CODE

Table 18.8.4.3—Nominal joint shear strength V_n

Column	Beam in direction of V_u	Confinement by transverse beams according to 15.2.8	V_n, N[1]
Continuous or meets 15.2.6	Continuous or meets 15.2.7	Confined	$1.7\lambda\sqrt{f'_c}A_j$
		Not confined	$1.2\lambda\sqrt{f'_c}A_j$
	Other	Confined	$1.2\lambda\sqrt{f'_c}A_j$
		Not confined	$1.0\lambda\sqrt{f'_c}A_j$
Other	Continuous or meets 15.2.7	Confined	$1.2\lambda\sqrt{f'_c}A_j$
		Not confined	$1.0\lambda\sqrt{f'_c}A_j$
	Other	Confined	$1.0\lambda\sqrt{f'_c}A_j$
		Not confined	$0.7\lambda\sqrt{f'_c}A_j$

[1]λ shall be 0.75 for lightweight concrete and 1.0 for normalweight concrete. A_j shall be calculated in accordance with 15.4.2.4.

18.8.5 *Development length of bars in tension*

18.8.5.1 For bar sizes No. 10 through No. 36 terminating in a standard hook, ℓ_{dh} shall be calculated by Eq. (18.8.5.1), but ℓ_{dh} shall be at least the greater of $8d_b$ and 150 mm for normalweight concrete and at least the greater of $10d_b$ and 190 mm for lightweight concrete.

$$\ell_{dh} = f_y d_b / (5.4\lambda\sqrt{f'_c}) \qquad (18.8.5.1)$$

The value of λ shall be 0.75 for concrete containing lightweight aggregate and 1.0 otherwise.

The hook shall be located within the confined core of a column or of a boundary element, with the hook bent into the joint.

18.8.5.2 For headed deformed bars satisfying 20.2.1.6, development in tension shall be in accordance with 25.4.4, by substituting a bar stress of $1.25f_y$ for f_y.

COMMENTARY

columns, when properly dimensioned and reinforced with longitudinal and transverse bars, provide effective confinement to the joint faces, thus delaying joint strength deterioration at large deformations (Meinheit and Jirsa 1981).

R18.8.5 *Development length of bars in tension*

R18.8.5.1 Minimum embedment length in tension for deformed bars with standard hooks is determined using Eq. (18.8.5.1), which is based on the requirements of 25.4.3. The embedment length of a bar with a standard hook is the distance, parallel to the bar, from the critical section (where the bar is to be developed) to a tangent drawn to the outside edge of the hook. The tangent is to be drawn perpendicular to the axis of the bar (refer to Table 25.3.1).

Because Chapter 18 stipulates that the hook is to be embedded in confined concrete, the coefficients 0.7 (for concrete cover) and 0.8 (for ties) have been incorporated in the constant used in Eq. (18.8.5.1). The development length that would be derived directly from 25.4.3 is increased to reflect the effect of load reversals. Factors such as the actual stress in the reinforcement being more than the yield strength and the effective development length not necessarily starting at the face of the joint were implicitly considered in the formulation of the expression for basic development length that has been used as the basis for Eq. (18.8.5.1).

The requirement for the hook to project into the joint is to improve development of a diagonal compression strut across the joint. The requirement applies to beam and column bars terminated at a joint with a standard hook.

R18.8.5.2 The factor 1.25 is intended to represent the potential increase in stresses due to inelastic response, including strain hardening that may occur in beams of special moment frames.