70 | 0.70 | 0.73 | 0.73 | 0.73 | 0.61 | 0.62 | 0.64 | 0.63 | 0.63 | 0.58 | 0.57 | 0.57 |
| 11 | | 0.94 | 0.94 | 0.94 | 0.78 | 0.78 | 0.80 | 0.80 | 0.81 | 0.68 | 0.68 | 0.71 | 0.70 | 0.70 | 0.64 | 0.63 | 0.63 |
| 12 | | 1.00 | 1.00 | 1.00 | 0.85 | 0.85 | 0.88 | 0.88 | 0.88 | 0.74 | 0.74 | 0.78 | 0.77 | 0.77 | 0.70 | 0.70 | 0.70 |
| 13 | | | | | 0.93 | 0.93 | 0.96 | 0.96 | 0.96 | 0.81 | 0.81 | 0.85 | 0.84 | 0.84 | 0.76 | 0.76 | 0.76 |
| 14 | | | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.87 | 0.87 | 0.91 | 0.91 | 0.91 | 0.82 | 0.82 | 0.82 |
| 15 | | | | | | | | | | 0.94 | 0.94 | 0.98 | 0.98 | 0.98 | 0.89 | 0.88 | 0.88 |
| 16 | | | | | | | | | | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 0.95 | 0.95 | 0.95 |
| 17 | | | | | | | | | | | | | | | 1.00 | 1.00 | 1.00 |

1. E = Embedment depth (inches).
2. $c_{act}$ = actual edge distance at which anchor is installed (inches).
3. $c_{cr}$ = critical edge distance for 100% load (inches).
4. $c_{min}$ = minimum edge distance for reduced load (inches).

* See p. 13 for an explanation of the load table icons.

5. $f_c$ = adjustment factor for allowable load at actual edge distance. $f_{ccr}$ = adjustment factor for allowable load at critical edge distance. $f_{ccr}$ is always = 1.00.
6. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
7. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

# **AT** Design Information — Concrete



## AT Allowable Load Adjustment Factors in Normal-Weight Concrete: Spacing, Tension Load

### How to use these charts

1. The following tables are for reduced spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the spacing ($s_{act}$) at which the anchor is to be installed.
5. The load-adjustment factor ($f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load-adjustment factor.
7. Reduction factors for multiple spacings are multiplied together.
8. Adjustment factors do not apply to allowable steel strength values
9. Adjustment factors are to be applied to allowable tension load based on bond strength values only.

