

Note: Section 8 starts with Para 201a. Para 201 is on page 217 (the last page of section 7).

MEASUREMENT OF KNOTS

201-a. Unless otherwise specified, knots shall be measured as the average of the maximum and minimum diameters as shown in Figure 1.

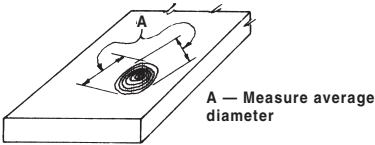


Figure 1.

201-b. In Grades of Studs, Light Framing, Structural Framing and other grades where specified, knots on wide faces are measured between lines parallel to the edges as shown in Figure 2. When tapering knots are encountered, their equivalent displacement is determined as shown in Figure 3. Narrow face and spike knots are judged by the amount of cross section they occupy as illustrated in Figures 4 and 5.

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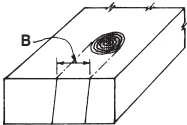


Figure 2.

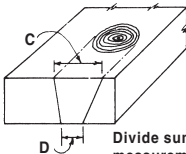


Figure 3. Divide sum of measurements C and D by 2.

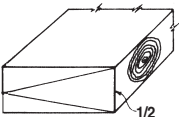


Figure 4. 1/2 Displacement.

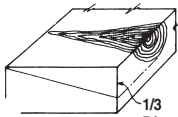


Figure 5. 1/3 Displacement.

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MEASUREMENT OF KNOTS

201-c. In Beam and Stringer grades, knots shall be measured as shown in Figures 6 and 7.

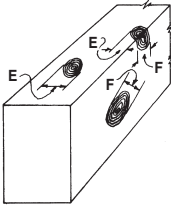


Figure 6.

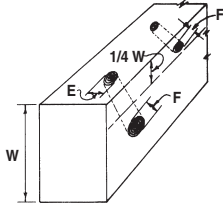


Figure 7.

E — Measure between lines parallel to the edges.
F — Measure least dimension.

201-d. In Post and Timber grades, knots shall be measured as shown in Figure 8.

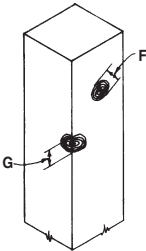


Figure 8.

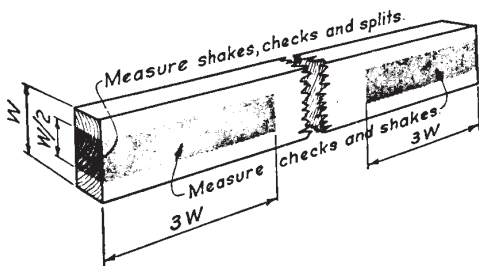
F - Measure least dimension.
G - Measure along corner or measure size most nearly representing diameter of branch causing the knot.

SHAKES, CHECKS AND SPLITS

202. Due to the nature of shakes, checks and splits, judgment must be used in evaluating their extent.

I. BEAMS and STRINGERS.

The measurement of shakes, checks and splits is confined to the middle 1/2 of the height of the piece and restrictions on checks are applied only for a distance from the ends equal to three times the width of the wide face.



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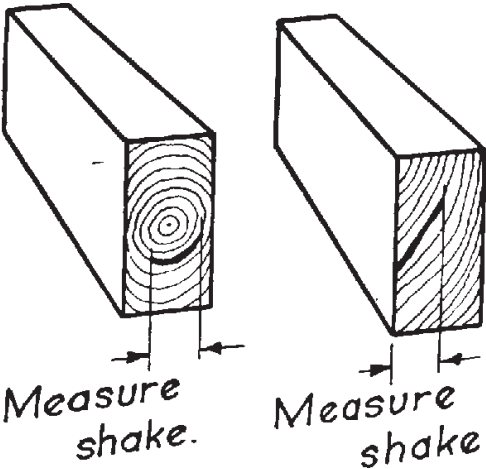
II. POSTS and TIMBERS.

Shakes and checks, as a rule, have little influence on the strength of a post or column, unless so extensive as to split the piece practically in two. The grade limitations are applied primarily for appearance.

III. MEASUREMENT OF SHAKES, CHECKS and SPLITS.

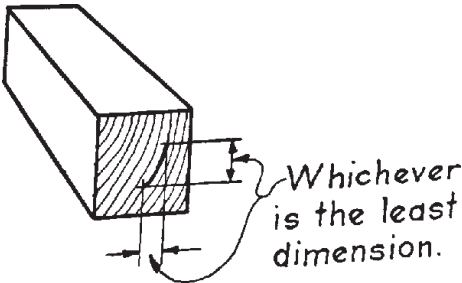
- (a) SHAKES in Structural Framing and Beams and Stringers are measured at the ends of pieces, between lines enclosing the shake and parallel to the wide faces.

