

CODE

17.5.1.2 Nominal strength for an anchor or anchor groups shall be based on design models that result in predictions of strength in substantial agreement with results of comprehensive tests. The materials used in the tests shall be compatible with the materials used in the structure. The nominal strength shall be based on the 5 percent fractile of the basic individual anchor strength. For nominal strengths related to concrete strength, modifications for size effects, number of anchors, effects of close spacing of anchors, proximity to edges, depth of the concrete member, eccentric loadings of anchor groups, and influence of cracking shall be taken into account. Limits on edge distance and anchor spacing in the design models shall be consistent with the tests that verified the model. Strength of anchors shall be based on design models that satisfy 17.5.1.2 for the following:

- (a) Steel strength of anchor in tension
- (b) Concrete breakout strength of anchor in tension
- (c) Pullout strength of a single cast-in anchor and single post-installed expansion, screw, and undercut anchor in tension
- (d) Concrete side-face blowout strength of headed anchor in tension
- (e) Bond strength of adhesive anchor in tension
- (f) Steel strength of anchor in shear
- (g) Concrete breakout strength of anchor in shear
- (h) Concrete pryout strength of anchor in shear

COMMENTARY

R17.5.1.2 This section provides requirements for establishing the strength of anchors in concrete. The various types of steel and concrete failure modes for anchors are shown in Fig. R17.5.1.2(a) and R17.5.1.2(b). Comprehensive discussions of anchor failure modes are included in [CEB \(1997\)](#), [Fuchs et al. \(1995\)](#), [Eligehausen and Balogh \(1995\)](#), and [Cook et al. \(1998\)](#). Tension failure modes related to concrete include concrete breakout failure (applicable to all anchor types), pullout failure (applicable to cast-in anchors, post-installed expansion, screw, and undercut anchors), side-face blowout failure (applicable to headed anchors), and bond failure (applicable to adhesive anchors). Shear failure modes related to concrete include concrete breakout failure and concrete pryout (applicable to all anchor types). These failure modes are described in the deemed-to-comply provisions of 17.6.2, 17.6.3, 17.6.4, 17.6.5, 17.7.2, and 17.7.3.

Any model that complies with the requirements of 17.5.1.2 and 17.5.2.3 can be used to establish the concrete-related strengths. Additionally, anchor tensile and shear strengths are limited by the minimum spacings and edge distances of 17.9 to preclude splitting. The design of post-installed anchors recognizes that the strength of anchors is sensitive to appropriate installation; installation requirements are included in [Chapter 26](#). Some post-installed anchors are less sensitive to installation errors and tolerances. This is reflected in various ϕ -factors given in 17.5.3 and based on the assessment criteria of [ACI 355.2](#) and [ACI 355.4M](#).

The breakout strength of an unreinforced connection can be taken as an indication of the load at which significant cracking will occur. Such cracking can represent a serviceability problem if not controlled (refer to R17.7.2.1).