CODE

COMMENTARY

Table 20.2.2.4(b)—Nonprestressed plain spiral reinforcement

Usage	Application	Maximum value of f_y or f_{yt} permitted for design calculations, MPa	Applicable ASTM specification	
			Plain bars	Plain wires
Lateral support of longitudinal bars; or concrete confinement	Spirals in special seismic systems	690	A615, A706, A955, A1035	A1064, A1022
	Spirals	690	A615, A706, A955, A1035	A1064, A1022
Shear	Spirals	420	A615, A706, A955, A1035	A1064, A1022
Torsion in nonprestressed beams	Spirals	420	A615, A706, A955, A1035	A1064, A1022

20.2.2.5 Deformed nonprestressed longitudinal reinforcement resisting earthquake-induced moment, axial force, or both, in special seismic systems and anchor reinforcement in Seismic Design Categories (SDC) C, D, E, and F shall be in accordance with (a) or (b):

(a) ASTM A706, Grade 420, 550, or 690 for special structural walls and Grade 420 and 550 for special moment frames.
(b) ASTM A615 Grade 420 if (i) through (iv) are satisfied. ASTM A615 Grade 550 and Grade 690 are not permitted in special seismic systems.
(i) Actual yield strength based on mill tests does not exceed f_y by more than 125 MPa
(ii) Ratio of the actual tensile strength to the actual yield strength is at least 1.25
(iii) Minimum fracture elongation in 200 mm shall be at least 14 percent for bar sizes No. 10 through No. 19, at least 12 percent for bar sizes No. 22 through No. 36, and at least 10 percent for bar sizes No. 43 through No. 57.
(iv) Minimum uniform elongation shall be at least 9 percent for bar sizes No. 10 through No. 32, and at least 6 percent for bar sizes No. 36, No. 43, and No. 57.

R20.2.2.5 The requirement for the tensile strength to be greater than the yield strength of the reinforcement by a factor of 1.25 is based on the assumption that the capability of a structural member to develop inelastic rotation capacity is a function of the length of the yield region along the axis of the member. In interpreting experimental results, the length of the yield region has been related to the relative magnitudes of probable and yield moments (ACI 352R). According to this interpretation, the greater the ratio of probable-to-yield moment, the longer the yield region. Members with reinforcement not satisfying this condition can also develop inelastic rotation, but their behavior is sufficiently different to exclude them from direct consideration on the basis of rules derived from experience with members reinforced with strain-hardening steel.

The required minimum elongations in 20.2.2.5(b) for ASTM A615 Grade 420 are the same as the values in ASTM A706 for Grade 420 deformed reinforcement.

ASTM A615 Grade 550 and Grade 690 are not permitted to resist moments and axial forces in special seismic systems because of concern associated with low-cycle fatigue behavior (Slavin and Ghannoum 2015).

20.3—Prestressing strands, wires, and bars

20.3.1 *Material properties*

20.3.1.1 Except as required in 20.3.1.3 for special moment frames and special structural walls, prestressing reinforcement shall conform to (a), (b), (c), or (d):

(a) ASTM A416 – strand
(b) ASTM A421 – wire
(c) ASTM A421 – low-relaxation wire including Supplementary Requirement S1, "Low-Relaxation Wire and Relaxation Testing"
(d) ASTM A722 – high-strength bar

20.3.1.2 Prestressing strands, wires, and bars not listed in ASTM A416, A421, or A722 are permitted provided they conform to minimum requirements of these specifications and are shown by test or analysis not to impair the performance of the member.

R20.3—Prestressing strands, wires, and bars

R20.3.1 *Material properties*

R20.3.1.1 Because low-relaxation prestressing reinforcement is addressed in a supplementary requirement to ASTM A421, which applies only if low-relaxation material is specified, the appropriate ASTM reference is listed as a separate entity.