SHAKES, CHECKS AND SPLITS



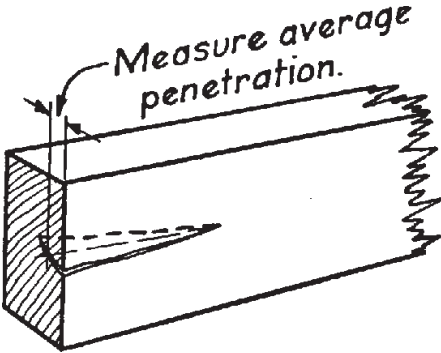
- (b) SHAKES in Posts and Timbers are measured at the ends of pieces, between lines parallel with the two faces that give the least dimension. The size of shake permitted in a grade is for unseasoned lumber. If the lumber is seasoned, the size of shake may be 1-1/2 times the size permitted in a grade.

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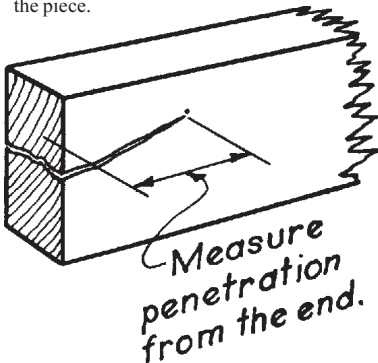
SHAKES, CHECKS AND SPLITS

- (c) CHECKS are measured as an average of the penetration perpendicular to the wide face. Where two or more checks appear on the same face, only the deepest one is measured. Where two checks are directly opposite each other, the sum of their depths is considered.



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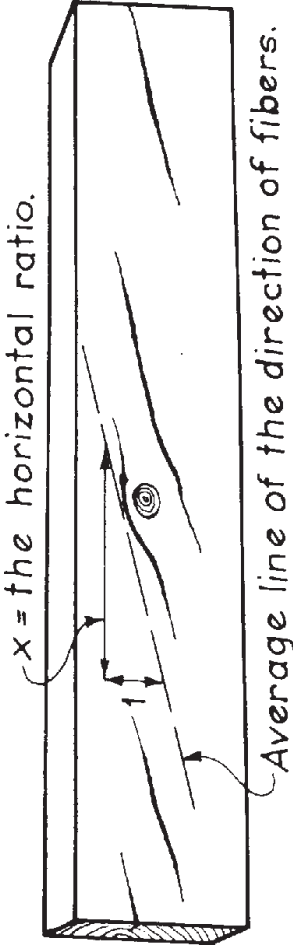
- (d) SPLITS are measured as the penetration of a split from the end of the piece and parallel to the edges of the piece.



SLOPE OF GRAIN

203. Slope of grain is the deviation of the wood fiber from a line parallel to the edges of a piece. The deviation is expressed as a ratio such as a slope of grain of 1 in 8, 1 in 10, 1 in 12 and 1 in 15.

Slope of grain as measured is representative of the general slope of the fibers and local deviations are disregarded. Measurement of slope of grain should be over a sufficient length and area so that local deviations will not be misleading.



MACHINE STRESS RATED LUMBER ALL SPECIES

2" and Less in Thickness
2" and Wider

206-a. MECHANICALLY STRESS RATED LUMBER.

Machine stress rated (MSR) lumber is lumber that has been evaluated by mechanical stress rating equipment. MSR lumber is distinguished from visually stress graded lumber in that each piece is nondestructively tested and marked to indicate the modulus of elasticity (E or MOE). MSR lumber is also required to meet certain visual requirements as set forth herein.

A grade stamp on Machine Stress Rated lumber indicates the stress rating system used meets requirements of the grading agency's certification and required quality control procedures. The grade stamp will show the agency trademark, the mill name or number, will include the phrase "MSR," the species identification and the "E" rating for the grade. The "E" rating is the rated average bending modulus of elasticity in millions of pounds per square inch for the grade when measured on edge (e.g. as a joist). Additionally, the grade stamp will include the fiber stress in bending value (F_b) and, when required, the allowable design tensile stress parallel to grain (F_t). The stamp will also include the F_v , $F_{c\perp}$, and long span E rating when the value is specifically qualified.

