Chapter ILHR 20-25

APPENDIX

Wisconsin Department of Industry, Labor and Human Relations Safety and Buildings Division P O Box 7969 Madison, WI 53707 Wisconsin Statutes 101.63, 101.73	**WISCONSIN UNIFORM BUILDING PERMIT APPLICATION** (See instructions on back of pink copy) The information you provide may be used by other government agency programs [Privacy Law, s. 15.04 (1) (m)].	Application No Parcel No.

PERMIT REQUESTED ☐ Constr ☐ HVAC ☐ Elec ☐ Plbg ☐ Erosion ☐ Other:

Owner's Name	Mailing Address	Telephone No. ( )
Contractor's Name: ☐ Con ☐ Elec ☐ HVAC ☐ Plbg Lic/Cert #	Mailing Address	Telephone No. ( )
Contractor's Name: ☐ Con ☐ Elec ☐ HVAC ☐ Plbg Lic/Cert #	Mailing Address	Telephone No ( )
Contractor's Name: ☐ Con ☐ Elec ☐ HVAC ☐ Plbg Lic/Cert #	Mailing Address	Telephone No. ( )
Contractor's Name: ☐ Con ☐ Elec ☐ HVAC ☐ Plbg Lic/Cert #	Mailing Address	Telephone No. ( )

PROJECT LOCATION Lot Area Sq. ft. 1/4, 1/4, Section , T N, R E (or) W

Building Address	Subdivision Name	Lot No.	Block No.
Zoning District(s) / Zoning Permit No.	Setbacks: Front ft. / Rear ft.	Left ft.	Right ft.

1. PROJECT
☐ New ☐ Repair
☐ Alteration ☐ Raze
☐ Addition ☐ Move
☐ Other _____

2. AREA INVOLVED
Unfinished Basement _____ Sq ft
Living Area _____ Sq ft
Garage _____ Sq ft
_____ Sq ft

3. OCCUPANCY
☐ Single Family
☐ Two Family
☐ Garage
☐ Other (print):

4. CONST. TYPE
☐ Site Constructed
☐ Manufactured

5. STORIES
☐ 1 Story
☐ 2 Story
☐ Other _____
☐ Plus Basement

6. ELECTRICAL
Entrance Panel Size: _____ amp
Service:
☐ Underground
☐ Overhead

7. FOUNDATION
☐ Concrete
☐ Masonry
☐ Treated Wood
☐ Other _____

8. USE
☐ Seasonal
☐ Permanent
☐ Other _____

9. HVAC EQUIPMENT
☐ Forced Air Furnace
☐ Radiant Baseboard or Panel
☐ Heat Pump
☐ Boiler
☐ Central Air Conditioning
☐ Other _____

10. PLUMBING
Sewer
☐ Municipal
☐ Septic
Permit No. _____

11. WATER
☐ Municipal Utility
☐ Private On-Site Well

12. ENERGY SOURCE

Fuel	Nat. Gas	L. P.	Oil	Elec. *	Solid	Solar
Space Htg	☐	☐	☐	☐	☐	☐
Water Htg	☐	☐	☐	☐	☐	☐

* ☐ Dwelling unit will have 3 kilowatt or more installed electric space heating equip infiltration control option is: ☐ Full sealing of joints ☐ Blower door test ☐ Exterior air infiltration barrier.

13. HEAT LOSS (Calculated)
Envelope _____ BTU/HR
Infiltration _____ BTU/HR

14. EST. BUILDING COST
$

The applicant agrees to comply with all applicable codes, statutes and ordinances and with the conditions of this permit; understands that the issuance of the permit creates no legal liability, express or implied, on the Department or municipality; and certifies that all the above information is accurate.

APPLICANT'S SIGNATURE _____ **DATE SIGNED** _____

APPROVAL CONDITIONS This permit is issued pursuant to the following conditions. Failure to comply may result in suspension or revocation of this permit or other penalty.

ISSUING JURISDICTION ☐ Town ☐ Village ☐ City ☐ County ☐ State of: Municipality Number of Dwelling Location: ___ ___ - ___ ___ ___

FEES:		PERMIT(S) ISSUED	WIS. UNIFORM PERMIT SEAL NO.	PERMIT ISSUED BY:
Plan Review	$	☐ Construction		Name
Inspection	$	☐ HVAC		Date
Wis. Permit Seal	$	☐ Electrical		
Other	$	☐ Plumbing		Cert No.
Total	$	☐ Erosion		
		☐ _____		

SBD 5823 (R 06/94) WHITE - Issuing Jurisdiction YELLOW - DILHR GREEN - Inspector PINK - Owner/Agent

Wisconsin Department of Industry, Labor and Human Relations

WISCONSIN ADMINISTRATIVE BUILDING PERMIT APPLICATION

(Wis. Stats. 101.63 (7) & 101.65 (3))

Safety and Buildings Division

Submit to non-enforcing municipalities for new 1- and 2- family dwellings.
SEE INSTRUCTIONS ON BACK OF YELLOW COPY.
The information you provide may be used by other government agency programs [Privacy Law, s. 15.04 (1) (m)].

PERMIT APPLICANT

Last Name	First Name	Middle Initial

Street Address

City	State	Zip Code	Telephone No. (include area code)

PROJECT LOCATION

Building Address	Subdivision Name	Lot #	Block #

Legal Description
_____ 1/4, _____ 1/4, Section _____ T _____ N, R _____ E or W

Parcel No.

1. PROJECT TYPE

☐ 1 Family
☐ 2 Family

2. PROJECT HVAC EQUIPMENT

☐ Forced Air Furnace ☐ Radiant Baseboard or Panel (Elec.) ☐ Heat Pump
☐ Boiler ☐ Central AC ☐ Other:

3. PROJECT ENERGY SOURCE

	Nat. Gas	L.P.	Oil	Elect.	Solid	Solar
Space Heating	☐	☐	☐	☐	☐	☐
Water Heating	☐	☐	☐	☐	☐	☐

4. PROJECT CONSTRUCTION TYPE

☐ Site Constructed
☐ Manufactured

5. PROJECT FOUNDATION

☐ Concrete ☐ Masonry ☐ Treated Wood
☐ Other (specify):

6. PROJECT AREA

Living area = Square Feet

7. ESTIMATED PROJECT BUILDING COST

$

I present that all the above information is correct, and understand that the issuance of this permit is for administrative purposes only. Onsite construction inspections will not and shall not be performed by the municipality which has not assumed jurisdiction per s. 101.65, Wis. Stats. I understand the Uniform Dwelling Code, Chapters ILHR 20-25, still applies to all new 1- and 2-family dwellings and must be complied with. I realize the issuance of this permit does not relieve me of compliance with other applicable codes and ordinances.

