Welcome to the 2001 NDS for Wood Construction eCourse.
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Third slide
STD103: Learning Outcomes

• By the end of this eCourse, you will be:

  1. Familiar with the many changes between the 2001 and 1997 NDS, including:
     • New product chapters on I-joists, structural composite lumber, wood structural panels, poles, shear walls and diaphragms, fire design
     • New Appendix for local stresses at connections
  2. Knowledgeable about revised provisions for shear design with increased shear design values, notching, end grain bearing, volume factors, connections and connection tables

The NDS for Wood Construction 2001 contains many changes from the 1997 edition which are summarized in this eCourse for your benefit. Significant changes include new product chapters on prefabricated wood I-joists, structural composite lumber, wood structural panels, and poles, shear walls and diaphragms, and fire design; and a new appendix for local stresses in members at connections. The course also covers revised provisions for: shear design (coinciding with increased shear design values) and notching, end grain bearing, volume factors, connections and connection tables.
The engineering procedures for applying Allowable Stress Design (ASD) methods to wood structures are published in ANSI/AF&PA NDS-2001. All three model codes have used or referenced the NDS for design of wood for literally decades, and the two new model codes will continue to.

The reference document used for wood materials is the NDS.

HISTORY - The National Design Specification for Wood Construction (NDS)
- 1971 - scope of the Specification had broadened to include additional wood products.
- 1977 - title was changed to reflect the new nature of the Specification.
- 1991 - was reorganized in an easier to use “equation format,” and was approved as an American National Standard via the ANSI Canvass process.
Design Values for Wood Construction, a Supplement to the NDS, provides design values for structural sawn lumber and structural glued laminated timber. The Supplement is an integral part of the NDS for Wood Construction.

There are many changes and additions for the 2001 document.
In the 2001 NDS, chapters have been added (yellow), condensed (green), or moved (blue) to provide a more comprehensive document for the design of wood products for building construction.
NDS 2001 Appendices Re-organization

2001 NDS Appendices E and L have changed substantially in content, now on the subjects of Local Stresses in Fastener Groups, and more fastener types accordingly. Appendices F and I also saw some minor changes.
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.
Once again, here is what is new in the 2001 NDS Provisions. In yellow are entirely new chapters, or new material additions to an existing chapter.
Three new product chapters have been added: Structural Composite Lumber, Wood Structural Panels, and Prefabricated Wood I-joists. These chapters parallel the format of chapters for sawn lumber and glued laminated timber. Product definitions, identification, standard adjustments to design values, and special design considerations are provided. To clarify applicability of adjustments for each product type, separate tables were developed to identify applicability of adjustment factors for each specific product in the NDS.
New Product Chapters - Poles

- combined with pile chapter
- construction pole design values, adjustment factors

Poles have the bigger end embedded in the ground (you hope), while piles are driven small end first. See www.preservedwood.com for more information on treated poles and piles.

Design information for construction poles is added and combined with an existing chapter on piles. Like other product chapters, the new chapter titled *Round Timber Poles and Piles* contains information such as applicable product standards and standard adjustments to design values. Pole design values are also included.

The design values for utility poles are developed using ANSI O5.1 and if they are to be used as construction poles with NDS provisions, the poles must be regraded in accordance with ASTM D3200.
A new chapter on shear walls and diaphragms covering general requirements for framing members, fasteners, and sheathing has been added to parallel similar language in *AF&PA/ASCE 16 Standard for Load and Resistance Factor Design (LRFD) for Engineered Wood Construction.*
A new chapter on the design of exposed wood members to meet building code prescribed fire endurance times has been added.
2001 NDS Provisions
The New - Fire Design

- Fire resistance up to *two hours*
  - Columns
  - Beams
  - Tension Members
  - Combined Loading

- Additional special provisions for glulam

**16.2.4 Special Provisions for Glued Laminated Timber Beams**

For glued laminated timber bending members given in Table 5A and rated for 1-hour fire endurance, an outer tension lamination shall be substituted for a core lamination on the tension side for unbalanced beams and on both sides for balanced beams. For glued laminated timber bending members given in Table 5A and rated for 1½ or 2-hour fire endurance, two outer tension laminations shall be substituted for two core laminations on the tension side for unbalanced beams and on both sides for balanced beams.

Provisions address tension, compression and bending members and members subjected to combined loading. Special provisions for glued laminated timber beams are also included.
TR10
Calculating the Fire Resistance of Exposed Wood Members

Expands the uses for large, exposed wood members (tension, bending/compression, bending/tension members, decking)

Expands applicability of current methods to other EWP’s (SCL)

Expands use of large, exposed wood members to 2 hour fire endurance applications.

The basis for Chapter 16 is found in AF&PA’s document TR 10: Design of Fire Resistive Exposed Wood Members

This document also forms the technical basis for AF&PA’s DCA 2. It is complete with detailed explanation, test results, and comprehensive calculation examples.
• Superior fire performance of heavy timbers
  – attributed to the charring effect of wood

• Benefits of charring
  – an insulating char layer is formed
  – protects the core of the section

The physical basis for Chapter 16 is the charring characteristic of wood when subjected to fire. Charring of wood occurs at a measurable rate, and because of wood’s insulation properties, the cross-section interior remains capable of sustaining and carrying load.
Charring rates of wood under standard fire exposure conditions were measured in studies world-wide. Glued products did not perform any differently than their solid counterparts.
New Mechanics-Based Design Method

• expands the use of large exposed wood members:
  – loading conditions
  – fire exposures
  – mechanical properties
  – stress interactions
  – expanded range of wood products

This design method is a rational approach that allows for exposed structural wood members to be used in structures that could be exposed to fire.
Design Considerations

• predicts reduced cross-sectional dimensions

• adjusts for charring at the corners

• accounts for the loss of strength and stiffness in the heated zone

The equations used in this method account for all the charring characteristics of a wood cross-section exposed to fire.
A standard terminology was established for describing the charred and uncharred section dimensions for two common fire exposures.
## Estimating Cross-sectional Dimensions due to Charring

