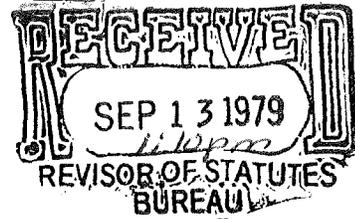


Ind 20 to 25

STATE OF WISCONSIN)
)
DEPARTMENT OF INDUSTRY,)
LABOR AND HUMAN RELATIONS)

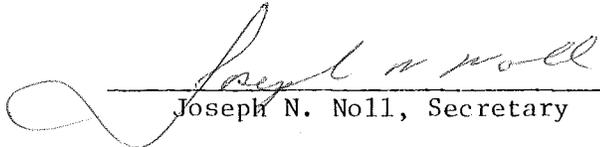


TO ALL TO WHOM THESE PRESENTS SHALL COME, GREETINGS:

I, Joseph N. Noll, Secretary of the Department of Industry, Labor and Human Relations, and custodian of the official records of said department, do hereby certify that Wis. Adm. Codes Chapter Ind 20--Dusts, Fumes, Vapors and Gases; Chapter Ind 21--Spray Coating; and Chapter Ind 25--Sanitary Facilities in Railroad Terminals and Caboose, are renumbered to Wis. Adm. Codes Chapter Ind 220, Chapter Ind 221 and Chapter Ind 225, respectively, and that the attached rules to create Chapter Ind 20--Administration and Enforcement; Chapter Ind 21--Construction Standards; Chapter Ind 23--Heating, Ventilating and Air Conditioning Standards; Chapter Ind 24--Electrical Standards; and Chapter Ind 25--Plumbing and Potable Water Standards, all a part of Wis. Adm. Code Chapters Ind 20-25--Uniform Dwelling Code, were adopted by this department on September 12, 1979.

I further certify that said copy has been compared by me with the original on file in this department and that the same is a true copy thereof and of the whole of such original.

IN TESTIMONY WHEREOF, I have hereunto set my hand and affixed the official seal of the department at the Capitol, in the City of Madison, this 12th day of September, A.D., 1979.



Joseph N. Noll, Secretary

ORDER OF
DEPARTMENT OF INDUSTRY, LABOR AND HUMAN RELATIONS

Pursuant to authority vested in the Department of Industry, Labor and Human Relations by sections 101.60 to 101.77, Wis. Stats., the Department of Industry, Labor and Human Relations hereby renumbers Wis. Adm. Code Chapter Ind 20--Dusts, Fumes, Vapors and Gases, to Wis. Adm. Code Chapter Ind 220 and creates a new chapter Ind 20--Administration and Enforcement, a part of Wis. Adm. Code chapters Ind 20-25--Uniform Dwelling Code; renumbers Wis. Adm. Code Chapter Ind 21--Spray Coating, to Wis. Adm. Code Chapter Ind 221 and creates a new Chapter Ind 21--Construction Standards, a part of Wis. Adm. Code chapters Ind 20-25--Uniform Dwelling Code; creates Chapter Ind 23--Heating, Ventilating and Air Conditioning Standards, a part of Wis. Adm. Code Chapters Ind 20-25--Uniform Dwelling Code; creates Chapter Ind 24--Electrical Standards, a part of Wis. Adm. Code Chapters Ind 20-25--Uniform Dwelling Code; renumbers Wis. Adm. Code Chapter Ind 25--Sanitary Facilities in Railroad Terminals and Caboose, to Wis. Adm. Code Chapter Ind 225 and creates a new Chapter Ind 25--Plumbing and Potable Water Standards, a part of Wis. Adm. Code Chapters Ind 20-25--Uniform Dwelling Code.

The rules attached hereto shall become effective six months following publication in the Wisconsin Administrative Register as provided in section 227.026, Wis. Stats.

Chapter Ind 20--Dusts, Fumes, Vapors and Gases, is renumbered Chapter Ind 220, and a new Chapter Ind 20--Administration and Enforcement, a part of the Uniform Dwelling Code, is created to read:

CHAPTER IND 20
ADMINISTRATION AND ENFORCEMENT

PART I--PURPOSE AND SCOPE

- Ind 20.01 Purpose
- Ind 20.02 Scope
- Ind 20.03 Effective date
- Ind 20.04 Applications
- Ind 20.05 Exemptions

PART II--JURISDICTION

- Ind 20.06 Procedure for municipalities exercising jurisdiction

PART III--DEFINITIONS

- Ind 20.07 Definitions

PART IV--APPROVAL AND INSPECTION OF ONE- AND TWO-FAMILY DWELLINGS

- Ind 20.08 Wisconsin uniform building permit
- Ind 20.09 Procedures for obtaining uniform building permit
- Ind 20.10 Inspections
- Ind 20.11 Suspension or revocation of Wisconsin uniform building permit

PART V--APPROVAL AND INSPECTION OF MANUFACTURED DWELLINGS AND THEIR COMPONENTS

- Ind 20.12 Scope
- Ind 20.13 Manufacture, sale and installation of dwellings
- Ind 20.14 Approval procedures
- Ind 20.15 Effect of approval
- Ind 20.16 Suspension and revocation of approval
- Ind 20.17 Effect of suspension and revocation

PART VI--APPROVAL OF MATERIALS

- Ind 20.18 Materials

PART VII--VARIANCES, APPEALS, VIOLATIONS, PENALTIES AND SEVERABLE CLAUSES

- Ind 20.19 Individual variance from a specific rule
- Ind 20.20 Municipal variance from code
- Ind 20.21 Appeals of orders, determinations and for extension of time
- Ind 20.22 Penalties and violations
- Ind 20.23 Saving and severable clauses

PART VIII--ADOPTION OF STANDARDS

- Ind 20.24 Adoption of standards

UNIFORM DWELLING CODE

CHAPTER IND 20
ADMINISTRATION AND ENFORCEMENT

PART I--PURPOSE AND SCOPE

Ind 20.01 PURPOSE. The purpose of this code is to establish uniform statewide construction standards and inspection procedures for one- and 2-family dwellings and manufactured buildings for dwellings in accordance with the requirements of sections 101.60 and 101.70, Stats.

Ind 20.02 SCOPE. The provisions of this code shall apply to the construction and inspection procedures used for all new one- and 2-family dwellings and manufactured buildings for dwellings.

(1) Municipal ordinances. (a) No municipality shall adopt an ordinance on any subject falling within the scope of this code including, but not limited to, establishing restrictions on the occupancy of dwellings for any reason other than noncompliance with the provisions of this code as set forth in section Ind 20.10 (3). This code does not apply to occupancy requirements occurring after the first occupancy for residential purposes following the final inspection referred to in section Ind 20.10 (1) (b) 3.

(b) This code shall not be construed to affect local requirements relating to land use, zoning, fire districts, side, front and rear setback requirements, property line requirements or other similar requirements. This code shall not affect the right of municipalities to establish safety regulations for the protection of the public from hazards at the job site.

(c) Any municipality may, by ordinance, require permits and fees for any construction, additions, alterations or repairs not within the scope of this code.

(2) Legal responsibility. The department or the municipality having jurisdiction shall not assume legal responsibility for the design or construction of dwellings.

(3) Retroactivity. The provisions of this code are not retroactive.

(4) Innovative dwellings. No part of this code is intended to prohibit or discourage the construction of innovative dwellings such as a dwelling built below ground, a geodesic dome, a concrete house, a fiber-glass house or any other nonconventional structure.

(5) Landscaping. The scope of this code does not extend to driveways, sidewalks, landscaping and other similar features not having an impact on the dwelling structure.

(6) Licensing. No licenses or special permits shall be required for persons obtaining building permits for or performing work on dwellings.

Ind 20.02 EFFECTIVE DATE. The effective date of chapter Ind 22 of this code is December 1, 1978. Chapters Ind 20, 21, 23, 24 and 25 shall become effective 6 months after the date of publication.

Ind 20.04 APPLICATIONS. (1) New dwellings. The provisions of this code shall apply to all dwellings and dwelling units, the initial construction of which was commenced on or after the effective date of this code. Additions and alterations to dwellings covered by this code shall comply with the provisions of this code at the time the permit for the addition or alteration is issued.

- (2) Recreational dwellings. Recreational dwellings, the initial construction of which was commenced on or after the effective date of this code, shall comply with all structural requirements of this code. The installation of any permanent heating, air conditioning, electrical or plumbing systems shall not be required; however, if such systems are installed, those systems shall comply with the provisions of this code. Any addition or alteration to such recreational dwelling or system therein shall comply with the provisions of the code at the time the permit for the addition or alteration is issued.

Ind 20.05 EXEMPTIONS. (1) Existing dwellings. The provisions of this code shall not apply to dwellings and dwelling units, the construction of which was commenced prior to the effective date of this code, or to additions or alterations to such dwellings.

- (2) Multifamily dwellings. The provisions of this code shall not apply to residences occupied by 3 or more families living independently or occupied by 2 such families and used also for business purposes.
- (3) Repairs. The provisions of this code do not apply to repairs or maintenance to dwellings or dwelling units, or to electrical, heating, ventilating, air conditioning and other systems installed therein.
- (4) Moving of dwellings. The status of a dwelling, new or existing, shall not be affected by the moving of the dwelling.
- (5) Accessory buildings. The provisions of this code do not apply to detached garages or to any accessory building(s) detached from the dwelling.
- (6) Farm buildings. The provisions of this code do not apply to the buildings used exclusively for farm operations.
- (7) Indian reservations. The provisions of this code do not apply to dwellings located on Indian reservation land held in trust by the United States.
- (8) Recreational vehicles and mobile homes. The provisions of this code do not apply to recreational vehicles or mobile homes, but shall apply to the on-site construction of additions to recreational vehicles and mobile homes.
- (9) Historical buildings. The provisions of this code do not apply to historical buildings designated as such by the federal or state government.

PART II--JURISDICTION

Ind 20.06 PROCEDURE FOR MUNICIPALITIES EXERCISING JURISDICTION. (1) Municipal jurisdiction. Pursuant to sections 101.65 and 101.76, Stats., cities, villages, towns and counties may exercise jurisdiction over the construction and inspection of new dwellings. Municipalities intending to exercise jurisdiction shall adopt the Uniform Dwelling Code in its entirety. No additional standards within the scope of this code shall be adopted by the municipality unless specific approval has been granted by the department pursuant to section Ind 20.20. No such municipality shall exercise jurisdiction except in accordance with the following procedure.

- (a) Intent to exercise jurisdiction. Municipalities intending to exercise jurisdiction shall notify the department, in writing, at least 30 days prior to the date upon which the municipality intends to exercise jurisdiction under this code. The notification of intent shall include a statement by the municipality as to which of the following methods will be used for enforcement:
1. Individual municipal enforcement.
 2. Joint municipal enforcement.
 3. Contract with certified inspector or independent inspection agency.
 4. Contract with another municipality.
 5. Contract with the department.
- (b) Submission of ordinances. Municipalities intending to exercise jurisdiction shall submit all ordinances adopting the Uniform Dwelling Code to the department at the same time as the notice of intent. The department shall promptly inform the municipality whether an ordinance complies with the provisions of this code. A municipality may appeal a determination by the department that an ordinance does not comply with the code. Any such appeal shall follow the procedure set out in section Ind 20.21 (2).
- (c) Passage of ordinances. A certified copy of all adopted ordinances and subsequent amendments thereto shall be filed with the department within 30 days after adoption.

Note: Municipalities adopting the model ordinance shall be considered to be in compliance with the provisions of this code and may exercise jurisdiction.

- (2) County jurisdiction. A county ordinance shall apply in any city, village or town which has not enacted ordinances pursuant to this section. No county ordinance shall apply until after 30 days after the effective date of this code unless a municipality within the county informs the department of its intent to have this code administered and enforced by the county. This section shall not be construed to prevent or prohibit any municipality from enacting and administering this code at any time after the effective date of this code.
- (3) Departmental jurisdiction. Pursuant to sections 101.63 and 101.73, Stats., the department will administer and enforce this code in any municipality which has not adopted, or is not covered by, an ordinance adopted in accordance with this section.

PART III--DEFINITIONS

Ind 20.07 DEFINITIONS. (1) Accessory building. Accessory building means a detached building, not used as a dwelling unit but is incidental to that of the main building and which is located on the same lot. Accessory building does not mean farm building.

- (2) Addition. Addition means new construction performed on a dwelling which increases the outside dimensions of the dwelling.
- (3) Allowable stress. Allowable stress means the specified maximum permissible stress of a material expressed in load per unit area.
- (4) Alteration. Alteration means a substantial change or modification other than an addition or repair to a dwelling or to systems involved within a dwelling.
- (5) Approved or approval. Approved means an approval by the department or its authorized representative. (Approval is not to be construed as an assumption of any legal responsibility for the design or construction of the dwelling or building component.)
- (6) Attic. Attic means a space under the roof and above the ceiling of the topmost part of a dwelling.
- (7) Balcony. A balcony is a landing or porch projecting from the wall of a building.

- (8) Basement. Basement means that portion of a dwelling between floor and ceiling which is below or partly below and partly above grade but so located that the vertical distance from the grade to the floor below is more than the vertical distance from grade to ceiling.
- (9) Building component. Building component means any subsystem, subassembly, or other system designed for use in or as part of a structure, which may include structural, electrical, mechanical, plumbing and fire protection systems and other systems affecting health and safety.
- (10) Building system. Building system means plans, specifications and documentation for a system of manufactured building or for a type or a system of building components, which may include structural, electrical, mechanical, plumbing and variations which are submitted as part of the building system.
- (11) Ceiling height. Ceiling height means the clear vertical distance from the finished floor to the finished ceiling.
- (12) Certified inspector. Certified inspector means a person certified by the department to engage in the administration and enforcement of this code.
- (13) Chimney. A chimney is one or more vertical, or nearly so, passageways or flues for the purpose of conveying flue gases to the atmosphere.
- (14) Chimney connector. Same as smoke pipe.
- (15) Closed construction. Closed construction means any building, building component, assembly or system manufactured in such a manner that it cannot be inspected before installation at the building site without disassembly, damage or destruction.
- (16) Code. Code means the Wisconsin uniform dwelling code.
- (17) Coefficient of performance (COP), cooling or heating. Coefficient of performance (COP) is the ratio of the rate of net heat removal or net heat output to the rate of total energy input, expressed in consistent units and under designated rating conditions.
- (18) Combustion efficiency. Combustion efficiency is expressed in percentage and is defined as 100% minus stack losses in percent of heat input. Stack losses are (a) loss due to sensible heat in dry flue gas, (b) loss due to incomplete combustion, and (c) loss due to sensible and latent heat in moisture formed by combustion of hydrogen in the fuel.
- (19) Compliance assurance program. Compliance assurance program means the detailed system documentation and methods of assuring that manufactured dwellings and dwelling components are manufactured, stored, transported, assembled, handled and installed in accordance with this code.
- (20) Cooling load. Cooling load is the rate at which heat must be removed from the space to maintain a selected indoor air temperature during periods of design outdoor weather conditions.
- (21) Dead load. Dead load means the vertical load due to all permanent structural and nonstructural components of the building such as joists, rafters, sheathing, finishes and construction assemblies such as walls, partitions, floors, ceilings and roofs, and systems.

- (22) Degree day, heating. Degree days are figured as the number of degrees the mean outdoor temperature deviates from 65° F each day during the heating season.

Note: For example, if, on December 15, the low temperature was + 30° F and the high temperature was + 50° F, the mean temperature would equal $(30° + 50°) \div 2 = 40°$; therefore, $65° - 40° = 25$ degree days.

- (23) Department. Department means the department of industry, labor and human relations.
- (24) Detached building. Detached building means any building which is not physically connected to the dwelling.
- (25) Dwelling. Dwelling means any building, the initial construction of which is commenced on or after the effective date of this code, which contains one or 2 dwelling units.
- (26) Dwelling, existing. An existing dwelling is a dwelling erected prior to the effective date of this code, one for which a valid building permit exists, or one for which lawful construction has commenced prior to the effective date of this code.
- (27) Dwelling unit. Dwelling unit means a structure, or that part of a structure, which is used or intended to be used as a home, residence or sleeping place by one person or by 2 or more persons maintaining a common household, to the exclusion of all others.
- (28) Energy efficiency ratio. The energy efficiency ratio is the ratio of net cooling capacity in Btu per hour to total rate of electric input, in watts, under designated operating conditions.
- (29) Exit. Exit means a continuous and unobstructed means of egress to a street, alley or open court and includes intervening doors, doorways, corridors, halls, balconies, ramps, fire escapes, stairways and windows.
- (30) Farm operation. The farm operation is the planting and cultivating of the soil and growing of farm products substantially all of which have been planted or produced on the farm premises.

Note: According to section 102.04 (3), Stats., the farm operation includes the management, conserving, improving and maintaining of the premises, tools, equipment improvements and the exchange of labor or services with other farmers; the processing, drying, packing, packaging, freezing, grading, storing, delivery to storage, carrying to market or to a carrier for transportation to market and distributing directly to the consumer; the clearing of such premises and the salvaging of timber and the management and use of wood lots thereon but does not include logging, lumbering and wood-cutting operations unless the operations are conducted as an accessory to other farm operations.

- (31) Farm premises. The farm premises is defined to be the area which is planted and cultivated. The farm premises does not include greenhouses, structures or other areas unless used principally for the production of food or farm products.
- (32) Farm products. Farm products are defined as agricultural, horticultural and arboricultural crops. Animals considered within the definition of agricultural include livestock, bees, poultry, fur-bearing animals, and wildlife or aquatic life.
- (33) Farming. Farming means the operation of a farm premises owned or rented by the operator.
- (34) Firebox. Firebox means that part of the fireplace used as the combustion chamber.
- (35) Garage. Garage means an unenclosed or enclosed portion of a dwelling used for storing motorized vehicles.
- (36) Gas appliance. Gas appliance means any furnace or heater, air conditioner, refrigerator, stove having an electrical supply cord, dishwasher, dryer, swimming pool heater, or other similar appliance or device used in a dwelling or dwelling unit which uses a gaseous fuel for operation.
- (37) Habitable room. Habitable room means any room used for sleeping, living or dining purposes, excluding such enclosed places as kitchens, closets, pantries, bath or toilet rooms, hallways, laundries, storage spaces, utility rooms, and similar spaces.
- (38) Hearth. Hearth means the floor of the fireplace. The inner part of the hearth is located within the firebox; the outer part of the hearth is located outside of the fireplace.
- (39) Heated space. Heated space is any space provided with a supply of heat to maintain the temperature of the space to at least 50° F. Heat supplied by convection from the energy-consuming systems may satisfy this requirement in basements if the energy-consuming systems are not insulated.
- (40) Heating load. Heating load is the probable heat loss of each room or space to be heated, based on maintaining a selected indoor air temperature during periods of design outdoor weather conditions. The total heat load includes: the transmission losses of heat transmitted through the wall, floor, ceiling, glass or other surfaces; the infiltration losses or heat required to warm outdoor air which leaks in through cracks and crevices, around doors and windows, or through open doors and windows; or heat required to warm outdoor air used for ventilation.
- (41) Independent inspection agency. Independent inspection agency means any person, firm, association, partnership or corporation certified by the department to perform certified inspections under this code.
- (42) Initial construction. Initial construction means the date of issuance of the Wisconsin uniform building permit.
- (43) Insignia. See "Wisconsin insignia."
- (44) Installation. Installation means the assembly of a manufactured building on site and the process of affixing a manufactured building to land, a foundation, footing or an existing building.

- (45) Intermittent ignition device. Intermittent ignition device means an ignition device which is actuated only when a gas appliance is in operation.
- (46) Kitchen. Kitchen means an area used, or designed to be used, for the preparation of food.
- (47) Landing. Landing means the level portion of a stairs located within a flight of stairs or located at the base and foot of a stairs.
- (48) Listed and listing. Listed and listing means equipment or building components which are tested by an independent testing agency and accepted by the department.
- (49) Live load. Live load means the weight superimposed on the floors, roof and structural and nonstructural components of the dwelling through use and by snow, ice or rain.
- (50) Loft. Loft means an upper room or floor which is open to the floor below.
- (51) Manufacture. Manufacture means the process of making, fabricating, constructing, forming or assembling a product from raw, unfinished, semifinished or finished materials.
- (52) Manufactured building. (a) Manufactured building means any structure or component thereof which is intended for use as a dwelling and:
1. Is of closed construction and fabricated or assembled on site or off site in manufacturing facilities for installation, connection or assembly and installation at the building site; or
 2. Is a building of open construction which is made or assembled in manufacturing facilities away from the building site for installation, connection, or assembly and installation on the building site and for which certification is sought by the manufacturer.
- (b) The term manufactured building does not include a building of open construction which is not subject to section 20.07 (52) (a) 2. A single or double width mobile home is not considered a manufactured building and is not subject to this code.
- (53) Masonry units (hollow) and (solid). (a) Hollow unit. A hollow unit is a masonry unit in which the net cross-sectional area parallel to the bearing face is less than 75% of the gross cross-sectional area.
- (b) Solid unit. Masonry units having net cross-sectional areas of 75% or more of the gross cross-sectional area are classified as solid units.
- (54) Multi-wythe wall. A multi-wythe wall is a masonry wall composed of 2 or more wythes of masonry units tied or bonded together.
- (55) Municipality. Municipality means any city, village, town or county in this state.
- (56) Open construction. Open construction means any building, building component, assembly or system manufactured in such a manner that it can be readily inspected at the building site without disassembly, damage or destruction.

- (57) Owner. Owner means any person having a legal or equitable interest in the dwelling.
- (58) Perm. Perm is the designation for the unit permeance which is a substitute for the unit, one grain per (hour) (square foot) (inch of mercury vapor pressure difference).
- (59) Pilaster. A pilaster is a projection of masonry or a filled cell area of masonry for the purpose of bearing concentrated loads or to stiffen the wall against lateral forces.
- (60) Recreational dwelling unit. Recreational dwelling unit means a permanent structure occupied occasionally or seasonally solely for recreational purposes and not used as a principal residence.
- (61) Repair. Repair means the act or process of restoring to original soundness, including, but not limited to, redecorating, refinishing, nonstructural repairs, maintenance repairs or replacement of existing fixtures, systems or equipment.
- (62) Resistance, thermal (R). Thermal resistance (R) is a measure of the ability to retard the flow of heat. The R-value is the reciprocal of a heat transfer coefficient, expressed by U ($R = 1/U$). The higher the R-value of a material, the more difficult it is for heat to flow through the material.
- (63) Single-wythe wall. A single-wythe wall is a masonry wall consisting of one unit of thickness.
- (64) Smoke chamber. A smoke chamber is that part of a fireplace which acts as a funnel to compress the smoke and gases from the fire so that they will enter the chimney above.
- (65) Smoke pipe. A smoke pipe is a connector between the solid or liquid fuel-burning appliance and the chimney.
- (66) Stairway. A stairway is one or more flights of steps, and the necessary platforms or landings connecting them, to form a continuous passage from one elevation to another.
- (67) Step(s). Step(s) is a unit(s) consisting of one riser and one tread, alone or in series.
- (68) Story. A story is that portion of a building located above the basement, between the floor and the ceiling.
- (69) Stove. A stove is a nonportable solid-fuel-burning, vented, nonducted heat-producing appliance located in the space that it is intended to heat. This definition does not include cooking appliances.
- (70) Stovepipe. Same as smoke pipe.
- (71) Strain. Strain means a change in the physical shape of a material caused by stress.
- (72) Stress. Stress means internal resistance to an external force expressed in load per unit area; stresses acting perpendicular (compression or tension) to the surface, shear stresses acting in the plane of the surface, or bending stresses which cause curving.

- (73) Structural analysis. Structural analysis is a branch of the physical sciences which uses the principles of mechanics in analyzing the impact of loads and forces and their effect on the physical properties of materials in the form of internal stress and strain.
- (74) Thermal transmittance (U). Thermal transmittance (U) is the coefficient of heat transmission or thermal transmittance (air to air) expressed in units of Btu per (hour) (square foot) (degree F). It is the time rate of heat flow. The U-value applies to combinations of different materials used in series along the heat flow path and also to single materials that comprise a building section, and includes cavity air spaces and surface air films on both sides. The lower the U-value of a material, the more difficult it is for heat to flow through the material.
- (75) Throat. The throat of a fireplace is the slot-like opening above the firebox through which flames, smoke and other products of combustion pass into the smoke chamber.
- (76) Vent. Vent means a vertical flue or passageway to vent fuel-burning appliances.
- (77) Vent connector. A vent connector is a connector between a fuel-burning appliance and the chimney or vent.
- (78) Window. Window means a glazed opening in an exterior wall, including glazed portions of doors, within a conditioned space.
- (79) Wisconsin insignia. Wisconsin insignia means a device or seal approved by the department to certify compliance with this code.

PART IV--APPROVAL AND INSPECTION OF ONE- AND TWO-FAMILY DWELLINGS

Ind 20.08 WISCONSIN UNIFORM BUILDING PERMIT. A Wisconsin uniform building permit shall be obtained from the department or the municipality administering and enforcing this code before any on-site construction within the scope of this code is commenced, except where a permit to start construction has been issued in accordance with section Ind 20.09 (5) (b) 2. A Wisconsin uniform building permit shall not be required for repairs.

Note 1: Section 20.09 (5) (b) 2. permits the issuance of a footing and foundation permit prior to the issuance of the Wisconsin uniform building permit.

Ind 20.09 PROCEDURES FOR OBTAINING UNIFORM BUILDING PERMIT. (1) Application for a Wisconsin uniform building permit. Application for a Wisconsin uniform building permit shall be on the forms obtained from the department or the municipality administering and enforcing this code. No application shall be accepted that does not contain all the information requested on the form.

Note 1: See appendix for a copy of the Wisconsin uniform building permit and application.

Note 2: Any municipality exercising jurisdiction may require reasonable supplementary information not contained on the Wisconsin building permit application.

- (2) Filing of the Wisconsin uniform building permit application. The Wisconsin uniform building permit application shall be filed with the municipality administering and enforcing this code or its authorized representative. The municipality shall promptly forward a copy of all applications to the department. If no municipality administers and enforces the code, the application shall be filed with the department or its authorized representative.

Note: Section 101.64, Stats., permits the department to collect and publish data.

- (3) Fees. (a) Municipal fees. Fees shall be submitted to the municipality at the time the Wisconsin uniform building permit application is filed. The municipality shall, by ordinance, determine fees to cover expenses for plan examination, inspection and the issuance of the Wisconsin uniform building permit. The municipality shall collect and send to the department the fee for the Wisconsin uniform building permit in accordance with Wis. Adm. Code section Ind 69.21.
- (b) Department fees. Where the department administers and enforces the code, the fees for plan examination, inspection, and the issuance of the Wisconsin uniform building permit, in accordance with section Ind 69.21, shall be submitted to the department, or its authorized representative, at the time the Wisconsin uniform building permit application is filed.
- (4) Submission of plans. At least 2 sets of plans for all one- and 2-family dwellings shall be submitted to the department, or the municipality administering and enforcing this code, for examination and approval at the time the Wisconsin uniform building permit application is filed. A municipality exercising jurisdiction may require a third set of plans at its option.
- (a) Required building plans. The required building plans shall be legible and drawn to scale or dimensioned and shall include the following:
1. Plot plan. The plot plan shall show the location of the dwelling and any other buildings, wells and disposal systems on the property with respect to property lines.
 2. Floor plans. Floor plans shall be provided for each floor. The size and location of all rooms, doors, windows, structural features, exit passageways and stairs shall be indicated. The location of plumbing fixtures, chimneys, and heating and cooling appliances, and, when requested, a heating distribution layout shall be included.
 3. Elevations. The elevations shall contain information on the exterior appearance of the building, indicate the location, size and configuration of doors, windows, roof, chimneys, exterior grade, footings and foundation walls, and include the type of exterior materials.
- (b) Data required. All required plans submitted for approval shall be accompanied by sufficient data and information to determine if the dwelling will meet the requirements of this code. The data and information for determining compliance with the energy conservation standards shall be submitted on forms provided by the department or other approved forms.

- (c) Master plans. Where a dwelling is intended to be identically and repetitively constructed at different locations, a master plan may be submitted for approval. The plans shall include floor plans, elevations and data as required in section Ind 20.09 (4) (a) 2. and 3. If the plans conform to the provisions of the code, an approval and a master plan number shall be issued. The number issued may be used in lieu of submitting building plans for each location. A plot plan shall be submitted for each location at the time of application for the Wisconsin uniform building permit.
- (5) Approval of plans and issuance of permits. (a) Plan approval. If the department, or the municipality administering and enforcing the code, determines that the plans submitted for a one- or 2-family dwelling substantially conform to the provisions of this code and other legal requirements, an approval shall be issued. The plans shall be stamped "conditionally approved" by a certified inspector or certified independent inspection agency. One copy shall be returned to the applicant; one copy shall be retained by the department or the municipality administering and enforcing the code. The conditions of approval shall be indicated by a letter or on the permit. All conditions of the approval shall be met during construction.
- (b) Issuance of permits. 1. Uniform building permit. The Wisconsin uniform building permit shall be issued if the requirements for filing and fees are satisfied and the plans have been conditionally approved. The permit shall expire 24 months after issuance if construction has not commenced. The municipality issuing the Wisconsin uniform building permit shall send a copy of the application to the department.
2. Permit to start construction of footings and foundation. Construction may begin on footings and foundations prior to the issuance of the Wisconsin uniform building permit where a permit to start construction is obtained. Upon submittal of the application for a permit to start construction, a plot plan, complete footing and foundation information including exterior grading, and a fee, the department or the municipality enforcing this code may issue a permit to start construction of the footings and foundation. The issuance of a permit to start construction shall not influence the approval or denial of the application.
- Note: Section 66.036, Stats., prohibits issuance of building permits by counties, cities, towns or villages for structures requiring connection to a private domestic sewerage treatment and disposal system unless such system satisfies all applicable requirements and all necessary permits for such system have been obtained.
- (c) Posting of permit. The Wisconsin uniform building permit shall be posted in a conspicuous place at the dwelling site.
- (6) Disapproval of plans and denial of permits. If the department, or the municipality administering and enforcing the code, determines that the Wisconsin uniform building permit application or the plans do not substantially conform to the provisions of this code or other legal requirements are not met, approval shall be denied.
- (a) Denial of application. A copy of the "denied" application, accompanied by a written statement specifying the reasons for denial, shall be sent to the applicant and to the owner as specified on the Wisconsin uniform building permit application.

- (b) Stamping of plans. Plans which do not substantially conform to the provisions of the code shall be stamped "not approved." One copy shall be returned to the person applying for the Wisconsin uniform building permit; one copy shall be retained by the department or the municipality administering and enforcing the code.
 - (c) Appeals. The applicant may appeal a denial of the application in accordance with the procedure outlined in section Ind 20.21.
- (7) Action to approve or deny. Action to approve or deny shall be taken promptly and in no case longer than 14 days from the date of application.

Ind 20.10 INSPECTIONS. All inspections, for the purpose of administering and enforcing this code, shall be performed by a certified inspector or certified independent inspection agency.

- (1) Required inspections. Inspections shall be conducted by the department or the municipality administering and enforcing this code to ascertain whether or not the construction or installations conform to the conditionally approved plans, the Wisconsin uniform building permit application and the provisions of this code and shall notify the permit holder and the owner of any violations to be corrected.
 - (a) Inspection notice. The applicant or an authorized representative shall, in writing or orally, request inspections of the department or the municipality administering and enforcing this code. The department, or the municipality administering and enforcing this code, shall perform the requested inspection within 48 hours after notification, except the final inspection. Construction shall not proceed beyond the point of inspection until the inspection has been completed. Construction may proceed if the inspection has not taken place within 48 hours of the notification, excluding Saturdays, Sundays and holidays, except if otherwise agreed between the applicant and the department or the municipality administering and enforcing the code.
 - (b) Inspection types. The following sequence of inspections shall be performed for the purpose of determining if the work complies with this code:
 - 1. Footing and foundation inspection. The excavation shall be inspected after the placement of forms, shoring and reinforcement, where required, and prior to the placement of footing materials. Where below-grade drain tiles, waterproofing or exterior insulation is required, the foundation shall be inspected prior to backfilling.
 - 2. Rough inspection. A rough inspection shall be performed for each inspection category listed in a. through e. of this section after the rough work is constructed but before it is concealed. All categories of work for rough inspections may be completed before the notice for inspection is provided. The applicant may request one rough inspection or individual rough inspections. A separate fee may be charged for each individual inspection.

- a. General construction, including framing.
- b. Rough electrical.
- c. Rough plumbing.
- d. Rough heating, ventilating and air conditioning.
- e. Insulation

3. Final inspection. The dwelling may not be occupied until a final inspection has been made which finds that no violations of this code exist that could reasonably be expected to affect the health and safety of the occupant.

a. The basement portion of the dwelling may be occupied prior to completion of the dwelling, but only if the basement portion to be occupied would otherwise comply with the provisions of this code, particularly those relating to construction of underground dwellings.

(c) Notice of compliance or noncompliance. Notice of compliance or noncompliance shall be written on the building permit and posted at the job site. Upon finding of noncompliance, the department or the municipality enforcing this code shall notify the applicant and the owner, in writing, of the violations to be corrected. All cited violations shall be ordered corrected within 30 days after written notification, unless an extension of time is granted pursuant to section Ind 20.21.

(3) Voluntary inspection. The department or its authorized representative may, at the request of the owner or the lawful occupant, enter and inspect dwellings, subject to the provisions of this code, to ascertain compliance with this code.

Ind 20.11 SUSPENSION OR REVOCATION OF WISCONSIN UNIFORM BUILDING PERMIT. The department, or the municipality administering and enforcing this code, may suspend or revoke any Wisconsin uniform building permit where it appears that the permit or approval was obtained through fraud or deceit, where the applicant has willfully refused to correct a violation order or where the inspector is denied access to the premises. No construction shall take place on the dwelling after suspension or revocation of the permit.

(1) Any person aggrieved by a determination made by the municipality exercising jurisdiction may appeal the decision in accordance with section Ind 20.21.

(2) Any person aggrieved by a determination made by the department may appeal the decision in accordance with section Ind 20.21.

PART V--APPROVAL AND INSPECTION OF MANUFACTURED DWELLINGS AND THEIR COMPONENTS

Ind 20.12 SCOPE. This part shall govern the design, manufacture, installation and inspection of manufactured dwellings, manufactured building systems and the components of the building systems displaying the Wisconsin insignia.

Ind 20.13 MANUFACTURE, SALE AND INSTALLATION OF DWELLINGS. (1) Manufacture and sale. No manufactured dwelling, manufactured building system or component of the building system subject to this part shall be manufactured for use, sold for initial use or installed in this state unless it is approved by the department and it bears the Wisconsin insignia issued or a state seal or an insignia reciprocally recognized by the department.

(2) Installation. A Wisconsin uniform building permit shall be obtained in accordance with the procedures outlined in sections Ind 20.09 (1), (2), (3) and (4) (a) 1. before any on-site construction falling within the scope of this code is commenced for a manufactured dwelling. The permit shall be issued in accordance with section Ind 20.09 (5) (b) 1.

Ind 20.14 APPROVAL PROCEDURES. (1) Application for approval. An application for the approval of any manufactured dwelling, building system or component shall be submitted to the department, in the form required by the department, along with the appropriate fees in accordance with section Ind 69.21.

(2) Approval of building systems and components. (a) Approval of building systems.

1. Plans and specifications. At least 3 complete sets of building, structural, mechanical and electrical plans (including elevations, sections, details), specifications and calculations of such building system shall be submitted to the department on behalf of the manufacturer for examination and approval.
2. Compliance assurance program. Three sets of the compliance assurance program shall be submitted for examination and approval. The compliance assurance program submitted to the department on behalf of the manufacturer shall meet the standards of the NBS "Model Rules and Regulations" [Ind 20.24 (3)] or their equivalent as determined by the department.

(b) Approval of building components.

1. Plans and specifications. At least 3 complete sets of plans and specifications for manufactured dwelling building components shall be submitted to the department on behalf of the manufacturer for examination and approval.
2. Compliance assurance program. Three sets of the compliance assurance program shall be submitted to the department on behalf of the manufacturer for examination and approval of components. The compliance assurance program shall meet the requirements established by the department or, where applicable, be in the form of the NBS "Model Rules and Regulations" [Ind 20.24 (3)].

(3) Notification of approval or denial of plans, specifications and compliance assurance program. (a) Conditional approval. If the department determines that the plans, specifications, compliance assurance program and application for approval submitted for such building system or component substantially conform to the provisions of this code, a conditional approval shall be issued. A conditional approval issued by the department shall not constitute an assumption of any liability for the design or construction of the manufactured building.

1. Written notice. The conditional approval shall be in writing and sent to the manufacturer and the person submitting the application for approval. Any noncompliance specified in the conditional approval shall be corrected before the manufacture, sale or installation of the dwelling, building system or component.
2. Stamping of plans, specifications and compliance assurance program. Approved plans, specifications and compliance assurance programs shall be stamped "conditionally approved." At least 2 copies shall be returned to the person designated on the application for approval; one copy shall be retained by the department.

- (b) Denial. If the department determines that the plans, specifications, compliance assurance program or the application for approval do not substantially conform to the provisions of this code, the application for approval shall be denied.
1. Written notice. The denial shall be in writing and sent to the manufacturer and the person submitting the application for approval. The notice shall state the reasons for denial.
 2. Stamping of plans, specifications and compliance assurance program. Plans, specifications and compliance assurance programs shall be stamped "not approved." At least 2 copies shall be returned to the person submitting the application for approval; one copy shall be retained by the department.
- (4) Evidence of approval. The manufacturer shall keep at each manufacturing plant where such building system or component is manufactured, one set of plans, specifications and compliance assurance program bearing the stamp of conditional approval. The conditionally approved plans, specifications and compliance assurance program shall be available for inspection by an authorized representative of the department during normal working hours.
- (5) Inspections. Manufacturers shall contract with the department or an independent inspection agency to conduct in-plant inspections to assure that the building system and components manufactured are in compliance with the plans, specifications and the compliance assurance program approved by the department. All inspections, for the purpose of administering and enforcing this code, shall be performed by a certified inspector or certified independent inspection agency.
- (6) Wisconsin insignia. Upon departmental approval of the plans, specifications and compliance assurance program, and satisfactory in-plant inspections of the building system and components, Wisconsin insignias shall be purchased from the department in accordance with the fee established in section Ind 69.21. A manufacturer shall be entitled to display the Wisconsin insignia on any approved system or component.
- (a) Lost or damaged insignia.
 1. Notification. If Wisconsin insignias become lost or damaged, the department shall be notified immediately, in writing, by the manufacturer or dealer.
 2. Return of damaged insignias. If Wisconsin insignias become damaged, the insignia shall be returned to the department with the appropriate fee to obtain a new insignia.
 - (b) Affixing Wisconsin insignias. Each Wisconsin insignia shall be assigned and affixed to a specific manufactured dwelling or component in the manner approved by the department before the dwelling is shipped from the manufacturing plant.

(c) Insignia records.

1. Manufacturer's insignia records. The manufacturer shall keep permanent records regarding the handling of all Wisconsin insignias, including construction compliance certificates, indicating the number of Wisconsin insignias which have been affixed to manufactured dwellings or manufactured building components (or groups of components); which Wisconsin insignias have been applied to which manufactured dwelling or manufactured building component; the disposition of any damaged or rejected Wisconsin insignias; and the location and custody of all unused Wisconsin insignias. The records shall be maintained by the manufacturer or by the independent inspection agency for at least 10 years. A copy of the records shall be sent to the department upon request.
2. Construction compliance certificate. Within 30 days after receiving the original Wisconsin insignias from the department, and at the end of each month thereafter, the manufacturer shall submit a construction compliance certificate, in the form determined by the department, for each manufactured dwelling intended for sale, use or installation in the state.

