CHAPTER 25 — WOOD

NOTE: Tables in Chapter 25 appear at the end of the Chapter.

Sec. 2501. (a) **Quality and Design.** The quality and design of wood members and their fastenings shall conform to the provisions of this Chapter, and to the following Standards: **General**

MATERIALS OR DESIGN	U.B.C. DESIGNATION
GRADING — LIGHT FRAMING, JOISTS AND PLANKS, DECKING, BEAMS AND STRINGERS, POSTS AND TIMBERS	
All Species of Lumber	25- 1
Cedar, Incense and Western Red	25- 3 and 25- 4
Cypress — Tidewater Red	25- 2
Douglas Fir, Coast Region	25- 3
Douglas Fir	25- 4
Fir, White	25- 3 and 25- 4
Fir, Balsam	25- 8
Hemlock, Eastern	25- 5
Hemlock, West Coast	25- 3
Hemlock, Western	25- 4
Larch	25- 4
Pine (Idaho White, Lodgepole, Ponderosa and Sugar)	25- 4
Pine, Norway	25- 5
Pine, Southern	25- 6
Redwood	25- 7
Spruce, Eastern	25- 8
Spruce, Engelmann	25- 4
Spruce, Sitka	25- 3
PLYWOOD	
Construction and Industrial Softwood	25- 9
Calculation of Diaphragm Deflection	25- 9
STRUCTURAL GLUED-LAMINATED TIMBER	
All Species of Lumber	25-10
Douglas Fir	25-11
Pine, Southern	25-11
Hardwood	25-11
PRESERVATIVE TREATMENT BY PRESSURE PROCESSES	25-12
WOOD POLES	25-13
ROUND TIMBER PILES	25-14
SPACED COLUMNS	25-15
FLEXURAL AND AXIAL LOADING	25-16

General (Continued)

(b) **Workmanship.** All members shall be framed, anchored, tied, and braced so as to develop the strength and rigidity necessary for the purposes for which they are used.

(c) **Fabrication.** Preparation, fabrication, and installation of wood members and their fastenings shall conform to accepted engineering practices and to the requirements of this Code.

(d) **Rejection.** The Building Official may deny permission for the use of a wood member where permissible grade characteristics or defects are present in such a combination that they affect the serviceability of the member.

(e) **Minimum Quality.** Minimum capacity of structural framing members may be established by performance tests. When tests are not made, capacity shall be based upon allowable stresses and design criteria specified in this Code.

Studs, joists, rafters, foundation plates or sills, planking 2 inches or more in depth, beams, stringers, posts, structural sheathing and similar load-bearing members shall be of at least the minimum grades set forth in Table No. 25-A-1 or No. 25-A-2, and in Groups I, II and III set forth in Table No. 25-F. Lumber set forth in Group IV of Table No. 25-F may be used only under conditions specifically approved by the Building Official.

(f) **Shrinkage.** Consideration shall be given in the design to the possible effect of cross grain dimensional changes considered vertically which may occur in lumber fabricated in a green condition.

Sec. 2502. (a) **Definitions.** The following terms used in this Chapter shall have the meanings indicated in this Section: **Definitions and Symbols**

FIBERBOARD is a fibrous-felted, homogeneous panel made from lignocellulosic fibers (usually wood or cane) and having a density of less than 31 pounds per cubic foot but more than 10 pounds per cubic foot, conforming to U.B.C. Standard No. 25-24.

GLUED BUILT-UP MEMBERS are structural elements, the sections of which are composed of built-up lumber, plywood or plywood in combination with lumber; all parts bonded together with adhesives.

GRADE (Lumber), the classification of lumber in regard to strength and utility in accordance with the grading rules of an approved lumber grading agency.

NOMINAL SIZE (Lumber), the commercial size designation of width and depth, in standard sawn lumber and glued-laminated lumber grades; somewhat larger than the standard net size of dressed lumber, in accordance with U.B.C. Standard No. 25-1 for sawn lumber and U.B.C. Standard No. 25-10 for structural glued-laminated timber.

NORMAL LOADING, a design load that stresses a member or fastening to the full allowable stress tabulated in this Chapter. This loading may be applied for approximately 10 years, either continuously or cumulatively, and 90 per cent of this load may be applied for the remainder of the life of the member or fastening.

PARTICLEBOARD, a mat-formed panel manufactured from lignocellulosic materials in the form of discrete pieces or particles, as distinguished from fibers, combined with a binder and bonded together under heat and pressure in accordance with U.B.C. Standard No. 25-25.

PLYWOOD, a built-up panel of laminated veneers conforming to U.B.C. Standard No. 25-9.

STRUCTURAL GLUED-LAMINATED TIMBER, any member comprising an assembly of laminations of lumber in which the grain of all laminations is approximately parallel longitudinally; in which the laminations are bonded with adhesives; and which is fabricated in accordance with U.B.C. Standard No. 25-10 or No. 25-11.

TREATED WOOD, wood treated with approved preservatives in accordance with U.B.C. Standard No. 25-12.

Definitions and Symbols (Continued)

WOOD OF NATURAL RESISTANCE TO DECAY, the heartwood of bald cypress, black locust, black walnut, the cedars and redwood.

(b) **Symbols.** The symbols used in this Chapter have the following definitions:

A = area of cross section.

b = breadth (width) of rectangular member.

C = coefficient, constant, or factor.

C_c = curvature factor.

C_d = depth effect factor.

C_f = form factor.

C_s = slenderness factor.

c = distance from neutral axis to extreme fiber.

D = diameter.

d = depth of rectangular member, or least dimension of compression member.

E = modulus of elasticity.

e = eccentricity.

F_b = allowable unit stress for extreme fiber in bending.

F_b' = allowable unit stress for extreme fiber in bending, adjusted for slenderness.

f_b = actual unit stress for extreme fiber in bending.

F_c = allowable unit stress in compression parallel to grain.

F_c' = allowable unit stress in compression parallel to grain adjusted for l/d ratio where d is the least dimension.

f_c = actual unit stress in compression parallel to grain.

$F_{c\perp}$ = allowable unit stress in compression perpendicular to grain.

$f_{c\perp}$ = actual unit stress in compression perpendicular to grain.

F_n = allowable unit stress acting perpendicular to the inclined surface p.s.i. (Hankinson's Formula).

F_r = allowable unit radial stress.

f_r = actual unit radial stress.

F_{rc} = allowable unit radial stress in compression.

f_{rc} = actual unit radial stress in compression.

F_{rt} = allowable unit radial stress in tension.

f_{rt} = actual unit radial stress in tension.

F_t = allowable unit stress in tension parallel to grain.

f_t = actual unit stress in tension parallel to grain.

Definitions and Symbols (Continued)

F_v = allowable unit horizontal shear stress.

f_v = actual unit horizontal shear stress.

h = rise.

I = moment of inertia.

L = span length of beam, or unsupported length of column, feet.

l = span length of beam, or unsupported length of column, inch.

M = bending moment.

m = unit bending moment.

N = acting perpendicular to the inclined surface *"lb"* (Hankinson's Formula).

P = total concentrated load, or axial compression load.

P/A = induced axial load per unit of cross-sectional area.

Q = statical moment of an area about the neutral axis.

R = radius of curvature.

R_H = horizontal reaction.

R_V = vertical reaction.

r = radius of gyration.

S = section modulus.

T = total axial tension load.

t = thickness.

V = total vertical shear.

W = total uniform load.

w = uniform load per unit of length.

Δ_A = allowable deformation or deflection.

Δ_a = actual deformation or deflection.

θ = angle between the direction of load and the direction of grain, degrees (Hankinson's Formula).

Size of Structural Members

Sec. 2503. Sizes of lumber, structural glued-laminated timber and plywood referred to in this Code are nominal sizes. Computations to determine the required sizes of members shall be based on the net dimensions (actual sizes) and not the nominal sizes.

Stresses

Sec. 2504. (a) **General.** Except as hereinafter provided, stresses shall not exceed the allowable unit stresses for the respective species and grades or fabricated products as set forth in Tables No. 25-A-1 and No. 25-A-2 for lumber, and

Stresses (Continued)

Tables No. 25-C and No. 25-D for structural glued-laminated timber.

The values for F_b and F_c tabulated in Table No. 25-A-1 for visually stress-rated lumber and in Table No. 25-A-2 for machine stress-rated lumber are for the design of structures when the strength of an individual member is premised on the assumption that each individual piece carries its design load.

The values for F_b tabulated in Table No. 25-A-1 may be increased 15 per cent for the design of an assembly of repetitive framing such as tongue-and-groove planks and decking, or members such as joists, rafters, and studs not over 4 inches in thickness spaced not more than 24 inches, not less than three in number and joined by transverse load distributing elements adequate to support the design load.

Values for species and grades not tabulated shall be approved by the Building Official.

Values for plywood shall be in accordance with Table No. 25-B. All plywood when designed to be exposed in outdoor applications shall be of the exterior type.

(b) **Wood Poles or Piles.** The values tabulated in Table No. 25-E shall be used for the design of round timber poles and piles.

Poles and piles shall conform to the requirements set forth in U.B.C. Standards No. 25-13 and No. 25-14.

(c) **Adjustment of Stresses.** 1. **General.** The allowable unit stresses specified in this Chapter shall be subject to the adjustments set forth in the footnotes to the appropriate stress tables and to the requirement of this Subsection.

2. **Preservative treatment.** The values for wood pressure impregnated with an approved process and preservative need no adjustment for treatment but are subject to other adjustments.

3. **Fire-retardant treatment.** The values shall be reduced 10 per cent for lumber pressure impregnated with approved fire-retardant chemicals. The values for plywood so treated shall be reduced 16 per cent except for modulus of elasticity which shall be reduced 10 per cent. Other adjustments are applicable.

Where structural glued-laminated timber is fire-retardant treated, values shall be reduced as approved by the Building Official.

Stresses (Continued)

4. **Duration of load.** Values for wood and mechanical fastenings (when the wood determines the load capacity) are subject to the following adjustments for the various durations of loading:

i. Where a member is fully stressed to the maximum allowable stress, either continuously or cumulatively, for more than 10 years under the conditions of maximum design load, the values shall not exceed 90 per cent of those in the tables.

ii. When the duration of the full maximum load during the life of the member does not exceed the period indicated below, the values may be increased in the tables as follows:

15 per cent for two months duration as for snow

25 per cent for seven days duration as for roof loads

33⅓ per cent for wind or earthquake

100 per cent for impact

The foregoing increases are not cumulative. For combined duration of loadings the resultant structural members shall not be smaller than required for the longer duration of loading.

iii. Values for normal loading conditions may be used without regard to impact if the stress induced by impact does not exceed the values for normal loading.

Identification

Sec. 2505. All lumber, plywood, particleboard, structural glued-laminated timber, piles and poles regulated by this Chapter shall conform to the applicable standards or grading rules specified in this Code and shall be so identified by the grade mark or a Certificate of Inspection issued by an approved agency.

Horizontal Member Design

Sec. 2506. (a) **Beam Span.** For simple beams, the span shall be taken as the distance from face to face of supports, plus one-half the required length of bearing at each end; for continuous beams, the span is the distance between centers of bearings on supports over which the beam is continuous.

(b) **Flexure.** 1. **Circular cross section.** A beam of circular cross section may be assumed to have the same strength in flexure as a square beam having the same cross-sectional area. If a circular beam is tapered, it shall be considered a beam of variable cross section.

Horizontal Member Design (Continued)

2. **Notching.** If possible, notching of beams should be avoided. For a beam notched at or near the middle of the span, the net depth shall be taken when determining the flexural strength. For effect of notch on shear strength, see Section 2506 (d).

3. **Lateral moment distribution.** Lateral moment distribution of a concentrated load from a critically loaded beam to adjacent parallel beams shall be calculated.

(c) **Horizontal Shear.** The maximum horizontal shear stress in a solid-sawn or glued-laminated wood beam shall not exceed that calculated by means of the formula:

$$f_v = \frac{3V}{2bd}$$

The actual unit shear stress, f_v, shall not exceed the allowable for the species and grade, as given in Table No. 25-A for solid-sawn lumber, and in Tables No. 25-C and No. 25-D for glued-laminated lumber, adjusted for duration of loading, as provided in Section 2504 (c).

When calculating the total vertical shear, V, distribution of load to adjacent parallel beams by flooring or other members may be considered and all loads within a distance from either support equal to the depth of the beam may be neglected.

(d) **Horizontal Shear in Notched Beams.** Where girders, beams, or joists are notched at points of support, they shall meet design requirements for net section in bending and in shear. The shear at such point shall not exceed the value calculated by the following formula:

$$V = \left(\frac{2\,bd'\,F_v}{3}\right)\left(\frac{d'}{d}\right)$$

WHERE:

d' = actual depth of beam at the notch.

d = total depth of beam.

Where notches or holes are made in other portions of the beam, the net remaining depth of beam shall be used in determining the bending strength.

(e) **Design of Eccentric Joints and of Beams Supported by Fastenings.** Eccentric connector and bolted joints, and beams supported by connectors or bolts, shall be designed so that f_v in the following formula does not exceed the allowable unit stresses in horizontal shear.

$$f_v = \frac{3V}{2bd_e}$$

in which

d_e (with connectors) = the depth of the member, less the distance from the unloaded edge of the member to the nearest edge of the nearest connector.

d_e (with bolts only) = the depth of the member, less the distance from the unloaded edge of the member to the center of the nearest bolt.

Allowable unit stresses in shear for such joint details shall be 150 per cent of the horizontal shear values as set forth in Tables No. 25-A, No. 25-C and No. 25-D.

(f) **Compression Perpendicular to Grain.** The allowable unit stresses for compression perpendicular to grain, in Tables No. 25-A, No. 25-C and No. 25-D apply to bearings of any length at the ends of the beam, and to all bearings 6 inches or more in length at any other location.

For bearings of less than 6 inches in length and not nearer than 3 inches to the end of a member, the maximum allowable load per square inch may be obtained by multiplying the allowable unit stresses in compression perpendicular to grain by the following factor:

$$\frac{l_b + .375}{l_b}$$

in which l_b is the length of bearing in inches measured along the grain of the wood.

The multiplying factors for indicated lengths of bearing on such small areas as plates and washers may be:

LENGTH OF BEARING (In Inches)	½	1	1½	2	3	4	6 OR MORE
Factor	1.75	1.38	1.25	1.19	1.13	1.10	1.00

Horizontal Member Design (Continued)

In using the preceding formula and table for round washers or bearing areas, use a length equal to the diameter.

In joists supported on a ribbon or ledger board and spiked to the studding, the allowable stress in compression perpendicular to grain may be increased 50 per cent.

(g) **Lateral Support.** 1. **Floor joists.** Floor joists, having a depth-to-thickness ratio of 6 or more, shall be supported laterally by bridging installed at intervals not exceeding 8 feet. Bridging may be omitted at the ends of joists which are nailed or otherwise fastened to framing members.

> **EXCEPTION:** Bridging between supports may be omitted for 2 x 12 floor joists where live loads do not exceed 40 pounds per square foot.

2. **Beams and roof joists.** For solid sawn rectangular beams and roof joists, the following rules, based on nominal dimensions, shall apply to provide lateral restraint:

If the ratio of depth to thickness is 2 to 1, no lateral support is needed.

If the ratio is 3 to 1, the ends shall be held in position.

If the ratio is 4 to 1, the piece shall be held in line as in a well-bolted chord member in a truss.

If the ratio is 5 to 1, one edge shall be held in line.

If the ratio is 6 to 1, the provisions of paragraph 1 may be applied.

If the ratio is 7 to 1, both edges shall be held in line.

If a beam is subject to both flexure and compression parallel to grain, the ratio may be as much as 5 to 1, if one edge is held firmly in line; e.g., by rafters (or by roof joists) and diagonal sheathing. If the dead load is sufficient to induce tension on the underside of the rafters, the ratio for the beam may be 6 to 1.

(h) **Lateral Deflection—Arches and Top Chords of Trusses.** Where roof joists, not purlins, are used between arches or the top chords of trusses, the depth, rather than the breadth, of the arch or top chord member (compression member) may be taken as its least dimension in determining the l/d. The roof joists shall be placed so that their upper edges are at least ½ inch above the tops of the arch or chord, but also placed low enough to provide adequate lateral support.

When roof joists or planks are placed on top of an arch or top chord of a truss, and are well spiked or otherwise securely fastened to the arch or top chord and to blocking placed be-

tween the joists, or when sheathing is nailed properly to the top chord of trussed rafters, the depth of the arch or individual chord members may be used as the least dimension d in determining l/d. **Horizontal Member Design (Continued)**

Sec. 2507. (a) **Column Classifications.** 1. **Simple solid wood columns.** Simple columns consist of a single piece or of pieces properly glued together to form a single member. **Column Design**

2. **Spaced columns, connector joined.** Spaced columns are formed of two or more individual members with their longitudinal axes parallel, separated at the ends and middle points of their length by blocking and joined at the ends by timber connectors capable of developing the required shear resistance. See U.B.C. Standard No. 25-15 for design.

3. **Built-up columns.** Built-up columns, other than connector-joined spaced columns and glued-laminated columns, shall not be designed as solid columns.

(b) **Limitation on l/d Ratios.** For simple solid columns l/d shall not exceed 50.

For individual members of a spaced column, l/d shall not exceed 80, nor shall l_2/d exceed 40.