Applicant's Signature _____ Date Signed _____

MUST BE COMPLETED BEFORE SUBMITTING TO DILHR:

ISSUING JURISDICTION:	☐ Town ☐ Village ☐ City ☐ County of:		
MUNICIPALITY NUMBER:	# ___ ___ - ___ ___ ___ Where Dwelling Located	**FEES:**	
PERMIT ISSUED BY:		**DATE ISSUED:**	

SBDB 8254 (R 09/94) White - Issuing Jurisdiction Pink - DILHR Within 30 Days Yellow - Applicant

Site Info

SUBDIVISION _____
LOT NO. _____ BLOCK NO. ____
ZONING DISTRICT _____
___¼, ___¼, SEC__, T__, N, R__ E or W
PARCEL NO. _____
SETBACKS:
FRONT _____ft REAR _____ ft
LEFT _____ft RIGHT _____ ft

Inspections

PHASE	RGH	FNL	EROSION
FOOTING			
FOUNDATION			
BSMT DRAIN TILES			
CONSTRUCTION			
PLUMBING			
HEAT/VENT/AC			
ELECTRICAL			
INSULATION			
OCCUPANCY			

Contractors

_____ # _____
G.C
_____ # _____
HVAC
_____ # _____
ELECT.
_____ # _____
PLBG
_____ # _____

SBD-5824(R 03/94)

Keep this card posted until final inspection has been made. Inspections shall be made 48 hrs. in advance. Work shall not proceed until the inspector has approved the various stages of construction or the 48 business hr. period since notification has elapsed. This permit will expire ___24 months after the date of issuance if the building's exterior has not been completed._____. (WI Stats. 101.63)

WISCONSIN UNIFORM BUILDING PERMIT#

_____

☐ const ☐ hvac ☐ elec ☐ plumb ☐ erosion

Project:

Issued to

OWNER (AGENT)
BUILDING SITE ADDRESS
CITY, VILLAGE TOWN, COUNTY

affix uniform permit seal here (when applicable) Seal No.
_____

Issued by

PERSON ISSUING | CERT. NO.
DATE ISSUED | TELEPHONE NUMBER

Comments: _____

NOTICE OF NONCOMPLIANCE: This issuing jurisdiction shall notify the applicant in writing of any violations to be corrected. All cited violations shall be corrected within 30 days after notification, unless extension of time is granted.

Wisconsin Department of Industry,
Labor and Human Relations

Safety and Buildings Division
201 E. Washington Ave.
P.O. Box 7969
Madison, WI 53707
Telephone: (608) 266-3151

Petition For Variance
Information & Instructions - ILHR 3

In instances where exact compliance with a particular code requirement cannot be met or alternative designs are desired, the Division has a petition for variance program where it reviews and considers acceptance of alternatives which are not in strict conformance with the letter of the code, but which meet the intent of the code. **A variance is not a waiver from a code requirement.** The petitioner must **provide an equivalency which meets the intent** of the code section petitioned to obtain a variance. Documentation of the rationale for the equivalency is requested below. Failure to provide adequate information may delay your petition. Pictures, sketches, and plans may be submitted to support equivalency. If the proposed equivalency does not adequately safeguard the health, safety, and welfare of occupants, frequenters, firefighters, etc., the variance will be denied. NOTE: A SEPARATE PETITION IS REQUIRED FOR EACH BUILDING AND EACH CODE ISSUE PETITIONED (i.e., a window size issue cannot be processed on the same petition as a stair width issue). It should be noted that **a petition for variance does not take the place of any required plan review submittal.**

The Division is unable to process petitions for variance that are not properly completed. Before submitting the application, the following items should be checked for completeness in order to avoid delays:

- Petitioner's name (typed or printed)
- Petitioner's signature

  The Petition For Variance Application must be signed by the owner of the building or project unless a power of attorney is submitted.
- Notary Public signature with affixed seal
- Analysis to establish equivalency, including any pictures, illustrations or sketches of the existing and proposed conditions to clearly convey your proposal to the reviewer.
- Proper fee
- Any required position statements by fire chief or municipal official

  A position statement from the chief of the local fire department is required for fire safety issues. **No position statement is required for** nonfire topics such as sanitary, energy conservation and barrier free environments. For rules relating to one and two-family dwellings, only a position statement from the local enforcing municipality is required. Position statements must be completed and signed by the appropriate fire chief or municipal official. See the back of SBD-9890, Petition For Variance Application form for these position statement forms. Signatures or seals on all documents must be originals. Photocopies are not acceptable.

SBD 9890 (R 05/94)

Contact numbers and fees for the Division's petition for variance program are as follows:

Chapters ILHR 20-25, Uniform Dwelling Code	(608) 267-5113	$125.00
Chapters ILHR 67-68, Rental Unit Energy Efficiency Code	(608) 266-1930	$125.00
Chapters ILHR 50-64, Commercial Building Code	(608) 267-9152	$490.00

- The cities of Milwaukee and Madison may process petitions for variances from chapters ILHR 50 through 64 requirements on projects in their jurisdiction.

Chapter ILHR 70, Historic Building Code (608) 266-7849	(608) 266-7849	$300.00
All other chapters		$200.00
Boilers and Pressure Vessels	(608) 266-7548	
Electrical	(608) 266-5649	
Elevators	(608) 267-9606	
Flammable Liquids	(608) 266-1542	

Priority Review: Does not apply to Uniform Dwelling Code or Historic Building Code issues which already are treated as a priority. ..... Double Above Amounts

Except for special cases, the Division will review and make a determination on a petition for variance within 30 business days of receipt of all calculations, documents, and fees required for the review. Uniform Dwelling Code petitions will be processed within 5 business days. Priority petitions will be processed within 10 business days.

Petitions for variance shall be submitted to:

DILHR Safety and Buildings
201 East Washington Avenue
P.O. Box 7969
Madison, Wisconsin 53707

General Plumbing or Private Sewage petitions must be submitted on a different form. For information or to acquire the form call the Madison office, (608) 266-3815, or any of the other full-service offices identified below.

Hayward Office	La Crosse Office	Shawano Office	Waukesha Office
209 W. First St. Hwy 63	2226 Rose St.	1053A E. Green Bay St.	401 Pilot Ct., Suite C
Route 8 Box 8072	La Crosse WI 54603	P.O. Box 434	Waukesha WI 53188
Hayward WI 54843		Shawano WI 54166	
Telephone: (715) 634-4870	Telephone: (608) 785-9334	Telephone: (715) 524-3626	Telephone: (414) 548-8606
Fax: (715) 634-5150	Fax: (608) 785-9330	Fax: (715) 524-3633	Fax: (414) 548-8614

Wisconsin Department of Industry, Labor and Human Relations

Safety & Buildings Division
201 E. Washington Ave.
P.O. Box 7969
Madison, WI 53707
Telephone: (608) 266-3151

Dept. Use Only
Plan No. _____
Amount Paid _____

Petition For Variance Application

Page 1 of _____

PLEASE TYPE OR PRINT CLEARLY - The information you provide may be used by other government agency programs [Privacy Law, s. 15.04(1)(m)].

1. Owner Information		2. Project Information	3. Designer Information	
Name		Building Occupancy Chapter(s) and Use	Designer	Registration #
Company Name		Tenant Name (if any)	Design Firm	
Number and Street		Project Location (number and street)	Number and Street	
City, State and Zip Code		☐ City ☐ Village ☐ Township of	City, State and Zip Code	
Contact Person		County of	Contact Person	
Telephone Number ( )	Fax Number ( )	Prop. ID # (tax parcel # - contact county)	Telephone Number ( )	Fax Number ( )

4. Plan Review Status

Review By: ☐ State ☐ Municipality

Plan Number _____

☐ On hold
☐ Preliminary design
☐ Approved, requesting revision
☐ Submitted with petition
☐ Already built
☐ Built according to older code but must be brought into compliance with current code
☐ Plan will be submitted after petition determination
☐ Other

5. State the code section being petitioned and the specific condition or issue you are requesting be covered under this petition for variance. _____

6. Reason why compliance with the code cannot be attained without the variance. _____

7. State your proposed means and rationale of providing equivalent degree of health, safety, or welfare as addressed by the code section petitioned. _____

8. List attachments to be considered as part of the petitioner's statements (i.e., model code sections, test reports, research articles, expert opinion, previously approved variances, pictures, plans, sketches, etc.)