(d) Unit identification. Each manufactured dwelling and major transportable section or component shall be assigned a serial number. The serial number shall be located on the manufacturer's data plate.

(e) Manufacturer's data plate. The manufacturer's data plate for building systems shall contain the following information, where applicable:

1. Manufacturer's name and address;
2. Date of manufacture;
3. Serial number of unit;
4. Model designation;
5. Identification of type of gas required for appliances and directions for water and drain connections;
6. Identification of date of the codes or standards complied with;
7. State insignia number;
8. Design loads;
9. Special conditions or limitations of unit;
10. Electrical ratings; instructions and warnings on voltage, phase, size and connections of units and grounding requirements.

(7) Reciprocity. Upon request, the department will make available to any person a list of those states whose dwelling codes are considered equal to the codes established by the department and whose products are accepted reciprocally by Wisconsin.

Ind 20.15 EFFECT OF APPROVAL. (1) Right to bear insignia. A manufactured dwelling or building component approved by the department, manufactured and inspected in accordance with this code, shall be entitled to bear the Wisconsin insignia.

- (2) Effect of insignia. Manufactured dwellings and manufactured building components bearing the Wisconsin insignia are deemed to comply with this code, except as to installation site requirements, regardless of the provisions of any other ordinance, rule, regulation or requirement.
- (3) Right to install. Manufactured dwellings and components bearing the Wisconsin insignia may be manufactured, offered for sale and shall be entitled to be installed anywhere in Wisconsin where the installation site complies with the other provisions of this code.

Ind 20.16 SUSPENSION AND REVOCATION OF APPROVAL. The department shall suspend or revoke its approval of a manufactured building system or manufactured building component if it determines that the standards for construction or the manufacture and installation of a manufactured building system or manufactured building component do not meet this code or that such standards are not being enforced as required by this code. The procedure for suspension and revocation of approval shall be as follows:

- (1) Filing of complaint. Proceedings to suspend or revoke an approval shall be initiated by the department or an independent inspection agency having a contract with the manufacturer whose approval is sought to be suspended or revoked. Initiation shall be by a signed, written complaint filed with the department. Any alleged violation of the code shall be set forth in the complaint with particular reference to time, place and circumstance.
- (2) Investigation and notification. The department may investigate alleged violations on its own initiative or upon the filing of a complaint. If it is determined that no further action is warranted, the department shall notify the persons affected. If the department determines that there is probable cause, it shall order a hearing and notify the persons affected.
- (3) Mailing. Unless otherwise provided by law, all orders, notices and other papers may be served by the department by certified mail to the persons affected at their last known address. If the service is refused, service may be made by sheriff without amendment of the original order, notice or other paper.
- (4) Response. Upon receipt of notification of hearing from the department, the person charged with noncompliance or nonenforcement may submit to the department a written response within 30 days of the date of service. If the person charged files a timely written response, such person shall thereafter be referred to as the respondent.
- (5) Conciliation agreement prior to hearing. If the department and the respondent are able to reach agreement on disposition of a complaint prior to hearing, such agreement shall:
 - (a) Be transmitted in writing to the secretary;
 - (b) Not be binding upon any party until signed by all parties and accepted by the secretary;
 - (c) Not be considered a waiver of any defense nor an admission of any fact until accepted by the secretary.

- (6) Hearings. (a) Subpoenas; witness fees. Subpoenas shall be signed and issued by the department or the clerk of any court of record. Witness fees and mileage of witnesses subpoenaed on behalf of the department shall be paid at the rate prescribed for witnesses in circuit court.
- (b) Conduct of hearings. All hearings shall be conducted by persons selected by the department. Persons so designated may administer oaths or affirmations and may grant continuances and adjournments for cause shown. The respondent shall appear in person and may be represented by an attorney-at-law. Witnesses may be examined by persons designated by all parties.
- (7) Findings. The department shall make findings and enter its order within 14 days of the hearing. Any findings as a result of petition or hearing shall be in writing and shall be binding unless appealed to the secretary.
- (8) Appeal arguments. Appeal arguments shall be submitted to the department in writing in accordance with chapter 227, Stats., unless otherwise ordered.

Ind 20.17 EFFECT OF SUSPENSION AND REVOCATION. (1) Bearing of insignia. Upon suspension or revocation by the department of the approval of any manufactured dwelling or manufactured building component, no further insignia shall be attached to any dwelling or building component manufactured with respect to which the approval was suspended or revoked. Upon termination of such suspension or revocation, insignias may again be attached to the dwelling or building component manufactured after the date approval is reinstated. Should any dwelling or building component have been manufactured during the period of suspension or revocation, it shall not be entitled to bear the Wisconsin insignia unless the department has inspected, or caused to be inspected, such manufactured dwelling or manufactured building component and is satisfied that all requirements for certification have been met.

- (2) Return of insignias. The manufacturer shall return to the department all insignias allocated for a manufactured dwelling or manufactured building component no later than 30 days from the effective date of any suspension or revocation of the approval by the department. The manufacturer shall also return to the department all insignias which it determines for any reason are no longer needed.

PART VI--APPROVAL OF MATERIALS

Ind 20.18 MATERIALS. (1) Alternate materials. No provision in this code is intended to prohibit or prevent the use of any alternate material or method of construction not specifically mentioned in this code. Approval of alternate materials or methods of construction shall be obtained from the department. Requests for approval shall be accompanied by evidence showing that the alternate material or method of construction performs in a manner equal to or superior to the material or method required by the code. The department may require any claims made regarding the equivalent performance of alternate materials or methods to be substantiated by test.

- (a) Tests. The department may require that the materials, methods, systems, components, or equipment be tested to determine the suitability for the intended use. The department will accept results of tests conducted by a recognized independent testing agency. The cost of testing shall be borne by the person requesting the approval.

1. The test method used to determine the performance shall be one that is a nationally recognized standard.
 2. If no nationally recognized standard exists, past performance or recognized engineering analysis may be used to determine suitability.
- (2) Ungraded or used materials. Ungraded or used building materials may be used or reused as long as the material possesses the essential properties necessary to achieve the level of performance required by the code for the intended use. The department or the municipality enforcing this code may require tests in accordance with (1) (a) of this section.

PART VII--VARIANCES, APPEALS, VIOLATIONS,
PENALTIES AND SEVERABLE CLAUSES

Ind 20.19 INDIVIDUAL VARIANCE FROM A SPECIFIC RULE. The department may grant an individual variance to a specific rule only if the granting of such variance does not result in lowering the level of health, safety and welfare established or intended by the specific rule. The department may consider other reasonable criteria in determining whether a variance should be granted including, but not limited to, the effect of granting the variance on statewide and local uniformity.

- (1) Application for variance. The applicant shall submit the application for variance to the municipality exercising jurisdiction. Where no municipality exercises jurisdiction, the application shall be submitted to the department. The following items shall be submitted when requesting a variance.
 - (a) A clear and concise written statement of the specific provisions of this code from which a variance is requested together with a specific statement of the procedure and materials to be used if the variance is granted.
 - (b) A fee to be determined by the department or the municipality exercising jurisdiction. Where the municipality administers and enforces the code, the department may require a fee for the processing of the application in addition to any municipal fee.
- (2) Municipal recommendation. The municipality administering and enforcing this code shall submit all applications for variance to the department, together with a municipal recommendation concerning whether or not a variance should be granted within 10 days, excluding Saturdays, Sundays and legal holidays, after the receipt of the application. The recommendation of the municipality shall include, but not be limited to, the following items:
 - (a) What inspections, if any, have actually taken place with regard to the dwelling for which a variance is requested;
 - (b) Whether or not any correction orders have been issued with regard to the dwelling; and
 - (c) Whether the granting of the variance would substantially affect the health, safety or welfare of any individual within the municipality.

- (3) Departmental action. Where a municipality administers and enforces the code, the department shall approve or deny applications for variance and shall mail said notification to the municipality and the applicant within 5 days, excluding Saturdays, Sundays and legal holidays, after receipt of the application for variance and recommendation is received from the municipality. Where the department administers and enforces the code, the department shall approve or deny applications for variance and shall mail said notification to the applicant within 15 days, excluding Saturdays, Sundays and legal holidays, after receipt of the application and fees by the department.
- (4) Appeals. Any aggrieved applicant, or the municipality administering and enforcing the code, may appeal the determination of the department in the manner set out in sections 101.02 (6) (e) to (i) and (8), Stats.

Ind 20.20 MUNICIPAL VARIANCE FROM THE CODE. Any municipality exercising or intending to exercise jurisdiction under this code may apply to the department for a variance permitting the municipality to adopt an ordinance not in conformance with this code.

- (1) Application for variance. The department may grant an application only under the following circumstances:
 - (a) The municipality has demonstrated that the variance is necessary to protect the health, safety or welfare of individuals within the municipality because of specific climate or soil conditions generally existing within the municipality.
 - (b) The municipality has demonstrated that the granting of the variance, when viewed both individually and in conjunction with other variances requested by the municipality, does not impair the statewide uniformity of this code.
- (2) Departmental inquiry. Prior to making a determination, the department shall solicit within the municipality and consider the statements of any interested persons as to whether or not said application should be granted.
- (3) Appeals. Any municipality aggrieved by the denial of such an application may appeal such determination in accordance with the procedure set out in sections 101.02 (6) (e) to (i) and (8), Stats.
- (4) Uniformity. This section shall be strictly construed in accordance with the goal of promoting statewide uniformity.

Ind 20.21 APPEALS OF ORDERS, DETERMINATIONS, AND FOR EXTENSION OF TIME.

- (1) Appeals of orders and determinations by a municipality exercising jurisdiction. Appeals of an order or determination of a municipality exercising jurisdiction under this code, including denials of application for permits, shall be made in accordance with the procedure set out in chapter 68, Stats., except as follows:
 - (a) Appeals of final determinations by a municipality exercising jurisdiction. Appeals of final determinations by municipalities shall be made to the department after the procedures prescribed in chapter 68, Stats., have been exhausted. All such appeals to the department shall be in writing stating the reason for the appeal. All such appeals shall be filed with the department within 14 days of the date the final determination is rendered under chapter 68, Stats. The department shall render a written decision on all appeals.

Note: Chapter 68, Stats., provides that municipalities may adopt alternate administrative appeal procedures that provide the same due process rights as chapter 68, Stats. Municipalities having adopted such alternate procedures may follow those alternate procedures.

- (2) Appeals of orders and determinations by the department. Appeals of an order of the department made pursuant to the provisions of this code, including denials of application for permits, shall be in accordance with the procedure set out in sections 101.02 (6) (e) to (i) and (8), Stats.
- (3) Extensions of time. (a) The time for correction of cited orders as set out in section Ind 20.10 shall automatically be extended in the event that an appeal of said orders is filed. The extension of time shall extend to the termination of the appeal procedure and for such additional time as the department or municipality administering and enforcing this code may allow.
 - (b) The department or municipality administering and enforcing this code may grant additional reasonable time in which to comply with a violation order.

Ind 20.22 PENALTIES AND VIOLATIONS. (1) Violations. No person shall construct or alter any dwelling in violation of any of the provisions of this code.

- (a) Injunction. When violations occur, the department may bring legal action to enjoin any violations.
 - (b) Ordinances. This code shall not affect the enforcement of any ordinance or regulation, the violation of which occurred prior to the effective date of this code.
- (2) Penalties. Pursuant to sections 101.66 and 101.77, Stats., whoever violates this code shall forfeit to the state not less than \$25 nor more than \$500 for each violation. Each day that the violation continues, after notice, shall constitute a separate offense.
 - (3) Municipal enforcement. Any municipality which administers and enforces this code may provide, by ordinance, remedies and penalties for violation of that jurisdiction exercised under section 101.65, Stats. These remedies and penalties shall be in addition to those which the state may impose under (1) and (2) of this section. Any municipality invoking a remedy or penalty, including forfeiture, shall promptly notify the department of the remedy or penalty being imposed and the reason therefore.

Ind 20.23 SAVING AND SEVERABLE CLAUSES. If, for any reason, any one or more sections, sentences, clauses or parts of this code are held invalid, such invalidity shall not affect, impair or invalidate the remaining provisions.

PART IX--ADOPTION OF STANDARDS

Ind 20.24 ADOPTION OF STANDARDS. All dwellings are required to be designed by the method of structural analysis or the method of accepted practice outlined in each chapter of the code. Dwellings designed by the method of structural analysis shall comply with the standards and manuals listed in (1) through (5) of this section. Pursuant to section 227.025, Stats., the attorney general and the revisor of statutes have consented to the incorporation by reference of the following standards. Copies of the standards are on file in the offices of the department, the secretary of state, the revisor of statutes and in each county law library. Copies for personal use may be obtained, at a reasonable cost, from the organizations listed.

- (1) American Institute of Steel Construction, 1221 Avenue of the Americas, New York, N. Y. 10020, SPECIFICATION FOR THE DESIGN, FABRICATION AND ERECTION OF STRUCTURAL STEEL FOR BUILDINGS, WITH COMMENTARY, November 1, 1978.
- (2) American Concrete Institute (ACI), P.O. Box 19150, Redford Station, Detroit, Michigan 48219, BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE, ACI 318-77.
- (3) National Bureau of Standards, U.S. Department of Commerce, Washington, D. C. 20234, MODEL DOCUMENTS FOR THE EVALUATION, APPROVAL, AND INSPECTION OF MANUFACTURED BUILDINGS, NBS Building Science Series 87, July 1976.
- (4) National Forest Products Association, 1619 Massachusetts Ave. NW, Washington, D. C. 20036, NATIONAL DESIGN SPECIFICATION FOR WOOD CONSTRUCTION, 1977 edition, including DESIGN VALUES FOR WOOD CONSTRUCTION, a supplement to the 1977 edition of National Design Specification for Wood Construction; ALL-WEATHER WOOD FOUNDATION SYSTEM, DESIGN, FABRICATION, INSTALLATION MANUAL, revised June 1976.
- (5) Portland Cement Association, 5420 Old Orchard Road, Skokie, Illinois 60076, CONCRETE MASONRY HANDBOOK FOR ARCHITECTS, ENGINEERS, BUILDERS, fourth edition, 1976.

The next page is numbered 25.

Chapter Ind 21--Spray Coating, is renumbered Chapter Ind 221, and a new Chapter Ind 21--Construction Standards, a part of the Uniform Dwelling Code, is created to read:

CHAPTER IND 21
CONSTRUCTION STANDARDS

PART I--SCOPE

Ind 21.01 Scope

PART II--DESIGN CRITERIA

- Ind 21.02 Loads and materials
- Ind 21.03 Exits, doors and hallways
- Ind 21.04 Stairs
- Ind 21.05 Light and ventilation
- Ind 21.06 Ceiling height
- Ind 21.07 Attic and crawl space access
- Ind 21.08 Firestopping and fire separation
- Ind 21.09 Smoke detectors
- Ind 21.10 Protection against decay and termites
- Ind 21.11 Foam plastic insulation

PART III--EXCAVATIONS

- Ind 21.12 Grade
- Ind 21.13 Excavations adjacent to adjoining property
- Ind 21.14 Excavations for footings and foundations

PART IV--FOOTINGS

- Ind 21.15 Footings
- Ind 21.16 Frost penetration
- Ind 21.17 Drain tiles

PART V--FOUNDATIONS

- Ind 21.18 Foundations

PART VI--FLOORS

- Ind 21.19 Floor design
- Ind 21.20 Concrete floors
- Ind 21.21 Precast concrete floors
- Ind 21.22 Wood frame floors

PART VII--WALLS

- Ind 21.23 Wall design
- Ind 21.24 Exterior covering
- Ind 21.25 Wood frame walls
- Ind 21.26 Masonry walls

PART VIII--ROOF AND CEILINGS

- Ind 21.27 Roof design
- Ind 21.28 Roof and ceiling wood framing

PART IX--FIREPLACE REQUIREMENTS

- Ind 21.29 Masonry fireplaces
- Ind 21.30 Factory-built fireplaces
- Ind 21.31 Factory-built fireplace stoves

CHAPTER IND 21
CONSTRUCTION STANDARDS

PART I--SCOPE

Ind 21.01 SCOPE. The provisions of this chapter shall apply to the design and construction of all one- and 2-family dwellings.

PART II--DESIGN CRITERIA

Ind 21.02 LOADS AND MATERIALS. Every dwelling shall be designed and constructed in accordance with the requirements of this section.

- (1) Design load. Every dwelling shall be designed and constructed to support the actual dead load, live loads and wind loads acting upon it without exceeding the allowable stresses of the material.
 - (a) Dead loads. Every dwelling shall be designed and constructed to support the actual weight of all components and materials. Earth-sheltered dwellings shall be designed and constructed to support the actual weight of all soil loads.
 - (b) Live loads. 1. Floors and ceilings. Floors and ceilings shall be designed and constructed to support the minimum live loads listed in Table 21.02. The design load shall be applied uniformly over the component area.

TABLE 21.02

Component	Design Load (pounds per sq. ft.)
Floors	40
Garage floors	60
Balconies	80
Ceilings (with storage)	20
Ceilings (without storage).	10

- 2. Snow loads. Roofs shall be designed and constructed to support the minimum snow loads listed on the zone map. The loads shall be assumed to act vertically over the roof area projected upon a horizontal plane.
- (c) Wind loads. Every dwelling shall be designed and constructed to withstand a horizontal and uplift pressure of 20 pounds per square foot acting over the surface area.
- (d) Fasteners. All building components shall be fastened to withstand the dead load, live load and wind load. Where the effect of the dead load exceeds the wind load effect, the dwelling need not be anchored to the foundation.

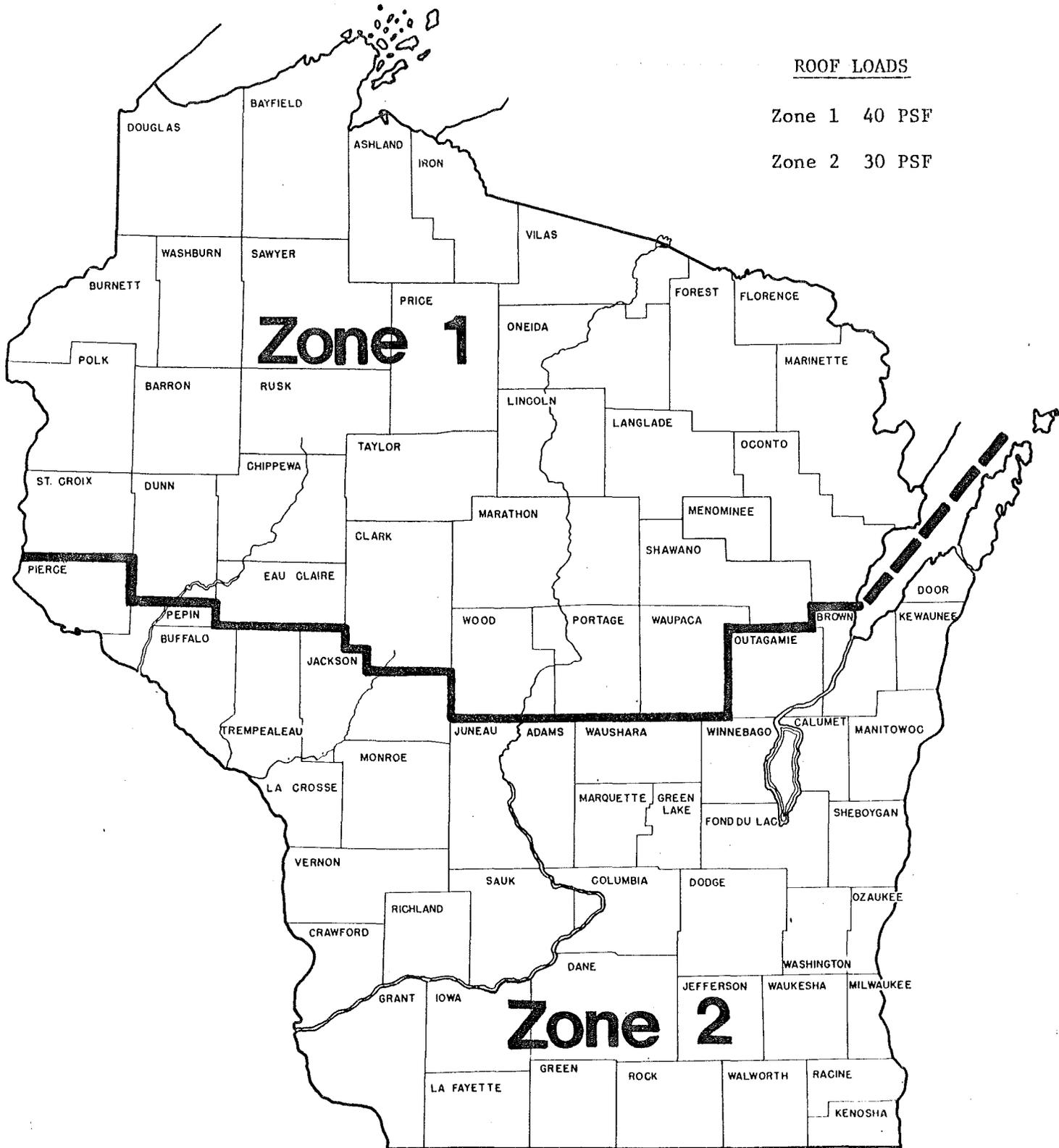
Note: See the Appendix for a schedule of fasteners.

ZONE MAP FOR ROOF LOADS

ROOF LOADS

Zone 1 40 PSF

Zone 2 30 PSF



- (2) Methods of design. All dwellings shall be designed by the method of structural analysis or the method of accepted practice specified in each part of this code.

Note: See Wis. Adm. Code chapter NR 116, rules of the department of natural resources, for special requirements relating to buildings located in flood plain zones. Information regarding the elevation of the regional flood may be obtained from the local zoning official.

- (3) Structural analysis standards. Structural analysis shall conform to the following nationally recognized standards.

- (a) Wood. Structural lumber, glue-laminated timber, timber pilings and fastenings shall be designed in accordance with the "National Design Specification for Wood Construction [Ind 20.24 (4)] and the "Design Values for Wood Construction," a supplement to the National Design Specification for Wood Construction.

Note #1: Span tables for various species are listed in the Appendix.

Note #2: The department will accept designs and installations in conformance with the following: (1) "Plywood Design Specification" including Supplement No. 1, "Design of Plywood Curved Panels"; Supplement No. 2, "Design of Plywood Beams"; Supplement No. 3, "Design of Flat Plywood Stressed-Skin Panels"; and Supplement No. 4, "Design of Flat Plywood Sandwich Panels"; (2) "Plywood Diaphragm Construction"; (3) Laboratory Report 121, "Plywood Folded Plate Design and Details"; (4) Laboratory Report 93, "Load-Bearing Plywood Sandwich Panels"; and (5) "Fabrication Specifications Plywood-Lumber Components: CP-8, BB-8, SS-8, SP-61, FF-62, PW-61" (above publications available from the American Plywood Association, 1119 A Street, Tacoma, Washington 98401); (6) Design Guide HP-SG-71, "Structural Design Guide for Hardwood Plywood" (available from the Hardwood Plywood Manufacturers Association, 2310 S. Walter Reed Drive, Arlington, Virginia 22206); (7) U.S. Product Standards PS 1-74 for Softwood Plywood Construction and Industrial (available from Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402); (8) TPI-78, "Design Specification for Metal Plate Connected Wood Trusses" (available from Truss Plate Institute, Inc., 7411 Riggs Road, Hyattsville, Maryland 20783); (9) "Wood Structural Design Data," 1978 edition (available from National Forest Products Association, 1619 Massachusetts Ave. NW, Washington, D. C. 20036).

Note #3: The department will accept plywood treated in accordance with the standards of the American Wood Preservers Association.

- (b) Structural steel. The design, fabrication and erection of structural steel for buildings shall conform to: AISC, "Specification for Design, Fabrication and Erection of Structural Steel for Buildings" [Ind 20.24 (1)] and the provisions of the accompanying commentary for this specification.

(c) Concrete. Plain, reinforced or prestressed concrete construction shall conform to the following standard:

1. ACI Std. 318, "Building Code Requirements for Reinforced Concrete" [Ind 20.24 (2)].

Note: The following standards are recognized by the department as being good construction practice: (1) "Commentary on Building Code Requirements for Reinforced Concrete," ACI Report 318; (2) "Recommended Practice for Selecting Proportions for Concrete," ACI Std. 211.1; (3) "Recommended Practice for Selecting Proportions for Structural Lightweight Concrete," ACI Std. 211.2; (4) "Recommended Practice for Hot Weather Concreting," ACI Std. 605; (5) "Recommended Practice for Cold Weather Concreting," ACI Std. 306; (6) "Manual of Standard Practice for Detailing Reinforced Concrete Structures," ACI Std. 315; (7) "Recommended Practice for Evaluation of Compression Test Results of Field Concrete," ACI Std. 214; (8) "Recommended Practice for Measuring, Mixing and Placing Concrete," ACI Std. 614; (9) "Recommended Practice for Concrete Formwork," ACI Std. 347; (10) "Specification for the Design and Construction of Reinforced Concrete Chimneys," ACI Std. 505; (11) "Suggested Design of Joints and Connections in Precast Structural Concrete," ACI Report 512; (12) "Guide for Cellular Concretes Above 50 pcf and for Aggregate Concretes Above 50 pcf with Compressive Strengths Less than 2500 psi," ACI JOURNAL, February 1975 (Copies of above standards may be obtained from American Concrete Institute, P. O. Box 19150, Redford Station, Detroit, Michigan 48219); (13) "Recommended Practices for Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction," AWS Std. 12.1 (American Welding Society, 2501 NW 7th St., Miami, Florida 33125).

(e) Masonry. The design and construction of masonry buildings shall conform to the "Concrete Masonry Handbook" [Ind 20.24 (5)].

Ind 21.03 EXITS, DOORS AND HALLWAYS. Every dwelling unit shall be provided with at least 2 exits. One exit shall lead to grade; the remaining exit may be an exit to grade, a balcony located within 10 feet of grade, or the exit may discharge into an attached garage with an exit door leading to the exterior. The overhead garage door may not be used as the exit door. The exits shall be located as far apart as practicable.

- (1) Exit doors. The main exit door shall be at least 3 feet 0 inches wide by 6 feet 4 inches high and the second exit door shall be at least 2 feet 8 inches wide by 6 feet 4 inches high. The second exit may be a sliding door. Where double doors are provided, the width of each single door shall be at least 2 feet 6 inches. The overhead garage door may not be considered as a second exit door.

(2) Interior circulation. All passageway doors to at least 50% of the bedrooms, at least one full bathroom, and the common-use areas such as kitchens, dining rooms, living rooms and family rooms shall be at least 2 feet 8 inches wide by 6 feet 4 inches high. Where cased or uncased openings are provided in lieu of doors, the clear width of the passageway openings shall measure at least 2 feet 6 inches.

(3) Hallways. Hallways shall be at least 3 feet in width.

Note: Door hardware, finish trim and heating registers may infringe upon this dimension.

Ind 21.04 STAIRS. Every exterior or interior exit stairs shall conform to the requirements of this section. Ladders may be used for access to occupied loft areas of not more than 200 square feet or to storage and equipment areas. Ladders or stairs not required by this code are exempt from the requirements of this section.

- (1) Minimum width. Every required exit stairs shall measure at least 3 feet 0 inches in width, except that stairs leading to basements may measure 2 feet 8 inches in width.
- (2) Headroom. Every stairs shall be provided with a minimum headroom clearance of 6 feet 4 inches. The minimum clearance shall be measured vertically from a line parallel to the edge of the treads to the ceiling or soffit directly above that line.
- (3) Treads and risers. Risers shall not exceed 8-1/4 inches in height, measured vertically from tread to tread. Treads shall be at least 9 inches wide, measured horizontally from riser to riser. There shall be no variation in uniformity exceeding 3/16-inch in the depth of tread or in the height of risers. No flight of stairs shall exceed 12 feet in height vertically unless landings are provided.
- (4) Landings.
 - (a) Intermediate landings. Intermediate landings located in a flight of stairs shall be at least as wide as the stairs and shall measure at least 3 feet 0 inches in the direction of travel. Trim and handrails may project no more than 3-1/2 inches into the required width.
 - (b) Landings at the top and base of stairs. A level landing shall be provided at the top and at the base of every stairs. The landing shall be at least as wide as the stairs and shall measure at least 3 feet 0 inches in the direction of travel.
 - (c) Doors at landings. Where a door is provided at the head or foot of a stairs, a level landing on each side of the door shall be provided between the door and the stairs, regardless of the door swing.
 1. Exception. No landing shall be required between the door and the basement stairs or stairs leading to a garage, provided the door does not swing over the stairs.
 2. Exception. A storm door or screen door shall be permitted to swing over an exterior platform or sidewalk provided the platform or sidewalk is located not more than 8-1/4 inches below the floor level and provided the platform has a length at least equal to the width of the door.

- (5) Handrails and guardrails. (a) Handrails. Every stairs of more than 3 risers shall be provided with at least one handrail. Handrails shall be provided on all open sides.
- (b) Guardrails. All openings between floors, open sides of landings, platforms, balconies or porches which are more than 24 inches above grade or a floor shall be protected with guardrails.
- (c) Handrail and guardrail details. 1. Height. Handrails shall be located at least 30 inches, but not more than 34 inches, above the upper surface of the tread. Guardrails shall be located at least 36 inches above the upper surface of the floor.
2. Open railings. Open guardrails or handrails shall be provided with intermediate rails or an ornamental pattern such that an object 12 inches in diameter cannot pass through.
3. Clearance. The clearance between the handrail and the wall surface shall be at least 1-1/2 inches.
- (6) Winders. Winder steps may be used in required exit stairs where the length of the tread is at least 3 feet 0 inches and the winder tread measures at least 7 inches in width at a point one foot from the narrow end of the tread.
- (7) Spiral stairs. Spiral stairs may be used as required exit stairs. The tread shall measure at least 26 inches from the outer edge of the supporting column to the inner edge of the handrail and at least 7 inches in width at a point one foot from the narrow end of the tread.

Ind 21.05 LIGHT AND VENTILATION.

- (1) Natural light. All habitable rooms, except those located in basements, shall be provided with natural light by means of glazed openings of at least 8% of the net floor area.
- (2) Ventilation. Natural or mechanical ventilation shall be provided as follows:
- (a) Natural ventilation. All habitable rooms, except kitchens and bathrooms, shall be provided with natural ventilation by means of openable exterior doors or windows of at least 3.5% of the net floor area.
- (b) Mechanical ventilation. Where a mechanical ventilation system is provided in lieu of openable exterior openings providing natural ventilation, the system shall be capable of providing at least one air change per hour. Exhaust ventilation shall terminate outside the building.
- (3) Cold-side venting. Cold-side venting of insulation shall be provided at roof/attic, flat-roof/ceiling and sloping-roof/ceiling assemblies. Ventilation shall be provided at the rate of one square foot of free ventilating area for each 300 square feet of area. At least 50% of the vents shall be located at the soffit area.

Note: Example: The venting area required for a 1500 square foot dwelling is $1500 \text{ sq. ft.} \times 1/300 = 5 \text{ sq. ft.}$

- (4) Crawl space venting. Unheated crawl spaces shall be provided with a concrete slab, roll roofing or plastic film vapor barrier and a minimum of 2 ventilators located at opposite sides of the crawl space. Ventilation shall be provided at the rate of one square foot of free ventilating area for each 1500 square feet of area.
- (5) Safety glass. Glass in entrance and exit doors, sliding glass doors, storm doors, bathtub enclosures, shower doors, and fixed glass panels immediately adjacent to doors shall be safety glass.

Ind 21.06 CEILING HEIGHT. Habitable rooms shall have a ceiling height of at least 7 feet 0 inches. Beams or dropped ceilings may project 8 inches into that height. Habitable rooms with sloped ceilings shall have an average ceiling height of at least 6 feet 0 inches; at least 50% of the ceiling shall exceed the height of 6 feet 0 inches.

Ind 21.07 ATTIC AND CRAWL SPACE ACCESS. (1) Attic. Attics shall be provided with an access opening of at least 14 by 24 inches, accessible from inside the structure.

- (2) Crawl space. Crawl spaces shall be provided with an access opening of at least 14 by 24 inches.

Ind 21.08 FIRESTOPPING AND FIRE SEPARATION. (1) Firestopping. Firestopping shall be provided in the walls at each floor and ceiling to cut off vertical draft openings between stories. Holes around ducts and pipes shall also be firestopped. Firestopping shall consist of wood at least 2 inches, nominal, in thickness; 2 boards, one inch, nominal, in thickness; or one piece of 3/4-inch plywood with joints backed by another piece of plywood. Gypsum wallboard, mineral-based insulation or other rigid noncombustibles may also be used for firestopping.

- (2) Fire separation. Attached garages shall be separated from the dwelling unit in accordance with the requirements of this section.

- (a) Separation from habitable areas. Attached garages shall be separated from the dwelling unit by at least 3/4-hour rated construction.

1. Exception. Gypsum drywall on the garage side may be untaped provided at least 5/8-inch firecode drywall is used on the garage side and all edges are tightly fitted.
2. Exception. Gypsum drywall on the garage side may be untaped provided at least 1/2-inch drywall is used on both sides of the wall separating the garage and the dwelling and all edges are tightly fitted.
3. Exception. Two layers of 1/2-inch drywall on the garage side may be untaped where no drywall is installed on the interior provided all edges are tightly fitted.

- (b) Separation from nonhabitable areas. Attached garages shall be separated from the attic or other nonhabitable areas of the dwelling by a rated assembly having a minimum 20-minute finish rating.

1. Exception. Gypsum drywall on the garage side may be untaped provided at least 1/2-inch drywall is used on the garage side and all edges are tightly fitted.

- (c) Doors. The door(s) between the garage and the dwelling unit shall be solid core, metal, or have a minimum 20-minute fire rating.
- (d) Floors. Garage floors shall be of noncombustible materials and sloped toward the exterior garage door or opening, unless drained.

Ind 21.09 SMOKE DETECTORS. Each dwelling shall be provided with a minimum of one approved, listed and labeled smoke detector sensing visible or invisible particles of combustion, installed in a manner and location consistent with its listing.

Ind 21.10 PROTECTION AGAINST DECAY AND TERMITES. (1) General. Wood used in the following locations shall be pressure treated with preservative, shall be a naturally durable, decay-resistant species and grade of lumber, or shall be protected against decay and termites.

- (a) Wood joists or the bottom of wood structural floors closer than 18 inches or wood girders closer than 12 inches to exposed earth in crawl spaces or unexcavated areas.
 - (b) Sills which rest on concrete or masonry walls and are less than 8 inches from exposed earth.
 - (c) Ends of wood girders entering masonry or concrete walls and having clearances of less than 1/2 inch on the tops, sides and ends.
 - (d) Wood siding having a clearance of less than 6 inches from the earth.
 - (e) Wood embedded in earth.
 - (f) Exception. Wood used in basements as furring or finish material or in nonbearing walls need not comply with this section.
- (2) Identification. All pressure-treated wood and plywood shall be identified.

Ind 21.11 FOAM PLASTIC INSULATION. Foam plastic insulation shall have a flame-spread rating of not more than 75 and a smoke-developed rating of not more than 450.

Note: The department will accept foam plastic insulation tested in accordance with ASTM E-84.

- (1) Protection. Foam plastic insulation shall be protected in accordance with the following:
 - (a) Walls. Foam plastic insulation may be used within the cavity of a masonry wall, in cores of masonry units, within the stud space of a wood frame wall, or on the inside of a building surface of a wall or ceiling if the foam plastic insulation is fully protected by a thermal barrier having a finish rating of at least 15 minutes.
 - (b) Roofs. Roof coverings may be applied over foam plastic insulation where the interior of the dwelling is separated from the foam plastic insulation by plywood sheathing at least 1/2-inch in thickness or other approved material having a minimum 15-minute finish rating.

- (c) Doors. Foam plastic insulation having a flame-spread rating of 75 or less may be used in doors when the door facing is of metal having a minimum thickness of 0.032-inch aluminum or No. 26 gauge sheet metal.
- (2) Specific approval. Foam plastic insulation not meeting the requirements of this section may be approved by the department based upon diversified tests which evaluate materials or assemblies representative of actual end use applications.

Note: Approved diversified tests may include, but are not limited to: ASTM E-84 (tunnel test), ASTM E-19 fire test, full-scale corner test, enclosed room corner test and ignition temperature test.

PART III--EXCAVATIONS

Ind 21.12 GRADE. The grade shall slope away from the dwelling to provide drainage away from the dwelling.

Ind 21.13 EXCAVATIONS ADJACENT TO ADJOINING PROPERTY.

- (1) Notice. Any person making or causing an excavation which may affect the lateral soil support of adjoining property or buildings shall provide at least 30 days written notice to all owners of adjoining buildings of the intention to excavate. The notice shall state that adjoining buildings may require permanent protection.
- (a) Exception. The 30-day time limit for written notification may be waived if such waiver is signed by the owner(s) of the adjoining properties.
- (2) Responsibility for underpinning and foundation extensions. (a) Excavations less than 12 feet in depth. If the excavation is made to a depth of 12 feet or less below grade, the person making or causing the excavation shall not be responsible for any necessary underpinning or extension of the foundations of any adjoining buildings.
- (b) Excavations greater than 12 feet in depth. If the excavation is made to a depth in excess of 12 feet below grade, the owner(s) of adjoining buildings shall be responsible for any necessary underpinning or extension of the foundations of their buildings to a depth of 12 feet below grade. The person making or causing the excavation shall be responsible for any underpinning or extension of foundations below the depth of 12 feet below grade.

Ind 21.14 EXCAVATIONS FOR FOOTINGS AND FOUNDATIONS. (1) Excavations below footings and foundations. No excavation shall be made below the footing and foundation unless provisions are taken to prevent the collapse of the footing or foundation.

- (2) Excavations for footings. All footings shall be located on undisturbed or compacted soil, free of organic material, unless the footings are reinforced to bridge poor soil conditions.

PART IV--FOOTINGS

Ind 21.15 FOOTINGS. The dwelling shall be supported on a structural system designed to transmit and safely distribute the loads to the soil. The loads for determining the footing size shall include the weight of the live load, roof, walls, floors, pier or column, plus the weight of the structural system and the soil over the footing. Footings shall be sized to not exceed the allowable material stresses. The bearing area shall be at least equal to the area required to transfer the loads to the supporting soil without exceeding the bearing values of the soil.

- (1) Size. Unless designed by structural analysis, unreinforced concrete footings shall comply with the following requirements:
- (a) Continuous footings. The minimum width of the footing on each side of the foundation wall shall measure at least 4 inches wider than the wall. The footing depth shall be at least 8 inches nominal. Footings placed in unstable soil shall be formed.
 - (b) Column or pier footing. The minimum width and length of column or pier footings shall measure at least 2 feet by 2 feet. The depth shall measure at least 12 inches nominal. The column shall be so placed as to provide equal projections on each side of the column.
 - (c) Trench footings. Footings poured integrally with the wall may be used when soil conditions permit. The minimum width shall be at least 8 inches nominal.
 - (d) Chimney and fireplace footings. Footings for chimneys or fireplaces shall extend at least 4 inches on each side of the chimney or fireplace. The minimum depth shall measure at least 12 inches nominal.
 - (e) Floating slabs. Any dwelling supported on a floating slab on grade shall be designed through structural analysis.
- (2) Soil-bearing capacity. No footing or foundation shall be placed on soil with a bearing capacity of less than 2,000 pounds per square foot unless the footing or foundation has been designed through structural analysis. The soil-bearing values of common soils may be determined through soil identification.

