## 2005 EDITION

ANSI/AF&PA NDS-2005
(revised standard)
Approval Date: JANUARY 6, 2005

ANSI

# NDS®

## NATIONAL DESIGN SPECIFICATION®

## FOR WOOD CONSTRUCTION
## ASD/LRFD

American
Forest &
Paper
Association

American Wood Council

## Table 4.3.1 Applicability of Adjustment Factors for Sawn Lumber

| | | ASD only | ASD and LRFD | | | | | | | | | | LRFD only | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Load Duration Factor | Wet Service Factor | Temperature Factor | Beam Stability Factor | Size Factor | Flat Use Factor | Incising Factor | Repetitive Member Factor | Column Stability Factor | Buckling Stiffness Factor | Bearing Area Factor | Format Conversion Factor | Resistance Factor | Time Effect Factor |
| $F_b' = F_b$ | x | $C_D$ | $C_M$ | $C_t$ | $C_L$ | $C_F$ | $C_{fu}$ | $C_i$ | $C_r$ | - | - | - | $K_F$ | $\phi_b$ | $\lambda$ |
| $F_t' = F_t$ | x | $C_D$ | $C_M$ | $C_t$ | - | $C_F$ | - | $C_i$ | - | - | - | - | $K_F$ | $\phi_t$ | $\lambda$ |
| $F_v' = F_v$ | x | $C_D$ | $C_M$ | $C_t$ | - | - | - | $C_i$ | - | - | - | - | $K_F$ | $\phi_v$ | $\lambda$ |
| $F_{c\perp}' = F_{c\perp}$ | x | - | $C_M$ | $C_t$ | - | - | - | $C_i$ | - | - | - | $C_b$ | $K_F$ | $\phi_c$ | $\lambda$ |
| $F_c' = F_c$ | x | $C_D$ | $C_M$ | $C_t$ | - | $C_F$ | - | $C_i$ | - | $C_P$ | - | - | $K_F$ | $\phi_c$ | $\lambda$ |
| $E' = E$ | x | - | $C_M$ | $C_t$ | - | - | - | $C_i$ | - | - | - | - | - | - | - |
| $E_{min}' = E_{min}$ | x | - | $C_M$ | $C_t$ | - | - | - | $C_i$ | - | - | $C_T$ | - | $K_F$ | $\phi_s$ | - |

## 4.3.5 Beam Stability Factor, $C_L$

Reference bending design values, $F_b$, shall be multiplied by the beam stability factor, $C_L$, specified in 3.3.3.

## 4.3.6 Size Factor, $C_F$

4.3.6.1 Reference bending, tension, and compression parallel to grain design values for visually graded dimension lumber 2" to 4" thick shall be multiplied by the size factors specified in Tables 4A and 4B.

4.3.6.2 When the depth of a rectangular sawn lumber bending member 5" or thicker exceeds 12", the reference bending design values, $F_b$, in Table 4D shall be multiplied by the following size factor:

$$C_F = (12 / d)^{1/9} \leq 1.0 \quad (4.3\text{-}1)$$

4.3.6.3 For beams of circular cross section with a diameter greater than 13.5", or for 12" or larger square beams loaded in the plane of the diagonal, the size factor shall be determined in accordance with 4.3.6.2 on the basis of an equivalent conventionally loaded square beam of the same cross-sectional area.

4.3.6.4 Reference bending design values for all species of 2" thick or 3" thick Decking, except Redwood, shall be multiplied by the size factors specified in Table 4E.

## 4.3.7 Flat Use Factor, $C_{fu}$

When sawn lumber 2" to 4" thick is loaded on the wide face, multiplying the reference bending design value, $F_b$, by the flat use factors, $C_{fu}$, specified in Tables 4A, 4B, 4C, and 4F shall be permitted.

## 4.3.8 Incising Factor, $C_i$

Reference design values shall be multiplied by the following incising factor, $C_i$, when dimension lumber is incised parallel to grain a maximum depth of 0.4", a maximum length of 3/8", and density of incisions up to

4.2.5.2 Decking Grades. Adjusted bending design values for Decking grades apply only when the load is applied to the wide face.

4.2.5.3 Post and Timber Grades. Adjusted bending design values for Post and Timber grades apply to members with the load applied to either the narrow or wide face.

4.2.5.4 Beam and Stringer Grades. Adjusted bending design values for Beam and Stringer grades apply to members with the load applied to the narrow face. When Post and Timber sizes of lumber are graded to Beam and Stringer grade requirements, design values for the applicable Beam and Stringer grades shall be used. Such lumber shall be identified in accordance with 4.1.2.1 as conforming to Beam and Stringer grades.

4.2.5.5 Continuous or Cantilevered Beams. When Beams and Stringers are used as continuous or cantilevered beams, the design shall include a requirement that the grading provisions applicable to the middle 1/3 of the length (see References 42, 43, 44, 45, 46, 47, and 49) shall be applied to at least the middle 2/3 of the length of pieces to be used as two span continuous beams, and to the entire length of pieces to be used over three or more spans or as cantilevered beams.