Verification By Owner - Petition is valid only if notarized with affixed seal and accompanied by review fee (See Section ILHR 2.52 for complete fee information)

Note: Petitioner must be the owner of the building or project. Tenants, agents, designers, contractors, attorneys, etc., shall not sign petition unless Power of Attorney is submitted with the Petition for Variance Application.

_____ , being duly sworn, I state as petitioner that I have read the foregoing petition and I believe it is true and that I have significant ownership rights to the subject building or project.
Petitioner's Name (type or print)

Petitioner's Signature	Subscribed and sworn to before me this date	Notary Public	My commission expires on

Complete Other Side

SBD-9890 (R 05/94)

Owner's Name	Project Location	Plan Number

Fire Department Position Statement

Page 2 of _____

To be completed for variances requested from ILHR 50-64, ILHR 10, and other fire related requirements

I have read the petition for variance and recommend: (check appropriate box)

☐ Approval ☐ Conditional Approval ☐ Denial ☐ No Comment

Explanation for recommendation including any conflicts with local rules and regulations and suggested conditions:

Fire Department Name and Address

Fire Chief or Designee Name (type or print)	Telephone Number
Fire Chief or Designee Signature	Date Signed

Municipal Building Inspection Recommendation

To be completed for variances requested from ILHR 20-23, also to be used if ILHR 50-64 plan review is by municipality or orders are written on the building under construction; optional in other cases.

I have read the petition for variance and recommend: (check appropriate box)

☐ Approval ☐ Conditional Approval ☐ Denial ☐ No Comment

Explanation for recommendation including any conflicts with local rules and regulations and suggested conditions:

Municipality Exercising Jurisdiction

Municipal Official 's Name and Address (type or print)	Telephone Number
Municipal Enforcement Official's Signature	Date Signed

ILHR 20-25 Appendix

FASTENER SCHEDULE TABLE

Description of Building Materials/Connection	Number and Type of Fastener [1 2 3 4]
Joist to sill or girder, toe nail	2-16d, 3-8d
Bridging to joist, toe nail each end	2-8d
1" x 6" subfloor or less to each joist, face nail	2-8d or 2 staples, 1¾"
Wider than 1" x 6" subfloor to each joist, face nail	3-8d or 4 staples, 1¾"
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 or sole plate to stud, end nail	2-16d
Stud to sole plate, toe nail	4-8d or 3-16d
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	2-16d, 3-8d
Continuous header to stud, toe nail	4-8d
Ceiling joist, laps over partitions, face nail	3-16d
Ceiling joist to parallel rafters, face nail	3-16d
Rafter to plate, toe nail	2-16d, 3-8d
1" brace to each stud and plate, face nail	2-8d or 2 staples, 1¾"
1" x 6" sheathing to each bearing, face nail	2-8d or 2 staples, 1¾"
1" x 8" sheathing to each bearing, face nail	2-8d or 3 staples, 1¾"
Wider than 1" x 8" sheathing to each bearing, face nail	3-8d or 4 staples, 1¾"
Built-up corner studs	16d at 30" o.c., 16d at 24"o.c.
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-inch planks	2-16d at each bearing
Roof rafters to ridge, valley or hip rafters, toe nail	4-16d
Roof rafters to ridge, valley or hip rafters, face nail	3-16d
Collar ties to rafters, face nail	3-8d
Plywood subfloor, roof and wall sheathing (to framing) [6]	
½-inch to 5/16-inch	6d[5] or staple
⅜-inch to ½-inch	8d smooth or common, 6d deformed, or staple
⅝-inch to 1-inch	8d[5]
1⅛-inch to 1¼-inch	10d smooth or common, or 8d deformed
Fiberboard sheathing[7]	
½-inch	6d common or staple, 1½" long or roofing nail[11]
25/32-inch	8d common or staple, 1½" long or roofing nail[11]
Gypsum sheathing, ½"[8]	1½ galvanized roofing nail, or 6d common, or staple
Particleboard wall sheathing (to framing)[6]	
⅜-inch to ½-inch	6d common
⅝-inch to ¾-inch	8d common or staple
Insulated sheathing	11-gauge roofing nails, 6d, 8d, or staple
Combination subfloor underlayment (to framing)[6]	
¾-inch and less	6d deformed
⅞-inch to 1-inch	8d deformed
1⅛-inch to 1¼-inch	10d smooth[9] or common or 8d deformed[9]
Panel siding (to framing)[10]	
½-inch or less	6d
⅝-inch	8d

[1]All nails are smooth-common, box or deformed shank except where otherwise stated.

[2]Nail is a general description and may be T-head, modified round head or round head.

[3]Staples are 16-gauge wire and have a minimum 7/16-inch o.d. crown width.

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

[5]Common or deformed shank.

[6]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.

[7]Nails spaced at 3 inches on center at edges, 6 inches at intermediate supports.

[8]Nails spaced at 4 inches on center at edges, 8 inches at intermediate supports.

[9]Nails spaced at 6 inches on center at edges and at intermediate supports.

[10]Corrosion-resistant siding and casing nails.

[11]Galvanized roofing nails with 7/16-inch diameter head and 1½-inch length for ½-inch sheathing and 1¾-inch for 25/32-inch sheathing.

APPENDIX A
COMMENTARY

A.1 Floor Joists

A.1.1 Floor Joists with L/360 Deflection Limitations

Tables F-1 through F-7 list spans for floor joists, used over a single span, with calculations based on modulus of elasticity, E, and the required bending design values, F_b, shown. Floor joist spans are determined based on a deflection limitation of L/360, where L is the span in inches. The deflection equation for a simple span beam with uniformly distributed load is:

$$\Delta_{max} = \frac{5wL^4}{384EI} \qquad \text{[Eq. A.1-1]}$$

Since $\Delta_{max} \leq L/360$ this equation can be rewritten to solve for L as follows:

$$L = \sqrt[3]{\frac{384EI}{5w\,(360)}} \qquad \text{[Eq. A.1-2]}$$

The uniform load, w, is based on the live load and joist spacing. The moment of inertia, I, is based on the joist size.

The required bending design value, F_b, is determined based on the calculated span. Note that the maximum moment, M_{max}, of a single span beam with uniform load is calculated as:

$$M_{max} = \frac{wL^2}{8} \qquad \text{[Eq. A.1-3]}$$

where the uniform load, w, is based on the total dead plus live load and joist spacing. The actual bending stress in a beam is calculated as $f_b = M/S$ where S is the section modulus of the joist. The allowable bending design value, F_b, is based on a fully supported member, properly sheathed and nailed on the top edge of the joist. Since the actual stress must be less than the allowable bending design value, F_b, the allowable bending design value can be calculated as:

$$F_b = \frac{wL^2}{8\,S} \qquad \text{[Eq. A.1-4]}$$

A.1.2 Floor Joists with L/480 or L/600 Deflection Limitations

Most codes require a minimum deflection limitation of L/360 for floor joists. In cases where a stricter deflection limit is desired, and the length shown is controlled by the L/360 deflection limit, the tabulated span lengths may be adjusted by the factors shown as follows:

Deflection Limit	Adjustment Factor
L/480	0.91
L/600	0.84

A.2 Ceiling Joists

Tables C-1 and C-2 list spans for ceiling joists used over a single span with calculations based on E and the required F_b values shown. The spans and required bending design values are determined from the same equations for a single span, uniformly

loaded beam as shown above for single span floor joists. The only difference in design criteria is L/240 deflection limitations for ceiling joists supporting drywall ceilings which are typically required by building codes. The allowable bending design value, F_b, is based on a fully supported member, properly sheathed and nailed on one edge of the joist.