(c) **Simple Solid-Column Design.** These formulas for simple solid columns are based on pin-end conditions but shall be applied also to square-end conditions.

Allowable unit stresses in pounds per square inch of cross-sectional area of simple solid columns shall be determined by the following formula, but such unit stresses shall not exceed the values for compression, parallel to grain F_c in Tables No. 25-A, No. 25-C and No. 25-D, adjusted in accordance with the provisions of Section 2504.

$$F_c' = \frac{n^2 E}{2.727 (l/r)^2} = \frac{3.619 E}{(l/r)^2}$$

For columns of square or rectangular cross section this formula becomes:

$$F_c' = \frac{0.30 E}{(l/d)^2}$$

(d) **Tapered Columns.** In determining the d for tapered column design, the diameter of a round column or the least

Column Design (Continued)

dimension of a column of rectangular section, tapered at one or both ends, shall be taken as the sum of the minimum diameter or least dimension and one-third the difference between the minimum and maximum diameters or lesser dimensions.

Flexural and Axial Loading Combined

Sec. 2508. (a) **Flexure and Axial Tension.** Members subjected to both flexure and axial tension, shall be so proportioned that

$$\frac{P/A}{F_t} + \frac{M/S}{F_b} \text{ does not exceed } ONE$$

(b) **Flexure and Axial Compression.** Members subjected to both flexure and axial compression, shall be so proportioned that

$$\frac{P/A}{F_c'} + \frac{M/S}{F'_b} \text{ does not exceed } ONE$$

(c) **Spaced Columns.** In the case of spaced columns, this combined stress formula may be applied only if the bending is in a direction parallel to the greater d of the individual member.

Compression at Angle to Grain

Sec. 2509. The allowable unit stress in compression at an angle of load to grain between 0° and 90° shall be computed from the Hankinson formula as follows:

$$F_n = \frac{F_c F_{c\perp}}{F_c \sin^2 \theta + F_{c\perp} \cos^2 \theta}$$

Timber Connections and Fastenings

Sec. 2510. (a) **Timber Connectors.** Timber connectors may be used to transmit stress between wood members and between wood and metal members. The allowable loads and installation of timber connectors shall be as set forth in U.B.C. Standard No. 25-17.

Safe loads and design practices for types of connectors not mentioned or fully covered in U.B.C. Standard No. 25-17 may be determined in a manner approved by the Building Official.

(b) **Bolts.** Bolted joints wherein bolts are used to resist or transfer stresses in wood structures shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-17. Safe loads in pounds for bolts in double shear and in seasoned lumber of the following species: Douglas fir (Coast Region) and Douglas fir; larch; pine, Southern; in joints consisting of three members in which the side members are one-half the thickness of the main member, shall not ex-

ceed values set forth in Tables No. 25-G and No. 25-H. (For other species see U.B.C. Standard No. 25-17.)

(c) **Drift Bolts or Pins.** Connections of wood structural members involving the use of drift bolts or drift pins shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-17.

(d) **Wood Screws.** Connections involving the use of wood screws shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-17.

(e) **Lag Screws.** Connections involving the use of lag screws shall be designed in accordance with the provisions set forth in U.B.C. Standard No. 25-17.

(f) **Nails and Spikes.** 1. **Safe lateral strength.** A common wire nail driven perpendicular to grain of the wood, when used to fasten wood members together, shall not be subjected to a greater load causing shear and bending than the safe lateral strength of the wire nail or spike as set forth in Table No. 25-I.

A wire nail driven parallel to the grain of the wood or toe-nailed shall not be subjected to more than two-thirds of the lateral load allowed when driven perpendicular to grain.

2. **Safe resistance to withdrawal.** A wire nail driven perpendicular to grain of the wood shall not be subjected to a greater load, tending to cause withdrawal, than the safe resistance of the nail to withdrawal, as set forth in Table No. 25-J.

Nails driven parallel to grain of the wood shall not be allowed for resisting withdrawal forces.

3. **Spacing and penetration.** Common wire nails shall have penetration into the piece receiving the point as set forth in Table No. 25-I. Nails or spikes for which the wire gauges or lengths are not set forth in Table No. 25-I shall have a required penetration of not less than 11 diameters, and allowable loads may be interpolated.

For wood to wood joints the spacing center-to-center shall be not less than the required penetration.

Edge and end distances shall be not less than one-half of the required penetration.

Holes for nails, where necessary to prevent splitting, shall be bored of a diameter smaller than that of the nails.

(g) **Joist Hangers and Framing Anchors.** Connections depending upon joist hangers or framing anchors, ties, and

Timber Connections and Fastenings (Continued)

other mechanical fastenings not otherwise covered may be used where approved.

(h) **Metal Plate Connector.** Metal plate connector employed as joint connector in light wood trusses shall conform to U.B.C. Standard No. 25-17.

Structural Glued-Laminated Timber Design

Sec. 2511. (a) **General Provisions.** 1. **Design requirements.** Except as otherwise provided in this Section, structural glued-laminated timber members shall be designed in accordance with the applicable engineering formulas used for sawn members.

2. **Fastenings.** The pertinent provisions and allowable loads for fastenings, given in this Chapter, shall apply to structural glued-laminated timber members.

3. **Allowable unit stresses.** The allowable unit stresses for structural glued-laminated timber shall be in accordance with Tables No. 25-C and No. 25-D and as modified by this Section.

(b) **Standard Sizes.** Standard finished widths of laminated members shall be as set forth in U.B.C. Standard No. 25-10.

Depth of straight and curved members, length of all members and net dimensions shall be specified on the plans.

(c) **Specifications.** For structural glued-laminated timber, the following shall be specified on the plans:

Whether for dry or wet conditions of use.

Species and applicable standard.

Stress requirements.

If the temperature of the timber exceeds 150°F. in service.

(d) **Design Stresses.** 1. **Dry conditions of use.** Allowable stress values for dry conditions of use shall be applicable for normal loading when the moisture content in service is less than 16 per cent, as in most covered structures.

2. **Wet conditions of use.** Allowable stress values for wet conditions of use shall be applicable for normal loading when the moisture content in service is 16 per cent or more, as may occur in exterior and submerged construction.

3. **Curvature factor.** For the curved portion of members, the allowable unit stress in bending shall be modified by multiplication by the following curvature factor:

$$C_c = 1\text{-}2000 \left(\frac{t}{R}\right)^2$$

in which

t = thickness of lamination in inches.

R = radius of curvature of inside face of lamination in inches, and t/R shall not exceed 1/100 for hardwoods and Southern pine, or 1/125 for other softwoods.

No curvature factor shall be applied to stress in the straight portion of an assembly, regardless of curvature elsewhere.

4. **Radial tension or compression.** The maximum radial stress induced in a curved member of rectangular cross section by a bending moment is:

$$f_r = \frac{3M}{2Rbd}$$

in which

f_r = radial stress in pounds per square inch.

M = bending moment in inch pounds.

R = radius of curvature at center line of member in inches.

b = width of cross section in inches.

d = depth of cross section in inches.

When M is in the direction tending to decrease curvature (increase the radius), the radial stress is in tension. For Douglas fir and larch, the radial tension stress shall not exceed one-third the allowable stress for horizontal shear for wind or earthquake loads, nor 15 pounds per square inch for other types of load. For other species of wood, the radial tension stress shall not exceed one-third the allowable stress for horizontal shear. Where mechanical reinforcement is provided to resist all radial tension stress, the foregoing limits do not apply.

When M is in the direction tending to increase curvature (decrease the radius) the radial stress is in compression and shall be limited to the allowable stress in compression perpendicular to the grain.

5. **Slenderness factor for beams.** When the depth of a beam exceeds its breadth, lateral support is required and the slenderness factor shall be calculated by the following formula:

$$C_s = \sqrt{\frac{l_e d}{b^2}}$$

Structural Glued-Laminated Timber Design (Continued)

in which

C_s = slenderness factor.

l_e = effective length of beam, inches, from the following table.

l_u = unsupported length of beam, inches.

d = depth of beam, inches.

b = breadth of beam, inches.

EFFECTIVE LENGTH OF GLUED-LAMINATED BEAMS

TYPE OF BEAM SPAN AND NATURE OF LOAD	VALUE OF EFFECTIVE LENGTH, "l_e"
Single span beam, load concentrated at center	$1.61l_u$
Single span beam, uniformly distributed load	$1.92l_u$
Single span beam, equal end moments	$1.84l_u$
Cantilever beam, load concentrated at unsupported end	$1.69l_u$
Cantilever beam, uniformly distributed load	$1.06l_u$
Single span or cantilever beam, any load	$1.92l_u$

When the slenderness factor C_s does not exceed 10, the full allowable unit stress in bending, F_b, may be used.

When the slenderness factor C_s is greater than 10, but does not exceed C_k, the allowable unit stress in bending F_b' shall be determined from the following formula:

$$F_b' = F_b \left[1 - \frac{1}{3} \left(\frac{C_s}{C_k} \right)^4 \right]$$

in which

$C_k = \sqrt{3E/5F_b}$

E = modulus of elasticity.

When the slenderness factor C_s is greater than C_k, but less than 50, the allowable unit stress in bending F_b' shall be determined by the following formula:

$$F_b' = \frac{0.40\,E}{(C_s)^2}$$

In no case shall C_s exceed 50.

When the compression edge of a beam is supported throughout its length to prevent its lateral displacement, and the ends at points of bearing have lateral support to prevent rotation, the unsupported length l_u may be taken as zero.

When lateral support is provided to prevent rotation at the points of end bearing, but no other lateral support is provided

throughout the length of the beam, the unsupported length l_u is the distance between such points of end bearing, or the length of a cantilever. **Structural Glued-Laminated Timber Design (Continued)**

When a beam is provided with lateral support to prevent rotational and lateral displacement at intermediate points as well as at the ends, the unsupported length l_u is the distance between such points of intermediate lateral support.

6. **Depth factor for beams.** When the depth of a rectangular beam exceeds 12 inches, the allowable unit stress in bending F_b shall be multiplied by the depth factor determined by the following formula:

$$C_d = 0.81 \frac{(d^2 + 143)}{(d^2 + 88)}$$

in which

C_d = depth factor.

d = depth of beam in inches.

7. **Combined slenderness and depth factors.** Adjustment of bending stress for depth factor is cumulative with adjustment for slenderness factor.

(e) **Tapered Faces.** No sawn tapered cuts shall be permitted on the tension face of any simple beam. Pitched or curved beams shall be so fabricated that the laminations are parallel to the tension face. Straight, pitched or curved beams may have sawn tapered cuts on the compression face.

For other members subject to bending, the slope of tapered faces, measured from the tangent to the lamination of the section under consideration, shall be not steeper than 1:24 on the tension side.

EXCEPTIONS: 1. This requirement shall not apply to arches.

2. Taper may be steeper at sections increased in size beyond design requirements for architectural projections.

(f) **Manufacture and Fabrication.** The manufacture and fabrication of structural glued-laminated timber shall be in accordance with U.B.C. Standard No. 25-10. All work shall be under the supervision of qualified personnel.

Form Factors

Sec. 2512. The allowable unit flexural stresses in nonprismatic members shall not exceed the value established by multiplying such stress by the form factor determined as follows:

Beam Section	Form Factor (C_f)
Circular	1.180
Square (with diagonal vertical)	1.414
Lumber I and Box Beams	$0.81 + C_g (C_d - .81)$

Form Factors (Continued)

WHERE:

C_f = form factor.

C_d = depth factor determined in accordance with Section 2511 (d) 6.

C_g = support factor = $p^2 (6 - 8p + 3p^2) (1 - q) + q$.

p = ratio of depth of compression flange to full depth of beam.

q = ratio of thickness of web or webs to the full width of beam.

Design of Glued Built-up Members

Sec. 2513. Plywood components shall be designed, fabricated and identified in accordance with U.B.C. Standard No. 25-18.

Wood Diaphragms

Sec. 2514 (a) **General.** Lumber and plywood diaphragms may be used to resist horizontal forces in horizontal and vertical distributing or resisting elements, provided the deflection in the plane of the diaphragm, as determined by calculations, tests, or analogies drawn therefrom, does not exceed the permissible deflection of attached distributing or resisting elements. See U.B.C. Standard No. 25-9 for a method of calculating the deflection of a blocked plywood diaphragm.

Permissible deflection shall be that deflection up to which the diaphragm and any attached distributing or resisting element will maintain its structural integrity under assumed load conditions, i.e. continue to support assumed loads without danger to occupants of the structure.

Connections and anchorages capable of resisting the design forces shall be provided between the diaphragms and the resisting elements. Openings in diaphragms which materially affect their strength shall be fully detailed on the plans, and shall have their edges adequately reinforced to transfer all shearing stresses.

Size and shape of diaphragms shall be limited as set forth in Table No. 25-K.

In buildings of wood frame construction where rotation is provided for, the depth of the diaphragm normal to the open side shall not exceed 25 feet nor two-thirds the diaphragm width, whichever is the smaller depth. Straight sheathing shall not be permitted to resist shears in diaphragms acting in rotation.

EXCEPTIONS: 1. One-story, wood-framed structures with the depth normal to the open side not greater than 25 feet, may have a depth equal to the width.

2. Where calculations show that diaphragm deflections can be tolerated, the depth normal to the open end may be increased to a depth to width ratio not greater than 1½:1 for diagonal sheathing or 2:1 for special diagonal sheathed or plywood diaphragms.

In masonry or concrete buildings lumber and plywood diaphragms shall not be considered as transmitting lateral forces by rotation.

Wood Diaphragms (Continued)

(b) **Diagonally Sheathed Diaphragms.** 1. **Conventional construction.** Such lumber diaphragms shall be made up of 1-inch nominal sheathing boards laid at an angle of approximately 45 degrees to supports. Sheathing boards shall be directly nailed to each intermediate bearing member with not less than two 8d nails for 1-inch by 6-inch nominal boards and three 8d nails for boards 8 inches, or wider; and in addition three 8d nails and four 8d nails shall be used for 6-inch and 8-inch boards, respectively, at the diaphragm boundaries. End joints in adjacent boards shall be separated by at least one joist or stud space, and there shall be at least two boards between joints on the same support. Boundary members at edges of diaphragms shall be designed to resist direct tensile or compressive chord stresses and shall be adequately tied together at corners.

Conventional lumber diaphragms may be used to resist shear, due to wind or seismic forces, not exceeding 300 pounds per lineal foot of width.

2. **Special construction.** Special diagonally sheathed diaphragms shall conform to conventional construction and in addition, shall have all elements designed in conformance with the provisions of this Code.

Each chord or portion thereof may be considered as a beam loaded with a uniform load per foot equal to 50 per cent of the unit shear due to diaphragm action. The load shall be assumed as acting normal to the chord, in the plane of the diaphragm and either toward or away from the diaphragm. The span of the chord, or portion thereof, shall be the distance between structural members of the diaphragm such as the joists, studs, and blocking, which serve to transfer the assumed load to the sheathing.

Special diagonally sheathed diaphragms shall include conventional diaphragms sheathed with two layers of diagonal sheathing at 90 degrees to each other and on the same face of the supporting members.

Special diagonally sheathed diaphragms may be used to resist shears, due to wind or seismic loads, provided such shears do not stress the nails beyond their allowable safe lateral strength and do not exceed 600 pounds per lineal foot of width.

(c) **Plywood Diaphragms.** Horizontal and vertical diaphragms sheathed with plywood may be used to resist horizontal forces not exceeding those set forth in Table No. 25-L for horizontal diaphragms, and Table No. 25-M for vertical diaphragms, or may be calculated by principles of mechanics without limitation by using values of nail strength and plywood shear values as specified elsewhere in this Code. Plywood for horizontal diaphragms shall be as set forth in Table No. 25-Q for corresponding joist spacing and loads. Maximum spans for plywood subfloor-underlayment shall be as set forth

Wood Diaphragms (Continued)

in Table No. 25-R. Plywood used for horizontal and vertical diaphragms shall conform to U.B.C. Standard No. 25-9.

All boundary members shall be proportioned and spliced where necessary to transmit direct stresses. Framing members shall be at least 2-inch nominal in the dimension to which the plywood is attached and such members shall be limited to a maximum spacing of 16 inches on center for vertical diaphragms. In general, panel edges shall bear on the framing members and butt along their center lines. Nails shall be placed not less than ⅜ inch in from the panel edge, nor more than 12 inches apart along intermediate supports and 6 inches along panel edge bearings, and shall be firmly driven into the framing members. No unblocked panels less than 12 inches wide shall be used.

Fiberboard Sheathing Diaphragms

Sec. 2515. Wood stud walls sheathed with fiberboard sheathing complying with U.B.C. Standard No. 25-24 may be used to resist horizontal forces not exceeding those set forth in Table No. 25-N. The fiberboard sheathing, 4 feet by 8 feet, shall be applied vertically to wood studs not less than 2-inch nominal in thickness spaced 16 inches on centers. Nailing shown in Table No. 25-N shall be provided at the perimeter of the sheathing board, and at intermediate studs. Blocking not less than 2-inch nominal in thickness shall be provided at horizontal joints when wall height exceeds length of sheathing panel and nail sheathing with nails shown in Table No. 25-N spaced 3 inches on centers each side of joint. Nails shall be spaced not less than ⅜ inch from edges and ends of sheathing. Marginal studs of shear walls or shear-resisting elements shall be adequately anchored at top and bottom and designed to resist all forces. The maximum height-width ratio shall be one and one-half to one.