<table>
<thead>
<tr>
<th>Exposure Type</th>
<th>Formula for Width</th>
<th>Formula for Depth</th>
</tr>
</thead>
<tbody>
<tr>
<td>4-Sided Exposure (i.e. columns)</td>
<td>$b = B - 2\beta t$</td>
<td>$d = D - 2\beta t$</td>
</tr>
<tr>
<td>3-Sided Exposure (i.e. beams)</td>
<td>$b = B - 2\beta t$</td>
<td>$d = D - \beta t$</td>
</tr>
<tr>
<td>2-Sided Exposure (i.e. decking)</td>
<td>$b = B - \beta t$</td>
<td>$d = D - \beta t$</td>
</tr>
</tbody>
</table>

**where:**

- $\beta$ is the char rate of the material
- $t$ is the fire exposure time

...which resulted in these relations for charred width and depth.
Model for Charring of Wood

- Nonlinear char model used - nominal linear char rate input.
- To account for rounding at corners and reduction of strength and stiffness of the heated zone, the nominal char rate values, $\beta_n$, are increased 20%.

\[
\beta_{\text{eff}} = 1.2 \frac{\beta_n}{t^{0.187}}
\]

where:
- $\beta_{\text{eff}}$ is the effective char rate (in/hr), adjusted for exposure time, $t$
- $\beta_n$ is the nominal linear char rate (in/hr), based on 1-hr exposure
- $t$ is the exposure time (hrs)

In terms of the charring characteristics of wood, this is the char model used.
Effective Char Rates and Char Layer Thickness (for $\beta_n = 1.5$ inches/hour)

<table>
<thead>
<tr>
<th>Required Fire Endurance (hr)</th>
<th>Effective Char Rate, $\beta_{\text{eff}}$ (in/hr)</th>
<th>Effective Char Layer Thickness, $\alpha_{\text{char}}$ (in)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1-Hour</td>
<td>1.80</td>
<td>1.8</td>
</tr>
<tr>
<td>1½-Hour</td>
<td>1.67</td>
<td>2.5</td>
</tr>
<tr>
<td>2-Hour</td>
<td>1.58</td>
<td>3.2</td>
</tr>
</tbody>
</table>

…and these are the charring results based on a typical char rate of 1.5 inches per hour.
Design for Member Capacity

\[
\text{Dead Load + Live Load} \leq K \times \text{Allowable Design Capacity}
\]

Where:

\( K \) is a factor to adjust from allowable design capacity to average ultimate capacity

The factor, \( K \), adjusts from allowable design capacity of the member to average ultimate capacity - the maximum capacity the member can physically sustain (no safety factors).
Allowable Design Stress to Average Ultimate Strength Adjustment Factor

<table>
<thead>
<tr>
<th>Member Capacity</th>
<th>K</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bending Moment Capacity, in-lb.</td>
<td>2.85</td>
</tr>
<tr>
<td>Tensile Capacity, lb.</td>
<td>2.85</td>
</tr>
<tr>
<td>Compression Capacity, lb.</td>
<td>2.58</td>
</tr>
<tr>
<td>Beam Buckling Capacity, lb.</td>
<td>2.03</td>
</tr>
<tr>
<td>Column Buckling Capacity, lb.</td>
<td>2.03</td>
</tr>
</tbody>
</table>

This table lists the values of K for various mode capacities to adjust to an ultimate strength basis.
General Comparison

• Given the theoretical derivation of the new mechanics-based design method, existing test results from fire tests of exposed, large wood members were compared against the model predictions.

• International and North American test data were reviewed.

The theoretical model was checked against full scale tests from all over the world...
Predicted Time vs. Fire Test Observed Time
(Wood Beams Exposed on 3-Sides)

Mechanics-Based Model Prediction

...and was found to be excellent agreement. Here is one such example where the model and test agreement were good for wood beams exposed on 3 sides.
And now, a detailed example, worked from start to finish.

Consider Douglas fir beams spanning 18 feet and spaced 6 feet apart. The beams support 100 psf live load and 15 psf dead load. Timber decking laterally braces the compression flange of the beams.

Size the beam for a 1 hour rating.
For the structural design of the beam, calculate the induced moment:

- **Beam load:**
  \[ w_{\text{total}} = s (q_{\text{dead}} + q_{\text{live}}) = (6')(15+100) = 690 \text{ plf} \]

- **Induced demand moment:**
  \[ M_{\text{max}} = \frac{w_{\text{total}} L^2}{8} = \frac{(690)(18)^2}{8} = 27,945 \text{ ft-lb} \]

**Solution:**

First, calculate the induced demand moment based on the tributary width of 6 feet (beam spacing).
Select a 6-3/4” x 12” 24F-V4 Douglas-fir glulam beam. Tabulated bending stress, $F_b$, equal to 2400 psi.

Calculate the beam section modulus:

$$S_s = BD^2/6 = (6.75)(12)^2 / 6 = 162.0 \text{ in}^3$$

Calculate the adjusted allowable bending stress:

Assuming: $C_D = 1.0$, $C_M = 1.0$, $C_t = 1.0$, $C_L = 1.0$, $C_V = 0.99$

$$F'_b = F_b C_D C_M C_t \text{ (lesser of } C_L \text{ or } C_V)$$

$$= 2400(1.0)(1.0)(1.0)(0.99)$$

$$= 2371 \text{ psi}$$

Pick a beam, calculate its section modulus from actual dimensions, and the adjusted allowable bearing stress of the material.
Calculate the design resisting moment:

\[ M' = F'_b S_s = \frac{(2371)(162)}{12} = 32,009 \text{ ft-lb} \]

Structural Capacity Check: \( M' \geq M_{\text{max}} \)

32,009 ft-lb \( > \) 27,945 ft-lb \( \checkmark \)

Multiply the adjusted allowable bending stress by the section modulus to get the maximum resisting moment offered by your chosen beam. Check for adequacy, and in this case, OK.
For the fire design of the wood beam:
• the loading is unchanged,
• therefore, the maximum moment is unchanged,
• the fire resistance must be calculated

From NDS Table 16.2.1, find charring depth $\alpha_{\text{char}}$ for 1 hour duration:

<table>
<thead>
<tr>
<th>Required Fire Endurance (hr)</th>
<th>Effective Char Rate, $\beta_{\text{eff}}$ (in/hr)</th>
<th>Effective Char Layer Thickness, $\alpha_{\text{char}}$ (in)</th>
</tr>
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<td>3.2</td>
</tr>
</tbody>
</table>

Now, design the cross-section for fire endurance. A certain amount of the cross-section will char during the duration of the rating time, reducing the cross-section size required to sustain load.

