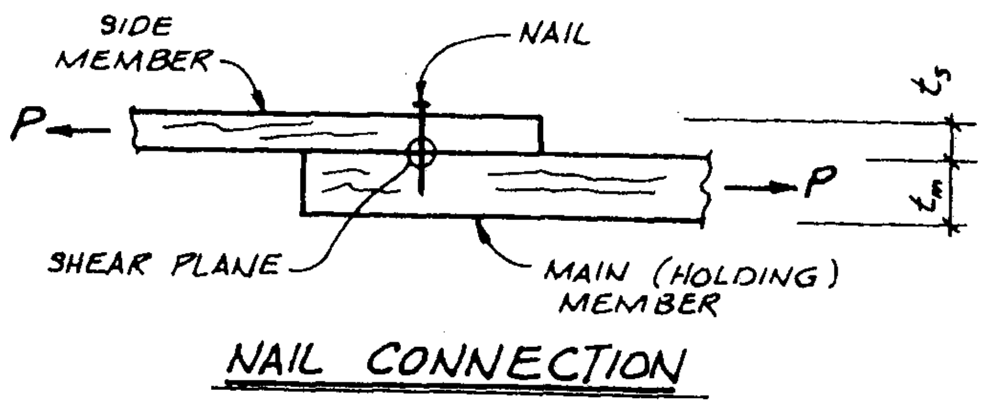
Wood Connections

CE479

Types of Connections

- Yield Limit Model- For Dowel Type Connections (first introduced in 1991 NDS) Laterally loaded connections relying on metal to wood bearing for transfer of lateral loads (shear connections). Load applied perpendicular to the length of the fastener.
  - Single shear
  - Double shear



- Z = nominal design value for single fastener subjected to lateral shear load

Types of Connections

- Connections relying on friction or mechanical interfaces for transfer of axial (withdrawal) loads. These are loads applie parallel to the length of the fastener.

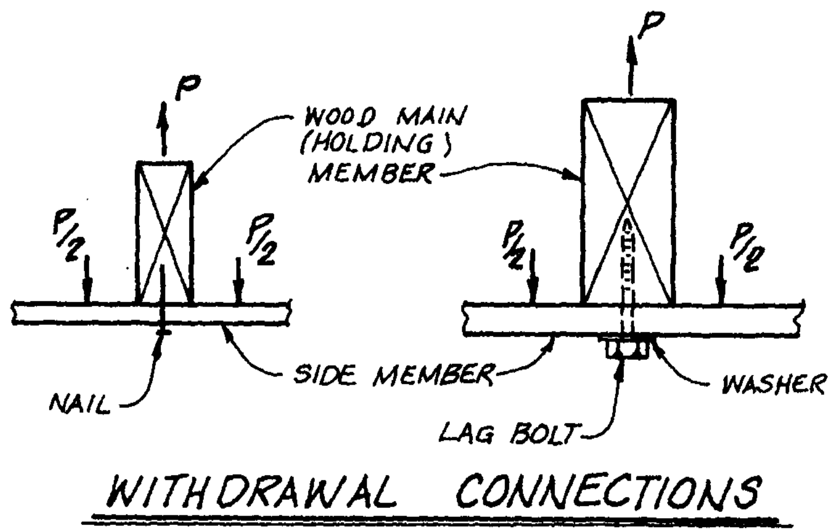


Figure 11.2a Nail and lag bolt connections subject to withdrawal loading.

- W = nominal design value for single fastener subjected to withdrawal load

Types of Fasteners

- Nails
- Bolts
- Lag Bolts or lag screws
- Split ring and shear plate connectors

Adjusted Value: Z’

- Shear Connections: the term nominal shear strength refers to the basic load capacity as defined in the NDS (Chapter 11)- Table 11.3.1A. However, these values apply to a given set of conditions and need to be adjusted to fit the actual conditions.
- Z’ = Z x adjustment factors (Table 10.3.1 NDS-01)

Failure Modes:

