CODE

24.3.2.1 Stress f_s in deformed reinforcement closest to the tension face at service loads shall be calculated based on the unfactored moment, or it shall be permitted to take f_s as $(2/3)f_y$.

24.3.2.2 Change in stress, Δf_{ps}, in bonded prestressed reinforcement at service loads shall be equal to the calculated stress based on a cracked section analysis minus the decompression stress f_{dc}. It shall be permitted to take f_{dc} equal to the effective stress in the prestressed reinforcement f_{se}. The value of Δf_{ps} shall not exceed 250 MPa. If Δf_{ps} does not exceed 140 MPa, the spacing limits in Table 24.3.2 need not be satisfied.

24.3.3 If there is only one bonded bar, pretensioned strand, or bonded tendon nearest to the extreme tension face, the width of the extreme tension face shall not exceed s determined in accordance with Table 24.3.2.

24.3.4 If the flange of a T-beam is in tension, the portion of the bonded flexural tension reinforcement not located over the beam web shall be distributed within the lesser of the effective flange width, as defined in accordance with 6.3.2 and $\ell_n/10$. If $\ell_n/10$ controls, additional bonded longitudinal reinforcement satisfying 24.4.3.1 shall be provided in the outer portions of the flange.

24.3.5 The spacing of bonded flexural reinforcement in nonprestressed and Class C prestressed one-way slabs and beams subject to fatigue, designed to be watertight, or exposed to corrosive environments, shall be selected based on investigations and precautions specific to those conditions and shall not exceed the limits of 24.3.2.

24.4—Shrinkage and temperature reinforcement

24.4.1 Reinforcement to resist shrinkage and temperature stresses shall be provided in one-way slabs in the direction

COMMENTARY

R24.3.2.1 For applications in which crack control is critical, the designer should consider reducing the value of f_s to help control cracking. Research by Frosch et al. (2014) and Puranam (2018) supports the use of these design provisions for Grade 690 reinforcement.

R24.3.2.2 It is conservative to take the decompression stress f_{dc} equal to f_{se}, the effective stress in the prestressed reinforcement. The maximum limitation of 250 MPa for Δf_{ps} is intended to be similar to the maximum allowable stress in Grade 420 reinforcement **(f_s = 280 MPa)**. The exemption for members with Δf_{ps} less than 140 MPa reflects that many structures designed by working stress methods and with low reinforcement stress served their intended functions with very limited flexural cracking.

R24.3.4 In a T-beam, distribution of the negative moment reinforcement for control of cracking should take into account two considerations: 1) wide spacing of the reinforcement across the full effective width of flange may cause some wide cracks to form in the slab near the web; and 2) close spacing near the web leaves the outer regions of the flange unprotected. The one-tenth limitation is to guard against a spacing that is too wide, with some additional reinforcement required to protect the outer portions of the flange.

For T-beams designed to resist negative moments due to gravity and wind loads, all tensile reinforcement required for strength is located within the lesser of the effective flange width and $\ell_n/10$. Common practice is to place more than half of the reinforcement over the beam web. For T-beams resisting load combinations including earthquake effects, all reinforcement placed within the effective flange width may contribute to the beam flexural strength for the anticipated drift (refer to 18.7.3).

R24.3.5 Although a number of studies have been conducted, clear experimental evidence is not available regarding the crack width beyond which a corrosion danger exists (ACI 222R). Exposure tests indicate that concrete quality, adequate consolidation, and ample concrete cover may be of greater importance for corrosion protection than crack width at the concrete surface (Schießl and Raupach 1997).

Provisions related to increased concrete cover and durability of reinforcement is covered in 20.5, while durability of concrete is covered in 19.3.

R24.4—Shrinkage and temperature reinforcement

R24.4.1 Shrinkage and temperature reinforcement is required at right angles to the principal reinforcement to minimize cracking and to tie the structure together to ensure

24 Serviceability