AMERICAN WOOD COUNCIL

January 2021

ERRATA
to the 2018 and Prior Editions of
the National Design Specification® (NDS®) for Wood Construction

Page	**Revision**
91	Revise footnote 1 in Table 12.5.1D as follows:

1. The ℓ/D ratio used to determine the minimum ~~edge distance~~ spacing between rows shall be the lesser of:
   (a) length of fastener in wood main member/D = ℓ_m/D
   (b) total length of fastener in wood side member(s)/D = ℓ_s /D

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AMERICAN WOOD COUNCIL

July 2020

ERRATA
to the 2018 and Prior Editions of
the National Design Specification® (NDS®) for Wood Construction

Page	**Revision**
166	Clarifies that the following calculations in Example E.7 Sample Solution of Row of Bolts is intended for a single-row bolted connection with a 3-1/2″ thick main member and 1-1/2″ thick side member:

E.7 Sample Solution of Row of Bolts

Calculate the net section area tension and row tear-out adjusted ASD design capacities for the single-shear single-row bolted connection represented in Figure E2.

Main and Side Members:
#2 grade Hem-Fir ~~2x4~~ lumber. See *NDS Supplement* Table 4A – Visually Graded Dimension Lumber for reference design values. Adjustment factors C_D, C_T, C_M, and C_i are assumed to equal 1.0 in this example for calculation of adjusted design values.

$F_t' = 525 \text{ psi } (C_F) = 525(1.5) = 788 \text{ psi}$

$F_v' = 150 \text{ psi}$

Connection Details:
Bolt diameter, D: 1/2 in.
Bolt hole diameter, D_h: 0.5625 in.
Adjusted ASD bolt design value, $Z_{||}'$: 550 lbs
(See NDS Table 12A for 3-1/2″ main member thickness and 1-1/2″ side member thickness. For this trial design, the group action factor, C_g, is taken as 1.0).

Adjusted ASD Connection Capacity, n $Z_{||}'$:

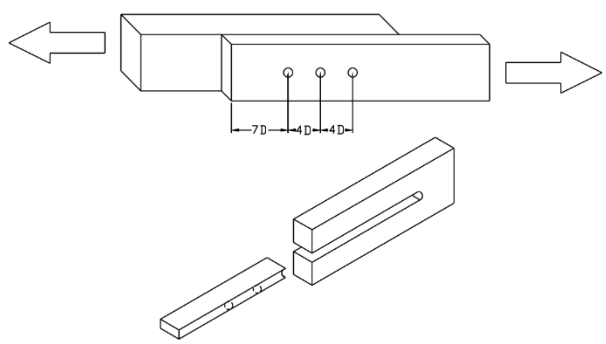
$nZ_{||}' = (3 \text{ bolts})(550 \text{ lbs}) = 1{,}650 \text{ lbs}$

~~Adjusted~~ For side member, adjusted ASD Net Section Area Tension Capacity, Z_{NT}':

$Z_{NT}' = F_t' \, t \, [w - n_{row} D_h]$

$Z_{NT}' = (788 \text{ psi})(1.5″)[3.5″ - 1(0.5625″)] = 3{,}470 \text{ lbs}$

Figure E2 Single Row of Bolts



~~Adjusted~~ For side member, adjusted ASD Row Tear-Out Capacity, Z_{RT}':

$Z_{RTi}' = n_i F_v' \, t s_{critical}$

$Z_{RT1}' = 3(150 \text{ psi})(1.5″)(2″) = 1{,}350 \text{ lbs}$

In this sample calculation, the adjusted ASD connection capacity is limited to 1,350 pounds by row tear-out, Z_{RT}'.

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Engineered and Traditional Wood Products

March 2002

2002 ADDENDUM
to the
1997 NDS and PRIOR EDITIONS

The 2001 Edition of the *National Design Specification®(NDS®) for Wood Construction* contains editorially clarified provisions for checking stresses in members at connections. The following requirements, included in the *2001 NDS*, are also applicable to all prior editions of the *NDS*:

Stresses in Members at Connections - Structural members shall be checked for load carrying capacity at connections in accordance with all applicable provisions of the *NDS*. Local stresses in connections using multiple fasteners shall be checked in accordance with principles of engineering mechanics.

One method for determining these stresses is provided in the attached Appendix E from the *2001 NDS*. All referenced sections and design values used in sample solutions of this Addendum are based on information in the *2001 NDS*.

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Appendix E (Non-mandatory) Local Stresses in Fastener Groups

E.1 General

Where a fastener group is composed of closely-spaced fasteners loaded parallel to grain, the capacity of the fastener group may be limited by wood failure at the net section or tear-out around the fasteners caused by local stresses. One method to evaluate member strength for local stresses around fastener groups is outlined in the following procedures.

E.1.1 Tabulated nominal design values for timber rivet connections in Chapter 13 account for local stress effects and do not require further modification by procedures outlined in this Appendix.

E.1.2 The capacity of connections with closely-spaced, large diameter bolts has been shown to be limited by the capacity of the wood surrounding the connection. Connections with groups of smaller diameter fasteners, such as typical nailed connections in wood-frame construction, may not be limited by wood capacity.