From the table in Chapter 16, find the char depth for the duration you are seeking, in this case, 1 hour.
Substitute in residual cross-section dimensions for 3-sided beam into the section modulus relation, i.e.:

• 3-Sided Exposure (i.e. beams)  
  \[ b = B - 2\beta \]  
  \[ d = D - \beta t \]  
  \[ = B - 2\alpha_{\text{char}} \]  
  \[ = D - \alpha_{\text{char}} \]

Calculate charred beam section modulus exposed on 3-sides:

\[ S_f = \frac{(B-2\alpha_{\text{char}})(D-\alpha_{\text{char}})^2}{6} = \frac{(6.75 - 2(1.8))(12-1.8)^2}{6} \]

\[ = 54.6 \text{ in}^3 \]

Determine the charred section dimensions and calculate a new charred section modulus for the residual section.
Calculate the adjusted allowable bending stress (some adjustment factors don’t apply and may have been other than 1.0 before):

\[ F'_b = F_b \text{ (lesser of } C_L \text{ or } C_V) = 2400 \times 0.99 = 2371 \text{ psi} \]

Calculate strength resisting moment using charred cross-section:

\[ M' = K F'_b S_f = (2.85)(2371)(54.6) / 12 = 30,758 \text{ ft-lb} \]

Fire Capacity Check:

\[ M' > M_{\text{max}} \]

\[ 30,758 \text{ ft-lb} > 27,945 \text{ ft-lb} \quad \checkmark \]

Recalculate the adjusted allowable bending stress, since not all of the adjustment factors apply here and may have been a value other than 1.0 before.

Determine the strength resisting moment based on the charred cross-section, and in this case is good for a 1 hour fire duration.
Full-scale test results indicate that the mechanics-based method will conservatively estimate the fire endurance time of all exposed wood members.

Given the theoretical derivation of the new mechanics-based design method, it can be easily incorporated in current wood structural design provisions.

Incorporation of new mechanics-based method in the NDS will assist in the proper design of all exposed wood members for standard fire exposures.

The modeled behavior is conservatively accurate, can be easily implemented as a design process, and permits designers to use exposed large section wood members in structural applications that could be subject to fire exposure.
These two existing 1997 NDS chapters have taken up new positions in the 2001 NDS document - similar material, different location.
Chapter 11 is one-stop shopping for connection data and procedures for dowel-type fasteners.

Separate chapters for the design of bolts, lag screws, wood screws, and nails have been consolidated into a single chapter in the 2001 edition: *Dowel-type Fasteners (Bolts, Lag Screws, Wood Screws, Nails/Spikes, Drift Bolts and Drift Pins)*. The new format was introduced to provide a consistent method for determining the lateral strength of dowel-type fasteners and minimize duplication of design provisions.
### 2001 NDS Provisions

#### Chapter Changes...

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<td>Timber Rivets</td>
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</table>

In terms of changes in the 2001 NDS, here are the affected Chapters this round.
2001 NDS Provisions
Changes...

• 3  Design Provisions and Equations
  – Bending Members
    • shear design
    • long term deflections
  – Compression Members
    • end grain bearing

Let’s take them by Chapter beginning with Chapter 3.
3  Bending Member Design - Shear

• response to change in ASTM values basis (now double 1997 NDS sawn lumber values)

Review of ASTM procedures used to establish allowable shear stresses revealed that shear values were being reduced by two separate factors for the effects of splits, checks and/or shakes. One of these adjustments was made to the base value, the other was an adjustment to design values for grade effects. In 2000, ASTM standard 245 was revised to remove one of these adjustments which resulted in an increase of nearly 2 for allowable shear design values; however, grade effect adjustments were eliminated.

In the 2001 NDS Supplement, shear design values for sawn lumber are approximately 1.95 times higher than values printed in the 1997 edition due to a change in the basis of the values established in ASTM standards. With this change in basis, shear related provisions in the NDS were re-evaluated and modified where necessary to provide appropriate designs. These changes showed up prominently in Chapter 3.
The shear strength increase factor which permitted shear design values to be increased based on wood free of splits, checks and shakes; was removed. Previously, if wood was free of these characteristics, a factor of two increase was applicable. The problem with this is, the increase could only be used with certainty in existing structures when defects are known to exist now or some time in the future. Many designers had trouble assessing when these defects would occur.

Further, there was already over-conservatism in the establishment of design values because reductions for these defects were accounted for twice. This change remedies a situation for the designer by alleviating the need to consider these defects at all.
To limit reduction in load for shear design of bending member, provisions for ignoring shear loads near supports were revised as follows:

3.4.3.1 (a) For beams supported by full bearing on one surface and loads applied to the opposite surface, uniformly distributed loads within a distance from supports equal to the depth of the bending member, d, shall be permitted to be ignored. For beams supported by full bearing on one surface and loads applied to the opposite surface, concentrated loads within a distance, d, from supports shall be permitted to be multiplied by x/d where x is the distance from the beam support face to the load (see Figure 3D).

This addresses a concern that very large loads next to the reaction should be accounted for in design.
2001 NDS Changes
3 Notches - Shear Design

• 1997 NDS

\[ f_v = \left[ \frac{3V}{2bd_n} \right] \left[ \frac{d}{d_n} \right] \]

• 2001 NDS

\[ V'_r = \left[ \frac{2}{3} F_v b d_n \right] \left[ \frac{d_n}{d} \right] \]

Shear strength check at connections less than 5d from the ends and at notches (where permitted) was revised. Changes include the addition of the squared component on the strength reduction term and reformat of the equations in an “allowable shear” format versus the “actual shear stress” format in the 1997 edition:

**Notches:**

3.4.3.2. (a) For bending members with rectangular cross section and notched on the tension face, the allowable design shear, \( V'_r \), shall be calculated using the equation above.
2001 NDS Changes
3 Connections - Shear Design

• 1997 NDS
  \[
  f_v = \left[ \frac{3V}{2bd_e} \right] \frac{d}{d_e}
  \]

• 2001 NDS
  \[
  V_r' = \left[ \frac{2}{3} F_b d_e \right] \left[ \frac{d}{d_e} \right]^2
  \]

• **no** 50% shear increase for connections greater than 5d from member end

...and

**Connections:**

3.4.3.3. (a) When the connection is less than five times the depth, 5d, of the member from its end, the allowable design shear, \( V_r' \), shall be calculated using the equation above.