### Spacing Tension ($f_s$)

| $s_{act}$ (in.) | Dia. | ⅜ | | | ½ | | | | ⅝ | | | ¾ | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rebar | | #3 | | | #4 | | #4 | | #5 | | | #6 | |
| | E | 1¾ | 3½ | 4½ | 2⅛ | 4¼ | 6 | 7½ | 2½ | 5½ | 9⅜ | 3⅜ | 6¾ | 11¼ |
| | $s_{cr}$ | 7 | 6⅛ | 18 | 8½ | 7½ | 24 | 30 | 10 | 9⅝ | 37½ | 13½ | 11⅞ | 45 |
| | $s_{min}$ | ⅞ | 1¾ | 2¼ | 1⅛ | 2⅛ | 3 | 3¾ | 1¼ | 2¾ | 4¾ | 1¾ | 3⅜ | 5⅝ |
| | $f_{smin}$ | 0.57 | 0.58 | 0.80 | 0.57 | 0.58 | 0.80 | 0.80 | 0.57 | 0.58 | 0.80 | 0.57 | 0.58 | 0.80 |
| ⅞ | | 0.57 | | | | | | | | | | | | |
| 1 | | 0.58 | | | | | | | | | | | | |
| 1½ | | 0.61 | | | 0.59 | | | | 0.58 | | | | | |
| 2 | | 0.65 | 0.60 | | 0.62 | | | | 0.61 | | | 0.58 | | |
| 2½ | | 0.68 | 0.64 | 0.80 | 0.65 | 0.61 | | | 0.63 | | | 0.60 | | |
| 3 | | 0.72 | 0.68 | 0.81 | 0.67 | 0.64 | 0.80 | | 0.66 | 0.59 | | 0.61 | | |
| 3½ | | 0.75 | 0.72 | 0.82 | 0.70 | 0.68 | 0.80 | | 0.68 | 0.62 | | 0.63 | 0.59 | |
| 4 | | 0.79 | 0.76 | 0.82 | 0.73 | 0.71 | 0.81 | 0.80 | 0.71 | 0.65 | | 0.65 | 0.61 | |
| 5 | | 0.86 | 0.84 | 0.83 | 0.78 | 0.79 | 0.82 | 0.81 | 0.75 | 0.71 | 0.80 | 0.68 | 0.66 | |
| 6 | | 0.93 | 0.92 | 0.85 | 0.84 | 0.86 | 0.83 | 0.82 | 0.80 | 0.77 | 0.81 | 0.72 | 0.71 | 0.80 |
| 7 | | 1.00 | 1.00 | 0.86 | 0.89 | 0.93 | 0.84 | 0.82 | 0.85 | 0.83 | 0.81 | 0.75 | 0.76 | 0.81 |
| 8 | | | | 0.87 | 0.95 | 1.00 | 0.85 | 0.83 | 0.90 | 0.88 | 0.82 | 0.79 | 0.81 | 0.81 |
| 9 | | | | 0.89 | 1.00 | | 0.86 | 0.84 | 0.95 | 0.94 | 0.82 | 0.82 | 0.85 | 0.82 |
| 10 | | | | 0.90 | | | 0.87 | 0.84 | 1.00 | 1.00 | 0.83 | 0.86 | 0.90 | 0.82 |
| 12 | | | | 0.92 | | | 0.89 | 0.86 | | | 0.84 | 0.93 | 1.00 | 0.83 |
| 14 | | | | 0.95 | | | 0.90 | 0.87 | | | 0.85 | 1.00 | | 0.84 |
| 16 | | | | 0.97 | | | 0.92 | 0.89 | | | 0.86 | | | 0.85 |
| 18 | | | | 1.00 | | | 0.94 | 0.90 | | | 0.88 | | | 0.86 |
| 20 | | | | | | | 0.96 | 0.92 | | | 0.89 | | | 0.87 |
| 24 | | | | | | | 1.00 | 0.94 | | | 0.91 | | | 0.89 |
| 28 | | | | | | | | 0.97 | | | 0.93 | | | 0.91 |
| 32 | | | | | | | | 1.00 | | | 0.95 | | | 0.93 |
| 36 | | | | | | | | | | | 0.98 | | | 0.95 |
| 40 | | | | | | | | | | | 1.00 | | | 0.97 |
| 45 | | | | | | | | | | | | | | 1.00 |

1. E = Embedment depth (inches).
2. $S_{act}$ = actual spacing distance at which anchors are installed (inches).
3. $S_{cr}$ = critical spacing distance for 100% load (inches).
4. $S_{min}$ = minimum spacing distance for reduced load (inches).
5. $f_s$ = adjustment factor for allowable load at actual spacing distance.
6. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
7. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
8. $f_s = f_{smin} + [(1 - f_{smin}) (s_{act} - s_{min}) / (s_{cr} - s_{min})]$.

⅞"–1 ¼" diameters on next page →



* See p. 13 for an explanation of the load table icons.