E.2 Net Section Tension Capacity

The allowable tension capacity is calculated in accordance with provisions of 3.1.2 and 3.8.1 as follows:

$$Z_{NT}' = F_t' A_{net} \qquad \text{(E.2-1)}$$

where:

Z_{NT}' = allowable tension capacity of net section area

F_t' = allowable tension design value parallel to grain

A_{net} = net section area per 3.1.2

E.3 Row Tear-Out Capacity

The allowable tear-out capacity of a row of fasteners can be estimated as follows:

$$Z_{RT_i}' = n_i \frac{F_v' A_{critical}}{2} \qquad \text{(E.3-1)}$$

where:

Z_{RTi}' = allowable row tear out capacity of row i

F_v' = allowable shear design value parallel to grain

$A_{critical}$ = minimum shear area of any fastener in row i

n_i = number of fasteners in row i

E3.1 Assuming one shear line on each side of bolts in a row (observed in tests of bolted connections), Equation E.3-1 becomes:

$$\begin{aligned} Z_{RT_i}' &= \frac{F_v' t}{2}[n_i S_{critical}](2 \text{ shear lines}) \\ &= n_i F_v' t S_{critical} \end{aligned} \qquad \text{(E.3-2)}$$

where:

$S_{critical}$ = minimum spacing in row i taken as the lesser of the end distance or the spacing between fasteners in row i

t = thickness of member

The total allowable row tear-out capacity of multiple rows of fasteners can be estimated as:

$$Z_{RT}' = \sum_{i=1}^{n_{row}} Z_{RT_i}' \qquad \text{(E.3-3)}$$

where:

Z_{RT}' = allowable row tear out capacity of multiple rows

n_{row} = number of rows

E.3.2 In Equation E.3-1, it is assumed that the induced shear stress varies from a maximum value of $f_v = F_v'$ to a minimum value of $f_v = 0$ along each shear line between fasteners in a row and that the change in shear stress/strain is linear along each shear line. The resulting triangular stress distribution on each shear line between fasteners in a row establishes an apparent shear stress equal to half of the design shear stress, $F_v'/2$, as shown in Equation E.3-1. This assumption is combined with the critical area concept for evaluating stresses in fastener groups and provides good agreement with results from tests of bolted connections.

E3.3 Use of the minimum shear area of any fastener in a row for calculation of row tear-out capacity is based on the assumption that the smallest shear area between fasteners in a row will limit the capacity of the row of fasteners. Limited verification of this approach is provided from tests of bolted connections.

E.4 Group Tear-Out Capacity

The allowable tear-out capacity of a group of "n" rows of fasteners can be estimated as:

$$Z_{GT}' = \frac{Z_{RT-1}'}{2} + \frac{Z_{RT-n}'}{2} + F_t' A_{group-net} \qquad \text{(E.4-1)}$$

where:

Z_{GT}' = allowable group tear-out capacity

Z_{RT-1}' = allowable row tear-out capacity of Row 1 of fasteners bounding the critical group area

Z_{RT-n}' = allowable row tear-out capacity of Row n of fasteners bounding the critical group area

$A_{group-net}$ = critical group net section area between Row 1 and Row n

E.4.1 For groups of fasteners with non-uniform spacing between rows of fasteners various definitions of critical group area should be checked for group tear-out in combination with row tear-out to determine the allowable capacity of the critical section.

E.5 Effects of Fastener Placement

E 5.1 Modification of fastener placement within a fastener group can be used to increase row tear-out and group tear-out capacity limited by local stresses around the fastener group. Increased spacing between fasteners in a row is one way to increase row tear-out capacity. Increased spacing between rows of fasteners is one way to increase group tear-out capacity.

E 5.2 Footnote 2 to Table 11.5.1D limits the spacing between outer rows of fasteners paralleling the member on a single splice plate to 5 inches. This requirement is imposed to limit local stresses resulting from shrinkage of wood members. When special detailing is used to address shrinkage, such as the use of slotted holes, the 5 inch limit can be adjusted.

E.6 Sample Solution of Staggered Bolts

Calculate the net section area tension, row tear-out, and group tear-out allowable design capacities for the double-shear bolted connection in Figure E1.

Main Member:
Combination 3 Douglas fir 3-1/8 x 12 glued laminated timber member
$F_t' = 1450$ psi
$F_v' = 240$ psi
Main member thickness, t_m: 3.125 inches
Main member width, w: 12 inches

Side Member:
A36 steel plates on each side
Side plate thickness, t_s: 0.25 inches

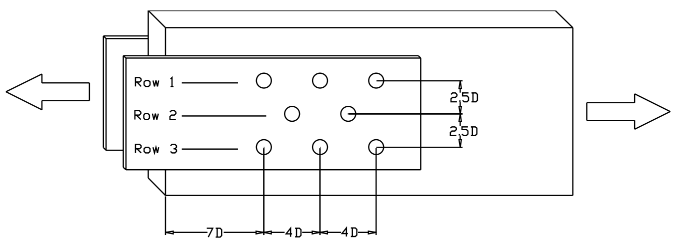
Connection Details:
Bolt diameter, D: 1 inch
Bolt hole diameter, D_h: 1.0625 inches

Allowable bolt design value, $Z_{||}'$: 4380 lbs. (see NDS Table 11I. For this trial design, the group action factor, C_g, is taken as 1.0).
Spacing between rows: $S_{row} = 2.5D$

Allowable Connection Capacity, $nZ_{||}'$:

$nZ_{||}' = (8 \text{ bolts})(4380 \text{ lbs.}) = 35{,}040$ lbs.