The 50% shear increase allowance when connections are more than 5d from the member end was removed. The change was made for consistency with the change in basis of the shear values for all wood members.
2001 NDS Changes
3 Deflection - Long Term Loading

- **1997 NDS**
  - $K_{cr} = 1.5$ for glulam and seasoned lumber in dry service conditions
  - $K_{cr} = 2.0$ for unseasoned lumber

- **2001 NDS**
  - $K_{cr} = 1.5$ for dry service conditions
  - $K_{cr} = 2.0$ for glulam in wet service conditions
  - $K_{cr} = 2.0$ for panels in dry service conditions

The 2001 NDS features the expansion of "creep" factors for long term loading (see 3.5.2).

3.5.2 Where total deflection under long term loading must be limited, increasing member size is one way to provide extra stiffness to allow for this time dependent deformation (see Appendix F). Total deflection shall be calculated using the equation above.

$K_{cr}$ now includes more materials in more varied environmental conditions.
End grain bearing values, $F_g$, are no longer tabulated in the *NDS Supplement*. Instead, provisions of the *NDS* specify the use of compression parallel to grain design values for end grain bearing (bearing parallel to grain) as follows:

3.10.1.1 The actual compressive bearing stress parallel to grain shall be based on the net bearing area and shall not exceed the tabulated compression design value parallel to grain multiplied by all applicable adjustment factors except the column stability factor, $f_c \leq F_c^*$.  

For dimension lumber, the compression parallel values are generally higher than $F_g$. For timbers, $F_g$ is typically higher than $F_c$. This results in a small capacity increase for high grade dimension lumber, while timber and low grade dimension lumber capacities are lower.
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2001 NDS Provisions
Changes...

• 4 Sawn Lumber
  – shear strength factor $C_H$ removed
  – two-beam shear provisions removed
  – incised lumber provisions clarified
  – notching limitations moved from Chapter 3 and clarified

Provisions for incising lumber have been clarified (see 4.3.8). The clarification is that incising factor is applicable to sawn lumber. Also, incision pattern was modified to be more reflective of patterns used on dimension lumber.
The shear strength increase factor which permitted shear design values to be increased based on wood free of splits, checks and shakes; was removed. Previously, if wood was free of these characteristics, a factor of two increase was applicable.
The two-beam shear provisions were removed which permitted load reductions for shear design of single span sawn lumber bending members. This provision was linked with assumptions used to develop previous shear design values and is no longer applicable.
Clarified provisions for incising lumber (see 4.3.8). - clarification: incising factor is applicable to dimension lumber. Also, incision pattern was modified to be more reflective of patterns used on dimension lumber.

These factors apply to dimension lumber incised with the reference incising pattern. For other incising patterns, reduced cross-section properties are permitted by test or to be calculated based on the depth and density of incisions.
Recommendations to avoid notching wherever possible are continued in the 2001 NDS. For sawn lumber, permitted notch locations and notch depths remain unchanged, but clarification is added that interior notch limits and locations are applicable to single span bending members.
Chapter 5 features modification of the notching and volume effect factor provisions.
2001 NDS Changes
5 Notches - Glulam

- 1997 NDS - Notch depth limited to 1/10 member depth
- 2001 NDS Notch depth limited to lesser of:
  - 1/10 member depth
  - 3 inches

Recommendations to avoid notching wherever possible are continued in the 2001 edition, however, locations where notches are permitted are clarified. For glued laminated timber, a limit of 3” is established for tension side end notches as follows:

5.4.4.1 The tension side of glued-laminated timber bending members shall not be notched, except at ends of members for bearing over a support, and notch depth shall not exceed the lesser of 1/10 the depth of the member or three inches…..

The 3 inch limit was developed in response to preliminary research which supported current shear design provisions for notched beam depths up to 30 inches.
The loading condition coefficient, $K_L$, has been removed from calculation of the volume factor. The $K_L$ factor comes from provisions of ASTM D3737 where it is used to statistically adjust certain load cases when developing design values from glulam test data. This simplification was considered to be appropriate since the $K_L$ factor was only available for a few idealized loading conditions and the overall range in adjustment is small. For glulam, removal of this coefficient will result in a 9% reduction and 4% increase in capacity for the single concentrated and 1/3 point load case, respectively.
The NDS provides factors to adjust design values for wood members and connections for specific conditions frequently encountered in service. It is the designer's responsibility to determine the design value adjustment factors that are appropriate for each application.

The 2001 NDS helps make this easier with new adjustment factor tables split out by wood product - now 7 products in all.
2001 NDS Provisions Changes...

- **10 Mechanical Connections**
  - local stresses
  - group action factor
  - connection design provisions
  - connection capacity tables
  - terminology: screw gauge = *screw number*

The Connections Chapter 10 received substantial modification in a variety of areas, one of the most important being the stress checks referenced in Appendix E.
10.1.2 Structural members shall be checked for load carrying capacity at connections in accordance with all applicable provisions of this standard including 3.1.2, 3.1.3, and 3.4.3.3. 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 Appendix E.

Provisions for stresses in members at connections have been clarified in the 2001 NDS. Provisions have been re-written as follows:

10.1.2 Structural members shall be checked for load carrying capacity at connections in accordance with all applicable provisions of this standard including 3.1.2, 3.1.3, and 3.4.3.3. 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 Appendix E.

More on Appendix E, later....

Wet Service Factor, $C_M$ for connection Z values

<table>
<thead>
<tr>
<th></th>
<th>Saturated</th>
<th>19% MC</th>
<th>Dry</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>$C_M$</td>
<td>1.0</td>
<td>1.0</td>
<td>0.7</td>
<td>0.7</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>0.4</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- bolts
- drift pins
- drift bolts
- lag screws
- wood screws

Connection strength varies with wood EMC, and the NDS has provisions to this effect - the Wet Service Factor $C_M$ that affects connection Z values. Two conditions of EMC at fabrication and in-service are important: $<19\%$ and $>19\%$. The latter condition includes both continuous or occasional exposure at moisture levels greater than 19%. The designer must assess the environmental situation to see which occurs when.