## Spacing Tension ($f_s$) (continued)

| $s_{act}$ (in.) | Dia. | ⅞ | | | 1 | | | 1⅛ | | | 1¼ | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rebar | | #7 | | | #8 | | | | #9 | | | #10 | #11 |
| | E | 3⅞ | 7¾ | 13⅛ | 4½ | 9 | 15 | 5⅛ | 10⅛ | 16⅞ | 5⅝ | 11¼ | 18¾ | 20⅝ |
| | $s_{cr}$ | 15½ | 13⅝ | 52½ | 18 | 15¾ | 60 | 20½ | 17¾ | 67½ | 22½ | 19¾ | 75 | 82½ |
| | $s_{min}$ | 2 | 3⅞ | 6⅝ | 2¼ | 4½ | 7½ | 2⅝ | 5⅛ | 8½ | 2⅞ | 5⅝ | 9⅜ | 10⅜ |
| | $f_{smin}$ | 0.57 | 0.58 | 0.80 | 0.57 | 0.58 | 0.80 | 0.57 | 0.58 | 0.80 | 0.57 | 0.58 | 0.80 | 0.80 |
| 2 | | 0.57 | | | | | | | | | | | | |
| 3 | | 0.60 | | | 0.59 | | | 0.58 | | | 0.57 | | | |
| 4 | | 0.63 | 0.59 | | 0.62 | | | 0.60 | | | 0.59 | | | |
| 5 | | 0.67 | 0.63 | | 0.65 | 0.60 | | 0.63 | | | 0.62 | | | |
| 6 | | 0.70 | 0.67 | | 0.67 | 0.64 | | 0.65 | 0.61 | | 0.64 | 0.59 | | |
| 8 | | 0.76 | 0.76 | 0.81 | 0.73 | 0.71 | 0.80 | 0.70 | 0.68 | | 0.68 | 0.65 | | |
| 10 | | 0.82 | 0.84 | 0.81 | 0.78 | 0.79 | 0.81 | 0.75 | 0.74 | 0.81 | 0.73 | 0.71 | 0.80 | |
| 12 | | 0.89 | 0.93 | 0.82 | 0.84 | 0.86 | 0.82 | 0.80 | 0.81 | 0.81 | 0.77 | 0.77 | 0.81 | 0.80 |
| 14 | | 0.95 | 1.00 | 0.83 | 0.89 | 0.93 | 0.82 | 0.84 | 0.88 | 0.82 | 0.81 | 0.83 | 0.81 | 0.81 |
| 16 | | 1.00 | | 0.84 | 0.95 | 1.00 | 0.83 | 0.89 | 0.94 | 0.83 | 0.86 | 0.89 | 0.82 | 0.82 |
| 20 | | | | 0.86 | 1.00 | | 0.85 | 0.99 | 1.00 | 0.84 | 0.95 | 1.00 | 0.83 | 0.83 |
| 24 | | | | 0.88 | | | 0.86 | 1.00 | | 0.85 | 1.00 | | 0.84 | 0.84 |
| 28 | | | | 0.89 | | | 0.88 | | | 0.87 | | | 0.86 | 0.85 |
| 32 | | | | 0.91 | | | 0.89 | | | 0.88 | | | 0.87 | 0.86 |
| 36 | | | | 0.93 | | | 0.91 | | | 0.89 | | | 0.88 | 0.87 |
| 40 | | | | 0.95 | | | 0.92 | | | 0.91 | | | 0.89 | 0.88 |
| 50 | | | | 0.99 | | | 0.96 | | | 0.94 | | | 0.92 | 0.91 |
| 60 | | | | 1.00 | | | 1.00 | | | 0.97 | | | 0.95 | 0.94 |
| 70 | | | | | | | | | | 1.00 | | | 0.98 | 0.97 |
| 80 | | | | | | | | | | | | | 1.00 | 0.99 |
| 83 | | | | | | | | | | | | | | 1.00 |

See notes on previous page.

## AT Allowable Load Adjustment Factors in Normal-Weight Concrete: Spacing, Shear Load

### How to use these charts

1. The following tables are for reduced spacing.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the spacing ($s_{act}$) at which the anchor is to be installed.
5. The load-adjustment factor ($f_s$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load-adjustment factor.
7. Reduction factors for multiple spacings are multiplied together.
8. Adjustment factors do not apply to allowable steel strength values.
9. Adjustment factors are to be applied to allowable shear load based on concrete edge distance values only.

