MASSACHUSETTS

RULES AND REGULATIONS FOR MANUFACTURED BUILDINGS, BUILDING COMPONENTS AND MOBILE HOMES

FORWARD

The promulgation and adoption of these uniform Rules and Regulations could not have been accomplished without the cooperative effort of the Massachusetts State Building Code Commission, Massachusetts Department of Public Safety, Massachusetts Board of Fire Prevention, Massachusetts State Examiners of Electricians, Massachusetts Board of State Examiners of Plumbers and the Massachusetts Gas Regulatory Board. With the use of these Rules and Regulations and the codes promulgated by the respective boards, there is established a statewide mechanism for acceptance into this Commonwealth of certified and approved Manufactured Buildings, Building Components and Mobile Homes.

More significantly, however, this method places the State on record as a proponent of technological change in an industry whose impact is both profound and pervasive on every citizen of the Commonwealth. Through the implementation of this system, the State will fulfill a most important obligation--that of promoting an improved quality of life in the most cost-efficient manner possible.

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SECTION I ADMINISTRATION

1.1 TITLE

The State Building Code Commission, Massachusetts Board of Fire Prevention Regulations, Massachusetts Gas Regulatory Board and the Massachusetts Board of State Examiners of Plumbers herewith establish the Rules and Regulations for Manufactured Buildings, Building Components and Mobile Homes.

1.2 DEFINITIONS

Unless otherwise expressly stated in the State Building Code, the following terms shall, for the purpose of these Rules and Regulations, have the meaning indicated in this section:

APPROVAL: approval by the State Administrative Agencies.

BUILDING COMPONENT: any sub-system, 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.

BUILDING SYSTEM: 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 fire protection systems and other systems affecting health and safety, including variations which are submitted as part of the building system.

CERTIFICATION: any manufactured building, building component or mobile home which meets the provisions of the applicable Codes and the Rules and Regulations pursuant thereto; and which has been labeled accordingly.

CODE: the Commonwealth of Massachusetts State Building Code or Specialized Codes as defined herein.

COMMISSION: the Commonwealth of Massachusetts State Building Code Commission.

DEPARTMENT - DPS: the Department of Public Safety.

INSPECTION AGENCIES: independent agency, sometimes referred to as "third party agency," retained by the manufacturer and approved by the State Administrative Agencies to perform inspections and evaluations of building systems, compliance assurance programs, manufactured buildings, building components and mobile homes.

INSTALLATION: the process of affixing, or assembling and affixing a manufactured building, building component or mobile home on the building site, and connecting it to utilities, and/or to an existing building. Installation may also mean the connecting of two (2) or more mobile home units designed and approved to be so connected for use as a dwelling.

LABEL: an approved device or seal evidencing certification in accordance with the applicable Codes and the Rules and Regulations promulgated pursuant thereto.

LOCAL ENFORCEMENT AGENCY: a department or agency in a municipality charged with the enforcement of the State Building Code and appropriate Specialized Codes which include, but are not limited to, the State Plumbing Code, Electrical Code and Gas Code.

MANUFACTURED BUILDING: any building which is of closed construction and which is made or assembled in manufacturing facilities, on or off the building site, for installation, or assembly and installation, on the building site. "Manufactured Building" also means any building or open construction for which certification under the applicable Codes is sought by the manufacturer and which is made or assembled in manufacturing facilities away from the building site for installation, or assembly and installation, on the building site. "Manufactured Building" does not mean "mobile home."

MOBILE HOME: a dwelling unit built on a chassis and containing complete electrical, plumbing and sanitary facilities, and designed to be installed on a temporary or permanent foundation for permanent living quarters.

MOBILE HOME SYSTEM: the plans, specifications and documentation for a design of mobile homes which may include structural, electrical, mechanical, plumbing and fire protection systems and other systems affecting health and safety, including variations which are submitted as part of the mobile home system.

SPECIALIZED CODES: Specialized construction codes, rules and regulations pertaining to building construction, reconstruction, alterations, repair, removal or demolition promulgated by and under the authority of the various boards which have been authorized from time to time by the general court. The specialized codes shall include, but not be limited to, the State Plumbing Code, Electrical Code, and Gas Code.

STATE ADMINISTRATIVE AGENCIES: boards, commissions, departments or agencies authorized to promulgate, adopt and amend codes and rules and regulations relating to buildings and structures and parts thereof and limited to the Massachusetts State Building Code Commission, Massachusetts Board of Fire Prevention Regulations (Massachusetts State Electrical Code), Massachusetts Gas Regulatory Board and the Massachusetts Board of State Examiners of Plumbers.

STATE ENFORCEMENT AGENCIES: boards, commissions, departments or agencies authorized to enforce the provisions of the codes and rules and regulations which have been promulgated, adopted and amended and which relate to buildings or structures and parts thereof and limited to the Department of Public Safety, Massachusetts Gas Regulatory Board, Massachusetts Board of State Examiners of Plumbers, and the Massachusetts State Examiners of Electricians.

1.3 SCOPE

A. These Rules and Regulations govern the design, manufacture, handling, storage, transportation and installation of manufactured buildings, building components and mobile homes intended for installation in this State and/or manufactured in this State for shipment to any other state in which such building, building components, or mobile homes and the labels thereon are accepted.

B. Subject to local zoning ordinances and by-laws, manufactured buildings, building components or mobile homes may be sold for, delivered to, or installed on, building sites located in any jurisdiction of this State if such buildings, building components or mobile homes have been approved and certified pursuant to the applicable Codes and these Rules and Regulations.

1.4 ADMINISTRATION AND ENFORCEMENT

The State Building Code Commission and the State Enforcement Agencies shall enforce all provisions of these Rules and Regulations. The State Enforcement Agencies shall have the responsibility for evaluating and recommending approval to the State Administrative Agencies of building systems, and for inspecting and recommending certification of manufactured buildings, building components and mobile homes for compliance with these Rules and Regulations and the applicable Codes. The State Enforcement Agencies and the local enforcement agencies shall accept manufactured buildings, building components, mobile homes, building systems and compliance assurance programs labeled and certified by inspection agencies approved by the State Administrative Agencies.

1.5 AUTHORIZATION OF THIRD PARTY INSPECTIONS

Upon recommendation of the State Enforcement Agencies, the State Administrative Agencies may authorize inspection agencies, sometimes referred to as third party inspection agencies, to perform all or part of the inspection and certification of manufactured buildings, building components, mobile homes, building systems and compliance assurance programs, including either or both the issuance and the attachment of labels thereto. The State Administrative Agencies may suspend or revoke such authorization for cause.

1.6 APPROVALS AND COMPLIANCE

Upon the recommendation of the State Enforcement Agencies, the State Administrative Agencies may approve building systems and compliance assurance programs which comply with the codes, standards, specifications and requirements and these Rules and Regulations.

1.7 TIME OF MANUFACTURE

For purposes of these regulations, a manufactured building, building component or mobile home is deemed to be manufactured at such time as the label is attached to it in accordance with the approved compliance assurance program.

1.8 RETROACTIVE CHANGES

No changes in the Codes, standards, specifications and requirements of these Rules and Regulations shall apply retroactively.

1.9 AMENDMENTS

The State Administrative Agencies shall notify the Commission, and the Commission shall notify all interested parties including State Enforcement Agencies, inspection agencies, manufacturers with approved building systems, and local governmental jurisdictions of all amendments to these Rules and Regulations, and each manufacturer shall have no more than 180 days following the sending of notification or such time as the State Administrative Agencies shall deem reasonable following the sending of such notifications to them, to submit to the Commission compliance assurance program revisions in order to comply with such amendments. Where imminent danger to life safety is involved, the State Administrative Agencies may require that immediate effect be given such amendments to the Codes, standards, specifications and requirements so adopted.

SECTION 2 COMPLIANCE ASSURANCE PROGRAMS

2.1 APPROVAL

In order to obtain approval for manufactured buildings, building components or mobile homes, a manufacturer shall submit a building system for evaluation to the State Building Code Commission for approvals by the State Administrative Agencies in accordance with these Rules and Regulations. The State Administrative Agencies shall notify the Commission of their approval or disapproval.

2.2 SUITABILITY

Prior to a full evaluation, the State Enforcement Agencies shall determine that building systems and/or the application for approval of the compliance assurance program submitted to it are suitable for processing. In the event that the application is found to be unsuitable for processing, the applicant shall be notified in writing of such unsuitability and the basis thereof, within thirty (30) days of the date the application is received by the Commission. In such event, all but twenty-five ($25) dollars of the fee will be returned and the findings of unsuitability will be without prejudice. Any subsequent submission shall be treated as a new application.

2.3 REQUISITES

The State Enforcement Agencies may require tests to determine whether a compliance assurance program meets the Codes, standards and requirements of the evaluation of plans, specifications and documentation. The procedures used shall be reviewed and evaluated by the State Administrative Agencies in accordance with these Rules and Regulations. The costs of such tests shall be borne by the applicant.

2.4 NOTIFICATION OF DISAPPROVAL

In the event a compliance assurance program is disapproved by the State Administrative Agencies, the Commission shall notify the applicant with a written explanation of the reasons for such disapproval thereto.

2.5 APPROVAL - EVIDENCE

Approval of a compliance assurance program shall be evidenced by the stamp of approval of the State Administrative Agencies on each sheet of the compliance assurance program, or by other effective means of identification. Each sheet shall be serially numbered and shall indicate effective dates of revision. One copy of all approved plans, specifications and documentation shall be returned to the applicant.

2.6 APPROVAL - REPORT

The State Enforcement Agencies shall prepare and the State Administrative Agencies shall issue to the applicant a building system approval report signed by the drafter and by the persons in charge of the evaluation, which shall be numbered and which shall contain a summary description of the building system and all of the conditions of its use including installation instructions.

2.7 APPROVAL - VARIATIONS

A building system and compliance assurance program, or any amendment thereto which has been approved, shall not be varied in any way without prior written authorization by the State Administrative Agencies. All amendments shall be in writing and shall be made a part of the written record of the approval.

2.8 AMENDMENTS - PROPOSED

Amendments to compliance assurance programs may be proposed by submitting to the Commission for approvals by the State Administrative Agencies, appropriate plans, specifications, or documentation showing the effect of the proposed amendment on each building system, and the required fee.

2.9 COMPLIANCE ASSURANCE PROGRAM

A manufacturer shall obtain approval from the State Administrative Agencies of a compliance assurance program for his building system. Buildings, building components or mobile homes shall be manufactured in accordance with an approved program in order to be certified. Compliance assurance programs shall be submitted to the Commission for approvals by the State Administrative Agencies in accordance with these Rules and Regulations.

SECTION 3 CERTIFICATION

Manufactured buildings, building components or mobile homes, accepted by the State Enforcement Agencies or an inspection agency as having been

manufactured according to an approved building system and an approved compliance assurance program, shall be certified by the State Administrative Agencies upon the recommendation of the State Enforcement Agencies as complying with the requirements of the applicable Codes and these Rules and Regulations. Certification shall be evidenced by the attachment of a label to each certified manufactured building, building component (or groups of components) or mobile homes.

3.1 MANUFACTURER'S DATA PLATE

3.11 CONTENTS

The following information shall be placed directly or by reference on one or more permanent manufacturer's data plates in the vicinity of the electrical distribution panel, or in some other designated location acceptable to the State Administrative Agencies, on the manufactured building, building component or mobile home where it will be readily accessible for inspection:

a) Manufacturer's name and address;

b) Serial number of the unit;

c) Label serial number;

d) Name and date of applicable building, plumbing, gas and electrical Codes and issue of their accumulative supplements complied with;

e) Model designation and name of manufacturer of major factory-installed appliances;

f) Identification of permissible type of gas for appliance and directions for water and drain connection;

g) Snow, wind, seismic and other live loads;

h) Electrical ratings - instructions and warnings on voltage;

i) Special conditions or limitations on use of the units, including unsuitability for areas in which specified environmental conditions prevail;

j) Methods of assembly or joining multiple units;

k) Type of construction, including fire rating, occupancy class, interior finish flame spread class, and toxicity class;

l) Building height and story limitation;

m) Floor area;

n) Minimum side yard requirements for fire rating.

If, in the opinion of the State Administrative Agencies, the shape or

size of a building component is such that this information cannot be attached to it permanently, the information may be placed in a manual crated with the component or on a tag attached to the crate in which the component is shipped, if the information is not such that the future occupant of the building should know it. If the occupant will need to know the information, it shall be contained in a manual which shall be presented to the occupant upon transfer of possession. If life safety is involved, the item in question shall be plainly labeled.

3.2 LABELS

Each manufactured building, building component or mobile home, which is certified pursuant to the applicable Codes and these Rules and Regulations, shall have permanently attached thereto, in a visible location as shown on the approved building system, an approved label which cannot be removed therefrom without destroying such label.

3.21 CONTENTS

An approved label shall bear the following information:

a) "This label certifies that this building (or building component or mobile home) has been manufactured in accordance with an approved building system and compliance assurance program approved by the Commonwealth of Massachusetts State Administrative Agencies and inspected by_____."

b) Label serial number;

c) Building system approval number;

d) Manufacturer's serial number;

e) The words "See data plate located on_____."

f) Date of manufacture.

At the direction of the State Administrative Agencies, labels and data plates may be limited in size and content for components whose shape and size does not permit the full information to be placed thereon.

3.22 ISSUANCE

The approved label shall be issued through the Department of Public Safety or its agents in accordance with the following:

a) If the State Administrative Agencies delegated the issuance of labels to an inspection agency, the agency shall be required to obtain approval from the Department of Public Safety for the manner in which they are handled;

b) Labels must be serially numbered;

c) A manufacturer's complaince assurance program, submitted in accordance with the Rules and Regulations hereof, shall include requirements for issuance, possession of, attachment of and accounting for all labels to assure that labels are attached only to buildings, building components, or mobile homes manufactured pursuant to an approved building system and inspected pursuant to an approved compliance assurance program.

d) If the State Enforcement Agencies determine that the manufacturer's record of compliance is such that the State Administrative Agencies or inspection agency need not maintain an inspector in a given plant at all times, the Department or inspection agency may entrust labels to the custody of one or more employees of the manufacturer, who shall be charged with controlling the use of such labels. Such employees shall not be given custody of more labels than are necessary to accommodate the manufacturer's anticipated production for one month. If the conditions of custody are violated, the Department or an inspection agency shall immediately regain possession of all labels that have not been applied to the manufactured buildings, building components or mobile homes and shall take such further action with respect to buildings, mobile homes or components already labeled and with respect to future labeling, as it may deem necessary to assure compliance with the applicable codes and these Rules and Regulations.

3.3 RECORDS OF LABELS

Permanent records shall be kept of the handling of all labels, indicating at least how many labels have been applied to buildings or building components (or groups of components) or mobile homes, which labels have been applied to which buildings, building components or mobile homes, the disposition of any damaged or rejected labels, and the location and custody of all unused labels. Such records shall be maintained by the manufacturer or by the inspection agency. A copy of such records covering attachment of each label shall be sent to the Deparment upon request and the Department shall forward all such records to the State Administrative Agencies.

3.4 ATTACHMENT OF LABELS

The inspection agency shall attach in consecutive numerical sequence labels to buildings, building components or mobile homes manufactured in accordance with an approved building system and meeting the requirements of an approved compliance assurance program.

a) Manufacturers shall attach labels to manufactured buildings, building components or mobile homes manufactured in accordance with an approved compliance assurance program, if custody of the labels has been entrusted to them in accordance with this Section.

3.5 SUSPENSION AND REVOCATION

The State Enforcement Agencies or an inspection agency may suspend or revoke, or cause to be suspended or revoked, the certification of any manufactured building, building component or mobile home which the State Enforcement Agencies or an inspection agency finds not to comply with the applicable Codes or these Rules and Regulations, or which has been manufactured pursuant to a building system or a compliance assurance program for which approval has been suspended or revoked, or which has not been manufactured in accordance with the approved compliance assurance program. The State Enforcement Agencies or an inspection agency shall remove or cause to be removed, labels from any such manufactured building, building component or mobile home until it is brought into compliance with the applicable Codes and these Rules and Regulations. Notice of suspension or revocation of certification shall be in writing with the reasons for suspension or revocation clearly set forth therein.

a) Upon suspension or revocation of the approval of any building system or compliance assurance program, no further labels shall be attached to any manufactured buildings, building components or mobile homes manufactured pursuant to the building system or compliance assurance program with respect to which the approval was suspended or revoked. Upon termination of such suspension or revocation, labels may again be attached to the manufactured building, building component or mobile home manufactured after the date approval was reinstated. Should any building, building component or mobile home have been manufactured during the period of suspension or revocation, it shall not be labeled unless the State Enforcement Agencies or inspection agency have inspected such building, building component or mobile home and is satisfied that all requirements for certification have been met.

b) The manufacturer shall return all labels allocated for a manufactured building, building component or mobile home to the Department no later than thirty (30) days from the effective date of any suspension or revocation of the State Enforcement Agencies or inspection agency, of the building system or compliance assurance program pursuant to which the manufactured building, building component or mobile home is being manufactured. The manufacturer shall also return to the Department all labels which it determines for any reason are no longer needed.

3.6 VARIATIONS OF CERTIFIED UNITS

Manufactured buildings, building components or mobile homes certified and labeled pursuant to the applicable Codes and these Rules and Regulations shall not be varied in any way prior to the issuance of a certificate of occupancy without resubmission to the Commission for approval of the State Administrative Agencies of the variation and of the unit which includes the variation. The State Enforcement Agencies or an inspection agency shall inspect the building, building component or mobile home wherever it is located and such inspection may include such tests or destructive or nondestructive disassembly as the State Enforcement Agencies or an inspection agency deems necessary

to assure compliance with the applicable Codes and these Rules and Regulations. Local Enforcement Agencies may be designated by the State Administrative Agencies as inspection agencies for such purposes.

SECTION 4 INSPECTION BY THE STATE ENFORCEMENT AGENCIES OR THEIR AGENTS

The State Enforcement Agencies shall make, or cause to be made, such inspections of the entire processing of manufacturing, certifying, handling, storing and transporting of manufactured buildings, building components and mobile homes produced pursuant to approved building systems as they deem necessary.

4.1 INSPECTION OF FACILITIES

As part of the process of evaluating building systems and compliance assurance programs, the State Enforcement Agencies shall inspect, or cause to be inspected, the manufacturing facilities in which the buildings, building components or mobile homes are to be manufactured.

4.2 INSPECTION ACCORDING TO COMPLIANCE ASSURANCE PROGRAMS

The State Enforcement Agencies or an inspection agency shall make such inspections as may be required by an approved compliance assurance program, or as may be deemed necessary by the State Enforcement Agencies.

4.3 INSPECTION OF DAMAGED COMPONENTS

Prior to the issuance of a certificate of occupancy, the State Enforcement Agencies or an inspection agency shall inspect, or cause to be inspected, certified manufactured buildings, building components or mobile homes which it determines to have been sufficiently damaged after certification to warrant such inspection and to take such action with regard to such buildings, building components or mobile homes as is authorized hereof, or as is otherwise necessary to eliminate dangerous conditions. The local enforcement agencies may be designated by the State Administrative Agencies as the inspection agency.

4.31 REPAIRING DAMAGED COMPONENTS

The State Enforcement Agencies or an inspection agency shall require manufactured buildings, building components or mobile homes which are so damaged as to no longer comply with the applicable Codes and these Rules and Regulations, to be repaired and made to comply within a reasonable time; or if they are so damaged that they cannot be brought into compliance, the State Enforcement Agencies or inspection agency shall order that the labels be removed from such buildings, building components or mobile homes.

4.32 IRREPARABLY DAMAGED COMPONENTS

Irreparably damaged buildings, building components or mobile homes shall be disposed of by the manufacturer.

4.4 MONITORING INSPECTION AGENCY

The State Enforcement Agencies or their designated agents shall examine each approved inspection agency, at any reasonable time, and without prior announcement, in order to monitor the reliability of each agency and of its monitoring of each compliance assurance program. Each such examination shall investigate the adequacy of all procedures used by the agency in monitoring compliance assurance programs including inspection, tests, production methods, process controls, operator performance, materials, receipts, storage and handling, workmanship standards, records and all other activities which implement the compliance assurance program in the manufacturing facility, during transport, on-site, and at critical subcontractors' facilities. The results of such examinations shall be filed with the office of the Commission. Copies of such reports shall be sent to the inspection agency and the State Administrative Agencies. Inspection agencies shall be specifically notified by the Commission of any deficiencies and of the manner and time by which such deficiencies must be eliminated. If deemed necessary by the State Enforcement Agencies an inspection agency's approval may be suspended or revoked by the State Administrative Agencies as provided herein.

