Design Values for Wood Structural Members

Design Values for Structural Members

- Section properties for sawn lumber and glulam are found in NDS Supplement
- All “tabulated” design values for sawn lumber, glulam, and decking found in the Supplement
- Design values for round timber piles and poles are listed in the NDS

Design Values for Structural Members

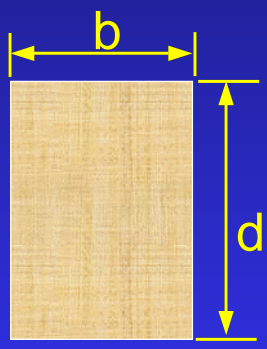
- The designer is responsible for making adjustments in design values for given end use conditions
- Some adjustment factors are found in Supplements
- Some adjustment factors are found in NDS

$$f \leq F' = FC_i$$

Wood Section Properties

A = area of cross section (in^2)

b = width (in.), d = depth (in.)



$A = bd$

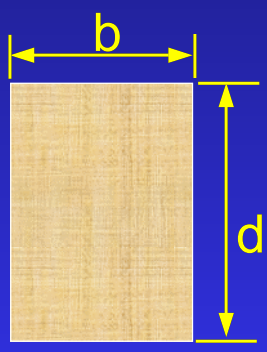
Wood Section Properties

I = moment of inertia (in^4)

S = section modulus (in^3)

$$I_{xx} = \frac{bd^3}{12}$$

$$S_{xx} = \frac{bd^2}{6}$$



Wood Section Properties from NDS Supplement

See Table 1B

Estimates for weight of sawn lumber components

See Table 1B

Glulam Section Properties

See Table 1D

Base Design Values for Visually Graded Dimension Lumber (all species except southern pine)

See Table 4A

Design Values for Visually Graded Southern Pine Dimension Lumber

See Table 4B

Design Values for Mechanically Graded Dimension Lumber

See Table 4C

Design Values for Visually Graded Timbers

See Table 4D

Design Values for Visually Graded Decking

See Table 4E

Design Values for Non-North American Visually Graded Dimension Lumber

See Table 4F

Design Values for Structural Glued-Laminated Softwood Timber (bending members)

See Table 5A

Design Values for Structural Glued-Laminated Softwood Timber (members loaded axially)

See Table 5B

Design Values for Structural Glued-Laminated Hardwood Timber (members loaded in bending)

See Table 5C

Design Values for Structural Glued-Laminated Hardwood Timber (members loaded axially)

See Table 5D

Design Provisions in the NDS

Adjustment Factors for design values
Chapter 2 in NDS

See provisions for each section of the NDS and its supplements to determine which adjustment factors apply for design situation

(4.3, 5.3, 6.3, 7.3, 8.3, 9.3, 10.3)

Adjustment Factors for Design Values

- Load Duration Factor, C_D
  - tabulated design values are for "normal" load duration (10 years)
  - when cumulative load duration under full design load is different than 10 years, all design values, except E and $Fc_{\perp}$, are adjusted

Adjustment Factors for Design Values

- Load Duration Factor, C_D
  - load duration factor for shortest duration load applies
  - load duration factors are independent of load combination factors
  - all load combinations should be examined to determine critical load combination

Adjustment Factors for Design Values

- Frequently Used Load Duration Factors

Load Duration	C_D	Typical Design Loads
Permanent	0.9	Dead Load
10 Years	1.0	Occupancy Live Load
2 Months	1.15	Snow Load
7 Days	1.25	Construction Load
10 Minutes	1.6	Wind / Earthquake Load
Impact	2.0	Impact Load

Adjustment Factors for Design Values

- Wet Service Factor, C_M
  - For high moisture conditions, design values are adjusted by C_M
  - Values for C_M found in NDS Supplement
- Temperature Factor, C_t
  - for sustained exposure to temperatures up to 150 deg. F
  - values for C_t found in NDS Table 2.3.3

Adjustment Factors for Design Values

- Fire Retardant Treatment
  - see manufacturer for any adjustments
- Beam Stability Factor, C_L
  - bending design values multiplied by C_L to account for tendency of beam to buckle laterally
  - C_L doesn't apply with C_V

Adjustment Factors for Design Values

- Size Factor, C_F
  - wood components experience size effects on strength
  - design values decrease for larger sawn lumber and timber members
  - values for C_F are found in Supplement
- Volume Factor, C_V
  - C_V used to adjust bending design values for glulam beams

Adjustment Factors for Design Values

- Size Factor, C_F
  - values for C_F are found in Supplement
    - individual values for most groups of dimension lumber
    - southern pine dimension lumber already adjusted
    - timbers use:

$$C_F = \left(\frac{12}{d}\right)^{\frac{1}{9}} \leq 1.0$$

Adjustment Factors for Design Values

- Volume Factor, C_V
  - equation for C_V is found in Supplement and in NDS chapter on glulam

$$C_V = K_L \left(\frac{21}{L}\right)^{\frac{1}{x}} \left(\frac{12}{d}\right)^{\frac{1}{x}} \left(\frac{5.125}{b}\right)^{\frac{1}{x}} \leq 1.0$$

  - L = length of beam (ft)
  - d = depth of beam (in.)
  - b = width of beam (in.)
  - K_L = loading condition coefficient

Adjustment Factors for Design Values

- Flat Use Factor, C_{fu}
  - when beams loaded on wide face, bending values can be adjusted by C_{fu}
- Incising Factor, C_i
  - C_i used to adjust design values for timbers incised during preservative treating process
  - incisions are used to increase preservative penetration in hardwoods and some western softwood species

Adjustment Factors for Design Values

- Repetitive Member Factor, C_r
  - dimension lumber bending design values can be multiplied by C_r when used as joists, truss chords, rafters, studs, etc.
  - must be in contact or spaced not more than 24 in. OC, at least 3 in number, and joined by roof, floor, etc.
  - $C_r = 1.15$

Adjustment Factors for Design Values

- Curvature Factor, C_c
  - for curved portion of glulam bending members, the bending design value is multiplied by C_c
- Form Factor, C_f
  - bending design values for circular or diamond cross sections are multiplied by C_f

Adjustment Factors for Design Values

- Column Stability Factor, C_P
  - compression parallel-to-grain values are multiplied by C_P to account for column tendency to buckle
- Buckling Stiffness Factor, C_T
  - for 2x4 compression truss chords under combined axial and bending loads, E can be multiplied by C_T

Adjustment Factors for Design Values

- Bearing Area Factor, C_b
  - values for $F_{c\perp}$ can be multiplied by C_b when bearings are less than 6 in. long and more than 3 in. away from the end of the piece