Note: The department will accept the soil-bearing values for the types of soil listed in the following table:

Type of Soil	PSF
1. Wet, soft clay; very loose silt; silty clay.	2,000
2. Loose, fine sand; medium clay; loose sandy clay soils.	2,000
3. Stiff clay; firm inorganic silt.	3,000
4. Medium (firm) sand; loose sandy gravel; firm sandy clay soils; hard dry clay	4,000
5. Dense sand and gravel; very compact mixture of clay, sand and gravel.	6,000
6. Rock	12,000

- (a) Minimum soil-bearing values. If the soil located directly under a footing or foundation overlies a layer of soil having a smaller allowable bearing value, the smaller soil-bearing value shall be used.
- (b) Unprepared fill material, organic material. No footing or foundation shall be placed upon unprepared fill material, organic soil, alluvial soil or mud unless the load will be supported. When requested, soil data shall be provided.

Note: The decomposition of organic material in landfill sites established for the disposal of organic wastes may produce odorous, toxic and explosive concentrations of gas which may seep into buildings through storm sewers and similar underground utilities unless provisions are taken to release the gases to the atmosphere.

Ind 21.16 FROST PENETRATION. Footings and foundations, including those for ramps and stoops, shall be placed below the frost penetration level, but in no case less than 42 inches below the ground. Such footings shall not be placed over frozen material.

- (1) Exceptions. (a) Floating slabs constructed on grade need not be installed below the minimum frost penetration line provided measures have been taken to prevent frost forces from damaging the structure.
- (b) Grade beams need not be installed to the minimum frost penetration line provided measures are taken to prevent frost forces from damaging the structure.
- (c) Stoops or ramps need not be installed below the minimum frost penetration level provided measures are taken to prevent frost forces from damaging the structure.
- (d) Footings or foundations may bear directly on rock located less than 42 inches below grade. Prior to placement, the rock shall be cleaned of all earth. All clay in the crevices of the rock shall be removed to the level of frost penetration or 1-1/2 times the width of the rock crevice. Provisions shall be taken at grade to prevent rain water from collecting along the foundation wall of the building.

Ind 21.17 DRAIN TILES. (1) Where required. Perforated drain tiles, or equivalent, shall be provided around footings located in soils where ground water levels occur above the elevation of the footing. The drain tiles shall discharge by gravity or mechanical means to grade or to an approved drainage system.

- (2) Protection of tiles. Where individual tiles are used, the joints shall be protected to prevent blockage of the system. The tiles shall be placed upon at least 2 inches of and covered with at least 6 inches of crushed rock or similar porous material.
- (3) Designation. Municipalities exercising jurisdiction under this code may determine under what circumstances drain tiles will be required. If required, the installation of drain tiles shall be installed in accordance with these requirements.

PART V--FOUNDATIONS

Ind 21.18 FOUNDATIONS. Foundation walls shall be designed and constructed to support the vertical loads of the dwelling, lateral soil pressure, and other loads without exceeding the allowable stresses of the materials of which the foundations are constructed.

- (1) Concrete foundation walls. Unless designed through structural analysis, the minimum thickness of concrete foundation walls shall be determined from Table 21.18-A, but in no case shall the thickness be less than the thickness of the wall it supports.

TABLE 21.18-A
CONCRETE WALL THICKNESSES

Type of Concrete	Nominal Thickness (inches)	Maximum Height of Unbalanced Fill ¹ for Material of Wall Being Supported (Wood frame - feet)
3000 psi	6	6.5
Unreinforced concrete	8	8
	10	9
	12 ²	10
	14	11.5

¹Unbalanced fill is the difference in elevation between the outside grade and the basement floor.

²The maximum height of unbalanced fill for a 12-inch thick plain concrete wall may be increased to 12 feet provided the wall is constructed of concrete with a minimum compressive value of 6,000 psi at 28 days.

- (2) Masonry foundation walls. Unless designed through structural analysis, the masonry foundation walls shall be constructed in accordance with the following requirements:
 - (a) Unreinforced masonry wall; thickness. The minimum thickness of unreinforced masonry foundation walls shall be determined by Table 21.18-B, but in no case shall the thickness be less than the thickness of the wall it supports.
 - (b) Reinforced masonry wall; thickness. Reinforced masonry walls shall be reinforced in accordance with the requirements of Tables 21.18-C and 21.18-D. In partially reinforced masonry walls, vertical reinforcement shall be provided on each side of any opening, at each wall corner, and at intervals indicated in the tables.

TABLE 21.18-B

MAXIMUM DEPTH BELOW GRADE* (HEIGHT OF FILL) AND THICKNESSES
FOR VARIOUS CONCRETE MASONRY FOUNDATION WALLS WITHOUT PILASTERS

Wall Construction Nominal Thickness, in., and Type of Unit	Maximum Depth Below Grade, feet, when Walls Support:	
	Frame Construction	Masonry, or Masonry Veneer Construction
Hollow-Load-Bearing:		
8"	5' (6')	6'
10"	6' (7')	7'
12"	7'	7'
Solid Load-Bearing:		
8"	5' (7')	7'
10"	6' (7')	7'
12"	7'	7'

*In well drained sand and gravel soils, the height of the unbalanced fill may be increased to the values shown in parentheses.

TABLE 21.18-C

MAXIMUM DEPTH BELOW GRADE (HEIGHT OF FILL)
FOR VARIOUS CONCRETE MASONRY FOUNDATION WALLS WITH PILASTERS

Wall Construction Nominal Thickness, in., and Type of Unit	Total Ht. of Wall (feet)	Max. Pilaster Spacing o.c. (feet)	Pilaster Size (nominal)	Max. Depth Below Grade (feet)
8-inch Hollow Load-Bearing	7.5	11	16" x 16"	6.5
8-inch Hollow Load-Bearing with Solid Pilasters or Filled Cells of Hollow Units	7.5	20	16" x 16"	6.5

TABLE 21.18-D

MAXIMUM DEPTH BELOW GRADE FOR PARTIALLY REINFORCED MASONRY WALLS

Wall Construction Nominal Thickness, in., and Type of Unit	Total Height of Wall (feet)	Reinforcement Size and Spacing (feet) Center to Center	Max. Depth Below Grade (feet)
8-inch Hollow Load-Bearing	7.0 to 8.5	#5 bars @ 8'	6.5
		#6 bars @ 8'	7.5
		#7 bars @ 8'	7.5

(3) Wood foundations. Wood foundations shall be designed and constructed in accordance with the National Forest Products Association standard, "All-Weather Wood Foundation System, Design, Fabrication, Installation Manual" [Ind 20. (4)] and the following exceptions. The thickness of the foundation wall shall be no less than the thickness of the wall it supports.

(a) Exceptions:

1. Section 3.3.1. Fasteners. Fasteners shall be of silicon bronze, copper or stainless steel types 304 or 316.
2. Section 6.7. Plastic film. Six-mil thick polyethylene sheeting shall be installed over the below-grade portion of exterior basement walls prior to backfilling. Joints in the polyethylene sheeting shall be lapped at least 6 inches and bonded. The top edge of the polyethylene sheeting shall be bonded to the plywood sheathing. A treated lumber or plywood strip shall be attached to the wall to cover the top edge to the polyethylene sheeting. The wood strip shall extend several inches above and below finish grade level to protect the polyethylene from exposure to light and from mechanical damage at or near grade. The joint between the strip and the wall shall be caulked full length prior to fastening the strip to the wall. Alternatively, asbestos-cement board, brick, stucco or other covering may be used in place of the wood strip. The polyethylene sheeting shall extend down to the bottom of the wood footing plate but shall not overlap or extend into the gravel footing.

(b) Materials. All lumber and plywood shall be pressure treated with preservative and labeled.

Note: The department will accept materials which meet the "Quality control Program for Soft-Wood Lumber, Timber and Plywood Pressure Treated with Water-Borne Preservatives for Ground Contact Use in Residential and Light Commercial Foundations," published by the American Wood Preservers Bureau.

PART VI--FLOORS

Ind 21.19 FLOOR DESIGN. Floors shall support all dead loads plus the minimum unit live loads as set forth in section Ind 21.02. The live loads shall be applied to act vertically and uniformly to each square foot of horizontal floor area.

Ind 21.20 CONCRETE FLOORS. When concrete floors are provided, the thickness of the concrete shall measure at least 3 inches. In clay soils, a 4-inch thick base course shall be placed in the subgrade consisting of clean graded sand, gravel or crushed stone. The base course may be omitted in sand and gravel soils. Basements shall be provided with a concrete or similar type floor.

Ind 21.21 PRECAST CONCRETE FLOORS. Unless designed through structural analysis, the maximum allowable stress, span or section size for precast concrete floors shall be determined from Table 21.21.

TABLE 21.21

HOLLOW-CORE

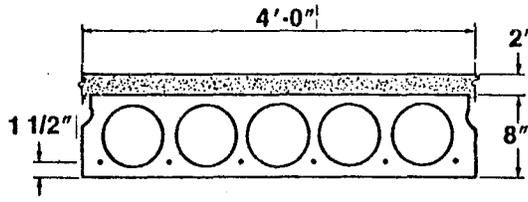
4'-0" x 8"
Normal Weight Concrete

Strand Patterns

Producer may vary size and strength (f_{pu}) of strands to achieve value shown in first column.

Safe loads shown include dead load of 10 psf for untopped members and 15 psf for topped members. Remainder is live load.

Capacity of sections of other configurations are similar. For precise values, see local hollow-core manufacturer.



$f'_{ci} = 5000 \text{ psi}$
 $f'_{cl} = 3500 \text{ psi}$

Section Properties

	Untopped	Topped
A =	215 in. ²	—
I =	1666 in. ⁴	3071 in. ⁴
Y_b =	4.00 in.	5.29 in.
Y_t =	4.00 in.	4.71 in.
Z_b =	416 in. ³	580 in. ³
Z_t =	416 in. ³	652 in. ³
b_w =	12.00 in.	12.00 in.
wt =	224 plf	323 plf
	56 psf	81 psf
V/S =	1.92 in.	

4HC8

Table of safe superimposed service load (psf)

No Topping

$A_{ps} \times f_{pu}$ kips per foot of width	Span, ft.																			
	14	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33
30-S	284	242	207	178	154	134	117	102	89	77	67	59	51							
40-S			285	247	216	189	166	147	130	115	102	90	80	71	63	56	49			
50-S				287	269	241	213	189	169	150	135	120	107	95	85	75	66	59	52	45
60-S				296	275	260	244	224	205	183	163	146	131	117	105	94	84	76	67	60
70-S				284	266	250	236	223	209	190	172	155	139	126	113	102	92	83	75	

4HC8 + 2

Table of safe superimposed service load (psf)

2" Normal Weight Topping

$A_{ps} \times f_{pu}$ kips per foot of width	Span, ft.																
	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32
30-S	260	223	192	166	143	124	107	93	76	61	48						
40-S			269	235	206	181	158	135	115	97	82	67	55	43			
50-S				299	264	234	205	178	154	133	115	98	83	70	58	47	
60-S					284	251	220	193	169	148	129	112	97	83	71	59	49
70-S					297	280	263	232	205	181	160	141	124	108	94	81	70

Bold type — Capacity governed by stresses, others governed by flexural or shear strength

Ind 21.22 WOOD FRAME FLOORS. Unless designed through structural analysis, wood frame floors shall comply with the following requirements:

- (1) Floor joists. Wood floor joists shall comply with the requirements of section Ind 21.02 (3) (a). The minimum live loads shall be determined from section Ind 21.02. Where sill plates are provided, the sill plates shall be fastened to the foundation.
- (2) Truss joists. Wood truss joists shall be designed through structural analysis.
- (3) Girders and beams. Girders and beams shall be selected from Table 21.22-A.
 - (a) Wood girders and beams shall be fitted at the post or column. Adjoining ends shall be fastened to each other to transfer horizontal loads across the joint. Beams shall also be fastened to the posts with framing anchors, angle clips, or equivalent.
 - (b) Where intermediate beams are used, they shall rest on top of the girders; or shall be supported by ledgers or blocks fastened to the sides of the girders; or they may be supported by approved metal hangers into which the ends of the beams shall be fitted.
- (4) Bearing. The minimum bearing for wood joists and rafters shall be at least 1-1/2 inches on wood or metal and at least 3 inches on masonry or concrete. Wood beams and girders shall have at least 3 inches of bearing on masonry or concrete. Tail ends of floor joists shall not overlap the beams by more than 8 inches.
- (5) Notching and boring. Notching or boring of beams or girders is prohibited unless determined through structural analysis.
 - (a) Notching.
 1. Notches located in the top or bottom of joists shall not exceed 1/6 the depth of the joist nor be located in the middle 1/3 of the span of the joist.
 2. Where joists are notched on the ends, the notch shall not exceed 1/4 the depth of the joist.
 - (b) Boring. Holes bored in joists shall be located in the center of the joist. The diameter of the hole shall not exceed 1/3 the depth of the joist.
- (6) Overhang of floors.
 - (a) Floor joists which are at right angles to the supporting wall shall not be cantilevered more than 2 feet over the supporting wall and shall support only the wall and roof above it.
 - (b) Where floor joists are parallel to the supporting wall, a double floor joist may be used to support lookout joists extending over the wall line below. The double joist shall be located a distance of twice the overhang from the lower wall. The lookout joists shall be fastened to the double joist with metal hangers.
- (7) Floor openings. Trimmers and headers shall be doubled when the span of the header exceeds 4 feet. Headers which span more than 6 feet shall have the ends supported by joist hangers or framing anchors, unless the ends are supported on a partition or beam. Tail joists (joists which frame into headers) more than 8 feet long shall be supported on metal framing anchors or on ledger strips of at least 2 inches by 2 inches nominal.

TABLE 21.22-A
MINIMUM SIZES FOR BEAMS AND GIRDERS OF STEEL OR WOOD

Column Spacing	Roof/Ceiling and One Floor				Roof/Ceiling + One Floor/Ceiling + One Floor			
	Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²		Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²	
	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1
24 ft. wide house:								
8 ft.	8x10 6x12	10x10 6x12	-- --	-- --	8x12 6x14	10x12 8x14	-- --	-- --
10 ft.	8x12 6x14	10x12 8x14	M 10x9 W 6x12	M 10x9 W 8x10	10x14 8x16	10x14 8x16	M 12x11.8 W 8x15	M 12x11.8 W 8x15
12 ft.	12x12 10x14	10x14 8x16	W 10x11.5 S 7x15.3	M 12x11.8 W 8x15	14x14 10x16	14x14 12x16	W 12x16.5 S 8x23	W 12x16.5 W 8x20
15 ft.	-- --	-- --	W 12x16.5 W 10x17	W 12x16.5 W 6x25	-- --	-- --	W 12x22 W 8x28	W 14x22 W 8x31
26 ft. wide house:								
8 ft.	10x10 6x12	10x10 8x12	-- --	-- --	10x12 8x14	10x12 8x14	-- --	-- --
10 ft.	10x12 8x14	10x12 8x14	M 10x9 W 8x10	S 6x17.25 W 8x13	10x14 8x16	12x14 8x16	M 12x11.8 W 8x15	W 12x14 W 8x17
12 ft.	10x14 8x16	10x14 8x16	M 12x11.8 W 8x15	M 12x11.8 W 6x20	14x14 12x16	12x16 10x18	W 12x16.5 W 8x20	W 10x19 W 8x24
15 ft.	-- --	-- --	W 12x16.5 W 8x20	W 10x19 W 8x24	-- --	-- --	W 14x22 W 8x31	W 14x22 W 8x35
28 ft. wide house:								
8 ft.	10x10 8x12	8x12 4x16	-- --	-- --	10x12 8x14	10x12 8x14	-- --	-- --
10 ft.	10x12 8x14	12x12 8x14	S 6x17.25 W 8x13	W 10x11.5 W 8x13	12x14 8x16	12x14 10x16	W 12x14 W 8x17	W 12x14 W 10x15
12 ft.	10x14 8x16	12x14 10x16	M 12x11.8 W 8x15	W 12x14 W 8x17	12x16 10x18	12x16 10x18	W 10x19 W 8x24	M 14x17.2 W 8x24
15 ft.	-- --	-- --	W 10x19 W 8x24	M 14x17.2 W 8x24	-- --	-- --	W 14x22 W 8x35	W 14x26 W 8x35

Column Spacing	Roof/Ceiling and One Floor				Roof/Ceiling + One Floor/Ceiling + One Floor			
	Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²		Wood Beams ¹ (in., nominal)		A 36 Steel Beams ²	
	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1	Zone 2	Zone 1
30 ft. wide house:								
8 ft.	10x10 8x12	8x12 6x14	-- --	-- --	10x12 8x14	12x12 8x14	-- --	-- --
10 ft.	10x12 8x14	12x12 10x14	S 6x17.25 W 8x13	W 10x11.5 W 8x13	12x14 10x16	12x14 10x16	W 12x14 W 10x15	W 12x14 S 8x18.4
12 ft.	12x14 8x16	12x14 10x16	W 12x14 W 8x17	W 12x14 W 8x17	12x16 10x18	14x16 12x18	M 14x17.2 W 8x24	M 14x17.2 W 8x24
15 ft.	-- --	-- --	M 14x17.2 W 8x24	W 10x21 W 8x28	-- --	-- --	W 14x26 W 8x35	W 14x26 W 10x33
32 ft. wide house:								
8 ft.	8x12 6x14	8x12 6x14	-- --	-- --	12x12 8x14	12x12 10x14	-- --	-- --
10 ft.	12x12 8x14	12x12 10x14	W 10x11.5 W 8x13	W 10x11.5 W 6x16	12x14 10x16	14x14 10x16	W 12x14 S 8x18.4	W 12x16.5 W 10x17
12 ft.	12x14 10x16	14x14 10x16	W 12x14 W 10x15	W 12x14 W 10x17	14x16 12x18	14x16 12x18	M 14x17.2 W 8x24	W 12x22 W 8x28
15 ft.	-- --	-- --	M 14x17.2 W 8x24	W 12x22 W 8x28	-- --	-- --	W 14x26 W 12x27	W 14x26 W 12x27

¹This table is based upon wood with a fiber bending stress of 1,000 psi. Two acceptable wood beam selections are listed for each loading condition.

²Two acceptable steel beam selections are listed for each loading condition. The first entry is the most economical selection based upon beam weight.

- (8) Floor sheathing, boards and planks. (a) Plywood sheathing. Plywood sheathing used for floors shall be limited to the allowable loads and spans shown in Table 21.22-B.
- (b) Plywood underlayment. Plywood underlayment shall be installed in accordance with Table 21.22-C.
- (c) Floor boards. Where wood boards are used for floor sheathing, the boards shall comply with the minimum thicknesses shown in Table 21.22-D.
- (d) Planks. Planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness. Planks shall terminate over beams unless the joints are end matched. The planks shall be laid so that no continuous line of joints will occur except at points of support. Planks shall be nailed to each beam.
- (9) Bridging. Bridging shall be provided at intervals not exceeding 8 feet.

TABLE 21.22-B

ALLOWABLE LOADS AND SPANS FOR PLYWOOD FLOOR AND ROOF SHEATHING
CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS¹

Panel Identification Index ³	Plywood Thickness (in inches)	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	5/16	12	12	155	150	0
16/0	5/16, 3/8	16	16	95	75	0
20/0	5/16, 3/8	20	20	75	65	0
24/0	3/8	24	20	65	50	0
24/0	1/2	24	24	65	50	0
30/12	5/8	30	26	70	50	12 ⁵
32/16	1/2, 5/8	32	28	55	40	16 ⁷
36/16	3/4	36	30	55	50	16 ⁷
42/20	5/8, 3/4, 7/8	42	32	40 ⁶	35	20 ⁷
48/24	3/4, 7/8	48	36	40 ⁶	35	24

¹These values apply to C-D, C-C, and structural I and II grades only. Spans shall be limited to values shown because of possible effect of concentrated loads.

²Uniform load deflection limitation: 1/180th of the span under live load plus dead load, 1/240th under live load only. Edges may be locked with lumber or other approved type of edge support.

³Identification index appears on all panels in the construction grades listed in footnote 1.

⁴Plywood 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 25/32-inch wood strip. Allowable uniform load based on deflection of 1/360 of span is 165 pounds per square foot.

⁵May be 16 inches if 25/32-inch wood strip flooring is installed at right angles to joists.

⁶For roof live load of 40 pounds per square foot or total load of 55 pounds per square foot, decrease spans by 13% or use panel with next greater identification index.

⁷May be 24 inches if 25/32-inch wood strip flooring is installed at right angles to joists.

TABLE 21.22-C

MINIMUM THICKNESS FOR PLYWOOD COMBINATION SUBFLOOR UNDERLAYMENT
 PLYWOOD CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN
 PERPENDICULAR TO SUPPORTS

Plywood Grade	Plywood Species Group	Maximum Support Spacing ¹			
		16" o.c. ^{2, 3}	20" o.c. ^{2, 3}	24" o.c. ²	48" o.c. ²
		Panel thickness (inch)	Panel thickness (inch)	Panel thickness (inch)	Panel thickness (inch)
Underlayment	1	1/2	5/8 ⁴	3/4 ⁴	--
C-C plugged	2 & 3	5/8 ⁴	3/4 ⁴	7/8 ⁴	--
Sanded exterior type	4	3/4 ⁴	7/8 ⁴	1 ⁴	--
2-4-1	1, 2 & 3	All panel groups have equal properties			1-1/8
Sturdi-I-Floor ⁵	1, 2, 3 & 4	Panel Index	Panel Index	Panel Index	Panel Index
		16" o.c.	20" o.c.	24" o.c.	48" o.c.

¹Spans shall be limited to values shown, based on possible effect of concentrated loads.

²Underlayment, C-C plugged, sanded exterior type: allowable uniform load based on deflection of $l/360$ of span for spans 24 inches or less is 125 psf; and for spans 48 inches, 65 psf.

³If a 25/32-inch wood finish floor is laid perpendicular to supports, thicknesses shown for 16-inch and 20-inch spans may be used for 24-inch span.

⁴Except for 1/2-inch, underlayment grade and C-C plugged panels may be of nominal thickness 1/32-inch less than the nominal thicknesses shown when marked with the reduced thickness.

⁵The department will accept subfloor underlayment panels such as sturd-i-floor which meet the requirements of APA manufacturing specification for sturd-i-floor panels.

TABLE 21.22-D

MINIMUM THICKNESS OF FLOOR BOARDS

Joist Spacing (inches)	Minimum Net Thickness (inches)	
	Perpendicular to Joist	Diagonal to Joist
24	11/16	3/4
16	5/8	5/8

PART VII--WALLS

Ind 21.23 WALL DESIGN. (1) Live and dead loads. All walls shall support all superimposed vertical dead loads and live loads from floors and roofs.

(2) Horizontal wind load. Walls shall be designed to withstand a horizontal wind pressure of at least 20 pounds per square foot applied to the vertical projection of that portion of the dwelling above grade. No wind load reduction shall be permitted for the shielding effect of other buildings.

Ind 21.24 EXTERIOR COVERING. The exterior walls shall be faced with a weather-resistant covering.

Ind 21.25 WOOD FRAME WALLS. Unless designed through structural analysis, wood frame walls shall comply with the following requirements.

- (1) Stud size and spacing. (a) Studs. Wood studs shall comply with the size and spacing requirements indicated in Table 21.25-A. Studs in the exterior walls shall be placed with the wide faces perpendicular to the plane of the wall.
- (b) Corner posts. Posts or multiple studs shall be provided at the corners of the walls.
- (c) Wood posts or columns. Posts and columns shall be anchored to resist loads.

TABLE 21.25-A
MAXIMUM SPACING AND HEIGHT OF STUDS

Size	Grade	Max. Height (feet)	Spacing (inches)			
			Supporting roof and ceiling only	Supporting one floor, roof and ceiling	Supporting two floors, roof and ceiling	Interior and non-load-bearing
2x3	Standard & better	8	16	N/P	N/P	24
2x4 or larger	Utility	8	24	16	12	24
2x4	Standard & better	12	24	24	12	24
2x6 or larger	No. 3 & better	18	24	24	16	24

N/P = Not permitted.

Note: A 3-story frame house with walls constructed of 2 x 4 studs would require a 12-inch stud spacing on the lowest level, a 16-inch stud spacing on the intermediate level, and a 24-inch stud spacing on the upper level.

- (2) Top plates. Studs at bearing walls shall be capped with double top plates. End joints in double top plates shall be offset at least 48 inches. Double top plates shall be overlapped at the corners and at intersections with partitions. The plate immediately above the stud shall be broken directly over the stud.

- (a) Exceptions. 1. A single top plate may be used in lieu of a double top plate where the rafter is located directly over the stud and the plate is securely tied at the end joints, corners and intersecting walls. Single top plates shall be broken directly over the stud.
2. A continuous header, consisting of two 2-inch members set on edge, may be used in lieu of a double plate if tied to the adjacent wall.
- (3) Wall openings. Where doors or windows occur, headers shall be used to carry the load across the opening.
 - (a) Header size. The size of headers shall be determined in accordance with the spans and loading conditions listed in tables 21.25-B, 21.25-C and 21.25-D.
 - (b) Header support. The ends of the header shall be fastened to a single stud when the span is limited to 3 feet. Double studs shall be provided on each side of the header in load-bearing walls exceeding 3 feet in width. Where the opening in load-bearing walls exceeds 6 feet in width, the end of the header shall be supported directly on one of the studs (shoulder stud).
 - (c) Flashing. Unless sealed or caulked, flashing shall be provided at the top and sides of all exterior window and door openings.
- (4) Notching. Notching and boring of columns or posts is prohibited unless designed through structural analysis. Studs shall not be cut or bored more than 1/3 the depth of the stud, unless the stud is reinforced.
- (5) Partitions. Load-bearing partitions shall be placed over beams, girders, or other load-bearing partitions. Load-bearing partitions running at right angles to the joists shall not be offset from the main girder or walls more than the depth of the joist unless the joists are designed to carry the load.
- (6) Wall sheathing. Exposed plywood panel siding and plywood wall sheathing shall conform to the requirements shown in Table 21.25-E.

TABLE 21.25-B

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ROOF/CEILING ASSEMBLIES*

House Width (feet)	Header Members									
	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1	
24	2.5	2.5	4	4	5	5	7	6	9	8
26	2.5	2	4	3	5	5	7	6	8	7
28	2.5	2	4	3	4	5	6	6	8	7
30	2.5	2	4	3	4	5	6	6	8	7
32	2	2	3	3	4	5	6	5	7	7

TABLE 21.25-C

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR*

House Width (feet)	Header Members				
	Two 2 x 4s	Two 2 x 6s	Two 2 x 8s	Two 2 x 10s	Two 2 x 12s
24	2.5	4	5	6	8
26	2.5	3	5	6	8
28	2	3	5	6	7
30	2	3	4	6	7
32	2	3	4	5	7

TABLE 21.25-D

ALLOWABLE SPANS (FEET) FOR HEADERS SUPPORTING ONE FLOOR AND ROOF/CEILING ASSEMBLY*

House Width (feet)	Header Members									
	Two 2 x 4s		Two 2 x 6s		Two 2 x 8s		Two 2 x 10s		Two 2 x 12s	
	Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1		Zone 2/Zone 1	
24	1.5	1.5	3	2.5	4	3	5	4	6	5
26	1.5	1.5	2.5	2.5	3	3	4	4	5	5
28	1.5	1.5	2.5	2.5	3	3	4	4	5	5
30	1.5	1.5	2.5	2.5	3	3	4	4	5	5
32	1.5	1.5	2.5	2	3	3	4	4	5	5

*These tables are based on wood with a fiber bending stress of 1,000. For other species with different fiber bending stresses, multiply the span by the ratio of the actual bending stress to 1,000. Example: The allowable roof/ceiling span for a 28-foot wide house in zone 2, using two 2 x 8 header members with a 1400 psi bending stress, is 4 ft. x 1400/1000 = 5.6 feet.

TABLE 21.25-E
EXPOSED PLYWOOD PANEL SIDING

Minimum Thickness ¹	Minimum No. of Plys	Stud Spacing (Inches) Plywood Siding Applied Direct to Studs or Over Sheathing
3/8"	3	16 ²
1/2"	4	24

¹Thickness of grooved panels is measured at bottom of grooves.

²May be 24 inches if plywood siding applied with face grain perpendicular to studs or over one of the following: (a) one-inch board sheathing; (b) 1/2-inch plywood sheathing; (c) 3/8-inch plywood sheathing with face grain of sheathing perpendicular to studs.

Ind 21.26 MASONRY WALLS. Masonry walls shall be constructed in accordance with the requirements of this section.

- (1) Cold weather work. In cold weather, provisions shall be taken to prevent masonry from being damaged by freezing.

Note: It will be the practice of the department to accept conformance with "Recommended Practices for Cold Weather Masonry Construction," available from International Masonry Institute, 823 15th Street NW, Washington, D.C. 20005.

- (2) Masonry units. All masonry units shall be free from physical defects which interfere with laying of the unit and impair the compressive strength of the unit.
- (3) Types of mortar. The type of masonry mortar to be used for various kinds of masonry work shall be determined from Table 21.26-A. The mortar shall be mixed in accordance with the proportions specified in Table 21.26-B.
- (a) Surface bond mortars. Surface bond mortars for masonry walls shall be mixed in accordance with the proportions specified on the bag.
- (4) Mortar components. Mortar components shall comply with the following requirements:
- (a) Water. Water shall be clean and free of deleterious amounts of acids, alkalies, or organic materials.
- (b) Admixtures or mortar colors. Admixtures or mortar colors shall not be added to the mortar unless the resulting mortar conforms to the requirements of the mortar specifications. Only calcium chloride may be used as an accelerant and shall be limited to 2% by weight of the cement used. Calcium chloride may not be used for any other purpose. Only mineral oxide may be used as mortar color and shall not exceed 10% by weight of the cement used.
- (c) Mixing. Mortar shall be mixed for at least 3 minutes after all ingredients have been added with the maximum amount of water to produce a workable consistency. Mortars that have stiffened due to water evaporation shall be re-tempered by adding water as frequently as needed to restore the required consistency. Mortars shall be used and placed in final position within 2-1/2 hours after mixing.

Note: To ensure proper mortar mixing, machine mixing is recommended.

TABLE 21.26-A
TYPES OF MORTAR FOR VARIOUS KINDS OF MASONRY

Kind of Masonry	Types of Mortar
Foundations:	
Footings	M, S
Walls of solid units	M, S, N
Walls of hollow units.	M, S
Hollow walls	M, S
Masonry other than foundation masonry:	
Piers of solid masonry	M, S, N
Piers of hollow units.	M, S
Walls of solid masonry	M, S, N, O
Walls of solid masonry not less than 12 in. thick or more than 35 ft. in height, supported laterally at intervals not exceeding 12 times the wall thickness.	M, S, N, O
Walls of hollow units; load-bearing or exterior, and hollow walls 12 in. or more in thickness	M, S, N
Hollow walls, less than 12 in. thick	M, S, N
Linings of existing masonry, either above or below grade	M, S
Masonry other than above	M, S, N

TABLE 21.26-B
MORTAR SPECIFICATIONS BY PROPORTION¹

Mortar Type, ASTM C 270	Parts by Volume			Sand, Damp Loose Volume
	Portland Cement	Masonry Cement	Hydrated Lime	
M	1	--	1/4	Not less than 2-1/4 and not more than 3 times the sum of the volumes of the cements and lime.
	1	1 (Type II)	--	
S	1	--	1/4 to 1/2	
	1/2	1 (Type II)	--	
N ²	1	--	1/2 to 1-1/4	
	--	1 (Type II)	--	

¹All cements are one cubic foot per sack; lime equals 1-1/4 cubic foot per sack.

²Limited to walls with a maximum depth of 5 feet below grade.

- (d) Cementitious material. Cementitious material shall conform to the standards approved by the department.

Note: The department will accept cementitious material conforming to the following standards: ASTM C91, Masonry Cement; ASTM C150, Portland Cement; ASTM C595, Portland Blast-Furnace Slag Cement; ASTM C207, Hydrated Lime for Masonry Purposes; and ASTM C5, Quick Lime for Structural Purposes.

- (e) Aggregates. Aggregates for use in masonry mortar shall consist of natural sand or manufactured sand and shall be graded.

Note: The department will accept aggregates in accordance with ASTM C144.

- (5) Cavity wall. (a) Corbeling. Cavity wall construction may be supported on an 8-inch foundation wall provided the 8-inch wall is corbeled with solid masonry to the width of the cavity wall. Individual corbels shall not exceed 2 inches nor more than one-third the height of each corbeled unit.
- (b) Projections. The projection of a wall beyond the edge of a supporting member other than masonry, such as a shelf angle or edge of a beam, shall not exceed 1-1/4 inches, unless at least 2/3 the mass of the wythe of masonry involved is located directly over the load-carrying member.
- (c) Flashing. In exterior hollow walls exposed to the weather, flashing shall be installed at the bottom of the cavity so as to drain any water outward. Open vertical joints or weep holes of 3/8-inch minimum diameter shall be provided in the facing just above the flashing at a horizontal spacing not exceeding 3 feet.
- (6) Openings and lintels. (a) Openings. The masonry above openings shall be supported. The bearing length of structural elements which support the masonry above the opening shall be not less than 4 inches.
- (b) Lintels. Unless designed through structural analysis, lintels shall be provided in accordance with Table 21.26-C.

TABLE 21.26-C

ALLOWABLE SPANS FOR LINTELS SUPPORTING MASONRY VENEER

Size of Steel Angle ¹ , 3	No Story Above	One Story Above	Two Stories Above	No. of 1/2" or Equivalent Reinforcing Bars ²
L 3 x 3 x 1/4	6' - 0"	3' - 6"	3' - 0"	1
L 4 x 3 x 1/4	8' - 0"	5' - 0"	3' - 0"	1
L 6 x 3-1/2 x 1/4	14' - 0"	8' - 0"	3' - 6"	2
2 - L 6 x 3-1/4 x 1/4	20' - 0"	11' - 0"	5' - 0"	4

¹Long leg of the angle shall be placed in a vertical position.

²Depth of reinforced lintels shall be not less than 8 inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than 8 inches into the support.

³Steel members indicated are adequate typical examples; other steel members meeting structural design requirements may be used.

- (7) Masonry veneers. (a) Veneer over frame construction. 1. Masonry veneers may be corbeled over the foundation wall, but the corbeling shall not exceed one inch.
2. An air space shall be provided between the veneer and the sheathing.
 3. Where no brick ledge is formed in the foundation wall, a 30-pound asphalt-saturated felt or corrosion-resistant metal base flashing shall extend over the top of the foundation wall from the outside face of the wall and shall extend at least 6 inches up on the wood sheathing under the building paper or water-resistant sheathing.
 4. Weepholes shall be provided at the bottom masonry course at intervals of approximately 4 feet.
- (b) Veneer over masonry back-up. A 30-pound asphalt-saturated felt or corrosion-resistant metal base flashing at the bottom of the veneer shall extend over the top of the foundation and up at least 6 inches and be embedded in the back-up course. Weepholes, at approximately every 3 feet, shall be provided.
- (8) Veneer anchorage. All veneers, supports and attachments shall be mechanically or adhesively anchored.
- (a) Mechanical anchorage. All anchors shall be corrosion-resistant.
1. Conventional size veneer (one square foot or less) shall be securely attached to its backing by anchors the equivalent of No. 22 U.S. gauge corrugated sheet steel 7/8-inch wide with at least one such tie located in every 2 square feet of wall. Ties shall be embedded 2 inches in a masonry joint and nailed to the framing with an 8d nail.
 2. Large size veneer (greater than one square foot) shall be securely attached with anchors the equivalent of not less than 1/4-inch diameter bolts in accordance with either of the following:
 - a. Each unit individually anchored to the supporting framework with at least 3 anchors.
 - b. Individual units doweled to each other at all horizontal joints and anchored to the backing at all horizontal and vertical joints so that one anchor is provided for every 6 square feet of wall surface.
- (b) Adhesive anchorage. Veneer may be cemented to a masonry or concrete wall or to exterior portland cement plaster in high rib galvanized metal lath with an adhesive, provided that the bond is sufficient to withstand a shearing stress of 50 psi after curing for 28 days.
- (9) Bearing. (a) Concentrated loads. Beams, girders, trusses, joists and other members producing concentrated loads shall bear a minimum of 3 inches on one of the following:

1. Concrete beam. The equivalent of a nominally reinforced 2,500 psi concrete beam 8 inches in height.
 2. Solid masonry. At least 8 inches in height of masonry composed of solid masonry units with all voids and joints completely filled with mortar.
 3. Metal plate. A metal plate of sufficient thickness and size to distribute the load to masonry units. For piers and columns, the bearing plate shall not exceed 60% of the cross-sectional area of the pier or column and the resultant reaction of all vertical and horizontal loads shall fall within the middle third of the member.
 4. Bond beam. The bond beam shall be the equivalent of not less than an 8-inch lintel (bond beam) block with 2 No. 4 bars embedded in high strength mortar fill or equivalent. The loads shall bear on the fill.
- (b) Continuous loads. Joists, trusses and beams other than wood, spaced 4 feet or more on center and 40 feet in length, slabs or other members causing continuous loads shall be transmitted to masonry with a minimum bearing of 3 inches upon solid masonry at least 2-1/2 inches in height, or as indicated for concentrated loads.
- (c) Stack bond walls. Concentrated loads shall be distributed into masonry laid in stack bond by a concrete beam or bond beam [as defined in (a)]. For masonry of solid units, 2 additional rows of a continuous tie assembly may be used instead of a concrete beam or bond beam.
- (d) Support of wood floor members. Where a wood structural member is buried in masonry for support, it shall be firecut or a self-releasing device shall be used. Where the end of a wood structural member is built into an exterior wall, a 1/2-inch air space shall be provided at the sides, top and end of such member.
- (10) Bonding. Unless designed through structural analysis, all masonry walls shall be bonded as follows:
- (a) Single-wythe walls. Masonry units in single-wythe walls shall be lapped at least 2 inches or one-third the height of the masonry unit, whichever is greater, or through the use of continuous tie assemblies spaced at 16-inch vertical intervals.
 - (b) Multi-wythe walls. Adjacent wythes shall be bonded with continuous tie assemblies spaced at vertical intervals not exceeding 16 inches; or individual ties of at least 3/16-inch diameter for each 4-1/2 square feet of wall area, spaced at a maximum vertical distance of 18 inches and a maximum horizontal distance of 36 inches; or bonded with a full course of masonry headers every seventh course. The clear distance between bond courses shall not exceed 16 inches for solid masonry units and 24 inches for hollow masonry units. Hollow walls shall not be bonded with headers.
- (11) Bolts and anchors. The allowable shear on steel bolts and anchors shall not exceed the values given in Table 21.26.

TABLE 21.26
ALLOWABLE SHEAR ON BOLTS AND ANCHORS

Bolt or Anchor Diameter (inches)	Embedment ¹ (inches)	Allowable Shear (pounds)
1/4	4	270
3/8	4	410
1/2	4	550
5/8	4	750
3/4	5	1100
7/8	6	1500
1	7	1850
1-1/8	8	2250

¹Bolts and anchors shall be solidly embedded in mortar or grout.