Figure E1 Staggered Rows of Bolts



Allowable Net Section Area Tension Capacity, Z_{NT}':

$$Z_{NT}' = F_t' t[w - n_{row} D_h]$$

$Z_{NT}' = (1450 \text{ psi})(3.125")[12"-3(1.0625")] = 39{,}930$ lbs.

Allowable Row Tear-Out Capacity, Z_{RT}':

$$Z_{RT_i}' = n_i F_v' t S_{critical}$$

$Z_{RT-1}' = 3(240 \text{ psi})(3.125")(4") = 9{,}000$ lbs.

$Z_{RT\text{-}2}' = 2(240\text{ psi})(3.125")(") = 6{,}000\text{ lbs.}$

$Z_{RT\text{-}3}' = 3(240\text{ psi})(3.125")(4") = 9{,}000\text{ lbs.}$

$$Z_{RT}' = \sum_{i=1}^{n_{row}} Z_{RT_i}' = 9{,}000 + 6{,}000 + 9{,}000 = 24{,}000\text{ lbs.}$$

Allowable Group Tear-Out Capacity, Z_{GT}':

$$Z_{GT}' = \frac{Z_{RT-1}'}{2} + \frac{Z_{RT-3}'}{2} + F_t' t[(n_{row} - 1)(S_{row} - D_h)]$$

$$\begin{aligned} Z_{GT}' = &\ (9{,}000\text{ lbs.})/2 + (9{,}000\text{ lbs.})/2 + \\ &\ (1450\text{ psi})(3.125")[(3\text{-}1)(2.5"\text{-}1.0625")] \\ = &\ 22{,}030\text{ lbs.} \end{aligned}$$

In this sample calculation, the connection capacity is limited to 22,030 pounds by group tear-out, Z_{GT}'.

E.7 Sample Solution of Row of Bolts

Calculate the net section area tension and row tear-out allowable design capacities for the single-shear single-row bolted connection represented in Figure E2.

Main and Side Members:
#2 grade Hem-Fir 2x4 lumber
$F_t' = 788$ psi
$F_v' = 145$ psi
Main member thickness, $t_{m:}$ 3.5 inches
Side member thickness, t_s: 1.5 inches
Main and side member width, w: 3.5 inches

Connection Details:
Bolt diameter, D: 1/2 inch
Bolt hole diameter, D_h: 0.5625 inches
Allowable bolt design value, $Z_{\|}'$: 550 lbs. (See NDS Table 11A. For this trial design, the group action factor, C_g, is taken as 1.0).

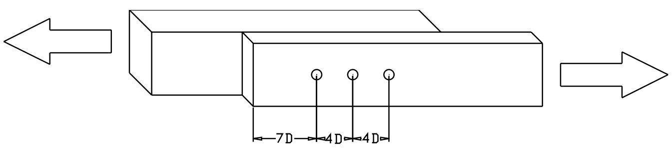
Allowable Connection Capacity, $nZ_{\|}'$:

$nZ_{\|}' = (3\text{ bolts})(550\text{ lbs.}) = 1{,}650\text{ lbs.}$

Allowable Net Section Area Tension Capacity, Z_{NT}':

$$Z_{NT}' = F_t' t[w - n_{row} D_h]$$

Figure E2 Single Row of Bolts



$Z_{NT}' = (788\text{ psi})(1.5")[3.5"\text{-}1(0.5625")] = 3{,}470\text{ lbs.}$

Allowable Row Tear-Out Capacity, Z_{RT}':

$$Z_{RT_i}' = n_i F_v' t S_{critical}$$

$Z_{RT1}' = 3(145\text{ psi})(1.5")(2") = 1{,}310\text{ lbs.}$

In this sample calculation, the connection capacity is limited to 1,310 pounds by row tear-out, Z_{RT}'.

E.8 Sample Solution of Row of Split Rings

Calculate the net section area tension and row tear-out allowable design capacities for the single-shear single-row split ring connection represented in Figure E3.

Main and Side Members:
#2 grade Southern Pine 2x4 lumber
$F_t' = 825$ psi
$F_v' = 175$ psi
Main member thickness, t_m: 1.5 inches
Side member thickness, t_s: 1.5 inches
Main and side member width, w: 3.5 inches

Connection Details:
Split ring diameter, D: 2.5 inch (see Appendix K for connector dimensions)
Allowable split ring design value, P′: 2730 lbs. (see NDS Table 12.2A. For this trial design, the group action factor, C_g, is taken as 1.0).

Allowable Connection Capacity, nP′:

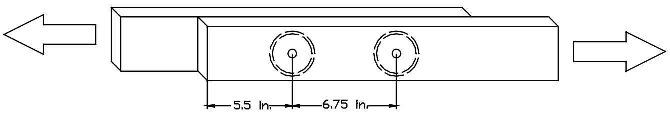
nP′ = (2 split rings)(2730 lbs.) = 5,460 lbs.

