CHAPTER 17—ANCHORING TO CONCRETE

CODE

17.1—Scope

17.1.1 This chapter shall apply to the design of anchors in concrete used to transmit loads by means of tension, shear, or a combination of tension and shear between: (a) connected structural elements; or (b) safety-related attachments and structural elements. Safety levels specified are intended for in-service conditions rather than for short-term handling and construction conditions.

17.1.2 Provisions of this chapter shall apply to the following anchor types (a) through (g):

(a) Headed studs and headed bolts having a geometry that has been demonstrated to result in a pullout strength in uncracked concrete equal to or exceeding $\mathbf{1.4}N_p$, where N_p is given in Eq. (17.6.3.2.2a).
(b) Hooked bolts having a geometry that has been demonstrated to result in a pullout strength without the benefit of friction in uncracked concrete equal to or exceeding $\mathbf{1.4}N_p$, where N_p is given in Eq. (17.6.3.2.2b)
(c) Post-installed expansion (torque-controlled and displacement-controlled) anchors that meet the assessment criteria of ACI 355.2.
(d) Post-installed undercut anchors that meet the assessment criteria of ACI 355.2.
(e) Post-installed adhesive anchors that meet the assessment criteria of ACI 355.4M.
(f) Post-installed screw anchors that meet the assessment criteria of ACI 355.2.
(g) Attachments with shear lugs.

17.1.3 The removal and resetting of post-installed mechanical anchors is prohibited.

17.1.4 This chapter does not apply for load applications that are predominantly high-cycle fatigue or due to impact.

COMMENTARY

R17.1—Scope

R17.1.1 This chapter is restricted in scope to structural anchors that transmit loads related to strength, stability, or life safety. Two types of applications are envisioned. The first is connections between structural elements where the failure of an anchor or anchor group could result in loss of equilibrium or stability of any portion of the structure. The second is where safety-related attachments that are not part of the structure (such as sprinkler systems, heavy suspended pipes, or barrier rails) are attached to structural elements. The levels of safety defined by the factored load combinations and ϕ-factors are appropriate for structural applications. Other standards may require more stringent safety levels during temporary handling.

The format for this chapter was revised in 2019 to be more consistent with the other chapters of this Code.

R17.1.2 Typical cast-in headed studs and headed bolts with head geometries consistent with ASME B1.1, B18.2.1, and B18.2.6 have been tested and proven to behave predictably; therefore, calculated pullout strengths are acceptable.

Post-installed expansion, screw, and undercut anchors do not have predictable pullout strengths, and therefore qualification tests to establish the pullout strengths according to ACI 355.2 are required. For post-installed expansion, screw, and undercut anchors to be used in conjunction with the requirements of this chapter, the results of the ACI 355.2 tests have to indicate that pullout failures exhibit acceptable load-displacement characteristics or that pullout failures are precluded by another failure mode.

For adhesive anchors, the characteristic bond stress and suitability for structural applications are established by testing in accordance with ACI 355.4M. Adhesive anchors are particularly sensitive to a number of factors including installation direction and load type. If adhesive anchors are used to resist sustained tension, the provisions include testing requirements for horizontal or upwardly inclined installations in 17.2.3, design requirements in 17.5.2.2, certification requirements in 26.7, and inspection requirements in 26.13. Adhesive anchors qualified in accordance with ACI 355.4M are tested in concrete with compressive strengths within two ranges: 17 to 28 MPa and 45 to 59 MPa. Bond strength is, in general, not highly sensitive to concrete compressive strength.

R17.1.3 ACI 355.2 prohibits reuse of post-installed mechanical anchors.

R17.1.4 The exclusion of load applications producing high-cycle fatigue or extremely short duration impact (such as blast or shock wave) from the scope of this chapter is not meant to exclude earthquake loads. Section 17.10 presents additional requirements for design when earthquake loads are included.