4.41 PRIOR TO APPROVAL

Such examinations may also be conducted before approving an inspection agency.

4.5 INSPECTION BY DISASSEMBLY

No inspection entailing disassembly, damage to or destruction of certified manufactured buildings, building components or mobile homes shall be conducted except to implement these Rules and Regulations.

SECTION 5 LOCAL ENFORCEMENT AGENCY PROCEDURES AND INSPECTIONS

5.1 PERMIT APPLICATIONS

Upon application in conformity with the provisions of the appropriate Codes, local enforcement agencies shall issue appropriate permits for certified manufactured buildings prior to installation, and shall not withhold approval of the appropriate permits for buildings containing certified building components which in all other respects comply with all applicable Codes, provided that any manufactured buildings, building components or mobile homes found by the State Enforcement Agencies not to comply with the appropriate Codes or these Rules and Regulations shall be brought into compliance before such permit shall be issued. An application to local enforcement agencies for an appropriate permit shall, when requested, in addition to any other requirements contain:

5.11 PERMIT APPLICATION - STATE OF CONTENT

A statement that the work to be performed under such permit is to include the installation of a certified manufactured building or building component in accordance with the provisions of the

applicable Codes, the statement to be signed by the applicant or his agent, with the appropriate address;

5.12 PERMIT APPLICATION - BUILDING SYSTEM

A true copy of the approved building system with respect to which the manufactured building or building component was manufactured or is to be manufactured, where one has not previously been furnished to that local enforcement agency; and

5.13 PERMIT APPLICATION - BUILDING SYSTEM APPROVAL

A copy of the Building System Approval Report, where it has not previously been furnished to that local enforcement agency.

5.2 INSPECTION OF SITE PREPARATION AND SERVICE CONNECTIONS

Appropriate local enforcement agencies shall inspect site preparation work including foundations, not within the scope of the approval and certification, and the structural, mechanical, plumbing and electrical connections among units, for compliance with applicable law, rules and regulations.

5.3 COMPLIANCE WITH INSTRUCTIONS

Appropriate local enforcement agencies shall inspect all manufactured buildings, building components or mobile homes upon, or promptly after, installation at the building site to determine whether all instructions in the Building System Approval Report or conditions listed on the manufacturer's data plate have been followed.

This may include tests for tightness of plumbing and mechanical systems, and for malfunctions in the electrical system and a visual inspection for obvious nonconformity with the approved building system.

5.31 DISASSEMBLY PROHIBITED

Unauthorized destructive disassembly of certified buildings and building components and mobile homes shall not be performed in order to conduct such tests or inspections, except as provided in section 4.3, nor shall there be imposed standards or test criteria different from those adopted by the State Enforcement Agencies or specified in the Building System Approval Report.

5.32 OPENING PANELS

Non-destructive disassembly may be performed only to the extent of opening access panels and cover plates.

5.4 DISPOSITION OF NONCOMPLYING UNITS

Local enforcement agencies shall cause the disposition of noncomplying manufactured buildings and building components after consultation with the State Enforcement Agencies and reasonable notice to the manufacturer

or owner thereof, as the case may be, of the proposed disposition.

5.5 CERTIFICATES OF OCCUPANCY

Appropriate local inspectors shall issue certificates of occupancy for certified manufactured buildings and mobile homes containing certified building components which otherwise comply with all the applicable Codes, after they have been installed and inspected pursuant to the applicable Codes and these Rules and Regulations, provided that any manufactured building, building component or mobile home found not to comply with the Building System Approval Report shall be brought into compliance before such certificate of occupancy shall be issued.

5.6 REPORTING OF VIOLATIONS TO DEPARTMENT OF PUBLIC SAFETY

When any local enforcement agency is making an inspection and finds violations or suspected violations, it shall report the details of the violations in writing to the Department. Where violations are hazardous to occupants, a certificate of occupancy shall not be issued and the building shall not be occupied before such hazards are corrected. If the violations are not hazardous, a provisional certificate of occupancy may be issued. The Department shall forward all such reports of violations to the State Administrative Agencies.

SECTION 6 FEES

6.1 DEPOSIT FOR APPLICATION TO THE COMMISSION

A deposit shall be required upon application to the Commission to perform any of the functions in these Rules and Regulations.

6.2 ESTABLISHMENT OF FEES

Fees charged by the Commission for functions performed shall be in accordance with the fee schedule established by the State Administrative Agencies as specified in Part VI, Section 18 of these Rules and Regulations.

SECTION 7 NOTIFICATION OF CHANGES IN NAME, ADDRESS, OWNERSHIP OR LOCATION

7.1 NOTIFICATION BY MANUFACTURERS

Manufacturers shall notify the Commission in writing within ten (10) days of any of the following occurrences.

a) The corporate name is changed;

b) The main address of the company is changed;

c) There is a change in twenty-five (25) percent or more of the ownership interest of the company within a twelve (12) month period;

d) The location of any manufacturing facility is changed;

e) A new manufacturing facility is established; or

f) There are changes in principal officers of the firm.

The Commission shall notify the State Administrative Agencies of such occurences.

7.2 NOTIFICATION BY INSPECTION AGENCIES

Inspection agencies shall notify the Commission in writing within ten (10) days of any of the following occurences:

a) The company name is changed;

b) The main address of the company is changed;

c) There is a change in twenty-five (25) percent or more of the ownership interest or control of the company within a twelve (12) month period;

d) The location of any testing facility is changed;

e) A new testing facility is established; or

f) There are changes in principal officers and key supervisory and responsible personnel of the firm.

The Commission shall notify the State Administrative Agencies of such occurences.

SECTION 8 PROPRIETARY INFORMATION

All information relating to building systems and compliance assurance programs which the manufacturer or other party considers proprietary shall be so designated by him at the time of its submission, and shall be so held by the State Enforcement Agencies and State Administrative Agencies, except as the State Administrative Agencies determine in each case, that disclosure is necessary to carry out the purposes of the applicable Codes and these Rules and Regulations.

PART II REQUIREMENTS FOR SUBMISSION OF BUILDING SYSTEMS AND COMPLIANCE ASSURANCE PROGRAMS

SECTION 9 BUILDING SYSTEMS

Building systems shall meet the requirements set forth below to be evaluated for compliance with the standards, specifications and requirements adopted by the State Administrative Agencies.

9.1 GENERAL REQUIREMENTS

9.11 PLANS, SPECIFICATIONS AND DOCUMENTATION

Building systems, including all plans, specifications and other documentation, shall be submitted in quadruplicate to the Commission who shall act as the depository and disburser of all such items. The Commission shall forward to the appropriate State Enforcement Agencies plans, specifications and documentation for their approvals.

9.12 FORM AND FEES

Building systems shall be submitted in the form prescribed by the State Administrative Agencies and shall be accompanied by all required fees.

9.13 IDENTIFICATION

All documents submitted with the application shall be identified to indicate the manufacturer's name, office address and address of the manufacturing facility.

9.14 PLANS SHOWING ELEMENTS

Plans shall be submitted showing all elements relating to specific systems on properly identifiable sheets.

9.15 APPLICATION - APPROVED ARCHITECT OR ENGINEER

Each building system application shall bear the signature and seal of an approved registered architect or registered professional engineer certifying that the building system complies with the applicable Codes and standards promulgated herein.

9.16 ON-SITE WORK IDENTIFIED

All work to be performed on-site, including connection of all systems, equipment and appliances, shall be identified and distinguished from work to be performed in the manufacturing facility.

9.17 SPACE FOR STATE ADMINISTRATIVE AGENCIES APPROVAL STAMP

A 3" x 4" blank rectangular space shall be provided on all sheets of plans near the title box for the State Administrative Agencies stamp of approval.

9.18 MATERIAL GRADE AND QUALITY

Grade, quality and identification of all material shall be specified.

9.19 CALCULATIONS AND TEST REPORTS

Design calculations and test reports shall be specified.

9.191 DRAWINGS TO SCALE

Drawings shall be drawn to scale.

9.192 LABEL AND DATA PLATE LOCATION

Drawings shall indicate the location of the approved label and data plate.

9.193 DRAWINGS DATED AND IDENTIFIED

Drawings shall be dated and identified. The number of sheets in each set shall be indicated.

9.2 REQUIRED CONSTRUCTION DETAILS

Building systems for manufactured buildings shall provide or show, but not be limited to, the details listed below including the method of their testing or evaluation, or both. These requirements shall apply to the building systems for building components only to the extent deemed necessary by the State Enforcement Agencies to permit a proper evaluation of the building component.

9.21 GENERAL

a) Details and methods of installation of manufactured buildings or building components on foundations and/or to each other.

b) All exterior elevations.

c) Cross sections as necessary to identify major building components.

d) Details of flashing, such as at openings and at penetrations through roofs and subcomponent connections. Indicate flashing material and guage to be used.

e) Attic access and attic ventilation.

f) Exterior wall, roof and soffit material as well as finish.

g) Interior wall and ceiling finish material.

h) Fire separation walls.

i) Sizes, locations and types of doors and windows.

j) Recommended foundation plans, vents and underfloor access.

9.22 BUILDING CLASSIFICATION

a) Occupancy or use.

b) Area, height, and number of stories.

c) Type of construction.

d) Fire resistance ratings.

9.23 SPACE AND FIRE SAFETY

a) Details of fire resistance rated assemblies for all stairway enclosures, doors, walls, floors, ceilings, partitions, columns, roof and shaft enclosures.

b) Details as to width of all aisles, exits, corridors, passageways and stairway enclosures.

c) Toxocity and flame spread classification of finished materials.

9.24 STRUCTURAL DETAIL REQUIREMENTS

a) Engineer's calculations of structural members, where appropriate,

b) Design soil bearing value.

c) Structural and framing details of all floors, roof and walls.

d) Details and stress diagrams of roof trusses.

e) Details of reinforcing steel.

f) Complete loading schedule.

g) Column loads and column schedule.

h) Lintel schedule.

i) Size, spacing and details of all structural elements.

j) Grade or quality of all structural elements (lumber, steel, etc.).

k) Elevation of structural elements, walls or sections thereof, providing resistance to vertical loads or lateral forces.

1) Complete details of all structural connections.

9.25 MECHANICAL DETAIL REQUIREMENTS

a) Location of all equipment and appliances. Indicate equipment and appliances listed or labeled by approved agencies.

b) Heat loss calculations, where appropriate.

c) Manufacturer's name, make, model, number, BTU, and input rating of all equipment and appliances, as appropriate, or the equal thereof.

d) Duct and register locations, sizes, and materials.

e) Clearances from combustible material or surfaces for all ducts, flues and chimneys.

f) Method of providing required combustion air and return air.

g) Location of flues, vents and chimneys and clearances from air intakes and other vents and flues.

h) Details regarding dampers in ducts penetrating fire separations.

i) Complete drawings of fire sprinkler system, standpipe system or fire alarm system, if required.

j) Detail of elevator or escalator system, including method of emergency operation.

9.26 PLUMBING DETAIL REQUIREMENTS

a) Plan or schematic drawing of the plumbing layout, including but not limited to, size of piping, fitting, traps and vents, cleanouts and valves, gas, water, and drainage system.

b) Plumbing materials, and location of all equipment and appliances to be used. Indicate fixture unit capacity of system(s) and the make, model, and rating/capacity of equipment and appliances. Indicate equipment and appliances listed or labeled by approved agencies.

c) Make and model of safety controls (such as for water heaters), their location, and whether listed or labeled by approved agencies.

d) How piping is to be supported and intervals of support.

e) Location of vents above roofs and required clearances, including but not limited to clearances from air intakes, other vents and flues.

f) Methods of testing.

9.27 ELECTRICAL DETAIL REQUIREMENTS

a) Plan of service equipment, including service entrance, conductors, service raceway and clearances above ground and above structures.

b) Method and detail for grounding service equipment.

c) Single line diagram of the entire electrical installation.

d) Load calculations for service and feeders.

e) Sizes of all feeders and branch circuits.

f) Size, rating and location of main disconnect/overcurrent protective devices.

g) Method of interconnection between manufactured buildings or building components and location of connections.

h) Location of all outlets and junction boxes.

i) Method of mounting fixtures and wiring installations.

SECTION 10 COMPLIANCE ASSURANCE PROGRAMS

Compliance assurance programs shall be approved if they meet the requirements set forth in this section. It is the manufacturer's responsibility to execute every aspect of this program. The manufacturer shall continue to be responsible for all corrective actions required and the contractural relationship between the manufacturer and the inspection agency shall not diminish such responsibility. The manufacturer shall cooperate with the inspection agency by providing the inspection agency with all necessary reports, information, documents, records, facilities, equipment, samples and other assistance for assuring compliance.

The manufacturer's compliance assurance program shall be submitted to the Commission in the form of a compliance assurance manual which shall contain complete documentation of all compliance assurance activities of both the manufacturer and the inspection agency. The manual shall be comprehensively indexed, and shall treat the material listed here in detail.

10.1 ORGANIZATION REQUIREMENTS

a) A procedure for periodic revision of the manual.

b) An organizational structure for implementing and maintaining the compliance assurance program and its functional relationship to other elements of the organization structure of the manufacturer, which structure shall provide for independence from the production department.

   1) Company officers and employees in charge of the compliance assurance program must be identified, and their training and qualifications specified.

c) A uniform system of audit (in-depth analysis of program effectiveness and means to identify deficiencies) to monitor program performance periodically.

d) Complete and reliable records of manufacturing and site operations, if any (suitable means of storage, preservation and accessibility of copies of forms to be utilized shall be included).

e) A system to control changes in production or inspection procedures.

f) A system to assure that working drawings and specifications, working instructions and standards, procurement documents, etc., conform to the approved building system.

g) A serial numbering system for buildings or building components.

h) The method of safekeeping, handling and attaching labels and identification of those employees responsible therefor.

10.2 MATERIALS CONTROL

a) Procedure to assure effective control over procurement sources to ensure that materials, supplies and other items used in production and site operations, if any, conform to the approved plans, specifications and quality requirements.

b) Procedures for inspection of materials, supplies and other items at the point of receipt.

c) Method of protection of materials, supplies and other items against deterioration prior to their incorporation in the certified buildings or building component.

d) Provision for disposal of rejected materials, supplies and other items.

10.3 PRODUCTION CONTROL

a) Procedures for timely remedial and preventive measures to assure product quality.

b) Provision, maintenance and use of testing and inspection.

c) Provision for frequency of sampling inspections.

d) Provision of necessary authority to reject defective work and carry out compliance assurance functions, notwithstanding any conflict with production department goals and needs.

e) A schematic of the manufacturing operation showing the location of inspection stations, and "hold" points for mandatory inspection characteristics.

f) Inspection and test procedures, including accept/reject criteria and mandatory inspection characteristics.

g) Standards of workmanship.

h) Provision of disposal of rejects.

10.4 FINISHED PRODUCT CONTROL

a) Procedure for final inspection of all manufactured buildings or building components before shipment to the site or storage point, including identification and labeling.

b) Procedures for handling and storing all finished manufactured buildings or building components, both at the manufacturing plant or other storage point and after delivery to the building site.

c) Procedures for packing, packaging and shipping operations and related inspections.

d) Procedures for transportation, including all measures to protect against damage while in transit, and setting forth the modes of transportation to be utilized and the carrying equipment and procedures.

10.5 INSTALLATION CONTROL

a) Installation procedures including component placement, equipment and procedures, field erection and finishing work, utility connection instructions and all appropriate on-site inspection criteria and test descriptions.

b) Organizational provisions for field repair and disposal of rejects.

10.6 PERMISSION FOR INSPECTION

The manufacturer shall provide the Commission with written permission, signed and notarized, for the State Enforcement Agencies to inspect his manufacturing facilities, his products, and building sites under his control at any reasonable time without prior announcement.

10.7 INSPECTIONS BY THE STATE ENFORCEMENT AGENCIES

The Compliance Assurance Manual shall contain detailed plans for inspections by the State Enforcement Agencies or inspection agency.

PART III APPROVAL OF INSPECTION AGENCIES

SECTION 11 REQUIREMENTS FOR SUBMISSION

An inspection agency seeking approval shall submit a quadruplicate application to the Commission which shall include the items listed in this section.

11.1 ARTICLES OF INCORPORATION

The original Articles of Incorporation of the agency and all subsequent amendments thereto, as filed in the State of Incorporation.

11.2 BYLAWS

The bylaws of the organization, if any.

11.3 BUSINESS AFFILIATIONS OF MEMBERS

The names, addresses and business affiliations of all members of the Board of Directors and of top management personnel.

11.4 STOCK OWNERSHIP

Individual interests representing more than ten (10) percent of the outstanding ownership reflecting the financial interest of the agency's Board of Directors and top management personnel.

11.5 CERTIFICATIONS

Certification by the agency that:

a) Its Board of Directors, as a body, and its technical personnel, as individuals, can exercise independence of judgment; and

b) Its activities pursuant hereto will result in no financial benefit to the agency via stock ownership, or other financial interests in any producer, supplier or vendor of products involved, other than through standard published fees for services rendered.

11.6 EXPERIENCE OF DIRECTORS

Names, years of experience, state in which professionally registered and other qualifications of the directors of inspection or evaluation programs.

11.7 EXPERIENCE OF EMPLOYEES

Names and years of experience of employees practicing in the following disciplines: architecture, structural engineering, mechanical engineering, electrical engineering, fire protection and other branches of engineering; the state in which each is registered and the service each performs.

11.8 ORGANIZATION CHART

An organization chart showing management and supervisory persons including the number of graduate engineers and architects, and the names of all consulting engineers or architects, designating which are full-time and which are part-time employees.

11.9 NUMBER AND LOCATION OF PERSONNEL

Number and location of factory inspectors, supervisors, and other technicians, including evaluators of factory inspectors and the qualifications of each specialized group, including records of work experience, licenses held and other pertinent qualifications; description of the types of work each group and each technician is expected to perform and the qualifications of each group and each technician to perform the work assigned.

11.10 EMPLOYEES TRAINING PROGRAMS

An outline of the training program, if any, of the agency to assure that all inspectors, evaluators and other technicians are properly trained to do each job assigned to them.

11.11 EMPLOYEE SUPERVISION

An outline of the general procedures for supervision of inspectors and evaluators, including checking and evaluation of their work.

11.12 NON-EMPLOYEES RELATIONSHIPS

All engineers, technicians and other personnel who will perform services for the organization but who are not employees of the organization, and the supervisory and other relationships which each will have to the agency.

11.13 PRODUCTS EVALUATED

Type of products, components, equipment, structures and other items which the organization has evaluated, tested or inspected and the number of years of experience the organization has had with each, and the type of codes, standards, specifications and requirements with respect to which the organization has had experience in providing evaluation, inspection or testing services, and the number of years experience with each.

11.14 FREQUENCY CAPABILITY

Description of the frequency with which the agency is capable of performing inspections or evaluations.

11.15 STATES APPROVED IN

List of the states in which the agency is now approved to inspect or evaluate manufactured buildings, building components, or mobile homes

or parts thereof for compliance with approved building systems.

SECTION 12 PROCEDURES FOR APPROVING INSPECTION AGENCIES

12.1 QUALIFICATIONS

Upon the recommendation of the State Enforcement Agencies, State Administrative Agencies may approve inspection agencies which meet the requirements of the applicable Codes and these Rules and Regulations and which the State Administrative Agencies find otherwise qualified to perform the functions proposed to be delegated to them.

12.2 SUITABILITY OF APPLICATION

Prior to a full evaluation of an application for approval, the Commission shall determine whether such application is suitable for processing. In the event the application is found to be unsuitable for processing, the applicant shall be notified in writing of such unsuitability and the basis thereof within thirty (30) days of the date the application is received by the Commission.

In such event, all but $25.00 of the fee will be returned, and the rulings of unsuitability shall be without prejudice. Any subsequent submission shall be treated as a new application.

12.3 APPROVALS

In the event of approval by the State Administrative Agencies, an inspection agency shall be notified by a letter from the Commission indicating such approval and stating specifically the functions which the applicant has been approved to perform. Such approval shall not constitute the actual delegation of such functions.