Allowable Net Section Area Tension Capacity, Z_{NT}':

$$Z_{NT}' = F_t' A_{net}$$

$$\begin{aligned} Z_{NT}' &= (825 \text{ psi})[5.25 \text{ in.}^2 - 1.5\text{"}\ (0.5625\text{"}) - 1.1 \text{ in.}^2] \\ &= 2{,}728 \text{ lbs.} \end{aligned}$$

Figure E3 Single Row of Split Ring Connectors



Allowable Row Tear-Out Capacity, Z_{RT}':

$$Z_{RT_i}' = n_i \frac{F_v' A_{critical}}{2}$$

$$\begin{aligned} Z_{RT1}' &= [(2 \text{ connectors})(175 \text{ psi})/2\ ] \times [(2 \text{ shear lines})(0.375\text{"})(5.5\text{"}) + (1 \text{ shear line})(17.6 \text{ in.}^2)] \\ &= 3{,}802 \text{ lbs.} \end{aligned}$$

In this sample calculation, the connection capacity is limited to 2,728 pounds by net section area tension capacity, Z_{NT}'.

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2000 Errata/Addendum
to
1997 Edition of

DESIGN VALUES FOR WOOD CONSTRUCTION, a Supplement to the NATIONAL DESIGN SPECIFICATION® (NDS®) FOR WOOD CONSTRUCTION

Page **Revision**

38-42 Revise Table 4D Design values as follows:

Species and Commercial Grade	Size Classification	Design values in pounds per square inch (psi)			Grading Rules Agency
		Bending F_b	Tension F_t	Compression Parallel to Grain F_c	
DOUGLAS FIR-LARCH					
Dense Select Structural	Beams and Stringers	~~1850~~ 1900	1100	1300	WWPA
Dense No. 2 No. 2	Posts and Timbers	~~800~~ 850 ~~700~~ 750	550 475	~~550~~ 825 ~~475~~ 700	WWPA
DOUGLAS FIR-SOUTH					
No. 2	Beams and Stringers	825	425	~~525~~ 550	WWPA
Select Structural No. 2	Posts and Timbers	~~1400~~ 1450 ~~650~~ 675	950 ~~400~~ 450	1050 ~~425~~ 650	WWPA
HEM-FIR					
Select Structural No. 1 No. 2	Beams and Stringers	~~1250~~ 1300 1050 675	~~725~~ 750 525 ~~325~~ 350	925 ~~775~~ 750 ~~475~~ 500	WWPA
No. 1 No. 2	Posts and Timbers	~~950~~ 975 ~~525~~ 575	650 ~~350~~ 375	850 ~~375~~ 575	WWPA
WESTERN CEDARS					
Select Structural	Beams and Stringers	1150	~~700~~ 675	875	WWPA
No. 2	Posts and Timbers	~~500~~ 550	350	~~375~~ 550	WWPA

Future Updates will be available at www.awc.org

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Shear Design Values for Lumber Shear design values for lumber have recently been revised and approved by the American Lumber Standard Committee, in accordance with changes to ASTM Standard D 245, *Establishing Structural Grades and Related Allowable Properties for Visually Graded Lumber*. These new lumber shear design values are higher than earlier assigned values. To obtain more information on new lumber shear design values, contact any of the following agencies:

Canadian Wood CouncilSouthern Pine Inspection BureauWest Coast Lumber Inspection BureauWestern Wood Products Association

Design provisions, including requirements for shear design of lumber, are published by the American Forest & Paper Association (AF&PA) in the *National Design Specification ® for Wood Construction (NDS®)*, an ANSI national consensus standard. NDS shear provisions are being revised in the next edition of the NDS in order to utilize new lumber shear design values. However, until revision of the NDS has been completed, 1997 NDS design provisions are only to be used with design values in the 1997 *NDS Supplement: Design Values for Wood Construction*, or similar values.

Until appropriate revisions to the NDS can be fully implemented, the American Forest & Paper Association recommends the following as guidance when using new shear design values with the 1997 or earlier editions of the NDS:

- The shear stress adjustment factor, C_H, for splits, checks, and shakes does not apply to the new shear design values.
- Tension-side notching equations (3.4-3 & 3.4-4) are only to be applied with 1997 *NDS Supplement* design values. These equations are being revised to permit the use of higher lumber shear design values. Until these design provisions are approved, tension-side notches should be designed using existing 1997 NDS design procedures and 1997 *NDS Supplement* design values.
- Provisions in 3.4.5 on shear design for bending members at connections, including equations (3.4-6 & 3.4-7), are only to be applied with 1997*NDS Supplement* design values. These provisions are being revised to permit the use of higher lumber shear design values. Until these design provisions are approved, shear design for bending members at connections should be in accordance with existing 1997 NDS design procedures and 1997*NDS Supplement* design values.
- Alternate design procedures in 4.4.2 do not apply to new shear design values.

For more information on the new shear design provisions for lumber, contact the American Wood Council (AWC) Helpdesk at 202/463-4713 or email awcinfo@afandpa.org.

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Page **Revision**

32-33 Revise Table 4B as follows:

Species and Commercial Grade	Size Classification
SOUTHERN PINE	
Construction Standard Utility[5]	2" - 4" thick 2" - 4" wide
MIXED SOUTHERN PINE	
Construction Standard Utility[5]	2" - 4" thick 2" - 4" wide

5. Design values apply to 4" widths only.

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2000 Errata
to
1999 Edition of

ASD STRUCTURAL-USE PANELS SUPPLEMENT to the ALLOWABLE STRESS DESIGN (ASD) MANUAL FOR ENGINEERED WOOD CONSTRUCTION

Page	**Revision**
4	Revise section 2.1 under Span Ratings as follows:

Span ratings indicate a maximum recommended support spacing, in inches, for specific applications. The span rating system applies when the panel is applied with the strength axis across ~~two~~ three or more supports. The strength axis is usually the primary axis (which is usually the long dimension) of the panel.