- (12) Joints. (a) The maximum thickness of a mortar joint shall be 1/2 inch.
- (b) Except for head joints used for weepholes and ventilation, solid masonry units shall be laid to achieve full head and bed joints.
- (c) Hollow masonry units shall be laid with full head joints and full bed joints under the full bearing areas of the face shells and under webs where the adjacent cells are to be filled with grout.
- (13) Cleaning. Chemical cleaning agents shall be prevented from harming the metal reinforcement of structural components and shall not be of a strength which will adversely affect the mortar.
- (14) Dampproofing. Masonry foundation walls of basements in clay-type soils shall be made dampproof by the application to the exterior surfaces of a continuous coat of at least 3/8-inch thick portland cement and sand coat mortar, or a type M mortar troweled smooth. Surface bonding material, 1/4-inch thick, applied to the exterior surfaces, may also be used.

PART VIII--ROOF AND CEILINGS

Ind 21.27 ROOF DESIGN. (1) Roof loads. Roof and roof/ceiling assemblies shall support all dead loads plus the minimum live loads as set forth in section Ind 21.02.

- (2) Uplift and suction forces. Roofs shall withstand a pressure of at least 20 pounds per square foot acting upward normal to the roof surface. Roof overhangs, eaves, canopies and cornices shall withstand an upward wind pressure of at least 20 pounds per square foot applied to the entire exposed area.
 - (a) Anchorage. Roofs shall be anchored to walls and columns to resist uplift.
 - (b) Stress increase. All stresses may be increased by a maximum of one third for wind forces.
- (3) Water. All roofs shall be designed and constructed to assure drainage of water.
 - (a) Roofing. Roofing shall be installed to shed water. Underlayment shall be provided under shingles. Fasteners shall be corrosion-resistant.
 - (b) Eave protection for shingles and shakes. Sheet metal, asphalt-impregnated felt paper or similar eave protection shall be provided on roof slopes of less than 4:12 (18.4°), extending from the edge of the roof a minimum distance of 2 feet 6 inches up the roof slope to a line not less than 12 inches inside the inner face of the exterior wall; except over unheated garages or porches.
- (4) Flashing. Flashings shall be installed at the junction of chimneys and roofs, in all valleys, and around all roof openings.
 - (a) Valley flashing.
 1. Open valleys. Open valleys shall be flashed with at least No. 28 gauge galvanized, corrosion-resistant sheet metal, 16 inches wide, or a layer of at least 50-pound roll roofing, 16 inches wide, placed over a layer of 15-pound roofing underlayment. Flashing sections shall be overlapped by at least 4 inches.
 2. Closed valleys. Where shingles are laced or woven over the valley, the valley shall be flashed with at least one layer of 50-pound roofing, at least 20 inches wide, over the layer of 15-pound roofing underlayment.
 - (b) Chimney flashing.
 1. Chimney crickets shall be installed where the upper side of a chimney is more than 30 inches wide on a sloping roof. The intersection of the cricket and the chimney shall be flashed and counter-flashed to a height of at least 4 inches.
 2. Chimneys not exceeding 30 inches wide shall be flashed and counter-flashed to a height of at least 6 inches.
 3. Chimney sides shall be flashed to a height of at least 4 inches.

Ind 21.28 ROOF AND CEILING WOOD FRAMING. Unless designed through structural analysis, wood rafters and ceiling joists, and components, shall comply with the requirements of section Ind 21.02 (3).

- (1) Roof rafters. Where rafters meet to form a ridge, the rafters shall be placed directly opposite and secured to each other or to a ridge board one inch, nominal, in thickness. Where rafters are offset more than the thickness of the rafter, a ridge board 2 inches, nominal, in thickness shall be used.
- (2) Anchorage. Roofs shall be anchored to resist horizontal thrust and uplift. Provisions shall be taken to absorb the horizontal thrust produced by the sloping roof, rafters or beams through collar ties installed in the upper third of the roof rafters on every third pair of rafters; or through the use of cross ties connecting beams; or through the use of metal straps or metal plates located at the ridge which tie the roof beams together. Rafters shall be notched to fit the exterior wall plate and fastened to the wall.
- (3) Ceiling joists. Ceiling joists shall be nailed to exterior walls and to the ends of rafters. Where joining over interior partitions, they shall be nailed to the plate or to each other. Where ceiling joists are placed at right angles to the rafters, as in flat or hip roofs, the lookout joists or ties shall be fastened to the parallel ceiling joists or rafters.
- (4) Valley and hip rafters; ladders. (a) Valley rafters. Where no bearing is provided under valley rafters at the intersection of 2 roof areas, the valley rafters shall be doubled in thickness and shall be at least 2 inches deeper than the required common rafter to permit full bearing at the beveled end. Where ridges are provided at different elevations, care should be taken to provide vertical support for the interior end of the lower ridge board.

(b) Hip rafters. Where no bearing is provided under hip rafters, the hip rafters shall be of the same thickness as common rafters and shall be at least 2 inches deeper to permit full contact with the jack rafter.

(c) Ladders. Overhangs at gable end walls shall be provided with ladders (rafters which extend over the wall) which are fastened to the wall and to the first rafter parallel to the gable end wall.
- (5) Trussed rafters and trusses. Trussed rafters and prefabricated trusses shall be designed through structural analysis. Truss members shall not be cut, bored or notched unless designed through structural analysis.
- (6) Notching and boring. Notching and boring of beams or girders is prohibited unless determined through structural analysis.

(a) Notching. 1. Notches located in the top or bottom of joists shall not exceed $1/6$ the depth of the joist nor be located in the middle third of the span of the joist.

2. Where joists are notched on the ends, the notch shall not exceed $1/4$ the depth of the joist.

(b) Boring. Holes bored in joists shall be located in the center of the joist. The diameter of the hole shall not exceed one third the depth of the joist.

- (7) Roof sheathing, boards and planking. (a) Plywood sheathing. Plywood sheathing shall be grade marked and stamped and limited to the allowable loads and spans indicated in tables 21.22-B and 21.28-A.
- (b) Roof boards. Roof boards shall comply with the minimum thicknesses shown in Table 21.28-B.
- (c) Roof planks. Roof planks shall be tongue and groove or splined and at least 2 inches, nominal, in thickness. Planks shall terminate over beams unless the joints are end matched. The planks shall be laid so that no continuous line of joints will occur except at points of support. Planks shall be nailed or fastened to each beam.

TABLE 21.28-A

ALLOWABLE LOADS AND SPANS FOR PLYWOOD ROOF SHEATHING
CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PARALLEL TO SUPPORTS¹

Species	Thickness (inches)	No. of Plies	Span (inches)	Total Load (psf)	Live Load (psf)
Structural I	1/2	4	24	35	25
	1/2	5	24	55	40
Other grades covered in PS-1	1/2	5	24	30	25
	5/8	4	24	40	30
	5/8	5	24	60	45

¹Uniform load deflection limitations: 1/180 of span under live load plus dead load, 1/240 under live load only. Edges shall be blocked with lumber or other approved type of edge supports.

TABLE 21.28-B

MINIMUM THICKNESS OF ROOF BOARDS

Rafter Spacing (inches)	Minimum Net Thickness (Inches)	
	Solid Sheathing	Spaced Sheathing
24	5/8	3/4

PART IX--FIREPLACE REQUIREMENTS

Ind 21.29 MASONRY FIREPLACES. Masonry fireplaces shall be constructed of masonry, stone or reinforced concrete.

- (1) Flue size. The fireplace flue size shall be based on the type of flue and the fireplace opening indicated in Table 21.29.

TABLE 21.29

MINIMUM FLUE SIZE FOR MASONRY FIREPLACES

Type of Flue	Minimum Cross-Sectional Area
Round	1/12 of fireplace opening
Square or rectangular	1/10 of fireplace opening
Lined with firebrick	1/8 of fireplace opening

- (2) Termination of chimney. Masonry chimneys shall extend at least 3 feet above the highest point where the chimney passes through the roof and at least 2 feet higher than any portion of the dwelling within 10 feet of the chimney.
- (3) Firebox materials. The firebox shall be of the preformed metal type, at least 1/4-inch thick; or shall be lined with firebrick, at least 2 inches thick and laid in thin joints of refractory cement. The back and sidewalls of the firebox, including the lining, shall be at least 8 inches nominally thick, at least 4 inches shall be solid masonry.
- (4) Lintel. Masonry over the fireplace opening shall be supported by a lintel of noncombustible material.
- (5) Ducts. Warm-air circulating ducts used with steel fireplace units shall be constructed of masonry or metal.
- (6) Hearth. Fireplace hearths shall be constructed of noncombustible material and extend at least 8 inches on each side of the fireplace opening and 16 inches from the firebox.
- (7) Dampers. Dampers shall be made of cast iron or at least No. 12 gauge sheet metal. The area of the damper opening shall be at least 90% of the required flue area when in the open position.
- (8) Hoods. Metal hoods, used as a part of a fireplace, shall be constructed of at least No. 19 gauge corrosion-resistant metal with all seams and connections of smokeproof construction. The hood shall be sloped at an angle of 45° or less from the vertical and shall extend horizontally at least 6 inches beyond the firebox limits. Metal hoods shall be kept a minimum of 18 inches from the combustible materials unless approved for reduced clearances.

Note: The department will accept dampers and hoods listed by nationally recognized laboratories.

- (9) Flue liners. Masonry chimneys shall be provided with fireclay flue liners of at least 5/8-inch thickness. The thickness of the masonry chimney wall shall be at least 4 inches. Flue liners shall be laid in a full mortar bed of refractory cement. If the flue liners are separated from the exterior shell by more than 4 inches, each individual flue shall be wrapped by 4 inches of masonry.

- (10) Cleanout openings. Fireplaces with ash dumps shall be provided with cleanout openings at the base. Doors and frames of the opening shall be made of ferrous material.
- (11) Mantel shelves. Woodwork or other combustible materials shall not be placed within 6 inches of the fireplace opening. Combustible materials located within 12 inches of the fireplace opening shall not project more than 1/8-inch for each inch distance from the opening.
- (12) Chimney caps. Precast or cast-in-place concrete caps shall have a minimum thickness of 2 inches and a minimum of one inch overhang. A minimum of a 1/4-inch soft joint shall be used between flues and caps and shall be caulked or sealed.
- (13) Framing around fireplaces. All wood headers, joists, beams, rafters and studs shall be located at least 2 inches from the outside face of the chimney or fireplace masonry and at least 6 inches from the inside surface of the flue lining. All spaces between the framing and the fireplace shall be firestopped with noncombustible material.

Ind 21.30 FACTORY BUILT FIREPLACES. Factory-built fireplaces consisting of a fire chamber assembly, one or more chimney sections, a roof assembly and other parts shall be tested and listed by a nationally recognized testing laboratory.

- (1) Fireplace assembly and maintenance. The fireplace assembly shall be erected and maintained in accordance with the conditions of the listing.
- (2) Distance from combustibles. Portions of the manufactured chimney extending through combustible floors or roof/ceiling assemblies shall be installed in accordance with the distances listed on the chimney in order to prevent contact with combustible materials.
- (3) Hearth extensions. Hearth extensions of not less than 3/8-inch thick asbestos, hollow metal, stone, tile or other approved material shall be provided.

Note: Hearth extensions should extend not less than 16 inches in front of and at least 8 inches beyond both sides of the fireplace opening.

Ind 21.31 FACTORY-BUILT FIREPLACE STOVES. Factory-built fireplace stoves, consisting of a free-standing chamber assembly, shall be tested and listed by a nationally recognized testing laboratory. The assembly shall be erected and maintained in accordance with the listing.

Chapter Ind 23--Heating, Ventilating and Air Conditioning Standards, a part of the Uniform Dwelling Code, is created to read:

CHAPTER IND 23
HEATING, VENTILATING AND AIR CONDITIONING STANDARDS

PART I--SCOPE

Ind 23.01 Scope

PART II--DESIGN

Ind 23.02 Design

PART III--HEATING EQUIPMENT

Ind 23.03 Selection of equipment

Ind 23.04 Types of equipment

Ind 23.05 Safety controls

Ind 23.06 Combustion air

PART IV--DELIVERY SYSTEMS

Ind 23.07 Air distribution systems

Ind 23.08 Ductwork

Ind 23.09 Dampers, registers and grilles

Ind 23.10 Piping

PART V--CHIMNEYS AND VENTS

Ind 23.11 General requirements

Ind 23.12 Masonry chimneys

Ind 23.13 Factory-built chimneys or vents

Ind 23.14 Gas vents

Ind 23.15 Chimney connectors, smoke pipes and stovepipes

PART VI--FUEL SUPPLY SYSTEMS

Ind 23.16 Fuel storage

PART VII--EQUIPMENT LOCATION AND OPERATION

Ind 23.17 Equipment location

Ind 23.18 Operation

CHAPTER IND 23
HEATING, VENTILATING AND AIR CONDITIONING STANDARDS

PART I--SCOPE

Ind 23.01 SCOPE. The provisions of this chapter shall apply to the design, installation and construction of all heating, ventilating and air conditioning systems in dwellings covered by this code.

PART II--DESIGN

Ind 23.02 DESIGN. Every dwelling shall be equipped with a heating system designed in accordance with this section. Heating equipment requirements may be waived for recreational dwellings used only during the non-heating season. Where a cooling system is provided, the cooling requirements of this section shall be met.

- (1) Heating and cooling system design. Indoor and outdoor design temperatures shall be selected from section Ind 22.04. The heating and cooling systems shall be designed to maintain the indoor design temperature at outdoor design conditions. When requested, room-by-room heat loss and heat gain calculations shall be furnished.
- (2) Distribution systems. Distribution systems shall be sized and located to satisfy the heating and cooling loads of each conditioned space. When requested, a layout of the distribution system shall be furnished to show that the system meets the requirements of this code.
- (3) Ventilation. Habitable rooms without openable windows shall be provided with a mechanical ventilation system producing one air change per hour. All required exhaust vents shall terminate outside the structure. Ductless recirculating fans may be used if approved by the department.

Note: The department will accept designs which meet the Air Conditioning Contractors of America manual; the Mechanical Contractors Association manual; and the Sheet Metal and Air Conditioning Contractors National Association standards for heating and air conditioning systems for one- and 2-family dwellings.

- (4) Controls. The temperature rise through the equipment shall not exceed 100° F unless listed. Controls shall be provided to maintain the inside temperature. Where forced, warm-air systems are used, controls shall be installed to control air movement.

PART III--HEATING EQUIPMENT

Ind 23.03 SELECTION OF EQUIPMENT. All heating and central cooling equipment shall be selected on the basis of air-handling capacity, pumping capacity, and thermal capacity to handle the calculated design heating or cooling load.

Ind 23.04 TYPES OF EQUIPMENT. Heating and cooling appliances shall be listed by a recognized testing agency. The clearances in tables 23.04-A and 23.04-B shall apply unless otherwise shown on listed appliances.

TABLE 23.04-A

STANDARD INSTALLATION CLEARANCES (INCHES) FOR HEAT-PRODUCING APPLIANCES

Residential Type Appliances for Installation in Rooms Which are Large (See Note 2)		Appliance ¹				
		Above Top of Casing or Appliance	From Top and Sides of Warm- Air Bonnet or Plenum	From Front See Note 3	From Back	From Sides
Boilers and Water Heaters Steam Boilers - 15 psi Water Boilers - 250° F Water Heaters - 200° F All Water Walls or Jacketed	Automatic Oil					
	or	6	--	24	6	6
	Comb. Gas-Oil					
	Automatic Gas	6	--	18	6	6
Furnaces - Central Gravity, Upflow, Downflow, Horizontal and Duct, Warm-Air - 250° F	Solid	6	--	48	6	6
	Electric	6	--	18	6	6
	Automatic Oil					
	or	6 ⁴	6 ⁴	24	6	6
Furnaces - Floor For Mounting in Combustible Floors	Comb. Gas-Oil					
	Automatic Gas	6 ⁴	6 ⁴	18	6	6
	Solid	18 ⁵	18 ⁵	48	18	18
	Electric	6 ⁴	6 ⁴	18	6	6
Heat Exchanger Steam - 15 psi Max. Hot Water - 250° F Max.	Automatic Oil					
	or	36	--	12	12	12
	Comb. Gas-Oil					
Room Heaters Circulating Type Vented or Unvented Radiant or Other Type Vented or Unvented	Automatic Gas	36	--	12	12	12
	Oil or Solid	36	--	36	36	36
	Gas	36	--	36	18	18
	Gas with dbl metal or ceramic back	36	--	36	12	18
	Gas	36	--	24	12	12
	Gas	36	--	24	12	12
Radiators Steam or Hot Water	Gas	36	--	6	6	6

TABLE 23.04-A (CONTINUED)

Residential Type Appliances for Installation in Rooms Which are Large (See Note 2)		Appliance ¹					
		Above Top of Casing or Appliance	From Top and Sides of Warm- Air Bonnet or Plenum	From Front See Note 3	From Back	From Sides	
Ranges - Cooking Stoves Vented or Unvented	Oil	See Note 6				Firing Side	Opp. Side
	Gas	30	--	--	9	24	18
	Solid - Clay lined firepot	30	--	--	6	6	6
	Solid - Un- lined firepot	30	--	--	24	24	18
	Electric	30	--	--	36	36	18
Clothes Dryers Listed Types	Gas	6	--	24	6	6	6
	Electric	6	--	24	0	0	0
Incinerators Residential Types	--	See Note 7	--	48	36	36	36

¹Standard clearances may be reduced by affording protection to combustible material in accordance with Table 23.04-B.

²Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least 12 times the total volume of a furnace and at least 16 times the total volume of a boiler. If the actual ceiling height of a room is greater than 8 feet, the volume of a room should be figured on the basis of a ceiling height of 8 feet.

³The minimum dimension should be that necessary for servicing the appliance including access for cleaning and normal care, tube removal, etc.

⁴For a listed oil, combination gas-oil, gas, or electric furnace this dimension may be 2 inches if the furnace limit control cannot be set higher than 250° F or this dimension may be one inch if the limit control cannot be set higher than 200° F.

⁵The dimension may be 6 inches for an automatically stoker-fired forced warm-air furnace equipped with 250° F limit control and with barometric draft control operated by draft intensity and permanently set to limit draft to a maximum intensity of 0.13 in. water gauge.

⁶To combustible material or metal cabinets. If the underside of such combustible material or metal cabinet is protected with asbestos millboard at least 1/4-inch thick covered with sheet metal of not less than No. 28 gauge, the distance may be not less than 24 inches.

⁷Clearance above charging door should be not less than 48 inches.

TABLE 23.04-B
CLEARANCES, INCHES, WITH SPECIFIED FORMS OF PROTECTION^{1, 2}

Type of Protection Applied to the combustible material unless otherwise specified and covering all surfaces within the distance specified as the required clearance with no protection. Thicknesses are minimum.	Where the required clearance with no protection is												
	36 inches			18 inches			12 inches		9 inches		6 inches		
	Chimney Sides or Vent & Con- nector			Chimney Sides or Vent & Con- nector			Sides & Rear		Chimney or Vent Con- nector		Chimney Sides or Vent & Con- nector		
	Above	Rear	connector	Above	Rear	connector	Above	Rear	Above	Rear	Above	Rear	connector
(a) 1/4-in. asbestos millboard spaced out 1 in. . .	30	18	30	15	9	12	9	6	6		3	2	3
(b) 0.013 in. (28 gage) sheet metal on 1/4-in. asbestos millboard . . .	24	18	24	12	9	12	9	6	4		3	2	2
(c) 0.013 in. (28 gage) sheet metal spaced out 1 in.	18	12	18	9	6	9	6	4	4		2	2	2
(d) 0.013 in. (28 gage) sheet metal on 1/8-in. asbestos millboard spaced out 1 in.	18	12	18	9	6	9	6	4	4		2	2	2
(e) 1-1/2 in. asbestos cement covering on heating appliance. . . .	18	12	36	9	6	18	6	4	9		2	1	6
(f) 1/4-in. asbestos millboard on 1 in. mineral fiber bats reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4		2	2	2
(g) 0.027 in. (22 gage) sheet metal on 1 in. mineral fiber bats reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2		2	2	2
(h) 1/4-in. asbestos millboard.	36	36	36	18	18	18	12	12	9		4	4	4
(i) 1/4-in. cellular asbestos	36	36	36	18	18	18	12	12	9		3	3	3

¹Except for the protection described in (e), all clearances should be measured from the outer surface of the appliance to the combustible material disregarding any intervening protection applied to the combustible material.

²Asbestos millboard referred to above is a different material from asbestos cement board. It is not intended that asbestos cement board be used in complying with these requirements when asbestos millboard is specified.

- (1) Furnaces. The input and output capacity of furnaces shall be listed on the nameplate. All nameplates shall show evidence that the equipment has been listed by a recognized testing laboratory.
 - (a) Fuel supply. Furnaces shall be fired with the fuel for which they have been approved, except as provided in (1) (d) of this section. Fuels shall be supplied to the furnace in the volume and at the pressure required on the label.
 - (b) Unvented fuel-fired furnaces and space heaters. Unvented fuel-fired furnaces and space heaters shall be prohibited in dwellings.
 - (c) Vented wall furnaces. Vented wall furnaces shall not be equipped with duct extensions beyond the vertical and horizontal limits of the enclosure unless listed. Vented wall furnaces shall be located to prevent the restriction of air circulation by doors, projections, or other openings. Vented wall furnaces shall be provided with combustion air.
 - (d) Conversion burners. Conversion burners shall be listed by a recognized testing laboratory. The existing equipment shall be reconditioned and defective parts replaced before a conversion burner is installed. Conversion burners shall be installed in accordance with the installation instructions.
 - (e) Location. No furnace shall be placed in a bedroom, bathroom, closet or garage unless listed for such installation.
- (2) Heat pump appliances.
 - (a) Size. Heat pump appliances shall be sized to provide control of the wet and dry bulb temperatures during cooling and maximum performance during heating. The heating balance point shall be considered to determine the outdoor temperature at which the heat pump must operate 100% of the time to offset the dwelling heat loss.
 - (b) Auxiliary heaters. Provisions for auxiliary heat to supplement the heat pump at outdoor temperatures below the balance point shall be provided. Auxiliary heaters shall be sized so that the heat pump auxiliary will offset the dwelling heat loss down to the heating design temperature.
- (3) Boilers. Boilers shall comply with Wis. Adm. Code chapters Ind 41-42, Boiler and Pressure Vessel Code, sections Ind 41.10 and Ind 41.50 through 41.53.

Note: The department will accept equipment listed by the American Society of Mechanical Engineers, Underwriters' Laboratories, and the American Gas Association.

- (4) Solid-fuel-burning appliances. Solid-fuel-burning appliances shall comply with the following requirements:
 - (a) Floor protection. Stoves may be installed on combustible floors provided the floor is protected with a material such as 24-gauge or thicker sheet metal, 1/4-inch or thicker asbestos millboard covered with 24-gauge sheet metal, 4-inch hollow bricks, or 4 inches of stone or concrete, or equivalent. Such protection shall extend beneath the stove, at least 12 inches beyond all sides and at least 18 inches beyond sides having a door or other similar opening. Stoves shall have a clearance of at least 4 inches to the floor.

- (b) Chimneys. Wood-burning appliances shall be connected to a masonry chimney with a flue liner or an all-fuel, residential type factory-built chimney. Wood-burning equipment shall not be connected to a flue serving a fireplace or other equipment. The chimney shall be designed to create a natural draft to carry away the products of combustion or provision shall be made for mechanically maintaining constant updraft during equipment operation. A cleanout opening shall be provided.
- (c) Chimney connector or stovepipe. The chimney connector or stovepipe shall comply with Table 23.15-A.
- (d) Damper. A manual cast iron damper to control the draft shall be provided in the chimney connector next to the appliance.
- (e) Supplemental units. Supplemental wood-burning units connected to a furnace shall be connected to the warm air side of the furnace in accordance with illustrations 23.01-A, 23.01-B or 23.01-C.
 - 1. Return air duct. The area of the return air duct shall be at least equal to the area of the warm air supply duct. The return air duct shall be of the same material as specified for supply air ducts.
 - 2. Blower. The blower on the furnace shall maintain the manufacturer's specifications for CFM and static pressure when the supplemental unit is in operation.
 - 3. Outside air intake. The outside air intake shall be connected to the cold air return plenum of the furnace. A volume damper shall be placed in the duct for the fresh air intake.
 - 4. Thermostat. The thermostat control on the supplemental heating unit shall activate the blower motor at a temperature between 100° and 120° F.

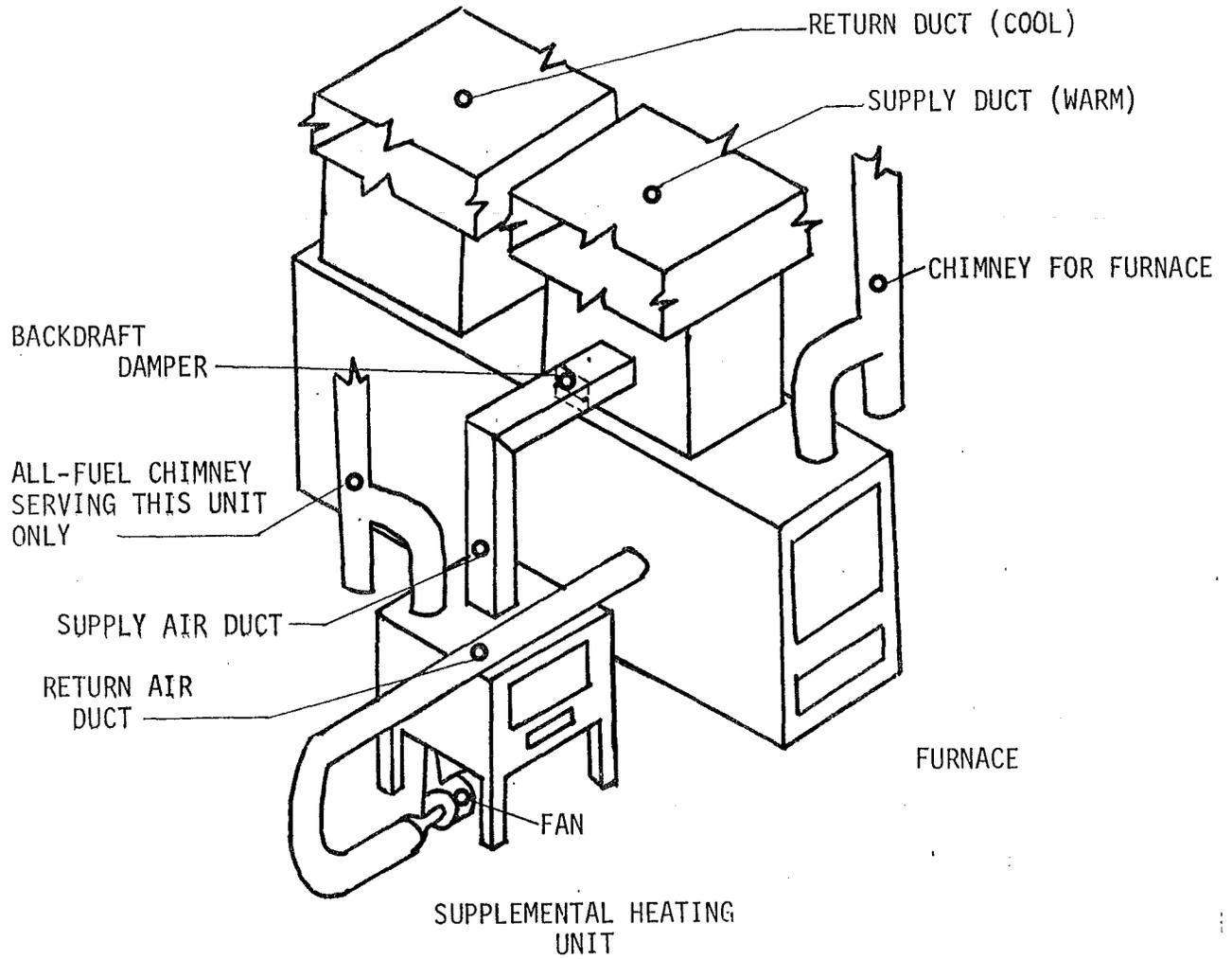


FIGURE 23.01-A

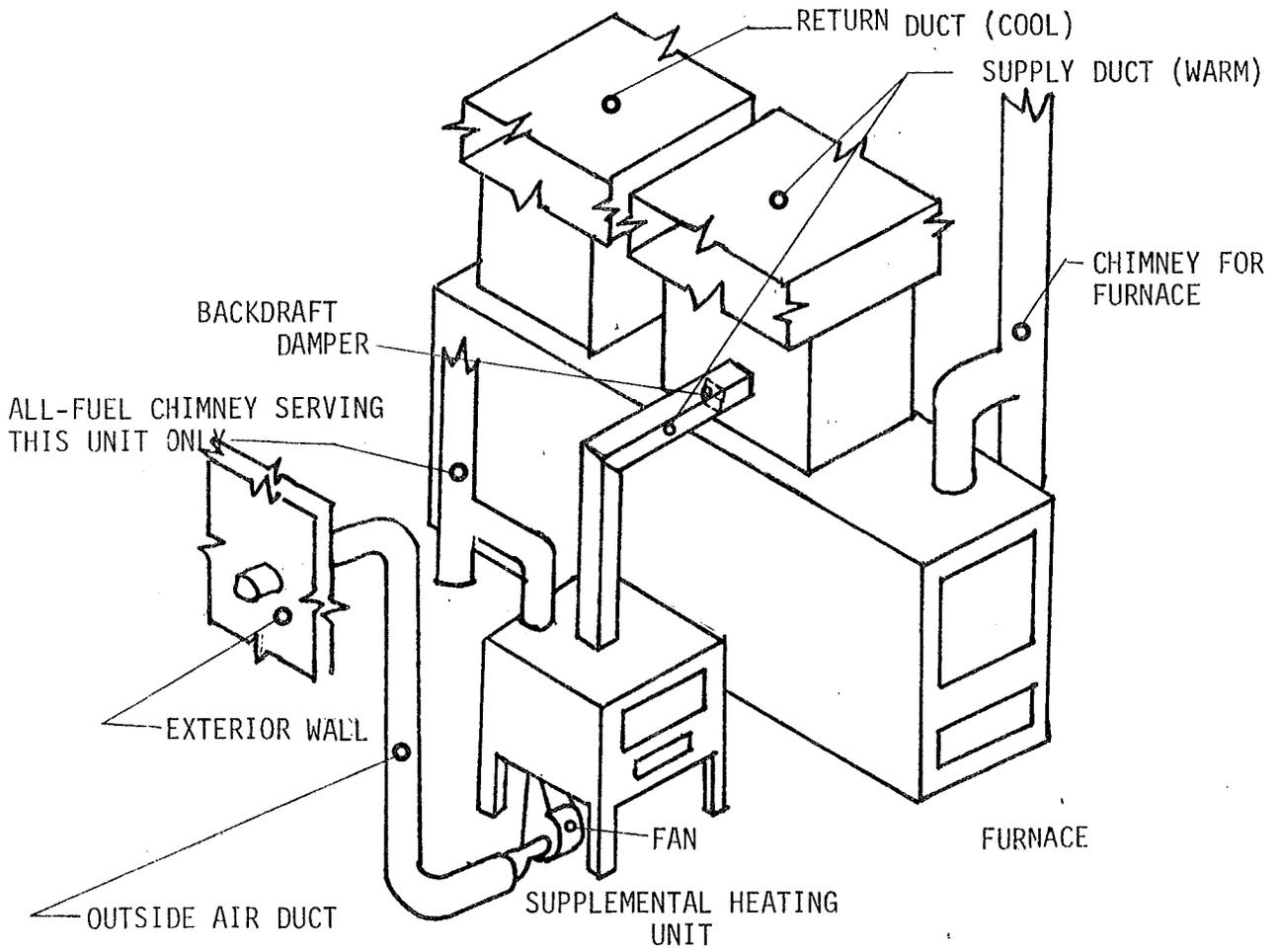


FIGURE 23.01-B

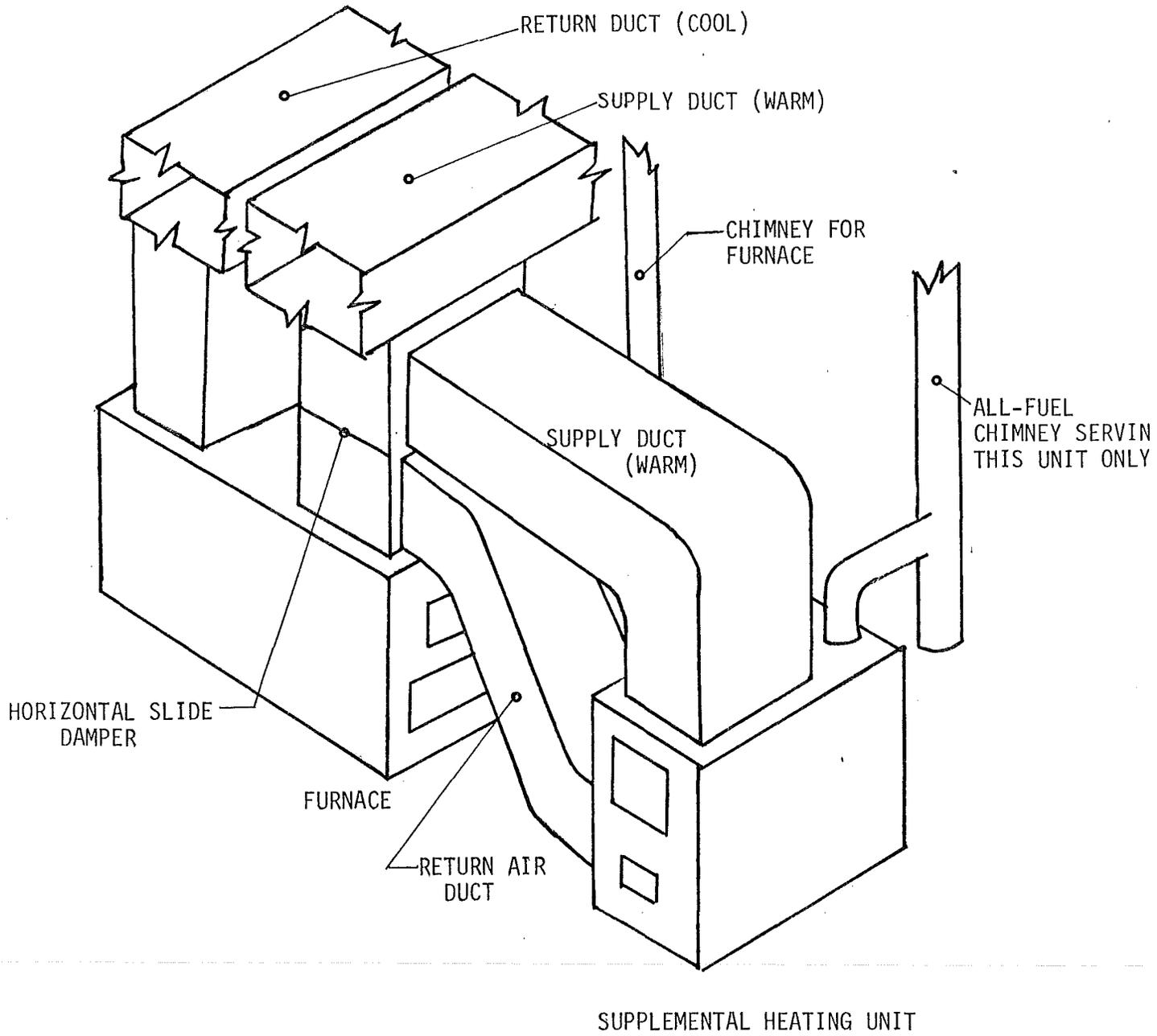


FIGURE 23.01-C

Ind 23.05 SAFETY CONTROLS. High limit, maximum outlet air temperature and similar safety controls shall be provided on heating equipment.

Ind 23.06 COMBUSTION AIR. All fuel-burning heating equipment, except sealed combustion appliances, cooking appliances, refrigerators and clothes dryers, shall be provided with a supply of air for fuel combustion.

- (1) Equipment located in unconfined spaces. (a) Infiltration. Combustion air may be provided by means of infiltration where the volume of the room (measured in cubic feet) in which the burner is located is greater than 1/20 of the maximum input BTU rating of the burner(s).
 - (b) Openings. Where exterior openings are used to provide combustion air from the outside to appliances located in unconfined spaces, the opening shall be designed to provide one square inch of area for each 5,000 BTU per hour of input rating.
- (2) Equipment located in confined spaces. Combustion air provided to equipment located in confined spaces shall be installed in accordance with the following:
 - (a) Air from inside the dwelling. Two openings shall be provided to the equipment enclosure. One opening shall be located within 12 inches from the floor and one opening shall be located within 24 inches from the top of the room. Each opening shall provide a minimum area of one square inch per 1,000 BTU per hour input.
 - (b) Air from outside the dwelling. Two openings shall be provided to the equipment enclosure. One opening shall be located within 12 inches from the floor and one opening shall be located within 24 inches from the top of the room. Each opening shall provide a minimum area of one square inch per 4,000 BTU per hour input.

PART IV--DELIVERY SYSTEMS

Ind 23.07 AIR DISTRIBUTION SYSTEMS. (1) Sizing. All air distribution systems shall be sized using the velocities and static pressure losses listed in Table 23.07.

TABLE 23.07
DUCT VELOCITIES

Designation	Maximum Static Pressure Loss (in WG/100 ft)	Minimum Velocity (feet/minute)	Maximum Velocity (feet/minute)
Main trunk duct	.10	700-900	800-1200
Branch duct	.10	600	700-1000
Branch riser	.10	500	650-800
Outdoor intake	.10	500	800
Grilles or openings	.10	400	600
Return air door undercuts	.10	200	300
Return air door or wall louvers	.10	200	300

WG = Water gauge per 100 feet.

- (2) System sizing. The distribution system, including the evaporator coil, air filters (installed external to the heating unit), ducts, fittings, grilles and registers, shall be sized so that the total external static pressure shall not exceed the static pressure capacity of the fan at the system rated air flow.
- (3) Changes in duct size. Where duct sizes are changed, the slope angle of the transition duct shall not exceed 45°.

Ind 23.08 DUCTWORK. (1) Duct use. Ducts designed for the transmission of air shall be used for no other purpose.

- (2) Interior ducts. All interior ducts shall be constructed in accordance with the following:
 - (a) Supply and return air ducts. All supply and return air ducts shall be constructed of sheet metal or lined with sheet metal or other noncombustible materials.
 1. Exception. Nonmetallic ducts or flexible ducts may be used except in connection with kitchen exhaust ducts or where the duct air temperature exceeds 250° F. Nonmetallic or flexible ducts shall not be connected to a furnace unless a connecting duct of sheet metal, having a length of at least 6 feet, is used to separate nonmetallic ducts from the appliance.
 2. Exception. Unlined wood joists and stud spaces may be used as return air ducts. Wood joists and stud spaces used as return air ducts shall be cut off from all remaining unused portions by tight-fitting stops of sheet metal or of wood at least 2 inches nominal thickness. Bridging shall be removed from the joist space.
- (3) Exterior ducts. Ducts located outside of the dwelling (in garages, attics and similar spaces) shall be constructed of galvanized steel or corrosion-resistive metal.
- (4) Underground ducts. Ducts, plenums and fittings constructed of asbestos cement, metal encased in concrete or ceramic, or other approved materials, may be installed in the ground. Supply air ducts installed parallel and adjacent to an outside wall shall be insulated with a moistureproof material having a resistance value of at least R-5 to a depth of at least 48 inches.
- (5) Metal standards. All sheet metal ducts and fittings shall be constructed in compliance with standards approved by the department.

Note: The department will accept ducts designed in accordance with the ASHRAE Handbook of Fundamentals, published by the American Society of Heating, Refrigerating and Air-Conditioning Engineers, or as illustrated in the low velocity or high velocity duct construction standards published by the Sheet Metal and Air Conditioning Contractors National Association, Inc.

