CODE

17.11.2.2 *Bearing factor*, $\psi_{brg,sl}$

17.11.2.2.1 Modification factor, $\psi_{brg,sl}$, for the effects of axial load, P_u, on bearing strength in shear, shall be determined by (a), (b), or (c):

(a) For applied axial tension:

$$\psi_{brg,sl} = 1 + \frac{P_u}{n N_{sa}} \leq 1.0 \qquad (17.11.2.2.1a)$$

where P_u is negative for tension and n is the number of anchors in tension.

(b) For no applied axial load:

$$\psi_{brg,sl} = 1 \qquad (17.11.2.2.1b)$$

(c) For applied axial compression:

$$\psi_{brg,sl} = 1 + 4\frac{P_u}{A_{bp} f_c'} \leq 2.0 \qquad (17.11.2.2.1c)$$

where P_u is positive for compression.

17.11.2.3 If used, the length of shear lug stiffeners in the direction of the shear load shall not be less than $0.5h_{sl}$.

17.11.2.4 For attachments with multiple shear lugs arranged perpendicular to the direction of applied shear, the bearing strength of the individual shear lugs may be considered to be additive provided the shear stress on a shear plane in the concrete at the bottom of the shear lugs, and extending between the shear lugs, does not exceed $0.2f_c'$. The nominal bearing strength of each individual lug shall be determined by Eq. (17.11.2.1) using the effective area of the lug.

17.11.3 *Concrete breakout strength of shear lug*, $V_{cb,sl}$

17.11.3.1 Nominal concrete breakout strength of a shear lug for shear perpendicular to the edge, $V_{cb,sl}$, shall be determined from 17.7.2 using Eq. (17.7.2.1a), where V_b is calculated using Eq. (17.7.2.2.1b) with c_{a1} taken as the distance from the bearing surface of the shear lug to the free edge and where A_{vc} is the projected area of the failure surface on the side of the concrete member.

17.11.3.1.1 A_{vc} is the projected concrete failure area on the side face of the concrete that is approximated as the rectangular shape resulting from projecting horizontally $1.5c_{a1}$ from the edge of the shear lug and projecting vertically $1.5c_{a1}$ from the edge of the effective depth of the shear lug, $h_{ef,sl}$. The effective area of the shear lug, $A_{ef,sl}$, shall not be included. The effective embedment depth of the shear lug, $h_{ef,sl}$, shall be taken as the distance from the concrete surface to the bottom of the effective bearing area, $A_{ef,sl}$.

COMMENTARY

R17.11.2.4 The limitation for considering multiple shear lugs to be effective is based on the maximum limits for shear friction in Table 22.9.4.4 and two tests reported in Rotz and Reifschneider (1984). The area of the shear plane is the clear distance between adjacent shear lugs measured in the direction of the applied shear multiplied by the width of the shear lugs perpendicular to the applied shear.

R17.11.3 *Concrete breakout strength of shear lug*, $V_{cb,sl}$

R17.11.3.1 The method for evaluating concrete breakout strength where shear is perpendicular to an edge is similar to that used in 17.7.2 for anchors. The difference is in the determination of A_{Vc}, which is illustrated in Fig. R17.11.3.1. The method has been confirmed by tests where the shear lug is concentrically loaded in shear (Gomez et al. 2009; Cook and Michler 2017). With shear transferred by the shear lug, embedded plate (if present), and welded anchors (if present), the bearing surfaces all displace the same amount with any incremental change in applied shear. This behavior is similar to connections with anchors welded to steel attachments where concrete edge failure originates from the row of anchors farthest from the edge. In anchorages with shear lugs, the effective contributions to concrete breakout strength from the bearing areas of the shear lug and embedded plate (if present) dominate over the contribution from the effective bearing area of anchors farther from the edge than the shear lug. As a result, concrete breakout strength for the anchorage