5 Revise section 2.1 under Span Ratings as follows:

Single Floor: The Single Floor span rating is an index number that provides the maximum recommended support spacing with the strength axis across ~~two~~ three or more supports. Typical Single Floor span ratings are 20 oc and 24 oc, although 16 oc, 32 oc, and 48 oc Single Floor panels are also available.

21 Revise Table 4.5 Panel Size Factor, C_s, as follows:

Table 4.5 Panel Size Factor, C_s

Panel Width, w	C_s
w≤8 inches	~~(8+w)/32~~ 0.5
8 inches < w < 24 inches	~~0.5~~ (8+w)/32
w≥24 inches	1.0

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1999 Edition of

ASD STRUCTURAL CONNECTIONS SUPPLEMENT to the ALLOWABLE STRESS DESIGN (ASD) MANUAL FOR ENGINEERED WOOD CONSTRUCTION

Page **Revision**

31 Revise Table 12.3A as follows:

Table 12.3A Common Wire or Box Nail Design Values (Z) for Single Shear (two member) Structural Connections[1,2,3]

Structural panel to lumber with structural panel side members with an effective G=0.50[4]		
Side Member Thickness t_s inches	Penny Weight[6]	
	Common	Box
1	-	6d[~~4~~3]
	6d[~~4~~3]	8d
	8d[~~4~~3]	10d, 12d
1-1/8	-	6d[~~4~~3]
	6d[~~4~~3]	8d
	8d[~~4~~3]	10d, 12d
1-1/4	-	6d[~~4~~3]
	6d[~~4~~3]	8d [~~4~~3]
	8d[~~4~~3]	10d, 12d
	10d [~~4~~3], 12d	20d, 30d

Page **Revision**

32 Revise Table 12.3C as follows:

Table 12.3C Common Wire and Box Nail Lengths, L, and Diameters, D

	30d		40d	
Common Wire Nail	**L, in.**	**D, in.**	**L, in.**	**D, in.**
	4-1/2	**~~0.225~~ 0.207**	**~~5-1/2~~ 5**	**~~0.225~~ 0.244**

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September 1998

1998 Identified Errata
to
1997 Edition of

NATIONAL DESIGN SPECIFICATION® (NDS®)
FOR WOOD CONSTRUCTION ANSI/AF&PA NDS-1997

Page	**Revision**
5	Definition for $Z_{\perp}$ should be:
	$Z_{\perp}$ = nominal lateral design value for a single bolt or lag screw wood-to-wood, wood-to-metal, or wood-to-concrete connection with all wood member(s) loaded perpendicular to grain, lbs.
45	Table 7.3.3 Wet Service Factors, C_M, for Connections, should be revised as follows. (Note: only changes to table are shown)

Fastener Type	Moisture Content		Load	
	At Time of Fabrication	In-Service	Lateral	Withdrawal
Bolts &	~~any~~ ≤ 19%	≤ 19%	1.0~~[3]~~	-
Drift Pins &	> 19%	≤ 19%	0.4[3]	-
Drift Bolts &	any	> 19%	0.7	-
Lag Screws &	~~any~~ ≤ 19%	≤ 19%	1.0~~[3]~~	1.0
Wood Screws	> 19%	≤ 19%	0.4[3]	1.0
	any	> 19%	0.7	0.7

~~3. For two or more rows of bolts or lag screws with single steel side plate(s) installed in wood with moisture content >19% at time of fabrication and ≤ 19% in service, C_M = 0.4.~~

3. C_M = 1.0 for wood screws. For bolt and lag screw connections with: 1) one fastener only, or 2) two or more fasteners placed in a single row parallel to grain, or 3) fasteners placed in two or more rows parallel to grain with separate splice plates for each row, C_M = 1.0.

Page	**Revision**
54	The second sentence of 8.2.3.1 should be revised as follows: "Table 8.2E provides nominal design values for various single shear bolted wood to concrete ~~or masonry~~ connections."
73	In Table 8.3D, “$Z_{1/21/2}$” should be “ZX” and “$Z_{\wedge}$” should be “$Z_{\perp}$”.
89	In Table 10.2B, the heading for the first column should be “Shear plate diameter”.
132	Section 13.1 - General, should be revised as follows: “Design criteria for timber rivet joints apply to timber rivets that satisfy the requirements of 13.1.1 loaded in single shear, with steel side plates on ~~Western Species~~ <u>Douglas Fir - Larch</u> or Southern Pine glued laminated timber manufactured in accordance with ANSI/AITC A190.1-1992 (Reference 4).”
156	Appendix B, item (e) should be: (e) Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives (see Reference 29), or fire retardant chemicals. The impact load duration factor shall not apply to connections.
159	In Equation D-3, “F_{cE}” should be “F_{bE}”.

New Provisions in the *National Design Specification*® (*NDS*®) for Wood Construction

John "Buddy" Showalter, P.E., and Phil Line, P.E.