A.3 Rafters

A.3.1 Rafters with L/240 Deflection Limitations

Tables R-1 through R-12 list spans for rafters with deflection limitations of L/240, used over a single span with calculations based on F_b values and the required E values shown. The allowable bending design value, F_b, is based on a fully supported member, properly sheathed and nailed on the top edge of the rafter. Generally, a deflection limitation of L/240 applies to rafters with a drywall ceiling attached to the underside (e.g., cathedral ceilings).

The maximum moment for a single span beam with a uniform load is defined above. This equation can be rewritten to solve for L as follows:

$$L = \sqrt{\frac{8 F_b S}{w}} \qquad \text{[Eq. A.3.1-1]}$$

The uniform load, w, is based on the total dead plus live load and joist spacing.

The required modulus of elasticity, E, is determined based on this calculated span as follows:

$$E = \frac{5wL^3(240)}{384 I} \qquad \text{[Eq. A.3.1-2]}$$

The uniform load, w, is based on the live load and joist spacing.

A.3.2 Rafters with L/180 Deflection Limitations

Tables R-13 through R-24 list spans for rafters with deflection limitations of L/180, used over a single span with calculations based on F_b values and the required E values shown. Calculations for span and required modulus of elasticity are the same as those for single span beams with deflection limitations of L/240, except that 180 is substituted for 240 in the numerator of Equation A.3.1-2. Generally, a deflection limitation of L/180 applies to rafters without a drywall ceiling attached to the underside. Some governing building codes also consider the slope of the rafter in determining deflection limitations, and only allow L/180 deflection limitations for rafters with slopes greater than 3 in 12 and no ceiling attached.

A.3.3 Roof Loads

Section 6 outlines adjustment factors for determining rafter spans and required E values for roof live loads of 12 psf or 16 psf. The tabulated spans are modified by the square root of the ratio of the total uniform load at 20 psf and the total uniform load at the reduced level (12 or 16 psf). This is based on Equation A.3.1-1 which is used to calculate the span of a rafter based on the square root of the total uniform load.

The E values are adjusted based on the modified span as noted above and the uniform live load ratio. Based on Equation A.3.1-2:

$$\frac{E_2}{E_1} = \left(\frac{w_2}{w_1}\right)\left(\frac{L_2}{L_1}\right)^3 \qquad \text{[Eq. A.3.3-1]}$$

$$= \left(\frac{LL_2}{LL_1}\right)\left(\frac{LL_1+DL_1}{LL_2+DL_2}\right)^{3/2} \qquad \text{[Eq. A.3.3-2]}$$

where subscript 1 denotes variables associated with the 20 psf uniform live load and subscript 2 denotes variables associated with the uniform live load at the reduced level. LL is the uniform live load and DL is the uniform dead load. All other variables are as previously defined in A.3.

A.4 Compression Perpendicular to Grain Design Requirements

Compression perpendicular to grain is also a design consideration for joists and rafters. Required compression perpendicular to grain design values

are tabulated in Table 9.1. These values are calculated assuming a bearing width of 1.5", a total load of 66.67 plf, and the calculated span. The 66.67 plf total load is based on a 40 psf live load and 10 psf dead load on joists at 16" on center, which is a typical condition of use. Alternate $F_{c\perp}$ values are possible by adjusting the tabulated values in direct proportion to the desired load. Adjustment factors for various loads and spacings are tabulated in Table 9.2 for convenience. Required compression design values perpendicular to grain are also applicable to bearing plates.

A.5 Lumber Design Values

The spans for nominal 2x5 joists or rafters are 82 percent of the spans tabulated for the same spacing of nominal 2x6 joists or rafters. For each joist or rafter spacing, the values of E for 2x5's are the same as the tabulated E values for 2x6's. The values of F_b for 2x5's shall be determined by multiplying the tabulated F_b values for 2x6's by 1.077.

A.6 Load Requirements

Applicable design criteria for each condition of use appear at the top of each table. While these criteria are directed principally to residential construction they are suitable for other occupancies having similar conditions of loading. Examples include, but are not limited to, assembly areas with fixed seats, cornices, fire escapes for single family residential buildings, cell blocks of penal institutions, multiple family dwelling units and hotel guest rooms. Check governing building code requirements for other applicable occupancies. Tabulated spans for rafters also apply to other types of occupancy, since the occupancy has little bearing on roof loading.

A.7 Support Requirements

Adequate support shall be provided for all joists and rafters. Ridge beams shall be installed at roof peaks, and rafters shall bear directly on the ridge beam or be supported by hangers or framing anchors. Ceiling joists shall not be required when properly designed ridge beams are used.

A ridge board shall be permitted to be substituted for a ridge beam when the roof slope equals or exceeds 3 in 12, except that ridge beams shall be required for cathedral ceilings. Ridge boards shall be at least 1 inch nominal in thickness and not less than the depth of the cut end of the rafter. Rafters shall be placed directly opposite each other, and ceiling joists shall be installed parallel with rafters to provide a continuous tie between exterior walls.

A.8 Repetitive Member Use

Repetitive member use is that condition where framing members such as joists, rafters, studs, planks, decking or similar members are in contact or spaced not more than 24 inches on-center, are not less than 3 in number and are joined by floor, roof or other load-distributing elements adequate to support the design load. Bending design values (F_b) for such use are 15 percent greater than for single-member use. Table W-1 of *Design Values for Joists and Rafters*, a supplement to these tables, provide bending design values for repetitive member use of joists and rafters.

A.9 Load Duration

For joists and rafters, bending design values (F_b) are adjusted for load duration by the following factors:

1.00 for 10 years (normal) duration, as for occupancy live load,

1.15 for 2 months duration, as for snow,

1.25 for 7 days duration, as for construction loading.