SECTION 13 SUSPENSION AND REVOCATION

13.1 GROUNDS

The State Administrative Agencies may suspend or revoke its approval of any inspection agency if the approval was issued in error; was issued on the basis of incorrect information; was issued in violation of any of the applicable Codes or these Rules and Regulations; if the inspection agency violates any of the applicable Codes or these Rules and Regulations; if examination discloses that the agency failed to perform properly; or for such other cause as may be deemed sufficient by the State Administrative Agencies to warrant such action.

13.2 PROCEDURES

13.21 GENERAL

If the State Administrative Agencies suspend or revoke the approval of an inspection agency, the inspection agency shall be given notice in writing from the Commission of the suspension or revocation with the reasons therefor set forth therein. Manufacturers being evaluated or

inspected by such agencies, all local enforcement agencies within this State and the State Enforcement Agencies shall also be notified in writing of such suspension or revocation. Such notices shall contain instructions to the manufacturer and to the local enforcement agency as to the procedures to be followed regarding manufactured buildings, building components or mobile homes previously certified by an agency whose approval has been suspended or revoked.

13.22 RECORDS

An inspection agency whose approval has been suspended or revoked shall within ninety (90) days of the suspension or revocation, deliver to the custody of the Commission the originals of all records required to be maintained during the course of the inspection agency's operations pursuant to the applicable Codes and these Rules and Regulations.

13.23 LABELS

An inspection agency for which approval has been suspended or revoked shall within ninety (90) days of the suspension or revocation, deliver to the custody of the Department all labels in the agency's possession, under its control, or for which it is responsible pursuant to the applicable Codes and these Rules and Regulations.

PART IV RECIPROCITY

If the State Administrative Agencies find that the standards for the manufacture and inspection of manufactured buildings, building components or mobile homes prescribed by statute or rules and regulations of another state, or other governmental agency, meet the objectives of the applicable Codes and these Rules and Regulations, and are enforced satisfactorily by such other state or other government agency, or by their agents, the State Enforcement Agencies shall accept manufactured buildings, building components or mobile homes which have been certified by such other state or governmental agency, and the Department shall assure that the appropriate label is attached thereto. The standards of another state or governmental agency shall not be deemed to adequately be enforced unless such other state or governmental agency provides for notification to the Department of suspensions or revocations of approvals issued by that other state of governmental agency in a manner satisfactory to the State Administrative Agencies and so notified the Department. The Department shall notify the State Administrative Agencies of any action taken under this section.

SECTION 14 PROCEDURES FOR GRANTING OR REFUSING RECIPROCITY TO ANOTHER JURISDICTION

14.1 EVALUATION

The State Administrative Agencies may evaluate the statute, codes, rules and regulations of another state or governmental agency at any time.

14.2 METHOD OF EXTENDING RECIPROCITY

If the State Administrative Agencies find that the standards prescribed by the statute or rules and regulations of another state or another governmental agency meet the objectives of the appropriate Codes and that these rules and regulations are satisfactorily enforced, it may extend reciprocity to that jurisdiction by:

a) Giving notice to any requesting manufacturer;

b) Giving notice to the Administrative Agency of the other jurisdiction;

c) Giving notice to the State Enforcement Agencies and all local enforcement agencies in this state.

14.3 REJECTIONS

If the standards of the other state or governmental agency do not meet the objectives of the appropriate Codes or are inadequately enforced, or both, reciprocity shall not be extended. In that event, the Commission shall notify any requesting manufacturer and the Administrative Agency of the other state of the refusal and the reasons therefor.

SECTION 15 PROCEDURES FOR RECIPROCITY CERTIFYING MANUFACTURED BUILDINGS, BUILDING COMPONENTS OR MOBILE HOMES

A manufacturer from a jurisdiction to which reciprocity has been extended shall submit to the Commission evidence that his building system and compliance assurance program have been approved by such state or governmental agency. The Commission shall verify the approval and shall notify the State Administrative Agencies, local enforcement agencies and the manufacturer in writing of such verification and that properly labeled buildings, building components or mobile homes of his manufacture will be accepted.

SECTION 16 SUSPENSION AND REVOCATION

The Commission shall suspend or revoke or cause to be suspended or revoked, the acceptance or certification or both of such reciprocally certified manufactured buildings, building components or mobile homes if the State Enforcement Agencies determine that the standards for the manufacture and inspection of which manufactured buildings, building components or mobile homes of such other state or other governmental agency do not meet the objectives of the appropriate Codes and these Rules and Regulations, or that such standards are not being enforced to the satisfaction of the State Enforcement Agencies. If such other state or governmental agency or its agents should suspend or revoke its approval and certification, the acceptance of certification or both granted under this Part shall be revoked or suspended accordingly. Notice to the State Administrative Agencies, local enforcement agencies, manufacturer and to the Administrative Agency of such other state of such suspension or revocation shall be in writing with the reasons for such suspension or revocations set forth therein. Appeals from such suspension or revocations shall receive timely review.

PART V APPEALS

SECTION 17 HEARINGS

All hearings shall comply with the applicable sections of the applicable Codes and the Rules and Regulations thereof established for the purpose of appeal.

PART VI SCHEDLUE OF FEES

SECTION 18 ESTABLISHMENT

The following is the SCHEDULE OF FEES established by the State Administrative Agencies for certifying manufactured buildings, building components and mobile homes. Fees shall be made payable to the "Commonwealth of Massachusetts State Building Code Commission" and shall accompany all applications for certification.

18.1 COMPLIANCE ASSURANCE PROGRAMS AND BUILDING SYSTEMS

a) An initial fee of five hundred ($500.00) dollars shall be charged each manufacturer for its certified compliance assurance program for each plant desiring certification. There shall be an additional charge of one hundred ($100.00) dollars per certified building system, except that there shall be no such additional charge per building component. The maximum fee charged under this section shall be one thousand ($1,000.00) dollars for each manufacturing plant.

18.2 THIRD PARTY INSPECTION AGENCIES

a) An initial fee of five hundred ($500.00) dollars shall be charged to each third party inspection agency.

18.3 ANNUAL RENEWAL FEES

a) One year from the date of certification of the manufacturer and the third party inspection agency, and every year thereafter certification is in effect, there shall be paid an annual renewal fee of two hundred and fifty ($250.00) dollars for each such certification.

18.4 LABELS

a) A fee of twelve dollars and fifty ($12.50) cents per unit of a mobile unit of a mobile home or manufactured building shall be charged for each label issued by the Department. Double wide units of mobile homes shall be treated as two units for this purpose.

1) A "unit" as used in this section shall mean any building or portion thereof which is towed or shipped separately to be somehow tied together at the site.

b) A fee of one ($1.00) dollar per building component shall be charged for each label issued by the Department for building components.

2) Manufacturers of building components shall be permitted to use

any labels as approved by State Administrative Agencies. If such labels are supplied by any source other than the Department, there shall be no charge for such labels.

c) Mutilated labels may be replaced at the option of the Department, at a cost of two ($2.00) dollars each.

d) Upon satisfactory proof to the Department of lost or stolen labels, not the result of negligence, labels may be replaced at a cost of two ($2.00) each.

e) Labels shall be purchased from the Department by the inspection agency or manufacturer.

ARTICLE 20

LIGHT-TRANSMITTING PLASTIC CONSTRUCTION

SECTION 2000.0 SCOPE

The provisions of this article shall govern the quality and methods of application of plastics for use as light-transmitting materials in buildings and structures. When used as interior finish, plastic materials shall meet the requirements of section 922.

2000.1 APPROVED MATERIALS: The use of all plastics which meet the strength, durability, sanitary and fireresistive requirements of the Basic Code and the reference standards of this article, shall be permitted, subject to the limitations of this article.

2000.11 APPLICATION FOR APPROVAL: Applicants desiring to use an approved plastic material, shall furnish evidence of the approval for the intended use from the State Building Code Commission.

2000.2 IDENTIFICATION: All plastic materials approved for use under the Basic Code shall be identified by the trade formula number or name or other acceptable identification so that it can be ascertained that the material is approved.

SECTION 2001.0 DEFINITIONS

APPROVED PLASTIC: any thermoplastic, thermosetting or reinforced thermosetting plastic material which meets the requirements of section 2000.1.

Class SE: plastic materials which are self-extinguishing (ASTM D 635).
Class VSB: plastic materials which have a burning rate less than 0.8 inches per minute (ASTM D 635).
Class SB: plastic materials which have a burning rate of less than 2.5 inches per minute (ASTM D 635).

Materials that give off smoke or gases more dense or more toxic than that given off by conventionally used interior finish materials under comparable exposure to heat or flame shall not be permitted.

LIGHT-DIFFUSING SYSTEM: a suspended construction consisting in whole or in part of lenses, panels, grids or baffles suspended below lighting fixtures.

PLASTIC GLAZING: material glazed or set in frame or sash and not held by mechanical fasteners which pass through the glazing material.

PLASTIC ROOF PANELS: approved plastic materials which are mechanically fastened to structural members or to structural panels or sheathing and which are used as light-transmitting media in roofs.

PLASTIC WALL PANEL: approved plastic materials which are mechanically fastened to structural members or to structural panels or sheathing and which are used as light-transmitting media in exterior walls.

REINFORCED THERMOSETTING PLASTIC: a thermosetting plastic reinforced with a glass fiber mat having not less than one and one-half (1 1/2) ounces of glass fiber per square foot.

THERMOPLASTIC MATERIAL: a solid plastic material which is capable of being repeatedly softened by increase of temperature and hardened by decrease of temperature.

THERMOSETTING MATERIAL: a solid plastic material which is capable of being changed into a substantially non-reformable product when cured under the application of heat or pressure.

SECTION 2002.0 DESIGN AND INSTALLATION

2002.1 STRUCTURAL REQUIREMENTS: All plastic materials and their assemblies shall be of adequate strength and durability to withstand the loads and forces specified in article 7 for their approved use.

2002.2 CONNECTIONS AND SUPPORTS: All fastenings, connections and supports shall be proportioned to safely transmit two and one-half (2 1/2) times the design live load. Adequate allowance shall be made in the fastenings and supports for differential expansion and contraction of the connected materials.

SECTION 2003.0 GLAZING OF UNPROTECTED OPENINGS

2003.1 USE IN TYPE 4-B CONSTRUCTION: Doors, sash and framed openings which are not required to be fire protected may be glazed with approved plastic materials in buildings of Type 4-B construction.

2003.2 USE GROUP D: In all types of construction of use group D, doors, sash and framed openings which are not required to be fire protected may be glazed with approved plastic materials.

2003.3 OTHER CLASSES OF CONSTRUCTION AND USE GROUP: In other classes of construction and use, such openings not required to be fire protected by section 916 may be glazed or equipped with approved plastic materials subject to the following requirements:

a) The area of such glazing shall not exceed twenty-five (25) percent of the wall face of the story in which it is installed. (See section 2003.4.)

b) The area of a unit or pane of glazing installed above the first story shall not exceed twelve (12) square feet and the vertical dimension of a unit or pane shall not exceed four (4) feet. There shall be a minimum three (3) feet vertical spandrel wall between stories.

c) Exceptions:

1) Installations of approved thermoplastic materials which will automatically vent a fire prior to ignition of the plastic materials may occupy a maximum of fifty (50) percent of the wall face and the story when installed in the first three (3) stories above grade.

2) Approved thermoplastic materials may be installed in areas up to fifty (50) percent of the wall area of each story in structures less than one hundred fifty (150) feet in height which are provided on each floor above the first floor with continuous architectural projections constituting an effective fire canopy extending at least three (3) feet from the surface of the wall in which the glazing is installed. The size and the dimensions of individual units shall not be limited in such installations except as required to meet structural loading requirements.

2003.4 AUTOMATIC SPRINKLERS: When complete automatic fire sprinkler protection is provided in the building the permissible area of glazing permitted by 2003.3 (a) may be increased one hundred (100) percent.

SECTION 2004.0 EXTERIOR WALL PANELS

2004.1 GENERAL: Approved plastic materials may be used as wall panels, in exterior walls not required to have a fireresistive rating (except in Use Groups A, F-1, F-2 and H), subject to the following requirements:

2004.11 INSTALLATION: Exterior wall panels installed as provided herein shall not alter the type-of-construction classification of the building.

2004.12 AREA LIMITATION AND SEPARATION: Area limitation and separation requirements of exterior wall panels shall be as provided in table 20-1.

2004.13 SPANDREL SEPARATION: Vertical spandrel wall separation between stories shall be as follows:

a) Three (3) feet for SE and VSB plastic wall panels.

b) Four (4) feet for SB plastic wall panels.

2004.14 FIRE CANOPIES: In structures which are provided, on any floor above the first, with continuous architectural projections constituting an effective fire canopy extending at least thirty-six (36) inches from the surface of the wall in which plastic wall panels are installed, there need be no vertical separation at that floor except that provided by the vertical thickness of the projection.

2004.2 AUTOMATIC SPRINKLERS: When complete automatic fire sprinkler protection is provided in the building, the maximum percent area of exterior wall in plastic panels and the maximum square feet of single area given in table 20-1 may be increased one hundred (100) percent, but in no case shall the area of plastic wall panels exceed fifty (50) percent of the wall area.

TABLE 20-1 - AREA LIMITATION AND SEPARATION REQUIREMENTS FOR PLASTIC WALL PANELS*

Fire Separation (ft.)	Class of Plastic	Max. % Area of Ext. Walls in Plastic Panels	Max sq. ft. Single area	Minimum Separation of Panels (ft.) Vertical	Horizontal
6 ft. or less	-	NP	NP	-	-
6 ft. or more But less than 11 ft.	SE	10	50	8	4
	VSB,SB	NP	NP	-	-
11 ft. or more But less than 30 ft.	SE	25	90	6	4
	VSB,SB	15	70	8	4
Over 30	SE,VSB	50	Not Limited	3**	0
	SB	50	100	6**	3

**See section 2004.14.

2004.3 COMBINATIONS OF GLAZING AND WALL PANELS: Combinations of plastic glazing and plastic wall panels shall be subject to the area, height, percentage limitations and separation requirements applicable to the class of plastics as prescribed for wall panel installations.

SECTION 2005.0 ROOF PANELS

2005.1 GENERAL: Approved plastic roof panels may be installed (except in use groups A, F-1, F-2, F-3 and H) as follows:

a) in roofs of buildings protected by complete automatic sprinklers; or

b) where the roof is not required to have a fireresistance rating by table 2-5.

Roof panels shall meet the requirements of sections 302.6 Roof Coverings, 903.4 Classifications of Roof Coverings, and 928.0 Roof Coverings, except when installed on buildings outside Fire District No. 1.

2005.2 SEPARATIONS: Individual roof panels shall be separated from each other by a distance of not less than four (4) feet measured in a horizontal plane.

2005.3 LOCATION: Where exterior wall openings are required to be fire protected by section 916, no roof panel or unit shall be installed within six (6) feet of such exterior wall.

2005.4 AREA LIMITATIONS: Roof panels or units shall be limited in area and the aggregate area of panels shall be limited by a percentage of the floor area of the room or space sheltered in accordance with the following:

Class of Plastic	Maximum Area Individual Unit or Panel (sq. ft.)	Maximum Aggregate Area (% of Floor Area)
SE	300	30
VSB	200	25
SB	100	20

2005.5 EXCEPTIONS:

a) one story buildings not more than sixteen (16) feet in height and not exceeding twelve hundred (1200) square feet in area and not closer than eleven (11) feet to another building are exempt from the limitations of 2005.4.

b) low hazard uses such as swimming pool shelters, greenhouses, etc. are exempt from the panel area limitations of section 2005.4 provided the buildings do not exceed twenty-four hundred (2400) square feet in area, twenty (20) feet in height and are not closer than eleven (11) feet to the property line or adjacent buildings.

c) roof coverings over terraces and patios of one and two-family dwellings shall be permitted with approved plastics.

SECTION 2006.0 SKYLIGHT ASSEMBLIES

2006.1 SKYLIGHT ASSEMBLIES: Skylight assemblies may be glazed with approved plastic materials (except in use group A) in accordance with the following provisions.

2006.11 MOUNTING: The plastic shall be mounted above the plane of the roof on a curb constructed consistent with the requirements for the type of construction classification.

2006.12 MAXIMUM AREA OF SKYLIGHT UNITS: Each skylight unit shall have a maximum area within the curb of one hundred (100) square feet.

2006.13 AGGREGATE AREA OF SKYLIGHTS: The aggregate area of skylights shall not exceed twenty-five (25) percent of the floor area of the room or space sheltered by the roof in which they are installed.

2006.14 SEPARATION: Skylights shall be separated from each other by a distance of not less than four (4) feet measured in a horizontal plane.

2006.15 LOCATION: Where exterior wall openings are required to be fire protected by section 916, no skylight shall be installed within six (6) feet of such exterior wall.

2006.16 EXCEPTIONS: Except for use groups A and H the aggregate area of approved plastic skylights may be increased one hundred (100) percent beyond the limitations set forth in section 2006.13 if the skylights are used as a fire venting system or if the building is equipped with a complete automatic fire sprinkler system.

2006.17 COMBINATIONS OF ROOF PANELS AND SKYLIGHTS: Combinations of plastic roof panels and skylights shall be subject to the area, percentage limitations and separation requirements applicable to roof panel installations.

SECTION 2007.0 LIGHT-DIFFUSING SYSTEMS

2007.1 GENERAL: Light-diffusing systems shall not be installed in use groups A and H nor in exitways. Plastic diffusers shall be supported directly or indirectly from ceiling or roof construction by use of noncombustible hangers. Hangers shall be at least No. 12 U.S. Standard gauge galvanized wire or equivalent.

2007.2 INSTALLATION: Approved plastic diffusers shall comply with section 922 (Interior Finish) unless the plastic panels will fall from their mountings before igniting and at an ambient temperature of at least two hundred (200) degrees F. below their ignition temperature.

2007.3 SIZE LIMITATIONS: Individual panels or units shall not exceed ten (10) feet in length nor sixteen (16) square feet in area.

2007.4 SPRINKLERS: In buildings having a complete automatic sprinkler system plastic light-diffusing systems shall have sprinklers both above and below unless the system has been specifically approved for sprinkler installations only above the light-diffusing system. Areas of light-diffusing systems shall not be limited if properly protected by approved automatic sprinklers.

SECTION 2008.0 PARTITIONS

2008.1 GENERAL: Approved plastic partitions may be installed as provided in section 910.4 Exceptions to Fireresistive Partitions.

SECTION 2009.0 BATHROOM ACCESSORIES

2009.1 USE OF PLASTICS: Approved plastics shall be permitted as glazing in shower stalls, shower doors, bathtub enclosures, and similar accessory units.

Reference Standards Article 20

ANSI	Z97.1	1972	Performance Specifications and Methods of Test for Transparent Safety Glazing Material Used in Buildings
ASTM	D374	1973	Tests for Thickness of Solid Electrical Insulation
ASTM	D635	1972	Test for Flammability of Self-Supporting Plastics
ASTM	D1929	1968	Test for Ignition Properties of Plastics
ASTM	D2843	1970	Standard Method of Test for Measuring the Density of Smoke from the Burning of Decomposition of Plastics
ASTM	E84	1970	Method of Test for Surface Burning Characteristics of Building Materials

ARTICLE 21

BUILDING CODE PROVISIONS FOR ONE AND TWO FAMILY DWELLINGS

Contained within Article 21 of the State Building Code are provisions which shall regulate one and two-family dwellings. These provisions are supplied to provide a single comprehensive basic reference for one and two-family dwellings.

The requirements for one and two-family dwellings are also supplied in other articles of the Basic Code on a performance-oriented basis. This article supplies far more extensive information on acceptable specifications, details, and methods of construction for one and two-family dwellings.

The provisions supplied within Article 21, as they apply to one and two-family dwellings, shall be considered as being applicable as stated, independently of the rest of the Basic Code. Any requirements for which provision is not made within this article, shall be subject to the provisions of the other articles of the Basic Code.

ARTICLE 21

BUILDING CODE PROVISIONS FOR ONE AND TWO-FAMILY DWELLINGS

SECTION 2100.0 BUILDING PLANNING

2100.1 GENERAL: Conformity with the applicable material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2100.2 DESIGN CRITERIA: One and two-family dwelling structures shall be designed based on the wind, snow and live load crtieria of Article 7 of the Basic Code and the live load criteria of Appendix H of the Basic Code.

2100.3 LOCATION ON LOT: Exterior walls of dwellings located less than two (2) feet from property lines shall have not less than one (1) hour fireresistive rating.

