CHAPTER 20—STEEL REINFORCEMENT PROPERTIES, DURABILITY, & EMBEDMENTS

CODE

20.1—Scope

20.1.1 This chapter shall apply to steel reinforcement, and shall govern (a) through (c):

(a) Material properties
(b) Properties to be used for design
(c) Durability requirements, including minimum specified cover requirements

20.1.2 Provisions of 20.6 shall apply to embedments.

20.2—Nonprestressed bars and wires

20.2.1 *Material properties*

20.2.1.1 Nonprestressed bars and wires shall be deformed, except plain bars or wires are permitted for use in spirals.

20.2.1.2 Yield strength of nonprestressed bars and wires shall be determined by either (a) or (b):

(a) The offset method, using an offset of 0.2 percent in accordance with ASTM A370
(b) The yield point by the halt-of-force method, provided the nonprestressed bar or wire has a sharp-kneed or well-defined yield point

20.2.1.3 Deformed bars shall conform to (a), (b), (c), (d), or (e), except bar sizes larger than No. 57 shall not be permitted:

(a) ASTM A615 – carbon steel, including requirements specified in Table 20.2.1.3(a)
(b) ASTM A706 – low-alloy steel, including requirements specified in (i), (ii), and (iii):
(i) Tensile property requirements for ASTM A706 Grade 690 reinforcement shall be as specified in Table 20.2.1.3(b), and bend test requirements for ASTM A706 Grade 690 reinforcement shall be the same as the bend test requirements for ASTM A706 Grade 550 reinforcement.

COMMENTARY

R20.1—Scope

R20.1.1 Materials permitted for use as reinforcement are specified. Other metal elements, such as inserts, anchor bolts, or plain bars for dowels at isolation or contraction joints, are not normally considered reinforcement under the provisions of this Code. Fiber-reinforced polymer (FRP) reinforcement is not addressed in this Code. ACI Committee 440 has developed guidelines for the use of FRP reinforcement (ACI 440.1R and ACI 440.2R).

R20.2—Nonprestressed bars and wires

R20.2.1 *Material properties*

R20.2.1.2 The majority of nonprestressed steel bar reinforcement exhibits actual stress-strain behavior that is sharply yielding or sharp-kneed (elasto-plastic stress-strain behavior). However, reinforcement products such as bars of higher strength grade, steel wire, coiled steel bar, and stainless steel bars and wire generally do not exhibit sharply-yielding stress-strain behavior, but instead are gradually-yielding. The method used to measure yield strength of reinforcement needs to provide for both types of reinforcement stress-strain relationships.

A study (Paulson et al. 2013) considering reinforcement manufactured during 2008 through 2012 found that the offset method, using an offset of 0.2 percent, provides for a reasonable estimate of the strength of reinforced concrete structures.

The yield strength is determined by the manufacturer during tensile tests performed at the mill on samples of reinforcement. Test methods for determining yield strength of steel, including the offset method and yield point by halt-of-force method, are referenced either in the ASTM standards for nonprestressed bars and wire or in ASTM A370 Test Methods and Definitions.

R20.2.1.3 The requirements specified in 20.2.1.3(a) and (b), and in Tables 20.2.1.3(a) through (c), are necessary because the referenced standards in Chapter 3, ASTM A615-18$^{\varepsilon 1}$ and ASTM A706-16, do not include these requirements. For project specifications, these requirements should be specified along with the corresponding ASTM requirements. The requirements provide for harmonization of minimum tensile strength requirements between ASTM A615 and ASTM A706, add new ductility requirements to both ASTM A615 and ASTM A706, and introduce Grade 690 reinforcement for ASTM A706. These requirements accommodate the introduction of higher strength reinforcement into the Code for special seismic applications and have been developed considering both structural safety and