At MC levels above 19%, wood is more elastic, and wood strength properties reduce somewhat. When wood connections are fabricated using wood with high MC’s over 19%, and MC levels are expected to drop to final values below 19% in service, considerable shrinkage takes place around the fasteners, and grouped fasteners are especially vulnerable in initiating tension perp failures; hence the low value of $C_M = 0.4$. A design penalty? Perhaps. But there is a workaround...
The NDS has a detailing provision for the 0.4 value on bolt and lag screw connections that can provide full fastener capacity ($C_M = 1.0$).

**Use:**
- one fastener only, or
- two or more fasteners placed in a single row parallel to grain, or
- use fasteners placed in two or more rows parallel to grain with separate splice plates for each row.

Minimum distances between fasteners, and fasteners and edges still need to be maintained. This detailing allows the wood to change shape across the grain on drying without being hung up on the fasteners - the fasteners can move with the wood.
Keep spacing between rows of bolts on a common splice plate to less than 5 inches to avoid splitting the wood due to changes in equilibrium moisture content. Good detailing on connections often pays off to avoid shrinkage-related problems.
2001 NDS Provisions

Changes...

• **11 Dowel-type Fasteners**
  
  – connection design provisions
    
    • one set of yield equations
      
      – which includes actual penetration depth \( C_d \) does not apply
    
    • no penetration depth factor \( C_d \) applied to tabulated values for standard penetration depths
      
      – see table footnotes for applying \( C_d \) to tabulated values for penetrations less than standard depth

Significant changes that improve consistency and minimize duplication of connection provisions include:

One set of yield limit equations, describing the behavior of dowels under lateral loads, is provided for all dowel type fasteners. Since penetration depth is a variable in the equations.

A requirement to check all yield modes is coupled with removal of the penetration depth factor, \( C_d \). In previous NDS-versions, different yield limit equations were provided for lag screws, wood screws, and nails, and penetration depth factors were used in lieu of checking all yield mode equations. Note that the penetration adjustment is still in the table footnotes, but only applies if using the tabulated values.
2001 NDS Provisions
Changes...

• **11 Dowel-type Fasteners**
  – connection design provisions
  • capacity reduction terms based on fastener diameter D
    – D ≥ ¼” vary by yield mode
    – D < ¼” vary linearly with diameter

Capacity reduction terms are based on fastener diameter rather than fastener type. For fasteners with diameter greater than or equal to ¼ inch (D ≥ ¼ inch), strength reductions vary by yield mode and are consistent with reductions used for bolts in the 1997 edition. For D < ¼ inch, strength reductions term vary linearly with diameter and are consistent with reductions used for nails in the 1997 edition.
2001 NDS Provisions
Changes...

• **11 Dowel-type Fasteners**
  - connection design provisions
    • $D \geq \frac{1}{4}$" dowel bearing strength is grain direction dependent

Differences in dowel bearing strength parallel and perpendicular to grain are recognized when $D \geq \frac{1}{4}$ inch. Previously, differences in dowel bearing strength parallel and perpendicular to grain were not recognized for nails and wood screws.
Confusion often arises in using the tabular values for fasteners over 1/4". There are various capacity values dependent on which member, and bearing grain orientation.

Here, we note the respective capacities for main member and side member parallel to grain. If both members are of the same wood species, one would extract the same $Z_{||}$ value for both members.
The difference shows up when wood is loaded perpendicular to grain. There are two values of $Z_{\perp}$ for main and side member respectively.
As is often the case, wood grain for both main and side members do not align with the external loading, or the direction of load applied to the wood member. Care must be taken to extract the right capacity value for the right member grain direction out of the $F_e$ dowel bearing strength table, if using the dowel bearing strength capacity approach.
2001 NDS Provisions
Changes...

• 11 Dowel-type Fasteners
  – connection design provisions
    • dowel bearing strengths for steel side members are increased for consistency with AISI and AISC recommendations
    • dowel bearing strengths for wood structural panels added

Dowel bearing strengths for steel side members, used to develop tabulated wood-to-steel connection values, are increased to be consistent with AISC and AISI standards.

Dowel bearing strengths are added for wood structural panels.
2001 NDS Provisions
Changes...

• 11 Dowel-type Fasteners
  – screws
    • terminology: screw gauge = screw number
    • minimum penetration for laterally loaded increased to 6D
    • root diameter $D_r$ used to determine lateral capacity

"Wood screw number" replaces "Wood screw gage" throughout the NDS document to update terminology.

Minimum penetration for wood screws loaded laterally is increased to 6D for consistency with requirements for nailed since the tapered tip is included in the penetration length. The change is more consistent with connections made with lag screws where the tip is not included in the penetration length.

Root diameter $D_r$ is used to calculate lag screw and wood screw lateral connection capacity unless a more detailed analysis is performed to account for the varying moment capacity of the fastener.
2001 NDS Provisions
Changes...

• **11** Dowel-type Fasteners
  – Tabulated Design Values
    • revised for consistency with design provisions
    • SCL sizes included
    • nail tables include wood structural panels
    • conservative capacity method for reduced fastener penetration

Tabulated design values for dowel type fastener connections have been revised to be consistent with changes in calculation design provisions. Bolt, lag screw, wood screw and nail connection tables include structural composite lumber sizes. Nail connection tables have been expanded to include connections with wood structural panel side members. Added footnotes to nail, lag screw, and wood screw connection tables provide a simple and conservative method for determining design values for connections with reduced penetration. This does not apply if using equations to determine yield modes as the equations have penetration depth built in as a variable. Dowel bearing strengths are added for wood structural panels.
For bolted connections between wood members, tabulated design values remain unchanged from the 1997 edition. Bolted wood-to-steel connection strength increased slightly compared to the 1997 edition due to increased bearing strength of steel. Similarly, nailed wood-to-steel connection strength also increased when compared to the 1997 edition.
Tabulated design values for lag screws are based on a “reduced body diameter” lag screw and tabulated values for wood screws are based on “rolled thread” wood screws. Because “reduced body diameter” lag screws and “rolled thread” wood screws have a shank diameter approximately equal to the root diameter, design values for these fasteners are smaller than those provided in the 1997 edition for “full body diameter” lag screws and “cut thread” wood screws. This change in basis was implemented to better address the use of reduced body diameter fasteners and the condition where full thread fasteners are used.
2001 NDS Provisions
Changes...