- (6) Thickness. Ducts shall conform to the minimum thicknesses listed in Table 23.08-A.
- (7) Duct support. Ductwork shall be fastened in place and braced to prevent lateral displacement in accordance with Table 23.08-B.

TABLE 23.08-A
DUCT CONSTRUCTION MINIMUM SHEET METAL GAUGES

	Minimum thickness galvanized sheet gauge	Minimum thickness aluminum B & S gauge
Metal gauges (duct not enclosed in partitions)		
<u>Round ducts</u>		
Diameter, inches		
Less than 12	30	26
12-14	28	26
15-18	26	24
Over 18	24	22
<u>Rectangular ducts</u>		
Width, inches		
Less than 14	28	24
14-24	26	22
25-30	24	22
Over 30	22	20
Metal gauges (ducts enclosed in partition)		
Width, inches		
14 or less	30	26
Over 14	28	24

TABLE 23.08-B
DUCT SUPPORT MATERIALS

Duct Type	Maximum Size or Diameter (inches)	Duct Position	Hanger or Strap Size and Spacing
Circular	10	Vertical	No. 18 gage galvanized steel x 2" @ 12' o.c.
		Horizontal	No. 30 gage galvanized steel x 1" or No. 18 steel wire @ 10' o.c.
	20	Vertical	No. 16 gage galvanized steel x 2" @ 12' o.c.
		Horizontal	No. 28 gage galvanized steel x 1" or No. 18 steel wire @ 10' o.c.
Rectangular ¹	24	Vertical	1" x 1/8" steel galvanized strap @ 12' o.c.
		Horizontal	No. 18 gage galvanized steel x 1" @ 10' o.c.
		Vertical	1" x 1-1/8" galvanized steel angle @ 12' o.c.
		Horizontal	1" x 1/8" galvanized steel strap @ 10' o.c.

¹Rectangular metal duct supports should consist of one hanger attached to one-inch wide circular bands of the duct extending around and supporting ducts exceeding 10 inches in diameter.

Note: This table does not prohibit nailing for duct support.

- (8) Joints and seams. All joints and seams shall be securely fastened or locked. Round pipe slip joints shall be lapped at least one inch.
- (9) Vibration control. When used, vibration isolation connectors shall be installed at the joint between the duct and fan or heating equipment. Vibration isolation connectors shall not be used where the air temperature is in excess of 250° F.

Ind 23.09 DAMPERS, REGISTERS AND GRILLES. (1) Volume and backdraft dampers. Volume duct dampers shall be provided to permit balancing of the system. No supply ducts shall terminate in a garage without a backdraft damper.

- (2) Air registers and grilles. (a) Supply air registers. All supply air outlets shall be provided with registers or devices which will provide a uniform distribution of air.
 - (b) Return air grilles. Return air grilles shall not be located in bathrooms, kitchens, garages, utility spaces or a confined space in which a draft diverter or draft regulator is located. All other habitable spaces shall have permanent openings to a return air grille equal in area to the supply outlet serving those areas. At least one return air opening shall be provided for each floor.

Ind 23.10 PIPING. (1) Pipe sizes and arrangement. All steam and hot water supply and return piping, air-line piping and auxiliary equipment shall be of appropriate sizes, elevations and arrangements to accomplish the calculated results without stress or other detriment.

Note: The sizes of pipe to be used for mains and risers may be selected from the ASHRAE Guide and Data Book, published by the American Society of Heating, Refrigerating and Air Conditioning Engineers; or the manuals published by the Institute of Boiler and Radiator Manufacturers or the Mechanical Contractors Association of America.

- (2) Expansion and contraction. The piping for the heating system shall be equipped with anchors, expansion swings or joints, supports and similar devices to relieve stress and strain caused by temperature change of the pipe material.
- (3) Pipe insulation. Unguarded steam, hot water supply and return piping shall be covered with insulating material where the pipes pass through occupied areas and the surface temperature exceeds 180° F.
- (4) Steam and hot water pipes. No pipe carrying hot water or steam at a surface temperature exceeding 250° F shall be placed within one inch of any combustible material, pass through a combustible floor, ceiling or partition unless the pipe is protected by a metal sleeve one inch larger in diameter than the pipe or with approved pipe covering.
- (5) Balancing. Balancing cocks shall be provided in each circuit of a hot water distribution system.

PART V--CHIMNEYS AND VENTS

Ind 23.11 GENERAL REQUIREMENTS. All heating appliances using solid, liquid or gas fuels shall be vented to the outside by an all-fuel factory-built or masonry chimney designed to remove the products of combustion. Gas-fired water heaters may be connected to an approved type "B" vent. Vented wall furnaces may be connected to an approved type "BW" vent. Listed appliances with direct vent systems may also be used.

- (1) Termination. All chimneys or vents depending on a principle of gravity for the removal of the products of combustion shall extend at least 3 feet above the highest point where the chimneys and vents pass through the roof of the building, and at least 2 feet higher than any ridge, peak, wall, or roof within 10 feet horizontally of the chimney or vent.
- (2) Chimney or vent inlets. Two appliances using the same type of fuel may be vented into the same flue provided the separate inlets are offset at least 12 inches vertically; or the separate inlets occur at right angles to each other; or the appliances are connected to a single inlet through a common manifold. Chimneys serving fireplaces or other solid-fuel-burning appliances shall not be used to vent any other equipment or appliance.

Ind 23.12 MASONRY CHIMNEYS. Masonry chimneys shall conform to the provisions of this section.

- (1) Materials. No masonry chimney shall rest upon wood. Combustible headers, beams, rafters, joists and studs shall be located at least 2 inches from the outside face of a chimney and at least 6 inches from the inside surface of the flue lining. The foundation shall be designed and built in conformity with the requirements for foundations. Masonry chimney walls shall be at least 4 inches nominal in thickness.
- (2) Flue size. Chimney flues for appliances shall be at least equal in area to that of the area of the connector from the appliance.
- (3) Multiple flue separation. When more than one flue is contained in the same chimney, a masonry separation of at least 4 inches nominal in thickness shall be provided between the individual flues. The flue joints shall be staggered by at least 7 inches.
- (4) Corbeling. Unless designed through structural analysis, masonry chimneys shall not be corbeled from a wall more than 6 inches nor shall a masonry chimney be corbeled from a wall less than 12 inches in thickness unless it projects equally on each side of the wall. The corbeling shall not exceed one-inch projection for each brick course.
- (5) Inlets. Thimbles shall be at least No. 24 manufacturer's standard gauge (.024 inch) or 5/8-inch thick refractory material. Each chimney shall have an inlet installed at the time of construction.
- (6) Clean-out opening. Every masonry chimney shall be provided with a clean-out opening at the base. Such openings shall be equipped with metal doors and frames arranged to remain closed when not in use.

- (7) Flue liners. (a) Masonry chimneys shall be lined with fireclay flue lining at least 5/8-inch thick, or with material that will resist corrosion, softening or cracking from flue gases at temperatures up to 1800° F. Flue liners shall commence at the chimney footing.
- (b) Where chimneys are built for solid-fuel burning, flue liners shall be laid in a full mortar bed of refractory mortar.
- (8) Chimney caps. Precast or cast-in-place concrete caps shall have a minimum thickness of 2 inches and a minimum of one inch overhang. A minimum of a 1/4-inch soft joint shall be used between flues and caps and shall be caulked or sealed.

Ind 23.13 FACTORY-BUILT CHIMNEYS OR VENTS. Factory-built chimneys or vents shall be of an approved type.

Note: The department recognizes as approved, factory-built chimneys or vents designated as "residential type and building heating appliance," "building heating appliance," "B," "BW," and "L" types listed by Underwriters' Laboratories, Inc.

- (1) Residential type and building heating appliance. An approved "residential type and building heating appliance" chimney or a "building heating appliance only" chimney may be used with solid, liquid or gas-fired heating appliances where the flue gas temperature does not exceed 1000° F continuously, and does not exceed 1400° F for infrequent brief periods of forced firing.
- (2) Type "B". An approved type "B" gas vent may be used with a vented, recessed wall heater.
- (3) Type "BW". An approved type "BW" gas vent may be used with a vented, recessed wall heater.

Ind 23.14 GAS VENTS. All gas-fired equipment shall be provided with vent pipes conforming to the requirements for smoke pipes or for gas vents as specified in section Ind 23.15 (2) (g).

Ind 23.15 CHIMNEY CONNECTORS, SMOKE PIPES AND STOVEPIPES. (1) Definition. Chimney connectors, smoke pipes or stovepipes are passages for conducting the products of combustion from a fuel-fired appliance to the chimney.

- (2) Construction and installation. The construction and installation of chimney connectors shall conform with the following requirements:
- (a) Concealed space. No chimney connector shall pass through any outside window, door or combustible outside wall, nor be concealed in any closet, attic or similar space.
- (b) Combustible partitions. Connectors for appliances shall not pass through walls or partitions constructed of combustible material unless they are guarded at the point of passage by:
1. Metal ventilated thimbles not less than 12 inches larger in diameter than the connector;
 2. Metal or burned fireclay thimbles built in brickwork or other approved fireproofing materials extending not less than 8 inches beyond all sides of the thimble.

- (c) Distance from materials. No part of any chimney connector shall be placed nearer to any combustible partition or wall than the diameter of the pipe, nor nearer to any non-fire-resistive ceiling than 1-1/2 times the diameter. The above distances may be reduced by one-half if the wall or ceiling is covered with not less than 1/4-inch asbestos board covered with sheet metal or with equivalent protection.

Note: See Table 23.04-B for reduced clearances.

- (d) Multiple appliance venting. Two or more listed appliances using the same type of fuel may be connected to a common gravity-type flue provided the appliances are equipped with listed primary safety controls and listed shutoff devices and comply with the following requirements.
1. The appliances shall be located in the same story, except for engineered venting systems.
 2. The appliances shall be joined at a manifold or Y-type fitting as close to the chimney as possible, unless the connector from each appliance enters a separate chimney inlet and the inlets are offset in accordance with the requirements of section Ind 23.11 (2).
 3. The chimney connector and chimney flue shall be sized to accommodate the total volume of flue gases. For gas-burning appliances, the venting area shall be at least equal to the size of the largest vent connector plus at least 50% of the area of the other vent connectors.
- (e) Pitch and length. Chimney or vent connectors shall have no more than two 45° offsets with the vertical. The horizontal length shall not exceed 75% of the total vertical height of the total venting system measured from the appliance outlet. Chimney or vent connectors shall be pitched at least 1/4-inch per foot from the appliance outlet collar vent to the chimney inlet.
- (f) Dampers. The use of manually operated dampers shall be prohibited in chimney or vent connectors of all appliances except wood-burning appliances. When used, listed automatically operated dampers interlocked with the heating appliance shall be installed in accordance with the approved listing.
- (g) Materials and thickness. Chimney or vent connectors serving liquid and solid fuel appliances shall conform to the type of material and thickness indicated in tables 23.15-A or 23.15-B.
- (h) Clearance. Single wall metal connectors shall be installed with clearance to combustibles as indicated in Table 23.15-C. These clearances may be reduced if the combustible material is protected in accordance with the requirements of Table 23.04-B.

TABLE 23.15-A

MINIMUM CHIMNEY CONNECTOR GAGES FOR OIL, WOOD AND COAL

Diameter of Connector	Galvanized Steel Gage Number	
	Min. thickness (inch)	Gage
Less than 6 inches	.019	26
6 inches to less than 10 inches	.024	24
10 inches to 13 inches	.030	22
14 inches to 16 inches	.036	20
Greater than 16 inches	.058	16

TABLE 23.15-B

MINIMUM VENT CONNECTOR GAGES FOR GAS

Diameter of Connector	Galvanized Steel Gage Number	
	Min. thickness (inch)	Gage
1 inch through 4 inches	.016	28
5 inches or over	.026	24

TABLE 23.15-C

CHIMNEY CONNECTOR AND VENT CONNECTOR CLEARANCES
FROM COMBUSTIBLE MATERIALS (See Note 4)

Description of Appliance	Minimum Clearance Inches (See Note 1)
Single-Wall Metal Pipe Connectors	
Gas Appliances Without Draft Hoods	18
Electric, Gas, and Oil Incinerators	18
Oil and Solid-Fuel Appliances	18
Unlisted Gas Appliances With Draft Hoods	9
Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	9
Oil Appliances Listed as Suitable for Use With Type L Venting Systems, but only when connected to chimneys	9
Listed Gas Appliances With Draft Hoods. See Note 3.	6
Type L Vent Piping Connectors	
Gas Appliances Without Draft Hoods	9
Electric, Gas, and Oil Incinerators	9
Oil and Solid-Fuel Appliances	9
Unlisted Gas Appliances With Draft Hoods	6
Boilers and Furnaces Equipped With Listed Gas Burners and With Draft Hoods	6
Oil Appliances Listed as Suitable for Use with Type L Vents	(See Note 2)
Listed Gas Appliances With Draft Hoods	(See Note 3)
Type B Gas Vent Piping Connectors	
Listed Gas Appliances With Draft Hoods	(See Note 3)

¹These clearances apply except if the listing of an appliance specifies different clearance, in which case the listed clearance takes precedence.

²If listed type L venting system piping is used, the clearance may be in accordance with the venting system listing.

³If listed type B or type L venting system piping is used, the clearance may be in accordance with the venting system listing.

⁴The clearances from connectors to combustible materials may be reduced if the combustible material is protected in accordance with Table 23.04-B.

PART VI--FUEL SUPPLY SYSTEMS

Ind 23.16 FUEL STORAGE. (1) Liquefied petroleum gas storage tanks. All liquefied petroleum gas storage tanks shall be constructed to conform with the applicable sections of Wis. Adm. Code chapter Ind 9, Liquefied Petroleum Gases and Liquefied Natural Gases.

- (a) No tanks shall be located inside dwellings.
 - (b) Gas shutoff valves shall be provided at each tank, at the gas service entry into the dwelling, and at each heating unit.
 - (c) Tanks shall have welded steel supports and be permanently installed on concrete pads or foundations.
- (2) Oil storage tanks. (a) Oil storage tanks on the inside of any dwelling shall be located at the same level as the furnace it serves.
- (b) The total storage capacity inside any dwelling unit shall be limited to 550 gallons in one tank, or not more than 275 gallons in each of 2 storage tanks cross-connected to a single burner.
 - (c) Underground tanks shall be constructed of steel or other approved noncombustible material, provided the material is compatible with fuel oil.
 - (d) Storage of fuel oil above ground shall not be in excess of 550 gallons. Storage tanks installed outside and above ground shall be installed on a firm and level foundation.
 - (e) The fuel oil tank shall be equipped with a fill pipe, vent pipe, oil gauge, oil filter and shutoff valve. The vent pipe and fill pipe shall terminate outside of the dwelling and be located at least 2 feet from any opening. The fill pipe shall be at least 2 inches in diameter and the vent pipe shall be at least 1-1/4 inches in diameter. The vent pipe and fill pipe shall be provided with a weatherproof cap.

Note: The department will accept installations which conform with NFPA standard No. 31, Oil-Burning Equipment.

- (3) Gas piping.
- (a) Materials. Gas piping materials shall be black IPS wrought iron or steel or other approved piping or tubing and fittings designed for use with fuel gas. Gas valves and connections shall be approved types designed for use with fuel gas.
 - (b) Piping support. Gas piping shall be supported by metal straps or hooks spaced not more than 10 feet apart.
- (4) Shutoff and control devices. (a) An accessible approved shutoff valve shall be installed ahead of the union or other connection in the fuel piping. Service valves on gas-fired equipment shall be located between 4 and 6 feet above the floor.
- (b) Automatic gas-burning heating appliances shall be equipped with listed devices which will shut off the gas to the pilot light and main burner(s) in the event of pilot failure.

- (c) Liquid fuel-burning appliances shall be equipped with primary safety controls which will shut off the flow of fuel to the burner(s) in the event of ignition failure.

Note: The department will accept installations conforming to NFPA standard No. 54, National Fuel Gas Code.

PART VII--EQUIPMENT LOCATION AND OPERATION

Ind 23.17 EQUIPMENT LOCATION. (1) Outdoor equipment. Outdoor equipment shall be located so as to not restrict the air flow or recirculation of air. Outdoor equipment so located as to be subject to damage shall be protected.

- (2) Indoor equipment. All indoor equipment shall be installed with a minimum of 24 inches of clearance for service.

Ind 23.18 OPERATION. (1) Instructions. Written instructions shall be provided the owner for the operation and maintenance of the system and equipment.

- (2) Final test required. The installer shall test and balance every heating, ventilating and air conditioning system.

Chapter Ind 24, Electrical Standards, a part of the Uniform Dwelling Code, is created to read:

CHAPTER IND 24
ELECTRICAL STANDARDS

Ind 24.01 ELECTRICAL STANDARDS. All electrical wiring, installations, equipment and materials used in the construction of dwellings shall comply with the requirements of the Wisconsin Administrative Electrical Code, Vol. 2.

Note: Section 167.16, Stats., requires that the company furnishing the electric current obtain proof that the wiring complies with these standards before furnishing the current. Proof must be a certificate furnished by the inspection department or officer, or if there is no officer, an affidavit furnished by the person doing the wiring.

Chapter Ind 25, Sanitary Facilities in Railroad Terminals and Caboose, is renumbered Chapter Ind 225, and a new Chapter Ind 25--Plumbing and Potable Water Standards, a part of the Uniform Dwelling Code is created to read:

CHAPTER IND 25
PLUMBING AND POTABLE WATER STANDARDS

PART I--SCOPE

Ind 25.01 Scope

PART II--POTABLE WATER

Ind 25.02 Public water supply

Ind 25.03 Well water supply

PART III--PLUMBING SYSTEMS

Ind 25.04 Plumbing systems

PART I--SCOPE

Ind 25.01 SCOPE. All one- and 2-family dwellings shall be provided with potable water and plumbing systems in accordance with the standards listed in this chapter.

PART II--POTABLE WATER

Ind 25.02 PUBLIC WATER SUPPLY. Each dwelling shall be provided with potable water from a public water supply when available.

Ind 25.03 WELL WATER SUPPLY. When a public water supply is not available, each dwelling shall be provided with a well(s) approved by the department of natural resources. Water samples from an approved well shall be tested at the state laboratory of hygiene, or a state approved laboratory, at least annually. The water supply shall be tested bacteriologically safe prior to use.

PART III--PLUMBING SYSTEMS

Ind 25.04 PLUMBING SYSTEMS. Every dwelling unit connected to a septic system or public sewer shall be provided with a water closet, a lavatory and a bathtub or shower. Each dwelling unit shall be provided with a kitchen area and every kitchen shall be provided with a sink.

(1) Water-conserving fixtures. Each dwelling shall be provided with the following water-conserving fixtures:

- (a) Water closets having a maximum water usage of 4 gallons or less per flush.
- (b) Lavatory (washbowl) faucets having a maximum flow rate of 3 gallons per minute (gpm).

Note: This rule is not intended to apply to faucets serving kitchen sinks, laundry tubs or bathtubs.

- (c) Showerheads having a maximum flow rate of 3 gallons per minute (gpm).

(2) Protection from freezing. All plumbing fixtures, and the pipes connecting therewith, shall be properly protected against freezing so that the fixtures will be in proper condition for use at all times.

Note: See Wis. Adm. Code chapter H 62 for the design, construction and installation of plumbing systems.

APPENDIX

CHAPTER IND 20

Note to Revisor: The building permit application form and the building permit are at WISCOMP. The camera copy should be available in two weeks.

WISCONSIN UNIFORM BUILDING PERMIT APPLICATION

PERMIT NO. _____
PARCEL NO. _____
SEAL NO. _____

PERMIT REQUESTED CONST HVAC ELEC PLUMB

Owner's Name _____ Mailing Address _____ Telephone _____

Contractor's Name _____ Mailing Address _____ Telephone _____

PROJECT LOCATION _____, T. _____ N., R. _____ E.(or)W

Building Address _____ Subdivision Name _____ Lot No. _____ Block No. _____

Zoning District	Lot Area	Setbacks																														
		Front	Rear	Left	Right																											
1. PROJECT TYPE <input type="checkbox"/> New <input type="checkbox"/> Addition <input type="checkbox"/> Alteration <input type="checkbox"/> Attached <input type="checkbox"/> Detached <input type="checkbox"/> Other _____ <input type="checkbox"/> Master plan no. _____ (if applicable)		2. USE <input type="checkbox"/> Single family <input type="checkbox"/> Two family <input type="checkbox"/> Other _____		3. ELECTRICAL Entrance Panel SIZE: _____ AMP Service <input type="checkbox"/> Underground <input type="checkbox"/> Overhead																												
9. AREA (outside dimension) <input type="checkbox"/> Basement _____ sq. ft. <input type="checkbox"/> Living Area _____ sq. ft. <input type="checkbox"/> Garage _____ sq. ft.		6. CONST. TYPE <input type="checkbox"/> Site const. <input type="checkbox"/> Manufactured		7. FOUNDATION <input type="checkbox"/> Concrete <input type="checkbox"/> Masonry <input type="checkbox"/> Treated Wood <input type="checkbox"/> Other _____																												
10. STORIES <input type="checkbox"/> 1-story <input type="checkbox"/> 2-story <input type="checkbox"/> Other _____		11. WALLS <input type="checkbox"/> Wood frame <input type="checkbox"/> Masonry <input type="checkbox"/> Other _____		4. HVAC EQUIPMENT <input type="checkbox"/> Forced Air Furnace <input type="checkbox"/> Radiant Baseboard or Panel <input type="checkbox"/> Boiler <input type="checkbox"/> Heat pump <input type="checkbox"/> Central Air Cond. <input type="checkbox"/> Other _____																												
		8. PLUMBING Sewer <input type="checkbox"/> Municipal <input type="checkbox"/> Septic <input type="checkbox"/> Permit No. _____ Piping <input type="checkbox"/> Plastic <input type="checkbox"/> Metal		5. ENERGY SOURCES <table border="1"> <thead> <tr> <th>Fuel</th> <th>Space Heat</th> <th>Water</th> </tr> </thead> <tbody> <tr> <td>LP Gas <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Nat. Gas <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Fuel oil <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Elec. <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Wood <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Solar <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Coal <input type="checkbox"/></td> <td><input type="checkbox"/></td> <td><input type="checkbox"/></td> </tr> <tr> <td>Other _____</td> <td></td> <td></td> </tr> </tbody> </table>		Fuel	Space Heat	Water	LP Gas <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Nat. Gas <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Fuel oil <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Elec. <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Wood <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Solar <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Coal <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	Other _____		
Fuel	Space Heat	Water																														
LP Gas <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																														
Nat. Gas <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																														
Fuel oil <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																														
Elec. <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																														
Wood <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																														
Solar <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																														
Coal <input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>																														
Other _____																																
				12. WATER <input type="checkbox"/> Private <input type="checkbox"/> Municipal																												

The applicant agrees to comply with the Wisconsin Uniform Dwelling Code and other municipal 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.

SIGNATURE OF APPLICANT _____ DATE _____

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

12. ISSUING JURISDICTION VILLAGE CITY TOWN COUNTY STATE

NAME _____ MUNIC NO. _____

FEEES PLAN REVIEW _____ INSPECTION _____ PERMIT SEAL _____ TOTAL _____ PERM-SBD-5823	PERMIT ISSUED <input type="checkbox"/> CONST <input type="checkbox"/> HVAC <input type="checkbox"/> ELEC <input type="checkbox"/> PLUMB	PERMIT ISSUED BY NAME _____ CERT NO. _____ DATE _____
--	--	---

Marginal Notes
Municipality
DILHR 2/10/2000

WISCONSIN UNIFORM

BUILDING PERMIT

STATE OF WISCONSIN
 DEPARTMENT OF INDUSTRY, LABOR AND JOURNAL RELATIONS
 DIVISION OF SAFETY AND BUILDING
 301 E. WASHINGTON AVE.
 BOYFOS
 MADISON, WIS 53707 WISCONSIN STATUTES 101.09

INSPECTION APPROVAL
 FOOTINGS AND FOUNDATION

ROUGH	FINAL
BUDG	BUDG
INSUL	INSUL
HVAC	HVAC
ELEC	ELEC
PLUMB	PLUMB
OTHER	

REMARKS

PERMIT NO.

Seal

SEAL NO.

PERMIT ISSUED CONST. HVAC ELEC PLUMB

owner's Name Telephone

Contractor's Name Telephone

PROJECT LOCATION 4 4 SECTION ; T N R E (or) W

Building Address Subdivision Name Lot No. Block No.

Zoning District	Lot Area	sqft	Setbacks	Front	Rear	Left	Right
		#	#	#	#	#	#

ISSUING JURISDICTION

NAME

PERMIT ISSUED BY NAME TELEPHONE DATE

Keep this card posted until final inspection has been made. Inspections shall be arranged 48 hrs. in advance. Work shall not proceed until the inspector has approved the various stages of construction or the 48 hr. period since notification has elapsed. This permit will expire 24 months after the date of issuance if construction has not commenced.

POST AT THE DWELLING SITE

APPENDIX

CHAPTER IND 21

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"x6" subfloor or less to each joist, face nail	2-8d or 2 staples, 1-3/4"
Wider than 1"x6" subfloor to each joist, face nail	3-8d or 4 staples, 1-3/4"
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, 1-3/4"
1"x6" sheathing to each bearing, face nail	2-8d or 2 staples, 1-3/4"
1"x8" sheathing to each bearing, face nail	2-8d or 3 staples, 1-3/4"
Wider than 1"x8" sheathing to each bearing, face nail	3-8d or 4 staples, 1-3/4"
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	
1/2-inch to 5/16-inch	6d ⁵ or staple
5/8-inch to 3/4-inch	8d smooth or common, 6d deformed, or staple
7/8-inch to 1-inch	8d ⁵
1-1/8-inch to 1-1/4-inch	10d smooth or common, or 8d deformed
Fiberboard sheathing ⁷	
1/2-inch	6d common or staple, 1-1/8" long or roofing nail ¹¹
25/32-inch	8d common or staple, 1-1/2" long or roofing nail ¹¹
Gypsum sheathing, 1/2" ⁸	1-1/2" galvanized roofing nail, or 6d common, or staple
Particleboard wall sheathing (to framing) ⁶	
3/8-inch to 1/2-inch	6d common
5/8-inch to 3/4-inch	8d common or staple
Insulated sheathing	11-gauge roofing nails, 6d, 8d, or staple

FASTENER SCHEDULE TABLE (CONTINUED)

Description of Building Materials/Connection	Number and Type			
	of Fastener ¹	2	3	4
Combination subfloor underlayment (to framing) ⁶				
3/4-inch and less	6d deformed			
7/8-inch to 1-inch	8d deformed			
1-1/8-inch to 1-1/4-inch	10d smooth ⁹ or common or 8d deformed ⁹			
Panel siding (to framing) ¹⁰				
1/2-inch or less	6d			
5/8-inch	8d			

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

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

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

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

⁵Common or deformed shank.

⁶Nails 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.

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

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

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

¹⁰Corrosion-resistant siding and casing nails.

¹¹Galvanized roofing nails with 7/16-inch diameter head and 1-1/2-inch length for 1/2-inch sheathing and 1-3/4-inch for 25/32-inch sheathing.

SPAN TABLES FOR JOISTS AND RAFTERS
(Recommended by National Forest Products Association)

EXPLANATION OF TABLES

These span tables for joists and rafters are calculated on the basis of a series of modulus of elasticity (E) and fiber bending stress (F_b) values. The range of values in the tables provides allowable spans for all species and grades of nominal 2-inch framing lumber customarily used in construction.

Tables J-1 through J-6 list spans for floor and ceiling joists used over a single span with calculations based on E and the required F_b values shown.

Tables R-1 through R-6 list spans for rafters used over a single span with calculations based on F_b and the required E values shown.

Tables TSJ-1 and TSJ-2 list spans for floor joists continuous over two equal spans with calculations based on E and the required F_b values shown.

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. Tabulated spans for rafters also apply to other types of occupancy, since the occupancy has little bearing on roof loading.

LUMBER SIZES

Tabulated spans apply to surfaced (S4S) lumber having dimensions which conform to the American Softwood Lumber Standard, PS 20-70. These sizes are as follows:

Reference	Dressed Size (inches)	
	Surfaced Dry	Surfaced Green
2 x 4	1-1/2 x 3-1/2	1-9/16 x 3-9/16
2 x 6	1-1/2 x 5-1/2	1-9/16 x 5-5/8
2 x 8	1-1/2 x 7-1/4	1-9/16 x 7-1/2
2 x 10	1-1/2 x 9-1/4	1-9/16 x 9-1/2
2 x 12	1-1/2 x 11-1/4	1-9/16 x 11-1/2

MOISTURE CONTENT

The listed dry and green sizes are related at 19% maximum moisture content. Tabulated spans are calculated on the basis of the dry sizes and are also applicable to the corresponding green sizes. The spans in these tables are intended for use in covered structures or where moisture content in use does not exceed 19%.

SPAN MEASUREMENT

Tabulated spans are the clear distance between supports. For sloping rafters, the span is measured along the horizontal projection.

LUMBER DESIGN VALUES

Use of these span tables requires reference to the applicable design values for the various species and grades of lumber. "Design Values for Joists and Rafters", a supplement to these span tables, provide such values in convenient-to-use form. Modulus of elasticity (E) and fiber bending stress (F_b) values

therein are based on the National Design Specification for Wood Construction (formerly National Design Specification for Stress Grade Lumber and Its Fastenings) and incorporate adjustments appropriate for repetitive-member use under various durations of load.

Repetitive-member use is that condition where framing members such as joists, rafters, studs, planks, decking or similar members are spaced not more than 24 inches, are not less than 3 in number and are joined by floor, roof or other load-distributing elements adequate to support the design load. Design values in bending (F_b) for such use are 15% greater than for single-member use.

For rafters, design values in bending (F_b) may be greater than the design values for normal duration of load, by the following amounts:

15% for 2 months' duration, as for snow.

25% for 7 days' duration, as for construction load.

The design value tables provide values for bending for repetitive-member use of joists and rafters under normal, 2-month and 7-day durations of load.

ROOF LOADS

Rafter spans are tabulated for the most common roof loads. For roof loads intermediate between those tabulated, straight line interpolation may be used.

LUMBER IDENTIFICATION

When used with the tabulated spans in these tables, lumber should be identified by the grademark of an agency recognized as being competent by the Board of Review of the American Lumber Standards Committee or the Canadian Lumber Standards Administrative Board.

USE OF THE SPAN TABLES

Spans for floor and ceiling joists are calculated on the basis of the modulus of elasticity (E) with the required fiber bending stress (F_b) listed below each span. Spans for rafters are calculated on the basis of fiber bending stress (F_b) with the required modulus of elasticity (E) listed below each span. Use of the tables is illustrated in the examples which follow.

Example 1. Floor joists. Assume a required span of 12'-9", a live load of 40 psf and joists spaced 16 inches on centers. Table J-1 shows that a grade of 2 x 8 having an E value of 1,600,000 psi and an F_b value of 1250 psi would have a span of 12'-10", which satisfies the condition.

Example 2. Rafters. Assume a horizontal projection span of 13'-0", a live load of 30 psf, dead load of 15 psf and rafters spaced 16 inches on centers. Table R-2 shows that a 2 x 8 having an F_b value of 1300 psi and an E value of 1,000,000 psi would have a span of 13'-3" of horizontal projection.

Since many combinations of size, spacing, E and F_b values are possible, it is recommended that the users examine the tables to determine which combination fits their particular case most effectively.

TABLE J-1
FLOOR JOISTS

40 Lbs. Per Sq. Ft. Live Load

(All rooms except those used for sleeping areas and attic floors.)

DESIGN CRITERIA:

Deflection - For 40 lbs. per sq. ft. live load.

Limited to span in inches divided by 360.

Strength - Live Load of 40 lbs. per sq. ft. plus dead load of 10 lbs. per sq. ft. determines the required fiber stress value.

JOIST SIZE SPACING (IN)	Modulus of Elasticity, "E", in 1,000,000 psi																			
	0.4	0.5	0.6	0.7	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	2.2	2.4	
2x6	12.0	6-9 450	7-3 520	7-9 590	8-2 660	8-6 720	8-10 780	9-2 830	9-6 890	9-9 940	10-0 990	10-3 1040	10-6 1090	10-9 1140	10-11 1190	11-2 1230	11-4 1280	11-7 1320	11-11 1410	12-3 1490
	13.7	6-6 470	7-0 550	7-5 620	7-9 690	8-2 750	8-6 810	8-9 870	9-1 930	9-4 980	9-7 1040	9-10 1090	10-0 1140	10-3 1190	10-6 1240	10-8 1290	10-10 1340	11-1 1380	11-5 1470	11-9 1560
	16.0	6-2 500	6-7 580	7-0 650	7-5 720	7-9 790	8-0 860	8-4 920	8-7 980	8-10 1040	9-1 1090	9-4 1150	9-6 1200	9-9 1250	9-11 1310	10-2 1360	10-4 1410	10-6 1460	10-10 1550	11-2 1640
	19.2	5-9 530	6-3 610	6-7 690	7-0 770	7-3 840	7-7 910	7-10 970	8-1 1040	8-4 1100	8-7 1160	8-9 1220	9-0 1280	9-2 1330	9-4 1390	9-6 1440	9-8 1500	9-10 1550	10-2 1650	10-6 1750
	24.0	5-4 570	5-9 660	6-2 750	6-6 830	6-9 900	7-0 980	7-3 1050	7-6 1120	7-9 1190	7-11 1250	8-2 1310	8-4 1380	8-6 1440	8-8 1500	8-10 1550	9-0 1610	9-2 1670	9-6 1780	9-9 1880
	32.0					6-2 1010	6-5 1090	6-7 1150	6-10 1230	7-0 1300	7-3 1390	7-5 1450	7-7 1520	7-9 1590	7-11 1660	8-0 1690	8-2 1760	8-4 1840	8-7 1950	8-10 2060
2x8	12.0	8-11 450	9-7 520	10-2 590	10-9 660	11-3 720	11-8 780	12-1 830	12-6 890	12-10 940	13-2 990	13-6 1040	13-10 1090	14-2 1140	14-5 1190	14-8 1230	15-0 1280	15-3 1320	15-9 1410	16-2 1490
	13.7	8-6 470	9-2 550	9-9 620	10-3 690	10-9 750	11-2 810	11-7 870	11-11 930	12-3 980	12-7 1040	12-11 1090	13-3 1140	13-6 1190	13-10 1240	14-1 1290	14-4 1340	14-7 1380	15-0 1470	15-6 1560
	16.0	8-1 500	8-9 580	9-3 650	9-9 720	10-2 790	10-7 850	11-0 920	11-4 980	11-8 1040	12-0 1090	12-3 1150	12-7 1200	12-10 1250	13-1 1310	13-4 1360	13-7 1410	13-10 1460	14-3 1550	14-8 1640
	19.2	7-7 530	8-2 610	8-9 690	9-2 770	9-7 840	10-0 910	10-4 970	10-8 1040	11-0 1100	11-3 1160	11-7 1220	11-10 1280	12-1 1330	12-4 1390	12-7 1440	12-10 1500	13-0 1550	13-5 1650	13-10 1750
	24.0	7-1 570	7-7 660	8-1 750	8-6 830	8-11 900	9-3 980	9-7 1050	9-11 1120	10-2 1190	10-6 1250	10-9 1310	11-0 1380	11-3 1440	11-5 1500	11-8 1550	11-11 1610	12-1 1670	12-6 1780	12-10 1880
	32.0					8-1 990	8-5 1080	8-9 1170	9-0 1230	9-3 1300	9-6 1370	9-9 1450	10-0 1520	10-2 1570	10-5 1650	10-7 1700	10-10 1790	11-0 1840	11-4 1950	11-8 2070
2x10	12.0	11-4 450	12-3 520	13-0 590	13-8 660	14-4 720	14-11 780	15-5 830	15-11 890	16-5 940	16-10 990	17-3 1040	17-8 1090	18-0 1140	18-5 1190	18-9 1230	19-1 1280	19-5 1320	20-1 1410	20-8 1490
	13.7	10-10 470	11-8 550	12-5 620	13-1 690	13-8 750	14-3 810	14-9 870	15-3 930	15-8 980	16-1 1040	16-6 1090	16-11 1140	17-3 1190	17-7 1240	17-11 1290	18-3 1340	18-7 1380	19-2 1470	19-9 1560
	16.0	10-4 500	11-1 580	11-10 650	12-5 720	13-0 790	13-6 850	14-0 920	14-6 980	14-11 1040	15-3 1090	15-8 1150	16-0 1200	16-5 1250	16-9 1310	17-0 1360	17-4 1410	17-8 1460	18-3 1550	18-9 1640
	19.2	9-9 530	10-6 610	11-1 690	11-8 770	12-3 840	12-9 910	13-2 970	13-7 1040	14-0 1100	14-5 1160	14-9 1220	15-1 1280	15-5 1330	15-9 1390	16-0 1440	16-4 1500	16-7 1550	17-2 1650	17-8 1750
	24.0	9-0 570	9-9 660	10-4 750	10-10 830	11-4 900	11-10 980	12-3 1050	12-8 1120	13-0 1190	13-4 1250	13-8 1310	14-0 1380	14-4 1440	14-7 1500	14-11 1550	15-2 1610	15-5 1670	15-11 1780	16-5 1880
	32.0					10-4 1000	10-9 1080	11-1 1150	11-6 1240	11-10 1310	12-2 1380	12-5 1440	12-9 1520	13-0 1580	13-3 1640	13-6 1700	13-9 1770	14-0 1830	14-6 1970	14-11 2080
2x12	12.0	13-10 450	14-11 520	15-10 590	16-8 660	17-5 720	18-1 780	18-9 830	19-4 890	19-11 940	20-6 990	21-0 1040	21-6 1090	21-11 1140	22-5 1190	22-10 1230	23-3 1280	23-7 1320	24-5 1410	25-1 1490
	13.7	13-3 470	14-3 550	15-2 620	15-11 690	16-8 750	17-4 810	17-11 870	18-6 930	19-1 980	19-7 1040	20-1 1090	20-6 1140	21-0 1190	21-5 1240	21-10 1290	22-3 1340	22-7 1380	23-4 1470	24-0 1560
	16.0	12-7 500	13-6 580	14-4 650	15-2 720	15-10 790	16-5 860	17-0 920	17-7 980	18-1 1040	18-7 1090	19-1 1150	19-6 1200	19-11 1250	20-4 1310	20-9 1360	21-1 1410	21-6 1460	22-2 1550	22-10 1640
	19.2	11-10 530	12-9 610	13-6 690	14-3 770	14-11 840	15-6 910	16-0 970	16-7 1040	17-0 1100	17-6 1160	17-11 1220	18-4 1280	18-9 1330	19-2 1390	19-6 1440	19-10 1500	20-2 1550	20-10 1650	21-6 1750
	24.0	11-0 570	11-10 660	12-7 750	13-3 830	13-10 900	14-4 980	14-11 1050	15-4 1120	15-10 1190	16-3 1250	16-8 1310	17-0 1380	17-5 1440	17-9 1500	18-1 1550	18-5 1610	18-9 1670	19-4 1780	19-11 1880
	32.0					12-7 1000	13-1 1080	13-6 1150	13-11 1220	14-4 1300	14-9 1380	15-2 1450	15-6 1520	15-10 1580	16-2 1650	16-5 1700	16-9 1770	17-0 1830	17-7 1950	18-1 2070

Note: The required extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

**TABLE J-2
FLOOR JOISTS**
30 lbs. Per Sq. Ft. Live Load
(All rooms used for sleeping areas and attic floors.)

DESIGN CRITERIA:
Deflection - For 30 lbs. per sq. ft. live load.
Limited to span in inches divided by 360.
Strength - Live Load of 30 lbs. per sq. ft. plus
dead load of 10 lbs. per sq. ft. determines
the required fiber stress value.