Introduction

The 1997 edition of the *National Design Specification (NDS) for Wood Construction* has been published by the American Forest & Paper Association's (AF&PA) American Wood Council (AWC). This culminates 5 years of development by the wood products industry to provide state-of-the-art information for wood design, improve the design process, and more accurately reflect the field performance of wood members and connections. This latest edition of the *NDS* was approved as an American National Standard on August 7, 1997, and designated *ANSI/AF&PA NDS-1997*. The *NDS Supplement Design Values for Wood Construction*, an integral part of the *NDS*, has also been updated to provide the latest design values for lumber and glued laminated timber. Changes to the *NDS* include:

- new provisions for timber rivets;
- new provisions for wood-to-concrete connections;
- new provisions for designing notches on the compression face of a bending member;
- new incising adjustment factors;
- simplified wet service factors for connectors;
- new combined lateral/withdrawal equation for nails;
- modification of nail clinching provisions;
- clarification of built-up column provisions;
- revised upper limit on load duration factors for pressure-preservative and fire retardant-treated wood;
- update of lumber and glued laminated timber design values (*NDS Supplement*); and
- permissive language replaced with mandatory language.

Timber Rivets

Timber rivet connections have been used in Canada for decades. New design criteria introduced in Chapter 13 of the *NDS* apply to joints with steel side plates for glued laminated timber made from either Southern Pine or western species. Originally called the "glulam rivet," the term "timber rivet" was chosen to accommodate future application to sawn lumber as well.

The high-strength nails used to attach steel side plates to wood members are rectangular in cross-section (Fig. 1) and must have a minimum ultimate tensile strength of 145,000 psi. Steel side plates must conform to *ASTM A36* (ASTM 1996) and be at least 1/8-inch thick. Timber rivet connections are evaluated for both wood capacity and rivet capacity. Minimum end and edge distance and spacing are prescribed, as well as fabrication sequence. Connection capacities as high as 129,000 pounds can be developed using timber rivets. Joint configurations can be developed to allow parallel-to-grain loads, perpendicular-to-grain loads, or loads at an angle to the grain (Fig. 2).

Wood-to-Concrete Connections

New provisions have been incorporated for wood-to-concrete connections. In previous editions of the *NDS*, a designer assumed a main member thickness (concrete) equal to twice the thickness of the side member (wood), with the same dowel-bearing strength as that of the wood member. In section 8.2.3 of the 1997 *NDS*, connection values may be calculated specifically using dowel-bearing strengths for the wood member and the concrete. Design values are tabulated assuming a concrete dowel-bearing strength of 6,000 psi for concrete with 6 inches and greater embedment depth. Wood member sizes of 1.5, 2.5, and 3.5 inches are tabulated. This will increase bolt design values (Z) by up to 30 percent for some common wood-to-concrete connections (Table 1).

Notches and Taper Cuts

New provisions for compression side notches and taper cuts at the ends of bending members have been added to section 3.4.4.5 of the 1997 *NDS*. These provisions are based on similar provisions included in AITC's *Timber Construc-*

tion Manual (AITC 1994) and apply to both glued laminated timber and dimension lumber. The new provisions recognize that a compression side notch is less severe than a tension side notch, and that a taper cut on the compression side is less severe than a notch on the compression side.

Adjustment Factors for Incised Lumber

New design value adjustment factors for timber and lumber that is incised to increase penetration of preservatives have been added to section 2.3.11 of the *NDS*. These provisions apply to structural sawn lumber with incisions made parallel-to-grain that have a maximum depth of 3/4-inch, a maximum length of 3/8-inch, and a maximum density of 357 incisions per square foot. Reductions are 5 percent for modulus of elasticity and 15 percent for bending, tension, and compression parallel-to-grain design values.

Wet Service Factors for Connectors

Table 7.3.3 of the 1997 *NDS*, which outlines wet service factors for connections, has been simplified from 23 to 15 cases. The technical committees of AF&PA and ANSI determined that the degree of accuracy being portrayed by showing, for example, a 0.75 factor for wood screws "exposed" to moisture in service versus a 0.67 factor for wood screws that are "wet" in service, was too precise. These factors, therefore, were combined to 0.7 for any in-service application where wood moisture content exceeds 19 percent. This change was made to all connectors included in the table. Factors for timber rivets were added to this table as well.

Combined Lateral/Withdrawal Equation for Nails

A new equation for calculating combined lateral/withdrawal design values for nails and spikes was developed consistent with those added to the 1991 *NDS* for wood screws and lag screws. Section 12.3.8 of the 1997 *NDS* incorporates this new provision.

Nail Clinching

Modification of nail clinching provisions to allow only a 1.75 increase instead of 2.0 for double shear nailed connections is included in section 12.3.3 of the latest edition of the *NDS*. Re-evaluation of the research used to develop the original provisions indicated that the increased capacity for clinched nails depended on the quality of the clinch (how far the nail was bent relative to 90°) and the direction of the clinch relative to grain orientation. The technical committees of AF&PA and ANSI determined that the 1.75 factor better reflected test data.