Appendix I NDS-01

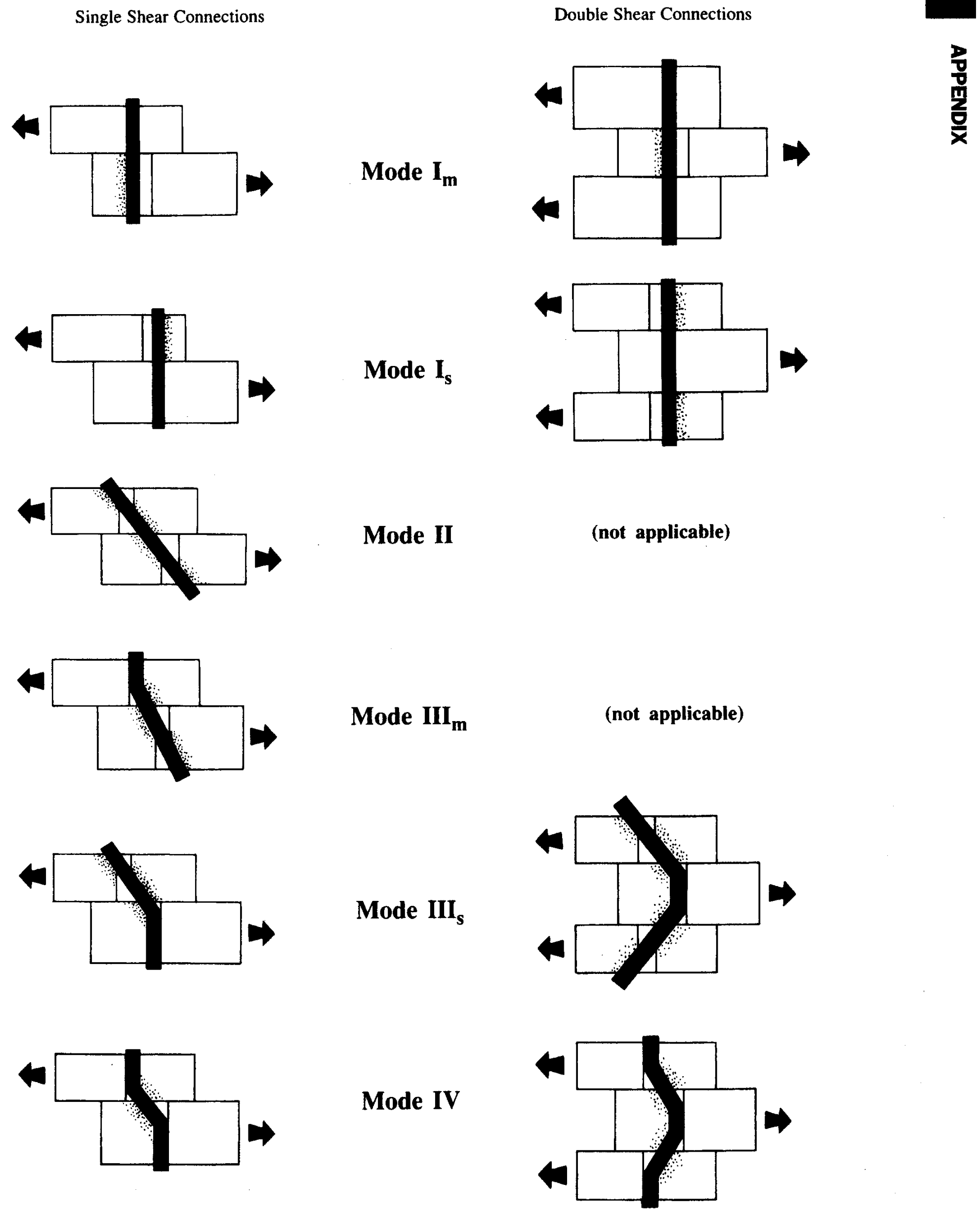
Im and Is: bearing modes

II: pivoting of the fastener with some bearing

IIIm and IIIs: fastener yield and some wood bearing failure

IV: fastener yielding at two plastic hinge points per shear plane and some localized wood crushing

Figure I1 (Non-mandatory) Connection Yield Modes



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Design Equations

Table 11.3.1A Yield Limit Equations

Yield Mode	Single Shear		Double Shear	
I_m	$Z=\dfrac{D\ell_m F_{em}}{R_d}$	(11.3-1)	$Z=\dfrac{D\ell_m F_{em}}{R_d}$	(11.3-7)
I_s	$Z=\dfrac{D\ell_s F_{es}}{R_d}$	(11.3-2)	$Z=\dfrac{2D\ell_s F_{es}}{R_d}$	(11.3-8)
II	$Z=\dfrac{k_1 D\ell_s F_{es}}{R_d}$	(11.3-3)		
III_m	$Z=\dfrac{k_2 D\ell_m F_{em}}{(1+2R_e)R_d}$	(11.3-4)		
III_s	$Z=\dfrac{k_3 D\ell_s F_{em}}{(2+R_e)R_d}$	(11.3-5)	$Z=\dfrac{2k_3 D\ell_s F_{em}}{(2+R_e)R_d}$	(11.3-9)
IV	$Z=\dfrac{D^2}{R_d}\sqrt{\dfrac{2F_{em}F_{yb}}{3(1+R_e)}}$	(11.3-6)	$Z=\dfrac{2D^2}{R_d}\sqrt{\dfrac{2F_{em}F_{yb}}{3(1+R_e)}}$	(11.3-10)

Note:

Constants and Defenitions

Note:

$$k_1 = \frac{\sqrt{R_e + 2R_e^2(1+R_t+R_t^2) + R_t^2 R_e^3} - R_e(1+R_t)}{(1+R_e)}$$

$$k_2 = -1 + \sqrt{2(1+R_e) + \frac{2F_{yb}(1+2R_e)D^2}{3F_{em}\ell_m^2}}$$

$$k_3 = -1 + \sqrt{\frac{2(1+R_e)}{R_e} + \frac{2F_{yb}(2+R_e)D^2}{3F_{em}\ell_s^2}}$$

D = diameter, in. (see 11.3.6)
F_{yb} = dowel bending yield strength, psi
R_d = reduction term (see Table 11.3.1B)
R_e = F_{em}/F_{es}
R_t = ℓ_m/ℓ_s
ℓ_m = main member dowel bearing length, in.
ℓ_s = side member dowel bearing length, in.
F_{em} = main member dowel bearing strength, psi (see Table 11.3.2)
F_{es} = side member dowel bearing strength, psi (see Table 11.3.2)

Dowel Bending Yield Strength

Table I1 Fastener Bending Yield Strengths, F_{yb}

Fastener Type	F_{yb} (psi)
Bolt, lag screw (with $D \geq 3/8"$), drift pin (SAE J429 Grade 1- F_y = 36,000 psi and F_u = 60,000 psi)	45,000
Common, box, or sinker nail, spike, lag screw, wood screw (low to medium carbon steel)	
$0.099" \leq D \leq 0.142"$	100,000
$0.142" < D \leq 0.177"$	90,000
$0.177" < D \leq 0.236"$	80,000
$0.236" < D \leq 0.273"$	70,000
$0.273" < D \leq 0.344"$	60,000
$0.344" < D \leq 0.375"$	45,000
Hardened steel nail (medium carbon steel)	
$0.120" \leq D \leq 0.142"$	130,000
$0.142" < D \leq 0.192"$	115,000
$0.192" < D \leq 0.207"$	100,000