JOIST SIZE SPACING (IN)		Modulus of Elasticity, "E", in 1,000,000 psi																		
		0.4	0.5	0.6	0.7	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	2.2	2.4
2x6	12.0	7-5 440	8-0 510	8-6 570	8-11 640	9-4 700	9-9 750	10-1 810	10-5 860	10-9 910	11-0 960	11-3 1010	11-7 1060	11-10 1100	12-0 1150	12-3 1200	12-6 1240	12-9 1280	13-1 1370	13-6 1450
	13.7	7-1 460	7-8 530	8-2 600	8-7 670	8-11 730	9-4 790	9-8 840	10-0 900	10-3 950	10-6 1010	10-10 1060	11-1 1110	11-3 1160	11-6 1200	11-9 1250	11-11 1300	12-2 1340	12-7 1430	12-11 1510
	16.0	6-9 480	7-3 560	7-9 630	8-2 700	8-6 770	8-10 830	9-2 890	9-6 950	9-9 1000	10-0 1060	10-3 1110	10-6 1160	10-9 1220	10-11 1270	11-2 1320	11-4 1360	11-7 1410	11-11 1500	12-3 1590
	19.2	6-4 510	6-10 600	7-3 670	7-8 740	8-0 810	8-4 880	8-8 940	8-11 1010	9-2 1070	9-5 1130	9-8 1180	9-10 1240	10-1 1290	10-4 1350	10-6 1400	10-8 1450	10-10 1500	11-3 1600	11-7 1690
	24.0	5-11 550	6-4 640	6-9 720	7-1 800	7-5 880	7-9 950	8-0 1020	8-3 1080	8-6 1150	8-9 1210	8-11 1270	9-2 1330	9-4 1390	9-7 1450	9-9 1510	9-11 1560	10-1 1620	10-5 1720	10-9 1820
	32.0					6-9 960	7-0 1040	7-3 1110	7-6 1190	7-9 1270	7-11 1330	8-2 1410	8-4 1470	8-6 1530	8-8 1590	8-10 1650	9-0 1710	9-2 1780	9-6 1910	9-9 2010
2x8	12.0	9-10 440	10-7 510	11-3 570	11-10 640	12-4 700	12-10 750	13-4 810	13-9 860	14-2 910	14-6 960	14-11 1010	15-3 1060	15-7 1100	15-10 1150	16-2 1200	16-6 1240	16-9 1280	17-4 1370	17-10 1450
	13.7	9-4 460	10-1 530	10-9 600	11-4 670	11-10 730	12-3 790	12-9 840	13-2 900	13-6 950	13-11 1010	14-3 1060	14-7 1110	14-11 1160	15-2 1200	15-6 1250	15-9 1300	16-0 1340	16-7 1430	17-0 1510
	16.0	8-11 480	9-7 560	10-2 630	10-9 700	11-3 770	11-8 830	12-1 890	12-6 950	12-10 1000	13-2 1060	13-6 1110	13-10 1160	14-2 1220	14-5 1270	14-8 1320	15-0 1360	15-3 1410	15-9 1500	16-2 1590
	19.2	8-5 510	9-0 600	9-7 670	10-1 740	10-7 810	11-0 880	11-4 940	11-9 1010	12-1 1070	12-5 1130	12-9 1180	13-0 1240	13-4 1290	13-7 1350	13-10 1400	14-1 1450	14-4 1500	14-9 1600	15-3 1690
	24.0	7-9 550	8-5 640	8-11 720	9-4 800	9-10 880	10-2 950	10-7 1020	10-11 1080	11-3 1150	11-6 1210	11-10 1270	12-1 1330	12-4 1390	12-7 1450	12-10 1510	13-1 1560	13-4 1620	13-9 1720	14-2 1820
	32.0					8-11 970	9-3 1040	9-7 1120	9-11 1200	10-2 1260	10-6 1340	10-9 1410	11-0 1470	11-3 1540	11-5 1590	11-8 1660	11-11 1730	12-1 1780	12-6 1900	12-10 2010
2x10	12.0	12-6 440	13-6 510	14-4 570	15-1 640	15-9 700	16-5 750	17-0 810	17-6 860	18-0 910	18-6 960	19-0 1010	19-5 1060	19-10 1100	20-3 1150	20-8 1200	21-0 1240	21-5 1280	22-1 1370	22-9 1450
	13.7	11-11 460	12-11 530	13-8 600	14-5 670	15-1 730	15-8 790	16-3 840	16-9 900	17-3 950	17-9 1010	18-2 1060	18-7 1110	19-0 1160	19-4 1200	19-9 1250	20-1 1300	20-5 1340	21-1 1430	21-9 1510
	16.0	11-4 480	12-3 560	13-0 630	13-8 700	14-4 770	14-11 830	15-5 890	15-11 950	16-5 1000	16-10 1060	17-3 1110	17-8 1160	18-0 1220	18-5 1270	18-9 1320	19-1 1360	19-5 1410	20-1 1500	20-8 1590
	19.2	10-8 510	11-6 600	12-3 670	12-11 740	13-6 810	14-0 880	14-6 940	15-0 1010	15-5 1070	15-10 1130	16-3 1180	16-7 1240	17-0 1290	17-4 1350	17-8 1400	18-0 1450	18-3 1500	18-10 1600	19-5 1690
	24.0	9-11 550	10-8 640	11-4 720	11-11 800	12-6 880	13-0 950	13-6 1020	13-11 1080	14-4 1150	14-8 1210	15-1 1270	15-5 1330	15-9 1390	16-1 1450	16-5 1510	16-8 1560	17-0 1620	17-6 1720	18-0 1820
	32.0					11-4 960	11-10 1050	12-3 1120	12-8 1200	13-0 1260	13-4 1330	13-8 1400	14-0 1470	14-4 1540	14-7 1590	14-11 1660	15-2 1720	15-5 1780	15-11 1890	16-5 2020
2x12	12.0	15-2 440	16-5 510	17-5 570	18-4 640	19-2 700	19-11 750	20-8 810	21-4 860	21-11 910	22-6 960	23-1 1010	23-7 1060	24-2 1100	24-8 1150	25-1 1200	25-7 1240	26-0 1280	26-10 1370	27-8 1450
	13.7	14-7 460	15-8 530	16-8 600	17-6 670	18-4 730	19-1 790	19-9 840	20-5 900	21-0 950	21-7 1010	22-1 1060	22-7 1110	23-1 1160	23-7 1200	24-0 1250	24-5 1300	24-10 1340	25-8 1430	26-5 1510
	16.0	13-10 480	14-11 560	15-10 630	16-8 700	17-5 770	18-1 830	18-9 890	19-4 950	19-11 1000	20-6 1060	21-0 1110	21-6 1160	21-11 1220	22-5 1270	22-10 1320	23-3 1360	23-7 1410	24-5 1500	25-1 1590
	19.2	13-0 510	14-0 600	14-11 670	15-8 740	16-5 810	17-0 880	17-8 940	18-3 1010	18-9 1070	19-3 1130	19-9 1180	20-2 1240	20-8 1290	21-1 1350	21-6 1400	21-10 1450	22-3 1500	22-11 1600	23-7 1690
	24.0	12-1 550	13-0 640	13-10 720	14-7 800	15-2 880	15-10 950	16-5 1020	16-11 1080	17-5 1150	17-11 1210	18-4 1270	18-9 1330	19-2 1390	19-7 1450	19-11 1510	20-3 1560	20-8 1620	21-4 1720	21-11 1820
	32.0					13-10 970	14-4 1040	14-11 1130	15-4 1190	15-10 1270	16-3 1340	16-8 1400	17-0 1460	17-5 1530	17-9 1590	18-1 1650	18-5 1720	18-9 1780	19-4 1890	19-11 2010

Note: The required extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE J-3
CEILING JOISTS

20 Lbs. Per Sq. Ft. Live Load
(Limited attic storage where development of future rooms is not possible)
(Plaster Ceiling)

DESIGN CRITERIA:

Deflection - For 20 lbs. per sq. ft. live load.
Limited to span in inches divided by 360.
Strength - Live load of 20 lbs. per sq. ft. plus
dead load of 10 lbs. per sq. ft. determines
required fiber stress value.

JOIST SIZE SPACING (IN) (IN)		Modulus of Elasticity, "E", in 1,000,000 psi																		
		0.4	0.5	0.6	0.7	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	2.2	2.4
2x4	12.0	5-5 430	5-10 500	6-2 560	6-6 630	6-10 680	7-1 740	7-4 790	7-7 850	7-10 900	8-0 950	8-3 990	8-5 1040	8-7 1090	8-9 1130	8-11 1170	9-1 1220	9-3 1260	9-7 1340	9-10 1420
	13.7	5-2 450	5-7 520	5-11 590	6-3 650	6-6 720	6-9 770	7-0 830	7-3 880	7-6 940	7-8 990	7-10 1040	8-1 1090	8-3 1140	8-5 1180	8-7 1230	8-8 1270	8-10 1320	9-2 1400	9-5 1490
	16.0	4-11 470	5-4 550	5-8 620	5-11 690	6-2 750	6-5 810	6-8 870	6-11 930	7-1 990	7-3 1040	7-6 1090	7-8 1140	7-10 1200	8-0 1240	8-1 1290	8-3 1340	8-5 1390	8-8 1480	8-11 1570
	19.2	4-8 500	5-0 580	5-4 660	5-7 730	5-10 800	6-1 870	6-3 930	6-6 990	6-8 1050	6-10 1110	7-0 1160	7-2 1220	7-4 1270	7-6 1320	7-8 1370	7-9 1420	7-11 1470	8-2 1570	8-5 1660
	24.0	4-4 540	4-8 630	4-11 710	5-2 790	5-5 860	5-8 930	5-10 1000	6-0 1070	6-2 1130	6-4 1190	6-6 1250	6-8 1310	6-10 1370	7-0 1420	7-1 1480	7-3 1530	7-4 1590	7-7 1690	7-10 1790
2x6	12.0	8-6 430	9-2 500	9-9 560	10-3 630	10-9 680	11-2 740	11-7 790	11-11 850	12-3 900	12-7 950	12-11 990	13-3 1040	13-6 1090	13-9 1130	14-1 1170	14-4 1220	14-7 1260	15-0 1340	15-6 1420
	13.7	8-2 450	8-9 520	9-4 590	9-10 650	10-3 720	10-8 770	11-1 830	11-5 880	11-9 940	12-1 990	12-4 1040	12-8 1090	12-11 1140	13-2 1180	13-5 1230	13-8 1270	13-11 1320	14-4 1400	14-9 1490
	16.0	7-9 470	8-4 550	8-10 620	9-4 690	9-9 750	10-2 810	10-6 870	10-10 930	11-2 990	11-5 1040	11-9 1090	12-0 1140	12-3 1200	12-6 1240	12-9 1290	13-0 1340	13-3 1390	13-8 1480	14-1 1570
	19.2	7-3 500	7-10 580	8-4 660	8-9 730	9-2 800	9-6 870	9-10 930	10-2 990	10-6 1050	10-9 1110	11-1 1160	11-4 1220	11-7 1270	11-9 1320	12-0 1370	12-3 1420	12-5 1470	12-10 1570	13-3 1660
	24.0	6-9 540	7-3 630	7-9 710	8-2 790	8-6 860	8-10 930	9-2 1000	9-6 1070	9-9 1130	10-0 1190	10-3 1250	10-6 1310	10-9 1370	10-11 1420	11-2 1480	11-4 1530	11-7 1590	11-11 1690	12-3 1790
2x8	12.0	11-3 430	12-1 500	12-10 560	13-6 630	14-2 680	14-8 740	15-3 790	15-9 850	16-2 900	16-7 950	17-0 990	17-5 1040	17-10 1090	18-2 1130	18-6 1170	18-10 1220	19-2 1260	19-10 1340	20-5 1420
	13.7	10-9 450	11-7 520	12-3 590	12-11 650	13-6 720	14-1 770	14-7 830	15-0 880	15-6 940	15-11 990	16-3 1040	16-8 1090	17-0 1140	17-5 1180	17-9 1230	18-0 1270	18-4 1320	18-11 1400	19-6 1490
	16.0	10-2 470	11-0 550	11-8 620	12-3 690	12-10 750	13-4 810	13-10 870	14-3 930	14-8 990	15-1 1040	15-6 1090	15-10 1140	16-2 1200	16-6 1240	16-10 1290	17-2 1340	17-5 1390	18-0 1480	18-6 1570
	19.2	9-7 500	10-4 580	11-0 660	11-7 730	12-1 800	12-7 870	13-0 930	13-5 990	13-10 1050	14-2 1110	14-7 1160	14-11 1220	15-3 1270	15-6 1320	15-10 1370	16-1 1420	16-5 1470	16-11 1570	17-5 1660
	24.0	8-11 540	9-7 630	10-2 710	10-9 790	11-3 860	11-8 930	12-1 1000	12-6 1070	12-10 1130	13-2 1190	13-6 1250	13-10 1310	14-2 1370	14-5 1420	14-8 1480	15-0 1530	15-3 1590	15-9 1690	16-2 1790
2x10	12.0	14-4 430	15-5 500	16-5 560	17-3 630	18-0 680	18-9 740	19-5 790	20-1 850	20-8 900	21-2 950	21-9 990	22-3 1040	22-9 1090	23-2 1130	23-8 1170	24-1 1220	24-6 1260	25-3 1340	26-0 1420
	13.7	13-8 450	14-9 520	15-8 590	16-6 650	17-3 720	17-11 770	18-7 830	19-2 880	19-9 940	20-3 990	20-9 1040	21-3 1090	21-9 1140	22-2 1180	22-7 1230	23-0 1270	23-5 1320	24-2 1400	24-10 1490
	16.0	13-0 470	14-0 550	14-11 620	15-8 690	16-5 750	17-0 810	17-8 870	18-3 930	18-9 990	19-3 1040	19-9 1090	20-2 1140	20-8 1200	21-1 1240	21-6 1290	21-10 1340	22-3 1390	22-11 1480	23-8 1570
	19.2	12-3 500	13-2 580	14-0 660	14-9 730	15-5 800	16-0 870	16-7 930	17-2 990	17-8 1050	18-1 1110	18-7 1160	19-0 1220	19-5 1270	19-10 1320	20-2 1370	20-7 1420	20-11 1470	21-7 1570	22-3 1660
	24.0	11-4 540	12-3 630	13-0 710	13-8 790	14-4 860	14-11 930	15-5 1000	15-11 1070	16-5 1130	16-10 1190	17-3 1250	17-8 1310	18-0 1370	18-5 1420	18-9 1480	19-1 1530	19-5 1590	20-1 1690	20-8 1790

Note: The required extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE J-4
CEILING JOISTS

20 Lbs. Per Sq. Ft. Live Load

(Limited attic storage where development of future rooms is not possible)
(Drywall Ceiling)

DESIGN CRITERIA:

Deflection - For 20 lbs. per sq. ft. live load.

Limited to span in inches divided by 240.

Strength - live load of 20 lbs. per sq. ft. plus dead load of 10 lbs. per sq. ft. determines required fiber stress value.

JOIST SIZE SPACING (IN)	Modulus of Elasticity, "E", in 1,000,000 psi																			
	0.4	0.5	0.6	0.7	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	2.2	2.4	
2x4	12.0	6-2 560	6-8 660	7-1 740	7-6 820	7-10 900	8-1 970	8-5 1040	8-8 1110	8-11 1170	9-2 1240	9-5 1300	9-8 1360	9-10 1420	10-0 1480	10-3 1540	10-5 1600	10-7 1650	10-11 1760	11-3 1860
	13.7	5-11 590	6-5 690	6-9 770	7-2 860	7-6 940	7-9 1010	8-1 1090	8-4 1160	8-7 1230	8-9 1300	9-0 1360	9-3 1420	9-5 1490	9-7 1550	9-9 1610	10-0 1670	10-2 1730	10-6 1840	10-9 1950
	16.0	5-8 620	6-1 720	6-5 810	6-9 900	7-1 990	7-5 1070	7-8 1140	7-11 1220	8-1 1290	8-4 1360	8-7 1430	8-9 1500	8-11 1570	9-1 1630	9-4 1690	9-6 1760	9-8 1820	9-11 1940	10-3 2050
	19.2	5-4 660	5-9 770	6-1 870	6-5 960	6-8 1050	6-11 1130	7-2 1220	7-5 1300	7-8 1370	7-10 1450	8-1 1520	8-3 1590	8-5 1660	8-7 1730	8-9 1800	8-11 1870	9-1 1930	9-4 2060	9-8 2180
	24.0	4-11 710	5-4 830	5-8 930	5-11 1030	6-2 1130	6-5 1220	6-8 1310	6-11 1400	7-1 1480	7-3 1560	7-6 1640	7-8 1720	7-10 1790	8-0 1870	8-1 1940	8-3 2010	8-5 2080	8-8 2220	8-11 2350
2x6	12.0	9-9 560	10-6 660	11-2 740	11-9 820	12-3 900	12-9 970	13-3 1040	13-8 1110	14-1 1170	14-5 1240	14-9 1300	15-2 1360	15-6 1420	15-9 1480	16-1 1540	16-4 1600	16-8 1650	17-2 1760	17-8 1860
	13.7	9-4 590	10-0 690	10-8 770	11-3 860	11-9 940	12-3 1010	12-8 1090	13-1 1160	13-5 1230	13-10 1300	14-2 1360	14-6 1420	14-9 1490	15-1 1550	15-5 1610	15-8 1670	15-11 1730	16-5 1840	16-11 1950
	16.0	8-10 620	9-6 720	10-2 810	10-8 900	11-2 990	11-7 1070	12-0 1140	12-5 1220	12-9 1290	13-1 1360	13-5 1430	13-9 1500	14-1 1570	14-4 1630	14-7 1690	14-11 1760	15-2 1820	15-7 1940	16-1 2050
	19.2	8-4 660	9-0 770	9-6 870	10-0 960	10-6 1050	10-11 1130	11-4 1220	11-8 1300	12-0 1370	12-4 1450	12-8 1520	12-11 1590	13-3 1660	13-6 1730	13-9 1800	14-0 1870	14-3 1930	14-8 2060	15-2 2180
	24.0	7-9 710	8-4 830	8-10 930	9-4 1030	9-9 1130	10-2 1220	10-6 1310	10-10 1400	11-2 1480	11-5 1560	11-9 1640	12-0 1720	12-3 1790	12-6 1870	12-9 1940	13-0 2010	13-3 2080	13-8 2220	14-1 2350
2x8	12.0	12-10 560	13-10 660	14-8 740	15-6 820	16-2 900	16-10 970	17-5 1040	18-0 1110	18-6 1170	19-0 1240	19-6 1300	19-11 1360	20-5 1420	20-10 1480	21-2 1540	21-7 1600	21-11 1650	22-8 1760	23-4 1860
	13.7	12-3 590	13-3 690	14-1 770	14-10 860	15-6 940	16-1 1010	16-8 1090	17-2 1160	17-9 1230	18-2 1300	18-8 1360	19-1 1420	19-6 1490	19-11 1550	20-3 1610	20-8 1670	21-0 1730	21-8 1840	22-4 1950
	16.0	11-8 620	12-7 720	13-4 810	14-1 900	14-8 990	15-3 1070	15-10 1140	16-4 1220	16-10 1290	17-3 1360	17-9 1430	18-2 1500	18-6 1570	18-11 1630	19-3 1690	19-7 1760	19-11 1820	20-7 1940	21-2 2050
	19.2	11-0 660	11-10 770	12-7 870	13-3 960	13-10 1050	14-5 1130	14-11 1220	15-5 1300	15-10 1370	16-3 1450	16-8 1520	17-1 1590	17-5 1660	17-9 1730	18-2 1800	18-5 1870	18-9 1930	19-5 2060	19-11 2180
	24.0	10-2 710	11-0 830	11-8 930	12-3 1030	12-10 1130	13-4 1220	13-10 1310	14-3 1400	14-8 1480	15-1 1560	15-6 1640	15-10 1720	16-2 1790	16-6 1870	16-10 1940	17-2 2010	17-5 2080	18-0 2220	18-6 2350
2x10	12.0	16-5 560	17-8 660	18-9 740	19-9 820	20-8 900	21-6 970	22-3 1040	22-11 1110	23-8 1170	24-3 1240	24-10 1300	25-5 1360	26-0 1420	26-6 1480	27-1 1540	27-6 1600	28-0 1650	28-11 1760	29-9 1860
	13.7	15-8 590	16-11 690	17-11 770	18-11 860	19-9 940	20-6 1010	21-3 1090	21-11 1160	22-7 1230	23-3 1300	23-9 1360	24-4 1420	24-10 1490	25-5 1550	26-4 1610	26-10 1670	26-10 1730	27-8 1840	28-6 1950
	16.0	14-11 620	16-0 720	17-0 810	17-11 900	18-9 990	19-6 1070	20-2 1140	20-10 1220	21-6 1290	22-1 1360	22-7 1430	23-2 1500	23-8 1570	24-1 1630	24-7 1690	25-0 1760	25-5 1820	26-3 1940	27-1 2050
	19.2	14-0 660	15-1 770	16-0 870	16-11 960	17-8 1050	18-4 1130	19-0 1220	19-7 1300	20-2 1370	20-9 1450	21-3 1520	21-9 1590	22-3 1660	22-8 1730	23-2 1800	23-7 1870	23-11 1930	24-9 2060	25-5 2180
	24.0	13-0 710	14-0 830	14-11 930	15-8 1030	16-5 1130	17-0 1220	17-8 1310	18-3 1400	18-9 1480	19-3 1560	19-9 1640	20-2 1720	20-8 1790	21-1 1870	21-6 1940	21-10 2010	22-3 2080	22-11 2220	23-8 2350

Note: The required extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE J-5
CEILING JOISTS

10 Lbs. Per Sq. Ft. Live Load

(No attic storage and roof slope not steeper than 3 in 12)
(Plaster Ceiling)

DESIGN CRITERIA:

Deflection - For 10 lbs. per sq. ft. live load.

Limited to span in inches divided by 360.

Strength - live load of 10 lbs. per sq. ft. plus
dead load of 5 lbs. per sq. ft. determines
required fiber stress value.

JOIST SIZE SPACING (IN) (IN)		Modulus of Elasticity, "E", in 1,000,000 psi																		
		0.4	0.5	0.6	0.7	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	2.2	2.4
2x4	12.0	6-10 340	7-4 400	7-10 450	8-3 500	8-7 540	8-11 590	9-3 630	9-7 670	9-10 710	10-1 750	10-4 790	10-7 830	10-10 860	11-1 900	11-3 930	11-6 970	11-8 1000	12-1 1070	12-5 1130
	13.7	6-6 360	7-0 410	7-6 470	7-10 520	8-3 570	8-7 610	8-10 660	9-2 700	9-5 740	9-8 780	9-11 820	10-2 860	10-4 900	10-7 940	10-9 970	11-0 1010	11-2 1050	11-6 1110	11-10 1180
	16.0	6-2 380	6-8 440	7-1 490	7-6 550	7-10 600	8-1 650	8-5 690	8-8 740	8-11 780	9-2 830	9-5 870	9-8 910	9-10 950	10-0 990	10-3 1030	10-5 1060	10-7 1100	10-11 1170	11-3 1240
	19.2	5-10 400	6-3 460	6-8 520	7-0 580	7-4 630	7-8 690	7-11 740	8-2 790	8-5 830	8-8 880	8-10 920	9-1 970	9-3 1010	9-5 1050	9-8 1090	9-10 1130	10-0 1170	10-4 1250	10-7 1320
	24.0	5-5 430	5-10 500	6-2 560	6-6 630	6-10 680	7-1 740	7-4 790	7-7 850	7-10 900	8-0 950	8-3 990	8-5 1040	8-7 1090	8-9 1130	8-11 1170	9-1 1220	9-3 1260	9-7 1340	9-10 1420
2x6	12.0	10-9 340	11-7 400	12-3 450	12-11 500	13-6 540	14-1 590	14-7 630	15-0 670	15-6 710	15-11 750	16-3 790	16-8 830	17-0 860	17-4 900	17-8 930	18-0 970	18-4 1000	18-11 1070	19-6 1130
	13.7	10-3 360	11-1 410	11-9 470	12-4 520	12-11 570	13-5 610	13-11 660	14-4 700	14-9 740	15-2 780	15-7 820	15-11 860	16-3 900	16-7 940	16-11 970	17-3 1010	17-6 1050	18-1 1110	18-8 1180
	16.0	9-9 380	10-6 440	11-2 490	11-9 550	12-3 600	12-9 650	13-3 690	13-8 740	14-1 780	14-5 830	14-9 870	15-2 910	15-6 950	15-9 990	16-1 1030	16-4 1060	16-8 1100	17-2 1170	17-8 1240
	19.2	9-2 400	9-10 460	10-6 520	11-1 580	11-7 630	12-0 690	12-5 740	12-10 790	13-3 830	13-7 880	13-11 920	14-3 970	14-7 1010	14-10 1050	15-2 1090	15-5 1130	15-8 1170	16-2 1250	16-8 1320
	24.0	8-6 430	9-2 500	9-9 560	10-3 630	10-9 680	11-2 740	11-7 790	11-11 850	12-3 900	12-7 950	12-11 990	13-3 1040	13-6 1090	13-9 1130	14-1 1170	14-4 1220	14-7 1260	15-0 1340	15-6 1420
2x8	12.0	14-2 340	15-3 400	16-2 450	17-0 500	17-10 540	18-6 590	19-2 630	19-10 670	20-5 710	20-11 750	21-5 790	21-11 830	22-5 860	22-11 900	23-4 930	23-9 970	24-2 1000	24-11 1070	25-8 1130
	13.7	13-6 360	14-7 410	15-6 470	16-3 520	17-0 570	17-9 610	18-4 660	18-11 700	19-6 740	20-0 780	20-6 820	21-0 860	21-5 900	21-11 940	22-4 970	22-9 1010	23-1 1050	23-10 1110	24-7 1180
	16.0	12-10 380	13-10 440	14-8 490	15-6 550	16-2 600	16-10 650	17-5 690	18-0 740	18-6 780	19-0 830	19-6 870	19-11 910	20-5 950	20-10 990	21-2 1030	21-7 1060	21-11 1100	22-8 1170	23-4 1240
	19.2	12-1 400	13-0 460	13-10 520	14-7 580	15-3 630	15-10 690	16-5 740	16-11 790	17-5 830	17-11 880	18-4 920	18-9 970	19-2 1010	19-7 1050	19-11 1090	20-4 1130	20-8 1170	21-4 1250	21-11 1320
	24.0	11-3 430	12-1 500	12-10 560	13-6 630	14-2 680	14-8 740	15-3 790	15-9 850	16-2 900	16-7 950	17-0 990	17-5 1040	17-10 1090	18-2 1130	18-6 1170	18-10 1220	19-2 1260	19-10 1340	20-5 1420
2x10	12.0	18-0 340	19-5 400	20-8 450	21-9 500	22-9 540	23-8 590	24-6 630	25-3 670	26-0 710	26-9 750	27-5 790	28-0 830	28-7 860	29-2 900	29-9 930	30-4 970	30-10 1000	31-10 1070	32-9 1130
	13.7	17-3 360	18-7 410	19-9 470	20-9 520	21-9 570	22-7 610	23-5 660	24-2 700	24-10 740	25-7 780	26-2 820	26-10 860	27-5 900	27-11 940	28-6 970	29-0 1010	29-6 1050	30-5 1110	31-4 1180
	16.0	16-5 380	17-8 440	18-9 490	19-9 550	20-8 600	21-6 650	22-3 690	22-11 740	23-8 780	24-3 830	24-10 870	25-5 910	26-0 950	26-6 990	27-1 1030	27-6 1060	28-0 1100	28-11 1170	29-9 1240
	19.2	15-5 400	16-7 460	17-8 520	18-7 580	19-5 630	20-2 690	20-11 740	21-7 790	22-3 830	22-10 880	23-5 920	23-11 970	24-6 1010	25-0 1050	25-5 1090	25-11 1130	26-4 1170	27-3 1250	28-0 1320
	24.0	14-4 430	15-5 500	16-5 560	17-3 630	18-0 680	18-9 740	19-5 790	20-1 850	20-8 900	21-2 950	21-9 990	22-3 1040	22-9 1090	23-2 1130	23-8 1170	24-1 1220	24-6 1260	25-3 1340	26-0 1420

Note: The required extreme fiber stress in bending, "F_b" in pounds per square inch is shown below each span.

TABLE J-6
CEILING JOISTS

10 Lbs. Per Sq. Ft. Live Load
(No attic storage and roof slope not steeper than 3 in 12)
(Drywall Ceiling)

DESIGN CRITERIA:

Deflection - For 10 lbs. per sq. ft. live load.
Limited to span in inches divided by 240.
Strength - live load of 10 lbs. per sq. ft. plus
dead load of 5 lbs. per sq. ft. determines
required fiber stress value.

JOIST SIZE SPACING (IN)	JOIST SIZE SPACING (IN)	Modulus of Elasticity, "E", in 1,000,000 psi																		
		0.4	0.5	0.6	0.7	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	2.2	2.4
2x4	12.0	7-10 450	8-5 520	8-11 590	9-5 650	9-10 710	10-3 770	10-7 830	10-11 880	11-3 930	11-7 980	11-10 1030	12-2 1080	12-5 1130	12-8 1180	12-11 1220	13-2 1270	13-4 1310	13-9 1400	14-2 1480
	13.7	7-6 470	8-1 540	8-7 610	9-0 680	9-5 740	9-9 800	10-2 860	10-6 920	10-9 970	11-1 1030	11-4 1080	11-7 1130	11-10 1180	12-1 1230	12-4 1280	12-7 1320	12-9 1370	13-2 1460	13-7 1550
	16.0	7-1 490	7-8 570	8-1 650	8-7 720	8-11 780	9-4 850	9-8 910	9-11 970	10-3 1030	10-6 1080	10-9 1140	11-0 1190	11-3 1240	11-6 1290	11-9 1340	11-11 1390	12-2 1440	12-6 1540	12-11 1630
	19.2	6-8 520	7-2 610	7-8 690	8-1 760	8-5 830	8-9 900	9-1 970	9-4 1030	9-8 1090	9-11 1150	10-2 1210	10-4 1270	10-7 1320	10-10 1380	11-0 1430	11-3 1480	11-5 1530	11-9 1630	12-2 1730
	24.0	6-2 560	6-8 660	7-1 740	7-6 820	7-10 900	8-1 970	8-5 1040	8-8 1110	8-11 1170	9-2 1240	9-5 1300	9-8 1360	9-10 1420	10-0 1480	10-3 1540	10-5 1600	10-7 1650	10-11 1760	11-3 1860
2x6	12.0	12-3 450	13-3 520	14-1 590	14-9 650	15-6 710	16-1 770	16-8 830	17-2 880	17-8 930	18-2 980	18-8 1030	19-1 1080	19-6 1130	19-11 1180	20-3 1220	20-8 1270	21-0 1310	21-8 1400	22-4 1480
	13.7	11-9 470	12-8 540	13-5 610	14-2 680	14-9 740	15-5 800	15-11 860	16-5 920	16-11 970	17-5 1030	17-10 1080	18-3 1130	18-8 1180	19-0 1230	19-5 1280	19-9 1320	20-1 1370	20-9 1460	21-4 1550
	16.0	11-2 490	12-0 570	12-9 650	13-5 720	14-1 780	14-7 850	15-2 910	15-7 970	16-1 1030	16-6 1080	16-11 1140	17-4 1190	17-8 1240	18-1 1290	18-5 1340	18-9 1390	19-1 1440	19-8 1540	20-3 1630
	19.2	10-6 520	11-4 610	12-0 690	12-8 760	13-3 830	13-9 900	14-3 970	14-8 1030	15-2 1090	15-7 1150	16-1 1210	16-4 1270	16-8 1320	17-0 1380	17-4 1430	17-8 1480	17-11 1530	18-6 1630	19-1 1730
	24.0	9-9 560	10-6 660	11-2 740	11-9 820	12-3 900	12-9 970	13-3 1040	13-8 1110	14-1 1170	14-5 1240	14-9 1300	15-2 1360	15-6 1420	15-9 1480	16-1 1540	16-4 1600	16-8 1650	17-2 1760	17-8 1860
2x8	12.0	16-2 450	17-5 520	18-6 590	19-6 650	20-5 710	21-2 770	21-11 830	22-8 880	23-4 930	24-0 980	24-7 1030	25-2 1080	25-8 1130	26-2 1180	26-9 1220	27-2 1270	27-8 1310	28-7 1400	29-5 1480
	13.7	15-6 470	16-8 540	17-9 610	18-8 680	19-6 740	20-3 800	21-0 860	21-8 920	22-4 970	22-11 1030	23-6 1080	24-0 1130	24-7 1180	25-1 1230	25-7 1280	26-0 1320	26-6 1370	27-4 1460	28-1 1550
	16.0	14-8 490	15-10 570	16-10 650	17-9 720	18-6 780	19-3 850	19-11 910	20-7 970	21-2 1030	21-9 1080	22-4 1140	22-10 1190	23-4 1240	23-10 1290	24-3 1340	24-8 1390	25-2 1440	25-11 1540	26-9 1630
	19.2	13-10 520	14-11 610	15-10 690	16-8 760	17-5 830	18-2 900	18-9 970	19-5 1030	19-11 1090	20-6 1150	21-0 1210	21-6 1270	21-11 1320	22-5 1380	22-10 1430	23-3 1480	23-8 1530	24-5 1630	25-2 1730
	24.0	12-10 560	13-10 660	14-8 740	15-6 820	16-2 900	16-10 970	17-5 1040	18-0 1110	18-6 1170	19-0 1240	19-6 1300	19-11 1360	20-5 1420	20-10 1480	21-2 1540	21-7 1600	21-11 1650	22-8 1760	23-4 1860
2x10	12.0	20-8 450	22-3 520	23-8 590	24-10 650	26-0 710	27-1 770	28-0 830	28-11 880	29-9 930	30-7 980	31-4 1030	32-1 1080	32-9 1130	33-5 1180	34-1 1220	34-8 1270	35-4 1310	36-5 1400	37-6 1480
	13.7	19-9 470	21-3 540	22-7 610	23-9 680	24-10 740	25-10 800	26-10 860	27-8 920	28-6 970	29-3 1030	30-0 1080	30-8 1130	31-4 1180	32-0 1230	32-7 1280	33-2 1320	33-9 1370	34-10 1460	35-10 1550
	16.0	18-9 490	20-2 570	21-6 650	22-7 720	23-8 780	24-7 850	25-5 910	26-3 970	27-1 1030	27-9 1080	28-6 1140	29-2 1190	29-9 1240	30-5 1290	31-0 1340	31-6 1390	32-1 1440	33-1 1540	34-1 1630
	19.2	17-8 520	19-0 610	20-2 690	21-3 760	22-3 830	23-2 900	23-11 970	24-9 1030	25-5 1090	26-2 1150	26-10 1210	27-5 1270	28-0 1320	28-7 1380	29-2 1430	29-8 1480	30-2 1530	31-2 1630	32-1 1730
	24.0	16-5 560	17-8 660	18-9 740	19-9 820	20-8 900	21-6 970	22-3 1040	22-11 1110	23-8 1170	24-3 1240	24-10 1300	25-5 1360	26-0 1420	26-6 1480	27-1 1540	27-6 1600	28-0 1650	28-11 1760	29-9 1860

Note: The required extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE R-1
FLAT OR SLOPED RAFTERS
Supporting Drywall Ceiling
(Flat roof or cathedral ceiling with no attic space)
Live Load - 20 lb. per sq. ft.

DESIGN CRITERIA:

Strength - 15 lbs. per sq. ft. dead load plus 20 lbs. per sq. ft. live load determines required fiber stress.

Deflection - For 20 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTER SIZE SPACING (IN) (IN)		Extreme Fiber Stress in Bending, "F _b " (psi).										
		300	400	500	600	700	800	900	1000	1100	1200	1300
2x6	12.0	6-7 0.12	7-7 0.19	8-6 0.26	9-4 0.35	10-0 0.44	10-9 0.54	11-5 0.64	12-0 0.75	12-7 0.86	13-2 0.98	13-8 1.11
	13.7	6-2 0.12	7-1 0.18	7-11 0.25	8-8 0.33	9-5 0.41	10-0 0.50	10-8 0.60	11-3 0.70	11-9 0.81	12-4 0.92	12-10 1.04
	16.0	5-8 0.11	6-7 0.16	7-4 0.23	8-1 0.30	8-8 0.38	9-4 0.46	9-10 0.55	10-5 0.65	10-11 0.75	11-5 0.85	11-10 0.96
	19.2	5-2 0.10	6-0 0.15	6-9 0.21	7-4 0.27	7-11 0.35	8-6 0.42	9-0 0.51	9-6 0.59	9-11 0.68	10-5 0.78	10-10 0.88
	24.0	4-8 0.09	5-4 0.13	6-0 0.19	6-7 0.25	7-1 0.31	7-7 0.38	8-1 0.45	8-6 0.53	8-11 0.61	9-4 0.70	9-8 0.78
2x8	12.0	8-8 0.12	10-0 0.19	11-2 0.26	12-3 0.35	13-3 0.44	14-2 0.54	15-0 0.64	15-10 0.75	16-7 0.86	17-4 0.98	18-0 1.11
	13.7	8-1 0.12	9-4 0.18	10-6 0.25	11-6 0.33	12-5 0.41	13-3 0.50	14-0 0.60	14-10 0.70	15-6 0.81	16-3 0.92	16-10 1.04
	16.0	7-6 0.11	8-8 0.16	9-8 0.23	10-7 0.30	11-6 0.38	12-3 0.46	13-0 0.55	13-8 0.65	14-4 0.75	15-0 0.85	15-7 0.96
	19.2	6-10 0.10	7-11 0.15	8-10 0.21	9-8 0.27	10-6 0.35	11-2 0.42	11-10 0.51	12-6 0.59	13-1 0.68	13-8 0.78	14-3 0.88
	24.0	6-2 0.09	7-1 0.13	7-11 0.19	8-8 0.25	9-4 0.31	10-0 0.38	10-7 0.45	11-2 0.53	11-9 0.61	12-3 0.70	12-9 0.78
2x10	12.0	11-1 0.12	12-9 0.19	14-3 0.26	15-8 0.35	16-11 0.44	18-1 0.54	19-2 0.64	20-2 0.75	21-2 0.86	22-1 0.98	23-0 1.11
	13.7	10-4 0.12	11-11 0.18	13-4 0.25	14-8 0.33	15-10 0.41	16-11 0.50	17-11 0.60	18-11 0.70	19-10 0.81	20-8 0.92	21-6 1.04
	16.0	9-7 0.11	11-1 0.16	12-4 0.23	13-6 0.30	14-8 0.38	15-8 0.46	16-7 0.55	17-6 0.65	18-4 0.75	19-2 0.85	19-11 0.96
	19.2	8-9 0.10	10-1 0.15	11-3 0.21	12-4 0.27	13-4 0.35	14-3 0.42	15-2 0.51	15-11 0.59	16-9 0.68	17-6 0.78	18-2 0.88
	24.0	7-10 0.09	9-0 0.13	10-1 0.19	11-1 0.25	11-11 0.31	12-9 0.38	13-6 0.45	14-3 0.53	15-0 0.61	15-8 0.70	16-3 0.78
2x12	12.0	13-5 0.12	15-6 0.19	17-4 0.26	19-0 0.35	20-6 0.44	21-11 0.54	23-3 0.64	24-7 0.75	25-9 0.86	26-11 0.98	28-0 1.11
	13.7	12-7 0.12	14-6 0.18	16-3 0.25	17-9 0.33	19-3 0.41	20-6 0.50	21-9 0.60	23-0 0.70	24-1 0.81	25-2 0.92	26-2 1.04
	16.0	11-8 0.11	13-5 0.16	15-0 0.23	16-6 0.30	17-9 0.38	19-0 0.46	20-2 0.55	21-3 0.65	22-4 0.75	23-3 0.85	24-3 0.96
	19.2	10-8 0.10	12-3 0.15	13-9 0.21	15-0 0.27	16-3 0.35	17-4 0.42	18-5 0.51	19-5 0.59	20-4 0.68	21-3 0.78	22-2 0.88
	24.0	9-6 0.09	11-0 0.13	12-3 0.19	13-5 0.25	14-6 0.31	15-6 0.38	16-6 0.45	17-4 0.53	18-2 0.61	19-0 0.70	19-10 0.78

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-1 (cont.)