Wood Combined with Masonry or Concrete

Sec. 2516. (a) **Dead Load.** Wood members shall not be used to permanently support the dead load of any masonry or concrete.

EXCEPTIONS: 1. Masonry or concrete nonstructural floor or roof surfacing not more than 4 inches thick may be supported by wood members.

2. Any structure may rest upon wood piles constructed in accordance with the requirements of Chapter 28.

3. Masonry or concrete fireplace with a factory built chimney conforming to Chapter 37 of the Code may be supported by wood framing.

(b) **Horizontal Force.** Wood members shall not be used to resist horizontal forces contributed by masonry or concrete construction in buildings over one story in height.

EXCEPTION: Wood floor and roof members may be used in horizontal trusses and diaphragms to resist horizontal forces imposed by wind, earthquake, or earth pressure, provided such forces are not resisted by rotation of the truss or diaphragm.

Sec. 2517. (a) **General.** The requirements in this Section apply to all wood frame construction.

General Construction Requirements

(b) **Preparation of Building Site.** All stumps and roots shall be removed from the soil to a depth of at least 12 inches below the surface of the ground in the area to be occupied by the building.

All wood forms which have been used in placing concrete, if within the ground or between foundation sills and the ground, shall be removed before a building is occupied or used for any purpose. Before completion, loose or casual wood shall be removed from direct contact with the ground under the building.

(c) **Protection against Decay and Termites.** 1. **Wood support embedded in ground.** Wood embedded in the ground or in direct contact with the earth and used for the support of permanent structures, shall be treated wood unless continuously below the ground waterline or continuously submerged in fresh water.

2. **Underfloor clearance.** Wood joists or the bottom of wood floors closer than 18 inches, or wood girders closer than 12 inches to the ground underfloor areas and their supports, shall be of treated wood or all heartwood of approved naturally durable species as listed in Section 2517 (c) 3.

Accessible underfloor areas shall be provided with an 18-inch by 24-inch access crawl hole.

3. **Plates, sills and sleepers.** All foundation plates or sills and sleepers on a concrete or masonry slab, which is in direct contact with earth and sills which rest on concrete or masonry foundations, shall be treated wood or Foundation redwood, all marked or branded by an approved agency. Foundation cedar or No. 2 Foundation redwood marked or branded by an approved agency may be used for sills in territories subject to moderate hazard, where termite damage is not frequent and when specifically approved by the Building Official. In territories where hazard of termite damage is slight, any species of wood permitted by this Code may be used for sills when specifically approved by the Building Official.

4. **Columns and posts.** All wood columns and posts shall be framed to true end bearings. Supports shall be designed to hold the column or post securely in position and to protect its base from deterioration. In areas exposed to water splash and in exterior locations, wood columns and posts shall be supported by piers projecting at least 2 inches above the finished floor and shall bear on a metal base plate or a foundation plate or sill as specified in Subsection (c) 3. Posts or columns of treated wood or of Foundation grade redwood or cedar may be placed directly on concrete, solid masonry or grouted masonry.

General Construction Requirements (Continued)

5. **Girders entering masonry or concrete walls.** Ends of wood girders entering masonry or concrete walls shall be provided with a ½-inch air space on tops, sides and ends unless approved wood of natural resistance to decay or treated wood is used.

6. **Foundation ventilation.** Underfloor areas shall be ventilated by an approved mechanical means or by openings in the foundation walls. Such wall openings shall have a net area of not less than 1½ square feet for each 25 linear feet of exterior wall. Openings shall be arranged to provide cross ventilation on at least two approximately opposing sides and shall be covered with corrosion resistant wire mesh of not less than ¼ inch nor more than ½ inch in any dimension.

7. **Wood and earth separation.** No wood other than that permitted in paragraph 3 above shall be nearer than 6 inches to any earth unless separated by concrete at least 3 inches in thickness with an impervious membrane installed between the earth and concrete.

Where planter boxes are installed adjacent to wood frame walls a 2-inch wide air space shall be provided between the planter and the wall. Flashings shall be installed when the air space is less than 6 inches in width. Where flashing is used provisions shall be made to permit circulation of air in the air space. The wood frame wall shall be provided with an exterior wall covering conforming to the provisions of Subsection (g) of this Section.

(d) **Wall Framing.** The framing of exterior and interior walls shall be in accordance with provisions specified in Section 2518 unless a specific design is furnished.

(e) **Floor Framing.** Wood-joisted floors shall be framed and constructed and anchored to supporting wood stud or masonry walls as specified in Chapter 23.

In wood-frame floor construction where suspended ceilings occur, the space between the ceiling and the floor above shall be divided into areas not exceeding 1000 square feet in a manner required for partitioning attic space in Section 3205.

(f) **Firestopping.** Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal) and shall form an effective barrier between stories, and between a top story and roof space. It shall be used in specific locations, as follows:

1. In exterior or interior stud walls, at ceilings and floor levels.

2. In all stud walls and partitions, including furred spaces, so placed that the maximum dimension of any concealed space is not over 10 feet.

3. Between stair stringers at top and bottom and between studs along and in line with run of stair adjoining stud walls and partitions.

General Construction Requirements (Continued)

4. Around top, bottom, sides and ends of sliding door pockets.

5. In spaces between chimneys and wood framing, loose noncombustible materials shall be placed in noncombustible supports, or a metal collar tightly fitted to the chimney and nailed to the wood framing may be used.

6. Any other locations not specifically mentioned above, such as holes for pipes, shafting, behind furring strips and similar places which could afford a passage for flames.

Firestops when of wood shall be 2-inch nominal thickness. If the width of opening is such that more than one piece of lumber is necessary, there shall be two thicknesses of 1-inch nominal material with joints broken or ¾-inch thick plywood.

Firestops may also be of gypsum board, cement asbestos board, mineral wool or other approved noncombustible materials, securely fastened in place.

(g) **Exterior Wall Coverings.** 1. **General.** Exterior wood stud walls shall be covered on the outside with the materials and in the manner specified in this Section or elsewhere in this Code. Studs or sheathing shall be covered on the outside face with a weather resistive barrier when required by Section 1707 (a). Exterior wall coverings of the minimum thickness specified in this Section are based upon a maximum stud spacing of 16 inches.

2. **Siding.** Siding shall have a minimum thickness of ⅜ inch unless placed over sheathing permitted by this Code.

Siding patterns known as rustic, drop siding, or shiplap, shall have an average thickness in place of not less than $\frac{19}{32}$ inch and shall have a minimum thickness of not less than ⅜ inch. Bevel siding shall have a minimum thickness measured at the butt section of not less than $\frac{7}{16}$ inch and a tip thickness of not less than $\frac{3}{16}$ inch. Siding of lesser dimensions may be used, provided such wall covering is placed over sheathing which conforms to the provisions specified elsewhere in this Code.

All weatherboarding or siding shall be securely nailed to each stud with not less than one nail, or to solid 1-inch nominal wood sheathing or ½-inch plywood sheathing with not less than one line of nails spaced not more than 24 inches on center in each piece of the weatherboarding or siding.

3. **Plywood.** Where plywood is used for covering the exterior of outside walls, it shall be of the Exterior type not less than ⅜ inch thick. Unless applied over 1-inch wood sheathing or ½-inch plywood sheathing, joints shall occur over framing members and shall be covered with a continuous wood batt; or joints shall be lapped horizontally or otherwise made waterproof to the satisfaction of the Building Official.

General Construction Requirements (Continued)

4. **Shingles or shakes.** Wood shingles or shakes and asbestos cement shingles may be used for exterior wall covering provided the frame of the structure is covered with building paper as specified in Section 1707 (a). All shingles or shakes attached to sheathing other than wood sheathing shall be secured with approved corrosion-resistant fasteners or on furring strips attached to the studs. Wood shingles or shakes may be applied over fiberboard shingle backer and sheathing with annular grooved nails. The thickness of wood shingles or shakes between wood nailing boards shall be not less than ⅜ inch. Wood shingles or shakes and asbestos shingles or siding may be nailed directly to approved fiberboard nailbase sheathing not less than ½-inch nominal thickness with approved corrosion-resistant annular grooved nails. Fiberboard nailbase sheathing and shingle backer shall comply with U.B.C. Standard No. 25-24.

5. **Particleboard.** Where particleboard is used for covering the exterior of outside walls, it shall be of the Exterior type 2-B-1 conforming to U.B.C. Standard No. 25-25, not less than ⅝ inch thick and not less than ¾ inch thick when applied directly to framing spaced 24 inches on center. Unless applied over 1-inch wood sheathing or ½-inch plywood sheathing joints shall occur over framing members and shall be covered with a continuous wood batt; or joints shall be lapped horizontally or otherwise made waterproof to the satisfaction of the Building Official.

6. **Nailing.** All fasteners used for the attachment of siding shall be of a corrosion-resistant type.

(h) **Structural Floor Sheathing.** Structural floor sheathing shall be designed in accordance with the general provisions of this Code and the special provisions in this Subsection.

Sheathing used as subflooring shall be designed to support all loads specified in this Code and shall be capable of supporting concentrated loads of not less than 300 pounds without failure. The concentrated load shall be applied by a loaded disc, 3 inches or smaller in diameter.

Flooring, including the finish floor, underlayment and subfloor, where used, shall meet the following requirements:

Deflection under uniform design load limited to 1/360 of the span between supporting joists or beams.

Deflection of flooring relative to joists under a 1-inch diameter concentrated load of 200 pounds limited to 0.125 inch or less when loaded midway between supporting joints or beams not over 24 inches on center and 1/360 of the span for spans over 24 inches.

Floor sheathing conforming to the provisions of Table No. 25-Q or No. 25-P shall be deemed to meet the requirements of this Subsection.

(i) **Structural Roof Sheathing.** Structural roof sheathing shall be designed in accordance with the general provisions of this Code and the special provisions in this Subsection. Structural roof sheathing shall be designed to support all loads specified in this Code and shall be capable of supporting concentrated loads of not less than 300 pounds without failure. The concentrated load shall be applied by a loaded disc, 3 inches or smaller in diameter. Structural roof sheathing shall meet the following requirement:

Deflection under uniform design live and dead load limited to 1/180 of the span between supporting rafters or beams and 1/240 under live load only.

Roof sheathing conforming to the provisions of Table No. 25-P or No. 25-Q shall be deemed to meet the requirements of this Subsection.

Plywood roof sheathing shall be bonded by intermediate or exterior glue.

(j) **Fastenings.** 1. **Nailing requirements.** The number and size of nails connecting wood members shall be not less than that set forth in Table No. 25-O. Other connections shall be fastened so as to provide equivalent strength. End and edge distances and nail penetrations shall be in accordance with the applicable provisions of Section 2510.

2. **Joist hangers and framing anchors.** Connections depending upon joist hangers or framing anchors, ties and other mechanical fastenings not otherwise covered may be used where approved.

(k) **Water Splash.** Where wood frame walls and partitions are covered on the interior with plaster, tile or similar materials and are subject to water splash, the framing shall be protected with approved waterproof paper conforming to Section 1707 (a).

(l) **Mechanically Laminated Floors and Decks.** A laminated lumber floor or deck built up of wood members set on edge, when meeting the following requirements may be designed as a solid floor or roof deck of the same thickness, and continuous spans may be designed on the basis of the full cross section using the simple span moment coefficient.

Nail length shall be not less than two and one-half times the net thickness of each lamination. When deck supports are 4 feet on center or less, side nails shall be spaced not more

General Construction Requirements (Continued)

than 30 inches on center and staggered one-third of the spacing in adjacent laminations. When supports are spaced more than 4 feet on center, side nails shall be spaced not more than 18 inches on center alternately near top and bottom edges, and also staggered one-third of the spacing in adjacent laminations. Two side nails shall be used at each end of butt jointed pieces.

Laminations shall be toe-nailed to supports with 20d or larger common nails. When the supports are 4 feet on center or less, alternate laminations shall be toe-nailed to alternate supports; when supports are spaced more than 4 feet on center alternate laminations shall be toe-nailed to every support.

A single span deck shall have all laminations full length.

A continuous deck of two spans shall have not more than every fourth lamination spliced within quarter points adjoining supports.

Joints shall be closely butted over supports or staggered across the deck but within the adjoining quarter spans.

No lamination shall be spliced more than twice in any span.

(m) **Post-beam Connections.** Where post and beam or girder construction is used, the design shall be in accordance with the provisions of this Code. Positive connection shall be provided to ensure against uplift and lateral displacement.

Conventional Construction Provisions

Sec. 2518. (a) **General.** The requirements contained in this Section are intended for light-frame construction. Other methods may be used provided a satisfactory design is submitted showing compliance with other provisions of this Code.

(b) **Foundation Plates or Sills.** Foundation plates or sills shall be bolted to the foundation or foundation wall with not less than ½-inch diameter steel bolts embedded at least 7 inches into concrete or reinforced masonry, or 15 inches into unreinforced grouted masonry and shall be spaced not more than 6 feet apart. There shall be a minimum of two bolts per piece with one bolt located within 12 inches of each end of each piece.

(c) **Girders.** Girders shall be designed to support all loads and when supporting first floor joists shall be not less than 4 inches by 4 inches for spans 5 feet or less, or not less than 4 inches by 6 inches placed on edge for spans not more than 7 feet. Laminated built-up beams with laminations not less than 2 inches in thickness may be used for girders when the laminations are parallel to applied load (see Table No. 25-O for nailing requirements). The end joints shall occur over supports. Where a girder is spliced over a support, an adequate tie shall be provided.

The ends of beams or girders supported on masonry or concrete shall have not less than 4 inches of bearing.

Conventional Construction Provisions (Continued)

(d) **Floor Joists.** 1. **General.** Spans for joists shall be in accordance with Table No. 25-T.

2. **Bearing.** Except where supported on a 1-inch by 4-inch ribbon strip and nailed to the adjoining stud, the ends of each joist shall have not less than 1½ inches of bearing on wood or metal, nor less than 3 inches on masonry.

3. **Framing details.** Joists shall be supported laterally at the ends and at each support by solid blocking except where the ends of joists are nailed to a header, band or rim joist or to an adjoining stud or by other approved means. Solid blocking shall be not less than 2 inches in thickness and the full depth of joist.

Notches on the ends of joists shall not exceed one-fourth the joist depth. Holes bored in joists shall not be within 2 inches of the top or bottom of the joist and the diameter of any such hole shall not exceed one-third the depth of the joist. Notches in the top or bottom of joists shall not exceed one-sixth the depth and shall not be located in the middle third of the span.

Joists framing from opposite sides of a beam, girder or partition shall be lapped at least 4 inches or the opposing joists shall be tied together in an approved manner.

Joists framing into the side of a wood girder shall be supported by framing anchors or on ledger strips not less than 2 inches by 2 inches.

Joists under bearing partitions shall be doubled.

4. **Framing around openings.** Trimmer and header joists shall be doubled, or of lumber of equivalent cross section, when the span of the header exceeds 4 feet. The ends of header joists more than 6 feet long shall be supported by framing anchors or joist hangers unless bearing on a beam, partition or wall. Tail joists over 12 feet long shall be supported at header by framing anchors or on ledger strips not less than 2 inches by 2 inches.

5. **Supporting bearing partitions.** Bearing partitions perpendicular to joists shall not be offset from supporting girders, walls or partitions more than the joist depth.

6. **Blocking.** Floor joists shall be blocked when required by the provisions of Sections 2506 (g) and 2518 (d) 3.

(e) **Subflooring.** 1. **Lumber subfloor.** Sheathing used as a structural subfloor shall conform to the limitations set forth in Table No. 25-P.

Joints in subflooring shall occur over supports unless end-matched lumber is used, in which case each piece shall bear on at least two joists.

Subflooring may be omitted when joist spacing does not exceed 16 inches and 1-inch nominal tongued-and-grooved wood strip flooring is applied perpendicular to the joists.

Conventional Construction Provisions (Continued)

2. **Plywood.** Where used as structural subflooring, plywood shall be as set forth in Table No. 25-Q. Plywood combination subfloor-underlayment shall have maximum spans as set forth in Table No. 25-R.

3. **Plank flooring.** Plank flooring shall be designed in accordance with the general provisions of this Code.

In lieu of such design, 2-inch tongue-and-groove planking may be used in accordance with Table No. 25-S. Joints in such planking may be randomly spaced provided the system is applied to not less than three continuous spans, planks are center-matched and end-matched or splined, each plank bears on at least one support and joints are separated by at least 24 inches in adjacent pieces. One-inch nominal strip square edged flooring, ½-inch tongue-and-groove flooring, or ⅜-inch plywood shall be applied over random length decking used as a floor. The "strip" and tongue-and-groove flooring shall be applied at right angles to the span of the planks. The ⅜-inch plywood shall be applied with the face grain at right angles to the span of the planks.

(f) **Wall Framing.** 1. **Size.** Studs in exterior walls and interior bearing walls of buildings not more than two stories in height shall be not less than 2 inches by 4 inches in size. For three-story buildings such studs shall be not less than 3 inches by 4 inches or 2 inches by 6 inches to the bottom of the second floor joists, and 2 inches by 4 inches for the two upper stories. Interior nonbearing partitions may be framed with 2-inch by 3-inch studs.