### 4.2.6 Compression Perpendicular to Grain, $F_{c\perp}$

For sawn lumber, the reference compression design values perpendicular to grain are based on a deformation limit that has been shown by experience to provide for adequate service in typical wood frame construction. The reference compression design values perpendicular to grain specified in Tables 4A, 4B, 4C, 4D, 4E, and 4F are species group average values associated with a deformation level of 0.04" for a steel plate on wood member loading condition. One method for limiting deformation in special applications where it is critical, is use of a reduced compression design value perpendicular to grain. The following equation shall be used to calculate the compression design value perpendicular to grain for a reduced deformation level of 0.02":

$$F_{c\perp 0.02} = 0.73\, F_{c\perp} \qquad (4.2\text{-}1)$$

where:

$F_{c\perp 0.02}$ = compression perpendicular to grain design value at 0.02" deformation limit

$F_{c\perp}$ = reference compression perpendicular to grain design value at 0.04" deformation limit (as published in Tables 4A, 4B, 4C, 4D, 4E, and 4F)

## 4.3 Adjustment of Reference Design Values

### 4.3.1 General

Reference design values ($F_b$, $F_t$, $F_v$, $F_{c\perp}$, $F_c$, $E$, $E_{min}$) from Tables 4A, 4B, 4C, 4D, 4E, and 4F shall be multiplied by the adjustment factors specified in Table 4.3.1 to determine adjusted design values ($F_b'$, $F_t'$, $F_v'$, $F_{c\perp}'$, $F_c'$, $E'$, $E_{min}'$).

### 4.3.2 Load Duration Factor, $C_D$ (ASD only)

All reference design values except modulus of elasticity, E, modulus of elasticity for beam and column stability, $E_{min}$, and compression perpendicular to grain, $F_{c\perp}$, shall be multiplied by load duration factors, $C_D$, as specified in 2.3.2.

### 4.3.3 Wet Service Factor, $C_M$

Reference design values for structural sawn lumber are based on the moisture service conditions specified in 4.1.4. When the moisture content of structural members in use differs from these moisture service conditions, reference design values shall be multiplied by the wet service factors, $C_M$, specified in Tables 4A, 4B, 4C, 4D, 4E, and 4F.

### 4.3.4 Temperature Factor, $C_t$

When structural members will experience sustained exposure to elevated temperatures up to 150°F (see Appendix C), reference design values shall be multiplied by the temperature factors, $C_t$, specified in 2.3.3.

1100/ft². Incising factors shall be determined by test or by calculation using reduced section properties for incising patterns exceeding these limits.

**Table 4.3.8 Incising Factors, $C_i$**

| Design Value | $C_i$ |
|---|---|
| $E$, $E_{min}$ | 0.95 |
| $F_b$, $F_t$, $F_c$, $F_v$ | 0.80 |
| $F_{c\perp}$ | 1.00 |

### 4.3.9 Repetitive Member Factor, $C_r$

Reference bending design values, $F_b$, in Tables 4A, 4B, 4C, and 4F for dimension lumber 2" to 4" thick shall be multiplied by the repetitive member factor, $C_r$ = 1.15, when such members are used as joists, truss chords, rafters, studs, planks, decking, or similar members which are in contact or spaced not more than 24" on center, are not less than three in number and are joined by floor, roof or other load distributing elements adequate to support the design load. (A load distributing element is any adequate system that is designed or has been proven by experience to transmit the design load to adjacent members, spaced as described above, without displaying structural weakness or unacceptable deflection. Subflooring, flooring, sheathing, or other covering elements and nail gluing or tongue and groove joints, and through nailing generally meet these criteria.) Reference bending design values in Table 4E for visually graded Decking have already been multiplied by $C_r$ = 1.15.

### 4.3.10 Column Stability Factor, $C_P$

Reference compression design values parallel to grain, $F_c$, shall be multiplied by the column stability factor, $C_P$, specified in 3.7.

### 4.3.11 Buckling Stiffness Factor, $C_T$

Reference modulus of elasticity for beam and column stability, $E_{min}$, shall be permitted to be multiplied by the buckling stiffness factor, $C_T$, as specified in 4.4.2.

### 4.3.12 Bearing Area Factor, $C_b$

Reference compression design values perpendicular to grain, $F_{c\perp}$, shall be permitted to be multiplied by the bearing area factor, $C_b$, as specified in 3.10.4.

### 4.3.13 Pressure-Preservative Treatment

Reference design values apply to sawn lumber pressure-treated by an approved process and preservative (see Reference 30). Load duration factors greater than 1.6 shall not apply to structural members pressure-treated with water-borne preservatives.

### 4.3.14 Format Conversion Factor, $K_F$ (LRFD only)

For LRFD, reference design values shall be multiplied by the format conversion factor, $K_F$, specified in Appendix N.3.1.

### 4.3.15 Resistance Factor, $\phi$ (LRFD only)

For LRFD, reference design values shall be multiplied by the resistance factor, $\phi$, specified in Appendix N.3.2.

### 4.3.16 Time Effect Factor, $\lambda$ (LRFD only)

For LRFD, reference design values shall be multiplied by the time effect factor, $\lambda$, specified in Appendix N.3.3.