


**AMERICAN
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ASSOCIATION**

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AMERICAN WOOD COUNCIL 
Engineered and Traditional Wood Products **WOOD WORKS**

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1995 ERRATA
to
1993 Edition of
COMMENTARY
on the
NATIONAL DESIGN SPECIFICATION® (NDS®)
FOR WOOD CONSTRUCTION
1991 EDITION

The following pages replace corresponding existing pages of the *NDS Commentary*. Shaded text indicates provisions that have changed.

Example C3.3-1

A Select Structural Southern Pine 4×16 beam on a 20 ft span supports a hoist located at the center of the span. Determine the maximum allowable load on the hoist (including its weight) based on bending. Assume normal load duration. Lateral support is provided at the ends only.

$$F_b = 1900 \text{ psi} \quad E = 1,800,000 \text{ psi} \quad (\text{Table 4B})$$

$$C_F = (0.9)(1.1) \quad C_D = 1.0 \quad A = 53.38 \text{ in}^2 \quad S = 135.7 \text{ in}^3$$

Beam Stability Factor C_L (3.3.3)

$$F_b' = F_b C_D C_F = (1900)(1.0)(0.9)(1.1) = 1880 \text{ psi}$$

$$\ell_u/d = (20)(12)/(15.25) = 15.7 > 7$$

$$\ell_e = 1.37\ell_u + 3d \quad (\text{Table 3.3.3})$$

$$= 1.37(20)(12) + 3(15.25) = 374.6 \text{ in.}$$

$$R_B = \sqrt{\frac{\ell_e d}{b^2}} = \sqrt{\frac{(374.6)(15.25)}{(3.5)^2}} = 21.6$$

$$K_{bE} = 0.438$$

$$F_{bE} = \frac{K_{bE} E'}{R_B^2} = \frac{(0.438)(1,800,000)}{(21.6)^2} = 1691 \text{ psi}$$

$$C_L = \frac{1+(F_{bE}/F_b')}{1.9} - \sqrt{\left[\frac{1+(F_{bE}/F_b')}{1.9}\right]^2 - \frac{F_{bE}/F_b'}{0.95}}$$

$$= \frac{1+1691/1880}{1.9} - \sqrt{\left[\frac{1+1691/1880}{1.9}\right]^2 - \frac{1691/1880}{0.95}}$$

$$= 0.770$$

Allowable Bending Design Value, F_b' (Table 2.3.1)

$$F_b' = F_b C_D C_L C_F = (1900)(1.0)(0.770)(0.9)(1.1)$$

$$= 1448 \text{ psi}$$

Maximum Moment

Assume density of beam = 37.5 lb/ft³
 weight of beam = (37.5)(53.38/144) = 13.9 lb/ft
 hoist plus payload = P

$$M_{max} = P\ell/4 + w\ell^2/8$$

$$= (P)(20)(12)/4 + (13.9)(20)^2(12)/8$$

$$= 60P + 8340$$

Maximum Allowable Load

$$M_{allow.} = F_b' S$$

Substituting,

$$P = (F_b' S - 8340)/60$$

$$= ((1448)(135.7) - 8340)/60$$

$$= 3136 \text{ lb} \sim 3100 \text{ lb}$$

Total allowable concentrated load = 3100 lb (hoist plus payload)

Example C3.3-2

A Select Structural Southern Pine 2×14 beam on a 16 ft span carries five 500 lb (DL+SL) concentrated loads from purlins spaced at 32 in. on center (1/6 points). Determine if the member is adequate for bending. Lateral support is provided at the purlins and the supports.

$$F_b = 1900 \text{ psi} \quad E = 1,800,000 \text{ psi} \quad (\text{Table 4B})$$

$$C_F = 0.9 \quad C_D = 1.15 \quad A = 19.88 \text{ in}^2 \quad S = 43.89 \text{ in}^3$$