2. **Height.** Unless supported laterally by adequate framing, the maximum allowable height for studs shall be 10 feet for 2-inch by 3-inch studs; 14 feet for 2-inch by 4-inch and 3-inch by 4-inch studs; and 20 feet for 2-inch by 6-inch studs.

When Group IV studs (as set forth in Table No. 25-F) are permitted to be used by the Building Official, the maximum allowable height shall be 8 feet for load-bearing and exterior wall studs and 10 feet for interior nonload-bearing studs. When used in bearing walls, Group IV studs shall support not more than a roof and ceiling load.

3. **Spacing.** Studs supporting floors shall be spaced not more than 16 inches. Two by 4 studs of Group I, II or III lumber (as set forth in Table No. 25-F) not more than 10 feet in length may be spaced not more than 24 inches on center when supporting only a ceiling and roof. The spacing of studs on nonbearing walls shall not exceed 24 inches.

When bearing studs are spaced at 24-inch intervals, care shall be exercised to insure centering of roof trusses over studs or, in lieu thereof, solid blocking equal in size to the studs shall be installed to reinforce the double plate above.

Conventional Construction Provisions (Continued)

4. **Framing details.** Studs shall be placed with their wide dimension perpendicular to the wall. Not less than three studs shall be installed at every corner of an exterior wall.

Studs shall be capped with double top plates installed to provide overlapping at corners and at intersections with bearing partitions. End joints in double top plates shall be offset at least 48 inches.

5. **Bracing.** All exterior walls and main cross stud partitions shall be effectively and thoroughly braced at each end, or as near thereto as possible, and at least every 25 feet of length by one of the following methods:

A. Nominal 1-inch by 4-inch continuous diagonal braces let into studs spaced not over 16 inches on center and placed at an angle not steeper than 60° from the horizontal so as to engage at least three stud spaces.

B. Wood boards of $\frac{5}{8}$-inch net minimum thickness applied diagonally on studs spaced not over 24 inches on center.

C. Plywood sheathing with a thickness not less than $\frac{5}{16}$ inch for 16-inch stud spacing and not less than $\frac{3}{8}$ inch for 24-inch stud spacing.

D. Fiberboard sheathing 4-foot by 8-foot panels not less than $\frac{7}{16}$ inch thick applied vertically on studs spaced not over 16 inches on center.

E. Gypsum sheathing panels not less than $\frac{1}{2}$ inch thick on studs spaced not over 16 inches on center when installed in accordance with Table No. 47-I.

F. Particleboard Exterior Type 2-B-1 sheathing panels not less than $\frac{3}{8}$ inch thick on studs spaced not more than 16 inches on center.

For methods B, C, D, E and F, the braced panel must be at least 48 inches in width, covering three stud spaces where studs are spaced 16 inches apart and covering two stud spaces where studs are spaced 24 inches apart.

Solid sheathing of one of the materials specified in subparagraphs B through F above shall be applied on the exterior walls of the first story of all wood framed buildings three stories in height.

All vertical joints of panel sheathing shall occur over studs. Horizontal joints shall occur over blocking equal in size to the studding unless panels are at least 4 feet by 8 feet in size and applied vertically.

6. **Cripple walls.** Cripple walls shall be framed of studs not less in size than the studding above with a minimum length of 14 inches, or shall be framed of solid blocking. When exceeding 4 feet in height, such walls shall be framed of studs having the size required for an additional story.

Such walls under bearing walls and partitions shall be thoroughly and effectively braced.

Conventional Construction Provisions (Continued)

7. **Headers.** All openings 4 feet wide or less in bearing walls shall be provided with headers consisting of either two pieces of 2-inch framing lumber placed on edge and securely fastened together or 4-inch lumber of equivalent cross section. All openings more than 4 feet wide shall be provided with headers or lintels. Such headers or lintels shall have not less than 2-inch solid bearing at each end to the floor or bottom plate, unless other approved framing methods or joint devices are used.

8. **Pipes in walls.** Stud partitions containing plumbing, heating, or other pipes shall be so framed and the joists underneath so spaced as to give proper clearance for the piping. Where a partition containing such piping runs parallel to the floor joists, the joists underneath such partitions shall be doubled and spaced to permit the passage of such pipes and shall be bridged. Where plumbing, heating or other pipes are placed in or partly in a partition, necessitating the cutting of the soles or plates, a metal tie not less than ⅛ inch thick and 1½ inches wide shall be fastened to the plate across and to each side of the opening with not less than four 16d nails.

9. **Bridging.** Unless covered by interior or exterior wall coverings or sheathings meeting the minimum requirements of this Code, all stud partitions or walls with studs having a height to least thickness ratio exceeding 50 shall have bridging not less than 2 inches in thickness and of the same width as the studs fitted snugly and nailed thereto to provide adequate lateral support.

(g) **Roof and Ceiling Framing.** 1. **General.** The framing details required in this subsection apply to roofs having a minimum pitch of 3:12 or greater. When the roof pitch is less than 3:12 members supporting rafters and ceiling joists such as ridge boards, hips and valleys shall be designed as beams.

2. **Spans.** Allowable spans for ceiling joists shall be in accordance with Table No. 25-U. Allowable spans for rafters shall be in accordance with Table No. 25-V or No. 25-W where applicable.

3. **Framing.** Rafters shall be framed directly opposite each other at the ridge. There shall be a ridge board at least 1-inch nominal thickness at all ridges and not less in depth than the cut end of the rafter. At all valleys and hips there shall be a single valley or hip rafter not less than 2 inches nominal thickness and not less in depth than the cut end of the rafter.

4. **Rafter ties.** Rafters shall be nailed to adjacent ceiling joists to form a continuous tie between exterior walls when such joists are parallel to the rafters. Where not parallel, rafters shall be tied to 1-inch by 4-inch (nominal) minimum sized cross ties. Rafter ties shall be spaced not more than 4 feet on center.

5. **Purlins.** Purlins to support roof loads may be installed to reduce the span of rafters within allowable limits and shall be supported by struts to bearing walls. The maximum span of 2-inch by 4-inch purlins shall be 4 feet. The maximum span of the 2-inch by 6-inch purlin shall be 6 feet but in no case shall the purlin be smaller than the supported rafter. Struts shall be not smaller than 2-inch by 4-inch members. The unbraced length of struts shall not exceed 8 feet and the minimum slope of the struts shall be not less than 45° from the horizontal.

6. **Blocking.** Rafters more than 8 inches in depth shall be supported laterally at the ends and at each support by solid blocking not less than 2 inches in thickness and the full depth of the rafter unless nailed to a header, band or rim joist or to an adjoining stud.

7. **Roof sheathing.** Roof sheathing shall be in accordance with Table No. 25-Q for plywood or No. 25-P for lumber.

Joints in lumber sheathing shall occur over supports unless approved end matched lumber is used in which case each piece shall bear on at least two supports.

Plywood used for roof sheathing shall be bonded by intermediate or exterior glue.

8. **Roof planking.** Planking shall be designed in accordance with the general provisions of this Code.

In lieu of such design, 2-inch tongle-and-groove planking may be used in accordance with Table No. 25-S. Joints in such planking may be randomly spaced provided the system is applied to not less than three continuous spans, planks are center-matched and end-matched or splined, each plank bears on at least one support and joints are separated by at least 24 inches in adjacent pieces.

TABLE NO. 25-A-1 — ALLOWABLE UNIT STRESSES FOR VISUALLY STRESS-RATED LUMBER
Normal Loading — See also Section 2504

†ABBREVIATIONS: J.&P.: Joists and Planks; B.&S.: Beams and Stringers; P.&T.: Posts and Timbers; L.F.: Light Framing; K.D.: Kiln Dried; S.R.: Stress Rated

SPECIES AND COMMERCIAL GRADE		ALLOWABLE UNIT STRESSES, POUNDS PER SQUARE INCH[1]						U.B.C. STDS. UNDER WHICH GRADED
		Tension Parallel to Grain	Extreme Fiber in Bending	Maximum Horizontal Shear	Compression Perpendicular to Grain	Compression Parallel to Grain	Modulus of Elasticity	
	SYMBOL:†	(F_t)[2]	(F_b)	(F_v)	($F_{c\perp}$)	(F_c)	E	
DOUGLAS FIR AND LARCH								
Dense Select Structural MC15	L.F.[5]	950	2350	95	455	1700	2,000,000	
Dense Select Structural Dry	L.F.	900	2150	95	455	1500	1,900,000	
Select Structural MC15	L.F.[5]	900	2150	95	415	1550	1,900,000	
Dense Select Structural	L.F.	850	2050	85	455	1500	1,700,000	
Select Structural Dry	L.F.	800	1950	95	415	1400	1,800,000	
Select Structural	L.F.	800	1900	85	415	1400	1,600,000	
1750f. Industrial MC15	L.F.	1350	2050	95	455	1600	2,000,000	
1750f. Industrial Dry	L.F.	1250	1850	95	455	1450	1,900,000	
1750f. Industrial	L.F.	1150	1750	85	455	1400	1,700,000	
1500f. Industrial MC15	L.F.[5]	1150	1750	95	390	1400	1,900,000	
1500f. Industrial Dry	L.F.	1050	1600	95	390	1200	1,800,000	
1500f. Industrial	L.F.	1000	1500	85	390	1200	1,600,000	25-3
1200f. Industrial MC15	L.F.[5]	950	1500	95	390	1200	1,700,000	&
1200f. Industrial Dry	L.F.	900	1350	95	390	1050	1,700,000	25-4
1200f. Industrial	L.F.	850	1200	85	390	1000	1,500,000	
Dense Select Structural MC15	J. & P.[5]	1200	2350	95	455	1850	2,000,000	
Dense Select Structural Dry	J. & P.	1100	2150	95	455	1750	1,900,000	
Select Structural MC15	J. & P.[5]	1100	2150	95	415	1650	1,900,000	
Dense Select Structural	J. & P.	1050	2050	85	455	1650	1,700,000	
Dense Construction MC15	J. & P.[5]	800	2050	95	455	1600	2,000,000	
Select Structural Dry	J. & P.	1050	2000	95	415	1600	1,800,000	
Select Structural	J. & P.	1000	1900	85	415	1500	1,600,000	
Dense Construction Dry	J. & P.	750	1850	95	455	1450	1,900,000	
Dense Construction	J. & P.	750	1750	85	455	1400	1,700,000	
Construction MC15	J. & P.[5]	700	1750	95	390	1400	1,900,000	
Construction Dry	J. & P.	650	1600	95	390	1200	1,800,000	

Construction	J. & P.	600	1500	85	390	1200	1,600,000	
Standard MC15	J. & P.[5]	550	1500	95	390	1200	1,700,000	
Standard Dry	J. & P.	500	1350	95	390	1100	1,700,000	
Standard	J. & P.	500	1200	85	390	1000	1,500,000	
Dense Select Structural	B. & S.	950	2050	85	455	1500	1,700,000	25-3
Select Structural	B. & S.	850	1900	85	415	1400	1,600,000	&
Dense Construction	B. & S.	650	1750	85	455	1200	1,700,000	25-4
Construction	B. & S.	550	1500	85	390	1000	1,600,000	
Dense Select Structural	P. & T.	1150	1900	85	455	1650	1,700,000	
Select Structural	P. & T.	1050	1750	85	415	1500	1,600,000	
Dense Construction	P. & T.	900	1500	85	455	1400	1,600,000	
Construction	P. & T.	750	1200	85	390	1200	1,500,000	
DOUGLAS FIR (SOUTH)[3]								
Dense Select Structural MC15	L.F.[5]	900	2300	95	330	1650	1,600,000	
Dense Select Structural Dry	L.F.	850	2100	90	330	1450	1,500,000	
Select Structural MC15	L.F.[5]	850	2100	95	280	1500	1,500,000	
Dense Select Structural	L.F.	800	2000	85	330	1350	1,300,000	
Select Structural Dry	L.F.	800	1900	90	280	1300	1,400,000	
Select Structural	L.F.	750	1850	85	280	1250	1,300,000	
1750f. Industrial MC15	L.F.	1250	2000	95	330	1600	1,600,000	
1750f. Industrial Dry	L.F.	1200	1800	90	330	1350	1,500,000	
1750f. Industrial	L.F.	1100	1700	85	330	1300	1,300,000	
1500f. Industrial MC15	L.F.[5]	1100	1700	95	280	1350	1,500,000	
1500f. Industrial Dry	L.F.	1000	1550	90	280	1150	1,400,000	
1500f. Industrial	L.F.	950	1450	85	280	1100	1,300,000	25-4
1200f. Industrial MC15	L.F.[5]	900	1450	95	285	1150	1,300,000	
1200f. Industrial Dry	L.F.	850	1300	90	280	1000	1,300,000	
1200f. Industrial	L.F.	800	1150	85	280	950	1,100,000	
Dense Select Structural MC15	J. & P.[5]	1150	2150	95	330	1800	1,600,000	
Dense Select Structural Dry	J. & P.	1050	2000	90	330	1550	1,500,000	
Select Structural MC15	J. & P.[5]	1050	2000	95	280	1650	1,500,000	
Dense Select Structural	J. & P.	1000	1850	85	330	1450	1,300,000	
Dense Construction MC15	J. & P.[5]	800	1850	95	330	1550	1,600,000	
Select Structural Dry	J. & P.	1000	1850	90	280	1400	1,400,000	
Select Structural	J. & P.	950	1700	85	280	1350	1,300,000	
Dense Construction Dry	J. & P.	750	1700	90	330	1300	1,500,000	
Dense Construction	J. & P.	700	1550	85	330	1250	1,300,000	

(Continued)

TABLE NO. 25-A-1 — ALLOWABLE UNIT STRESSES FOR VISUALLY STRESS-RATED LUMBER — Continued

Normal Loading — See also Section 2504

†ABBREVIATIONS: J.&P.: Joists and Planks; B.&S.: Beams and Stringers; P.&T.: Posts and Timbers; L.F.: Light Framing; K.D.: Kiln Dried; S.R.: Stress Rated

SPECIES AND COMMERCIAL GRADE		ALLOWABLE UNIT STRESSES, POUNDS PER SQUARE INCH[1]						U.B.C. STDS. UNDER WHICH GRADED
		Tension Parallel to Grain	Extreme Fiber in Bending	Maximum Horizontal Shear	Compression Perpendicular to Grain	Compression Parallel to Grain	Modulus of Elasticity	
	SYMBOL:†	(F_t)[2]	(F_b)	(F_v)	($F_{c\perp}$)	(F_c)	E	
Construction MC15	J. & P.[5]	650	1550	95	280	1300	1,500,000	
Construction Dry	J. & P.	600	1450	90	280	1150	1,400,000	
Construction	J. & P.	600	1350	85	280	1050	1,300,000	
Standard MC15	J. & P.[5]	500	1300	95	280	1200	1,300,000	
Standard Dry	J. & P.	500	1200	90	280	1000	1,300,000	
Standard	J. & P.	450	1100	85	280	950	1,100,000	
Dense Select Structural	B. & S.	900	1800	85	330	1150	1,300,000	25-4
Select Structural	B. & S.	850	1650	85	280	1050	1,300,000	
Dense Construction	B. & S.	600	1500	85	330	1000	1,300,000	
Construction	B. & S.	550	1250	85	280	850	1,300,000	
Dense Select Structural	P. & T.	1100	1650	85	330	1250	1,300,000	
Select Structural	P. & T.	1000	1550	85	280	1150	1,300,000	
Dense Construction	P. & T.	850	1250	85	330	1050	1,200,000	
Construction	P. & T.	750	1100	85	280	900	1,100,000	
HEMLOCK, WESTERN AND WEST COAST								
Select Structural MC15	L.F.[5]	650	1800	80	365	1200	1,600,000	
Select Structural Dry	L.F.	600	1650	75	365	1100	1,500,000	
Select Structural	L.F.	550	1500	70	365	1100	1,400,000	
1500f. Industrial MC15	L.F.[5]	950	1650	80	365	1150	1,600,000	
1500f. Industrial Dry	L.F.	900	1550	75	365	1100	1,500,000	
1500f. Industrial	L.F.	850	1400	70	365	1000	1,400,000	
1200f. Industrial MC15	L.F.[5]	800	1400	80	365	1050	1,500,000	25-3 & 25-4
1200f. Industrial Dry	L.F.	750	1300	75	365	900	1,400,000	
1200f. Industrial	L.F.	700	1200	70	365	900	1,200,000	
Select Structural MC15	J. & P.[5]	800	1550	80	365	1300	1,600,000	
Select Structural Dry	J. & P.	750	1400	75	365	1250	1,500,000	
Select Structural	J. & P.	700	1300	70	365	1200	1,400,000	
Construction MC15	J. & P.[5]	750	1450	80	365	1250	1,600,000	
Construction Dry	J. & P.	700	1350	75	365	1150	1,500,000	