Openings shall not be permitted in exterior walls of dwellings located less than three (3) feet from the property line.

2100.4 LIGHT AND VENTILATION: All habitable rooms shall be provided with aggregate glazing area of not less than ten (10) square feet nor one-tenth (1/10) of the floor area of such rooms. One-half (1/2) of the required area of glazing shall be openable.

EXCEPTION: A combination of natural and mechanical ventilation shall be allowed when evidence is submitted that the combination meets the minimum requirements established in this article.

The minimum design standard for mechanical ventilation, either used by itself or in combination with natural ventilation, shall be 0.25 cfm/ft^2 of room floor area.

The maximum mechanical ventilation allowed for bathroom and kitchen shall be fifty (50) cfm for each room.

If a window is available in a bathroom, which is unrestricted and opens directly to the outer air, no mechanical ventilation shall be necessary.

2100.5 ROOM SIZES: Habitable rooms shall have an area of not less than seventy (70) square feet.

Habitable rooms except kitchens shall be not less than seven (7) feet in any horizontal dimension.

2100.6 CEILING HEIGHT: Habitable rooms shall have a clear height from floor to finished ceiling of not less than seven and one-half (7 1/2) feet, except that in attics and top stories the height shall

be not less than seven and one-third (7 1/3) feet over not less than one-third (1/3) the area of the floor when used for sleeping, study or similar activity.

EXCEPTION: Beams and girders spaced not less than four (4) feet on center may project not more than six (6) inches below the required ceiling height.

All other rooms, including hallways and corridors, shall have a ceiling height of not less than seven (7) feet measured to the lowest projection from the ceiling.

2100.7 SANITATION: Every dwelling unit shall meet the requirements of the Department of Public Health and the Massachusetts State Plumbing Code relative to sanitation.

2100.8 GLAZING: Glazing in entrance and exit doors and fixed glazed panels immediately adjacent to doors, sliding glass doors, storm doors, bathtub enclosures, shower doors, and similar glazed

TABLE 2100-1 GLAZING REQUIREMENTS

Glazing Location	Size of Individual Panes	Thickness and Type of Glass Permitted[1]						
		.115 in. Annealed	3/16 in. Annealed (minimum)	1/8 in. Tempered[2]	3/16 in. Tempered[2]	1/4 in. Laminated[2]	1/4 in. Wire[2]	1/8 in. Rigid Plastic[2]
Entrance & Exit Doors & Adjacent Fixed Glazed Panels	Over 6 sq/ft.	No	Yes	Yes	Yes	Yes	Yes	Yes
Sliding Glass Doors (both fixed & sliding panels)	All sizes	No	No	Yes	Yes	Yes	Yes	Yes
Storm Doors	All sizes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Shower Doors	All sizes	No	No	Yes	Yes	Yes	Yes	Yes
Bathtub Enclosures	All sizes	No	No	Yes	Yes	Yes	Yes	Yes

Note 1: Glass shall conform with reference standard RS-21-2. Annealed glass shall be protected by grills on both exposed sides.

Note 2: Safety Glazing Materials shall conform with reference standard RS-21-2.

openings which may be subject to frequent and recurrent accidental human impact shall comply with Table 2100-1.

Such glass shall be identified by a permanent marking on each piece.

EXCEPTION: Fixed glass panels nineteen (19) inches or less in width or located not less than eighteen (18) inches above adjacent finished floor or walking surfaces.

2100.9 PRIVATE GARAGES: There shall be no openings from a private garage directly into a room used for sleeping purposes. Other openings between the garage and residence shall be equipped with doors of wood or steel or composite construction providing a fire rating equivalent to twenty (20) **minutes.**

The garage shall have five-eighths (5/8) inch fire code sheetrock on any side facing or adjacent to the house, and wherever the attic area is continuous between the garage and the house a firestop of one-half (1/2) inch gypsum sheetrock shall be used to form a barrier to separate the garage and house.

Garage and carport floor surfaces shall be of approved noncombustible material.

2100.10 MEANS OF EGRESS: In one and two-family dwellings, each dwelling unit shall have two independent means of egress, remote as possible from each other and leading to grade, in addition, every floor within a dwelling unit shall have at least one (1) means of egress which shall provide a continuous and unobstructed path leading to grade.

Sleeping rooms shall have at least one (1) openable window or exterior door to permit emergency exit or rescue. Where windows are provided they shall have a sill height of not more than forty-eight (48) inches above the floor and shall provide not less than five (5) square feet of openable area with no dimension less than twenty-two (22) inches.

2100.11 DOORWAYS AND HALLWAYS: The minimum clear width of single doorways shall be thirty-two (32) inches; except at grade level leading directly to the outside, the doorway may be thirty (30) inches in width.

The minimum clear width of every exitway doorway to or from a stairway shall be thirty-six (36) inches.

The minimum height of required egress doorways shall be six (6) feet eight (8) inches.

The minimum width of a hallway or exitway access shall be three (3) feet ~~eight (8) inches~~. PER LTR. FROM SBC DATED 10-8-75.

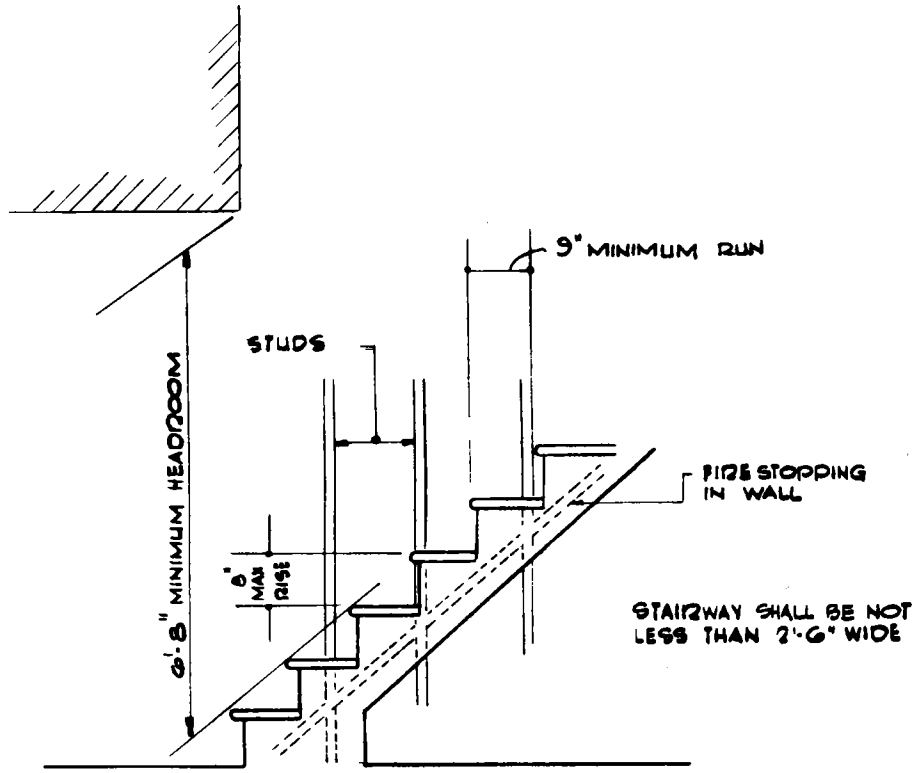
2100.12 **LANDING:** A landing shall be provided on each side of an exit door and shall have a minimum width and depth of three (3) feet. Storm, screen or other doors accessory to exit doors **which** swing over stairs shall require a landing where it swings in the direction of stairs.

EXCEPTION: A landing is not required where the exit door does not swing over the stair.

The landing over which a door does not swing shall be located not more than seven and one-half (7 1/2) inches below the threshold level. The landing over which the door swings shall be located not more than one and one-half (1 1/2) inches below the threshold level.

2100.13 STAIRWAYS: Stairways shall be not less than three (3) feet in clear width and the headroom, rise and run shall conform to Figure 2100-1. Minimum headroom for basement and service stairs shall be six (6) feet four (4) inches. Handrails may project from each

FIGURE 2100-1



STAIR DETAIL

NOTE: INDICATE FIRESTOPPING AS THE DOTTED LINES PARALLEL TO THE STAIR STRINGERS

side of stairway a distance of three and one-half (3 1/2) inches into the required width.

Spiral stairways are permitted provided the width of the tread at a point not more than twelve (12) inches from side where the treads are narrower is not less than nine (9) inches and the minimum width is not less than six (6) inches.

2100.14 HANDRAILS AND GUARDRAILS: Handrails having minimum and maximum heights of thirty (30) inches and thirty-four (34) inches, respectively, measured vertically from the nosing of the treads shall be provided on at least one (1) side of stairways of three (3) or more risers. Open sides of stairs shall be protected.

All enclosed floor and roof openings, open and glazed sides of landings and ramps, balconies or porches which are more than thirty (30) inches above grade or floor below, and roofs used for other than service of the building, shall be protected by guardrails. Guardrails shall be not less than thirty-six (36) inches in height. Open guardrails and stair railings shall have intermediate rails or an ornamental pattern such that a sphere six (6) inches in diameter cannot pass through. The height of stair railings on open sides may be thirty (30) to thirty-four (34) inches in height in lieu of providing a thirty-six (36) inch guardrail and handrail.

2100.15 GUTTERS: Gutters shall be provided when roof overhangs are less than twelve (12) inches in width for one (1) story or twenty-four (24) inches in width for two (2) stories.

2100.16 MINIMUM SIZE OF GUTTERS: Gutters shall have the same area as downspouts for spacings up to forty (40) feet between downspouts. The width of the gutter shall be increased by one (1) inch for each additional twenty (20) feet of gutter.

2100.17 DOWNSPOUTS: Downspouts shall be sized on the basis of approximately one hundred (100) square feet of roof surface to one (1) square inch leader.

2100.18 SMOKE/HEAT DETECTORS: Every building or structure erected or substantially altered to be occupied as a one or two-family dwelling unit shall be protected throughout with automatic smoke or smoke and heat detection devices. Such devices shall initiate the sounding of an alarm capable of being heard in all occupied areas. Such a system shall conform to the requirements of reference standard RS-21-13.

SECTION 2101.0 FOUNDATIONS

2101.1 GENERAL: Foundations, footings and basement walls shall be constructed in accordance with the requirements of this section.

2101.2 MATERIALS: Conformity with the applicable standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

The ultimate compressive strength of concrete at twenty-eight (28) days shall be not less than two thousand (2,000) pounds per square inch except where weather exposure requires a greater strength or cement content.

2101.3 FOOTINGS: All exterior walls shall be supported on continuous solid masonry or concrete footings. Where the bearing capacity of the soil can be demonstrated as adequate, the footing may be eliminated. Other structural systems which can be shown to be adequate for the conditions to safely support all imposed loads, may be used.

Foundation walls shall extend at least six (6) inches above the finished grade adjacent to the foundation at all points.

Foundations for all buildings where the surface of the ground slopes more than one (1) foot in ten (10) feet shall be level or shall be stepped so that both top and bottom of such foundations are level.

Unformed foundation walls may be used when soil conditions warrant and subject to the approval of the building official.

Foundation walls in all cases shall extend below the frost line.

2101.4 BASEMENT WALLS: Basement walls shall be constructed in accordance with the provisions of this section and footings in accordance with accepted practice.

Where unstable soil or ground water conditions do not exist, walls may be constructed of unreinforced masonry or concrete with the thickness shown in Table 2101-1.

Where unstable soil conditions exist or in Seismic Zones specified by the State Building Code Commission, basement walls may be constructed of reinforced masonry or concrete as set forth in Table 2101-2 provided the walls are not subjected to equivalent fluid pressures of more than thirty (30) pounds per square foot.

EXCEPTION: Basement walls retaining less than four (4) feet of unbalanced fill need not be reinforced.

Basement walls subjected to more than thirty (30) pounds per square foot equivalent fluid pressure shall be designed in accordance with accepted engineering pratices.

Backfill adjacent to the wall shall not be placed until the wall has sufficient strength or has been sufficiently braced to prevent damage by the backfill.

Basement walls shall be drained and dampproofed in accordance with Section 2101.5 and Section 2101.6 respectively.

TABLE 2101-1 MINIMUM THICKNESS AND ALLOWABLE DEPTH OF UNBALANCED FILL FOR UNREINFORCED MASONRY AND CONCRETE BASEMENT WALLS[1] WHERE UNSTABLE SOIL OR GROUND WATER CONDITIONS DO NOT EXIST

Foundation Wall Construction	Nominal Thickness (inches)	Maximum depth of unbalanced fill in feet[1]		
		Type of Super-Structure		
		Wood Frame	Masonry Veneer	Masonry
Masonry of Hollow Units	8	4 (6)	4.5 (6)	5 (7)
	10	5 (7)	5.5 (7)	6 (7)
	12	7	7	7
Masonry of Solid Units	6	3	4	4
	8	5 (7)	5.5 (7)	6 (7)
	10	6 (7)	6 (7)	6.5 (7)
	12	7	7	7
Plain Concrete	6[2]	4	4	4
	8	7	7	7
	10	7	7	7
	12	7	7	7
Rubble Stone	Foundation walls of rubble stone shall be at least 16 inches thick. Rough or random rubble shall not be used as foundations for walls exceeding 35 feet in height.			

Note 1: The depth of unbalanced fill may be increased up to the values shown in parenthesis where it is warranted by soil conditions. Unbalanced fill is the height of outside finish grade above the basement floor or inside grade.

Note 2: Six (6) inch plain concrete walls shall be formed both sides.

TABLE 2101-2 REINFORCEMENT REQUIRED FOR BASEMENT WALLS SUBJECTED TO NOT MORE THAN 30 POUNDS PER SQUARE FOOT EQUIVALENT FLUID PRESSURE

Material Type	Height of[3] Unbalanced Fill in Feet	Length of Wall Between Supporting Masonry or Concrete Walls in Feet	Minimum[1] Wall Thickness in Inches	Required Reinforcing	
				Horizontal Bar in Upper 12 Inches of Wall	Size and Spacing of Vertical Bars
Hollow Masonry	4 or less	unlimited	8	not required	not required
	more than 4	design required	design req.	design required	design required
Concrete or Solid Masonry[2]	4 or less	unlimited	8	not required	not required
	more than 4	less than 8	8	2-No. 3	No. 3 @ 18" O.C.
	8 or less	8 to 10	8	2-No. 4	No. 3 @ 18" O.C.
	8 or less	10 to 12	8	2-No. 5	No. 3 @ 18" O.C.
	more than 8	design required	design req.	design required	design required

Note 1: Thickness of concrete walls may be six (6) inches provided reinforcing is placed not less than one (1) inch nor more than two (2) inches from the face of the wall not against the earth.

Note 2: Solid masonry shall include solid brick or concrete units and hollow concrete units with all cells grouted.

Note 3: Backfilling shall not be commenced until after the wall is anchored to the floor.

2101.5 WATERPROOFING: Drains shall be provided around foundations enclosing habitable or usable spaces located below grade and which are subjected to ground water conditions. Drains shall be installed at or below the area to be protected and shall discharge by gravity or by mechanical means into an approved drainage system.

The top joints and perforations of drain tiles shall be protected with strips of building paper and the tiles shall be placed on two (2) inches of crushed rock and covered with not less than six (6) inches of the same material.

2101.6 DAMPPROOFING: Exterior foundation walls of masonry construction enclosing basements shall be dampproofed by applying not less than three-eighths (3/8) inch of portland cement parging to the wall from footing to finish grade. The parging shall be covered with a coat of approved bituminous material applied at the recommended rate. Exterior foundation walls of concrete

construction enclosing basements shall be dampproofed by applying a coat of approved bituminous material to the wall from the footing to the finish grade at the recommended rate.

Foundation walls of habitable rooms located below grade shall be waterproofed with membranes extending from the edge of the footing to the finish grade line. The membrane shall consist of either two (2) ply hot-mopped felts, six (6) mil polyvinyl chloride, fifty-five (55) pound roll roofing or equivalent material. The laps in the waterproofing membrane shall be sealed and firmly affixed to the wall.

Basement walls may be dampproofed or waterproofed using materials or methods of construction other than covered in the section where approved by the building official.

2101.7 FOUNDATION STUDS: Foundation studs shall have a minimum length of fourteen (14) inches and shall be not less in size and spacing than the studding required for exterior walls, and when exceeding four (4) feet in height shall be of the size required for an additional story.

Foundation studs of exterior walls and bearing partitions shall be thoroughly and effectively braced in accordance with Figure 2102-2.

Column bases shall be protected against decay or corrosion except when approved wood of natural decay resistance or treated wood as set forth in Section 2101.8 is used.

EXCEPTION: Basement posts or columns supported by piers projecting two (2) inches above the finish floor and separated therefrom by an approved impervious barrier.

The columns shall be adequately anchored to prevent lateral displacement at either their top or the bottom. Wood columns shall be not less in nominal size than four (4) inches by four (4) inches and steel columns shall be not less than three (3) inch diameter standard pipe or approved equivalent.

2101.8 PROTECTION AGAINST DECAY AND TERMITES: The expression "approval" as used in the following statements means approval in accordance with the procedure established by the Basic Code.

a) WHERE CONDITIONS ARE FAVORABLE TO DECAY:

1) WOOD IN CONTACT WITH THE GROUND: All wood in contact with the ground and supporting permanent structures shall be approved or treated wood.

2) UNTREATED WOOD: Untreated wood may be used where entirely below ground water level or continuously submerged in fresh water and may be used in contact with the ground for detached accessory buildings not intended for human

occupance, for temporary structures and for fences.

b) WOOD JOISTS OR THE BOTTOM OF WOOD STRUCTURAL FLOORS: When wood joists or the bottom of wood structural floors without joists are closer than eighteen (18) inches, or wood girders are closer than twelve (12) inches, to exposed ground located within the periphery of the building over crawl spaces or unexcavated areas, they shall be approved durable or treated wood. Adequate ventilation shall be provided.

c) SILLS: All sills which rest on concrete or masonry exterior walls and are less than six (6) inches from exposed earth shall be of approved durable or treated wood.

d) SLEEPERS AND SILLS: Sleepers and sills on a concrete or masonry slab which is in direct contact with earth shall be of approved durable or treated wood.

e) POSTS OR COLUMNS: Posts or columns in cellars shall be supported by piers projecting at least two (2) inches above the finish floor and separated therefrom by an approved impervious barrier except when approved durable or treated wood is used. Posts or columns used in damp locations below grade shall be of approved durable or treated wood.

f) WALL POCKETS: Ends of wood girders entering masonry or concrete walls shall be provided with a one-half (1/2) inch air space on top, sides and end unless approved durable or treated wood is used.

g) CLEARANCE BETWEEN WOOD SIDING: Clearance between wood siding and earth on the exterior of a building shall be not less than six (6) inches.

h) WHERE APPROVED DURABLE OR TREATED WOODS ARE REQUIRED: Where approved durable or treated woods are required in this Code, the building official may require identification by an approved mark or certificate of inspection.

i) PRESSURE TREATMENT: Where pressure treatment of wood members is required by the Basic Code, preservatives and methods of treatment shall conform to the standards for pressure treatment and preserving of lumber listed in the reference standards of this article.

j) WOOD APPROVED FOR USE IN ACCORDANCE WITH SECTION 2101.8 a, 1, AS BEING DECAY RESISTANT ARE AS FOLLOWS: heartwood of redwood, cypress, black walnut, catalpa, chestnut, osage orange, red mulberry, white oak or cedar.

k) WOOD APPROVED FOR USE IN ACCORDANCE WITH SECTION 2101.8 a, 1, AS BEING TERMITE RESISTANT ARE AS FOLLOWS: heartwood of bald cypress, redwood and eastern red cedar.

Lumber and plywood required to be preservatively treated in accordance with this article shall bear the quality mark of an approved inspection agency.

2101.9 UNDERFLOOR SPACE: The space between the bottom of the floor joists and the earth under any building (except such space as is occupied by a basement or cellar) shall be provided with a sufficient number of ventilating openings through foundation walls or exterior walls to insure ample ventilation, and such openings shall be covered with a corrosion-resistant wire mesh not greater than one-half (1/2) inch nor less than one-quarter (1/4) inch in any dimension. The minimum total area of ventilating openings shall be proportioned on the basis of two (2) square feet for each one hundred (100) square feet of crawl space area. One such ventilating opening shall be within three (3) feet of each corner of said buildings.

