10.4.4 Lateral Resistance

10.4.4.1

The factored lateral strength resistance of a bolted connection, P_r, Q_r, or N_r, varies directly with the number of shear planes and shall be greater than or equal to the effect of the factored loads:

- For parallel to grain loading

$\phi P_u n_s n_f$

- For perpendicular-to-grain loading

$\phi Q_u n_s n_f$

for loads at angle, θ, to grain

$P_r Q_r$

$P_r \sin^2\theta + Q_r \cos^2\theta$

where

ϕ = 0.7

$p_u(K_1 K_{sl} K_t)$ or $q_u(K_1 K_{sl} K_t)$

= lateral strength resistance for parallel to grain loading (Clause 10.4.4.2), N

n_s = number of shear planes

$n_f = l_1 l_2$

l_1 = factor for two to maximum 12 bolts in a row

$0.33\left(\frac{l}{d}\right)^{0.5}\left(\frac{s}{d}\right)^{0.2} N^{-0.3}$, but is not greater than 1.0

where

l = member thickness (see Clause 10.4.2), mm

s = bolt spacing in the row, mm

d = bolt diameter, mm

N = number of bolts in a row

Note: l_1 = 1.0 *in cases with only one bolt per row, and in all wood-to-concrete connections.*

l_2 = factor for loaded end distance

= 0.75 for end distance of 7d, or 1.0 for 10d (for intermediate values, interpolate linearly)

K_t = factor for number of rows

= 1.0 for 1 row, or for 1 bolt per row

= 0.8 for 2 rows (2 or more bolts in a row)

= 0.6 for 3 rows (2 or more bolts in a row)

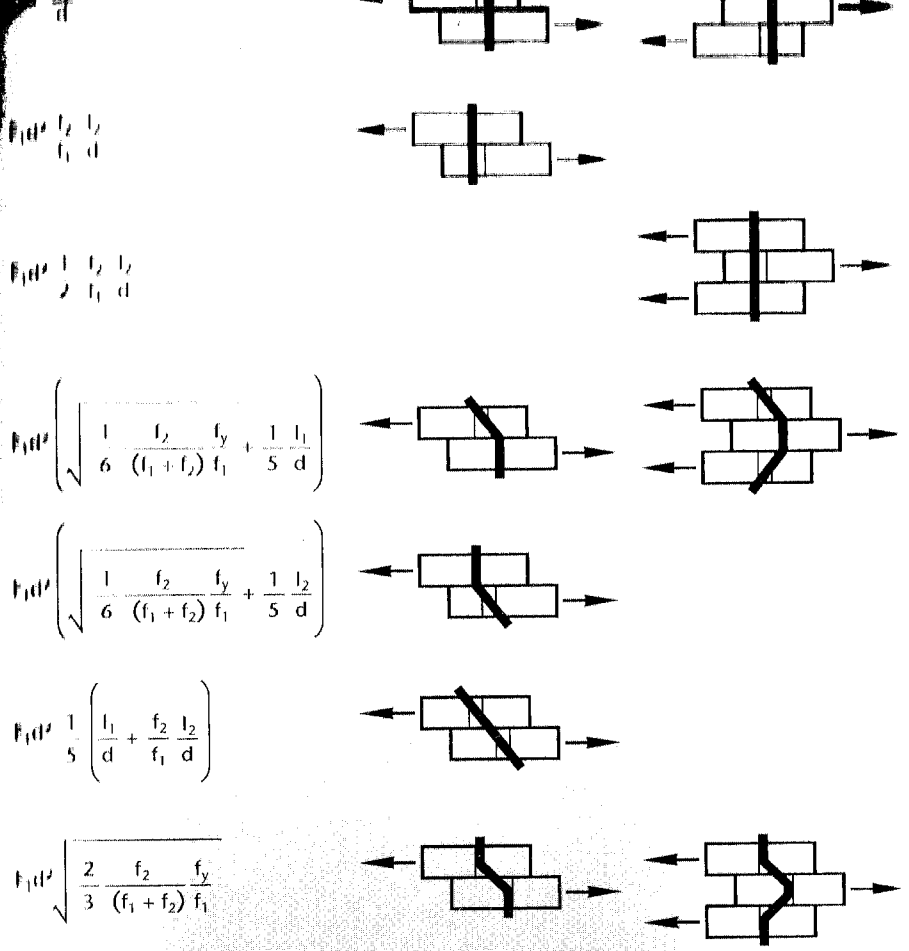
$p_u(K_1 K_{sl} K_t)$ or $q_u(K_1 K_{sl} K_t)$

= lateral strength resistance for perpendicular to grain loading (Clause 10.4.4.2), N

10.4.4.2

The bolt lateral strength resistances, p_u or q_u, (N per shear plane) shall be taken as the smallest value determined from formulae (a) to (g) as follows:

For two-member connections, only formulae (a), (b), (d), (e), (f), and (g), are valid. For three member connections, only formulae (a), (c), (d), and (g) are valid.



(a) $P_1 d = f_1 \frac{l_1}{d}$

(b) $P_1 d = f_2 \frac{l_2}{d}$

(c) $P_1 d = \frac{1}{2} f_2 \frac{l_2}{d}$

(d) $P_1 d = \sqrt{\frac{1}{6} \frac{f_2}{(f_1 + f_2)} f_y + \frac{1}{5} \frac{l_1}{d}}$

(e) $P_1 d = \sqrt{\frac{1}{6} \frac{f_2}{(f_1 + f_2)} f_y + \frac{1}{5} \frac{l_2}{d}}$

(f) $P_1 d = \frac{1}{5}\left(\frac{l_1}{d} + \frac{f_2}{f_1}\frac{l_2}{d}\right)$

(g) $P_1 d = \sqrt{\frac{2}{3} \frac{f_2}{(f_1 + f_2)} f_y}$

where

P_1 = $0.8 f_1$

d = bolt diameter, mm

l_1 = side member thickness, mm

f_1 = embedding strength of main member, MPa

l_2 = main member thickness, mm

f_2 = embedding strength of side member, MPa

f_y = bolt yield strength, MPa

= 310 MPa for ASTM A 307 bolts

Wood member embedding strength:

f_1 = 63G (1–0.01d), for parallel-to-grain loading

f_2 = 27.4G (1–0.01d), for perpendicular-to-grain loading

G = mean relative density (Table A10.1)