Construction	J. & P.	700	1250	70	365	1100	1,400,000	
Standard MC15	J. & P.	550	1200	80	365	1150	1,500,000	
Standard Dry	J. & P.	500	1100	75	365	1000	1,400,000	
Standard	J. & P.[5]	500	1050	70	365	1000	1,200,000	
Construction	B. & S.	600	1200	70	365	1000	1,400,000	
Construction	P. & T.	700	1100	70	365	1100	1,400,000	
DOUGLAS FIR AND LARCH								
Select Dex & Selected	Decking	–	1500	–	390	–	1,600,000[4]	25-3 & 25-4
Commercial Dex & Commercial	Decking	–	1200	–	390	–	1,500,000[4]	
DOUGLAS FIR (SOUTH)[3]								
Select Dex & Selected	Decking	–	1450	–	330	–	1,300,000	
Commercial Dex & Commercial	Decking	–	1150	–	330	–	1,100,000	
HEMLOCK, WESTERN AND WEST COAST								
Select Dex & Selected	Decking	–	1100	–	365	–	1,400,000[4]	
Commercial Dex & Commercial	Decking	–	850	–	365	–	1,200,000[4]	
SPRUCE, SITKA								
Select Dex	Decking	–	1100	–	305	–	1,300,000[4]	25-3
Commercial Dex	Decking	–	850	–	305	–	1,200,000[4]	
WHITE FIR								25-3 & 25-4
Select Dex & Selected	Decking	–	1100	–	365	–	1,400,000[4]	
Commercial Dex & Commercial	Decking	–	850	–	365	–	1,200,000[4]	
PINE, NORWAY								
Prime Structural	J. & P.[5, 6]	–	1200	75	360	900	1,200,000	25-5
Common Structural	J. & P.[5, 6]	–	1100	75	360	775	1,200,000	
Utility Structural	J. & P.[5, 6]	–	950	75	360	650	1,200,000	
PINE, (IDAHO WHITE, LODGEPOLE, PONDEROSA AND SUGAR)								25-4
Selected	Decking	–	900	–	305	–	1,100,000[4]	
Commercial	Decking	–	700	–	305	–	1,000,000[4]	

(Continued)

TABLE NO. 25-A-1 — ALLOWABLE UNIT STRESSES FOR VISUALLY STRESS-RATED LUMBER — Continued

Normal Loading — See also Section 2504

†ABBREVIATIONS: J.&P.: Joists and Planks; B.&S.: Beams and Stringers; P.&T.: Posts and Timbers; L.F.: Light Framing; K.D.: Kiln Dried; S.R.: Stress Rated

SPECIES AND COMMERCIAL GRADE		ALLOWABLE UNIT STRESSES, POUNDS PER SQUARE INCH[1]						U.B.C. STDS. UNDER WHICH GRADED
		Tension Parallel to Grain	Extreme Fiber in Bending	Maximum Horizontal Shear	Compression Perpendicular to Grain	Compression Parallel to Grain	Modulus of Elasticity	
	SYMBOL:†	(F_t)[2]	(F_b)	(F_v)	($F_{c\perp}$)	(F_c)	E	
CEDAR, INCENSE AND WESTERN RED								25-3 & 25-4
Select Dex & Selected	Decking	—	900	—	240	—	1,000,000[4]	
Commercial Dex & Commercial	Decking	—	700	—	240	—	900,000[4]	
SPRUCE, ENGELMANN								25-4
Selected	Decking	—	750	—	215	—	1,000,000[4]	
Commercial	Decking	—	600	—	215	—	900,000[4]	
HEMLOCK, EASTERN	J. & P.[6]							25-5
Select Structural	B. & S.[6]		1300	85	360	850	—	
Prime Structural	J. & P.[5, 6]		1200	60	360	775	—	
Common Structural	J. & P.[5, 6]		1100	60	360	650	—	
Utility Structural	J. & P.[5, 6]		950	60	360	600	—	
Select Structural	P. & T.		—	—	360	850	—	
SOUTHERN PINE[7] (Moisture content not over 15 per cent)								25-6
No. 1 KD		1150	1700	105	405	1350	1,900,000	
No. 1 Dense KD		1350	2000	105	475	1600	2,000,000	
No. 2 KD		1000	1500	90	405	1150	1,700,000	
No. 2 Dense KD		1150	1750	90	475	1400	1,800,000	
Special KD	2" Thick	800	1200	75	305	950	1,300,000	
No. 3 KD	Only	475	700	80	335	550	1,300,000	
No. 3 MG KD		550	825	90	405	650	1,500,000	
No. 3 Dense KD		650	975	90	475	775	1,600,000	
KD Stud		475	700	80	335	550	1,300,000	

No. 1 SR KD	2½" to 4" Thick	1150	1700	125	405	1600	1,900,000	25-6
No. 1 Dense SR KD		1350	2000	125	475	1850	2,000,000	
No. 2 SR KD		1000	1500	105	405	1150	1,700,000	
No. 2 Dense SR KD		1150	1750	105	475	1400	1,800,000	
Dense Structural 86 KD	2" to 4" Thick	2000	3000	160	475	2350	2,000,000	
Dense Structural 72 KD		1650	2500	135	475	2000	2,000,000	
Dense Structural 65 KD		1500	2250	120	475	1800	2,000,000	
Dense Std. Fac. KD (T&G)	2" to 4" Thick Decking	1350	2000	105	475	1850	2,000,000	
No. 1 Dense Fac. KD (T&G)		1150	1750	90	475	1400	1,800,000	
No. 1 Fac. KD (T&G)		1000	1500	90	405	1150	1,700,000	
No. 2 Dense Fac. KD (T&G)		1150	1750	90	475	1400	1,800,000	
No. 2 Fac. KD (T&G)		1000	1500	90	405	1150	1,700,000	
Select Dense KD (DT&G)	3" to 4" Thick Decking	1350	2000	105	475	1850	2,000,000	
Select KD (DT&G)		1150	1700	105	405	1600	1,900,000	
No. 1 Dense KD (DT&G)		1150	1750	90	475	1400	1,800,000	
No. 1 KD (DT&G)		1000	1500	90	405	1150	1,700,000	
No. 2 Dense KD (DT&G)		1150	1750	90	475	1400	1,800,000	
No. 2 KD (DT&G)		1000	1500	90	405	1150	1,700,000	
SOUTHERN PINE[7] (Moisture content not over 19 per cent)								
No. 1 Dry	2" Thick Only	1050	1600	100	405	1150	1,800,000	
No. 1 Dense Dry		1250	1850	100	475	1350	1,900,000	
No. 2 Dry		925	1350	90	405	1000	1,600,000	
No. 2 Dense Dry		1050	1600	90	475	1200	1,700,000	
Special Dry		725	1100	70	305	800	1,200,000	
No. 3 Dry		425	650	75	335	475	1,300,000	
No. 3 MG Dry		500	775	90	405	575	1,400,000	
No. 3 Dense Dry		600	900	90	475	650	1,500,000	
Stud Dry		425	650	75	335	475	1,300,000	

(Continued)

TABLE NO. 25-A-1 — ALLOWABLE UNIT STRESSES FOR VISUALLY STRESS-RATED LUMBER — Continued

Normal Loading — See also Section 2504

†ABBREVIATIONS: J.&P.: Joists and Planks; B.&S.: Beams and Stringers; P.&T.: Posts and Timbers; L.F.: Light Framing; K.D.: Kiln Dried; S.R.: Stress Rated

SPECIES AND COMMERCIAL GRADE		ALLOWABLE UNIT STRESSES, POUNDS PER SQUARE INCH[1]						U.B.C. STDS. UNDER WHICH GRADED
	SYMBOL:†	Tension Parallel to Grain (F_t)[2]	Extreme Fiber in Bending (F_b)	Maximum Horizontal Shear (F_v)	Compression Perpendicular to Grain ($F_{c\perp}$)	Compression Parallel to Grain (F_c)	Modulus of Elasticity E	
No. 1 SR Dry	2½" to 4" Thick	1050	1600	120	405	1350	1,800,000	25-6
No. 1 Dense SR Dry		1250	1850	120	475	1600	1,900,000	
No. 2 SR Dry		925	1350	100	405	1000	1,600,000	
No. 2 Dense SR Dry		1050	1600	100	475	1200	1,700,000	
Dense Structural 86 Dry	2" to 4" Thick	1850	2750	150	475	2050	1,900,000	
Dense Structural 72 Dry		1550	2300	125	475	1700	1,900,000	
Dense Structural 65 Dry		1400	2100	115	475	1550	1,900,000	
Dense Std. Factory Dry	2" to 4" Thick	1250	1850	100	475	1600	1,900,000	
No. 1 Dense Factory Dry		1050	1600	90	475	1200	1,700,000	
No. 1 Factory Dry		925	1350	90	405	1000	1,600,000	
No. 2 Dense Factory Dry		1050	1600	90	475	1200	1,700,000	
No. 2 Factory Dry		925	1350	90	405	1000	1,600,000	
SOUTHERN PINE (Over 19 per cent moisture content)[7]								
No. 1 SR	2½" and Thicker	850	1250	110	270	925	1,600,000	
No. 1 Dense SR		1000	1500	110	315	1050	1,600,000	
No. 2 SR		725	1100	95	270	675	1,400,000	
No. 2 Dense SR		850	1300	95	315	775	1,500,000	

Dense Structural 86 Dense Structural 72 Dense Structural 65	2½" and Thicker	1450 1250 1100	2200 1850 1650	140 120 105	315 315 315	1350 1150 1000	1,600,000 1,600,000 1,600,000	
Dense Std. Factory No. 1 Dense Factory No. 1 Factory No. 2 Dense Factory No. 2 Factory	2½" to 5" Thick	1000 850 725 850 725	1500 1300 1100 1300 1100	110 95 95 95 95	315 315 270 315 270	1050 775 675 775 675	1,600,000 1,500,000 1,400,000 1,500,000 1,400,000	25-6
CALIFORNIA REDWOOD[8] Clear Heart – Clear Structural Select Heart – Select Structural Construction Heart – Construction Structural	2" and Thicker	 1300 1200 1000	 1950 1750 1450	 135 135 125	 305 305 305	 1600 1250 1050	 1,240,000	25-7
SPRUCE, EASTERN 1450f.-Structural Grade 1300f.-Structural Grade 1200f.-Structural Grade	J. & P.[6] J. & P.[6] J. & P.[6]	 – – –	 1450 1300 1200	 110 95 95	 300 300 300	 1050 975 900	 – – –	25-8

See Footnotes on page 212.

TABLE NO. 25-A-1 — ALLOWABLE UNIT STRESSES FOR VISUALLY STRESS-RATED LUMBER — Continued

[1]If lumber is in service under wet conditions of use, or where the moisture content is at or above the fiber saturation point, as when continuously submerged, (a) the allowable unit stresses for F_b, F_t, F_v and modulus of elasticity shall be limited in all thicknesses to the stresses listed for the corresponding unseasoned grade; (b) the allowable unit stress for F_c shall be limited in all thicknesses to the stresses listed for the corresponding unseasoned grade; and (c) the allowable unit stresses for $F_{c\perp}$ shall be reduced one third.

[2]Where members are specially graded so that the slope of grain limitations applicable to the middle portion applies throughout the full length of the piece and are so identified by appropriate marking, the allowable stress in tension parallel to the grain may be increased in accordance with the procedures set forth in U.B.C. Standard No. 25-1.

[3]Douglas fir (South) indicates Douglas fir produced in the States of Utah, Colorado, New Mexico, Arizona and Nevada and allowable unit stresses are shown thereunder. Douglas fir (South) shall be identified to indicate its origin by the use of the symbol *S* as part of the species identification on the grade stamp. Allowable unit stresses for Douglas fir produced in other states are shown under Douglas fir and larch.

[4]The value of *E* may be increased 17 per cent where the lumber is manufactured at a maximum moisture content of 15 per cent.

[5]These grades applicable to 2-inch thickness only.

[6]The allowable unit stresses for tension parallel to grain *t* and compression parallel to grain *c* are applicable when the following additional provisions are applied to the grades:

The sum of the sizes of all knots in any 6 inches of the length of the piece shall not exceed twice the maximum permissible size of knot. Two knots of maximum permissible size shall not be within the same 6 inches of length of any face.

[7]All stress-rated grades for Southern pine lumber are established on a basis that permits cutting graded members to shorter lengths without impairment of stress ratings in the shorter pieces. In addition, the stresses apply to members used either flat or on edge. Grade restrictions apply the entire length of each piece, and each piece is suitable for use in continuous spans, over double spans, or under concentrated loads, without the necessity of regrading for shear or other stress requirements.

[8]For lumber seasoned below the fiber saturation point (approximately 30 per cent moisture content) before full design load is applied, and which will remain dry in service, the tabulated modulus of elasticity may be increased 2 per cent, and the tabulated F_c values may be increased 10 per cent.

For lumber 4 inches and thinner, where the moisture content in service will not exceed 19 per cent, the tabulated values may be increased as follows:

Fiber stress in bending F_b and tension parallel to grain, F_t	24 per cent
Horizontal shear, F_v	None[9]
Compression perpendicular to grain, $F_{c\perp}$	50 per cent
Compression parallel to grain, F_c	45 per cent
Modulus of elasticity	11 per cent

[9]For lumber manufactured at or below 19 per cent moisture content, the tabulated F_v values may be increased 8 per cent.

For lumber 4 inches and thinner, kiln dried to 15 per cent maximum moisture content, the tabulated values may be increased as follows:

Fiber stress in bending, F_b and tension parallel to grain, F_t	34 per cent
Horizontal shear, F_v	13 per cent
Compression perpendicular to grain, $F_{c\perp}$	50 per cent
Compression parallel to grain, F_c	68 per cent
Modulus of elasticity	15 per cent

TABLE NO. 25-A-2 — ALLOWABLE UNIT STRESSES FOR MACHINE STRESS-RATED LUMBER NORMAL LOADING[1] (in p.s.i.)

EXTREME FIBER IN BENDING (F_b)[2]	MODULUS OF ELASTICITY (E)	TENSION (F_t)	COMPRESSION PARALLEL TO GRAIN (F_c)	COMPRESSION PERPENDICULAR TO GRAIN ($F_{c\perp}$)[3]				HORIZONTAL SHEAR (F_v)			
				Douglas Fir and Larch	Western Hemlock and White Fir	Ponderosa Pine	Engelmann Spruce	Douglas Fir and Larch	Western Hemlock	White Fir and Engelmann Spruce	Ponderosa Pine
900	1,000,000	350	725	390							
1200	1,200,000	600	950	390							
1500	1,400,000	900	1200	390	365	310	215	90	75	60	70
1800	1,600,000	1175	1450	390							
2100	1,800,000	1575	1700	415							
2400	2,000,000	1925	1925	455							

[1]For visual grading rules which also apply, see U.B.C. Standard No. 25-1, Section 25.113.
[2]The above stresses are for lumber used on edge. When loaded flatwise F_b may be increased 18 per cent.
[3]The values for compression perpendicular and parallel to the grain are for lumber that will be continuously dry in use as in most covered structures. For wet conditions of use reduce the values 33⅓ per cent for compression perpendicular to the grain and 10 per cent for compression parallel to the grain.

TABLE NO. 25-B — ALLOWABLE UNIT STRESSES FOR CONSTRUCTION AND INDUSTRIAL SOFTWOOD PLYWOOD
(In Pounds per Square Inch)
(To be used with section properties in Plywood-Design Specification — See U.B.C. Standard No. 25-9)

TYPE OF STRESS	SPECIES[1] GROUP	EXTERIOR A-A, A-C, C-C[2] STRUCTURAL I A-C, C-C (Use Group 1 Stresses)	EXTERIOR A-B, B-B, B-C, C-C (PLUGGED) STRUCTURAL I C-D (Use Group 1 Stresses) STRUCTURAL II C-D (Use Group 3 Stresses) STANDARD SHEATHING (Exterior Glue)[2] ALL INTERIOR GRADES WITH EXTERIOR GLUE	ALL OTHER GRADES OF INTERIOR INCLUDING STANDARD SHEATHING[2]
Extreme fiber in bending Tension Face grain parallel or perpendicular to span (at 45° to face grain use ⅙)	1 2, 3 4	2000 1400 1200	1650 1200 1000	1650 1200 1000
Compression Parallel or perpendicular to face grain (at 45° to face grain use ⅓)	1 2, 3 4	1650 1200 1000	1550 1100 950	1550 1100 950
Bearing (on face)	1 2, 3 4		340 220 160	
Shear in plane perpendicular to plies[3] Parallel or perpendicular to face grain (at 45° increase 100 per cent)	1 2, 3 4	250 185 175	250 185 175	230 170 160

Shear, rolling in plane of plies, parallel or perpendicular to face grain (at 45° increase ⅓)[4]	All	53	53	48
Modulus of Elasticity in bending. Face grain parallel or perpendicular to span	1 2 3 4	1,800,000 1,500,000 1,200,000 900,000		

[1]See U.B.C. Standard No. 25-9 for plywood species groups.

[2]Exterior C-C and Standard Sheathing: The combination of Identification-Index designation and panel thickness determines the minimum species group and, therefore, the stress permitted, as follows:

5/16-20/0, 3/8-24/0, 1/2-32/16, 5/8-42/20, 3/4-48/24—use Group 2 working stresses.

All other combinations—use Group 4 working stresses.

[3]Shear through the thickness stresses are based on the most common structural applications where the plywood is attached to framing around its boundary. Where the plywood is attached to framing at only two sides, such as in the heel joint of a truss, reduce the allowable shear through the thickness values by 11 per cent where framing is parallel to face grain and 25 per cent where it is perpendicular.

[4]For Structural I and Structural II use 75 pounds per square inch and 56 pounds per square inch respectively.