EXCEPTIONS:

a) Ventilation openings may be vented to the interior of buildings where warranted by climatic conditions.

b) The total area of ventilation openings may be reduced to one-fifteen-hundredths (1/500) of the underfloor area where the ground surface is treated with an approved vapor barrier material.

c) Ventilation openings may be omitted on one side.

An access crawl hole eighteen (18) inches by twenty-four (24) inches shall be provided to the underfloor space.

The underfloor grade shall be cleaned of all vegetation and organic material.

SECTION 2102.0 WALL CONSTRUCTION

2102.1 GENERAL: Wall and partition construction shall conform to the requirements of this section.

Conformity with the applicable grading material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2102.2 WOOD

a) IDENTIFICATION: All load-bearing lumber, plywood and particleboard shall conform to applicable standards or grading rules and shall be so identified by the grade mark, or certificate of inspection issued by an approved grading or inspection bureau or agency. The grade mark for such load-bearing lumber shall provide adequate information to determine the "f" and "E" values.

b) GRADE: All headers and studs shall be of No. 2, Standard or Stud Grade Lumber or equivalent.

EXCEPTIONS:

1) Bearing studs not supporting floors may be No. 3, One Star or Utility Grade or equivalent provided the studs are spaced not more than sixteen (16) inches on center.

2) Nonbearing studs may be of No. 3, One Star or Utility Grade or equivalent lumber.

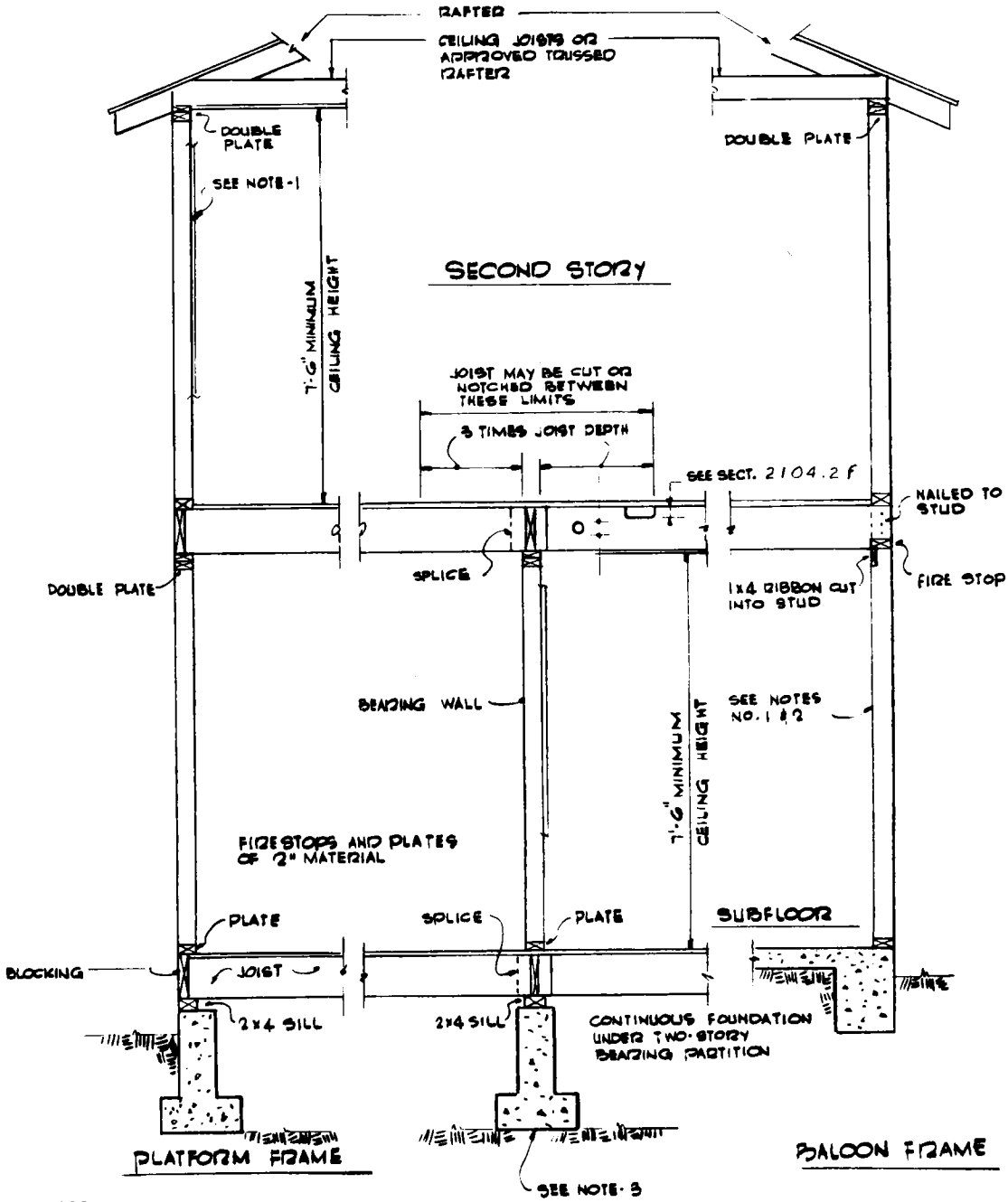
c) CONSTRUCTION: Exterior walls of wood frame residential buildings shall be constructed in accordance with Figures 2102-1 and 2102-2 and nailed in accordance with Table 2102-1.

Exterior walls subject to wind pressures greater than thirty (30) pounds per square foot, as established in the Basic Code shall be designed in accordance with accepted engineering practice.

Interior load-bearing partitions shall be constructed, framed and firestopped as specified for exterior walls. Interior nonbearing partitions may be constructed with two (2) inch by four (4) inch flat studs spaced sixteen (16) inches on centers.

d) CUTTING AND NOTCHING: Stud partitions containing plumbing, heating or other pipes shall be so framed and the joists underneath so spaced as to give proper clearance for the piping. Where bearing partitions containing such piping run parallel to the floor joists, the double joists required underneath such partitions shall be spaced to permit the passage of such pipes. Where plumbing, heating, or other pipes are placed in or partly in a partition, necessitating the cutting of the soles or plates, a metal tie not less than one-eighth (1/8) inch thick and one and one-half (1 1/2) inches wide shall be fastened to the plate across and to each side of the opening with not less than four (4) 16d nails.

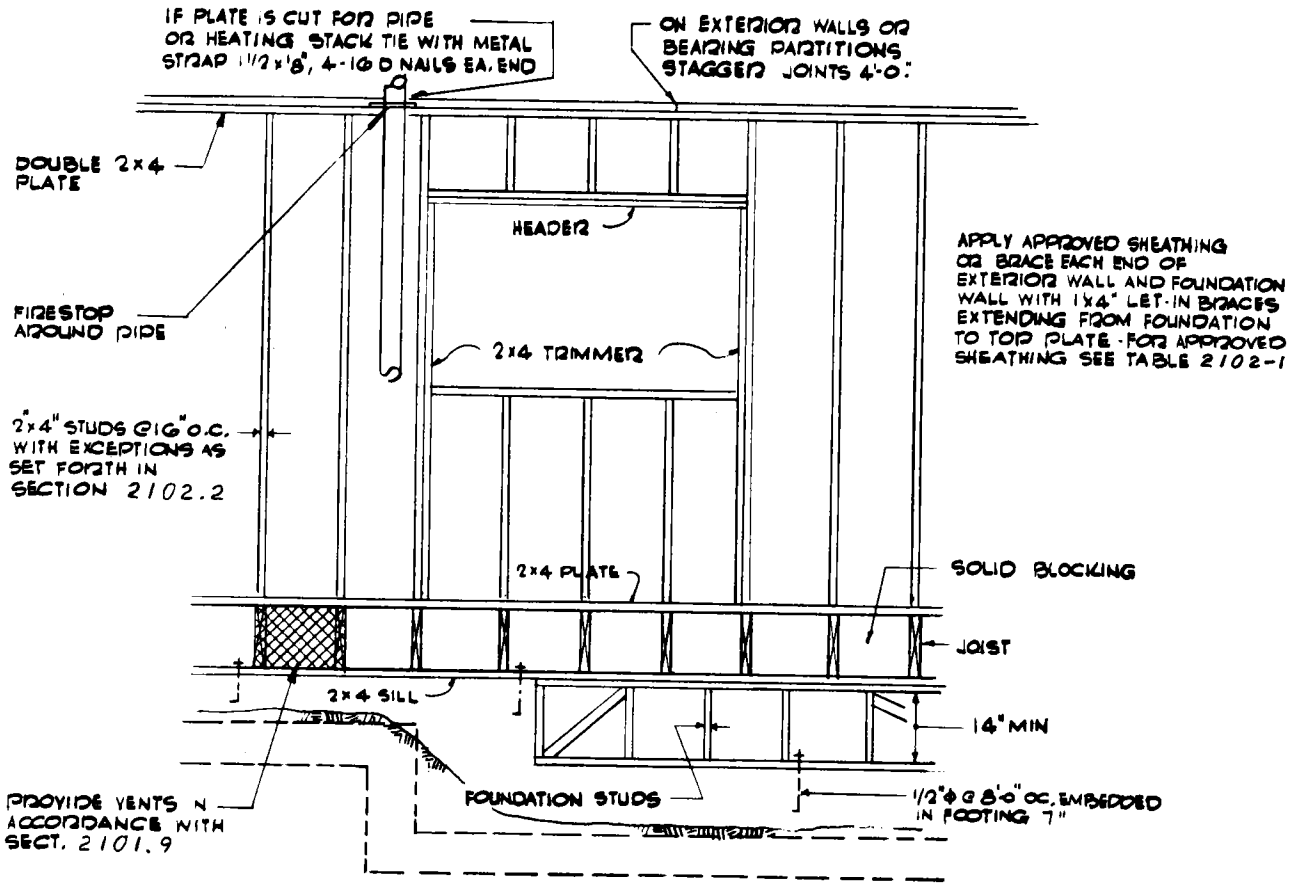
FIGURE 2102-1 STRUCTURAL FRAMING DETAILS



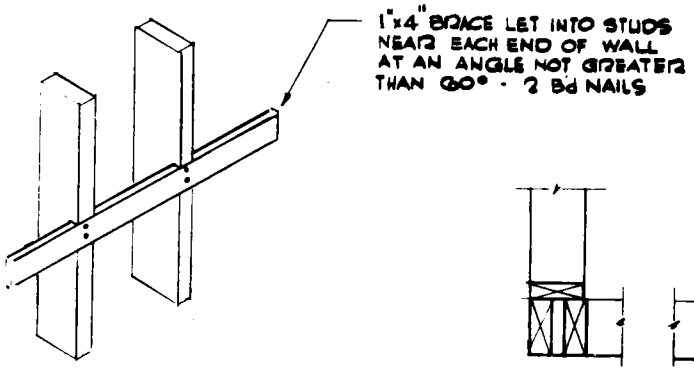
NOTES:

1. ALL BEARING STUDS IN ONE AND TWO STORY BUILDINGS SHALL BE 2"x4" SPACED 16" O.C. EXCEPTION: STUDS MAY BE SPACED 24" O.C. WHERE THEY DO NOT SUPPORT FLOORS AND ARE ADEQUATELY BRACED WITH FIGURE NO. B4 AND TABLE NO. 4A.
2. ALL BEARING STUDS IN THE FIRST STORY OF THREE STORY BUILDINGS SHALL BE EITHER 2"x6" OR 3"x4" SPACED 16" O.C.

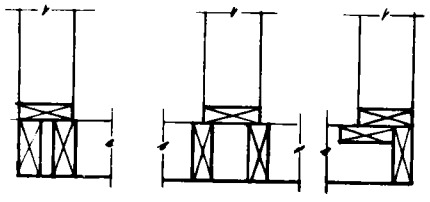
FIGURE 2102-2 WALL FRAMING DETAILS



WALL FRAMING ABOVE FOUNDATION



LET-IN BRACE



CORNER STUDS

TABLE 2102-1 FASTENER SCHEDULE FOR STRUCTURAL MEMBERS

DESCRIPTION OF BUILDING MATERIALS	NUMBER & TYPE[1] OF FASTENER[2, 3, 5]	SPACING OF FASTENERS
Joist to sill or girder, toe nail	3-8d	-
1" x 6" subfloor or less to each joist, face nail	2-8d 2-staples, 1 3/4"	- -
Wider than 1" x 6" subfloor to each joist, face nail	3-8d 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	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	24" o.c.
Doubled top plates, face nail	16d	16" o.c.
Top plates, taps and intersections, face nail	2-16d	-
Continued header, two pieces	16d	16" o.c. along each edge
Ceiling joists to plate, toe nail	2-16d	-
Continuous header to stud, toe nail	4-8d	-
Ceiling joist, taps over partitions, face nail	3-16d	-
Ceiling joist to parallel rafters, face nail	3-16d	-
Rafter to plate, toe nail	3-8d	-
1" brace to each stud and plate, face nail	2-8d 2-staples, 1 3/4"	- -
1" x 6" sheathing to each bearing, face nail	2-8d 2-staples, 1 3/4"	- -
1" x 8" sheathing to each bearing, face nail	2-8d 3-staples, 1 3/4"	- -
Wider than 1" x 8" sheathing to each bearing, face nail	3-8d 4-staples, 1 3/4"	- -
Built-up corner studs	16d	30" o.c.
Built-up girder and beams	20d	32" o.c. at top & bottom & staggered 2-20d at ends & at ea. splice
2-inch planks	2-16d	at each bearing
Roof rafters to ridge, valley or hip rafters, toe nail face nail	 2-16d 3-16d	 - -
Collar ties to rafters, face nail	3-8d	-

TABLE 2102-1 (continued)

DESCRIPTION OF BUILDING MATERIALS	DESCRIPTION[1] OF FASTENERS[2, 3, 5]	SPACING OF FASTENERS edges	SPACING OF FASTENERS inter. sup.[4]
Plywood subfloor, roof and wall sheathing to frame			
1/2 inch - 5/16 inch	6d staple 16 ga.	6" 4"	10" 7"
5/8 inch - 3/4 inch	8d smooth or 6d deformed	6"	10"
7/8 inch	8d	6"	10"
1 inch - 1 1/8 inch	10d smooth or 8d deformed	6"	6"
Other wall sheathing[7]			
1/2" Fiberboard Sheathing	1-1/2" galvanized roofing nail 6d common nail staple 16 ga. 1-1/8" long	3"	6"
25/32" Fiberboard Sheathing	1-3/4" galvanized roofing nail 8d common nail staple 16 ga. 1-1/2" long	3"	6"
1/2" Gypsum Sheathing	1-1/2" galvanized roofing nail 6d common nail staple 16 ga. 1-1/2" long	4"	8"
Particleboard wall sheathing (Exterior-Type 2-B-1) 3/8" - 1/2"	6d common nail	6"	12"
5/8" - 3/4"	8d common nail staple 16 ga. 1-1/2" long	6"	12"
Combination subfloor-underlayment to framing			
3/4 inch and less	6d deformed	6"	10"
7/8 inch - 1 inch	8d deformed	6"	10"
1-1/8 inches - 1-1/4 inches	10d smooth or 8d deformed	6"	6"

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

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

Note 3: Staples are 16 gauge wire and have a minimum seven-sixteenths (7/16) inch O.D. crown width.

Note 4: Nails shall be spaced at not more than six (6) inches o.c. at all supports where spans are forty-eight (48) inches or greater. Nails shall be spaced at not more than ten (10) inches o.c. at intermediate supports for floors.

Note 5: The number of fasteners required for connections not included in this table shall be based on the values set forth in Reference Standard RS-21-6.

Note 6: Four (4) foot x eight (8) foot or four (4) foot x nine (9) foot panels shall be applied vertically.

e) HEADERS: The allowable space for headers in bearing walls shall not exceed the values set forth in Table 2102-2.

Exceptions are allowed when an engineering analysis using standard accepted practice is provided to justify variations from the above table.

f) FIRESTOPPING: Firestopping shall be provided to cut off all concealed draft openings (both vertical and horizontal) and form an effective fire barrier between stories, and between a top story and the roof space. It shall also be used in:

1) stud walls at ceilings and floor levels.

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

Firestopping shall consist of approved noncombustible materials or of wood two (2) inches nominal thickness. If width of opening is such that more than one (1) piece of lumber is necessary, there shall be two (2) thicknesses of one (1) inch material with staggered joints.

TABLE 2102-2 MAXIMUM ALLOWABLE SPANS FOR HEADERS SUPPORTING WOOD FRAME WALLS

Size of Steel Header	Size of Wood Header [3,4]	Allowable Span of Headers in Feet for Bearing Walls [1,2]			
		No Story Above	One Story Above	Two Stories Above	Allowable Span of Headers in Garages or in Walls not Supporting Floors or Roofs
2-1/2 x 2-1/2 x 1/4 3-1/2 x 3-1/2 x 1/4 6 x 1-7/8 JR 4 x 2-5/8 7 x 2-1/8 JR	2-2" x 4" 2-2" x 6" 2-2" x 8" 2-2" x 10" 2-2" x 12"	4' 4' to 6' 6' to 8' 8' to 10' 10' to 12'	– 4' 4' to 6' 6' to 8' 8' to 10'	– – – 4' to 6' 6' to 8'	6' 6' to 8' 8' to 10' 10' to 12' 12' to 16'

Note 1: Based on ten (10) foot tributary floor and roof loads; in other words, headers located in exterior walls and supporting twenty (20) foot span joists or headers located in interior bearing walls and supporting joists spanning ten (10) foot wide rooms on each side.

NOTES FOR TABLE 2102-2 (continued)

Note 2: Based on header providing support for wall height equal to width of opening.

Note 3: Nominal four (4) inch wide single headers may be substituted for the double members.

Note 4: Spans are based on No. 2 or Standard Grade lumber. No. 3 Grade lumber may be used with appropriate design.

TABLE 2102-3 PLYWOOD WALL SHEATHING
Face Grain Parallel or Perpendicular to Studs

Minimum Thickness	Panel Identification Index	Stud Spacing (inches)		
		Siding Nailed to Studs	Sheathing Parallel to Studs	Siding Nailed to Sheathing Sheathing Perpendicular to Studs
5/16	12/0, 16/0 20/0	16	—	16
3/8	16/0, 20/0 24/0	24	16	24
1/2	24/0, 32/16	24	24	24

2102.3 METAL: Steel structural elements in walls and partitions may be either hot rolled structural steel shapes or bar sections or members cold formed to shape from steel sheet, strap or plate, or a fabricated combination thereof. Members shall be straight and free of any defects which would significantly affect their structural performance. The allowable span for steel headers in bearing walls shall not exceed the values set forth in Table 2102-3.

Aluminum structural elements in walls and partitions shall be constructed of materials and designed in accordance with accepted engineering practice.

2102.4 GENERAL MASONRY CONSTRUCTION:

a) CORBELING: Corbels may be built only into solid masonry walls twelve (12) inches or more in thickness. The projection for each course in such corbel shall not exceed one (1) inch and the maximum projection shall not exceed one-third (1/3) the total thickness of the wall when used to support structural members, and not more than six (6) inches when used to support a chimney built into the wall. The top course of all corbels shall be a header course.

b) COMBINED UNITS: In walls or other structural members composed of different kinds or grades of units, materials, or mortars, the maximum stress shall not exceed the allowable stress for the weakest of the combination units, materials, and mortars of which the member is composed. The net thickness of any facing unit which is used to resist stress shall be not less than one and one-half (1 1/2) inches.

c) PIERS: Every structural pier whose width is less than three (3) times its thickness shall be designed and constructed as required for columns.

d) CHASES: Chases and recesses in masonry walls shall be designed and constructed so as not to reduce the required strength or required fireresistance of the wall.

e) STACK BOND: In unreinforced masonry where masonry units are laid in stack bond, longitudinal reinforcements consisting of not less than two (2) continuous wires each with a minimum aggregate cross-sectional area of .017 square inch shall be provided in horizontal bed joints spaced not more than sixteen (16) inches on center vertically.

f) UNSUPPORTED HEIGHT: The unsupported height of masonry walls shall not exceed the values set forth in Table 2102-4. The unsupported height shall be measured between points of anchorage. Footings may be considered as points of lateral support.

Where wall stability is provided by intersecting walls or vertical stiffening elements such as pilasters, the unsupported length may be measured between these elements providing the stiffening elements are anchored to the roof and floor with connectors capable of transmitting all tributary wind and seismic forces.