Beam Stability Factor C_L (3.3.3)

$$F_b' = F_b C_D C_F = (1900)(1.15)(0.9) = 1967 \text{ psi}$$

$$\ell_u = 32 \text{ in.}$$

$$\ell_e = 1.73\ell_u = 1.73(32) = 55.4 \text{ in.} \quad (\text{Table 3.3.3})$$

$$R_B = \sqrt{\frac{\ell_e d}{b^2}} = \sqrt{\frac{(55.4)(13.25)}{(1.5)^2}} = 18.1$$

$$K_{bE} = 0.438$$

$$F_{bE} = \frac{K_{bE} E'}{R_B^2} = \frac{(0.438)(1,800,000)}{(18.1)^2} = 2418 \text{ psi}$$

$$C_L = \frac{1+(F_{bE}/F_b')}{1.9} - \sqrt{\left[\frac{1+(F_{bE}/F_b')}{1.9}\right]^2 - \frac{F_{bE}/F_b'}{0.95}}$$

$$= \frac{1+2418/1967}{1.9} - \sqrt{\left[\frac{1+2418/1967}{1.9}\right]^2 - \frac{2418/1967}{0.95}}$$

$$= 0.886$$

Allowable Bending Design Value, F_b' (Table 2.3.1)

$$F_b' = F_b C_D C_L C_F = (1900)(1.15)(0.886)(0.9)$$

$$= 1742 \text{ psi}$$

(cont.)

the highest E value grade and species of visually graded lumber was used, the 1977 C_T equations were applicable to all grades and species of this material. Machine stress rated lumber has higher E grades than the highest such grade for visually graded material and the coefficient of variation associated with machine stress rated E values is only 11 percent. Therefore many of the stiffer grades of machine stress rated lumber had a higher 5 percent exclusion value of E than that used in the derivation of the 1977 equations. As a result, the equations were applicable only to those machine stress rated grades having a design E of 1,400,000 psi or less.

Based on additional analyses of the effects of various levels of chord E on the stiffness contribution of sheathing to chord buckling (79), the C_T equations were revised in the 1982 edition to apply to all grades of machine stress rated lumber and to any grade or species of visually graded lumber. As shown below, the equations are entered with a nominal 5 percent exclusion value, $E_{0.05}$, which is computed from tabulated E values (Tables 4A, 4B and 4C) as

$$E_{0.05, 1977} = [1 - 1.645(0.25)] E_{table} = 0.59 E_{table}$$

and

$$E_{0.05, 1982} = [1 - 1.645(0.11)] E_{table} = 0.82 E_{table}$$

for visually graded and machine stress rated material, respectively.

For lumber dry at time of plywood attachment:

$$C_T = 1 + \frac{2300 l_e}{E_{0.05}} \quad (C4.4-12)$$

For lumber unseasoned or partially seasoned at time of plywood attachment:

$$C_T = 1 + \frac{1200 l_e}{E_{0.05}} \quad (C4.4-13)$$

The 1982 C_T equations have been carried forward unchanged to the 1991 edition. Application is limited to 2 inch thick lumber 4 inches or less in depth. The equations have not been verified beyond chord lengths of 96 inches and therefore, C_T factors for longer chord lengths should be based on a length of 96 inches.

The C_T adjustment for E is intended for use in checking loads on the chords of trusses subject to combined bending and compression. The interaction equation of 3.9.2 is entered with an F_c' allowable stress and Euler buckling stress in the primary (d_1) plane of bending computed with E' equal to $C_T E$.

The equations of 4.4.3 apply only to plywood sheathing panels. Buckling stiffness factors for other types of structural panels, which have different nail load-slip relationships than plywood, have not been established.

4.4.3.2 The design of triangular and parallel chord wood trusses made with metal connector plates are governed by specific national standards of practice for these components (186,187). Such practices employ provisions of this Specification that relate to the performance characteristics of individual pieces of lumber used as chord or web members.

