CODE

properties of the anchor material and the physical dimensions of the anchors.

17.6.1.2 Nominal steel strength of an anchor in tension, $\boldsymbol{N_{sa}}$, shall be calculated by:

$$N_{sa} = A_{se,N} f_{uta} \tag{17.6.1.2}$$

where $\boldsymbol{A_{se,N}}$ is the effective cross-sectional area of an anchor in tension, mm^2, and $\boldsymbol{f_{uta}}$ used for calculations shall not exceed either $\mathbf{1.9}\boldsymbol{f_{ya}}$ or 860 MPa.

COMMENTARY

R17.6.1.2 The nominal strength of anchors in tension is best represented as a function of $\boldsymbol{f_{uta}}$ rather than $\boldsymbol{f_{ya}}$ because the large majority of anchor materials do not exhibit a well-defined yield point. AISC has based tension strength of anchors on $\boldsymbol{A_{se,N} f_{uta}}$ since the 1986 edition of their specifications. The use of Eq. (17.6.1.2) with the load factors provided in 5.3 and the ϕ-factors provided in 17.5.3 result in design strengths consistent with AISC 360.

The limitation of $\mathbf{1.9}\boldsymbol{f_{ya}}$ on $\boldsymbol{f_{uta}}$ is to ensure that, under service load conditions, the anchor does not exceed $\boldsymbol{f_{ya}}$. Although not a concern for standard structural steel anchors (maximum value of $\boldsymbol{f_{uta}/f_{ya}}$ is 1.6 for ASTM A307), the limitation is applicable to some stainless steels. The limit on $\boldsymbol{f_{uta}}$ of $\mathbf{1.9}\boldsymbol{f_{ya}}$ was determined by converting the LRFD provisions to corresponding service level conditions. From 5.3, the average load factor of 1.4 (from $\mathbf{1.2}\boldsymbol{D}$ + $\mathbf{1.6}\boldsymbol{L}$) divided by the highest ϕ-factor (0.75 for tension) results in a limit of $\boldsymbol{f_{uta}/f_{ya}}$ of 1.4/0.75 = 1.87.

For post-installed anchors having a reduced cross-sectional area anywhere along the anchor length, such as wedge-type anchors, the effective cross-sectional area of the anchor should be provided by the manufacturer. For threaded rods and headed bolts, ASME B1.1 defines $\boldsymbol{A_{se,N}}$ as

$$A_{se,N} = \frac{\pi}{4}\left(d_a - \frac{0.9743}{n_t}\right)^2$$

where $\boldsymbol{n_t}$ is the number of threads per mm.

CODE

17.6.2 *Concrete breakout strength of anchors in tension,* N$_{cb}$

17.6.2.1 Nominal concrete breakout strength in tension, $\boldsymbol{N_{cb}}$ of a single anchor or $\boldsymbol{N_{cbg}}$ of an anchor group satisfying 17.5.1.3.1, shall be calculated by (a) or (b), respectively:

(a) For a single anchor

$$N_{cb} = \frac{A_{Nc}}{A_{Nco}} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \tag{17.6.2.1a}$$

(b) For an anchor group

$$N_{cbg} = \frac{A_{Nc}}{A_{Nco}} \psi_{ec,N} \psi_{ed,N} \psi_{c,N} \psi_{cp,N} N_b \tag{17.6.2.1b}$$

where $\boldsymbol{\psi_{ec,N}}$, $\boldsymbol{\psi_{ed,N}}$, $\boldsymbol{\psi_{c,N}}$, and $\boldsymbol{\psi_{cp,N}}$ are given in 17.6.2.3, 17.6.2.4, 17.6.2.5, and 17.6.2.6, respectively.

COMMENTARY

R17.6.2 *Concrete breakout strength of anchors in tension,* N$_{cb}$

R17.6.2.1 The effects of multiple anchors, spacing of anchors, and edge distance on the nominal concrete breakout strength in tension are included by applying the modification factors $\boldsymbol{A_{Nc}/A_{Nco}}$ and $\boldsymbol{\psi_{ed,N}}$ in Eq. (17.6.2.1a) and (17.6.2.1b).

Figure R17.6.2.1(a) shows $\boldsymbol{A_{Nco}}$ and the development of Eq. (17.6.2.1.4). $\boldsymbol{A_{Nco}}$ is the maximum projected area for a single anchor. Figure R17.6.2.1(b) shows examples of the projected areas for various single-anchor and multiple-anchor arrangements. Because $\boldsymbol{A_{Nc}}$ is the total projected area for an anchor group, and $\boldsymbol{A_{Nco}}$ is the area for a single anchor, there is no need to include $\boldsymbol{n}$, the number of anchors, in Eq. (17.6.2.1b). If anchor groups are positioned in such a way that their projected areas overlap, the value of $\boldsymbol{A_{Nc}}$ is required to be reduced accordingly.