TABLE 2102-4 ALLOWABLE SPAN FOR MASONRY WALLS BETWEEN LATERAL SUPPORTS

TYPE OF MASONRY WALL	ALLOWABLE[4] H or L (between supports)[1]
Stone	14 × t^2
Cavity and[3] Hollow Units	18 × t^2
Solid and Grouted (plain)	20 × t^2
Reinforced Grouted	25 × t^2

Note 1: Support may be provided by roofs, floors, foundations, beams, etc., in vertical direction or by pilasters, columns, piers, cross walls, etc., in horizontal direction, either but now both are required.

Note 2: "t" is taken as the nominal thickness of the wall in inches.

Note 3: "t" for cavity walls, is the sum of the nominal thickness of the wythes without the cavity.

Note 4: An additional unsupported height of six (6) feet is permitted for gable end walls.

g) LINTELS: Masonry walls shall be reinforced over openings in accordance with Table 2102-5. Exceptions are allowed when an engineering analysis using standard accepted practice is provided to justify variations from the table below.

The reinforcement shall be located in spaces fully grouted to a depth of not less than eight (8) inches and shall extend not less than twelve (12) inches beyond the sides of the opening.

TABLE 2102-5 ALLOWABLE SPAN FOR MASONRY AND STEEL LINTELS SUPPORTING MASONRY WALLS

Number of 1/2"[1] Diameter, or Equivalent Area, Reinforcing Bars	Allowable Span in[2] Feet and Inches			Structural[3] Steel
	No Floor Above	One Floor Above	Two Floors Above	
1	4'-6"	3'-0"	2'-6"	∠ 2-1/2 x 2-1/2 x 5/16 ∠ 3 x 3 x 1/4
2	6'-0"	4'-0"	3'-6"	∠ 3-1/2 x 3-1/2 x 5/16 ST 5 I
3	8'-6"	5'-0"	4'-0"	ST 5 ST 6 I
4	10'-0"	6'-0"	5'-0"	ST 6 ST 8 B

Note 1: Depth of reinforced lintels shall be not less than eight (8) inches and all cells of hollow masonry lintels shall be grouted solid. Reinforcing bars shall extend not less than eight (8) inches into the support.

Note 2: Based on ten (10) foot tributary floor and roof loads; in other words, headers located in exterior walls and supporting twenty (20) foot span joists or headers located in interior bearing walls and supporting joists spanning ten (10) foot wide rooms on each side.

Note 3: Extend steel lintels six (6) inches into the support.

h) ANCHORAGE: Masonry walls shall be anchored to floor and roof systems in accordance with the details shown in Figure 2102-3. Footings may be considered as points of lateral support.

i) REINFORCEMENT: Masonry walls subject to wind loads greater than forty (40) pounds per square foot shall be constructed in accordance with the requirements of this section. The minimum area of reinforcement shall be not less than 0.002 times the gross cross-sectional area of the wall, not more than two-thirds (2/3) of which may be used in either direction. No required vertical reinforcement shall be less than three-eighths (3/8) inch in diameter. Principal wall steel shall have a maximum spacing of four (4) feet on center. A lesser amount of reinforcement may be used to resist tensile stresses specified for partially reinforced masonry construction.

Partially reinforced walls may be considered as reinforced walls for unsupported height provisions provided the reinforcement is designed to resist all horizontal forces and the vertical reinforcement is spaced not more than eight (8) feet on center and not less than .2 square inch of horizontal reinforcement is provided at the top of footings, at top and bottom of openings, at the roof and floor levels and at the top of parapets.

All bars shall be completely embedded in mortar or grout. Joint reinforcement embedded in horizontal mortar joints shall have not less than five-eighths (5/8) inch mortar coverage from the exposed face. All other reinforcement shall have a minimum coverage of one (1) bar diameter over all bars, but not less than three-quarter (3/4) inch except where exposed to weather or soil in which cases the minimum coverage shall be two (2) inches.

j) BEAM SUPPORTS: Beams, girders or other concentrated loads supported by a wall or column shall have bearing of at least three (3) inches in depth measured parallel to the beam and three (3) inches in length upon solid masonry or upon a metal bearing plate of adequate design and dimensions to distribute the load safely, or upon a continuous reinforced masonry member projecting not less than four (4) inches from the face of the wall.

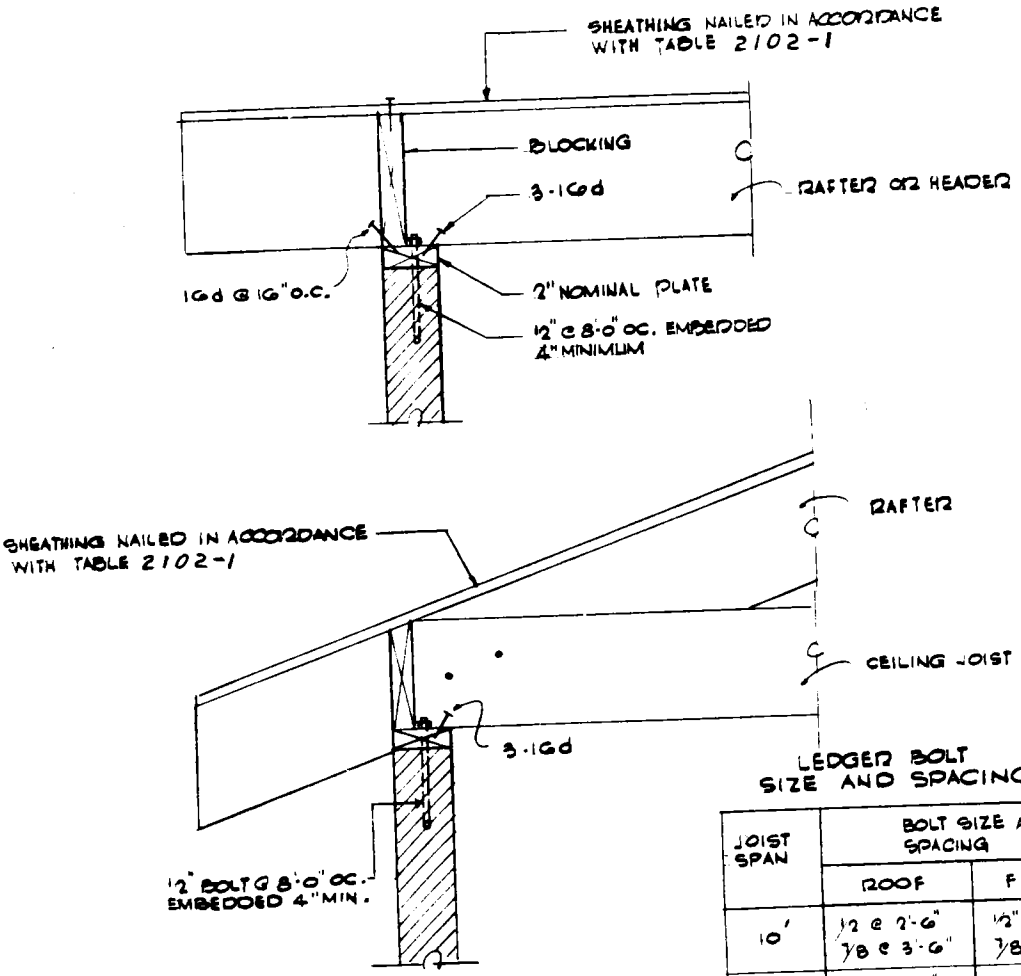
Joists shall be supported in accordance with Figure 2102-3.

2102.5 HOLLOW UNIT MASONRY:

a) GENERAL: Hollow unit masonry shall be laid with full face shell mortar beds and head and end joints shall be solidly silled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells.

b) BONDING: Where two (2) or more hollow units are used to make up the thickness of a wall, the stretcher courses shall be bonded at vertical intervals not exceeding thirty-four (34)

FIGURE 2102-3 ANCHORAGE REQUIREMENTS FOR MASONRY WALLS LOCATED WHERE WIND LOADS ARE LESS THAN 30 P.S.F.

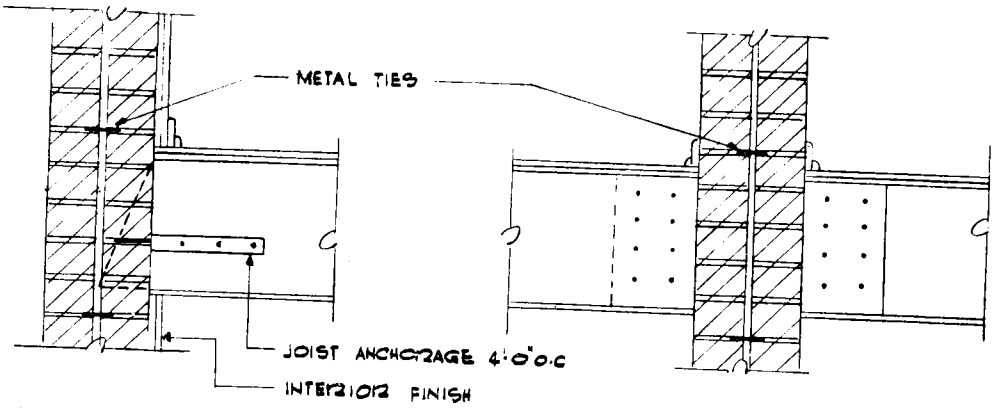


LEDGER BOLT SIZE AND SPACING

JOIST SPAN	BOLT SIZE AND SPACING	
	ROOF	FLOOR
10'	½ @ 2'-6" ⅞ @ 3'-6"	½" @ 2'-0" ⅞" @ 2'-9"
10'-15'	½ @ 1'-9" ⅞ @ 2'-6"	½ @ 1'-4" ⅞ @ 2'-0"
15'-20'	½ @ 1'-3" ⅞ @ 2'-0"	½" @ 1'-0" ⅞" @ 1'-6"

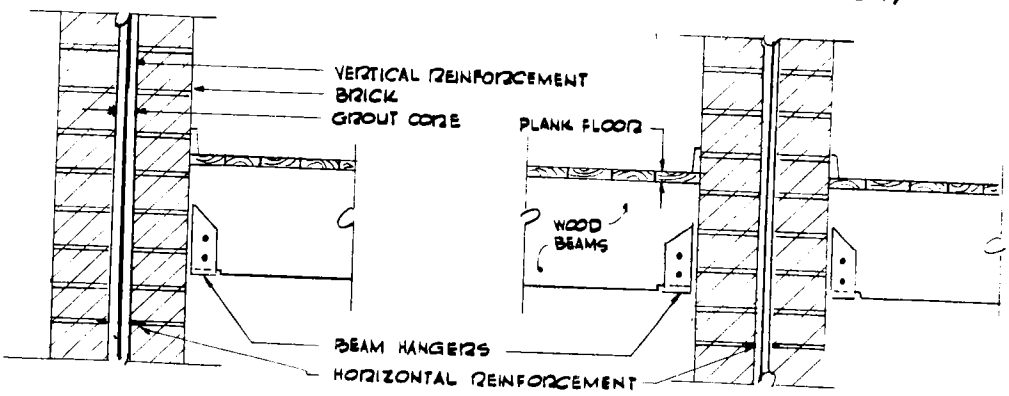
ANCHORAGE REQUIREMENTS FOR MASONRY WALLS

FIGURE 2102-3 (continued)



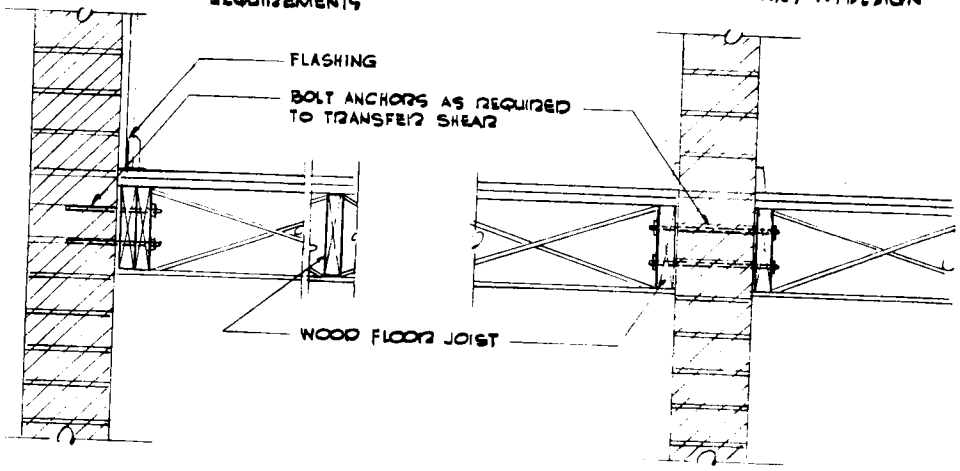
8" BRICK BEARING WALLS - WOOD JOIST FLOOR

1. MASONRY HEADER MAY BE USED IN LIEU OF METAL TIES
2. LARGER BRICK USED IN UNEXPOSED WYTHE FOR ECONOMY



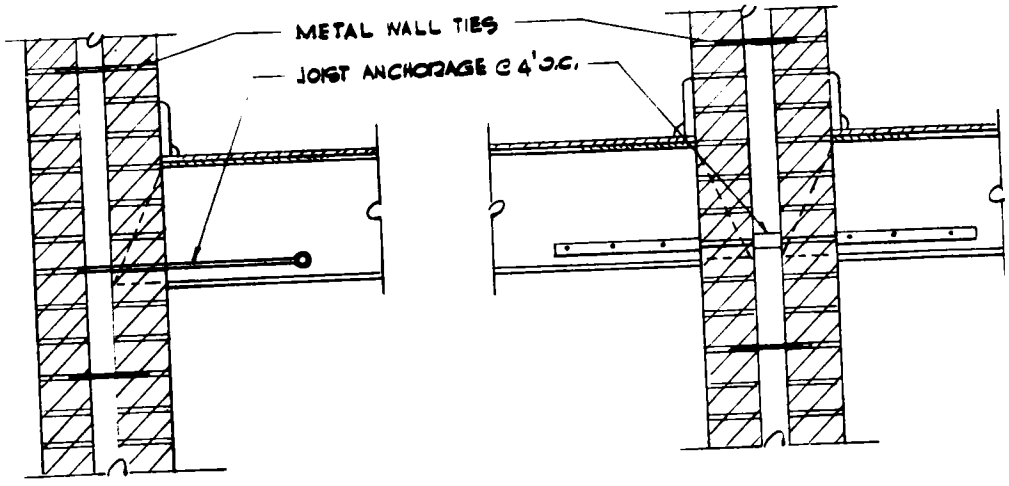
10" RBM BEARING WALLS - PLANK AND BEAM TIMBER FLOOR

1. HORIZONTAL AND VERTICAL REINFORCEMENT WILL VARY W/DESIGN REQUIREMENTS



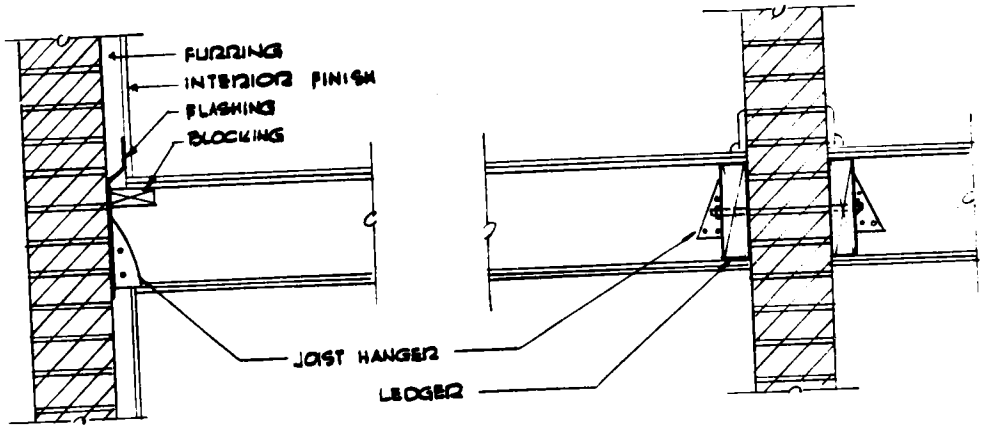
6" BRICK SHEAR WALLS - WOOD JOIST FLOOR

FIGURE 2102-3 (continued)



10" BRICK AND BRICK CAVITY BEARING WALLS
WOOD JOIST FLOOR

1. CAVITY IN INTERIOR WALLS PROVIDES MECHANICAL SPACE AND CONTRIBUTES TO HIGH SOUND RESISTANCE.
2. CAVITY MAY BE INSULATED



6" BRICK BEARING WALLS - WOOD JOIST FLOOR

1. FURRING SPACE MAY BE INSULATED IF DESIRED.

inches by lapping at least four (4) inches over the unit below or by lapping at vertical intervals not exceeding seventeen (17) inches with units which are at least fifty (50) percent greater in thickness than the units below; or by bonding with corrosion-resistant metal ties conforming to the requirements for cavity walls. There shall be one (1) metal tie for not more than each four and one-half (4 1/2) square feet of wall area. Ties in alternate courses shall be staggered, and the maximum vertical distance between ties shall not exceed eighteen (18) inches and the maximum horizontal distance shall not exceed thirty-six (36) inches. Walls bonded with metal ties shall conform to the requirements for allowable stress, lateral support, thickness, height, and mortar for cavity walls.

2102.6 SOLID MASONRY:

a) GENERAL: In each wythe of plain solid masonry, not less than seventy-five (75) percent of the units in any vertical plane perpendicular to the wall plane shall lap the ends of the units above and below a distance not less than one and one-half (1 1/2) inches or one-half (1/2) the height of the units, whichever is greater, or the masonry shall be reinforced longitudinally.

b) BONDING: Adjacent wythes in bearing and nonbearing walls shall be bonded by either headers or metal ties.

Where headers are used the facing and backing shall be bonded so that not less than four (4) percent of the exposed face area is composed of solid headers extending not less than four (4) inches into the backing. The distance between adjacent full-length headers shall not exceed twenty-four (24) inches vertically or horizontally.

Where the backing consists of two (2) or more wythes the headers shall extend not less than four (4) inches into the most distant wythe or the backing wythes shall be bonded together with separate headers whose area and spacing conform to the foregoing.

Where metal ties are used the facing and backing shall be bonded with approved corrosion-resistant unit metal ties or cross wires of masonry joint reinforcement. Unit ties shall be of sufficient length to engage all wythes, with ends embedded not less than one (1) inch in mortar, or shall consist of two (2) lengths the inner embedded ends of which are hooked and lapped not less than two (2) inches.

2102.7 CAVITY WALL MASONRY:

a) GENERAL: Cavity wall masonry is that type of construction made with brick, structural clay tile or concrete masonry units or any combination of such units in which facing and backing are completely separated except for the

metal ties which serve as bonding.

b) CONSTRUCTION: In cavity walls neither the facing nor the backing shall be less than four (4) inches in thickness and the cavity shall be not less than one (1) inch net in width nor more than four (4) inches in width. The backing shall be at least as thick as the facing.

EXCEPTION: Where both the facing and backing are constructed with clay or shale brick, the facing and backing may be three (3) inches in thickness.

The facing and backing of cavity walls shall be bonded with three-sixteenths (3/16) inch diameter steel rods or metal ties of equivalent strength and stiffness embedded in the horizontal joints. There shall be one (1) metal tie for not more than each four and one-half (4 1/2) square feet of wall area for cavity widths up to three and one-half (3 1/2) inches net in width. Where the cavity exceeds three and one-half (3 1/2) inches net in width, there shall be one (1) metal tie for not more than three (3) square feet of wall area. Ties in alternate courses shall be staggered and the maximum vertical distance between ties shall not exceed twenty-four (24) inches and the maximum horizontal distance shall not exceed thirty-six (36) inches. Rods bent to rectangular shape shall be used with hollow masonry units laid with the cells vertical; in other walls the ends of ties shall be bent to ninety (90) degree angles to provide hooks not less than two (2) inches long. Additional bonding ties shall be provided at all openings, spaced not more than three (3) feet apart around the perimeter and within twelve (12) inches of the opening. Ties shall be of corrosion-resistant metal, or shall be coated with a corrosion-resistant metal or other approved protective coating.

2102.8 GROUTED MASONRY:

a) GENERAL: At the time of laying, all masonry units shall be free of excessive dust and dirt. Only Type M or Type S mortar consisting of a mixture of portland cement, hydrated lime and aggregate shall be used.

b) LOW-LIFT GROUT: Requirements for construction shall be as follows:

1) All units in the two (2) outer tiers shall be laid with full shoved head and bed mortar joints. Masonry headers shall not project into the grout space.

