CODE

22.5.4 *Composite concrete members*

22.5.4.1 This section shall apply to members constructed in separate placements but connected so that all elements resist loads as a unit.

22.5.4.2 For calculation of V_n for composite members, no distinction shall be made between shored and unshored members.

22.5.4.3 For calculation of V_n for composite members where the specified concrete compressive strength, density (unit weight), or other properties of different elements vary, properties of the individual elements shall be used in design. Alternatively, it shall be permitted to use the properties of the element that results in the most critical value of V_n.

22.5.4.4 If an entire composite member is assumed to resist vertical shear, it shall be permitted to calculate V_c assuming a monolithically cast member of the same cross-sectional shape.

22.5.4.5 If an entire composite member is assumed to resist vertical shear, it shall be permitted to calculate V_s assuming a monolithically cast member of the same cross-sectional shape if shear reinforcement is fully anchored into the interconnected elements in accordance with 25.7.

22.5.5 V_c *for nonprestressed members*

22.5.5.1 For nonprestressed members, V_c shall be calculated in accordance with Table 22.5.5.1 and 22.5.5.1.1 through 22.5.5.1.3.

Table 22.5.5.1—V_c for nonprestressed members

Criteria		V_c	
$A_v \geq A_{v,min}$	Either of:	$\left[0.17\lambda\sqrt{f_c'}+\frac{N_u}{6A_g}\right]b_wd$	(a)
		$\left[0.66\lambda(\rho_w)^{1/3}\sqrt{f_c'}+\frac{N_u}{6A_g}\right]b_wd$	(b)
$A_v < A_{v,min}$		$\left[0.66\lambda_s\lambda(\rho_w)^{1/3}\sqrt{f_c'}+\frac{N_u}{6A_g}\right]b_wd$	(c)

Notes:
1. Axial load, N_u, is positive for compression and negative for tension.
2. V_c shall not be taken less than zero.

COMMENTARY

R22.5.4 *Composite concrete members*

R22.5.4.1 The scope of Chapter 22 includes composite concrete members. In some cases with cast-in-place concrete, separate placements of concrete may be designed to act as a unit. In these cases, the interface is designed for the loads that will be transferred across the interface. Composite structural steel-concrete beams are not covered in this Code. Design provisions for such composite members are covered in AISC 360.

R22.5.5 V_c *for nonprestressed members*

R22.5.5.1 Test results (Kuchma et al. 2019) for nonprestressed members without shear reinforcement indicate that measured shear strength, attributed to concrete, does not increase in direct proportion with member depth. This phenomenon is often referred to as the "size effect." For example, if the member depth doubles, the shear at failure for the deeper beam may be less than twice the shear at failure of the shallower beam (Sneed and Ramirez 2010). $A_{v,min}$ for beams and one-way slabs is defined in 9.6.3.4.

Research (Angelakos et al. 2001; Lubell et al. 2004; Brown et al. 2006; Becker and Buettner 1985; Anderson 1978; Bažant et al. 2007) has shown that shear stress at failure is lower for beams with increased depth and a reduced area of longitudinal reinforcement.

In Table 22.5.5.1, for $A_v > A_{v,min}$, either equation for V_c may be used. Equation (a) is provided as a simpler option.

When calculating V_c by Table 22.5.5.1, an axial tension force can cause V_c to have a negative value. In those cases, the Code specifies that V_c should be taken equal to zero.