WET OR DAMP LOCATION:

Where moisture content is 16 per cent or more, decrease the dry location values as follows: All grades of Exterior and Interior plywood with Exterior glue: Extreme fiber in bending 25 per cent; Tension, 31 per cent; Compression, 39 per cent; Bearing, 33 per cent; Shear, 16 per cent; Modulus of Elasticity, 11 per cent. For all other grades of Interior: Extreme fiber in bending, 31 per cent; Tension, 31 per cent; Compression, 39 per cent; Bearing, 33 per cent; Shear, 16 per cent; Modulus of Elasticity, 20 per cent.

TABLE NO 25-C — ALLOWABLE UNIT STRESSES FOR STRUCTURAL GLUED-LAMINATED SOFTWOOD TIMBER FOR NORMAL LOADING DURATION

1	2	3	4	5	6	7	8
		ALLOWABLE UNIT STRESSES IN POUNDS PER SQUARE INCH					
		FIBER BENDING (F_b)					
COMBINATION SYMBOL	NUMBER OF LAMINATIONS	LOAD PARALLEL TO WIDE FACE OF LAMINATIONS	LOAD PERPENDICULAR TO WIDE FACE OF LAMINATIONS	TENSION PARALLEL TO GRAIN (F_t)	COMPRESSION PARALLEL TO GRAIN (F_c)	HORIZONTAL SHEAR (F_v)	COMPRESSION PERPENDICULAR TO GRAIN ($F_{c\perp}$)
1 – DRY CONDITIONS OF USE							
Douglas Fir & Larch[3] – Modulus of Elasticity: 1,800,000							
A[1]	4 or more	–	2400	1600	1500	165	450
B[1]	4 or more	–	2200	1600	1500	165	450
C[1]	4 or more	–	2000	1600	1500	165	450
E[2]	4 or more	2400	2400	1900	2200	145[6]	450
F[2]	4 or more	2000	2000	1600	2100	145[6]	450
G[2]	4 or more	1600	1600	1200	1800	145[6]	385
H[2]	4 or more	1100	1100	900	1500	145[6]	385
Southern Pine[4] – Modulus of Elasticity: 1,800,000							
A-1	9 or more	See Note 4	2400	1900	2000	200	385
A-2	14 to 21		2400	1900	2000	200	450
A-3	22 or more		2400	1900	2000	200	450
A-4	13 or more		2400	1900	2000	200	450
B-1	4 or more	See Note 4	2200	1700	2000	200	385
B-2	12 or more		2200	1700	2000	200	450
B-3	25 or more		2200	1700	2000	200	385
B-4	9 or more		2200	1700	2000	200	385
C-1	6 or more	See Note 4	2000	1600	1900	200	450
C-2	14 or more		2000	1600	2000	200	385
C-3	18 or more		2000	1600	1900	200	385
D-1	10 or more	See Note 4	1800	1400	1900	200	385
D-2	10 or more		1800	1400	1900	200	385

1 – DRY CONDITIONS OF USE (Continued)							
E-1 E-2	4 or more 12 or more	See Note 4	1600 1600	1200 1200	1900 1800	200 200	385 385
California Redwood[3] – Modulus of Elasticity: 1,300,000							
A[1] B[1] C[1]	4 or more 4 or more 4 or more	See Note 3	2000 2000 2000	1600 1600 1600	2200 2000 2000	125 125 125	325 325 325
D[2] E[2] F[2]	4 or more 4 or more 4 or more	2200[5] 1400[5] 1000[5]	2000 1800 1300	1600 1400 1000	2200 2000 1800	125 125 125	325 325 325
2 – WET CONDITIONS OF USE							
Douglas Fir & Larch[3] – Modulus of Elasticity: 1,600,000							
A[1] B[1] C[1]	4 or more 4 or more 4 or more	– – –	1800 1600 1400	1300 1200 1100	1100 1100 1100	145 145 145	305 305 305
E[2] F[2] G[2] H[2]	4 or more 4 or more 4 or more 4 or more	1800 1600 1300 800	1800 1600 1300 800	1400 1200 1000 600	1600 1500 1300 1100	120[7] 120[7] 120[7] 120[7]	305 305 260 260
Southern Pine[4]– Modulus of Elasticity: 1,600,000							
A-1 A-2 A-3 A-4	9 or more 14 to 21 22 or more 13 or more	See Note 4	1800 1800 1800 1900	1400 1400 1400 1500	1500 1400 1400 1400	175 175 175 175	260 300 300 300
B-1 B-2 B-3 B-4	4 or more 12 or more 25 or more 9 or more	See Note 4	1700 1800 1700 1700	1300 1400 1300 1300	1400 1400 1400 1400	175 175 175 175	260 300 260 260
C-1 C-2 C-3	6 or more 14 or more 18 or more	See Note 4	1600 1600 1500	1200 1200 1200	1400 1400 1400	175 175 175	300 260 260

(Continued)

TABLE NO 25-C — ALLOWABLE UNIT STRESSES FOR STRUCTURAL GLUED-LAMINATED SOFTWOOD TIMBER FOR NORMAL LOADING DURATION
(Continued)

1	2	3	4	5	6	7	8
		ALLOWABLE UNIT STRESSES IN POUNDS PER SQUARE INCH					
		FIBER BENDING (F_b)					
COMBINATION SYMBOL	NUMBER OF LAMINATIONS	LOAD PARALLEL TO WIDE FACE OF LAMINATIONS	LOAD PERPENDICULAR TO WIDE FACE OF LAMINATIONS	TENSION PARALLEL TO GRAIN (F_t)	COMPRESSION PARALLEL TO GRAIN (F_c)	HORIZONTAL SHEAR (F_v)	COMPRESSION PERPENDICULAR TO GRAIN ($F_{c\perp}$)
2 – WET CONDITIONS OF USE (Continued)							
D-1	10 or more	See Note 4	1400	1100	1400	175	260
D-2	10 or more		1400	1100	1400	175	260
E-1	4 or more	See Note 4	1300	1000	1400	175	260
E-2	12 or more		1300	1000	1300	175	260
California Redwood[3] – Modulus of Elasticity: 1,200,000							
A[1]	4 or more	See Note 3	1600	1200	1600	110	215
B[1]	4 or more		1600	1200	1500	110	215
C[1]	4 or more		1600	1200	1500	110	215
D[2]	4 or more	1600[5]	1600	1200	1600	110	215
E[2]	4 or more	1000[5]	1400	1100	1500	110	215
F[2]	4 or more	700[5]	1000	800	1300	110	215

[1]For members stressed principally in bending.
[2]For members stressed principally in axial tension or axial compression.
[3]For more details see U.B.C. Standards No. 25-10 and No. 25-11. This does not include Douglas fir (South) as defined in footnote 3 of Table No. 25-A-1.
[4]For more details see U.B.C. Standards No. 25-10 and No. 25-11. In addition to the combination symbol, it is necessary to specify the required unit stresses in bending, tension and compression parallel to grain since the allowable slope of grain in individual laminations varies with the type of unit stress.
[5]Bending value F_b applied to three or more laminations when load is parallel to wide face of laminations.
[6]When loaded perpendicular to wide face of laminations, these values may be increased to 165 p.s.i.
[7]When loaded perpendicular to wide face of laminations, these values may be increased to 145 p.s.i.

TABLE NO. 25-D — PART A — ALLOWABLE UNIT STRESSES FOR GLUED HARDWOOD LAMINATED LUMBER[1] FOR NORMAL LOADING DURATION — DRY CONDITIONS OF USE[2]

SPECIES	MULTIPLY THE APPROPRIATE STRESS MODULE IN PART B BY THE FACTORS BELOW TO DETERMINE ALLOWABLE STRESS FOR		ALLOWABLE UNIT STRESS (Pounds per Square Inch)		
	Extreme Fiber in Bending f or Tension Parallel to Grain t	Compression Parallel to Grain c	Horizontal Shear H	Compression Perpendicular to Grain q	Modulus of Elasticity E
Hickory, true and pecan	3.90	3.05	260	730	2,000,000
Beech, American	3.05	2.45	230	610	1,800,000
Birch, sweet and yellow	3.05	2.45	230	610	1,800,000
Elm, rock	3.05	2.45	230	610	1,400,000
Maple, black and sugar (hard maple)	3.05	2.45	230	610	1,800,000
Ash, commercial white	2.85	2.20	230	610	1,600,000
Oak, commercial red and white	2.85	2.05	230	610	1,600,000
Elm, American and slippery (white or soft elm)	2.20	1.60	190	310	1,300,000
Sweet gum (red or sap gum)	2.20	1.60	190	370	1,300,000
Tupelo, black (black gum)	2.20	1.60	190	370	1,300,000
Tupelo, water	2.20	1.60	190	370	1,300,000
Ash, black	2.00	1.30	170	370	1,200,000
Poplar, yellow	1.80	1.45	150	270	1,200,000
Cottonwood, Eastern	1.55	1.20	110	180	1,100,000

(Continued)

TABLE NO. 25-D — PART B — VALUES FOR USE IN COMPUTING WORKING STRESSES WITH FACTORS OF PART A TOGETHER WITH LIMITATIONS REQUIRED TO PERMIT THE USE OF SUCH STRESSES[2]

RATIO OF SIZE OF MAXIMUM PERMITTED KNOT TO FINISHED WIDTH OF LAMINATION[4]	NUMBER OF LAMINATIONS	EXTREME FIBER IN BENDING			TENSION PARALLEL TO GRAIN			COMPRESSION PARALLEL TO GRAIN	
		Stress Module	Steepest Grain Slope	Steepest Scarf Slope	Stress Module	Steepest Grain Slope	Steepest Scarf Slope	Stress Module	Steepest Grain Slope
0.1	4 to 14	800	1:16	1:10	800	1:16	1:10	970	1:15
.1	15 or more	800	1:16	1:10	800	1:16	1:10	980	1:15
.2	4 to 14	800	1:16	1:10	800	1:16	1:10	930	1:15
.2	15 or more	800	1:16	1:10	800	1:16	1:10	950	1:15
.3	4 to 14	670	1:12	1:8	800	1:16	1:10	870	1:15
.3	15 or more	770	1:16	1:10	800	1:16	1:10	900	1:15
.4	4 to 14	520	1:8	1:5	640	1:12	1:8	810	1:12
.4	15 or more	660	1:12	1:8	750	1:15	1:8	860	1:14
.5	4 to 14	390	1:8	1:5	480	1:8	1:5	730	1:10
.5	15 or more	550	1:10	1:15	630	1:12	1:8	800	1:12

[1]The allowable unit stresses in bending obtained from Table No. 25-D apply when the wide faces of the lamination are normal to the direction of the load.

[2]Allowable stresses for dry conditions of use shall be applicable when the moisture content in service is 16 per cent or less as in most covered structures. For wet conditions of use the following maximum percentage of the dry use stresses shall be permitted:

F_b (bending) and F_t (tension) 80 per cent
F_v (horizontal shear) and E (modulus of elasticity) 90 per cent
F_c (compression parallel to grain) 70 per cent
$F_{c\perp}$ (compression perpendicular to grain) 67 per cent

[3]For modification of allowable unit stresses for structural glued-laminated lumber see Section 2504.

[4]Factors for knot sizes of 0.1 and 0.2 are identical in case of extreme fiber in bending and in tension parallel to grain because a slope of grain of 1:16 is a greater limitation than knot size. The smaller knot size may be specified for reasons other than strength.

TABLE NO. 25-E — ALLOWABLE UNIT STRESSES FOR ROUND TIMBER POLES AND PILES
(In p.s.i. and for Normal Duration of Load)

SPECIES	EXTREME FIBER IN BENDING[1]	COMPRESSION PARALLEL TO GRAIN (L/D = 11 OR LESS)	COMPRESSION PERPENDICULAR TO GRAIN	HORIZONTAL SHEAR	AVERAGE MODULUS OF ELASTICITY (In Millions)
Southern Pine	2150	1200	260	130	1,600,000
Douglas Fir (Coast)	2150	1200	260	110	1,600,000
Western Larch	2150	1200	260	110	1,600,000
Red Oak	2000	1100	400	150	1,500,000
Ponderosa Pine	1200	830	200	100	1,000,000
Lodgepole Pine	1200	800	180	80	1,000,000
Red (Norway) Pine	1550	850	180	100	1,200,000

Extreme fiber in bending values include 18 per cent increase allowed for round shape.

TABLE NO. 25-F — GROUP CLASSIFICATION — NONSTRESS-GRADED LUMBER

SPECIES	MINIMUM GRADE	UNIFORM BUILDING CODE STANDARD NUMBER
GROUP I		
Douglas Fir & Larch[1]	Construction	25-3 25-4
GROUP II		
Bald Cypress (Tidewater Red Cypress)	No. 2	25-2
Douglas Fir (South)[1]	Construction	25-4
Fir, White	Construction	25-3 25-4
Hemlock, Eastern	No. 1	25-5
Hemlock, West Coast & Western[1]	Construction	25-3 25-4
Pine, Red (Norway Pine)	No. 1	25-5
Redwood, California	Select Heart	25-7
Spruce, Eastern	No. 1	25-8
Spruce, Sitka	Construction	25-3
Spruce, White and Western White	Construction	25-4[2]
GROUP III		
Cedar, Western	Construction West Coast Studs	25-3
Cedar, Western Red and Incense	Construction	25-4
Douglas Fir & Larch[1]	Standard West Coast Studs	25-3 25-4
Douglas Fir (South)[1]	Standard	25-4
Fir, Balsam	No. 1	25-8
Fir, White	Standard West Coast Studs	25-3 25-4
Hemlock, Eastern	No. 2	25-5
Hemlock, West Coast & Western[1]	Standard West Coast Studs	25-3 25-4
Pine, Ponderosa, Lodgepole, Sugar, Idaho White	Construction	25-4
Redwood, California	Construction	25-7
Redwood, California (studs only)	Two Star	25-7
Spruce, Engelmann	Construction	25-4
Spruce, Sitka	Standard West Coast Studs	25-3
Spruce, White and Western White	Standard	25-4[2]
GROUP IV [See Section 2501 (e)]		
Cedar, Western	Utility	25-3
Cedar, Western Red and Incense	Utility	25-4
Douglas Fir & Larch	Utility	25-3 25-4
Douglas Fir (South)	Utility	25-4
Fir, White	Utility	25-3 25-4
Hemlock, West Coast & Western	Utility	25-3 25-4
Pine, Ponderosa, Lodgepole, Sugar, Idaho White	Utility	25-4
Redwood, California	Merchantable	25-7
Redwood, California (studs only)	One Star	25-7
Spruce, Engelmann	Utility	25-4
Spruce, Sitka	Utility	25-3
Spruce, White and Western White	Utility	25-4[2]

[1]Two-inch by 4-inch only.
[2]Spruce (White and Western White) shall be graded under the requirements of Section 25.409 of U.B.C. Standard No. 25-4.

TABLE NO. 25-G — HOLDING POWER OF BOLTS

Loads Parallel to Grain (p)

In Double Shear in Douglas Fir (Coast Region), Douglas Fir, Larch, Southern Pine
(See U.B.C. Standard No. 25-17 for values in other species.)

LENGTH OF BOLT IN MAIN MEMBER[1] (Inches)	DIAMETER OF BOLT (Inches)						
	½	⅝	¾	⅞	1	1⅛	1¼
1⅝	1010	1290	1550	1810	2070		
2⅝	1280	1890	2430	2900	3340		
3⅝	1290	2010	2860	3680	4430		
4½	1290	2010	2890	3920	4980	5980	
5½		2010	2890	3940	5120	6440	
6½		2010	2890	3940	5140	6500	
7½		2010	2890	3940	5140	6500	
9½			2890	3940	5140	6500	8040
11½					5140	6500	8040

[1]This assumes dressed size lumber. Safe loads for other lengths of bolt in main member may be obtained by interpolation.

TABLE NO. 25-H — HOLDING POWER OF BOLTS

Loads Perpendicular to Grain (q)

In Double Shear in Douglas Fir (Coast Region), Douglas Fir, Larch, Southern Pine
(See U.B.C. Standard No. 25-17 for values in other species.)

LENGTH OF BOLT IN MAIN MEMBER[1] (Inches)	DIAMETER OF BOLT (Inches)						
	½	⅝	¾	⅞	1	1⅛	1¼
1⅝	480	540	600	670	730		
2⅝	780	880	980	1080	1170		
3⅝	1020	1210	1350	1490	1620		
4½	1020	1440	1680	1840	2010	2190	
5½		1450	1940	2250	2460	2680	
6½		1390	1940	2510	2880	3170	
7½		1300	1880	2500	3130	3610	
9½			1690	2350	3050	3830	4590
11½					2850	3660	4490

[1]This assumes dressed size lumber. Safe loads for other lengths of bolt in main member may be obtained by interpolation.

TABLE NO. 25-I — SAFE LATERAL STRENGTH AND REQUIRED PENETRATION OF COMMON WIRE NAILS[1] DRIVEN PERPENDICULAR TO GRAIN OF WOOD

SIZE OF NAIL	STANDARD LENGTH (Inches)	WIRE GAUGE	PENETRATION REQUIRED (Inches)	LOADS (Pounds)[2]	
				Douglas Fir Larch or Southern Pine	*Other* Species
6d	2	11½	1¼	63	See U.B.C. Standard No. 25-17
8d	2½	10¼	1½	78	
10d	3	9	1⅝	94	
12d	3¼	9	1⅝	94	
16d	3½	8	1¾	107	
20d	4	6	2⅛	139	
30d	4½	5	2¼	154	
40d	5	4	2½	176	
50d	5½	3	2¾	202	
60d	6	2	2⅞	223	

[1]The lateral strength values of box wire nails shall not exceed 75 per cent of the values for common wire nails. The safe lateral strength values may be increased 25 per cent where metal side plates are used.