• 11 Dowel-type Fasteners
  – *Tabulated* Lateral Design Values - Threaded Hardened Nails
    • removed - nail type is not addressed in ASTM F1557
  – *Calculated* Lateral Design Values - Threaded Hardened Nails
    • see Table I1 (must know $F_{yb}$)
  – Withdrawal values still tabulated

Finally, the *tabulated* design values for threaded hardened nails were removed since this nail type is not specifically standardized in ASTM F1557. However, the NDS still allows calculation of threaded hardened lateral design values per Appendix I, Table I1, where $F_{yb}$ is shown.

Withdrawal design values are still tabulated in the NDS for threaded nails.
2001 NDS Provisions
Changes...

• **12 Split Ring and Shear Plate Connectors**
  – species groups based on specific gravity range

Species groups for shear plate and split ring connectors are now based on Specific Gravity range for consistency with LRFD (see Table 12A).
Allowable design capacity tables for timber rivet connections (wood capacity parallel to grain) are now tabulated to the nearest 10 pounds to match format of bolts and shear plate connectors. Previously table values were rounded to the nearest kip. This rounding allows for more precision at the smaller capacity levels where normally fewer rivets would be required.
2001 NDS Provisions
Appendices Changes...

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</tbody>
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In terms of changes in the 2001 NDS, here are the affected Appendices this round.
Appendix E  Local Stresses in Fastener Groups

- new material
- retroactive to all previous editions of the NDS

Looking now at changes in the Appendices, we start with a significant one - Appendix E.

Local stresses in fastener groups is new to the 2001 NDS and provides one method to evaluate capacity of a fastener group limited by wood related failure mechanisms. Example problems are added to demonstrate application of Appendix E provisions for checking net section tension capacity, row tear-out capacity, and group tear-out capacity.
Local Stresses in Fastener Groups

- Closely spaced fasteners
  - brittle failure
  - lower capacity

*wood failure mechanisms need to be considered in design*

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.
Local Stresses in Fastener Groups

- Properly spaced fasteners
  - increased ductility
  - higher capacity

spread out the fasteners!

By increasing the spacing between the fasteners, much higher capacity and ductility is achieved, even with fewer fasteners!

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 Appendix E from the 2001 NDS, which is also available free from www.awc.org. All referenced sections and design values used in sample solutions of this Addendum are based on information in the 2001 NDS.
Local Stresses in Fastener Groups

- Appendix E  NDS Expressions
  - Net tension: 
    \[ Z_{NT} = F_i A_{net} \]
  - Row tear-out: 
    \[ Z_{RT} = n_i F_i t_{s_{min}} \]
    \[ Z_{RT} = \sum_{i=1}^{n} Z_{RT_i} \]

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 Appendix E. **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.

Appendix E leads the designer through the stress checks for three failure modes: net tension capacity of the wood through the cross-section, row tear-out, and...
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.

Footnote 2 to Table 11.5.1D(2001 NDS) 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.

These provisions apply to the 2001 NDS and ALL PRIOR EDITIONS. The example calculations provided in Appendix E use design values from the 2001 NDS. Appendix E in its entirety is available as a free PDF download from www.awc.org.
Here is a summary of the three stress checks that may be applied to various common connector situations.
Local Stresses in Fastener Groups

Example

Truss Bottom Chord and Splice

• Design the bottom chord of a sawn lumber commercial/industrial truss to support a tensile force (T) of 20,000 lbs.

• Assume a dry moisture service condition, un-incised material and a load duration factor of 1.0.

Now, let’s work a complete example for truss bottom chord splice.

Example 3-1: Truss Bottom Chord
Example 3-1: Truss Bottom Chord

**Practical Considerations**

Efficient choice of a trial section requires practical, as well as engineering, considerations. For example, choice of lumber species, grade and even commonly available sizes may differ among geographic regions of the country. Consult your local supplier for assistance. In addition, other considerations include dimensional compatibility with the other members of the truss or minimum sizes required to adequately connect the truss members (while meeting fastener edge distance requirements).
Local Stresses in Fastener Groups

Example Solution

Solution:

- Select a member(s) from the Tension Member Selection Tables in the Structural Lumber Supplement that is adequate to resist 20,000 lbs tensile force (T) due to combined dead load and occupancy live load (D+L).

Engineering Calculations

Using Selection Tables: Select a member(s) from the tension member selection tables in the Structural Lumber Supplement that is adequate to resist 20,000 lbs tensile force (T) due to combined dead load and occupancy live load (D+L).

A double chord of nominal 2x12 ’s meets practical considerations. Try No.1 Douglas Fir-Larch:
Local Stresses in Fastener Groups

Example Solution

Solution:

double chord of nominal 2x12’s meets practical considerations. Try No.1 Douglas Fir-Larch:

\[ T' = (11,900 \text{ lbs.})(2 \text{ plies}) = 23,800 \text{ lbs.} \]

Engineering Calculations

\[ T' = (11,900 \text{ lbs.})(2 \text{ plies}) = 23,800 \text{ lbs.} \]

But...
Local Stresses in Fastener Groups

Example Solution

Solution:

- Using Design Value Tables: Calculate allowable tension capacity using tabulated design values and adjustment factors.

Try a nominal 4x12 No.1 Hem-Fir.

*(Hem-Fir's on sale this week!)*

…the local lumber yard has Hem-Fir on sale this week, and you like the price.
Local Stresses in Fastener Groups

Example Solution

Solution:

• Obtain $F_t$ and applicable adjustment factors from the *NDS-2001 Supplement* and the *Structural Lumber Supplement*. Calculate the tensile capacity:

$$T' = F_t' A = F_t CD CF A$$

$$(625 \text{ psi})(1.0)(1.0)(39.38 \text{ in}^2)$$

$$= 24,600 \text{ lbs} > 20,000 \text{ lbs} \quad \text{OK}$$

*This member satisfies the strength criteria for a tension member.*

Using Design Value Tables: calculate allowable tension capacity using tabulated design values and adjustment factors. Try a nominal 4x12 No.1 Hem-Fir. Obtain $F_t$ and applicable adjustment factors from the *NDS-2001 Supplement* and the *Structural Lumber Supplement*.