Example C12.1-1

Yield mode lateral design values for wood-to-wood single shear nailed connections:

Single and mixed species joints of southern pine and spruce-pine-fir made with 8d common nails in side member thicknesses of 3/8, 1/2 and 5/8 inches and with 60d common nails in side member thicknesses of 1/2, 1-1/2, and 2-1/2 inches

- F_{em}, F_{es} = 5550 psi southern pine (SP)
- = 3350 psi spruce-pine-fir (SPF)
- F_{yb} = 100,000 psi 8d
- = 70,000 psi 60d
- D = 0.131 8d
- = 0.263 60d
- K_D = 2.2 8d
- = 3.0 60d
- p = nail length - side member thickness

Nail Penny- Weight	Side Member Thickness in.	Species		Yield Mode Design Values, lbs			
		Main	Side	ZI _i	ZIII _m	ZIII _i	ZIV
8d	3/8	SP	SP	124	242	<u>78</u>	106
		SPF	SP	124	160	<u>69</u>	92
		SP	SPF	75	219	<u>65</u>	92
		SPF	SPF	75	149	<u>59</u>	82
	1/2	SP	SP	165	229	<u>85</u>	106
		SPF	SP	165	152	<u>76</u>	92
		SP	SPF	100	207	<u>68</u>	92
		SPF	SPF	100	141	<u>61</u>	82
	5/8	SP	SP	207	216	<u>94</u>	106
		SPF	SP	207	144	<u>84</u>	92
		SP	SPF	125	195	<u>72</u>	92
		SPF	SPF	125	134	<u>65</u>	82
60d	1/2	SP	SP	243	905	<u>188</u>	262
		SPF	SP	243	593	<u>165</u>	228
		SP	SPF	147	821	161	228
		SPF	SPF	147	551	<u>144</u>	204
	1-1/2	SP	SP	730	745	288	<u>262</u>
		SPF	SP	730	491	260	<u>228</u>
		SP	SPF	441	676	<u>207</u>	228
		SPF	SPF	441	456	<u>191</u>	204
	2-1/2	SP	SP	1216	588	433	<u>262</u>
		SPF	SP	1216	391	392	<u>228</u>
		SP	SPF	734	533	294	<u>228</u>
		SPF	SPF	734	363	272	<u>204</u>

this will result in significant underestimation of joint capacity.

Comparison of 1991 and Earlier Edition Lateral Design Values. Differences in lateral design values for single shear nailed connections in the 1991 and 1986 editions resulting from the change to the yield limit model and the use of individual species rather than fastener group values is illustrated in Table C12.3-1.

Table C12.3-1 - Comparison of 1991 and 1986 NDS Wood-to-Wood Single Shear Nail Lateral Design Values

Side Member Thick- ness, in.	Nail Penny- Weight	Nail Diam. in.	Nail Lateral Design Value, lbs					
			Southern Pine		Spruce-Pine-Fir			
			1991	1986	Ratio	1991	1986	Ratio
Box Nails:								
1/2	8d	0.113	67	63	1.06	47	51	0.92
	20d	0.148	101	94	1.07	73	77	0.95
3/4	8d	0.113	79	63	1.25	57	51	1.12
	20d	0.148	121	94	1.29	83	77	1.08
Common Nails:								
1/2	8d	0.131	85	78	1.09	61	64	0.95
	20d	0.192	137	139	0.99	103	114	0.90
1-1/2	20d	0.192	185	139	1.33	144	114	1.26
	60d	0.263	262	223	1.17	191	182	1.05
Threaded Hardened Nails:								
1/2	8d	0.120	80	78	1.03	58	64	0.91
	20d	0.177	147	139	1.06	111	114	0.97
1-1/2	16d	0.148	145	108	1.34	113	88	1.28
	70d	0.207	227	176	1.30	171	144	1.19
Spikes:								
1/2	20d	0.225	162	176	0.92	123	144	0.85
	60d	0.283	201	248	0.81	155	203	0.76
1-1/2	40d	0.263	262	223	1.17	191	182	1.05
	3/8	0.375	428	379	1.13	290	310	1.07

The consistently higher 1991/1986 lateral design value ratios for the 3/4 and 1-1/2 inch side member thicknesses relative to the ratios for the 1/2 inch side member thickness reflect the use of side member thickness as a variable in the yield mode equations whereas previous lateral design values were independent of member thickness. The generally lower lateral design value ratios for the fasteners with diameters over 0.25 inches relative to those with diameters less than 0.17 inches represents the effect of the larger K_D factor (3.0) used in the yield mode equations for the former as compared to the factor (2.2) used with the latter.