

CODE

where A_{cv} is the gross area of concrete bounded by diaphragm web thickness and depth, reduced by void areas if present; the value of $\sqrt{f'_c}$ used to calculate V_n shall not exceed 8.3 MPa; and ρ_t refers to the distributed reinforcement oriented parallel to the in-plane shear.

12.5.3.4 For a diaphragm that is entirely cast-in-place, cross-sectional dimensions shall be selected to satisfy Eq. (12.5.3.4).

$$V_u \leq 0.66\phi A_{cv}\sqrt{f'_c} \quad (12.5.3.4)$$

where the value of $\sqrt{f'_c}$ used to calculate V_n shall not exceed 8.3 MPa.

12.5.3.5 For diaphragms that are cast-in-place concrete topping slabs on precast elements, (a) and (b) shall be satisfied:

(a) V_n shall be calculated in accordance with Eq. (12.5.3.3), and cross-sectional dimensions shall be selected to satisfy Eq. (12.5.3.4). A_{cv} shall be calculated using the thickness of the topping slab for noncomposite topping slab diaphragms and the combined thickness of cast-in-place and precast elements for composite topping slab diaphragms. For composite topping slab diaphragms, the value of f'_c in Eq. (12.5.3.3) and (12.5.3.4) shall not exceed the lesser of f'_c for the precast members and f'_c for the topping slab.

(b) V_n shall not exceed the value calculated in accordance with the shear-friction provisions of 22.9 considering the thickness of the topping slab above joints between precast elements in noncomposite and composite topping slab diaphragms and the reinforcement crossing the joints between the precast members.

12.5.3.6 For diaphragms that are interconnected precast elements without a concrete topping, and for diaphragms that are precast elements with end strips formed by either a cast-in-place concrete topping slab or edge beams, it shall be permitted to design for shear in accordance with (a), (b), or both.

(a) The nominal strength of grouted joints shall not exceed 0.55 MPa. Reinforcement shall be designed to resist shear through shear-friction in accordance with 22.9. Shear-friction reinforcement shall be in addition to reinforcement designed to resist tension due to moment and axial force.

(b) Mechanical connectors crossing joints between precast elements shall be designed to resist required shear under anticipated joint opening.

12.5.3.7 For any diaphragm, where shear is transferred from the diaphragm to a collector, or from the diaphragm or collector to a vertical element of the lateral-force-resisting system, (a) or (b) shall apply:

COMMENTARY

R12.5.3.5 For diaphragms with cast-in-place topping slab on precast elements, the effective thickness in 12.5.3.5(a) is reduced to the topping slab thickness if the topping slab is not composite with the precast elements. Topping slabs tend to develop cracks above and along the joints between precast elements. Thus, 12.5.3.5(b) limits the shear strength to the shear-friction strength of the topping slab above the joints between the precast elements.

R12.5.3.6 This Code does not contain provisions for untopped diaphragms in buildings assigned to Seismic Design Categories D, E, and F. Diaphragm shear in untopped diaphragms can be resisted by using shear-friction reinforcement in grouted joints (FEMA P751). Required shear-friction reinforcement is in addition to reinforcement required by design to resist other tensile forces in the diaphragm, such as those due to diaphragm moment and axial force, or due to collector tension. The intent is to reduce joint opening while simultaneously resisting shear through shear-friction. Alternatively, or additionally, mechanical connectors can be used to transfer shear across joints of precast elements. In this case, some joint opening should be anticipated. The mechanical connectors should be capable of maintaining design strength under anticipated joint opening.

R12.5.3.7 In addition to having adequate shear strength within its plane, a diaphragm should be reinforced to transfer shear through shear-friction or mechanical connectors to collectors and to vertical elements of the lateral-force-resisting