8

The "E" "F_b" grade combinations which can be qualified are not restricted to those combinations shown in Table 13. If the assigned allowable F_t is different for the MSR grade than that shown in Table 13 for the same F_b level, the assigned F_t value shall be included on the grade stamp. The remaining three assigned allowable properties (F_c , $F_{c\perp}$, F_v) for a grade shall be those listed for the equivalent F_b level. Higher values for F_v and $F_{c\perp}$ may be assigned as described below.

For some uses it may be desirable to qualify and quality control a bending modulus of elasticity representative of different test conditions (e.g., long span MOE per Paragraph 154-d.) in addition to the standard edge bending

MACHINE STRESS RATED LUMBER ALL SPECIES

MOE qualification for MSR. When the MSR grade is qualified and quality controlled for this specific MOE, the qualifying MOE value for the grade may be included as an additional mechanical property value for the grade. When so qualified, the MOE value must be included on the grade stamp.

A specific gravity value (based on oven dry weight/oven dry volume) higher than that listed in Table 14 may be assigned to a grade when the specific gravity of the grade is verified by test and controlled as part of the daily quality control program. When so qualified, the specific gravity value shall be included on the grade stamp.

The allowable stresses for compression perpendicular to grain and horizontal shear listed after Table 14 are appropriate for all grades. Compression perpendicular to grain ($F_{c\perp}$) and Horizontal shear (F_v) have been shown to be well correlated with specific gravity. The equations given to calculate compression perpendicular to grain ($F_{c\perp}$) and horizontal shear (F_v) allowable stresses from specific gravity are based on that correlation. When the equations given, using the assigned grade specific gravity, produce higher allowable stresses for $F_{c\perp}$ or F_v than those assigned to all grades, the higher value may be used.

206-b. VISUAL GRADING REQUIREMENTS

8

Mechanically Stress Rated lumber must be well manufactured and visually graded to limit certain characteristics even though the actual strength is not affected. All pieces shall be visually graded to assure that the characteristics affecting strength are no more serious than the following limiting characteristics:

For grades 1000 Fb and above

Checks — Seasoning checks not limited. Through checks at ends limited as splits.

Shake — If through at ends limited as splits. Away from ends through heart shakes up to 2' long, well separated. If not through, single shakes may be 3' or up to 1/4 the length, whichever is greater.

MACHINE STRESS RATED LUMBER ALL SPECIES

Skips — Hit and miss, and in addition 5% of the pieces may be hit or miss or heavy skip not longer than 2'. See Para. 720(e), (f) and (g).

Splits — Equal in length to 1-1/2 times the width of the piece.

Wane — 1/3 thickness and 1/3 width full length, or equivalent on each face, provided that wane not exceed 2/3 thickness or 1/2 the width for up to 1/4 the length (See Paragraph 750).

Warp — Light. See table, Para. 752.

Manufacture — Standard F. See Para. 722(f)

For grades below 1000 Fb.

Checks-Seasoning checks not limited. Through checks at ends limited as splits.

Shake - Surface shakes permitted. If through at edges or ends, limited as splits. Elsewhere through shakes 1/3 the length, scattered along the length.

Skips - Hit or miss, with a maximum of 10% of the pieces containing heavy skips. See Para. 720(e), and (g).

Splits - Equal to 1/6 the length of the piece.

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Stain - Stained wood - not limited.

Wane - 1/2 thickness and 1/2 width full length, or equivalent on each face, provided that wane not exceed 7/8 the thickness or 3/4 the width for up to 1/4 the length (See Paragraph 750).

Warp - Medium. See table, Para. 752.

White Speck and Honeycomb - Firm.

Manufacture - Standard F. See Para. 722(f).

In addition to the visual limitations listed, knots, knot holes, burls, distorted grain or decay partially or wholly at edges of wide faces, must not occupy more of the net cross-section than:

MACHINE STRESS RATED LUMBER ALL SPECIE

Fb Class

| | |
|----------------------|-----------------------|
| 1/2 for 0 to 1000 | 1/4 for 1500 to 2050 |
| 1/3 for 1050 to 1450 | 1/6 for 2100 and over |

Characteristics which occur in any end portion of the pieces which are not evaluated by the stress grading equipment shall be limited as follows:

Edge knots — Limited as listed above.

Non-edge knots — Equal to the largest non-edge knot in the tested portion of the piece or the next larger edge knot, whichever is greater. For 1/2 edge knot category, non-edge knot limited to 2/3 cross section.