$T' = F_t' A = F_t CD CF A$

From the Supplements, $F_t$ is 625 psi, $CD$ equals 1.0, and $CF$ equals 1.0. The area of a 4x12 is 39.38 square inches. Thus the allowable tension capacity is:

$T' = (625)(39.38) = 24,600 \text{ lbs}$

This member satisfies the strength criteria for a tension member.
Local Stresses in Fastener Groups

Example Solution

Solution:

same as the table value

\[ T' = 24,600 \text{ lbs} \]

…or use the Tension Member Selection Table from the *Structural Lumber Supplement* and get the same answer:

\[ T' = 24,600 \text{ lbs}. \]

This member satisfies the strength criteria for a tension member.
Solution:

The chord includes connections with two rows of 7/8 inch bolts (in a 1/16 inch oversized hole) spaced per NDS Section 11.5 for full design values.

- Check the local stresses at the chord connection to verify your member size selection.

Now for the splice connection. To make this easy, we'll consider a single shear connection using one splice plate and neglect the eccentricity in the fasteners. We'll set the rows at the 1/3 depths, 'cause it looks nice (it's well within NDS spacing limitations). Let's see if this works.
Local Stresses in Fastener Groups

Example Solution

Solution:
Using Appendix E provisions:

Net Section Tension

Net cross section area = (3.5)(11.25 - 2(0.875+0.0625))
= 32.8 in.²

\[ Z'_{NT} = 625(32.8) = 20,500 \text{ lbs.} \]

OK so far...

Engineering Calculations

Using NDS Appendix E provisions, calculate local stresses in the fastener group:

Net Section Tension

Calculations follow those previously, but the net area of (3.5)(11.25 - (2)(0.9375)) = 32.8 square inches replaces the gross area (39.38 in.²) in the calculation:

\[ Z'_{NT} = 625(32.8) = 20,500 \text{ lbs} \]

OK so far...
**Local Stresses in Fastener Groups**

**Example Solution**

**Solution:**
Using Appendix E provisions:

- **Row Tear-out Capacity**

  From the *NDS Supplement*, $F_v' = 150$psi

  Critical spacing $s_{critical}$ is lessor of end distance (7D), or fastener spacing (4D) = 4(0.875") = 3.5 inches.

  $$Z_{RT'} = n_{row} n_i F_v' t s_{critical} = (2)(8)(150)(3.5)(3.5) = 29,400 \text{ lbs.}$$

  > 20,000 lbs. demand  OK

**Engineering Calculations**

**Row Tear-out Capacity**

From the *NDS Supplement*, $F_v' = 150$psi. Critical spacing is the lessor of the end distance (7D here for full design value), or the spacing between fasteners in a row (4D); in this case, 3.5 inches. Therefore, row tear-out capacity is calculated as:

$$Z_{RT'} = n_{row} n_i F_v' t s_{critical} = (2)(8)(150)(3.5)(3.5) = 29,400 \text{ lbs}$$

Still OK...
Local Stresses in Fastener Groups

Example Solution

Solution:

Using Appendix E provisions:

- **Group Tear-out Capacity**
  
  Assume:
  
  - uniform row spacing
  
  - edge distance = 3.75 inches
  
  \[ Z_{GT'} = \frac{Z_{RT'}}{2} + F_t A_{\text{group-net}} \]
  
  \[ = \frac{29,400}{2} + 625(3.5)[11.25 - 2(3.75) - (0.9375)] \]
  
  \[ = 20,850 \text{ lbs.} > 20,000 \text{ lbs. Demand OK} \]

  The design is still acceptable.  Design is net section critical.

Engineering Calculations

**Group Tear-out Capacity**

Assuming a uniform row spacing, and edge distance of 3.75 inches, calculate group tear-out capacity as:

\[ Z_{GT'} = \frac{Z_{RT'}}{2} + F_t A_{\text{group-net}} = \frac{29,400}{2} + 625(3.5)[11.25 - 2(3.75) - (0.9375)] = 20,850 \text{ lbs.} \]

Note that Group_{net} is the net area between the outer rows in the group, which is why the bolt holes are subtracted out.

The design is still acceptable. We have met all three checks.
Local Stresses in Fastener Groups

Example Solution

**Exploration: maximum spacing between rows**

Using *Appendix E* provisions:

- **Group Tear-out Capacity**
  
  Assume:
  
  - uniform row spacing
  - edge distance = 1.31 inches

  \[ Z_{GT}' = \frac{Z_{RT}'}{2} + F_t' A_{\text{group-net}} \]

  \[ = \frac{(29,400)}{2} + 625(3.5) [11.25 – 2(1.31) - (0.875 + 0.0625)] \]

  \[ = 31,527 \text{ lbs.} > 20,000 \text{ lbs.} \text{ Demand OK} \]

  *The design is still acceptable. Capacity dramatically increases with increased row spacing.*

What happens if spread out the rows to the minimum permissible edge distance of 1.5 D?

**Engineering Calculations**

**Group Tear-out Capacity**

Assuming a uniform row spacing and edge distance of 1.31 inches, calculate group tear-out capacity as:

\[ Z_{GT}' = \frac{Z_{RT}'}{2} + F_t' A_{\text{group-net}} = \frac{(29,400)}{2} + 625(3.5)[11.25 – 2(1.31) – (0.9375)] = 31,527 \text{ lbs} \]

…a dramatic capacity increase at that!
Local Stresses in Fastener Groups

**Example Solution**

*Exploration:* minimum spacing between rows

Using *Appendix E* provisions:

- **Group Tear-out Capacity**

  Assume:
  - uniform row spacing
  - inter-row distance = 1.31 inches

\[
Z_{GT'} = Z_{RT'}/2 + F_t \cdot A_{\text{group-net}}
\]

\[
= (29,400)/2 + 625(3.5)[1.31]
\]

\[
= 17,566 \text{ lbs.} < 20,000 \text{ lbs.} \text{ Demand NG}
\]

*The design is unacceptable. Spacing between rows is too tight!*

Well then, what happens if we space the rows really close together on the NDS minimum spacing?

**Engineering Calculations**

**Group Tear-out Capacity**

Assuming a uniform row spacing and inter-row distance of 1.31 inches, calculate group tear-out capacity as:

\[
Z_{GT'} = Z_{RT'}/2 + F_t \cdot A_{\text{group-net}} = (29,400)/2 + 625(3.5)[1.31] = 17,566 \text{ lbs}
\]

Not good - in fact dangerous! Message: *spread out the fasteners!*
2001 NDS Provisions
Changes...