## Spacing Shear ($f_s$)

| $s_{act}$ (in.) | Dia. | ⅜ | | ½ | | ⅝ | | ¾ | | ⅞ | | 1 | | 1⅛ | | 1¼ | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Rebar | | #3 | | #4 | | #5 | | #6 | | #7 | | #8 | | | | |
| | E | 1¾ | 3½ | 2⅛ | 4¼ | 2½ | 5½ | 3⅜ | 6¾ | 3⅞ | 7¾ | 4½ | 9 | 5⅛ | 10⅛ | 5⅝ | 11¼ |
| | $s_{cr}$ | 2⅝ | 5¼ | 3¼ | 6⅜ | 3¾ | 8¼ | 5⅛ | 10⅛ | 5⅞ | 11⅝ | 6¾ | 13½ | 7¾ | 15¼ | 8½ | 16⅞ |
| | $s_{min}$ | ⅞ | 1¾ | 1⅛ | 2⅛ | 1¼ | 2¾ | 1¾ | 3⅜ | 2 | 3⅞ | 2¼ | 4½ | 2⅝ | 5⅛ | 2⅞ | 5⅝ |
| | $f_{smin}$ | 0.90 | 0.83 | 0.90 | 0.83 | 0.90 | 0.83 | 0.90 | 0.83 | 0.90 | 0.83 | 0.90 | 0.83 | 0.90 | 0.83 | 0.90 | 0.83 |
| ⅞ | | 0.90 | | | | | | | | | | | | | | | |
| 1 | | 0.91 | | | | | | | | | | | | | | | |
| 1½ | | 0.94 | | 0.92 | | 0.91 | | | | | | | | | | | |
| 2 | | 0.96 | 0.84 | 0.94 | | 0.93 | | 0.91 | | 0.90 | | | | | | | |
| 2½ | | 0.99 | 0.87 | 0.96 | 0.85 | 0.95 | | 0.92 | | 0.91 | | 0.91 | | | | | |
| 3 | | 1.00 | 0.89 | 0.99 | 0.87 | 0.97 | 0.84 | 0.94 | | 0.93 | | 0.92 | | 0.91 | | 0.90 | |
| 3½ | | | 0.92 | 1.00 | 0.89 | 0.99 | 0.85 | 0.95 | 0.83 | 0.94 | | 0.93 | | 0.92 | | 0.91 | |
| 4 | | | 0.94 | | 0.91 | 1.00 | 0.87 | 0.97 | 0.85 | 0.95 | 0.83 | 0.94 | | 0.93 | | 0.92 | |
| 5 | | | 0.99 | | 0.95 | | 0.90 | 1.00 | 0.87 | 0.98 | 0.85 | 0.96 | 0.84 | 0.95 | | 0.94 | |
| 6 | | | 1.00 | | 0.99 | | 0.93 | | 0.90 | 1.00 | 0.88 | 0.98 | 0.86 | 0.97 | 0.84 | 0.96 | 0.84 |
| 7 | | | | | 1.00 | | 0.96 | | 0.92 | | 0.90 | 1.00 | 0.88 | 0.99 | 0.86 | 0.97 | 0.85 |
| 8 | | | | | | | 0.99 | | 0.95 | | 0.92 | | 0.90 | 1.00 | 0.88 | 0.99 | 0.87 |
| 9 | | | | | | | 1.00 | | 0.97 | | 0.94 | | 0.92 | | 0.90 | 1.00 | 0.88 |
| 10 | | | | | | | | | 1.00 | | 0.96 | | 0.93 | | 0.91 | | 0.90 |
| 12 | | | | | | | | | | | 1.00 | | 0.97 | | 0.95 | | 0.93 |
| 14 | | | | | | | | | | | | | 1.00 | | 0.98 | | 0.96 |
| 16 | | | | | | | | | | | | | | | 1.00 | | 0.99 |
| 17 | | | | | | | | | | | | | | | | | 1.00 |

1. E = Embedment depth (inches).
2. $s_{act}$ = actual spacing distance at which anchors are installed (inches).
3. $s_{cr}$ = critical spacing distance for 100% load (inches).
4. $s_{min}$ = minimum spacing distance for reduced load (inches).
5. $f_s$ = adjustment factor for allowable load at actual spacing distance.
6. $f_{scr}$ = adjustment factor for allowable load at critical spacing distance. $f_{scr}$ is always = 1.00.
7. $f_{smin}$ = adjustment factor for allowable load at minimum spacing distance.
8. $f_s = f_{smin} + [(1 - f_{smin})\ (s_{act} - s_{min})\ /\ (s_{cr} - s_{min})]$.

* See p. 13 for an explanation of the load table icons.

# **AT** Design Information — Concrete



## AT Allowable Load Adjustment Factors in Sand-Lightweight Concrete: Edge Distance, Tension and Shear Loads

### How to use these charts

1. The following tables are for reduced edge distance only.
2. Locate the anchor size to be used for either a tension and/or shear load application.
3. Locate the embedment (E) at which the anchor is to be installed.
4. Locate the edge distance ($c_{act}$) at which the anchor is to be installed.
5. The load-adjustment factor ($f_c$) is the intersection of the row and column.
6. Multiply the allowable load by the applicable load-adjustment factor.
7. Reduction factors for multiple edges are multiplied together.
8. Adjustment factors do not apply to allowable steel strength values.
9. Adjustment factors are to be applied to allowable tension load based on bond strength values or allowable shear load based on concrete edge distance values only.