[2]For wood diaphragm calculations these values may be increased 30 per cent. (See U.B.C. Standard No. 25-17.)

TABLE NO. 25-J — SAFE RESISTANCE TO WITHDRAWAL OF COMMON WIRE NAILS

Inserted Perpendicular to Grain of the Wood, in Pounds per Linear Inch of Penetration into the Main Member

KIND OF WOOD	SIZE OF NAIL									
	6d	8d	10d	12d	16d	20d	30d	40d	50d	60d
Douglas Fir, Larch or Southern Pine	33	39	44	44	48	57	61	67	72	78
Other Species	See U.B.C. Standard No. 25-17									

TABLE NO. 25-K — MAXIMUM DIAPHRAGM DIMENSION RATIOS

	HORIZONTAL DIAPHRAGMS	VERTICAL DIAPHRAGMS
	Maximum Span-Width Ratios	Maximum Height-Width Ratios
1. Diagonal sheathing, conventional	3:1	2:1
2. Diagonal sheathing, special	4:1	3½:1
3. Plywood, nailed all edges	4:1	3½:1
4. Plywood, blocking omitted at intermediate joints	4:1	2:1

TABLE NO. 25-L — ALLOWABLE SHEAR IN POUNDS PER FOOT FOR HORIZONTAL PLYWOOD DIAPHRAGMS[1]

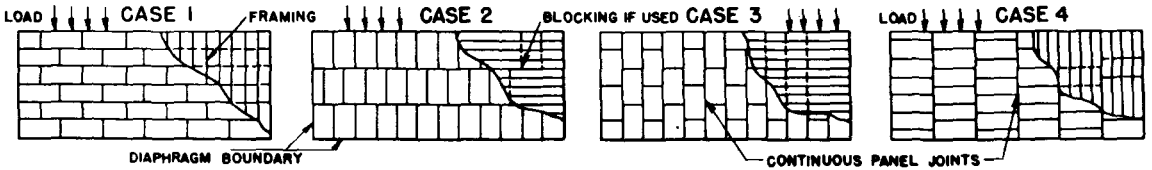
PLYWOOD GRADE	Common Nail Size	Minimum Nominal *Penetration* in Framing (in Inches)	Minimum Nominal Plywood Thickness (in Inches)	Minimum Nominal Width of Framing Member (in Inches)	BLOCKED DIAPHRAGMS				UNBLOCKED DIAPHRAGM	
					Nail Spacing at diaphragm boundaries (all cases) and continuous panel edges parallel to load (cases 3 & 4)				Nails spaced 6" max. at supported end	
					6	4	2½	2	*Load* perpendicular to unblocked edges and continuous panel joints (case 1)	*All other* configurations (cases 2, 3 & 4)
					Nail spacing at other plywood panel edges					
					6	6	4	3		
STRUCTURAL I	6d	1¼	$\frac{5}{16}$	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1½	⅜	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10d	1⅝	½	2	320	425	640[2]	730[2]	285	215
				3	360	480	720	820	320	240
STRUCTURAL II, C-C Exterior, Standard Sheathing and Other Grades Covered in U.B.C. Standard No. 25-9	6d	1¼	$\frac{5}{16}$	2	170	225	335	380	150	110
				3	190	250	380	430	170	125
			⅜	2	185	250	375	420	165	125
				3	210	280	420	475	185	140
	8d	1½	⅜	2	240	320	480	545	215	160
				3	270	360	540	610	240	180
			½	2	270	360	530	600	240	180
				3	300	400	600	675	265	200
	10d	1⅝	½	2	290	385	575[2]	655[2]	255	190
				3	325	430	650	735	290	215
			⅝	2	320	425	640[2]	730[2]	285	215
				3	360	480	720	820	320	240

(Continued)

TABLE NO. 25-L (Continued)

[1]These values are for short time loads due to wind or earthquake and must be reduced 25 per cent for normal loading. Space nails 12 inches on center along intermediate framing members.

[2]Reduce tabulated allowable shears 10 per cent when boundary members provide less than 3-inch nominal nailing surface.



NOTE: Framing may be located in either direction for blocked diaphragms.

TABLE NO. 25-M — ALLOWABLE SHEAR FOR WIND OR SEISMIC FORCES IN POUNDS PER FOOT FOR PLYWOOD SHEAR WALLS[1]

PLYWOOD GRADE	NAIL SIZE (Common or Galvanized Box)	MINIMUM NAIL PENETRATION IN FRAMING (Inches)	MINIMUM NOMINAL PLYWOOD THICKNESS (Inches)	PLYWOOD APPLIED DIRECT TO FRAMING — Nail Spacing at Plywood Panel Edges 6	4	2½	2	NAIL SIZE (Common or Galvanized Box)	PLYWOOD APPLIED OVER ½-INCH GYPSUM SHEATHING — Nail Spacing at Plywood Panel Edges 6	4	2½	2
STRUCTURAL I	6d	1¼	5/16	200	300	450	510	8d	200	300	450	510
	8d	1½	3/8	280	430	640	730	10d	280	430	640[2]	730[2]
	10d	1⅝	½	340	510	770[2]	870[2]	—	—	—	—	—
STRUCTURAL II, C-C Exterior, Standard Sheathing, Panel Siding Plywood and Other Grades Covered in U.B.C. Standard No. 25-9	6d	1¼	5/16	180	270	400	450	8d	180	270	400	450
	8d	1½	3/8	260	380	570	640	10d	260	380	570[2]	640[2]
	10d	1⅝	½	310	460	690[2]	770[2]	—	—	—	—	—
	NAIL SIZE (Galvanized Casing)							NAIL SIZE (Galvanized Casing)				
Plywood Panel Siding in Grades Covered in U.B.C. Standard No. 25-9	6d	1¼	5/16	140	210	320	360	8d	140	210	320	360
	8d	1½	3/8	160	240	360	410	10d	160	240	360	410

[1]All panel edges backed with 2-inch nominal or wider framing. Plywood installed either horizontally or vertically. Space nails at 12 inches on center along intermediate framing members. These values are for short time loads due to wind or earthquake and must be reduced 25 per cent for normal loading.
[2]Reduce tabulated allowable shears 10 per cent when boundary members provide less than 3-inch nominal nailing surface.

TABLE NO 25-N — ALLOWABLE SHEARS FOR WIND OR SEISMIC LOADING ON VERTICAL DIAPHRAGMS OF FIBERBOARD SHEATHING BOARD CONSTRUCTION FOR TYPE V CONSTRUCTION ONLY[1]

SIZE AND APPLICATION	NAIL SIZE	SHEAR VALUE 3-INCH NAIL SPACING AROUND PERIMETER AND 6-INCH AT INTERMEDIATE POINTS
7/16" x 4' x 8'	No. 11 ga. gal. roofing nail 1½" long, 7/16" head	125[2]
25/32" x 4' x 8'	No. 11 ga. gal. roofing nail 1¾" long, 7/16" head	175

[1]Fiberboard sheathing diaphragms shall not be used to brace concrete or masonry walls.
[2]The shear value may be 175 for ½-inch x 4 foot x 8 foot fiberboard nail-base sheathing.

TABLE NO. 25-O — NAILING SCHEDULE

CONNECTION	NAILING[1]
Joist to sill or girder, toe nail	3-8d
Bridging to joist, toe nail each end	2-8d
1" x 6" subfloor or less to each joist, face nail	2-8d
Wider than 1" x 6" subfloor to each joist, face nail	3-8d
2" subfloor to joist or girder, blind and face nail	2-16d
Sole plate to joist or blocking, face nail	16d at 16" o.c.
Top plate to stud, end nail	2-16d
Stud to sole plate, toe nail	4-8d
Doubled studs, face nail	16d at 24" o.c.
Doubled top plates, face nail	16d at 16" o.c.
Top plates, laps and intersections, face nail	2-16d
Continuous header, two pieces	16d at 16" o.c. along each edge
Ceiling joists to plate, toe nail	3-8d
Continuous header to stud, toe nail	4-8d
Ceiling joists, laps over partitions, face nail	3-16d
Ceiling joists to parallel rafters, face nail	3-16d
Rafter to plate, toe nail	3-8d
1" brace to each stud and plate, face nail	2-8d
1" x 8" sheathing or less to each bearing, face nail	2-8d
Wider than 1" x 8" sheathing to each bearing, face nail	3-8d
Built-up corner studs	16d at 24" o.c.

(Continued)

TABLE NO. 25-0 (Continued)

CONNECTION	NAILING[1]
Built-up girder and beams	20d at 32″ o.c. at top and bottom and staggered 2-20d at ends and at each splice
2″ planks	2-16d at each bearing
Particleboard:[5]	
Wall Sheathing (to framing):	8d[3]
Plywood:[5]	
Subfloor, roof and wall sheathing (to framing):	
½″ and less	6d[2]
⅝″-¾″	8d[3] common or 6d[4]
⅞″-1″	8d[2]
1⅛″-1¼″	10d[3] or 8d[4]
Combination Subfloor-underlayment (to framing):	
¾″ and less	6d[4]
⅞″-1″	8d[4]
1⅛″-1¼″	10d[3] or 8d[4]
Fiberboard Sheathing:[7]	
½″	No. 11 ga.[6] 6d[3] No. 16 ga.[8]
$\frac{25}{32}$″	No. 11 ga.[6] 8d[3] No. 16 ga.[8]

[1]Common box nails may be used except where otherwise stated.

[2]Common or deformed shank.

[3]Common.

[4]Deformed shank.

[5]Nails spaced at 6 inches on center at edges, 12 inches at intermediate supports (10 inches at intermediate supports for floors), except 6 inches at all supports where spans are 48 inches or more. For nailing of plywood diaphragms and shear walls refer to Section 2514 (c).

[6]Galvanized roofing nails with $\frac{7}{16}$-inch diameter head and 1½-inch length for ½-inch sheathing and 1¾ inch for $\frac{25}{32}$-inch sheathing.

[7]Fasteners spaced 3 inches on center at exterior edges and 6 inches on center at intermediate supports.

[8]Galvanized staple with $\frac{7}{16}$-inch crown and 1⅛-inch length for ½-inch sheathing and 1½-inch length for $\frac{25}{32}$-inch sheathing.

TABLE NO. 25-P — ALLOWABLE SPANS FOR LUMBER FLOOR AND ROOF SHEATHING[1]

SPAN (Inches)	MINIMUM NET THICKNESS (Inches) OF LUMBER PLACED	
	PERPENDICULAR TO SUPPORTS	DIAGONALLY TO SUPPORTS
	FLOORS	
24	11/16	3/4
16	5/8	5/8
	ROOFS	
24	5/8	—

[1]Installation details shall conform to Sections 2518 (e) 1 and 2518 (g) 7 for floor and roof sheathing, respectively.
Sheathing lumber shall meet the following minimum grade requirements:

BOARD GRADE		
SOLID FLOOR OR ROOF SHEATHING	SPACED ROOF SHEATHING	U.B.C. STANDARD NO.
Utility	Standard	25-3
Utility	Standard	25-4
No. 3	No. 2	25-6
Merchantable	Construction	25-7

TABLE NO. 25-Q — ALLOWABLE SPANS FOR PLYWOOD FLOOR AND ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS[1]

PANEL IDENTIFICATION INDEX[3]	ROOF[2]				FLOOR MAXIMUM SPAN[4] (In Inches)
	MAXIMUM SPAN (In Inches)		LOAD (IN POUNDS PER SQUARE FOOT)		
	Edges Blocked	Edges Unblocked	Total Load	Live Load	
12/0	12		130	100	0
16/0	16		75	55	0
20/0	20		55	45	0
24/0	24	16	60	45	0
30/12	30	26	55	40	12[5]
32/16	32[6]	28	50[7]	40	16[8]
36/16	36	30	50[7]	35[7]	16[8]
42/20	42	32	45[7]	35[7]	20[8]
48/24	48	36	40[7]	40	24

[1]These values apply for Structural I and II, Standard Sheathing and C-C grades only. Spans shall be limited to values shown because of possible effect of concentrated loads.
[2]Uniform load deflection limitation: 1/180th of the span under live load plus dead load, 1/240th under live load only. Edges may be blocked with lumber or other approved type of edge support.
[3]Identification index appears on all panels in the construction grades listed in Footnote No. 1.
[4]Plywood edges shall have approved tongue and groove joints or shall be supported with blocking, unless ¼-inch minimum thickness underlayment is installed, or finish floor is 25/32-inch wood strip. Allowable uniform load based on deflection of 1/360 of span is 100 pounds per square foot.
[5]May be 16-inch if 25/32-inch wood strip flooring is installed at right angles to joists.

(Continued)

[6]One-half inch thick Structural I, when continuous over two or more spans, may be laid with face grain parallel to supports provided all panel edges are blocked or other approved type edge support is provided, the spacing of the supports does not exceed 24 inches on center, and the live load does not exceed 30 pounds per square foot. For other grades, a thickness of 5/8-inch is required.

[7]For roof live load of 40 pounds per square foot or total load of 55 pounds per square foot, decrease spans by 13 per cent or use panel with next greater identification index.

[8]May be 24 inch if 23/32-inch wood strip flooring is installed at right angles to joists.

TABLE NO. 25-R — ALLOWABLE SPAN FOR PLYWOOD COMBINATION SUBFLOOR-UNDERLAYMENT[1]
Plywood Continuous over Two or More Spans and Face Grain Perpendicular to Supports

SPECIES GROUPS[2]	MAXIMUM SPACING OF JOISTS		
	16″	20″	24″
1	1/2″	5/8″	3/4″
2, 3	5/8″	3/4″	7/8″
4	3/4″	7/8″	1″

[1]Applicable to Underlayment Grade, C-C (plugged) and all grades of sanded Exterior type plywood. Spans limited to values shown because of possible effect of concentrated loads. Allowable uniform load based on deflection of 1/360 of span is 100 pounds per square foot. Plywood edges shall have approved tongue and groove joints or shall be supported with blocking, unless 1/4-inch minimum thickness underlayment is installed, or finish floor is 23/32-inch wood strip. If wood strips are perpendicular to supports, thicknesses shown for 16 and 20-inch spans may be used on 24-inch span.

[2]See U.B.C. Standard No. 25-9 for plywood species groups.

TABLE NO. 25-S — ALLOWABLE SPANS FOR TWO-INCH TONGUE-AND-GROOVE DECKING[1]

SPAN (In Feet)	LIVE LOAD	DEFLECTION LIMIT	*f* (p.s.i.)	*E* (p.s.i.)
ROOFS				
4	20	1/240	160	170,000
		1/360		256,000
	30	1/240	210	256,000
		1/360		384,000
	40	1/240	270	340,000
		1/360		512,000
4.5	20	1/240	200	242,000
		1/360		305,000
	30	1/240	270	363,000
		1/360		405,000
	40	1/240	350	484,000
		1/360		725,000
5.0	20	1/240	250	332,000
		1/360		500,000
	30	1/240	330	495,000
		1/360		742,000

(Continued)

TABLE NO. 25-S (Continued)

SPAN (In Feet)	LIVE LOAD	DEFLECTION LIMIT	*f* (p.s.i.)	*E* (p.s.i.)
	40	1/240 1/360	420	660,000 1,000,000
5.5	20	1/240 1/360	300	442,000 660,000
	30	1/240 1/360	400	662,000 998,000
	40	1/240 1/360	500	884,000 1,330,000
6.0	20	1/240 1/360	360	575,000 862,000
	30	1/240 1/360	480	862,000 1,295,000
	40	1/240 1/360	600	1,150,000 1,730,000
6.5	20	1/240 1/360	420	595,000 892,000
	30	1/240 1/360	560	892,000 1,340,000
	40	1/240 1/360	700	1,190,000 1,730,000
7.0	20	1/240 1/360	490	910,000 1,360,000
	30	1/240 1/360	650	1,370,000 2,000,000
	40	1/240 1/360	810	1,820,000 2,725,000
7.5	20	1/240 1/360	560	1,125,000 1,685,000
	30	1/240 1/360	750	1,685,000 2,530,000
	40	1/240 1/360	930	2,250,000 3,380,000
8.0	20	1/240 1/360	640	1,360,000 2,040,000
	30	1/240 1/360	850	2,040,000 3,060,000
FLOORS				
4 4.5 5.0	40	1/360	840 950 1060	1,000,000 1,300,000 1,600,000

[1]Spans are based on simple beam action with 10 pounds per square foot dead load and provisions for a 300-pound concentrated load on a 12-inch width of floor decking. Random lay-up permitted in accordance with the provisions of Section 2518 (e). Lumber thickness assumed at 1½ inches, net.

