Table 1 General Dowel Equations

Yield Mode	Single Shear	Double Shear	Description
I_m	$P = q_m \ell_m$	$P = q_m \ell_m$	Main member bearing
I_s	$P = q_s \ell_s$	$P = 2q_s \ell_s$	Side member bearing
II-IV	$P = \frac{-B + \sqrt{B^2 - 4AC}}{2A}$	$P = \frac{-B + \sqrt{B^2 - 4AC}}{A}$	General equation for member bearing and dowel yielding

Inputs A, B, & C for Yield Modes II-IV

	A	B	C	
II[1]	$A = \frac{1}{4q_s} + \frac{1}{4q_m}$	$B = \frac{\ell_s}{2} + g + \frac{\ell_m}{2}$	$C = -\frac{q_s \ell_s^2}{4} - \frac{q_m \ell_m^2}{4}$	Side and main member bearing
III_m[1,2]	$A = \frac{1}{2q_s} + \frac{1}{4q_m}$	$B = g + \frac{\ell_m}{2}$	$C = -M_s - \frac{q_m \ell_m^2}{4}$	Main member bearing and dowel yielding in the side member
III_s[2]	$A = \frac{1}{4q_s} + \frac{1}{2q_m}$	$B = \frac{\ell_s}{2} + g$	$C = -\frac{q_s \ell_s^2}{4} - M_m$	Side member bearing and dowel yielding in the main member
IV[2]	$A = \frac{1}{2q_s} + \frac{1}{2q_m}$	$B = g$	$C = -M_s - M_m$	Dowel yielding in the side and main member

Notes:

P = nominal lateral connection value, lbs.
ℓ_s = side member dowel bearing length, in.
ℓ_m = main member dowel bearing length, in.
q_s = side member dowel-bearing resistance= $F_{es}D$, lbs./in.
q_m = main member dowel-bearing resistance= $F_{em}D$, lbs./in.
F_{es} = side member dowel-bearing strength, psi
F_{em} = main member dowel-bearing strength, psi
g = gap between members, in.
D = dowel shank diameter, in.
F_b = dowel bending strength, psi
D_s = dowel diameter at max. stress in side member, in.
D_m = dowel diameter at max. stress in main member, in.
M_s = side member dowel moment resistance[2], in-lbs. = $F_b(D_s^3/6)$
M_m = main member dowel moment resistance[2], in-lbs.= $F_b(D_m^3/6)$

[1]Yield Modes II and III_m are not applicable to double shear connections.
[2]For proportional limit values, $M_s = F_{b,pl}(\pi D_s^3/32)$ and $M_m = F_{b,pl}(\pi D_m^3/32)$.

Table 2 Reduction Terms Adjusting $P_{5\%}$ Values to Nominal Design Values

Fastener Type	Yield Mode	Reduction Term
Bolts, drift pins	I_m, I_s	$4K_\theta$
	II	$3.6K_\theta$
	III_m, III_s, IV	$3.2K_\theta$
Lag screws	I_m†, I_s	$4K_\theta$
	II†, III_m†, III_s	$2.8K_\theta$
	IV	$3K_\theta$
Nails, spikes	I_m†, I_s, II†, III_m, III_s, IV	K_D
Wood screws	I_m†, I_s, II†, III_m†, III_s, IV	K_D

Notes:

$K_\theta = 1 + 0.25(\theta/90)$
θ = maximum angle of load to grain ($0^\circ \le \theta \le 90^\circ$) for any member in a connection
D = fastener shank diameter

$K_D = 2.2$ for $D \le 0.17$”
$K_D = 10D + 0.5$ for $0.17” < D < 0.25”$
$K_D = 3.0$ for $D \ge 0.25”$

†Yield modes and corresponding reduction terms are not provided in the NDS.

E1