FLOOR JOISTS WITH L/360 DEFLECTION LIMITATIONS

Table No.	Live Load (psf)	Dead[1] Load (psf)	Material or Occupancy
F-2	40	10	Decks and all rooms except those used for sleeping areas and attic floors

1. Dead load includes the weight of the framing members

CEILING JOISTS WITH L/240 DEFLECTION LIMITATIONS

Table No.	Live Load (psf)	Dead[1] Load (psf)	Material or Occupancy
C-1	10	5	Drywall ceiling attached no attic storage
C-2	20	10	Drywall ceiling attached, limited attic storage where development of future rooms is not possible

1. Dead load includes the weight of the framing members

RAFTERS WITH L/240 DEFLECTION LIMITATIONS
(Drywall ceiling attached to underside of rafter)

Table No.	Live Load (psf)	Dead[1] Load (psf)	Material or Occupancy
R-2	30	10	Light roof (up to 2 courses of asphalt shingles, or wood shakes/shingles)
R-3	40	10	Light roof (up to 2 courses of asphalt shingles, or wood shakes/shingles)
R-10	30	20	Heavy roof covering (3" clay book tile)
R-11	40	20	Heavy roof covering (3" clay book tile)

1. Dead load includes the weight of the framing members

RAFTERS WITH L/180 DEFLECTION LIMITATIONS
(No drywall ceiling attached to underside of rafter)

Table No.	Live Load (psf)	Dead[1] Load (psf)	Material or Occupancy
R-14	30	10	Light roof (up to 2 courses of asphalt shingles, or wood shakes/shingles)
R-15	40	10	Light roof (up to 2 courses of asphalt shingles, or wood shakes/shingles)
R-22	30	20	Heavy roof covering (3" clay book tile)
R-23	40	20	Heavy roof covering (3" clay book tile)

1. Dead load includes the weight of the framing members

TABLE F-2
FLOOR JOISTS WITH L/360 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection - For 40 psf live load.
Limited to span in inches divided by 360.
Strength - Live load of 40 psf plus dead load
of 10 psf determines the required bending design value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
2x 6	12.0	8-6	8-10	9-2	9-6	9-9	10-0	10-3	10-6	10-9	10-11	11-2	11-4	11-7	11-9	11-11	12-1	12-3
	16.0	7-9	8-0	8-4	8-7	8-10	9-1	9-4	9-6	9-9	9-11	10-2	10-4	10-6	10-8	10-10	11-0	11-2
	19.2	7-3	7-7	7-10	8-1	8-4	8-7	8-9	9-0	9-2	9-4	9-6	9-8	9-10	10-0	10-2	10-4	10-6
	24.0	6-9	7-0	7-3	7-6	7-9	7-11	8-2	8-4	8-6	8-8	8-10	9-0	9-2	9-4	9-6	9-7	9-9
2x 8	12.0	11-3	11-8	12-1	12-6	12-10	13-2	13-6	13-10	14-2	14-5	14-8	15-0	15-3	15-6	15-9	15-11	16-2
	16.0	10-2	10-7	11-0	11-4	11-8	12-0	12-3	12-7	12-10	13-1	13-4	13-7	13-10	14-1	14-3	14-6	14-8
	19.2	9-7	10-0	10-4	10-8	11-0	11-3	11-7	11-10	12-1	12-4	12-7	12-10	13-0	13-3	13-5	13-8	13-10
	24.0	8-11	9-3	9-7	9-11	10-2	10-6	10-9	11-0	11-3	11-5	11-8	11-11	12-1	12-3	12-6	12-8	12-10
2x10	12.0	14-4	14-11	15-5	15-11	16-5	16-10	17-3	17-8	18-0	18-5	18-9	19-1	19-5	19-9	20-1	20-4	20-8
	16.0	13-0	13-6	14-0	14-6	14-11	15-3	15-8	16-0	16-5	16-9	17-0	17-4	17-8	17-11	18-3	18-6	18-9
	19.2	12-3	12-9	13-2	13-7	14-0	14-5	14-9	15-1	15-5	15-9	16-0	16-4	16-7	16-11	17-2	17-5	17-8
	24.0	11-4	11-10	12-3	12-8	13-0	13-4	13-8	14-0	14-4	14-7	14-11	15-2	15-5	15-8	15-11	16-2	16-5
2x12	12.0	17-5	18-1	18-9	19-4	19-11	20-6	21-0	21-6	21-11	22-5	22-10	23-3	23-7	24-0	24-5	24-9	25-1
	16.0	15-10	16-5	17-0	17-7	18-1	18-7	19-1	19-6	19-11	20-4	20-9	21-1	21-6	21-10	22-2	22-6	22-10
	19.2	14-11	15-6	16-0	16-7	17-0	17-6	17-11	18-4	18-9	19-2	19-6	19-10	20-2	20-6	20-10	21-2	21-6
	24.0	13-10	14-4	14-11	15-4	15-10	16-3	16-8	17-0	17-5	17-9	18-1	18-5	18-9	19-1	19-4	19-8	19-11
F_b	12.0	718	777	833	888	941	993	1043	1092	1140	1187	1233	1278	1323	1367	1410	1452	1494
F_b	16.0	790	855	917	977	1036	1093	1148	1202	1255	1306	1357	1407	1456	1504	1551	1598	1644
F_b	19.2	840	909	975	1039	1101	1161	1220	1277	1333	1388	1442	1495	1547	1598	1649	1698	1747
F_b	24.0	905	979	1050	1119	1186	1251	1314	1376	1436	1496	1554	1611	1667	1722	1776	1829	1882

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

TABLE C-1
CEILING JOISTS WITH L/240 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection - For 10 psf live load.
Limited to span in inches divided by 240.
Strength - Live Load of 10 psf plus
dead load of 5 psf determines the required fiber stress value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
2x 4	12.0	9-10	10- 3	10- 7	10-11	11- 3	11- 7	11-10	12- 2	12- 5	12- 8	12-11	13- 2	13- 4	13- 7	13- 9	14- 0	14- 2
	16.0	8-11	9- 4	9- 8	9-11	10- 3	10- 6	10- 9	11- 0	11- 3	11- 6	11- 9	11-11	12- 2	12- 4	12- 6	12- 9	12-11
	19.2	8- 5	8- 9	9- 1	9- 4	9- 8	9-11	10- 2	10- 4	10- 7	10-10	11- 0	11- 3	11- 5	11- 7	11- 9	12- 0	12- 2
	24.0	7-10	8- 1	8- 5	8- 8	8-11	9- 2	9- 5	9- 8	9-10	10- 0	10- 3	10- 5	10- 7	10- 9	10-11	11- 1	11- 3
2x 6	12.0	15- 6	16- 1	16- 8	17- 2	17- 8	18- 2	18- 8	19- 1	19- 6	19-11	20- 3	20- 8	21- 0	21- 4	21- 8	22- 0	22- 4
	16.0	14- 1	14- 7	15- 2	15- 7	16- 1	16- 6	16-11	17- 4	17- 8	18- 1	18- 5	18- 9	19- 1	19- 5	19- 8	20- 0	20- 3
	19.2	13- 3	13- 9	14- 3	14- 8	15- 2	15- 7	15-11	16- 4	16- 8	17- 0	17- 4	17- 8	17-11	18- 3	18- 6	18-10	19- 1
	24.0	12- 3	12- 9	13- 3	13- 8	14- 1	14- 5	14- 9	15- 2	15- 6	15- 9	16- 1	16- 4	16- 8	16-11	17- 2	17- 5	17- 8
2x 8	12.0	20- 5	21- 2	21-11	22- 8	23- 4	24- 0	24- 7	25- 2	25- 8								
	16.0	18- 6	19- 3	19-11	20- 7	21- 2	21- 9	22- 4	22-10	23- 4	23-10	24- 3	24- 8	25- 2	25- 7	25-11		
	19.2	17- 5	18- 1	18- 9	19- 5	19-11	20- 6	21- 0	21- 6	21-11	22- 5	22-10	23- 3	23- 8	24- 0	24- 5	24- 9	25- 2
	24.0	16- 2	16-10	17- 5	18- 0	18- 6	19- 0	19- 6	19-11	20- 5	20-10	21- 2	21- 7	21-11	22- 4	22- 8	23- 0	23- 4
2x10	12.0	26- 0																
	16.0	23- 8	24- 7	25- 5														
	19.2	22- 3	23- 1	23-11	24- 9	25- 5												
	24.0	20- 8	21- 6	22- 3	22-11	23- 8	24- 3	24-10	25- 5	26- 0								
F_b	12.0	711	769	825	880	932	983	1033	1082	1129	1176	1221	1266	1310	1354	1396	1438	1480
F_b	16.0	783	847	909	968	1026	1082	1137	1191	1243	1294	1344	1394	1442	1490	1537	1583	1629
F_b	19.2	832	900	965	1029	1090	1150	1208	1265	1321	1375	1429	1481	1533	1583	1633	1682	1731
F_b	24.0	896	969	1040	1108	1174	1239	1302	1363	1423	1481	1539	1595	1651	1706	1759	1812	1864