### Edge Distance Tension ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Dia. | ⅜ | | ½ | | ⅝ | |
|---|---|---|---|---|---|---|---|
| | E | 1¾ | 3½ | 2⅛ | 4¼ | 2½ | 5 |
| | $c_{cr}$ | 2⅝ | 5¼ | 3⅛ | 6⅜ | 3¾ | 7½ |
| | $c_{min}$ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ |
| | $f_{cmin}$ | **0.59** | **0.59** | **0.50** | **0.50** | **0.50** | **0.50** |
| 1¾ | | 0.59 | 0.59 | 0.50 | 0.50 | 0.50 | 0.50 |
| 2 | | 0.71 | 0.62 | 0.59 | 0.53 | 0.56 | 0.52 |
| 2¼ | | 0.82 | 0.65 | 0.68 | 0.55 | 0.63 | 0.54 |
| 2½ | | 0.94 | 0.68 | 0.77 | 0.58 | 0.69 | 0.57 |
| 2¾ | | 1.00 | 0.71 | 0.86 | 0.61 | 0.75 | 0.59 |
| 3 | | | 0.74 | 0.95 | 0.64 | 0.81 | 0.61 |
| 3¼ | | | 0.77 | 1.00 | 0.66 | 0.88 | 0.63 |
| 3½ | | | 0.80 | | 0.69 | 0.94 | 0.65 |
| 3¾ | | | 0.82 | | 0.72 | 1.00 | 0.67 |
| 4 | | | 0.85 | | 0.74 | | 0.70 |
| 4¼ | | | 0.88 | | 0.77 | | 0.72 |
| 4½ | | | 0.91 | | 0.80 | | 0.74 |
| 4¾ | | | 0.94 | | 0.82 | | 0.76 |
| 5 | | | 0.97 | | 0.85 | | 0.78 |
| 5¼ | | | 1.00 | | 0.88 | | 0.80 |
| 5½ | | | | | 0.91 | | 0.83 |
| 5¾ | | | | | 0.93 | | 0.85 |
| 6 | | | | | 0.96 | | 0.87 |
| 6¼ | | | | | 0.99 | | 0.89 |
| 6½ | | | | | 1.00 | | 0.91 |
| 6¾ | | | | | | | 0.93 |
| 7 | | | | | | | 0.96 |
| 7¼ | | | | | | | 0.98 |
| 7½ | | | | | | | 1.00 |

### Edge Distance Shear ($f_c$)

| Edge Dist. $c_{act}$ (in.) | Dia. | ⅜ | | ½ | | ⅝ | |
|---|---|---|---|---|---|---|---|
| | E | 1¾ | 3½ | 2⅛ | 4¼ | 2½ | 5 |
| | $c_{cr}$ | 2⅝ | 5¼ | 3⅛ | 6⅜ | 3¾ | 7½ |
| | $c_{min}$ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ | 1¾ |
| | $f_{cmin}$ | **0.40** | **0.35** | **0.18** | **0.15** | **0.12** | **0.11** |
| 1¾ | | 0.40 | 0.35 | 0.18 | 0.15 | 0.12 | 0.11 |
| 2 | | 0.57 | 0.40 | 0.33 | 0.20 | 0.23 | 0.15 |
| 2¼ | | 0.74 | 0.44 | 0.48 | 0.24 | 0.34 | 0.19 |
| 2½ | | 0.91 | 0.49 | 0.63 | 0.29 | 0.45 | 0.23 |
| 2¾ | | 1.00 | 0.54 | 0.78 | 0.33 | 0.56 | 0.26 |
| 3 | | | 0.58 | 0.93 | 0.38 | 0.67 | 0.30 |
| 3¼ | | | 0.63 | 1.00 | 0.43 | 0.78 | 0.34 |
| 3½ | | | 0.68 | | 0.47 | 0.89 | 0.38 |
| 3¾ | | | 0.72 | | 0.52 | 1.00 | 0.42 |
| 4 | | | 0.77 | | 0.56 | | 0.46 |
| 4¼ | | | 0.81 | | 0.61 | | 0.50 |
| 4½ | | | 0.86 | | 0.66 | | 0.54 |
| 4¾ | | | 0.91 | | 0.70 | | 0.57 |
| 5 | | | 0.95 | | 0.75 | | 0.61 |
| 5¼ | | | 1.00 | | 0.79 | | 0.65 |
| 5½ | | | | | 0.84 | | 0.69 |
| 5¾ | | | | | 0.89 | | 0.73 |
| 6 | | | | | 0.93 | | 0.77 |
| 6¼ | | | | | 0.98 | | 0.81 |
| 6½ | | | | | 1.00 | | 0.85 |
| 6¾ | | | | | | | 0.88 |
| 7 | | | | | | | 0.92 |
| 7¼ | | | | | | | 0.96 |
| 7½ | | | | | | | 1.00 |

1. E = Embedment depth (inches).
2. $c_{act}$ = actual edge distance at which anchor is installed (inches).
3. $c_{cr}$ = critical edge distance for 100% load (inches).
4. $c_{min}$ = minimum edge distance for reduced load (inches).
5. $f_c$ = adjustment factor for allowable load at actual edge distance.
6. $f_{ccr}$ = adjustment factor for allowable load at critical edge distance. fccr is always = 1.00.
7. $f_{cmin}$ = adjustment factor for allowable load at minimum edge distance.
8. $f_c = f_{cmin} + [(1 - f_{cmin}) (c_{act} - c_{min}) / (c_{cr} - c_{min})]$.

* See p. 13 for an explanation of the load table icons.