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

Extreme Fiber Stress in Bending, "F _b " (psi).											RAFTER SPACING SIZE (IN)	
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700		
14-2 1.24	14-8 1.37	15-2 1.51	15-8 1.66	16-1 1.81	16-7 1.96	17-0 2.12	17-5 2.28	17-10 2.44				12.0
13-3 1.16	13-9 1.29	14-2 1.42	14-8 1.55	15-1 1.69	15-6 1.83	15-11 1.98	16-3 2.13	16-8 2.28	17-5 2.60			13.7
12-4 1.07	12-9 1.19	13-2 1.31	13-7 1.44	13-11 1.56	14-4 1.70	14-8 1.83	15-1 1.97	15-5 2.11	16-1 2.41			16.0
11-3 0.98	11-7 1.09	12-0 1.20	12-4 1.31	12-9 1.43	13-1 1.55	13-5 1.67	13-9 1.80	14-1 1.93	14-8 2.20			19.2
10-0 0.88	10-5 0.97	10-9 1.07	11-1 1.17	11-5 1.28	11-8 1.39	12-0 1.50	12-4 1.61	12-7 1.73	13-2 1.97	13-11 2.35		24.0
18-9 1.24	19-5 1.37	20-0 1.51	20-8 1.66	21-3 1.81	21-10 1.96	22-4 2.12	22-11 2.28	23-6 2.44				12.0
17-6 1.16	18-2 1.29	18-9 1.42	19-4 1.55	19-10 1.69	20-5 1.83	20-11 1.98	21-5 2.13	21-11 2.28	22-11 2.60			13.7
16-3 1.07	16-9 1.19	17-4 1.31	17-10 1.44	18-5 1.56	18-11 1.70	19-5 1.83	19-10 1.97	20-4 2.11	21-3 2.41			16.0
14-10 0.98	15-4 1.09	15-10 1.20	16-4 1.31	16-9 1.43	17-3 1.55	17-8 1.67	18-2 1.80	18-7 1.93	19-5 2.20			19.2
13-3 0.88	13-8 0.97	14-2 1.07	14-7 1.17	15-0 1.28	15-5 1.39	15-10 1.50	16-3 1.61	16-7 1.73	17-4 1.97	18-5 2.35		24.0
23-11 1.24	24-9 1.37	25-6 1.51	26-4 1.66	27-1 1.81	27-10 1.96	28-7 2.12	29-3 2.28	29-11 2.44				12.0
22-4 1.16	23-2 1.29	23-11 1.42	24-7 1.55	25-4 1.69	26-0 1.83	26-8 1.98	27-4 2.13	28-0 2.28	29-3 2.60			13.7
20-8 1.07	21-5 1.19	22-1 1.31	22-10 1.44	23-5 1.56	24-1 1.70	24-9 1.83	25-4 1.97	25-11 2.11	27-1 2.41			16.0
18-11 0.98	19-7 1.09	20-2 1.20	20-10 1.31	21-5 1.43	22-0 1.55	22-7 1.67	23-2 1.80	23-8 1.93	24-9 2.20			19.2
16-11 0.88	17-6 0.97	18-1 1.07	18-7 1.17	19-2 1.28	19-8 1.39	20-2 1.50	20-8 1.61	21-2 1.73	22-1 1.97	23-5 2.35		24.0
29-1 1.24	30-1 1.37	31-1 1.51	32-0 1.66	32-11 1.81	33-10 1.96	34-9 2.12	35-7 2.28	36-5 2.44				12.0
27-2 1.16	28-2 1.29	29-1 1.42	29-11 1.55	30-10 1.69	31-8 1.83	32-6 1.98	33-3 2.13	34-1 2.28	35-7 2.60			13.7
25-2 1.07	26-0 1.19	26-11 1.31	27-9 1.44	28-6 1.56	29-4 1.70	30-1 1.83	30-10 1.97	31-6 2.11	32-11 2.41			16.0
23-0 0.98	23-9 1.09	24-7 1.20	25-4 1.31	26-0 1.43	26-9 1.55	27-5 1.67	28-2 1.80	28-9 1.93	30-1 2.20			19.2
20-6 0.88	21-3 0.97	21-11 1.07	22-8 1.17	23-3 1.28	23-11 1.39	24-7 1.50	25-2 1.61	25-9 1.73	26-11 1.97	28-6 2.35		24.0

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-2
FLAT OR SLOPED RAFTERS
Supporting Drywall Ceiling
(Flat roof or cathedral ceiling with no attic space)
Live Load - 30 lb. per sq. ft.

DESIGN CRITERIA:

Strength - 15 lbs. per sq. ft. dead load plus 30

lbs. per sq. ft. live load determines required
fiber stress.

Deflection - For 30 lbs. per sq. ft. live load.

Limited to span in inches divided by 240.

RAFTER SIZE SPACING (IN) (IN)		Extreme Fiber Stress in Bending, "F _b " (psi).										
		300	400	500	600	700	800	900	1000	1100	1200	1300
2x6	12.0	5-10 0.13	6-8 0.19	7-6 0.27	8-2 0.36	8-10 0.45	9-6 0.55	10-0 0.66	10-7 0.77	11-1 0.89	11-7 1.01	12-1 1.14
	13.7	5-5 0.12	6-3 0.18	7-0 0.25	7-8 0.33	8-3 0.42	8-10 0.52	9-5 0.61	9-11 0.72	10-5 0.83	10-10 0.95	11-3 1.07
	16.0	5-0 0.11	5-10 0.17	6-6 0.24	7-1 0.31	7-8 0.39	8-2 0.48	8-8 0.57	9-2 0.67	9-7 0.77	10-0 0.88	10-5 0.99
	19.2	4-7 0.10	5-4 0.15	5-11 0.22	6-6 0.28	7-0 0.36	7-6 0.44	7-11 0.52	8-4 0.61	8-9 0.70	9-2 0.80	9-6 0.90
	24.0	4-1 0.09	4-9 0.14	5-4 0.19	5-10 0.25	6-3 0.32	6-8 0.39	7-1 0.46	7-6 0.54	7-10 0.63	8-2 0.72	8-6 0.81
2x8	12.0	7-8 0.13	8-10 0.19	9-10 0.27	10-10 0.36	11-8 0.45	12-6 0.55	13-3 0.66	13-11 0.77	14-8 0.89	15-3 1.01	15-11 1.14
	13.7	7-2 0.12	8-3 0.18	9-3 0.25	10-1 0.33	10-11 0.42	11-8 0.52	12-5 0.61	13-1 0.72	13-8 0.83	14-4 0.95	14-11 1.07
	16.0	6-7 0.11	7-8 0.17	8-7 0.24	9-4 0.31	10-1 0.39	10-10 0.48	11-6 0.57	12-1 0.67	12-8 0.77	13-3 0.88	13-9 0.99
	19.2	6-1 0.10	7-0 0.15	7-10 0.22	8-7 0.28	9-3 0.36	9-10 0.44	10-6 0.52	11-0 0.61	11-7 0.70	12-1 0.80	12-7 0.90
	24.0	5-5 0.09	6-3 0.14	7-0 0.19	7-8 0.25	8-3 0.32	8-10 0.39	9-4 0.46	9-10 0.54	10-4 0.63	10-10 0.72	11-3 0.81
2x10	12.0	9-9 0.13	11-3 0.19	12-7 0.27	13-9 0.36	14-11 0.45	15-11 0.55	16-11 0.66	17-10 0.77	18-8 0.89	19-6 1.01	20-4 1.14
	13.7	9-1 0.12	10-6 0.18	11-9 0.25	12-11 0.33	13-11 0.42	14-11 0.52	15-10 0.61	16-8 0.72	17-6 0.83	18-3 0.95	19-0 1.07
	16.0	8-5 0.11	9-9 0.17	10-11 0.24	11-11 0.31	12-11 0.39	13-9 0.48	14-8 0.57	15-5 0.67	16-2 0.77	16-11 0.88	17-7 0.99
	19.2	7-8 0.10	8-11 0.15	9-11 0.22	10-11 0.28	11-9 0.36	12-7 0.44	13-4 0.52	14-1 0.61	14-9 0.70	15-5 0.80	16-1 0.90
	24.0	6-11 0.09	8-0 0.14	8-11 0.19	9-9 0.25	10-6 0.32	11-3 0.39	11-11 0.46	12-7 0.54	13-2 0.63	13-9 0.72	14-4 0.81
2x12	12.0	11-10 0.13	13-8 0.19	15-4 0.27	16-9 0.36	18-1 0.45	19-4 0.55	20-6 0.66	21-8 0.77	22-8 0.89	23-9 1.01	24-8 1.14
	13.7	11-1 0.12	12-10 0.18	14-4 0.25	15-8 0.33	16-11 0.42	18-1 0.52	19-3 0.61	20-3 0.72	21-3 0.83	22-2 0.95	23-1 1.07
	16.0	10-3 0.11	11-10 0.17	13-3 0.24	14-6 0.31	15-8 0.39	16-9 0.48	17-9 0.57	18-9 0.67	19-8 0.77	20-6 0.88	21-5 0.99
	19.2	9-5 0.10	10-10 0.15	12-1 0.22	13-3 0.28	14-4 0.36	15-4 0.44	16-3 0.52	17-1 0.61	17-11 0.70	18-9 0.80	19-6 0.90
	24.0	8-5 0.09	9-8 0.14	10-10 0.19	11-10 0.25	12-10 0.32	13-8 0.39	14-6 0.46	15-4 0.54	16-1 0.63	16-9 0.72	17-5 0.81

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-2 (cont.)

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

Extreme Fiber Stress in Bending, "F _b " (psi).											RAFTER SPACING SIZE (IN)	
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700	(IN)	(IN)
12-6 1.28	13-0 1.41	13-5 1.56	13-10 1.71	14-2 1.86	14-7 2.02	15-0 2.18	15-4 2.34	15-8 2.51			12.0	2x6
11-9 1.19	12-2 1.32	12-6 1.46	12-11 1.60	13-3 1.74	13-8 1.89	14-0 2.04	14-4 2.19	14-8 2.35			13.7	
10-10 1.10	11-3 1.22	11-7 1.35	11-11 1.48	12-4 1.61	12-8 1.75	13-0 1.89	13-3 2.03	13-7 2.18	14-2 2.48		16.0	
9-11 1.01	10-3 1.12	10-7 1.23	10-11 1.35	11-3 1.47	11-6 1.59	11-10 1.72	12-2 1.85	12-5 1.99	13-0 2.26		19.2	
8-10 0.90	9-2 1.00	9-6 1.10	9-9 1.21	10-0 1.31	10-4 1.43	10-7 1.54	10-10 1.66	11-1 1.78	11-7 2.02	12-4 2.41	24.0	
16-6 1.28	17-1 1.41	17-8 1.56	18-2 1.71	18-9 1.86	19-3 2.02	19-9 2.18	20-3 2.34	20-8 2.51			12.0	2x8
15-5 1.19	16-0 1.32	16-6 1.46	17-0 1.60	17-6 1.74	18-0 1.89	18-5 2.04	18-11 2.19	19-4 2.35			13.7	
14-4 1.10	14-10 1.22	15-3 1.35	15-9 1.48	16-3 1.61	16-8 1.75	17-1 1.89	17-6 2.03	17-11 2.18	18-9 2.48		16.0	
13-1 1.01	13-6 1.12	13-11 1.23	14-5 1.35	14-10 1.47	15-2 1.59	15-7 1.72	16-0 1.85	16-4 1.99	17-1 2.26		19.2	
11-8 0.90	12-1 1.00	12-6 1.10	12-10 1.21	13-3 1.31	13-7 1.43	13-11 1.54	14-4 1.66	14-8 1.78	15-3 2.02	16-3 2.41	24.0	
21-1 1.28	21-10 1.41	22-6 1.56	23-3 1.71	23-11 1.86	24-6 2.02	25-2 2.18	25-10 2.34	26-5 2.51			12.0	2x10
19-8 1.19	20-5 1.32	21-1 1.46	21-9 1.60	22-4 1.74	22-11 1.89	23-7 2.04	24-2 2.19	24-8 2.35			13.7	
18-3 1.10	18-11 1.22	19-6 1.35	20-1 1.48	20-8 1.61	21-3 1.75	21-10 1.89	22-4 2.03	22-10 2.18	23-11 2.48		16.0	
16-8 1.01	17-3 1.12	17-10 1.23	18-4 1.35	18-11 1.47	19-5 1.59	19-11 1.72	20-5 1.85	20-10 1.99	21-10 2.26		19.2	
14-11 0.90	15-5 1.00	15-11 1.10	16-5 1.21	16-11 1.31	17-4 1.43	17-10 1.54	18-3 1.66	18-8 1.78	19-6 2.02	20-8 2.41	24.0	
25-7 1.28	26-6 1.41	27-5 1.56	28-3 1.71	29-1 1.86	29-10 2.02	30-7 2.18	31-4 2.34	32-1 2.51			12.0	2x12
24-0 1.19	24-10 1.32	25-7 1.46	26-5 1.60	27-2 1.74	27-11 1.89	28-8 2.04	29-4 2.19	30-0 2.35			13.7	
22-2 1.10	23-0 1.22	23-9 1.35	24-5 1.48	25-2 1.61	25-10 1.75	26-6 1.89	27-2 2.03	27-10 2.18	29-1 2.48		16.0	
20-3 1.01	21-0 1.12	21-8 1.23	22-4 1.35	23-0 1.47	23-7 1.59	24-2 1.72	24-10 1.85	25-5 1.99	26-6 2.26		19.2	
18-1 0.90	18-9 1.00	19-4 1.10	20-0 1.21	20-6 1.31	21-1 1.43	21-8 1.54	22-2 1.66	22-8 1.78	23-9 2.02	25-2 2.41	24.0	

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-3
FLAT OR SLOPED RAFTERS
Supporting Drywall Ceiling
(Flat roof or cathedral ceiling with no attic space)
Live Load - 40 lb. per sq. ft.

DESIGN CRITERIA:

Strength - 15 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines required fiber stress.
Deflection - For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

RAFTER SIZE SPACING (IN) (IN)		Extreme Fiber Stress in Bending, "F _b " (psi).										
		300	400	500	600	700	800	900	1000	1100	1200	1300
2x6	12.0	5-3 0.12	6-1 0.19	6-9 0.27	7-5 0.35	8-0 0.44	8-7 0.54	9-1 0.65	9-7 0.76	10-0 0.88	10-6 1.00	10-11 1.13
	13.7	4-11 0.12	5-8 0.18	6-4 0.25	6-11 0.33	7-6 0.42	8-0 0.51	8-6 0.61	8-11 0.71	9-5 0.82	9-10 0.93	10-3 1.05
	16.0	4-6 0.11	5-3 0.17	5-10 0.23	6-5 0.31	6-11 0.39	7-5 0.47	7-10 0.56	8-3 0.66	8-8 0.76	9-1 0.86	9-5 0.98
	19.2	4-2 0.10	4-9 0.15	5-4 0.21	5-10 0.28	6-4 0.35	6-9 0.43	7-2 0.51	7-7 0.60	7-11 0.69	8-3 0.79	8-8 0.89
	24.0	3-8 0.09	4-3 0.14	4-9 0.19	5-3 0.25	5-8 0.31	6-1 0.38	6-5 0.46	6-9 0.54	7-1 0.62	7-5 0.71	7-9 0.80
2x8	12.0	6-11 0.12	8-0 0.19	8-11 0.27	9-9 0.35	10-7 0.44	11-3 0.54	12-0 0.65	12-7 0.76	13-3 0.88	13-10 1.00	14-5 1.13
	13.7	6-6 0.12	7-6 0.18	8-4 0.25	9-2 0.33	9-11 0.42	10-7 0.51	11-2 0.61	11-10 0.71	12-5 0.82	12-11 0.93	13-6 1.05
	16.0	6-0 0.11	6-11 0.17	7-9 0.23	8-6 0.31	9-2 0.39	9-9 0.47	10-4 0.56	10-11 0.66	11-6 0.76	12-0 0.86	12-6 0.98
	19.2	5-6 0.10	6-4 0.15	7-1 0.21	7-9 0.28	8-4 0.35	8-11 0.43	9-6 0.51	10-0 0.60	10-6 0.69	10-11 0.79	11-5 0.89
	24.0	4-11 0.09	5-8 0.14	6-4 0.19	6-11 0.25	7-6 0.31	8-0 0.38	8-6 0.46	8-11 0.54	9-4 0.62	9-9 0.71	10-2 0.80
2x10	12.0	8-10 0.12	10-2 0.19	11-5 0.27	12-6 0.35	13-6 0.44	14-5 0.54	15-3 0.65	16-1 0.76	16-11 0.88	17-8 1.00	18-4 1.13
	13.7	8-3 0.12	9-6 0.18	10-8 0.25	11-8 0.33	12-7 0.42	13-6 0.51	14-3 0.61	15-1 0.71	15-10 0.82	16-6 0.93	17-2 1.05
	16.0	7-8 0.11	8-10 0.17	9-10 0.23	10-10 0.31	11-8 0.39	12-6 0.47	13-3 0.56	13-11 0.66	14-8 0.76	15-3 0.86	15-11 0.98
	19.2	7-0 0.10	8-1 0.15	9-0 0.21	9-10 0.28	10-8 0.35	11-5 0.43	12-1 0.51	12-9 0.60	13-4 0.69	13-11 0.79	14-6 0.89
	24.0	6-3 0.09	7-2 0.14	8-1 0.19	8-10 0.25	9-6 0.31	10-2 0.38	10-10 0.46	11-5 0.54	11-11 0.62	12-6 0.71	13-0 0.80
2x12	12.0	10-9 0.12	12-5 0.19	13-10 0.27	15-2 0.35	16-5 0.44	17-6 0.54	18-7 0.65	19-7 0.76	20-6 0.88	21-5 1.00	22-4 1.13
	13.7	10-0 0.12	11-7 0.18	12-11 0.25	14-2 0.33	15-4 0.42	16-5 0.51	17-5 0.61	18-4 0.71	19-3 0.82	20-1 0.93	20-11 1.05
	16.0	9-3 0.11	10-9 0.17	12-0 0.23	13-2 0.31	14-2 0.39	15-2 0.47	16-1 0.56	17-0 0.66	17-9 0.76	18-7 0.86	19-4 0.98
	19.2	8-6 0.10	9-10 0.15	10-11 0.21	12-0 0.28	12-11 0.35	13-10 0.43	14-8 0.51	15-6 0.60	16-3 0.69	17-0 0.79	17-8 0.89
	24.0	7-7 0.09	8-9 0.14	9-10 0.19	10-9 0.25	11-7 0.31	12-5 0.38	13-2 0.46	13-10 0.54	14-6 0.62	15-2 0.71	15-9 0.80

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-3 (cont.)

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

Extreme Fiber Stress in Bending, "F _b " (psi).											RAFTER SPACING SIZE (IN)	
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700	(IN)	(IN)
11-4 1.26	11-9 1.40	12-1 1.54	12-6 1.68	12-10 1.83	13-2 1.99	13-6 2.15	13-10 2.31	14-2 2.48			12.0	
10-7 1.18	11-0 1.31	11-4 1.44	11-8 1.57	12-0 1.72	12-4 1.86	12-8 2.01	13-0 2.16	13-3 2.32			13.7	
9-10 1.09	10-2 1.21	10-6 1.33	10-10 1.46	11-1 1.59	11-5 1.72	11-9 1.86	12-0 2.00	12-4 2.15	12-10 2.45		16.0	2x6
8-11 0.99	9-3 1.10	9-7 1.22	9-10 1.33	10-2 1.45	10-5 1.57	10-8 1.70	11-0 1.83	11-3 1.96	11-9 2.23		19.2	
8-0 0.89	8-3 0.99	8-7 1.09	8-10 1.19	9-1 1.30	9-4 1.41	9-7 1.52	9-10 1.63	10-0 1.75	10-6 2.00	11-1 2.38	24.0	
14-11 1.26	15-5 1.40	16-0 1.54	16-5 1.68	16-11 1.83	17-5 1.99	17-10 2.15	18-3 2.31	18-9 2.48			12.0	
14-0 1.18	14-6 1.31	14-11 1.44	15-5 1.57	15-10 1.72	16-3 1.86	16-8 2.01	17-1 2.16	17-6 2.32			13.7	
12-11 1.09	13-5 1.21	13-10 1.33	14-3 1.46	14-8 1.59	15-1 1.72	15-5 1.86	15-10 2.00	16-3 2.15	16-11 2.45		16.0	2x8
11-10 0.99	12-3 1.10	12-7 1.22	13-0 1.33	13-5 1.45	13-9 1.57	14-1 1.70	14-6 1.83	14-10 1.96	15-5 2.23		19.2	
10-7 0.89	10-11 0.99	11-3 1.09	11-8 1.19	12-0 1.30	12-4 1.41	12-7 1.52	12-11 1.63	13-3 1.75	13-10 2.00	14-8 2.38	24.0	
19-1 1.26	19-9 1.40	20-4 1.54	21-0 1.68	21-7 1.83	22-2 1.99	22-9 2.15	23-4 2.31	23-11 2.48			12.0	
17-10 1.18	18-5 1.31	19-1 1.44	19-8 1.57	20-2 1.72	20-9 1.86	21-4 2.01	21-10 2.16	22-4 2.32			13.7	
16-6 1.09	17-1 1.21	17-8 1.33	18-2 1.46	18-9 1.59	19-3 1.72	19-9 1.86	20-2 2.00	20-8 2.15	21-7 2.45		16.0	2x10
15-1 0.99	15-7 1.10	16-1 1.22	16-7 1.33	17-1 1.45	17-7 1.57	18-0 1.70	18-5 1.83	18-11 1.96	19-9 2.23		19.2	
13-6 0.89	13-11 0.99	14-5 1.09	14-10 1.19	15-3 1.30	15-8 1.41	16-1 1.52	16-6 1.63	16-11 1.75	17-8 2.00	18-9 2.38	24.0	
23-2 1.26	24-0 1.40	24-9 1.54	25-6 1.68	26-3 1.83	27-0 1.99	27-8 2.15	28-5 2.31	29-1 2.48			12.0	
21-8 1.18	22-5 1.31	23-2 1.44	23-11 1.57	24-7 1.72	25-3 1.86	25-11 2.01	26-7 2.16	27-2 2.32			13.7	
20-1 1.09	20-9 1.21	21-5 1.33	22-1 1.46	22-9 1.59	23-5 1.72	24-0 1.86	24-7 2.00	25-2 2.15	26-3 2.45		16.0	2x12
18-4 0.99	19-0 1.10	19-7 1.22	20-2 1.33	20-9 1.45	21-4 1.57	21-11 1.70	22-5 1.83	23-0 1.96	24-0 2.23		19.2	
16-5 0.89	17-0 0.99	17-6 1.09	18-1 1.19	18-7 1.30	19-1 1.41	19-7 1.52	20-1 1.63	20-6 1.75	21-5 2.00	22-9 2.38	24.0	

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-4
FLAT OR SLOPED RAFTERS
Supporting Plaster Ceiling
(Flat roof or cathedral ceiling with no attic space)
Live Load - 20 lb. per sq. ft.

DESIGN CRITERIA:

Strength - 15 lbs. per sq. ft. dead load plus 20 lbs. per sq. ft. live load determines required fiber stress.

Deflection - For 20 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTER SIZE SPACING (IN) (IN)		Extreme Fiber Stress in Bending, "F _b " (psi).									
		300	400	500	600	700	800	900	1000	1100	1200
2x6	12.0	6-7 0.18	7-7 0.28	8-6 0.40	9-4 0.52	10-0 0.66	10-9 0.80	11-5 0.96	12-0 1.12	12-7 1.29	13-2 1.48
	13.7	6-2 0.17	7-1 0.27	7-11 0.37	8-8 0.49	9-5 0.61	10-0 0.75	10-8 0.90	11-3 1.05	11-9 1.21	12-4 1.38
	16.0	5-8 0.16	6-7 0.25	7-4 0.34	8-1 0.45	8-8 0.57	9-4 0.70	9-10 0.83	10-5 0.97	10-11 1.12	11-5 1.28
	19.2	5-2 0.15	6-0 0.22	6-9 0.31	7-4 0.41	7-11 0.52	8-6 0.63	9-0 0.76	9-6 0.89	9-11 1.02	10-5 1.17
	24.0	4-8 0.13	5-4 0.20	6-0 0.28	6-7 0.37	7-1 0.46	7-7 0.57	8-1 0.68	8-6 0.79	8-11 0.92	9-4 1.04
2x8	12.0	8-8 0.18	10-0 0.28	11-2 0.40	12-3 0.52	13-3 0.66	14-2 0.80	15-0 0.96	15-10 1.12	16-7 1.29	17-4 1.48
	13.7	8-1 0.17	9-4 0.27	10-6 0.37	11-6 0.49	12-5 0.61	13-3 0.75	14-0 0.90	14-10 1.05	15-6 1.21	16-3 1.38
	16.0	7-6 0.16	8-8 0.25	9-8 0.34	10-7 0.45	11-6 0.57	12-3 0.70	13-0 0.83	13-8 0.97	14-4 1.12	15-0 1.28
	19.2	6-10 0.15	7-11 0.22	8-10 0.31	9-8 0.41	10-6 0.52	11-2 0.63	11-10 0.76	12-6 0.89	13-1 1.02	13-8 1.17
	24.0	6-2 0.13	7-1 0.20	7-11 0.28	8-8 0.37	9-4 0.46	10-0 0.57	10-7 0.68	11-2 0.79	11-9 0.92	12-3 1.04
2x10	12.0	11-1 0.18	12-9 0.28	14-3 0.40	15-8 0.52	16-11 0.66	18-1 0.80	19-2 0.96	20-2 1.12	21-2 1.29	22-1 1.48
	13.7	10-4 0.17	11-11 0.27	13-4 0.37	14-8 0.49	15-10 0.61	16-11 0.75	17-11 0.90	18-11 1.05	19-10 1.21	20-8 1.38
	16.0	9-7 0.16	11-1 0.25	12-4 0.34	13-6 0.45	14-8 0.57	15-8 0.70	16-7 0.83	17-6 0.97	18-4 1.12	19-2 1.28
	19.2	8-9 0.15	10-1 0.22	11-3 0.31	12-4 0.41	13-4 0.52	14-3 0.63	15-2 0.76	15-11 0.89	16-9 1.02	17-6 1.17
	24.0	7-10 0.13	9-0 0.20	10-1 0.28	11-1 0.37	11-11 0.46	12-9 0.57	13-6 0.68	14-3 0.79	15-0 0.92	15-8 1.04
2x12	12.0	13-5 0.18	15-6 0.28	17-4 0.40	19-0 0.52	20-6 0.66	21-11 0.80	23-3 0.96	24-7 1.12	25-9 1.29	26-11 1.48
	13.7	12-7 0.17	14-6 0.27	16-3 0.37	17-9 0.49	19-3 0.61	20-6 0.75	21-9 0.90	23-0 1.05	24-1 1.21	25-2 1.38
	16.0	11-8 0.16	13-5 0.25	15-0 0.34	16-6 0.45	17-9 0.57	19-0 0.70	20-2 0.83	21-3 0.97	22-4 1.12	23-3 1.28
	19.2	10-8 0.15	12-3 0.22	13-9 0.31	15-0 0.41	16-3 0.52	17-4 0.63	18-5 0.76	19-5 0.89	20-4 1.02	21-3 1.17
	24.0	9-6 0.13	11-0 0.20	12-3 0.28	13-5 0.37	14-6 0.46	15-6 0.57	16-6 0.68	17-4 0.79	18-2 0.92	19-0 1.04

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-4 (cont.)

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

Extreme Fiber Stress in Bending, "F _b " (psi).									RAFTER SPACING SIZE (IN) (IN)	
1300	1400	1500	1600	1700	1800	1900	2000	2100		
13-8 1.66	14-2 1.86	14-8 2.06	15-2 2.27	15-8 2.49						12.0
12-10 1.56	13-3 1.74	13-9 1.93	14-2 2.12	14-8 2.33	15-1 2.54					13.7
11-10 1.44	12-4 1.61	12-9 1.79	13-2 1.97	13-7 2.15	13-11 2.35	14-4 2.55				16.0
10-10 1.32	11-3 1.47	11-7 1.63	12-0 1.80	12-4 1.97	12-9 2.14	13-1 2.32	13-5 2.51			19.2
9-8 1.18	10-0 1.31	10-5 1.46	10-9 1.61	11-1 1.76	11-5 1.92	11-8 2.08	12-0 2.24	12-4 2.41		24.0
18-0 1.66	18-9 1.86	19-5 2.06	20-0 2.27	20-8 2.49						12.0
16-10 1.56	17-6 1.74	18-2 1.93	18-9 2.12	19-4 2.33	19-10 2.54					13.7
15-7 1.44	16-3 1.61	16-9 1.79	17-4 1.97	17-10 2.15	18-5 2.35	18-11 2.55				16.0
14-3 1.32	14-10 1.47	15-4 1.63	15-10 1.80	16-4 1.97	16-9 2.14	17-3 2.32	17-8 2.51			19.2
12-9 1.18	13-3 1.31	13-8 1.46	14-2 1.61	14-7 1.76	15-0 1.92	15-5 2.08	15-10 2.24	16-3 2.41		24.0
23-0 1.66	23-11 1.86	24-9 2.06	25-6 2.27	26-4 2.49						12.0
21-6 1.56	22-4 1.74	23-2 1.93	23-11 2.12	24-7 2.33	25-4 2.54					13.7
19-11 1.44	20-8 1.61	21-5 1.79	22-1 1.97	22-10 2.15	23-5 2.35	24-1 2.55				16.0
18-2 1.32	18-11 1.47	19-7 1.63	20-2 1.80	20-10 1.97	21-5 2.14	22-0 2.32	22-7 2.51			19.2
16-3 1.18	16-11 1.31	17-6 1.46	18-1 1.61	18-7 1.76	19-2 1.92	19-8 2.08	20-2 2.24	20-8 2.41		24.0
28-0 1.66	29-1 1.86	30-1 2.06	31-1 2.27	32-0 2.49						12.0
26-2 1.56	27-2 1.74	28-2 1.93	29-1 2.12	29-11 2.33	30-10 2.54					13.7
24-3 1.44	25-2 1.61	26-0 1.79	26-11 1.97	27-9 2.15	28-6 2.35	29-4 2.55				16.0
22-2 1.32	23-0 1.47	23-9 1.63	24-7 1.80	25-4 1.97	26-0 2.14	26-9 2.32	27-5 2.51			19.2
19-10 1.18	20-6 1.31	21-3 1.46	21-11 1.61	22-8 1.76	23-3 1.92	23-11 2.08	24-7 2.24	25-2 2.41		24.0

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-5
FLAT OR SLOPED RAFTERS
Supporting Plaster Ceiling
(Flat roof or cathedral ceiling with no attic space)
Live Load - 30 lb. per sq. ft.

DESIGN CRITERIA:

Strength - 15 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines required fiber stress.

Deflection - For 30 lbs. per sq. ft. live load. Limited to Span in inches divided by 360.

RAFTER SIZE SPACING (IN) (IN)		Extreme Fiber Stress in Bending, "F _b " (psi).									
		300	400	500	600	700	890	900	1000	1100	1200
2x6	12.0	5-10 0.19	6-8 0.29	7-6 0.41	8-2 0.54	8-10 0.68	9-6 0.83	10-0 0.99	10-7 1.15	11-1 1.33	11-7 1.52
	13.7	5-5 0.18	6-3 0.27	7-0 0.38	7-8 0.50	8-3 0.63	8-10 0.77	9-5 0.92	9-11 1.08	10-5 1.25	10-10 1.42
	16.0	5-0 0.16	5-10 0.25	6-6 0.35	7-1 0.46	7-8 0.59	8-2 0.72	8-8 0.85	9-2 1.00	9-7 1.15	10-0 1.31
	19.2	4-7 0.15	5-4 0.23	5-11 0.32	6-6 0.42	7-0 0.53	7-6 0.65	7-11 0.78	8-4 0.91	8-9 1.05	9-2 1.20
	24.0	4-1 0.13	4-9 0.21	5-4 0.29	5-10 0.38	6-3 0.48	6-8 0.58	7-1 0.70	7-6 0.82	7-10 0.94	8-2 1.07
2x8	12.0	7-8 0.19	8-10 0.29	9-10 0.41	10-10 0.54	11-8 0.68	12-6 0.83	13-3 0.99	13-11 1.15	14-8 1.33	15-3 1.52
	13.7	7-2 0.18	8-3 0.27	9-3 0.38	10-1 0.50	10-11 0.63	11-8 0.77	12-5 0.92	13-1 1.08	13-8 1.25	14-4 1.42
	16.0	6-7 0.16	7-8 0.25	8-7 0.35	9-4 0.46	10-1 0.59	10-10 0.72	11-6 0.85	12-1 1.00	12-8 1.15	13-3 1.31
	19.2	6-1 0.15	7-0 0.23	7-10 0.32	8-7 0.42	9-3 0.53	9-10 0.65	10-6 0.78	11-0 0.91	11-7 1.05	12-1 1.20
	24.0	5-5 0.13	6-3 0.21	7-0 0.29	7-8 0.38	8-3 0.48	8-10 0.58	9-4 0.70	9-10 0.82	10-4 0.94	10-10 1.07
2x10	12.0	9-9 0.19	11-3 0.29	12-7 0.41	13-9 0.54	14-11 0.68	15-11 0.83	16-11 0.99	17-10 1.15	18-8 1.33	19-6 1.52
	13.7	9-1 0.18	10-6 0.27	11-9 0.38	12-11 0.50	13-11 0.63	14-11 0.77	15-10 0.92	16-8 1.08	17-6 1.25	18-3 1.42
	16.0	8-5 0.16	9-9 0.25	10-11 0.35	11-11 0.46	12-11 0.59	13-9 0.72	14-8 0.85	15-5 1.00	16-2 1.15	16-11 1.31
	19.2	7-8 0.15	8-11 0.23	9-11 0.32	10-11 0.42	11-9 0.53	12-7 0.65	13-4 0.78	14-1 0.91	14-9 1.05	15-5 1.20
	24.0	6-11 0.13	8-0 0.21	8-11 0.29	9-9 0.38	10-6 0.48	11-3 0.58	11-11 0.70	12-7 0.82	13-2 0.94	13-9 1.07
2x12	12.0	11-10 0.19	13-8 0.29	15-4 0.41	16-9 0.54	18-1 0.68	19-4 0.83	20-6 0.99	21-8 1.15	22-8 1.33	23-9 1.52
	13.7	11-1 0.18	12-10 0.27	14-4 0.38	15-8 0.50	16-11 0.63	18-1 0.77	19-3 0.92	20-3 1.08	21-3 1.25	22-2 1.42
	16.0	10-3 0.16	11-10 0.25	13-3 0.35	14-6 0.46	15-8 0.59	16-9 0.72	17-9 0.85	18-9 1.00	19-8 1.15	20-6 1.31
	19.2	9-5 0.15	10-10 0.23	12-1 0.32	13-3 0.42	14-4 0.53	15-4 0.65	16-3 0.78	17-1 0.91	17-11 1.05	18-9 1.20
	24.0	8-5 0.13	9-8 0.21	10-10 0.29	11-10 0.38	12-10 0.48	13-8 0.58	14-6 0.70	15-4 0.82	16-1 0.94	16-9 1.07

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-5 (cont.)

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

Extreme Fiber Stress in Bending, "F _b " (psi).									RAFTER SPACING SIZE (IN) (IN)
1300	1400	1500	1600	1700	1800	1900	2000	2100	
12-1 1.71	12-6 1.91	13-0 2.12	13-5 2.34	13-10 2.56					12.0
11-3 1.60	11-9 1.79	12-2 1.98	12-6 2.19	12-11 2.39					13.7
10-5 1.48	10-10 1.66	11-3 1.84	11-7 2.02	11-11 2.22	12-4 2.41				16.0
9-6 1.35	9-11 1.51	10-3 1.68	10-7 1.85	10-11 2.02	11-3 2.20	11-6 2.39	11-10 2.58		19.2
8-6 1.21	8-10 1.35	9-2 1.50	9-6 1.65	9-9 1.81	10-0 1.97	10-4 2.14	10-7 2.31	10-10 2.48	24.0
15-11 1.71	16-6 1.91	17-1 2.12	17-8 2.34	18-2 2.56					12.0
14-11 1.60	15-5 1.79	16-0 1.98	16-6 2.19	17-0 2.39					13.7
13-9 1.48	14-4 1.66	14-10 1.84	15-3 2.02	15-9 2.22	16-3 2.41				16.0
12-7 1.35	13-1 1.51	13-6 1.68	13-11 1.85	14-5 2.02	14-10 2.20	15-2 2.39	15-7 2.58		19.2
11-3 1.21	11-8 1.35	12-1 1.50	12-6 1.65	12-10 1.81	13-3 1.97	13-7 2.14	13-11 2.31	14-4 2.48	24.0
20-4 1.71	21-1 1.91	21-10 2.12	22-6 2.34	23-3 2.56					12.0
19-0 1.60	19-8 1.79	20-5 1.98	21-1 2.19	21-9 2.39					13.7
17-7 1.48	18-3 1.66	18-11 1.84	19-6 2.02	20-1 2.22	20-8 2.41				16.0
16-1 1.35	16-8 1.51	17-3 1.68	17-10 1.85	18-4 2.02	18-11 2.20	19-5 2.39	19-11 2.58		19.2
14-4 1.21	14-11 1.35	15-5 1.50	15-11 1.65	16-5 1.81	16-11 1.97	17-4 2.14	17-10 2.31	18-3 2.48	24.0
24-8 1.71	25-7 1.91	26-6 2.12	27-5 2.34	28-3 2.56					12.0
23-1 1.60	24-0 1.79	24-10 1.98	25-7 2.19	26-5 2.39					13.7
21-5 1.48	22-2 1.66	23-0 1.84	23-9 2.02	24-5 2.22	25-2 2.41				16.0
19-6 1.35	20-3 1.51	21-0 1.68	21-8 1.85	22-4 2.02	23-0 2.20	23-7 2.39	24-2 2.58		19.2
17-5 1.21	18-1 1.35	18-9 1.50	19-4 1.65	20-0 1.81	20-6 1.97	21-1 2.14	21-8 2.31	22-2 2.48	24.0

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-6
FLAT OR SLOPED RAFTERS
Supporting Plaster Ceiling
(Flat roof or cathedral ceiling with no attic space)
Live Load - 40 lb. per sq. ft.

DESIGN CRITERIA::

Strength - 15 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines required fiber stress.