Cross-section knots — Displacement of all knots in the same cross section must not exceed the size of the permitted non-edge knot.

Slope of grain — The general slope of grain in the untested end portion shall not exceed:

| <u>Slope</u> | <u>Fb Class</u> |
|--------------|-----------------|
| 1 in 12 | 2100 and over |
| 1 in 10 | 1500 to 2050 |
| 1 in 8 | 1050 to 1450 |
| 1 in 4 | 0 to 1000 |

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**MACHINE STRESS RATED LUMBER
ALL SPECIES**

TABLE 13. Machine Stress Rated Lumber:
2" or less in thickness — all widths
Design Values, PSI, Normal Loading
Grade Description Para. 206.

| Modulus of Elasticity E | Extreme fiber in bending F-b* | Tension parallel to grain F-t | Compression parallel to grain F-c |
|----------------------------|----------------------------------|----------------------------------|--------------------------------------|
| 1,000,000 | 900 | 350 | 1,050 |
| 1,200,000 | 1,200 | 600 | 1,400 |
| 1,300,000 | 1,350 | 750 | 1,600 |
| 1,300,000 | 1,450 | 800 | 1,625 |
| 1,400,000 | 1,250 | 800 | 1,475 |
| 1,400,000 | 1,500 | 900 | 1,650 |
| 1,500,000 | 1,450 | 875 | 1,625 |
| 1,500,000 | 1,650 | 1,020 | 1,700 |
| 1,600,000 | 1,650 | 1,175 | 1,700 |
| 1,600,000 | 1,700 | 1,175 | 1,725 |
| 1,600,000 | 1,800 | 1,175 | 1,750 |
| 1,700,000 | 1,950 | 1,375 | 1,800 |
| 1,800,000 | 1,800 | 1,200 | 1,750 |
| 1,800,000 | 2,100 | 1,575 | 1,875 |
| 1,800,000 | 2,250 | 1,750 | 1,925 |
| 1,900,000 | 2,250 | 1,750 | 1,925 |
| 2,000,000 | 1,800 | 1,175 | 1,750 |
| 2,000,000 | 2,400 | 1,925 | 1,975 |
| 2,000,000 | 2,700 | 1,800 | 2,100 |
| 2,100,000 | 2,550 | 2,050 | 2,025 |
| 2,200,000 | 2,500 | 1,750 | 2,000 |
| 2,200,000 | 2,700 | 2,150 | 2,100 |
| 2,300,000 | 2,850 | 2,300 | 2,150 |

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NOTE: For flatwise use, the modulus of elasticity (E) value listed in the table may be increased 100,000 psi for grades with assigned E greater than 1,300,000 psi, and 50,000 psi for grades with assigned E of 1,300,000 psi or less. Additional grades not listed may be qualified by test. When such grades are qualified, property values shall be rounded as indicated below. Compression parallel to grain (Fc) values may be interpolated based on assigned Fb.

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**MACHINE STRESS RATED LUMBER
ALL SPECIES**

NOTE (cont.):

| Property | Rounding |
|---------------------------------------|--|
| Modulus of Elasticity (E) | 100,000 psi |
| Fiber Stress in Bending (Fb) | 25 psi below 1000 psi 50 psi at 1000 psi and above |
| Tensile Stress Parallel to Grain (Ft) | 25 psi |
| Compression Parallel to Grain (Fc) | 25 psi |

TABLE 14
Assigned Specific Gravity

| Species | Grade Modulus of Elasticity (psi) | Specific Gravity |
|----------------|-----------------------------------|------------------|
| Douglas Fir | Less than 2,000,000 | 0.50 |
| | 2,000,000 | 0.51 |
| | 2,100,000 | 0.52 |
| | 2,200,000 | 0.53 |
| | 2,300,000 | 0.54 |
| | 2,400,000 | 0.55 |
| Hem-Fir | Less than 1,600,000 | 0.43 |
| | 1,600,000 | 0.44 |
| | 1,700,000 | 0.45 |
| | 1,800,000 | 0.46 |
| | 1,900,000 | 0.47 |
| | 2,000,000 | 0.48 |
| | 2,100,000 | 0.49 |
| | 2,200,000 | 0.50 |
| | 2,300,000 | 0.51 |
| | 2,400,000 | 0.52 |
| S-P-F South | All Grades | 0.36 |
| Western Cedars | All Grades | 0.36 |
| Western Woods | All Grades | 0.36 |

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1. Specific gravity basis is oven dry weight/oven dry volume. Higher values may be claimed, if specifically qualified and quality controlled (see para. 206-a).
2. For imported species, see para. 200-1.