- **Appendix F**  Design for Creep and Critical Deflection Applications
  - apparent E values clarified with respect to the inclusion of shear deflection
  - new provision for calculating a shear-free E for Glulam

<table>
<thead>
<tr>
<th>Material</th>
<th>Shear-free E / Tabulated E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sawn Lumber</td>
<td>1.03</td>
</tr>
<tr>
<td>Glulam</td>
<td>1.05</td>
</tr>
</tbody>
</table>

In Appendix F, the basis of apparent E values for sawn lumber and glued laminated timber are clarified.
The addition of bending yield strength table for dowel type connectors is featured in Appendix I. Previously, assumptions were spread over table footnotes.

There is also an addition of a reference to AF&PA’s Technical Report TR-12 from Appendix I.
Appendix J was expanded to include Hankinson’s Formula for determining bolt or lag screw connection design values, \( Z \), from tabular values, when members(s) are loaded at an angle to grain between 0 degrees and 90 degrees. The new provisions give up to 20% conservatism in capacity values using the \( Z \) form of the Hankinson Equation which gives a simpler form of design process through the use of the tabular capacity values.
Appendix L was expanded to include figures and typical dimensions for bolts, lag screws, wood screws, and nails. For lag screws, a footnote is revised to clarify that tabulated thread lengths represent minimum thread lengths for lag screws and that screws can be fully threaded. Figures of cut thread and rolled thread wood screws and tabular information identifies wood screws by *number* than *gage* used in previous editions.
Let’s look now at the new changes for the 2001 Supplement.

Design provisions in the 2001 NDS are integral with design values in the 2001 NDS Supplement.

First, there is the addition of design value tables for non-North American dimension lumber and expanded design value tables for mechanically graded dimension lumber.
For glued laminated timber, revised tables for glued laminated *hardwood* timber design values are provided in a format consistent with tables for softwood glued laminated timber. For softwood glulam, a consolidated table of design values grouped by stress class is provided in addition to the familiar combination symbol tables from the 1997 edition. Increased shear design values for prismatic members are tabulated. For notched members and certain other conditions, reduction in design values is required as specified in table footnotes.
Design values in the supplement are unique to its companion NDS. As such, it is not appropriate to mix design values and provisions from different editions of the NDS. The 2001 NDS Supplement contains increased shear design values for sawn lumber to reflect changes to ASTM standards and provisions of the 2001 NDS have been revised to address those increases.
Other changes in the 2001 NDS Supplement include addition of design value tables in Chapter 2 for non-North American dimension lumber and expanded design value tables for mechanically graded dimension lumber.
2001 NDS Supplement
Changes...

• 2 Species Combinations
  – glued laminated timber
    • hardwood glulam tables format similar to softwood tables
    • softwood glulam tabulated by stress class in addition to combination symbol
    • increased shear design values for prismatic members
    • shear design values reduced for notched members, members at connections, impact or cyclic load, non-prismatic sections, radial tension

For glued laminated timber, revised tables for glued laminated hardwood timber design values are provided in a format consistent with tables for softwood glued laminated timber. For softwood glued laminated timber, a consolidated table of design values grouped by stress class is provided in addition to the familiar combination symbol based tables of design values. Increased shear design values for prismatic members are tabulated. For notched members and certain other conditions, reduction in design values is required as specified in the table footnotes.
For glued laminated timber, revised tables for glued laminated hardwood timber design values are provided in a format consistent with tables for softwood glued laminated timber. For softwood glued laminated timber, a consolidated table of design values grouped by stress class is provided in addition to the familiar combination symbol based tables of design values. Increased shear design values for prismatic members are tabulated. For notched members and certain other conditions, reduction in design values is required as specified in the table footnotes.
It’s good to get on board early for when the new model codes take effect.
So then, where is the 2001 Commentary?

New news! The Commentary is going digital to be distributed free on-line.

The Commentary to the 1997 and earlier editions of the NDS is currently out of print. Archival copies are available for $25 from AWC publications. Once an update to the Commentary for the 2001 NDS is complete, it will be included on the AWC website.
Here is a summary of changes found in the 2002 NDS....
2001 NDS Provisions
Summary of Changes - Connections

• allowable design capacity tables for timber rivet connections (wood capacity parallel to grain) *tabulated* to the nearest 10 pounds to match format of bolts and shear plate connectors. Previously table values were rounded to the nearest kip.

• *addition* of bending yield strength table for dowel type connectors (See Appendix I). Previously, assumptions were spread over table footnotes.

• *addition* of a reference to TR-12 from Appendix I.

• *replace* "Wood screw gage" with "wood screw number" throughout document to update terminology.

…and...
2001 NDS Provisions
Summary of Changes - Appendices

• Appendix F, the basis of apparent E values for sawn lumber and glued laminated timber are clarified.
• Appendix L, table for lag screws is revised to clarify that minimum thread lengths are provided and that screws can be fully threaded.

...
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.
The new 2001 NDS is available now and is included with the new 2001 ASD Manual.

The new 2001 ASD Manual consists of 6 bound volumes including the 2 NDS volumes. The ASD Manual volume is your starting point that references information contained in the NDS and other volumes.
The ASD Manual Supplements are bound together and tabbed for easy reference. Here you will find product information supplements for lumber, glulam, poles & piles, wood structural panels, and wood shear walls & diaphragms.
Similarly, product guidelines are bound into one tabbed volume containing generic guidelines for product guidelines for I-joists, SCL, trusses, and connections.
New in the 2001 ASD Manual is the ASD/LRFD Special Design Provisions for Wind and Seismic loads. This dual format document covers design and construction of wood members, fasteners, and assemblies to resist wind and seismic forces. It exists as a separate supplement for now because of the dynamic nature of the information inside the document, particularly seismic loads. It is the NFPA 5000 model building code reference for wind and seismic wood design. BSSC NEHRP will also reference this supplement towards the final objective that all model building codes will reference it, and changes to the supplement could then be recommended through the consensus process underlying the document.

To order a copy of the 2001 ASD Manual, contact the AWC Publications Department at 1 800 890 7732, or visit the AWC website at www.awc.org for online ordering information.
See the web site at www.awc.org; your first source for technical information on wood and wood products.

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This concludes this approved continuing education program.