Deflection - For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

RAFTER SIZE SPACING (IN) (IN)		Extreme Fiber Stress in Bending, "F _b " (psi).									
		300	400	500	600	700	800	900	1000	1100	1200
2x6	12.0	5-3 0.19	6-1 0.29	6-9 0.40	7-5 0.53	8-0 0.67	8-7 0.82	9-1 0.97	9-7 1.14	10-0 1.31	10-6 1.50
	13.7	4-11 0.18	5-8 0.27	6-4 0.38	6-11 0.50	7-6 0.62	8-0 0.76	8-6 0.91	8-11 1.07	9-5 1.23	9-10 1.40
	16.0	4-6 0.16	5-3 0.25	5-10 0.35	6-5 0.46	6-11 0.58	7-5 0.71	7-10 0.84	8-3 0.99	8-8 1.14	9-1 1.30
	19.2	4-2 0.15	4-9 0.23	5-4 0.32	5-10 0.42	6-4 0.53	6-9 0.64	7-2 0.77	7-7 0.90	7-11 1.04	8-3 1.18
	24.0	3-8 0.13	4-3 0.20	4-9 0.28	5-3 0.37	5-8 0.47	6-1 0.58	6-5 0.69	6-9 0.81	7-1 0.93	7-5 1.06
2x8	12.0	6-11 0.19	8-0 0.29	8-11 0.40	9-9 0.53	10-7 0.67	11-3 0.82	12-0 0.97	12-7 1.14	13-3 1.31	13-10 1.50
	13.7	6-6 0.18	7-6 0.27	8-4 0.38	9-2 0.50	9-11 0.62	10-7 0.76	11-2 0.91	11-10 1.07	12-5 1.23	12-11 1.40
	16.0	6-0 0.16	6-11 0.25	7-9 0.35	8-6 0.46	9-2 0.58	9-9 0.71	10-4 0.84	10-11 0.99	11-6 1.14	12-0 1.30
	19.2	5-6 0.15	6-4 0.23	7-1 0.32	7-9 0.42	8-4 0.53	8-11 0.64	9-6 0.77	10-0 0.90	10-6 1.04	10-11 1.18
	24.0	4-11 0.13	5-8 0.20	6-4 0.28	6-11 0.37	7-6 0.47	8-0 0.58	8-6 0.69	8-11 0.81	9-4 0.93	9-9 1.06
2x10	12.0	8-10 0.19	10-2 0.29	11-5 0.40	12-6 0.53	13-6 0.67	14-5 0.82	15-3 0.97	16-1 1.14	16-11 1.31	17-8 1.50
	13.7	8-3 0.18	9-6 0.27	10-8 0.38	11-8 0.50	12-7 0.62	13-6 0.76	14-3 0.91	15-1 1.07	15-10 1.23	16-6 1.40
	16.0	7-8 0.16	8-10 0.25	9-10 0.35	10-10 0.46	11-8 0.58	12-6 0.71	13-3 0.84	13-11 0.99	14-8 1.14	15-3 1.30
	19.2	7-0 0.15	8-1 0.23	9-0 0.32	9-10 0.42	10-8 0.53	11-5 0.64	12-1 0.77	12-9 0.90	13-4 1.04	13-11 1.18
	24.0	6-3 0.13	7-2 0.20	8-1 0.28	8-10 0.37	9-6 0.47	10-2 0.58	10-10 0.69	11-5 0.81	11-11 0.93	12-6 1.06
2x12	12.0	10-9 0.19	12-5 0.29	13-10 0.40	15-2 0.53	16-5 0.67	17-6 0.82	18-7 0.97	19-7 1.14	20-6 1.31	21-5 1.50
	13.7	10-0 0.18	11-7 0.27	12-11 0.38	14-2 0.50	15-4 0.62	16-5 0.76	17-5 0.91	18-4 1.07	19-3 1.23	20-1 1.40
	16.0	9-3 0.16	10-9 0.25	12-0 0.35	13-2 0.46	14-2 0.58	15-2 0.71	16-1 0.84	17-0 0.99	17-9 1.14	18-7 1.30
	19.2	8-6 0.15	9-10 0.23	10-11 0.32	12-0 0.42	12-11 0.53	13-10 0.64	14-8 0.77	15-6 0.90	16-3 1.04	17-0 1.18
	24.0	7-7 0.13	8-9 0.20	9-10 0.28	10-9 0.37	11-7 0.47	12-5 0.58	13-2 0.69	13-10 0.81	14-6 0.93	15-2 1.06

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE R-6 (cont.)

RAFTERS: Spans are measured along the horizontal projection and loads are considered as applied on the horizontal projection.

Extreme Fiber Stress in Bending, "F _b " (psi).									RAFTER SPACING SIZE (IN) (IN)
1300	1400	1500	1600	1700	1800	1900	2000	2100	
10-11 1.69	11-4 1.89	11-9 2.09	12-1 2.31	12-6 2.53					12.0
10-3 1.58	10-7 1.77	11-0 1.96	11-4 2.16	11-8 2.36	12-0 2.57				13.7
9-5 1.46	9-10 1.63	10-2 1.81	10-6 2.00	10-10 2.19	11-1 2.38	11-5 2.58			16.0
8-8 1.34	8-11 1.49	9-3 1.65	9-7 1.82	9-10 2.00	10-2 2.18	10-5 2.36	10-8 2.55		19.2
7-9 1.19	8-0 1.33	8-3 1.48	8-7 1.63	8-10 1.79	9-1 1.95	9-4 2.11	9-7 2.28	9-10 2.45	24.0
14-5 1.69	14-11 1.89	15-5 2.09	16-0 2.31	16-5 2.53					12.0
13-6 1.58	14-0 1.77	14-6 1.96	14-11 2.16	15-5 2.36	15-10 2.57				13.7
12-6 1.46	12-11 1.63	13-5 1.81	13-10 2.00	14-3 2.19	14-8 2.38	15-1 2.58			16.0
11-5 1.34	11-10 1.49	12-3 1.65	12-7 1.82	13-0 2.00	13-5 2.18	13-9 2.36	14-1 2.55		19.2
10-2 1.19	10-7 1.33	10-11 1.48	11-3 1.63	11-8 1.79	12-0 1.95	12-4 2.11	12-7 2.28	12-11 2.45	24.0
18-4 1.69	19-1 1.89	19-9 2.09	20-4 2.31	21-0 2.53					12.0
17-2 1.58	17-10 1.77	18-5 1.96	19-1 2.16	19-8 2.36	20-2 2.57				13.7
15-11 1.46	16-6 1.63	17-1 1.81	17-8 2.00	18-2 2.19	18-9 2.38	19-3 2.58			16.0
14-6 1.34	15-1 1.49	15-7 1.65	16-1 1.82	16-7 2.00	17-1 2.18	17-7 2.36	18-0 2.55		19.2
13-0 1.19	13-6 1.33	13-11 1.48	14-5 1.63	14-10 1.79	15-3 1.95	15-8 2.11	16-1 2.28	16-6 2.45	24.0
22-4 1.69	23-2 1.89	24-0 2.09	24-9 2.31	25-6 2.53					12.0
20-11 1.58	21-8 1.77	22-5 1.96	23-2 2.16	23-11 2.36	24-7 2.57				13.7
19-4 1.46	20-1 1.63	20-9 1.81	21-5 2.00	22-1 2.19	22-9 2.38	23-5 2.58			16.0
17-8 1.34	18-4 1.49	19-0 1.65	19-7 1.82	20-2 2.00	20-9 2.18	21-4 2.36	21-11 2.55		19.2
15-9 1.19	16-5 1.33	17-0 1.48	17-6 1.63	18-1 1.79	18-7 1.95	19-1 2.11	19-7 2.28	20-1 2.45	24.0

Note: The required modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE TSJ-1
TWO-SPAN FLOOR JOISTS
 40 Lbs. Per Sq. Ft. Live Load
 (All rooms except those used for sleeping areas and attic floors)

DESIGN CRITERIA:

Deflection - For 40 lbs. per sq. ft. live load on one span and 20 lbs. per sq. ft. on other. Limited to span in inches divided by 360.
 Strength - Live load of 40 lbs. per sq. ft. plus dead load of 10 lbs. per sq. ft. on both spans determines the required fiber stress value.

JOIST SIZE 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	2.2	2.4	2.6	
2x6	12.0	10-3 1060	10-8 1150	11-1 1230	11-5 1310	11-9 1390	12-1 1460	12-5 1540	12-8 1610	13-0 1680	13-3 1750	13-6 1820	13-9 1880	14-0 1950	14-2 2010	14-5 2080	14-8 2140
	13.7	9-10 1110	10-3 1200	10-7 1280	10-11 1370	11-3 1450	11-7 1530	11-10 1610	12-2 1680	12-5 1760	12-8 1830	12-11 1900	13-1 1970	13-4 2040	13-7 2100	13-9 2170	14-0 2240
	16.0	9-4 1170	9-9 1260	10-1 1350	10-5 1440	10-8 1530	11-0 1610	11-3 1690	11-6 1770	11-9 1850	12-0 1920	12-3 2000	12-6 2070	12-8 2140	12-11 2210	13-2 2280	13-4 2350
	19.2	8-9 1240	9-2 1340	9-6 1440	9-9 1530	10-1 1620	10-4 1710	10-7 1800	10-10 1880	11-1 1960	11-4 2040	11-6 2120	11-9 2200	11-11 2280	12-2 2350	12-4 2430	12-6 2500
	24.0	8-2 1330	8-6 1440	8-9 1550	9-1 1650	9-4 1750	9-7 1840	9-10 1940	10-1 2030	10-3 2120	10-6 2200	10-8 2290	10-11 2370	11-1 2450	11-3 2530	11-5 2610	11-7 2690
2x8	12.0	13-7 1060	14-1 1150	14-7 1230	15-1 1310	15-6 1390	15-11 1460	16-4 1540	16-9 1610	17-1 1680	17-5 1750	17-9 1820	18-1 1880	18-5 1950	18-9 2010	19-0 2080	19-4 2140
	13.7	13-0 1110	13-6 1200	14-0 1290	14-5 1370	14-10 1450	15-3 1530	15-8 1610	16-0 1680	16-4 1760	16-8 1830	17-0 1900	17-4 1970	17-7 2040	17-11 2110	18-2 2180	18-6 2240
	16.0	12-4 1170	12-10 1260	13-3 1350	13-8 1440	14-1 1530	14-6 1610	14-10 1690	15-2 1770	15-6 1850	15-10 1930	16-2 2000	16-5 2070	16-9 2150	17-0 2220	17-3 2290	17-6 2360
	19.2	11-7 1240	12-1 1340	12-6 1440	12-11 1530	13-3 1620	13-8 1710	14-0 1800	14-4 1880	14-7 1970	14-11 2050	15-2 2130	15-6 2200	15-9 2280	16-0 2360	16-3 2430	16-6 2500
	24.0	10-9 1340	11-2 1440	11-7 1550	12-0 1650	12-4 1750	12-8 1840	13-0 1940	13-3 2030	13-7 2320	13-10 2200	14-1 2290	14-4 2370	14-7 2460	14-10 2540	15-1 2620	15-4 2700
2x10	12.0	17-4 1060	18-0 1150	18-8 1230	19-3 1310	19-10 1390	20-4 1460	20-10 1540	21-4 1610	21-10 1680	22-3 1750	22-8 1820	23-1 1880	23-6 1950	23-11 2010	24-3 2080	24-8 2140
	13.7	16-7 1110	17-3 1200	17-10 1290	18-5 1370	19-0 1450	19-6 1530	20-0 1610	20-5 1680	20-10 1760	21-4 1830	21-9 1900	22-1 1970	22-6 2040	22-10 2110	23-3 2170	23-7 2240
	16.0	15-9 1170	16-4 1260	16-11 1350	17-6 1440	18-0 1530	18-6 1610	19-0 1690	19-5 1770	19-10 1850	20-3 1930	20-7 2000	21-0 2070	21-4 2150	21-9 2220	22-1 2290	22-5 2360
	19.2	14-10 1240	15-5 1340	15-11 1440	16-6 1530	16-11 1620	17-5 1710	17-10 1800	18-3 1880	18-8 1970	19-0 2050	19-5 2130	19-9 2200	20-1 2280	20-5 2360	20-9 2430	21-1 2500
	24.0	13-9 1340	14-3 1440	14-9 1550	15-3 1650	15-9 1750	16-2 1840	16-7 1940	16-11 2030	17-4 2120	17-8 2200	18-0 2290	18-4 2370	18-8 2460	19-0 2540	19-3 2620	19-7 2700
2x12	12.0	21-1 1060	21-11 1150	22-8 1230	23-5 1310	24-1 1390	24-9 1460	25-5 1540	26-0 1610	26-7 1680	27-1 1750	27-7 1820	28-1 1880	28-7 1950	29-1 2010	29-6 2080	30-0 2140
	13.7	20-2 1110	20-11 1200	21-8 1290	22-5 1370	23-1 1450	23-8 1530	24-2 1610	24-10 1680	25-5 1760	25-11 1830	26-5 1900	26-11 1970	27-4 2040	27-9 2110	28-3 2170	28-8 2240
	16.0	19-2 1170	19-11 1260	20-7 1350	21-3 1440	21-11 1530	22-6 1610	23-1 1690	23-7 1770	24-1 1850	24-7 1930	25-1 2000	25-7 2070	26-0 2150	26-5 2220	26-10 2290	27-3 2360
	19.2	18-0 1240	18-9 1340	19-5 1440	20-0 1530	20-7 1620	21-2 1710	21-8 1800	22-3 1880	22-8 1970	23-2 2050	23-7 2130	24-0 2200	24-5 2280	24-10 2360	25-3 2430	25-7 2500
	24.0	16-9 1340	17-5 1440	18-0 1550	18-7 1650	19-2 1750	19-8 1840	20-2 1940	20-8 2030	21-1 2120	21-6 2200	21-11 2290	22-4 2370	22-8 2460	23-1 2540	23-5 2620	23-9 2700

Note: The required extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE TSJ-2
TWO-SPAN FLOOR JOISTS
 30 Lbs. Per Sq. Ft. Live Load
 (All rooms used for sleeping and attic floors)

DESIGN CRITERIA:

Deflection - For 30 lbs. per sq. ft. live load on one span and 15 lbs. per sq. ft. on other Limited to span in inches divided by 360.
 Strength - Live load of 30 lbs. per sq. ft. plus dead load of 10 lbs. per sq. ft. on both spans determines the required fiber stress value.

JOIST SIZE 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	2.2	2.4	2.6
2x6	12.0	11.4 1030	11.9 1110	12.2 1190	12.7 1270	13.0 1340	13.4 1420	13.8 1490	14.0 1560	14.3 1630	14.7 1700	14.10 1760	15.1 1830	15.5 1890	15.8 1950	15.10 2010	16.1 2070
	13.7	10.10 1070	11.3 1160	11.8 1250	12.0 1330	12.5 1410	12.9 1480	13.1 1560	13.4 1630	13.8 1700	13.11 1770	14.2 1840	14.5 1910	14.8 1970	14.11 2040	15.2 2100	15.5 2170
	16.0	10.3 1130	10.8 1220	11.1 1310	11.5 1400	11.9 1480	12.1 1560	12.5 1640	12.8 1720	13.0 1790	13.3 1870	13.6 1940	13.9 2010	14.0 2080	14.2 2150	14.5 2210	14.8 2280
	19.2	9.8 1200	10.1 1300	10.5 1390	10.9 1480	11.1 1570	11.5 1660	11.8 1740	11.11 1820	12.2 1900	12.5 1980	12.8 2060	12.11 2130	13.2 2210	13.4 2280	13.7 2350	13.9 2420
	24.0	9.0 1290	9.4 1400	9.8 1500	10.0 1600	10.3 1690	10.7 1790	10.10 1880	11.1 1960	11.4 2050	11.7 2130	11.9 2220	12.0 2300	12.2 2380	12.5 2460	12.7 2530	12.9 2610
2x8	12.0	14.11 1030	15.6 1110	16.1 1190	16.7 1270	17.1 1350	17.7 1420	18.0 1490	18.5 1560	18.10 1630	19.2 1700	19.7 1760	19.11 1830	20.3 1890	20.7 1950	20.11 2010	21.3 2070
	13.7	14.3 1080	14.10 1160	15.5 1250	15.11 1330	16.4 1410	16.10 1480	17.3 1560	17.7 1630	18.0 1700	18.4 1770	18.9 1840	19.1 1910	19.5 1980	19.9 2040	20.0 2110	20.4 2170
	16.0	13.7 1130	14.1 1220	14.7 1310	15.1 1400	15.6 1480	15.11 1560	16.4 1640	16.9 1720	17.1 1790	17.5 1870	17.9 1940	18.1 2010	18.5 2080	18.9 2150	19.0 2220	19.4 2280
	19.2	21.9 1200	13.3 1300	13.9 1390	14.2 1490	14.7 1570	15.0 1660	15.5 1740	15.9 1830	16.1 1910	16.5 1980	16.9 2060	17.0 2140	17.4 2210	17.7 2280	17.11 2350	18.2 2430
	24.0	11.10 1290	12.4 1400	12.9 1500	13.2 1600	13.7 1690	13.11 1790	14.3 1880	14.7 1970	14.11 2050	15.3 2140	15.6 2220	15.10 2300	16.1 2380	16.4 2460	16.7 2540	16.10 2610
2x10	12.0	19.1 1030	19.10 1110	20.6 1190	21.2 1270	21.10 1350	22.5 1420	23.0 1490	23.6 1560	24.0 1630	24.6 1700	25.0 1760	25.5 1830	25.11 1890	26.4 1950	26.9 2010	27.1 2070
	13.7	18.3 1080	19.0 1160	19.8 1250	20.3 1330	20.11 1410	21.5 1480	22.0 1560	22.6 1630	23.0 1700	23.5 1770	23.11 1840	24.4 1910	24.9 1980	25.2 2040	25.7 2110	25.11 2170
	16.0	17.4 1120	18.0 1220	18.8 1310	19.3 1400	19.10 1480	20.4 1560	20.11 1640	21.4 1720	21.10 1790	22.3 1870	22.8 1940	23.1 2010	23.6 2080	23.11 2150	24.3 2220	24.8 2280
	19.2	16.4 1200	16.11 1300	17.7 1390	18.1 1490	18.8 1570	19.2 1660	19.8 1740	20.1 1830	20.6 1910	20.11 1980	21.4 2060	21.9 2140	22.1 2210	22.6 2280	22.10 2350	23.2 2430
	24.0	15.1 1290	15.9 1400	16.4 1500	16.10 1600	17.4 1690	17.9 1790	18.3 1880	18.8 1970	19.1 2050	19.5 2140	19.10 2220	20.2 2300	20.6 2380	20.11 2460	21.2 2540	21.6 2610
2x12	12.0	23.2 1030	24.1 1110	25.0 1190	25.10 1270	26.7 1350	27.3 1420	27.11 1490	28.7 1560	29.3 1630	29.10 1700	30.5 1760	30.11 1830	31.6 1890	32.0 1950	32.6 2010	33.0 2070
	13.7	22.2 1080	23.1 1160	23.11 1250	24.8 1330	25.5 1410	26.1 1480	26.9 1560	27.4 1630	27.11 1700	28.6 1770	29.1 1840	29.7 1910	30.1 1980	30.7 2040	31.1 2110	31.7 2170
	16.0	21.1 1130	21.11 1220	22.8 1310	23.5 1400	24.1 1480	24.9 1560	25.5 1640	26.0 1720	26.7 1790	27.1 1870	27.7 1940	28.1 2010	28.7 2080	29.1 2150	29.6 2220	30.0 2280
	19.2	19.10 1200	20.7 1300	21.4 1390	22.1 1490	22.8 1570	23.4 1660	23.11 1740	24.5 1830	25.0 1910	25.6 1980	26.0 2060	26.6 2140	26.11 2210	27.4 2280	27.9 2350	28.2 2430
	24.0	18.5 1290	19.2 1400	19.10 1500	20.6 1600	21.1 1690	21.8 1790	22.2 1880	22.8 1970	23.2 2050	23.8 2140	24.2 2220	24.7 2300	25.0 2380	25.5 2460	25.10 2540	26.2 2610

Note: The required extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

DESIGN VALUES FOR JOISTS AND RAFTERS--VISUAL GRADING

These "F_b" values are for use where repetitive members are spaced not more than 24 inches. For wider spacing, the "F_b" values should be reduced 13%.

Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

Species and Grade	Size	Design Value in Bending "F _b "			Modulus of Elasticity "E"	Grading Rules Agency	
		Normal Duration	Snow Loading	7-Day Loading			
BALSAM FIR (Surfaced dry or surfaced green)							
Select Structural	2x4	1550	1780	1940	1,200,000	Northeastern Lumber Manufacturers Association	
No. 1		1300	1500	1620	1,200,000		
No. 2		1100	1260	1380	1,100,000		
No. 3		600	690	750	900,000		
Appearance		1150	1320	1440	1,200,000		
Stud		600	690	750	900,000		
Construction Standard Utility							
	2x4	800	920	1000	900,000	Northern Hardwood & Pine Manufacturers Association	
		450	520	560	900,000		
		200	230	250	900,000		
Select Structural No. 1 & Appearance							
No. 2	2x5 and wider	1350	1550	1690	1,200,000	(See notes 1 and 3)	
No. 3		1150	1320	1440	1,200,000		
		950	1090	1190	1,100,000		
Stud		550	630	690	900,000		
		550	630	690	900,000		
DOUGLAS FIR-LARCH (Surfaced dry or surfaced green)							
Dense Select Structural	2x4	2800	3220	3500	1,900,000	Western Wood Products Association (See notes 1 and 3)	
Select Structural		2400	2760	3000	1,800,000		
Dense No. 1		2400	2760	3000	1,900,000		
No. 1 & Appearance		2050	2360	2560	1,800,000		
Dense No. 2		1950	2240	2440	1,700,000		
No. 2		1650	1900	2060	1,700,000		
No. 3		925	1060	1160	1,500,000		
Stud		925	1060	1160	1,500,000		
Construction Standard Utility							
	2x4	1200	1380	1500	1,500,000		West Coast Lumber Inspection Bureau
		675	780	840	1,500,000		
		325	370	410	1,500,000		
Dense Select Structural							
Select Structural	2x5 and wider	2400	2760	3000	1,900,000	Western Wood Products Association (See notes 1 and 3)	
Dense No. 1		2050	2360	2560	1,800,000		
No. 1 & Appearance		2050	2360	2560	1,900,000		
		1750	2010	2190	1,800,000		
Dense No. 2		1700	1960	2120	1,700,000		
No. 2		1450	1670	1810	1,700,000		
No. 3		850	980	1060	1,500,000		
Stud		850	980	1060	1,500,000		

DESIGN VALUES FOR JOISTS AND RAFTERS--VISUAL GRADING (CONT)

These "F_b" values are for use where repetitive members are spaced not more than 24 inches. For wider spacing, the "F_b" values should be reduced 13%.

Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

Species and Grade	Size	Design Value in Bending "F _b "			Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading	7-Day Loading		
EASTERN SPRUCE (Surfaced dry or surfaced green)						
Select Structural	2x4	1750	2010	2190	1,400,000	Northeastern Lumber Manufacturers Association
No. 1		1500	1720	1880	1,400,000	
No. 2		1200	1380	1500	1,200,000	
No. 3		675	780	840	1,100,000	
Appearance		1250	1440	1560	1,400,000	
Stud		675	780	840	1,100,000	
Northern Hardwood & Pine Manufacturers Association						
Construction Standard	2x4	875	1010	1090	1,100,000	
Utility		500	580	620	1,100,000	
		225	260	280	1,100,000	
Select Structural	2x5	1500	1720	1880	1,400,000	(See notes 1 and 3)
No. 1 & Appearance	and	1250	1440	1560	1,400,000	
No. 2	wider	1000	1150	1250	1,200,000	
No. 3		600	690	750	1,100,000	
Stud		600	690	750	1,100,000	
EASTERN WHITE PINE (Surfaced dry or surfaced green)						
Select Structural	2x4	1550	1780	1940	1,200,000	Northeastern Lumber Manufacturers Association
No. 1 & Appearance		1350	1550	1690	1,200,000	
No. 2		1100	1260	1380	1,100,000	
No. 3		600	690	750	1,000,000	
(See note 1)						
Construction Standard	2x4	800	920	1000	1,000,000	NeLMA and NHPMA
Utility		450	520	560	1,000,000	
Stud		200	230	250	1,000,000	
		600	690	750	1,000,000	
(See note 1)						
Select Structural	2x5	1350	1550	1690	1,200,000	Northeastern Lumber Manufacturers Association
No. 1 & Appearance	and	1150	1320	1440	1,200,000	
No. 2	wider	950	1090	1190	1,100,000	
No. 3		550	630	690	1,000,000	
Stud		550	630	690	1,000,000	
(See notes 1 and 3)						

DESIGN VALUES FOR JOISTS AND RAFTERS--VISUAL GRADING (CONT)

These "F_b" values are for use where repetitive members are spaced not more than 24 inches. For wider spacing, the "F_b" values should be reduced 13%.

Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

Species and Grade	Size	Design Value in Bending "F _b "			Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading	7-Day Loading		
EASTERN WHITE PINE (NORTH) (Surfaced dry or surfaced green)						
Select Structural	2x4	1550	1780	1940	1,200,000	National Lumber Grades Authority (A Canadian Agency-- See notes 1, 2 and 3)
No. 1 & Appearance		1350	1550	1690	1,200,000	
No. 2		1100	1260	1380	1,100,000	
No. 3		600	690	750	1,000,000	
Stud		600	690	750	1,000,000	
Construction Standard	2x4	800	920	1000	1,000,000	
Utility		450	520	560	1,000,000	
Select Structural	2x5	1350	1550	1690	1,200,000	
No. 1 & Appearance	and wider	1150	1320	1440	1,200,000	
No. 2		950	1090	1190	1,100,000	
No. 3		550	630	690	1,000,000	
Stud		550	630	690	1,000,000	
HEM-FIR (Surfaced dry or surfaced green)						
Select Structural	2x4	1900	2180	2380	1,500,000	Western Wood Products Association (See notes 1 and 3) West Coast Lumber Inspection Bureau
No. 1 & Appearance		1600	1840	2000	1,500,000	
No. 2		1350	1550	1690	1,400,000	
No. 3		725	830	910	1,200,000	
Stud		725	830	910	1,200,000	
Construction Standard	2x4	975	1120	1220	1,200,000	
Utility		550	630	690	1,200,000	
Select Structural	2x5	1650	1900	2060	1,500,000	
No. 1 & Appearance	and wider	1400	1610	1750	1,500,000	
No. 2		1150	1320	1440	1,400,000	
No. 3		675	780	840	1,200,000	
Stud		675	780	840	1,200,000	
NORTHERN PINE (Surfaced dry or surfaced green)						
Select Structural	2x4	1850	2130	2310	1,400,000	Northeastern Lumber Manufacturers Association Northern Hardwood & Pine Manufacturers Association (See notes 1 and 3)
No. 1		1600	1840	2000	1,400,000	
No. 2		1300	1500	1620	1,300,000	
No. 3		725	830	910	1,100,000	
Appearance		1400	1610	1750	1,400,000	
Stud		725	830	910	1,100,000	
Construction Standard	2x4	950	1090	1190	1,100,000	
Utility		525	600	660	1,100,000	
Select Structural	2x5	1600	1840	2000	1,400,000	
No. 1 & Appearance	and wider	1400	1610	1750	1,400,000	
No. 2		1100	1260	1380	1,300,000	
No. 3		650	750	810	1,100,000	
Stud		650	750	810	1,100,000	

DESIGN VALUES FOR JOISTS AND RAFTERS--VISUAL GRADING (CONT)

These "F_b" values are for use where repetitive members are spaced not more than 24 inches. For wider spacing, the "F_b" values should be reduced 13%.

Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

Species and Grade	Size	Design Value in Bending "F _b "			Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading	7-Day Loading		
SOUTHERN PINE (Surfaced dry)						
Select Structural	2x4	2300	2640	2880	1,700,000	Southern Pine Inspection Bureau (See note 3)
Dense Select Structural		2700	3100	3380	1,800,000	
No. 1		1950	2240	2440	1,700,000	
No. 1 Dense		2300	2640	2880	1,800,000	
No. 2		1650	1900	2060	1,600,000	
No. 2 Dense		1900	2180	2380	1,600,000	
No. 3		900	1040	1120	1,400,000	
No. 3 Dense		1050	1210	1310	1,500,000	
Stud		900	1040	1120	1,400,000	
Construction Standard	2x4	1150	1320	1440	1,400,000	Southern Pine Inspection Bureau (See note 3)
Utility		675	780	840	1,400,000	
Utility		300	340	380	1,400,000	
Select Structural	2x5 and wider	2000	2300	2500	1,700,000	(See note 3)
Dense Select Structural		2350	2700	2940	1,800,000	
No. 1		1700	1960	2120	1,700,000	
No. 1 Dense		2000	2300	2500	1,800,000	
No. 2		1400	1610	1750	1,600,000	
No. 2 Dense		1650	1900	2060	1,600,000	
No. 3		800	920	1000	1,400,000	
No. 3 Dense		925	1060	1160	1,500,000	
Stud		850	980	1060	1,400,000	
SOUTHERN PINE (Surfaced at 15% moisture content-KD)						
Select Structural	2x4	2500	2880	3120	1,800,000	Southern Pine Inspection Bureau (See note 3)
Dense Select Structural		2900	3340	3620	1,900,000	
No. 1		2100	2420	2620	1,800,000	
No. 1 Dense		2450	2820	3060	1,900,000	
No. 2		1750	2010	2190	1,600,000	
No. 2 Dense		2050	2360	2560	1,700,000	
No. 3		975	1120	1220	1,500,000	
No. 3 Dense		1150	1320	1440	1,500,000	
Stud		975	1120	1220	1,500,000	
Construction Standard	2x4	1250	1440	1560	1,500,000	Southern Pine Inspection Bureau (See note 3)
Utility		725	830	910	1,500,000	
Utility		300	340	380	1,500,000	
Select Structural	2x5 and wider	2150	2470	2690	1,800,000	(See note 3)
Dense Select Structural		2500	2880	3120	1,900,000	
No. 1		1850	2130	2310	1,800,000	
No. 1 Dense		2150	2470	2690	1,900,000	
No. 2		1500	1720	1880	1,600,000	
No. 2 Dense		1750	2010	2190	1,700,000	
No. 3		875	1010	1090	1,500,000	
No. 3 Dense		1000	1150	1250	1,500,000	
Stud		900	1040	1120	1,500,000	

DESIGN VALUES FOR JOISTS AND RAFTERS--VISUAL GRADING (CONT)

These "F_b" values are for use where repetitive members are spaced not more than 24 inches. For wider spacing, the "F_b" values should be reduced 13%.

Values for surfaced dry or surfaced green lumber apply at 19% maximum moisture content in use.

Species and Grade	Size	Design Value in Bending "F _b "			Modulus of Elasticity "E"	Grading Rules Agency
		Normal Duration	Snow Loading	7-Day Loading		
SPRUCE-PINE-FIR (Surfaced dry or surfaced green)						
Select Structural	2x4	1650	1900	2060	1,500,000	National Lumber Grades Authority (A Canadian Agency-- See notes 1, 2 and 3)
No. 1 & Appearance		1400	1610	1750	1,500,000	
No. 2		1150	1320	1440	1,300,000	
No. 3		650	750	810	1,200,000	
Stud		650	750	810	1,200,000	
Construction Standard	2x4	850	980	1060	1,200,000	
Utility		475	550	590	1,200,000	
		225	260	280	1,200,000	
Select Structural	2x5 and wider	1450	1670	1810	1,500,000	
No. 1 & Appearance		1200	1380	1500	1,500,000	
No. 2		1000	1150	1250	1,300,000	
No. 3		575	660	720	1,200,000	
Stud		575	660	720	1,200,000	
WHITE WOODS (WESTERN WOODS) (Surfaced dry or surfaced green)						
Select Structural	2x4	1550	1780	1940	1,100,000	Western Wood Products Association (See notes 1 and 3)
No. 1 & Appearance		1300	1500	1620	1,100,000	
No. 2		1050	1210	1310	1,000,000	
No. 3		600	690	750	900,000	
Stud		600	690	750	900,000	
Construction Standard	2x4	775	890	970	900,000	
Utility		425	490	530	900,000	
		200	230	250	900,000	
Select Structural	2x5 and wider	1300	1500	1620	1,100,000	
No. 1 & Appearance		1100	1260	1380	1,100,000	
No. 2		925	1060	1160	1,000,000	
No. 3		550	630	690	900,000	
Stud		550	630	690	900,000	

1. When 2-inch lumber is manufactured at a maximum moisture content of 15% (grade-marked MC-15) and used in a condition where the moisture content does not exceed 15% the design values shown for "surfaced dry or surfaced green" lumber may be increased 8% for design value in bending "F_b", and 5% for modulus of elasticity "E".

2. National Lumber Grades Authority is the Canadian rules writing agency responsible for preparation, maintenance and dissemination of a uniform softwood lumber grading rule for all Canadian species.

3. Design values for stud grade in 2x5 and wider size classifications apply to 5-inch and 6-inch widths only.

INDEX

See also first page of each chapter for listing of section headings.

	<u>Ind Section No(s).</u>
A	
ACCESS	
To attics.	21.07
To crawl spaces.	21.07
ACCESSORY BUILDING	20.05
Definition	20.07
ADDITIONS.	20.04
Definition	20.07
ADMINISTRATION (Chapter Ind 20)	
ADOPTION OF STANDARDS.	20.24
AIR DISTRIBUTION SYSTEMS	23.07
AIR LEAKAGE.	22.07
ALTERATIONS.	20.04
Definition	20.07
ALTERNATE MATERIALS.	20.18
APPEALS.	20.21
APPLICATION OF CODE.	20.04
APPROVAL	20.09, 20.14, 20.15
Definition	20.07
ATTIC	
Access	21.07
Definition	20.07
Ventilation.	22.05
B	
BASEMENT, Definition	20.07
BATHROOMS.	25.04
BEAMS.	21.22
Bearing (masonry).	21.26
Bond	21.26
BUILDING COMPONENTS.	20.12, 20.13
Definition	20.07
BUILDING PERMIT.	20.08, 20.09
Suspension/Revocation.	20.11
BUILDING SYSTEM.	20.12, 20.13
Definition	20.07

C

CEILING HEIGHT	21.06
CHIMNEYS	23.11
All-purpose.	23.04
Connectors	23.15
Factory-built.	23.13
Masonry.	23.12
CLEARANCES	
Chimneys	23.12
Equipment.	23.17
Fireplaces	21.29, 21.30
Piping	23.10
Smoke pipes and stove pipes.	23.15
COMBUSTION AIR	23.06
CONCRETE	
Floors	21.20
Footings	21.15
Foundations.	21.18
Standards.	21.02
CONTROLS	
Fuel storage	23.16
Heating and ventilating equipment.	23.02
Safety	23.05
Temperature.	22.09
Zone	22.10
COVERING	
Building envelope.	22.06
Exterior wall.	21.24

D

DAMPERS.	22.13, 23.09
DECAY (Protection against)	21.10
DEFINITIONS.	20.07, 22.03
DESIGN	
Loads.	21.02
Temperatures	22.04
DOORS.	21.03, 21.08
DRAINAGE	
Drain tiles.	21.17
Garage	21.08
Grade.	21.12
Roof	21.27
DUCT WORK.	23.08
Insulation	22.11
DWELLING, Definition	20.07

E

ELECTRICAL STANDARDS (Chapter Ind 24)

ENERGY CONSERVATION (Chapter Ind 22)

ENFORCEMENT. 20.06

EQUIPMENT (Heating, Ventilating & Air Conditioning)

 Efficiencies 22.12

 Heating. 23.03, 23.04

 Selection. 22.08

EVIDENCE OF APPROVAL 20.09

EXCAVATIONS. 21.13

EXEMPTIONS 20.05

EXHAUST. 23.02

EXITS. 21.03

F

FEES (See Chapter Ind 69)

FIREPLACES

 Factory-built. 21.30

 Masonry. 21.29

 Stove. 21.31

FIRE SEPARATIONS 21.08

FIRESTOPPING 21.08

FLASHING 21.25, 21.26

FLOORS

 Concrete 21.20

 Loads. 21.02

 Precast. 21.21

 Wood frame 21.22

FLUE 23.11, 23.12, 23.15

 Damper 22.13

FOOTINGS

 Excavations. 21.14

 Size 21.15

 Soil bearing 21.16

FOUNDATIONS. 21.18

FROST PENETRATION. 21.16

FUEL SUPPLY SYSTEMS. 23.16

FURNACE

 Combustion air 23.06

 Controls 22.13, 23.05

 Types. 23.04

G

GARAGES

 Definition 20.07

 Separations. 21.08

GUARDRAILS 21.04

H

HABITABLE ROOM	
Definition	20.07
HALLWAYS	21.03
HANDRAILS.	21.04
HEADERS.	21.25, 21.26
HEADROOM (Stairs).	21.04
HEATING, VENTILATING & AIR CONDITIONING (Chapter Ind 23)	

I

INNOVATIVE DESIGNS	20.02
Energy conservation.	22.14, 22.15
INSPECTION	20.10, 20.14
INSULATION	22.06, 22.11, 23.10
Foam plastic	21.11

J

JOISTS	21.22
JURISDICTION	20.02, 20.06

K

KITCHEN.	25.04
------------------	-------

L

LANDINGS	21.04
LANDSCAPING.	20.02
LICENSING.	20.02
LIGHT (Natural).	21.05
LINTELS.	21.25, 21.26
LOADS.	21.02
LOCAL REGULATIONS.	20.02, 20.06

M

MANUFACTURED DWELLINGS AND COMPONENTS	
Approval	20.14, 20.15
Insignia	20.14
Inspection	20.15
Installation	20.13
Reciprocity.	20.14
Scope.	20.12
Suspension/revocation of approval.	20.16, 20.17
MASONRY	
Foundations.	21.18
Walls.	21.26
MOISTURE CONTROL	22.05

N

NOTCHING (Joists).	21.22, 21.28
----------------------------	--------------

P

PENALTIES	20.20
PERMIT TO START CONSTRUCTION	20.09
PIPING	23.10
Insulation	22.11, 23.10
PLANS	20.09, 20.14
PLUMBING (Chapter Ind 25)	
PLYWOOD	
Floors	21.22
Foundations	21.18
Roofs	21.28
Walls	21.25
PRECAST CONCRETE	
Floors	21.21
Standards	21.02

R

RAFTERS	21.28
REGISTERS	23.09
RETROACTIVITY	20.02
RISERS	21.04
ROOF	
Designs	21.27
Loading	21.02
Wood framing	21.28

S

SAFETY GLAZING	21.05
SCOPE (Code)	20.02
SETBACK REQUIREMENTS	20.02
SMOKE DETECTION	21.09
SOIL BEARING	21.15
SOLAR DESIGN	22.14, 22.15
SPIRAL STAIRS	21.04
STAIRS	21.04
STEEL	
Beams	21.22
Standards	21.02
STOVE	21.31
STRUCTURAL STANDARDS	21.02

T

TERMITES (Protection against)	21.10
TIES (Veneer)	21.26
TREADS	21.04
TRUSSES	21.22, 21.28
Standards	21.02

V

VAPOR BARRIERS	22.05
VARIANCES	20.19
VENTILATION	21.05, 22.05, 23.02
VENTS	23.11, 23.13
VIOLATIONS	20.20

W

WAIVERS	20.19
WALLS	
Design	21.23
Exterior covering	21.24
Foundation	21.18
Masonry	21.26
Wood frame	21.25
WINDERS	21.04
WINDOWS	21.05
WOOD-BURNING EQUIPMENT	21.29, 21.30, 21.31, 23.04