MACHINE STRESS RATED LUMBER ALL SPECIES

Assigned-

| | | |
|--|----------------------------|-----------|
| Horizontal Shear (Fv) for all stress levels | Douglas fir | = 170 PSI |
| | Hem-fir | = 140 PSI |
| | S-P-F S | = 125 PSI |
| | Western Cedars | = 140 PSI |
| | Western Woods | = 125 PSI |
| | Imported - see para. 200-1 | |

When a grade is qualified by test and quality controlled for specific gravity, the allowable horizontal shear value may be calculated from the following formula:

$$F_v = 20.6 + (136.08 * Sp. Gr.)$$

NOTE: Specific gravity is at oven dry weight and oven dry volume. Assigned values shall be rounded to the nearest 5 psi.

Values calculated from the equation above may be multiplied by 1.05 for MC 15 material.

The assigned Horizontal Shear values for MSR lumber from imported species shall be the same value that was assigned the visually graded lumber, see Tables 5c&d.

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Assigned-

| | | |
|--|----------------------------|-----------|
| Compression Perpendicular to Grain (Fc⊥) | Douglas fir | = 625 PSI |
| | Hem-fir | = 405 PSI |
| | S-P-F S | = 335 PSI |
| | Western Cedars | = 425 PSI |
| | Western Woods | = 335 PSI |
| | Imported - see para. 200-1 | |

When a grade is qualified by test and quality controlled for specific gravity, the allowable compression perpendicular to grain value may be calculated from the following formula:

$$F_{c\perp} = (2252.4 * Sp. Gr.) - 480$$

NOTE: Specific gravity is at oven dry weight and oven dry volume. Assigned values shall be rounded to the nearest 5 psi.

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MACHINE STRESS RATED LUMBER ALL SPECIES

Values calculated from the equation above may be multiplied by 1.16 for MC 15 material.

Compression perpendicular to grain values determined from the equation above are based on a 0.04 inch deformation limit and are for standard design of most structures.

Values at .02 inch deformation can be obtained with the following equations:

$$F_{c\perp} (.02) = (0.71 * F_{c\perp} .04) + 14.1$$

$$F_{c\perp} (.02) = (1605.5 * \text{Sp. Gr.}) - 327.5$$

Note: Specific gravity is at oven dry weight and oven-dry volume.

The assigned Compression Perpendicular to Grain values for MSR lumber from imported species shall be the same value that was assigned the visually graded lumber, see Tables 5c&d.

STRUCTURAL GLUED LUMBER

210. STRUCTURAL GLUED LUMBER (all Species)

210. Glued lumber identified as structural glued lumber shall meet both the grade specifications of the grade rules under which the lumber is graded, and the glue bond requirements of this paragraph and the WCLIB Glued Lumber Certification and Quality Control Manual. Structural glued lumber identified by a Bureau structural glued quality mark shall be considered as a solid piece. Grade specifications and limitations for structural glued lumber are the same as for lumber without glue joints. The quality of the glue joints is considered a separate factor. Structural glued lumber shall be ordered, acknowledged, and invoiced as structural glued material

210a. "CERTIFIED GLUED LUMBER". All structural glued lumber identified by the Bureau Certification of Structural Glue Joint mark shall meet all the requirements of the rules under which it is graded, and all applicable requirements for end, face, and/or edge joints for exterior adhesives of American National Standard ANSI/AITC A190.1 for Structural Glued Laminated Timber. Adhesives used shall meet the requirements of ASTM D2559.

210b. "CERTIFIED END JOINT". All end jointed material identified by the Bureau Certification of End Joint mark shall meet all the requirements of the rules under which it is graded, and all applicable requirements for end joints using exterior adhesives of American National Standard ANSI/AITC A190.1 for Structural Glued Laminated Timber. Adhesives used shall meet the requirements of ASTM D2559.

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210.c. "STUD USE ONLY". End jointed lumber manufactured with adhesives meeting all the provisions of ASTM D2559 for exterior adhesives with the exception of creep (Section 16), may be stamped with "STUD USE ONLY" end joint stamps. "STUD USE ONLY" end jointed lumber is limited to 6" and less in nominal width and 12' and shorter in length.

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STRUCTURAL GLUED LUMBER

