

(U.S. Customary Units)

$$n = 505 / \sqrt{f'_c}$$

(SI Units)

$$n = \frac{41.9}{\sqrt{f'_c}}$$

(a) Loads shall be applied in their chronological order.

(b) The loads at a particular time shall be divided into the following two categories:

(1) the applied load or loads

(2) those loads existing prior to application of the applied load or loads under consideration

(c) If the actual chronological loading order cannot be determined between two or more loads, then the load with the least V/M ratio at the section under consideration shall be applied first.

(d) If $(M_{cr} - M_i)$ is not positive in sign, then it shall be considered as zero.

(e) All existing and applied shear loads shall be taken at the section under consideration.

(f) All moments and other loads affecting the determination of M_{cr} shall be taken at a distance $d/2$ from the section being investigated for shear measured in the direction of decreasing moment.

(g) If the section under consideration is subjected to membrane tension, then eq. CC-3421.4.1(c)(7) shall be used in conjunction with eqs. (8) and (9) with the lowest value of v_c used in the design.

(h) The following definitions shall be used:

f_{pc} = the membrane stress, due to all loads, in the concrete at the centroid of the section where V is applied (positive if compression)

I = moment of inertia at the distance $d/2$ from the section being investigated for shear, measured in the direction of decreasing moment

M = the applied moment associated with the applied shear load

M_{cr} = the moment necessary to cause cracking (always positive)

M_i = the existing moments associated with the existing shear loads (positive if applied in the same direction as the applied moments)

V = the applied shear load at the section under consideration

V_i = the existing shear loads at the section under consideration (positive if applied in the same direction as V)

y_t = distance from the centroidal axis of gross section, neglecting the reinforcement, to the extreme fiber in tension

ρ = A_s/bd , ratio of bonded tension reinforcement

CC-3421.5 Tangential Shear. Tangential shear is a membrane shear in the plane of the containment shell resulting from lateral load such as earthquake, wind, or tornado loading.

CC-3421.5.1 Reinforced Concrete. No tangential shear strength shall be considered as provided by the concrete, i.e.,

$$V_c = 0$$

CC-3421.5.2 Prestressed Concrete. Where a minimum prestress as defined in CC-3521.1.2 is present,

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$$V_c = 4\sqrt{f'_c}bt \sqrt{1 + \left[\frac{f_m + f_h}{4\sqrt{f'_c}} \right] + \left[\frac{f_m f_h}{(4\sqrt{f'_c})^2} \right]} \quad (10)$$

(SI Units)

$$V_c = \frac{\sqrt{f'_c}}{3}bt \sqrt{1 + \left[\frac{f_m + f_h}{\frac{\sqrt{f'_c}}{3}} \right] + \left[\frac{f_m f_h}{\left(\frac{\sqrt{f'_c}}{3}\right)^2} \right]}$$

where f_m and f_h are membrane stresses respectively in meridional and hoop directions, compression positive, psi. Thermal membrane stresses shall be included in f_m and f_h .

CC-3421.6 Peripheral Shear. Peripheral shear is a transverse shear and is similar to punching shear in slab analysis. It is the shear resulting from a concentrated force or reaction acting transverse to the plane of the wall. An example of peripheral shear is the transverse shear associated with a local concentrated load. Another example of peripheral shear is the transverse shear which can occur at the perimeter of penetrations. In this example, radial shear must also be considered.

(a) The value of v_c shall be calculated as a weighted average of v_{ch} and v_{cm} : v_{ch} is the allowable shear stress on a failure surface perpendicular to a meridional line, and v_{cm} is the allowable shear stress on a meridional failure surface perpendicular to the plane of the shell. For a circular failure surface, v_c is the average of v_{ch} and v_{cm} .

(b) When the membrane stress f_h or f_m is tensile, the peripheral or punching shear stress taken by the concrete on the assumed failure surface at loaded areas that are circular, square, or rectangular with an aspect ratio β_c less than 2, shall not exceed v_c as obtained in (a) above.