2) All longitudinal vertical joints shall be grouted and shall be not less than three-quarters (3/4) inch in thickness. In members of three (3) or more tiers in thickness, interior bricks shall be embedded into the

grout so that at least three-quarters (3/4) inch of grout surrounds the sides and ends of each unit. All grout shall be puddled with a grout stick immediately after pouring.

3) One (1) exterior tier may be carried up sixteen (16) inches before grouting, but the other exterior tier shall be laid up and grouted in lifts not to exceed six (6) times the width of the grout space with a maximum of eight (8) inches.

4) If the work is stopped for one (1) hour or longer, the horizontal construction joints shall be formed by stopping all tiers at the same elevation and with the grout one (1) inch below the top.

c) HIGH-LIFT GROUT: All units in the two (2) tiers shall be laid with full head and bed mortar joints.

1) The two (2) tiers shall be bonded together with wall ties. Ties shall be not less than No. 9 wire in the form of rectangles four (4) inches wide and two (2) inches in length less than the over-all wall thickness. Kinks, water drips or deformations shall not be permitted in the ties. One (1) tier of the wall shall be built up not more than sixteen (16) inches ahead of the other tier. Ties shall be laid not to exceed twenty-four (24) inches on center horizontally and sixteen (16) inches on center vertically for running bond and not more than twenty-four (24) inches on center horizontally and twelve (12) inches on center vertically for stack bond.

2) Provision shall be made for cleaning grout space. Mortar projections, which project more than one-half (1/2) inch into grout space and any other foreign matter shall be removed from grout space prior to inspection and grouting.

3) The grout space (longitudinal vertical joint) shall be not less than three (3) inches in width and not less than the thickness required by the placement of steel with the required clearances and shall be poured solidly with grout. Masonry walls shall cure at least three (3) days to gain strength before pouring grout.

EXCEPTION: If the grout space contains no horizontal steel, it may be reduced to two (2) inches.

4) Vertical grout barriers or dams shall be built of solid masonry across the grout space the entire height of the wall to control the flow of the grout horizontally. Grout barriers shall be not more than twenty-five (25) feet apart.

5) Grout shall be a plastic mix suitable for pumping without segregation of the constituents and shall be mixed thoroughly. Grout shall be placed by pumping or by an approved alternate method and shall be placed before any initial set occurs and in no case more than one and one-half (1 1/2) hours after water has been added.

6) Grouting shall be done in a continuous pour, in lifts not exceeding four (4) feet. It shall be consolidated by puddling or mechanical vibrating during placing and reconsolidated after excess moisture has been absorbed out before plasticity is lost. The grouting of any section of a wall between control barriers shall be completed in one (1) day with no interruptions greater than one (1) hour.

7) Special inspection during grouting shall be provided where required by the building official.

8) Grout shall not be pumped through aluminum pipes.

2102.9 REINFORCED GROUTED MASONRY:

a) GENERAL: Reinforced grouted masonry shall conform to all of the requirements for grouted masonry specified in Section 2102.8 and also the requirements of this section.

b) CONSTRUCTION: The thickness of grout or mortar between masonry units and reinforcement shall be not less than one-quarter (1/4) inch, except that one-quarter (1/4) inch bars may be laid in horizontal mortar joints at least one-half (1/2) inch thick and steel wire reinforcement may be laid in horizontal mortar joints at least twice the thickness of the wire diameter.

2102.10 REINFORCED HOLLOW UNIT MASONRY:

a) GENERAL: Reinforced hollow unit masonry is that type of construction made with hollow masonry units in which certain cells are continuously filled with concrete or grout, and in which reinforcement is embedded. Only Type M or Type S mortar consisting of a mixture of portland cement, hydrated lime and aggregate shall be used.

b) CONSTRUCTION: Requirements for construction shall be as follows:

1) All reinforced hollow unit masonry shall be built to preserve the unobstructed vertical continuity of the cells to be filled. Walls and cross webs forming such cells to be filled shall be full-bedded in mortar to prevent leakage of grout. All head (or end) joints shall be solidly filled with mortar for a distance in from the face of the wall or unit not less than the thickness of the longitudinal face shells. Bond shall be

provided by lapping units in successive vertical courses or by equivalent mechanical anchorage.

2) Vertical cells to be filled shall have vertical alignment sufficient to maintain a clear, unobstructed continuous vertical cell measuring not less than two (2) by three (3) inches.

3) Cleanout openings shall be provided at the bottom of all cells to be filled at each pour of grout where such grout pour is in excess of four (4) feet in height. Any overhanging mortar or other obstruction or debris shall be removed from the insides of such cell walls. The cleanouts shall be sealed before grouting, and after inspection.

4) Vertical reinforcement shall be held in position at top and bottom and at intervals not exceeding one hundred ninety-two (192) diameters of the reinforcement.

5) All cells containing reinforcement shall be filled solidly with grout. Grout shall be poured in lifts of eight (8) feet maximum height. All grout shall be consolidated at time of pouring by puddling or vibrating and then reconsolidated by again puddling later, before plasticity is lost.

When total grout pour exceeds eight (8) feet in height the grout shall be placed in lifts not exceeding four (4) feet each and special inspection during grouting shall be required. Minimum cell dimension shall be three (3) inches.

6) When the grouting is stopped for one (1) hour or longer, horizontal construction joints shall be formed by stopping the pour of grout one and one-half (1 1/2) inches below the tope of the uppermost unit.

SECTION 2103.0 WALL COVERING

2103.1 GENERAL: Interior and exterior wall covering shall conform to the requirements of this section.

Conformity with the applicable material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2103.2 INTERIOR COVERINGS:

a) GENERAL: Interior coverings shall be installed in accordance with this section and Tables 2103-1, 2103-2, 2103-3, 2103-4, 2103-5 and 2103-6.

b) VERTICAL ASSEMBLIES: Vertical support for lath or gypsum wallboard shall be not less than two (2) inches nominal in least dimension. Wood stripping for furring shall be not less than two (2) inches nominal thickness in the least dimension except that furring strips not less than one (1) inch by two (2) inch dimension may be used over solid backing.

c) INTERIOR LATH: Gypsum lath shall not be installed until weather protection for the installation is provided. Where wood frame walls and partitions are covered on the interior with portland cement plaster or tile or similar material and subject to water splash, the framing shall be protected with an approved moisture barrier.

Thickness, spacing of supports and the methods of attachment of gypsum lath shall be as set forth in Tables 2103-1 and

TABLE 2103-1 MAXIMUM SPACING OF SUPPORTS FOR LATH

TYPE OF LATH[1]	MINIMUM WEIGHT (Per Square Yard) GAUGE AND MESH SIZE	VERTICAL (In Inches)			HORIZONTAL (In Inches)	
			Metal			
		Wood	Solid Plaster Partitions	Other	Wood or Concrete	Metal
Expanded Metal Lath (Diamond Mesh)	2.5	16	16	12	—	—
	3.4	16	16	16	16	13½
Flat Rib Expanded Metal Lath	2.75	16	16	16	16	12
	3.4	19	24	19	19	19
Stucco Mesh Expanded Metal Lath	1.8 and 3.6	16[2]	—	—	—	—
3/8" Rib Expanded Metal Lath	3.4	24	24	24	24	24
	4.0	24	—	24	24	24
Sheet Lath	4.5	—	—	—	36[3]	36[3]
3/4" Rib Expanded Metal Lath	5.4	24	24	24	24	24
Wire Lath — Welded	1.95 pounds, No.11 gauge, 2" x 2"	16	16	16	16	16
	1.4 pounds, No.16 gauge, 2" x 2"	16	—	—	—	—
	1.4 pounds, No. 18 gauge, 1" x 1"[4]		—	—	—	—
Wire Lath — Woven	1.4 pounds, No.17 gauge, 1½" Hexagonal[4]	16	—	—	—	—
	1.4 pounds, No.18 gauge, 1" Hexagonal[5]	16	—	16	16	16
3/8" Gypsum Lath (perforated)		16	—	16	16	16
3/8" Gypsum Lath (plain)		16	—	16	16	16
1/2" Gypsum Lath (perforated)		24	—	24	24	24
1/2" Gypsum Lath (plain)						

Note 1: Metal lath and wire lath used as reinforcement for portland cement plaster shall be furred out away from vertical supports at least one-quarter (¼) inch. Self-furring lath meets furring requirements.

Note 2: Wire backing required on open vertical frame construction except under expanded metal lath and paperback wire lath.

Note 3: Contact or furred ceilings only. May not be used in suspended ceilings.

Note 4: Stucco netting, not to be used as a base for gypsum plaster.

2103-2. Approved wire and sheet metal attachment clips may be used.

Gypsum lath shall be applied with the long dimension perpendicular to supports, and with end joints staggered in successive courses. End joints may occur on one support where lath is applied the full length of the joint.

The type and weight of metal lath, the gauge and spacing of nails and staples, the spacing of supports, and the methods of attachment to wood supports shall be as set forth in Tables 2103-1 and 2103-2, except that gypsum veneer plaster may be applied in one (1) coat.

d) INTERIOR PLASTER: Plastering with gypsum plaster or portland cement plaster shall be not less than three (3) coats when applied over metal lath or wire lath and shall be not less than two (2) coats when applied over other bases permitted by this section except that veneer plaster may be applied in one (1) coat, not to exceed three-sixteenths (3/16) inch thickness.

e) GYPSUM WALLBOARD: All gypsum wallboard shall be installed in accordance with the provisions of this section.

Gypsum wallboard shall not be installed until weather protection is provided.

Supports shall be spaced not to exceed the spacing as set forth in Table 2103-6 for single-ply application.

TABLE 2103-2 MAXIMUM SPACING OF FASTENERS FOR SUPPORT OF LATH

TYPE OF LATH	NAILS			STAPLES[1] (Round or Flattened Wire)				
	Type	Maximum Spacing		Leg[2]	Wire Gage No.	Minimum Crown Width	Maximum Spacing	
		Vertical	Horizontal				Vertical	Horizontal
		(In Inches)			(In Inches)			
Diamond Mesh Expanded Metal Lath and Flat Rib Metal Lath	4d blued box (clinched)[3]	6	—	7/8	16	7/16	6	6
	1" No.11 gauge, 7/16" head, barbed	6	—					
	1-1/2" No.11 gauge, 7/16" head, barbed	6	6					
3/8" Rib Metal Lath and Sheet Lath	1-1/2" No.11 gauge, 7/16" head, barbed	6	6	1-1/4	16	7/16	6	6
3/4" Rib Metal Lath	4d Common	At ribs	—	1-3/4	16	7/16	At ribs	At ribs
	2", No.11 gauge, 7/16" head, barbed	—	At ribs	—	—	—	—	—
Wire Lath[4]	4d blued box (clinched)[3]	6	—	7/8	16	7/16	6	6
	1" No.11 gauge, 7/16" head, barbed	6	—					
	1-1/2" No.11 gauge, 7/16" head, barbed	6	6					
	1-1/4" No. 12 gauge, 3/8" head, furring	6	—					
3/8" Gypsum Lath	1-1/8" No.13 gauge, 19/64" head, blued[3]	5	5	7/8	16	7/16	5	5
1/2" Gypsum Lath	1-1/4" No.13 gauge, 19/64" head, blued[3]	5[5]	5[5]	1-1/8	16	7/16	4	4
		4[6]	4[6]					

Note 1: With divergent points and semi-flattened round wire for gypsum lath.

Note 2: When lath and stripping are stapled simultaneously, increase leg length of staple one-eighth (1/8) inch.

Note 3: For interior only.

NOTES FOR TABLE 2103-2 (continued)

Note 4: Attach self-furring wire fabric lath to supports at furring device.

Note 5: Perforated lath.

Note 6: Plain lath.

All edges and ends of gypsum wallboard shall occur on the framing members, except those edges and ends which are perpendicular to the framing members.

The size and spacing of fasteners shall comply with Table 2103-6.

f) SHOWER AND BATH COMPARTMENTS: Shower and bath compartments shall be finished in accordance with the requirements of the Massachusetts State Sanitary Code promulgated by the Department of Public Health.

g) OTHER INTERIOR FINISHES: Other approved interior finishes shall conform to the applicable reference standards of this article.

2103.3 EXTERIOR COVERINGS:

a) GENERAL: Exterior covering shall be installed in accordance with this section and Tables 2103-1, 2103-2, 2103-3, 2103-5, and 2103.7.

b) EXTERIOR LATH: All lath and lath attachments shall be of corrosion-resistant materials and shall conform to Tables 2103-1 and 2103-2.

Backing for vertical surfaces shall consist of sheathing or of not less than No. 18 U.S. gauge steel wire stretched taut horizontally and spaced not more than six (6) inches apart vertically.

Where lath on vertical surfaces extends between rafters, or other similar projecting members, solid backing shall be installed to provide support for lath and attachments.

Gypsum lath shall not be used, except that on horizontal supports of ceilings or roof soffits, it may be used as backing for metal lath or wire lath and portland cement plaster.

Backing is not required under metal lath or paperbacked wire lath.

c) EXTERIOR PLASTER: Plastering with portland cement plaster shall be not less than three (3) coats when applied over metal lath or wire lath and shall be not less than two (2) coats when applied over masonry, concrete, or gypsum back-

ing. If plaster surface is completely covered by veneer of other facing material, or is completely concealed, plaster application need only be two (2) coats provided the total thickness is as set forth in Table 2103-5.

On wood frame construction with an on-grade concrete floor slab system, exterior plaster shall be applied in such a manner as to cover, but not to extend below, lath, paper and screed.

TABLE 2103-3 THICKNESS OF PLASTER

PLASTER BASE	FINISHED THICKNESS OF PLASTER FROM FACE OF LATH, MASONRY, CONCRETE	
	Gypsum Plaster	Portland Cement Plaster
Expanded Metal Lath	5/8" minimum[1]	5/8" minimum[1]
Wire Lath	5/8" minimum[1]	3/4" minimum (interior)[2] 7/8" minimum (exterior)[2]
Gypsum Lath	1/2" minimum	
Masonry Walls[3]	1/2" minimum	1/2" minimum
Monolithic Concrete Walls[3,4]	5/8" maximum	7/8" maximum
Monolithic Concrete Ceilings[3,4]	3/8" maximum[5]	1/2" maximum
Gypsum Veneer Base[6]	1/16" minimum	

Note 1: When measured from back plane of expanded metal lath, exclusive of ribs, or self-furring lath, plaster thickness shall be three-quarter (3/4) inch minimum.

Note 2: When measured from face of support or backing.

Note 3: Because masonry and concrete surfaces may vary in plane, thickness of plaster need not be uniform.

Note 4: When applied over a liquid bonding agent, finish coat may be applied directly to concrete surface.

Note 5: Approved acoustical plaster may be applied directly to concrete, or over base coat plaster, beyond the maximum plaster thickness shown.

Note 6: Attachment shall be in accordance with Table 2103-6.

Only approved plasticity agents and approved amounts thereof may be added to portland cement when plastic cement is used, no additional lime or plasticizers shall be added. Hydrated lime or the equivalent amount of lime putty used as a plasticizer, may be added to standard portland cement in an amount not to exceed twenty (20) percent by weight of the portland cement.

The proportion of aggregate to cementitious materials shall be as set forth in Table 2103-5.

TABLE 2103-4 GYPSUM PLASTER PROPORTIONS

NUMBER	COAT	PLASTER BASE OR LATH	MAXIMUM VOLUME AGGREGATE PER 100 POUNDS NEAT PLASTER[2] (Cubic Feet)	
			Damp Loose Sand[3]	Perlite or Vermiculite[3]
Two-coat Work	Base Coat	Gypsum Lath	2½	2
	Base Coat	Masonry	3	3
Three-coat Work	First Coat	Lath	2[4]	2
	Second Coat	Lath	3[4]	2[5]
	First and Second Coats	Masonry	3	3

Note 1: Wood fibered gypsum plaster may be mixed in the proportions of one hundred (100) pounds of gypsum to not more than one (1) cubic foot of sand where applied on masonry or concrete.

Note 2: When determining the amount of aggregate in set plaster, a tolerance of ten (10) percent shall be allowed.

Note 3: Combinations of sand and lightweight aggregate may be used provided the volume and weight relationship of the combined aggregate to gypsum plaster is maintained.

Note 4: If used for both first and second coats, the volume of aggregate may be two and one-half (2½) cubic feet.

Note 5: Where plaster is one (1) inch or more in total thickness the proportions for the second coat may be increased to three (3) cubic feet.

TABLE 2103-5 PORTLAND CEMENT PLASTER

Coat	MAXIMUM VOLUME AGGREGATE PER VOLUME CEMENTITIOUS MATERIAL[1]			Approximate Minimum Thickness[4]	Minimum Period Moist Curing	Minimum Interval Between Coats
	Portland Cement Plaster[2] Maximum Volume Aggregate per Volume Cement	Portland Cement Lime Plaster[2] Maximum Volume Lime per Volume Cement	Portland Cement Lime Plaster[2] Maximum Volume Sand per Volume Cement and Lime			
First	4	3/4	4	3/8"[5]	48[6] Hours	48[7] Hours
Second	5	3/4	5	1st and 2nd Coats	48 Hours	7 Days[8]
Finished	3[9]	–	3[9]	1/8"	–	–[9]

Note 1: When determining the amount of aggregate in set plaster, a tolerance of ten (10) percent may be allowed.

Note 2: From ten (10) to twenty (20) pounds of dry hydrated lime (or an equivalent amount of lime putty) may be added as a plasticizing agent to each sack of Type I and Type II Standard portland cement in base coat plaster.

Note 3: No additions of plasticizing agents shall be made.

Note 4: See Table 2103-3.

Note 5: Measured from face of support or backing to crest of scored plaster.

Note 6: Twenty-four (24) hours minimum period for moist curing of interior portland cement plaster.

Note 7: Twenty-four (24) hours minimum interval between coats of interior portland cement plaster.

Note 8: Finish coat plaster may be applied to interior portland cement base coats after a forty-eight (48) period.

Note 9: For finish coat, plaster up to an equal part of dry hydrated lime by weight (or an equivalent volume of lime putty) may be added to Type I, Type II and Type III Standard portland cement.

TABLE 2103-6 APPLICATION OF GYPSUM WALLBOARD

THICKNESS OF GYPSUM WALLBOARD (Inch)	PLANE OF FRAMING SURFACE	LONG DIMENSION OF GYPSUM WALLBOARD SHEETS IN RELATION TO DIRECTION OF FRAMING MEMBERS	MAXIMUM SPACING OF FRAMING MEMBERS (center-to-center) (In Inches)	MAXIMUM SPACING OF FASTENERS (center-to-center) (In Inches)		NAILS[1] — TO WOOD
				NAILS[1,2]	SCREWS[3]	
1/2	Horizontal	Either Direction	16		12	No.13 gauge, 1-3/8" long, 19/64" head No. .098 gauge, 1-1/4" long, Annular ringed 5d, cooler nail
	Horizontal	Perpendicular	24	7	12	
	Vertical		24	8	12	
5/8	Horizontal	Either Direction	16	7	12	No. 13 gauge, 1-5/8" long, 19/64" head No. .098 gauge, 1-3/8" long, Annular ringed 6d, cooler nail
	Horizontal	Perpendicular	24	7	12	
	Vertical	Either Direction	24		12	
Fastening Required with Adhesive Application						
1/2 or 5/8	Horizontal	Either Direction	16	16	16	As required for 1/2" and 5/8" gypsum wallboard, see above
		Perpendicular	24	12	16	
	Vertical	Either Direction	24	24	24	
2-3/8 (3/4 total)	Horizontal	Perpendicular	24	16	16	Base ply nailed as required for 1/2" gypsum wallboard and face ply placed with adhesive
	Vertical	Either Direction	24	24	24	

Note 1: Where the metal framing has a clinching design formed to receive the nails by two (2) edges of metal, the nails shall be not less than five-eighths (5/8) inch longer than the wallboard thickness, and shall have ringed shanks. Where the metal framing has a nailing groove formed to receive the nails, the nails shall have barbed shanks or be 5d, No. 13½ gauge, one and five-eighths (1 5/8) inches long, fifteen-sixty-fourths (15/64) inch head for one-half (½) inch gypsum wallboard; 6d, No. 13 gauge, one and seven-eighths (1 7/8) inches long, fifteen-sixty-fourths (15/64) inch head for five-eighths (5/8) inch gypsum wallboard.