Built-Up Columns

Provisions for built-up columns in section 15.3 of the 1997 *NDS* have been updated to clarify the application of column stability coefficients for nailed and bolted built-up columns. Column stability coefficients, K_f, of 0.6 and 0.75 are applicable to the potential buckling direction perpen-

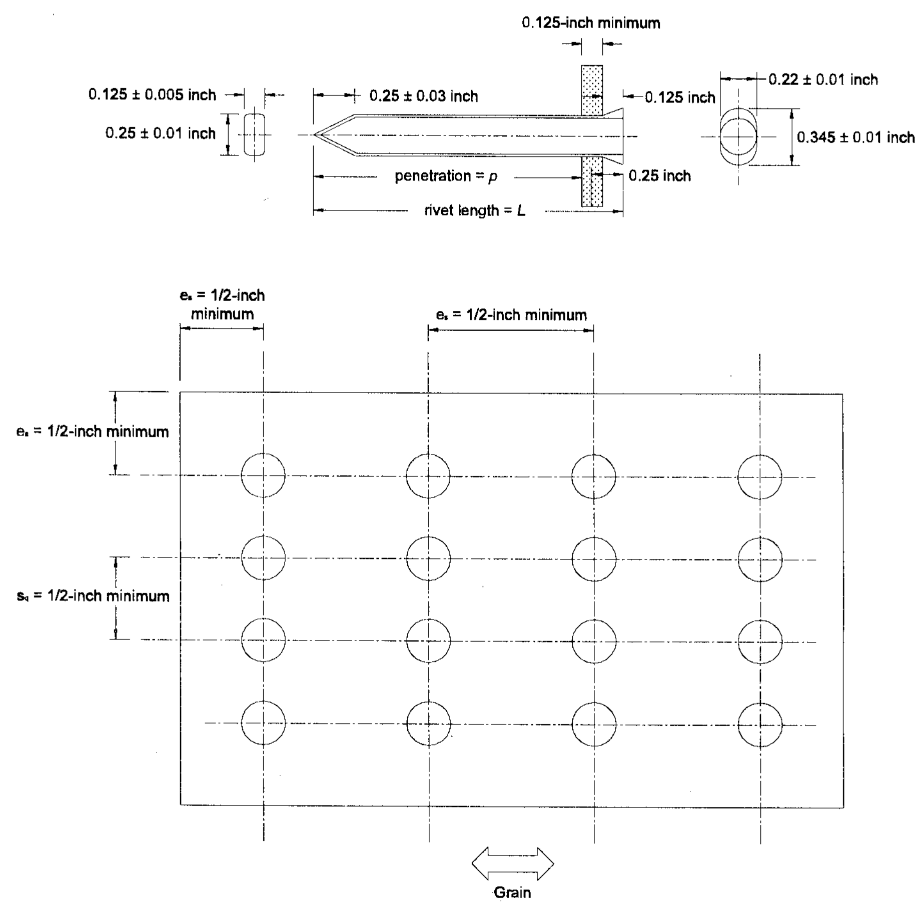

Figure 1.—Timber rivet and steel side plate (AF&PA 1997).

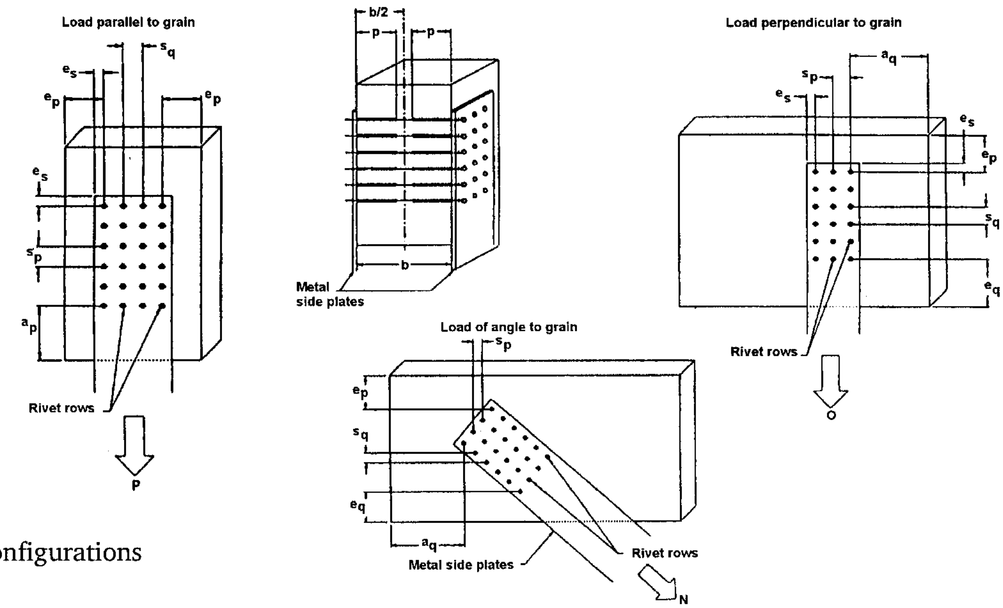

Figure 2.—Timber rivet joint configurations (AF&PA 1997).

Table 1.—Increases in bolt design values (Z) for single shear (two member) wood-to-concrete connections made with Southern Pine (G=0.55)[a].

			1997 NDS		1991 NDS		Ratio 1997/1991	
t_m	t_s	D	$Z_{\|\|}$	$Z_{\perp}$	$Z_{\|\|}$	$Z_{\perp}$	$Z_{\|\|}$	$Z_{\perp}$
---- (in.) ----								
6+	1.5	0.50	660	400	660	360	1.00	1.1
		0.75	1,270	660	1,270	500	1.00	1.3
		1.00	2,140	760	1,740	580	1.23	1.3

[a] Excerpted from Table 8.2E of the 1997 *NDS*; t_m equals embedment depth in concrete, t_s equals thickness of wood member, D equals bolt diameter.

dicular to the weak axis of individual members for nailed and bolted built-up columns, respectively. A column stability coefficient of 1.0 is used for the potential buckling direction parallel to the strong axis of individual members.