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

TABLE C-2
CEILING JOISTS WITH L/240 DEFLECTION LIMITS

DESIGN CRITERIA:
Deflection - For 20 psf live load.
Limited to span in inches divided by 240.
Strength - Live Load of 20 psf plus
dead load of 10 psf determines the required bending design value.

Joist Size (in)	Spacing (in)	Modulus of Elasticity, E, in 1,000,000 psi																
		0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9	2.0	2.1	2.2	2.3	2.4
2x 4	12.0	7-10	8- 1	8- 5	8- 8	8-11	9- 2	9- 5	9- 8	9-10	10- 0	10- 3	10- 5	10- 7	10- 9	10-11	11- 1	11- 3
	16.0	7- 1	7- 5	7- 8	7-11	8- 1	8- 4	8- 7	8- 9	8-11	9- 1	9- 4	9- 6	9- 8	9- 9	9-11	10- 1	10- 3
	19.2	6- 8	6-11	7- 2	7- 5	7- 8	7-10	8- 1	8- 3	8- 5	8- 7	8- 9	8-11	9- 1	9- 3	9- 4	9- 6	9- 8
	24.0	6- 2	6- 5	6- 8	6-11	7- 1	7- 3	7- 6	7- 8	7-10	8- 0	8- 1	8- 3	8- 5	8- 7	8- 8	8-10	8-11
2x 6	12.0	12- 3	12- 9	13- 3	13- 8	14- 1	14- 5	14- 9	15- 2	15- 6	15- 9	16- 1	16- 4	16- 8	16-11	17- 2	17- 5	17- 8
	16.0	11- 2	11- 7	12- 0	12- 5	12- 9	13- 1	13- 5	13- 9	14- 1	14- 4	14- 7	14-11	15- 2	15- 5	15- 7	15-10	16- 1
	19.2	10- 6	10-11	11- 4	11- 8	12- 0	12- 4	12- 8	12-11	13- 3	13- 6	13- 9	14- 0	14- 3	14- 6	14- 8	14-11	15- 2
	24.0	9- 9	10- 2	10- 6	10-10	11- 2	11- 5	11- 9	12- 0	12- 3	12- 6	12- 9	13- 0	13- 3	13- 5	13- 8	13-10	14- 1
2x 8	12.0	16- 2	16-10	17- 5	18- 0	18- 6	19- 0	19- 6	19-11	20- 5	20-10	21- 2	21- 7	21-11	22- 4	22- 8	23- 0	23- 4
	16.0	14- 8	15- 3	15-10	16- 4	16-10	17- 3	17- 9	18- 1	18- 6	18-11	19- 3	19- 7	19-11	20- 3	20- 7	20-11	21- 2
	19.2	13-10	14- 5	14-11	15- 5	15-10	16- 3	16- 8	17- 1	17- 5	17- 9	18- 1	18- 5	18- 9	19- 1	19- 5	19- 8	19-11
	24.0	12-10	13- 4	13-10	14- 3	14- 8	15- 1	15- 6	15-10	16- 2	16- 6	16-10	17- 2	17- 5	17- 9	18- 0	18- 3	18- 6
2x10	12.0	20- 8	21- 6	22- 3	22-11	23- 8	24- 3	24-10	25- 5	26- 0								
	16.0	18- 9	19- 6	20- 2	20-10	21- 6	22- 1	22- 7	23- 1	23- 8	24- 1	24- 7	25- 0	25- 5	25-10			
	19.2	17- 8	18- 4	19- 0	19- 7	20- 2	20- 9	21- 3	21- 9	22- 3	22- 8	23- 1	23- 7	23-11	24- 4	24- 9	25- 1	25- 5
	24.0	16- 5	17- 0	17- 8	18- 3	18- 9	19- 3	19- 9	20- 2	20- 8	21- 1	21- 6	21-10	22- 3	22- 7	22-11	23- 4	23- 8
F_b	12.0	896	969	1040	1108	1174	1239	1302	1363	1423	1481	1539	1595	1651	1706	1759	1812	1864
F_b	16.0	986	1067	1145	1220	1293	1364	1433	1500	1566	1631	1694	1756	1817	1877	1936	1995	2052
F_b	19.2	1048	1134	1216	1296	1374	1449	1522	1594	1664	1733	1800	1866	1931	1995	2058	2120	2181
F_b	24.0	1129	1221	1310	1396	1480	1561	1640	1717	1793	1866	1939	2010	2080	2149	2217	2283	2349

Note: The required bending design value, F_b, in pounds per square inch is shown at the bottom of each table and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less.Check sources of supply for availability of lumber in lengths greater than 20'.

TABLE R-2
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength - Live Load of 30 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection - For 30 psf live load.
Limited to span in inches divided by 240.

