CODE

(c) For shear parallel to an edge, V_{cb} or V_{cbg} shall be permitted to be twice the value of the shear calculated by Eq. (17.7.2.1a) or (17.7.2.1b), respectively, with the shear assumed to act perpendicular to the edge and $\psi_{ed,V}$ taken equal to 1.0.

(d) For anchors located at a corner, the limiting nominal concrete breakout strength shall be calculated for each edge, and the lesser value shall be used.

where $\psi_{ec,V}$, $\psi_{ed,V}$, $\psi_{c,V}$, and $\psi_{h,V}$ are given in 17.7.2.3, 17.7.2.4, 17.7.2.5, and 17.7.2.6, respectively.

17.7.2.1.1 A_{Vc} is the projected area of the failure surface on the side of the concrete member at its edge for a single anchor or an anchor group. It shall be permitted to evaluate A_{Vc} as the base of a truncated half-pyramid projected on the side face of the member where the top of the half-pyramid is given by the axis of the anchor row selected as critical. The value of c_{a1} shall be taken as the distance from the edge to this axis. A_{Vc} shall not exceed nA_{Vco}, where n is the number of anchors in the group.

COMMENTARY

Figure R17.7.2.1a shows A_{Vco} and the development of Eq. (17.7.2.1.3). A_{Vco} is the maximum projected area for a single anchor that approximates the surface area of the full breakout volume for an anchor unaffected by edge distance, spacing, or depth of member. Figure R17.7.2.1b shows examples of the projected areas for various single-anchor and multiple-anchor arrangements. A_{Vc} approximates the full surface area of the breakout for the particular arrangement of anchors. Because A_{Vc} is the total projected area for an anchor group, and A_{Vco} is the area for a single anchor, there is no need to include the number of anchors in the equation.

As shown in the examples in Fig. R17.7.2.1b of two-anchor groups loaded in shear, when using Eq. (17.7.2.1b) for cases where the anchor spacing s is greater than the edge distance to the near-edge anchor $c_{a1,1}$, both assumptions for load distribution illustrated in Cases 1 and 2 should be considered. This is because the anchors nearest to the free edge could fail first or the entire group could fail as a unit with the failure surface originating from the anchors farthest from the edge. For Case 1, the steel shear strength is provided by both anchors. For Case 2, the steel shear strength is provided entirely by the anchor farthest from the edge; no contribution of the anchor near the edge is considered. In addition, checking the near-edge anchor for concrete breakout under service loads is advisable to preclude undesirable cracking at service conditions. If the anchor spacing s is less than the edge distance to the near-edge anchor, the failure surfaces may merge (Eligehausen et al. 2006b) and Case 3 of Fig. R17.7.2.1b may be taken as a conservative approach.

If the anchors are welded to a common plate (regardless of anchor spacing s), when the anchor nearest the front edge begins to form a breakout failure, shear is transferred to the stiffer and stronger rear anchor. For this reason, only Case 2 need be considered, which is consistent with Section 6.5.5 of the *PCI Design Handbook* (PCI MNL 120). For determination of steel shear strength, it is conservative to consider only the anchor farthest from the edge. However, for anchors having a ratio of $s/c_{a1,1}$ less than 0.6, both the front and rear anchors may be assumed to resist the shear (Anderson and Meinheit 2007). For ratios of $s/c_{a1,1}$ greater than 1, it is advisable to check concrete breakout of the near-edge anchor to preclude undesirable cracking at service conditions.

Further discussion of design for multiple anchors is given in Primavera et al. (1997).

For anchors near a corner required to resist a shear force with components normal to each edge, a satisfactory solution is to check the connection independently for each component of the shear force. Other specialized cases, such as the shear resistance of anchor groups where all anchors do not have the same edge distance, are treated in Eligehausen et al. (2006a).

The detailed provisions of 17.7.2.1(a) apply to the case of shear directed toward an edge. If the shear is directed away from the edge, the strength will usually be governed by 17.7.1 or 17.7.3. The case of shear parallel to an edge