Load Duration Factors for Treated Lumber

Recent research at the USDA Forest Products Laboratory, Madison, Wisconsin, indicated that the load duration factor for pressure-preservative treated wood should be limited to 1.6 or less. As a result, footnote 2 of *NDS* Table 2.3.2 now states "Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives, or fire retardant chemicals. The impact load duration factor shall not apply to connections." Frequently used load duration factors for wood design are presented in Table 2.3.2 of the *NDS*.

Design Values for Lumber and Glued Laminated Timber

Design values for lumber and glued laminated timber have been revised to reflect current data from the wood industry. Changes, for the most part, are minor and include rounding increases; new machine stress-rated (MSR) lumber and mechanically evaluated lumber (MEL) grades; higher specific gravity (G), horizontal shear (F_v), and compression perpendicular-to-grain ($F_{c\perp}$) design values for certain MSR and MEL grades; and new glued laminated timber combinations and design values.

New grades of MSR lumber include 1700f-1.6E, 1750f-2.0E, 2250f-1.7E, and 2250f-1.8E. MSR grades that were eliminated include 3150f-2.5E and 3300f-2.6E, and all 6-inch and wider sizes. New grades of MEL include M-5 through M-9, M-28, and M-29. Additionally, design values for certain species and grades of MSR and MEL have increased (Table 2).

New Southern Pine glued laminated timber combinations include 26F visual rated, and 28F and 30F E-rated. Also, compression perpendicular-to-grain values for most Southern Pine glued laminated timber combinations have increased from 650 psi to 740 psi. Horizontal shear values for certain Southern Pine glued laminated timber combinations have increased from 200 psi to 240 psi, and those for Douglas Fir-Larch from 165 psi to 190 psi.

Mandatory Language

Of the 130 changes balloted to the ANSI committee for the *NDS*, approximately two-thirds requested modification of *NDS* language to make the document more suitable for building code enforcement. Some building code policies require mandatory language rather than permissive statements to ensure enforceability. Therefore, terms like "may" were changed to "shall" in various sections of the *NDS* to accommodate this requirement. Much of the background information contained in the *NDS* was moved to the *NDS Commentary*.

Table 2.—Increases in design values for MEL and MSR lumber.

Species	Grade	G 1997	G 1991	$F_{c\perp}$ 1997	$F_{c\perp}$ 1991	F_v 1997	F_v 1991
				(psi)			
Spruce-Pine-Fir	$E \geq 2{,}000{,}000$	0.50	0.42	615	425	no change	
Southern Pine	$E \geq 1{,}900{,}000$	0.57	0.55	805	565	100	90
Engelmann Spruce-Lodgepole Pine	$F_b \geq 1650$f	0.46	0.38	no change		no change	

NDS Commentary

The *Commentary* to the *NDS* is being updated to reflect changes in the 1997 edition. An addendum to the *NDS Commentary* should be available in 1998.

WoodWorks® Software

WoodWorks Sizer has been updated to incorporate the latest provisions of the 1997 *NDS*. New features of *Sizer 97* include:

- design for fire resistance in accordance with AWC's *Design of Fire-Resistive Exposed Wood Members—DCA No. 2*;
- ability to design multi-span joists;
- viewing results anywhere along a member length;
- printout of materials list;
- walls supported by joist areas away from bearing supports; and
- output for reactions on foundations.

Sizer is available on CD-ROM as part of the *WoodWorks Design Office 97* package. Additional features of *WoodWorks* include:

- *Sizer*—designs beams, columns, and beam-columns;
- *Connections*—designs bolted and nailed connections;
- *Shearwalls*—designs traditional and perforated shearwalls for high wind applications;
- 1997 *NDS* in Adobe® Acrobat® PDF format—electronic version of the *NDS;*
- *Code Conforming Wood Design*—determines allowable heights and areas for wood structures; and
- Adobe Acrobat Reader—reads PDF files (for the electronic version of the *NDS*).

The *NDS, NDS Supplement Design Values for Wood Construction,* and *NDS Commentary* are available from AWC and can be ordered by calling 1-800-890-7732. *WoodWorks Design Office 97* can be ordered by calling 1-800-844-1275. A demonstration copy of *WoodWorks* software can be downloaded from AWC's website at www.awc.org. Contact the AWC Technical Inquiry Clearinghouse at 1-800-AWC-AFPA or email awcinfo@afandpa.org for more information.

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News

Leading Engineering Societies Worldwide Develop First International Conference for Structural Engineers

Six worldwide structural engineering related organizations have come together to develop the first global conference for structural engineers. The Structural Engineers World Congress (SEWC) will take place July 19-23, 1998, at the San Francisco Marriott in the heart of San Francisco's business district. SEWC will feature a comprehensive technical program, addressing every major structural issue from seismic design to state-of-the-art materials.

SEWC also boasts the largest number of sessions devoted to the business and practice of structural engineering ever presented at one conference—30 sessions and more than 100 papers. The congress will also feature the largest exhibition of suppliers of structural materials and systems and computer modeling programs ever organized for practicing structural engineers The conference is designed to be one of the most user-friendly ever, featuring a take-home package that includes a CD-