Rafter Size (in)	Spacing (in)	Bending Design Value, F_b, (psi)																					
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
	12.0	6-2	7-1	7-11	8-8	9-5	10-0	10-8	11-3	11-9	12-4	12-10	13-3	13-9	14-2	14-8	15-1	15-6	15-11				
	16.0	5-4	6-2	6-10	7-6	8-2	8-8	9-3	9-9	10-2	10-8	11-1	11-6	11-11	12-4	12-8	13-1	13-5	13-9	14-1	14-5		
2x 6	19.2	4-10	5-7	6-3	6-10	7-5	7-11	8-5	8-11	9-4	9-9	10-1	10-6	10-10	11-3	11-7	11-11	12-3	12-7	12-10	13-2	13-6	
	24.0	4-4	5-0	5-7	6-2	6-8	7-1	7-6	7-11	8-4	8-8	9-1	9-5	9-9	10-0	10-4	10-8	10-11	11-3	11-6	11-9	12-0	12-4
	12.0	8-1	9-4	10-6	11-6	12-5	13-3	14-0	14-10	15-6	16-3	16-10	17-6	18-1	18-9	19-4	19-10	20-5	20-11				
	16.0	7-0	8-1	9-1	9-11	10-9	11-6	12-2	12-10	13-5	14-0	14-7	15-2	15-8	16-3	16-9	17-2	17-8	18-1	18-7	19-0		
2x 8	19.2	6-5	7-5	8-3	9-1	9-9	10-6	11-1	11-8	12-3	12-10	13-4	13-10	14-4	14-10	15-3	15-8	16-2	16-7	16-11	17-4	17-9	
	24.0	5-9	6-7	7-5	8-1	8-9	9-4	9-11	10-6	11-0	11-6	11-11	12-5	12-10	13-3	13-8	14-0	14-5	14-10	15-2	15-6	15-10	16-3
	12.0	10-4	11-11	13-4	14-8	15-10	16-11	17-11	18-11	19-10	20-8	21-6	22-4	23-1	23-11	24-7	25-4	26-0					
	16.0	8-11	10-4	11-7	12-8	13-8	14-8	15-6	16-4	17-2	17-11	18-8	19-4	20-0	20-8	21-4	21-11	22-6	23-1	23-8	24-3		
2x10	19.2	8-2	9-5	10-7	11-7	12-6	13-4	14-2	14-11	15-8	16-4	17-0	17-8	18-3	18-11	19-6	20-0	20-7	21-1	21-8	22-2	22-8	
	24.0	7-4	8-5	9-5	10-4	11-2	11-11	12-8	13-4	14-0	14-8	15-3	15-10	16-4	16-11	17-5	17-11	18-5	18-11	19-4	19-10	20-3	20-8
	12.0	12-7	14-6	16-3	17-9	19-3	20-6	21-9	23-0	24-1	25-2												
	16.0	10-11	12-7	14-1	15-5	16-8	17-9	18-10	19-11	20-10	21-9	22-8	23-6	24-4	25-2	25-11							
2x12	19.2	9-11	11-6	12-10	14-1	15-2	16-3	17-3	18-2	19-0	19-11	20-8	21-6	22-3	23-0	23-8	24-4	25-0	25-8				
	24.0	8-11	10-3	11-6	12-7	13-7	14-6	15-5	16-3	17-0	17-9	18-6	19-3	19-11	20-6	21-2	21-9	22-5	23-0	23-6	24-1	24-8	25-2
E	12.0	0.15	0.23	0.32	0.43	0.54	0.66	0.78	0.92	1.06	1.21	1.36	1.52	1.69	1.86	2.04	2.22	2.41	2.60				
E	16.0	0.13	0.20	0.28	0.37	0.47	0.57	0.68	0.80	0.92	1.05	1.18	1.32	1.46	1.61	1.76	1.92	2.08	2.25	2.42	2.60		
E	19.2	0.12	0.18	0.26	0.34	0.43	0.52	0.62	0.73	0.84	0.95	1.08	1.20	1.33	1.47	1.61	1.75	1.90	2.05	2.21	2.37	2.53	
E	24.0	0.11	0.16	0.23	0.30	0.38	0.46	0.55	0.65	0.75	0.85	0.96	1.08	1.19	1.31	1.44	1.57	1.70	1.84	1.98	2.12	2.27	2.41

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

TABLE R-3
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength - Live Load of 40 psf plus
Dead Load of 10 psf determines the required bending design value.
Deflection - For 40 psf live load.
Limited to span in inches divided by 240.

Rafter Size (in)	Spacing (in)	Bending Design Value, F_b, (psi)																					
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400
2x 6	12.0	5- 6	6- 4	7- 1	7- 9	8- 5	9- 0	9- 6	10- 0	10- 6	11- 0	11- 5	11-11	12- 4	12- 8	13- 1	13- 6	13-10	14- 2				
	16.0	4- 9	5- 6	6- 2	6- 9	7- 3	7- 9	8- 3	8- 8	9- 1	9- 6	9-11	10- 3	10- 8	11- 0	11- 4	11- 8	12- 0	12- 4	12- 7	12-11		
	19.2	4- 4	5- 0	5- 7	6- 2	6- 8	7- 1	7- 6	7-11	8- 4	8- 8	9- 1	9- 5	9- 9	10- 0	10- 4	10- 8	10-11	11- 3	11- 6	11- 9	12- 0	12- 4
	24.0	3-11	4- 6	5- 0	5- 6	5-11	6- 4	6- 9	7- 1	7- 5	7- 9	8- 1	8- 5	8- 8	9- 0	9- 3	9- 6	9- 9	10- 0	10- 3	10- 6	10- 9	11- 0
2x 8	12.0	7- 3	8- 4	9- 4	10- 3	11- 1	11-10	12- 7	13- 3	13-11	14- 6	15- 1	15- 8	16- 3	16- 9	17- 3	17- 9	18- 3	18- 9				
	16.0	6- 3	7- 3	8- 1	8-11	9- 7	10- 3	10-10	11- 6	12- 0	12- 7	13- 1	13- 7	14- 0	14- 6	14-11	15- 5	15-10	16- 3	16- 7	17- 0		
	19.2	5- 9	6- 7	7- 5	8- 1	8- 9	9- 4	9-11	10- 6	11- 0	11- 6	11-11	12- 5	12-10	13- 3	13- 8	14- 0	14- 5	14-10	15- 2	15- 6	15-10	16- 3
	24.0	5- 2	5-11	6- 7	7- 3	7-10	8- 4	8-11	9- 4	9-10	10- 3	10- 8	11- 1	11- 6	11-10	12- 2	12- 7	12-11	13- 3	13- 7	13-11	14- 2	14- 6
2x10	12.0	9- 3	10- 8	11-11	13- 1	14- 2	15- 1	16- 0	16-11	17- 9	18- 6	19- 3	20- 0	20- 8	21- 4	22- 0	22- 8	23- 3	23-11				
	16.0	8- 0	9- 3	10- 4	11- 4	12- 3	13- 1	13-10	14- 8	15- 4	16- 0	16- 8	17- 4	17-11	18- 6	19- 1	19- 7	20- 2	20- 8	21- 2	21- 8		
	19.2	7- 4	8- 5	9- 5	10- 4	11- 2	11-11	12- 8	13- 4	14- 0	14- 8	15- 3	15-10	16- 4	16-11	17- 5	17-11	18- 5	18-11	19- 4	19-10	20- 3	20- 8
	24.0	6- 6	7- 7	8- 5	9- 3	10- 0	10- 8	11- 4	11-11	12- 6	13- 1	13- 7	14- 2	14- 8	15- 1	15- 7	16- 0	16- 6	16-11	17- 4	17- 9	18- 1	18- 6
2x12	12.0	11- 3	13- 0	14- 6	15-11	17- 2	18- 4	19- 6	20- 6	21- 7	22- 6	23- 5	24- 4	25- 2	26- 0								
	16.0	9- 9	11- 3	12- 7	13- 9	14-11	15-11	16-10	17- 9	18- 8	19- 6	20- 3	21- 1	21- 9	22- 6	23- 2	23-10	24- 6	25- 2	25- 9			
	19.2	8-11	10- 3	11- 6	12- 7	13- 7	14- 6	15- 5	16- 3	17- 0	17- 9	18- 6	19- 3	19-11	20- 6	21- 2	21- 9	22- 5	23- 0	23- 6	24- 1	24- 8	25- 2
	24.0	7-11	9- 2	10- 3	11- 3	12- 2	13- 0	13- 9	14- 6	15- 3	15-11	16- 7	17- 2	17- 9	18- 4	18-11	19- 6	20- 0	20- 6	21- 1	21- 7	22- 0	22- 6
E	12.0	0.14	0.22	0.31	0.41	0.51	0.63	0.75	0.88	1.01	1.15	1.30	1.45	1.61	1.77	1.94	2.12	2.30	2.48				
E	16.0	0.12	0.19	0.27	0.35	0.44	0.54	0.65	0.76	0.88	1.00	1.12	1.26	1.39	1.54	1.68	1.83	1.99	2.15	2.31	2.48		
E	19.2	0.11	0.18	0.24	0.32	0.41	0.50	0.59	0.69	0.80	0.91	1.03	1.15	1.27	1.40	1.54	1.67	1.81	1.96	2.11	2.26	2.42	2.58
E	24.0	0.10	0.16	0.22	0.29	0.36	0.44	0.53	0.62	0.71	0.81	0.92	1.03	1.14	1.25	1.37	1.50	1.62	1.75	1.89	2.02	2.16	2.30

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.