TABLE NO. 25-T—ALLOWABLE SPANS FOR FLOOR JOISTS USING NONSTRESS-GRADED LUMBER[1]

SIZE OF FLOOR JOISTS (Inches)	SPACING OF FLOOR JOISTS (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches)							
		GROUP I		GROUP II		GROUP III		GROUP IV[2]	
		Plastered Ceiling Below	Without Plastered Ceiling Below	Plastered Ceiling Below	Without Plastered Ceiling Below	Plastered Ceiling Below	Without Plastered Ceiling Below	Plastered Ceiling Below	Without Plastered Ceiling Below
2 x 6	12	10-6	11-6	9-0	10-0	7-6	8-0	5-6	6-0
	16	9-6	10-0	8-0	8-6	6-6	7-0	5-0	5-0
	24	7-6	8-0	6-6	7-0	5-6	6-0	4-0	4-0
2 x 8	12	14-0	15-0	12-6	13-6	10-6	11-6	8-0	8-6
	16	12-6	13-6	11-0	11-6	9-0	10-0	7-0	7-6
	24	10-0	11-0	9-0	9-6	7-6	8-0	6-0	6-6
2 x 10	12	17-6	19-0	16-6	17-6	13-6	14-6	10-6	11-6
	16	15-6	16-6	14-6	15-6	12-0	13-0	9-6	10-0
	24	13-0	14-0	12-0	13-0	10-0	10-6	7-6	8-6
2 x 12	12	21-0	23-0	21-0	21-6	17-6	19-0	13-6	14-6
	16	18-0	20-0	18-0	19-6	15-6	16-6	12-0	13-0
	24	15-0	16-6	15-0	16-6	12-6	13-6	10-0	10-6

DESIGN LOADING AND DEFLECTION CRITERIA:

Live load—Forty pounds per square foot[3]; Dead load weight of floor—Five pounds per square foot—plus weight of joists; eight pounds per square foot—weight of lath and plaster; Deflection with or without plaster—Not to exceed 1/360th of the span with live load nor 1/240th with dead load and live load.

[1]Species of lumber are divided into groups as set forth in Table No. 2 5-F. The allowable spans are based upon stress and deflection criteria set forth in U.B.C. Standard No. 25-21. Span lengths for stress-graded lumber as set forth in Tables No. 25-A-1 and No. 25-A-2 may be based on the stresses therein. Spans in Group I are suitable for any species of stress-graded lumber given in Table No. 25-A-1 or No. 25-A-2 which has a modulus of elasticity of 1,600,000 pounds per square inch and an allowable extreme fiber stress in bending of 1100 pounds per square inch.

[2]Lumber in Group IV may be used only under conditions specifically approved by the Building Official.

[3]For live loads of 50 pounds per square foot, spans shall be reduced to 90 per cent of the tabulated values.

TABLE NO. 25-U—ALLOWABLE SPANS FOR CEILING JOISTS USING NONSTRESS-GRADED LUMBER[1]

Size of Ceiling Joists (Inches)	Spacing of Ceiling Joists (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches)			
		GROUP I	GROUP II	GROUP III	GROUP IV[2]
2 x 4	12	11-6	11-0	9-6	5-6
	16	10-6	10-0	8-6	5-0
2 x 6	12	18-0	16-6	15-6	12-6
	16	16-0	15-0	14-6	11-0
2 x 8	12	24-0	22-6	21-0	19-0
	16	21-6	20-6	19-0	16-6
DESIGN LOADING AND DEFLECTION CRITERIA:					
Live Load—None. Dead Load—Ten pounds per square foot—weight of joists and lath and plaster; Deflection—Not to exceed 1/360 of the span.					

[1]Species of lumber are divided into groups as set forth in Table No. 25-F. Span lengths for stress-graded lumber as set forth in Tables No. 25-A-1 and No. 25-A-2 may be based on the stresses therein. Spans in Group I are suitable for any species of stress-graded lumber given in Table No. 25-A-1 or No. 25-A-2 which has a modulus of elasticity of 1,600,000 pounds per square inch and an allowable extreme fiber stress in bending of 1100 pounds per square inch. The allowable spans are based upon stress and deflection criteria set forth in U.B.C. Standard No. 25-21.

[2]Lumber in Group IV may be used only under conditions specifically approved by the Building Official.

TABLE NO. 25-V — ALLOWABLE SPANS FOR RAFTERS[1]
(Slopes 4:12 or greater)

SIZE OF RAFTER (Inches)	SPACING OF RAFTER (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches Measured Along the Horizontal Projection)											
		LIVE LOAD 16 POUNDS[2]				SNOW LOAD 30 POUNDS[3]				SNOW LOAD 40 POUNDS[3]			
		Group I	Group II	Group III	Group IV[4]	Group I	Group II	Group III	Group IV[4]	Group I	Group II	Group III	Group IV[4]
2 x 4	12	10-0	9-0	7-0	4-0	8-0	7-0	5-6	3-0	7-0	6-0	4-6	3-0
	16	9-0	7-6	6-0	3-6	7-0	6-0	4-6	2-6	6-0	5-6	4-0	2-6
	24	7-6	6-6	5-0	3-0	5-6	5-0	4-0	2-0	5-0	4-6	3-6	2-0
	32	6-6	5-6	4-6	2-6	5-0	4-0	3-6	2-0	4-6	3-6	3-0	1-6
2 x 6	12	17-6	15-0	12-6	9-0	13-6	11-6	9-6	7-0	12-0	10-0	8-6	6-0
	16	15-6	13-0	11-0	8-0	12-0	10-0	8-6	6-0	10-6	9-0	7-6	5-6
	24	12-6	11-0	9-0	6-6	9-6	8-0	7-0	5-0	8-6	7-6	6-0	4-6
	32	11-0	9-6	8-0	5-6	8-6	7-0	6-0	4-6	7-6	6-6	5-6	4-0
2 x 8	12	23-0	20-0	17-0	13-0	18-0	15-6	13-0	10-0	16-0	14-0	12-0	9-0
	16	20-0	18-0	15-0	11-6	15-6	13-6	11-6	9-0	14-0	12-6	10-6	8-0
	24	17-0	15-0	12-6	9-6	13-0	11-6	9-6	7-6	11-6	10-0	8-6	6-6
	32	14-6	13-0	11-0	8-6	11-0	10-0	8-6	6-6	10-0	9-0	7-6	5-6
2 x 10	12	28-6	26-6	22-0	17-6	22-6	21-0	17-0	13-6	20-0	18-6	15-6	12-0
	16	25-6	23-6	19-6	15-6	19-6	18-0	15-0	12-0	17-6	16-6	13-6	10-6
	24	21-0	19-6	16-0	12-6	16-0	15-0	12-6	10-0	14-6	13-6	11-0	8-6
	32	18-6	17-0	14-0	11-0	14-0	13-0	11-0	8-6	12-6	11-6	9-6	7-6
DESIGN LOADING CRITERIA		Dead Load — Weight of roof equals seven pounds per square foot plus weight of rafters. All loads applied on horizontal projection.											

[1]Span lengths for stress-graded lumber set forth in Table No. 25-A-1 or 25-A-2 may be based on the stresses therein. Spans in Group I are suitable for any species of stress-graded lumber in Table No. 25-A-1 or 25-A-2 which has a modulus of elasticity of 1,600,000 pounds per square inch and an allowable extreme fiber stress in bending of 1100 pounds per square inch. The allowable spans are based upon stress and deflection criteria set forth in U.B.C. Standard No. 25-21. Species of lumber are divided into groups as set forth in Table No. 25-F.

[2]Allowable stresses increased 25 per cent for roof loading [Section 2504 (c) 4].

[3]Allowable stresses are increased 15 per cent for roof loading [Section 2504 (c) 4].

[4]Lumber in Group IV may be used only under conditions specifically approved by the Building Official.

TABLE NO. 25-W—ALLOWABLE SPANS FOR ROOF RAFTERS USING NONSTRESS-GRADED LUMBER[1]
(Slopes less than 4:12)

SIZE OF ROOF RAFTERS (Inches)	SPACING OF ROOF RAFTERS (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches Measured Along the Horizontal Projection)							
		GROUP I		GROUP II		GROUP III		GROUP IV[2]	
		Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling
2 x 4	12	8-0	9-6	7-0	8-0	5-6	6-6	3-0	4-0
	16	7-0	8-0	6-0	7-0	5-0	5-6	3-0	3-6
	24	5-6	6-6	5-0	6-0	4-0	4-6	2-6	3-0
	32	5-0	6-0	4-6	5-0	3-6	4-0	2-0	2-6
2 x 6	12	13-0	16-6	12-0	14-0	10-6	11-6	7-0	8-6
	16	11-6	14-6	10-6	12-0	8-6	10-0	6-0	7-6
	24	10-0	12-0	8-6	10-0	7-0	8-6	5-0	6-0
	32	8-6	10-6	7-6	9-0	6-0	7-6	4-6	5-6
2 x 8	12	17-0	21-6	16-0	19-0	13-6	16-0	10-6	12-6
	16	15-6	19-0	14-0	16-6	12-0	14-0	9-0	11-0
	24	13-6	15-6	11-6	13-6	10-0	11-6	7-6	9-0
	32	11-6	13-6	10-0	12-0	8-6	10-0	6-6	8-0
2 x 10	12	21-6	27-0	20-0	25-0	17-6	20-6	14-0	16-0
	16	19-6	23-6	18-6	22-0	15-6	18-0	12-0	14-0
	24	16-6	19-6	15-6	18-0	13-0	15-0	10-0	12-0
	32	14-6	17-0	13-6	16-0	11-0	13-0	9-0	10-6

TABLE NO. 25-W—ALLOWABLE SPANS FOR ROOF RAFTERS USING NONSTRESS-GRADED LUMBER[1]—Continued

SIZE OF ROOF RAFTERS (Inches)	SPACING OF ROOF RAFTERS (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches Measured Along the Horizontal Projection)							
		GROUP I		GROUP II		GROUP III		GROUP IV[2]	
		Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling
2 x 12	12	25-6	32-0	24-0	31-0	22-6	26-6	17-6	20-6
	16	23-6	28-0	22-0	27-6	20-6	23-6	15-6	18-0
	24	20-0	23-6	19-6	23-0	16-6	19-6	13-0	15-0
	32	17-6	20-6	17-0	20-0	14-6	17-0	11-0	13-0

DESIGN LOADING AND DEFLECTION CRITERIA:

Live load—20 pounds per square foot on the horizontal projection. Dead load weight of roof—seven pounds per square foot on the horizontal projection—plus weight of rafters. Eleven pounds per square foot on the horizontal projection—weight of lath and plaster ceiling; Deflection—With plastered ceiling—not to exceed 1/360 of the span with live load nor 1/240 of the span with dead and live load—Without plastered ceiling—not considered.

[1]Species of lumber are divided into groups as set forth in Table No. 25-F. Allowable stresses are increased 25 per cent for roof loading [Section 2504 (c) 4]. Span lengths for stress-graded lumber set forth in Tables No. 25-A-1, No. 25-A-2 and No. 25-B may be based on the stresses therein. Spans in Group I are suitable for any species of stress graded lumber in Tables No. 25-A-1 and No. 25-A-2 or No. 25-B which have a modulus of elasticity of 1,600,000 pounds per square inch and an allowable extreme fiber stress in bending of 1100 pounds per square inch. The allowable spans are based upon stress and deflection criteria set forth in U.B.C. Standard No. 25-21.

[2]Lumber in Group IV may be used only under conditions specifically approved by the Building Official.

TABLE NO. 25-W-SL-30[1] — ALLOWABLE SPANS FOR ROOF RAFTERS, USING NONSTRESS-GRADED LUMBER
(Slopes less than 4:12)

SIZE OF ROOF RAFTERS (Inches)	SPACING OF ROOF RAFTERS (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches Measured Along the Horizontal Projection)							
		GROUP I		GROUP II		GROUP III		GROUP IV[2]	
		Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling
2 x 4	12	7-0	8-0	6-0	7-0	4-6	5-6	3-0	3-0
	16	6-0	7-0	5-0	6-0	4-0	4-6	2-6	2-6
	24	5-0	5-6	4-6	5-0	3-6	4-0	2-0	2-0
	32	4-0	5-0	3-6	4-0	3-0	3-6	1-6	2-0
2 x 6	12	12-0	13-6	10-0	11-6	8-6	9-6	6-0	7-0
	16	10-6	12-0	9-0	10-0	7-6	8-6	5-6	6-0
	24	8-6	9-6	7-6	8-0	6-0	7-0	4-6	5-0
	32	7-6	8-6	6-6	7-0	5-6	6-0	4-0	4-6
2 x 8	12	16-0	18-0	14-0	15-6	11-6	13-0	9-0	10-0
	16	13-0	15-6	12-0	13-6	10-0	11-6	8-0	9-0
	24	11-6	13-0	10-0	11-6	8-6	9-6	6-6	7-6
	32	10-0	11-0	8-6	10-0	7-6	8-6	5-6	6-6
2 x 10	12	20-0	22-6	18-6	21-0	15-6	17-0	12-0	13-6
	16	17-6	19-6	16-0	18-0	13-6	15-0	10-6	12-0
	24	14-6	16-0	13-6	15-0	11-0	12-6	8-6	10-0
	32	12-6	14-0	11-6	13-0	9-6	11-0	7-6	8-6
2 x 12	12	24-0	27-0	22-6	26-0	19-6	22-0	15-0	17-0
	16	20-0	23-6	20-6	23-0	17-0	19-6	13-6	15-0
	24	17-6	19-6	17-0	19-0	14-6	16-0	11-0	12-6
	32	15-0	17-0	14-6	16-6	12-6	14-0	9-6	11-0

DESIGN LOADING AND DEFLECTION CRITERIA:

Snow load—30 pounds per square foot on the horizontal projection. Dead load weight of roof—seven pounds per square foot on the horizontal projection—plus weight of rafters. Eleven pounds per square foot on the horizontal projection—weight of lath and plaster ceiling; Deflection—With plastered ceiling—not to exceed 1/360 of the span with snow load nor 1/240 of the span with dead and snow load—Without plastered ceiling—not considered.

SEE FOOTNOTES ON PAGE 240.

TABLE NO. 25-W-SL-40[1] — ALLOWABLE SPANS FOR ROOF RAFTERS USING NONSTRESS-GRADED LUMBER
(Slopes less than 4:12)

SIZE OF ROOF RAFTERS (Inches)	SPACING OF ROOF RAFTERS (Inches)	MAXIMUM ALLOWABLE SPAN (Feet and Inches Measured Along the Horizontal Projection)							
		GROUP I		GROUP II		GROUP III		GROUP IV[2]	
		Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling	Supporting Ceiling	Not Supporting Ceiling
2 x 4	12	6-0	7-0	5-6	6-0	4-6	4-6	2-6	3-0
	16	5-6	6-0	4-6	5-6	3-6	4-0	2-0	2-6
	24	4-6	5-0	4-0	4-6	3-0	3-6	2-0	2-0
	32	4-0	4-6	3-6	3-6	2-6	3-0	1-6	1-6
2 x 6	12	11-0	12-0	9-6	10-0	7-6	8-6	5-6	6-0
	16	9-6	10-6	8-0	9-0	6-6	7-6	5-0	5-6
	24	8-0	8-6	6-6	7-6	5-6	6-0	4-0	4-6
	32	7-0	7-6	6-0	6-6	5-0	5-6	3-6	4-0
2 x 8	12	14-6	16-0	12-6	14-0	10-6	12-0	8-6	9-0
	16	12-6	14-0	11-0	12-6	9-6	10-6	7-0	8-0
	24	10-6	11-6	9-0	10-0	7-6	8-6	6-0	6-6
	32	9-0	10-0	8-0	9-0	6-6	7-6	5-0	5-6
2 x 10	12	18-0	20-0	17-0	18-6	14-0	15-6	11-0	12-0
	16	16-0	17-6	15-0	16-6	12-0	13-6	9-6	10-6
	24	13-0	14-6	12-0	13-6	10-0	11-0	8-0	8-6
	32	11-6	12-6	10-6	11-6	8-6	9-6	7-0	7-6
2 x 12	12	22-0	24-0	21-0	23-6	18-0	20-0	14-0	15-6
	16	19-0	21-0	18-6	20-6	16-0	17-6	12-0	13-6
	24	16-0	17-6	15-6	17-0	13-0	14-6	10-0	11-0
	32	13-6	15-0	13-6	15-0	11-6	12-6	9-0	9-6

DESIGN LOADING AND DEFLECTION CRITERIA:

Snow load—40 pounds per square foot on the horizontal projection. Dead load weight of roof—seven pounds per square foot on the horizontal projection—plus weight of rafters. Eleven pounds per square foot on the horizontal projection—weight of lath and plaster ceiling; Deflection—With plastered ceiling—not to exceed 1/360 of the span with snow load nor 1/240 of the span with dead and snow load—Without plastered ceiling—not considered.

SEE FOOTNOTES ON PAGE 240.

FOOTNOTES TO TABLES NO. 25-W-SL-30 AND NO. 25-W-SL-40

[1]Species of lumber are divided into groups as set forth in Table No. 25-F. Allowable stresses are increased 15 per cent for roof loading [Section 2504 (c) 4]. Span lengths for stress-graded lumber set forth in Table No. 25-A-1 or 25-A-2 may be based on the stresses therein. Spans in Group I are suitable for any species of stress-graded lumber in Table No. 25-A-1 or 25-A-2 which has a modulus of elasticity of 1,600,000 pounds per square inch and an allowable extreme fiber stress in bending of 1100 pounds per square inch. The allowable spans are based upon stress and deflection criteria set forth in U.B.C. Standard No. 25-21.

[2]Lumber in Group IV may be used only under conditions specifically approved by the Building Official.