CODE

22.5.1.11 If $\frac{v_{u,x}}{\phi v_{n,x}} > 0.5$ and $\frac{v_{u,y}}{\phi v_{n,y}} > 0.5$ then Eq. (22.5.1.11) shall be satisfied.

$$\frac{v_{u,x}}{\phi v_{n,x}} + \frac{v_{u,y}}{\phi v_{n,y}} \le 1.5 \qquad (22.5.1.11)$$

22.5.2 *Geometric assumptions*

22.5.2.1 For calculation of V_c and V_s in prestressed members, d shall be taken as the distance from the extreme compression fiber to the centroid of prestressed and any nonprestressed longitudinal reinforcement but need not be taken less than $0.8h$.

22.5.2.2 For calculation of V_c and V_s, it shall be permitted to assume (a) through (c):

(a) d equal to 0.8 times the diameter for circular sections
(b) b_w equal to the diameter for solid circular sections
(c) b_w equal to twice the wall thickness for hollow circular sections

22.5.3 *Limiting material strengths*

22.5.3.1 The value of $\sqrt{f'_c}$ used to calculate V_c, V_{ci}, and V_{cw} for one-way shear shall not exceed 8.3 MPa, unless allowed in 22.5.3.2.

22.5.3.2 Values of $\sqrt{f'_c}$ greater than 8.3 MPa shall be permitted in calculating V_c, V_{ci}, and V_{cw} for reinforced or prestressed concrete beams and concrete joist construction having minimum web reinforcement in accordance with 9.6.3.4 or 9.6.4.2.

22.5.3.3 The values of f_y and f_{yt} used to calculate V_s shall not exceed the limits in 20.2.2.4.

COMMENTARY

and Jirsa 1984). Considering shear along each centroidal axis independently can be unconservative. Thus, linear interaction accounts for biaxial shear.

R22.5.2 *Geometric assumptions*

R22.5.2.1 Although the value of d may vary along the span of a prestressed beam, studies (MacGregor and Hanson 1969) have shown that, for prestressed concrete members, d need not be taken less than $0.8h$. The beams considered had some straight prestressed reinforcement or reinforcing bars at the bottom of the section and had stirrups that enclosed the longitudinal reinforcement.

R22.5.2.2 Shear tests of members with circular sections indicate that the effective area can be taken as the gross area of the section or as an equivalent rectangular area (Joint ACI-ASCE Committee 426 1973; Faradji and Diaz de Cossio 1965; Khalifa and Collins 1981).

Although the transverse reinforcement in a circular section may not consist of straight legs, tests indicate that Eq. (22.5.8.5.3) is conservative if d is taken as defined in 22.5.2.2 (Faradji and Diaz de Cossio 1965; Khalifa and Collins 1981).

R22.5.3 *Limiting material strengths*

R22.5.3.1 Because of a lack of test data and practical experience with concretes having compressive strengths greater than 70 MPa, the Code imposes a maximum value of 8.3 MPa on $\sqrt{f'_c}$ for use in the calculation of shear strength of concrete members. Exceptions to this limit are permitted in beams and joists if the transverse reinforcement satisfies the requirements in 22.5.3.2.

R22.5.3.2 Based on the beam test results in Mphonde and Frantz (1984), Elzanaty et al. (1986), Roller and Russell (1990), Johnson and Ramirez (1989), and Ozcebe et al. (1999), an increase in the minimum amount of transverse reinforcement is required for high-strength concrete. These tests indicate a reduction in reserve shear strength occurs as f'_c increases in beams reinforced with transverse reinforcement providing an effective shear stress of 0.35 MPa. By providing minimum transverse reinforcement, which increases as f'_c increases, the reduction in shear strength is offset.

R22.5.3.3 The upper limit of 420 MPa on the value of f_y and f_{yt} used in design is intended to control diagonal crack widths.