TABLE R-10
RAFTERS WITH L/240 DEFLECTION LIMITATION

DESIGN CRITERIA:
Strength - Live Load of 30 psf plus
Dead Load of 20 psf determines the required bending design value.
Deflection - For 30 psf live load.
Limited to span in inches divided by 240.

Rafter Size (in)	Spacing (in)	Bending Design Value, F_b, (psi)																								
		300	400	500	600	700	800	900	1000	1100	1200	1300	1400	1500	1600	1700	1800	1900	2000	2100	2200	2300	2400	2500	2600	2700
2x 6	12.0	5- 6	6- 4	7- 1	7- 9	8- 5	9- 0	9- 6	10- 0	10- 6	11- 0	11- 5	11-11	12- 4	12- 8	13- 1	13- 6	13-10	14- 2	14- 7	14-11	15- 3	15- 7	15-11		
	16.0	4- 9	5- 6	6- 2	6- 9	7- 3	7- 9	8- 3	8- 8	9- 1	9- 6	9-11	10- 3	10- 8	11- 0	11- 4	11- 8	12- 0	12- 4	12- 7	12-11	13- 2	13- 6	13- 9	14- 0	14- 3
	19.2	4- 4	5- 0	5- 7	6- 2	6- 8	7- 1	7- 6	7-11	8- 4	8- 8	9- 1	9- 5	9- 9	10- 0	10- 4	10- 8	10-11	11- 3	11- 6	11- 9	12- 0	12- 4	12- 7	12-10	13- 1
	24.0	3-11	4- 6	5- 0	5- 6	5-11	6- 4	6- 9	7- 1	7- 5	7- 9	8- 1	8- 5	8- 8	9- 0	9- 3	9- 6	9- 9	10- 0	10- 3	10- 6	10- 9	11- 0	11- 3	11- 5	11- 8
2x 8	12.0	7- 3	8- 4	9- 4	10- 3	11- 1	11-10	12- 7	13- 3	13-11	14- 6	15- 1	15- 8	16- 3	16- 9	17- 3	17- 9	18- 3	18- 9	19- 2	19- 8	20- 1	20- 6	20-11		
	16.0	6- 3	7- 3	8- 1	8-11	9- 7	10- 3	10-10	11- 6	12- 0	12- 7	13- 1	13- 7	14- 0	14- 6	14-11	15- 5	15-10	16- 3	16- 7	17- 0	17- 5	17- 9	18- 1	18- 6	18-10
	19.2	5- 9	6- 7	7- 5	8- 1	8- 9	9- 4	9-11	10- 6	11- 0	11- 6	11-11	12- 5	12-10	13- 3	13- 8	14- 0	14- 5	14-10	15- 2	15- 6	15-10	16- 3	16- 7	16-10	17- 2
	24.0	5- 2	5-11	6- 7	7- 3	7-10	8- 4	8-11	9- 4	9-10	10- 3	10- 8	11- 1	11- 6	11-10	12- 2	12- 7	12-11	13- 3	13- 7	13-11	14- 2	14- 6	14-10	15- 1	15- 5	
2x10	12.0	9- 3	10- 8	11-11	13- 1	14- 2	15- 1	16- 0	16-11	17- 9	18- 6	19- 3	20- 0	20- 8	21- 4	22- 0	22- 8	23- 3	23-11	24- 6	25- 1	25- 7				
	16.0	8- 0	9- 3	10- 4	11- 4	12- 3	13- 1	13-10	14- 8	15- 4	16- 0	16- 8	17- 4	17-11	18- 6	19- 1	19- 7	20- 2	20- 8	21- 2	21- 8	22- 2	22- 8	23- 1	23- 7	24- 0
	19.2	7- 4	8- 5	9- 5	10- 4	11- 2	11-11	12- 8	13- 4	14- 0	14- 8	15- 3	15-10	16- 4	16-11	17- 5	17-11	18- 5	18-11	19- 4	19-10	20- 3	20- 8	21- 1	21- 6	21-11
	24.0	6- 6	7- 7	8- 5	9- 3	10- 0	10- 8	11- 4	11-11	12- 6	13- 1	13- 7	14- 2	14- 8	15- 1	15- 7	16- 0	16- 6	16-11	17- 4	17- 9	18- 1	18- 6	18-11	19- 3	19- 7
2x12	12.0	11- 3	13- 0	14- 6	15-11	17- 2	18- 4	19- 6	20- 6	21- 7	22- 6	23- 5	24- 4	25- 2	26- 0											
	16.0	9- 9	11- 3	12- 7	13- 9	14-11	15-11	16-10	17- 9	18- 8	19- 6	20- 3	21- 1	21- 9	22- 6	23- 2	23-10	24- 6	25- 2	25- 9						
	19.2	8-11	10- 3	11- 6	12- 7	13- 7	14- 6	15- 5	16- 3	17- 0	17- 9	18- 6	19- 3	19-11	20- 6	21- 2	21- 9	22- 5	23- 0	23- 6	24- 1	24- 8	25- 2	25- 8		
	24.0	7-11	9- 2	10- 3	11- 3	12- 2	13- 0	13- 9	14- 6	15- 3	15-11	16- 7	17- 2	17- 9	18- 4	18-11	19- 6	20- 0	20- 6	21- 1	21- 7	22- 0	22- 6	23- 0	23- 5	23-10
E	12.0	0.11	0.17	0.23	0.31	0.38	0.47	0.56	0.66	0.76	0.86	0.97	1.09	1.21	1.33	1.46	1.59	1.72	1.86	2.00	2.14	2.29	2.44	2.60		
E	16.0	0.09	0.14	0.20	0.26	0.33	0.41	0.49	0.57	0.66	0.75	0.84	0.94	1.05	1.15	1.26	1.37	1.49	1.61	1.73	1.86	1.99	2.12	2.25	2.39	2.53
E	19.2	0.09	0.13	0.18	0.24	0.30	0.37	0.44	0.52	0.60	0.68	0.77	0.86	0.95	1.05	1.15	1.25	1.36	1.47	1.58	1.70	1.81	1.93	2.05	2.18	2.31
E	24.0	0.08	0.12	0.16	0.22	0.27	0.33	0.40	0.46	0.54	0.61	0.69	0.77	0.85	0.94	1.03	1.12	1.22	1.31	1.41	1.52	1.62	1.73	1.84	1.95	2.06

Note: The required modulus of elasticity, E, in 1,000,000 pounds per square inch is shown at the bottom of each table, is limited to 2.6 million psi and less, and is applicable to all lumber sizes shown. Spans are shown in feet-inches and are limited to 26' and less. Check sources of supply for availability of lumber in lengths greater than 20'.