Note 2: Two (2) nails spaced not less than two (2) inches apart, nor more than two and one-half (2½) inches apart and pairs of nails spaced not more than twelve (12) inches center-to-center may be used.

Note 3: Screws shall be No. 6 with tapered head and long enough to penetrate into wood framing not less than five-eighths (5/8) inch and metal framing not less than one-quarter (¼) inch.

TABLE 2103-7 WEATHER-RESISTANT SIDING ATTACHMENT

Siding Material		Nominal[1] Thickness (Inches)	Joint Treatment	Weather Resistance Membrane Required	TYPE OF SUPPORTS FOR THE SIDING MATERIAL AND FASTENERS[9]				
					Wood or Plywood Sheathing	Fiberboard Sheathing into Stud	Gypsum Sheathing into Stud	Direct to Studs	Number or Spacing of Fasteners
Horiz. Alum.[8]	Without Insulation	.019[10]	Lap	No	.120-Nail-1½"	.120-Nail-2"	.120-Nail-2"	Not Allowed	Same as Stud Spacing
	Without Insulation	.024	Lap	No	.120-Nail 1½" long	.120-Nail 2" long	.120-Nail 2" long	Not Allowed	
	With Insulation	.019	Lap	No	.120-Nail-1½"	.120-Nail-2½"	.120-Nail-2½"	.120-Nail-1½"	
Horizontal Asbestos Cement Boards Shingles[7]		5/32 1/8	(2) Lap	(2) Yes	.113-Nail-1½"	.113-Nail-2"	.113-Nail-1 3/4"	.113-Nail-1 3/8"	2 Nails per Shingle
Brick Veneer Clay Tile Veneer Concrete Veneer		2 1/4 to 1 2	Sec. 2103.3	Yes	-See Sec. 2103.3 and Figure 2103-1-				
Horizontal Fiberboard[3]		1/2	Sec. 2103.3	No	.099-Nail-2" Staple 1 3/4"	.113-Nail-2 3/4" Staple 2½"	.113-Nail-2½" Staple 2½"	.099-Nail-2" Staple 1 3/4"	Same as Stud Spacing
Hardboard[3] Board and Batten Vertical		1/4	(2)	(2)	.099-Nail-2" Staple 1½"	.099-Nail-2½" Staple 2"	.099-Nail-2" Staple 1 3/4"	.099-Nail-1 3/4" Staple 1½"	6" Panel Edges 8" Inter. Sup.
Hardboard[3] Lap-Siding-Horizontal		7/16	(2)	(2)	.099-Nail-2" Staple 1 7/8"	.099-Nail-2½" Staple 2½"	.099-Nail-2½" Staple 2½"	.099-Nail-2" Staple 1 7/8"	Same as Stud Spacing 2 per Bearing
Vertical Panel Siding		7/16	(2)	(2)	.099-Nail-2" Staple-1½"	.099-Nail-2½" Staple-2½"	.099-Nail-2" Staple-2"	.080-Nail-1 3/4" Staple-1½"	6" Panel Edges 12" Inter. Sup.
Steel[3]		29 ga.	Lap	No	.113-Nail-1 3/4" Staple 1 3/4"	.113-Nail-2 3/4" Staple 2½"	.113-Nail-2½" Staple 2½"	Not Allowed	Same as Stud Spacing
Stone Veneer		2	Sec. 2103.3	Yes	-See Sec. 2103.3 and Figure 2103-3-				
Particleboard Panels		3/8	(2)	(2)	.113-NG 1-2" Staple 1 3/8"	.113-Nail-2½" Staple 2½"	.113-Nail 1-2" Staple 2"	Not Allowed	6" on Edges 8" Inter. Sup.
		5/8	(2)	(2)	.113-Nail-2" Staple 1 7/8"	.113-Nail-2½" Staple 2½"	.113-Nail-2½" Staple 2½"	.113-Nail-2" Staple 1 5/8"	6" on Edges 8" Inter. Sup.
Plywood Panels[11] (Exterior Grade)		3/8	(2)	(2)	.099-Nail-2" Staple 1 3/8"	.113-Nail-2½" Staple 2½"	.099-Nail-2" Staple 2"	.099-Nail-2" Staple 1 3/8"	6" on Edges 12" Inter. Sup.
Wood Rustic, Drop Shiplap		3/8 Min. 19/32 Av.	Lap	No	Fastener Penetration Into Stud - 1"			.113-Nail-2½" Staple-2"	Face Nailing up to 6" Widths, 1 Nail per Bearing. 8" Widths and over, 2 Nails per Bearing
Bevel		7/16	Lap	No					
Butt		3/16	Lap	No					
Tipp									
Shakes[7]		3/8	Lap	Yes	.0915-Nail-2" Staple 2"				
Shingles[7]		3/8	Lap	Yes	16" and 18" Shingles		.076-Nail-1¼"		2 Fasteners per Shingle or Shake
							Staple - 1¼"		
					24" Shingles		.080-Nail-1½"		
							Staple - 1½"		

NOTE FOR TABLE 2103-7

Note 1: Based on stud spacing of sixteen (16) inches o.c. Where studs are spaced twenty-four (24) inches siding may be applied to sheathing approved for that spacing.

Note 2: If boards are applied over sheathing or weather-resistant membrane joints need not be treated. Otherwise vertical joints must occur at studs and covered with batts.

Note 3: Shall be of approved type.

Note 4: Nail is a general description and may be T-head, modified round hear, or round hear with smooth or deformed shanks.

Note 5: Staples shall have a minimum crown width of seven-sixteenths (7/16) inch o.d. and be manufactured of minimum 16 gauge wire.

Note 6: All attachments shall be coated with a corrosion-resistive coating.

Note 7: Shingles and shakes applied over regular density fiberboard or gypsum sheathing shall be fastened to horizontal wood nailers or fiberboard shingle backer.

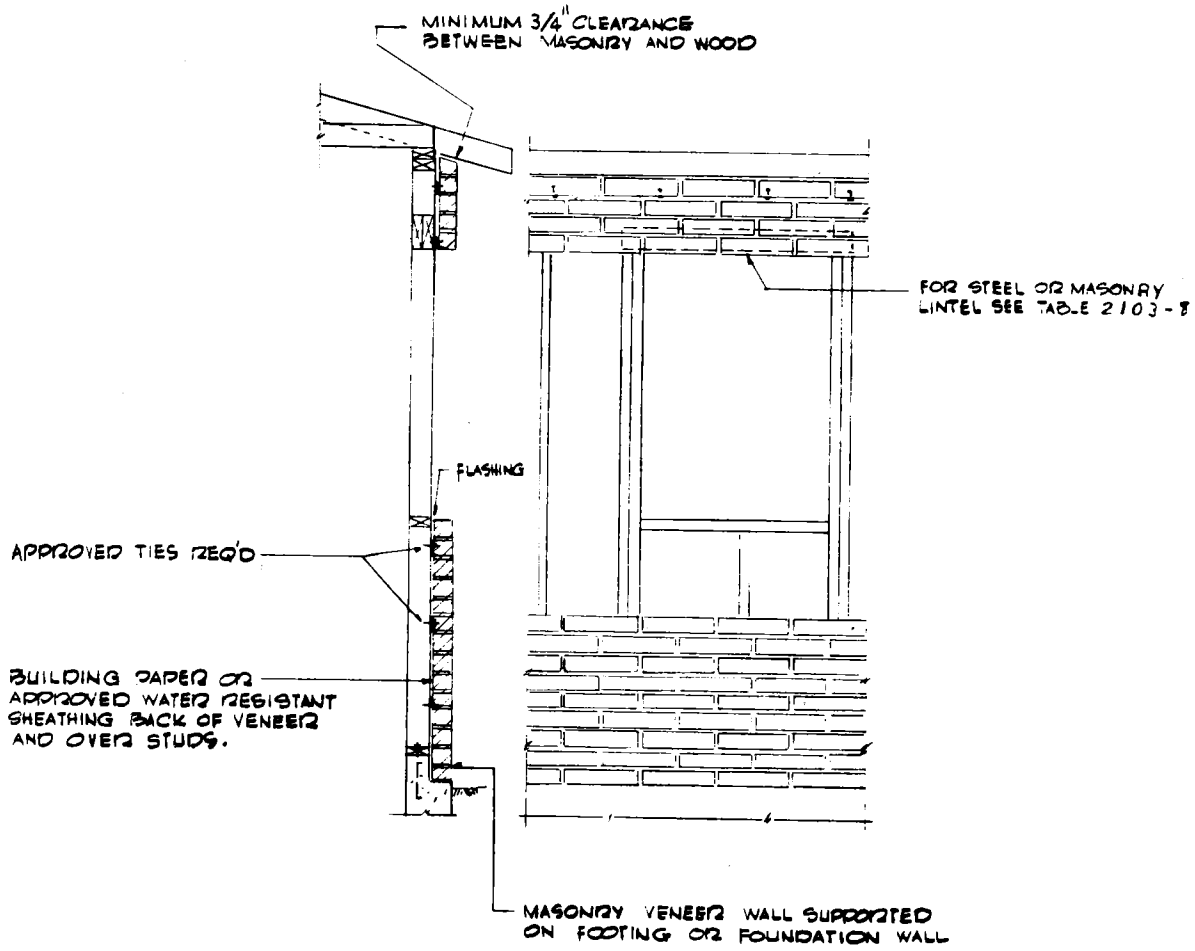
Note 8: Aluminum nails shall be used to attach aluminum siding.

Note 9: Nails or staples must be aluminum, galvanized, or rust-preventative coated and shall be driven into the studs for fiberboard or gypsum backing.

Note 10: Aluminum (0.19-inch) may be unbacked only when the flat areas are five (5) inches or less in the naroow dimension.

Note 11: Three-eighths (3/8) inch plywood may be applied direct to studs spaced sixteen (16) inches on center. One-half (½) inch plywood may be applied direct to studs spaced twenty-four (24) inches on center.

FIGURE 2103-1 MASONRY VENEERED WALL



MASONRY VENEERED WALL

d) MASONRY VENEER, GENERAL: All masonry veneer shall be installed in accordance with this section. Figure 2103-1 and Table 2103-7. Exterior masonry veneer shall not be attached to wood at any point more than thirty (30) feet above the adjacent ground elevation.

1) Masonry veneer shall not support any vertical load other than the dead load of the veneer above. Veneer above openings shall be supported upon lintels of noncombustible material and the allowable span shall not exceed the values set forth in Table 2103-8. The lintels shall have a bearing of not less than four (4) inches.

2) Masonry veneer shall be attached to the supporting wall with corrosion-resistant metal ties.

Veneer ties, if strand wire, shall be not less in thickness than No. 6 U.S. gauge wire and shall have a hook embedded in the mortar joint, or if sheet metal, not less than No. 22 U.S. gauge corrugated. Each tie shall be spaced not more than twenty-four (24) inches on center horizontally and shall support not more than three and one-quarter (3 1/4) square feet of wall area.

EXCEPTION: In wind areas of more than thirty (30) pounds per square foot, each tie shall support not more than two (2) square feet of wall area.

In lieu of such wire ties, an approved method of grouting the veneer to a paperbacked reinforcement attached directly to the studs may be used.

e) WEATHER PROTECTION: Exterior walls shall be covered with a weather-resistant siding and/or membrane.

f) WEATHER-RESISTANT SIDING: The weather-resistant covering shall be attached in accordance with Table 2103-7 and where required the cellular spaces shall be ventilated so as not to make ineffective the firestopping at floor, attic and roof levels. In addition, where cellular spaces are provided with interior non-corrodible vapor type barriers other means shall be used to avoid condensation and leakage of moisture.

g) WEATHER-RESISTANT MEMBRANE: Asphalt-saturated felt free from holes and breaks and weighing not less than fourteen (14) pounds per one hundred (100) square feet or other approved weather-resistant membrane shall be applied over studs or sheathing of all exterior walls as required by Table 2103-7. Such felt or membrane shall be applied weatherboard fashion, lapped not less than two (2) inches at horizontal joints and not less than six (6) inches

at vertical joints.

Such felt or membrane may be omitted in the following cases:

1) Under weather-resistant siding.

2) In accessory buildings.

3) Over water-repellant panel sheathing.

4) Under approved paperbacked metal or wire fabric lath.

5) Under metal lath, wire lath or wire fabric lath on noncombustible construction.

h) FLASHING: Approved corrosion-resistive flashing shall be provided at top and sides of all exterior window and door openings in such manner as to be leakproof. Similar flashings shall be installed at the intersection of chimneys or other masonry construction with frame or stucco walls, with projecting lips on both sides under stucco copings; under and at the ends of masonry, wood or metal copings and sills; continuously above all projecting wood trim; at wall and roof intersections; under built-in gutters; at junction of chimneys and roofs; in all roof valleys and around all roof openings.

i) PLYWOOD APPLICATION: Exterior plywood joints shall occur over framing members, unless wood or plywood sheathing is used or joints are lapped horizontally a minimum of one and one-half (1 1/2) inches or otherwise made waterproof to the satisfaction of the building official.

j) ATTACHMENT: All wall coverings shall be securely fastened in accordance with Table 2103-7, or with other approved aluminum, copper, zinc, zinc-coated or other approved corrosion-resistive fasteners.

Shingles and other weather coverings shall be attached with appropriate standard shingle nails or other approved pneumatically, mechanically driven fasteners to furring strips securely nailed to studs, or with approved mechanically-bonding nails.

Wood shingles or shakes attached with approved corrosion-resistive annular grooved nails may be applied over fiberboard shingle backer and nail base type fiberboard sheathing installed in accordance with Table 2103-7. Wood shingles or shakes and asbestos shingles or siding may be nailed directly to approved nail base fiberboard sheathing not less than one-half (1/2) inch nominal thickness with approved corrosion-resistive annular grooved nails.

TABLE 2103-8 ALLOWABLE SPANS FOR LINTELS
SUPPORTING MASONRY VENEER

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

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

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

SECTION 2104.0 FLOORS

2104.1 GENERAL: Design of floors shall be based on a loading of thirty (30) pounds per square foot for bedroom area, and forty (40) pounds per square foot for all other areas. Floors shall be constructed in accordance with the requirements of this article and Figures 2102-1, 2102-2, 2104-1, 2105-1 and nailed in accordance with Table 2102-1.

Conformity with the applicable material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2104.2 WOOD:

a) IDENTIFICATION: All load-bearing lumber, plywood and particleboard shall conform to applicable standards or grading rules and shall be so identified by a grade mark, or certificate of inspection issued by an approved lumber grading or inspection bureau or agency. The grade mark on such load-bearing lumber shall provide information adequate to determine "F_b," the allowable stress in bending and "E," the modulus of elasticity.

b) GRADE: All joists and beams shall be of No. 3 or Standard Grade lumber or equivalent. Blocking and sheathing may be of Utility or No. 4 Grade lumber or equivalent.

c) ALLOWABLE SPANS: The unsupported spans of floor joists shall not exceed the values set forth in Tables 2104-1, 2104-2. The modulus of elasticity, "E," and the actual stress in bending, "F_b," shown in the Tables shall not exceed the values as required by Section 2106.1. The values of "F_b" (engineered uses) may be increased fifteen (15) percent for repetitive framing members spaced not more than twenty-four (24) inches o.c.

The allowable spans of girders shall not exceed the values set forth in Tables 2104-3, 2104-4. Exceptions to Tables 2104-3, 2104-4 are allowed when an engineering analysis using standard accepted practice is provided to justify variations from the above-mentioned tables.

The allowable spans and minimum grades for plywood floor sheathing shall conform to the requirements set forth in Tables 2104-5 and 2104-6. The allowable spans for floor sheathing shall conform to the requirements set forth in Table 2104-7.

d) BEARING: The ends of each joist shall have not less than one and one-half (1 1/2) inches of bearing on wood or metal and not less than three (3) inches on masonry except where supported on a one (1) inch by four (4) inch ribbon strip and nailed to the adjacent stud.

e) LATERAL SUPPORT: Joists shall be supported laterally at

TABLE 2104-1 ALLOWABLE SPANS FOR FLOOR JOISTS

40 Lbs. Per Sq. Ft. Live Load
(All rooms except those used for sleeping areas and attic floors.)
Strength - Live Load of 40 lbs. per sq. ft. plus dead load of
10 lbs. per sq. ft. determines the fiber stress value shown.

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

HOW TO USE TABLES: Enter Table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

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

TABLE 2104-2 ALLOWABLE SPANS FOR FLOOR JOISTS

30 Lbs. Per Sq. Ft. Live Load
(All rooms used for sleeping areas and attic floors.)
Strength - Live Load of 30 lbs. per sq. ft. plus
dead load of 10 lbs. per sq. ft. determines the
fiber stress value shown.

DESIGN CRITERIA:
Deflection - For 30 lbs. per sq. ft. live load
Limited to span in inches divided by 360.

HOW TO USE TABLES: Enter Table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

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 extreme fiber stress in bending, "Fb", in pounds per square inch is shown below each span.

the ends by solid blocking or diagonal bridging except where the ends of joists are nailed to a header, band joist or to an adjoining stud. Solid blocking or approved diagonal bridging shall be provided in accordance with Figure 2104-1.

f) NOTCHING: Notches on the ends of joists shall not exceed one-quarter (1/4) the depth. Holes bored in joists shall not be within two (2) inches of the top or bottom of the joists and their diameter shall not exceed one-third (1/3) the depth of the joist. Notches in the top or bottom of joists shall not exceed one-sixth (1/6) the depth and shall not be located in the middle third of the span.

TABLE 2104-3 ALLOWABLE SPAN FOR GIRDERS SUPPORTING ONE FLOOR ONLY

SIZE OF WOOD GIRDER		SIZE OF STEEL GIRDER	Floor Live Load (In Pounds Per Sq. Ft.)	SPACING OF GIRDERS[2] "S"				
				4'	6'	8'	10'	16'
4" x 4"	–	–	30	5' - 6"	4' - 6"	3' - 6"	3' - 0"	2' - 6"
			40	5' - 0"	4' - 0"	3' - 6"	3' - 0"	2' - 6"
4" x 6"	–	–	30	8' - 0"	6' - 6"	5' - 6"	5' - 0"	4' - 6"
			40	7' - 6"	6' - 0"	5' - 6"	4' - 6"	4' - 0"
4" x 8"	6" x 6"	3 x 2-3/8 x 5.7	30	11' - 0"	9' - 0"	8' - 0"	7' - 0"	5' - 6"
			40	10' - 0"	8' - 6"	7' - 6"	6' - 6"	5' - 0"
4" x 10"	6" x 8"	S4 x 7.7 M6 x 4.4	30	14' - 0"	11' - 6"	10' - 0"	8' - 6"	6' - 0"
			40	13' - 0"	10' - 6"	9' - 6"	8' - 6"	5' - 6"
4" x 12"	6" x 10"	S5 x 10 M7 x 5.5	30	16' - 6"	14' - 0"	12' - 0"	11' - 0"	9' - 0"
			40	16' - 0"	12' - 6"	11' - 0"	10' - 0"	8' - 0"

Note 1: Spans are based on No. 2 or Standard Grade lumber. No. 3 Grade lumber may be used with appropriate design.

Note 2: The spacing "S" is the tributary load to the girder. It is found by adding the unsupported spans of the floor joists on each side which are supported by the girder and dividing by 2.

2104.3 CONCRETE FLOORS (ON GROUND):

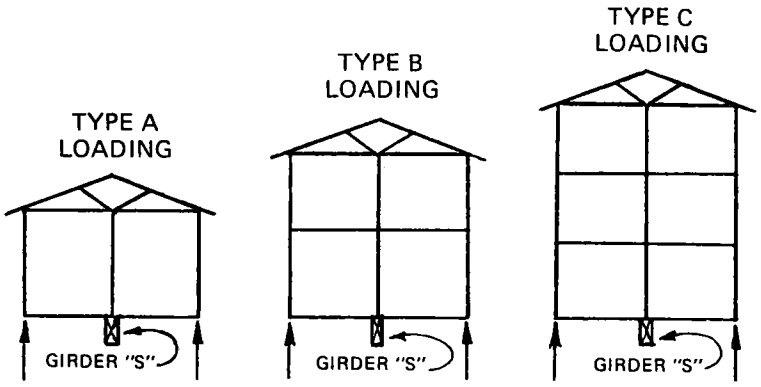
a) GENERAL: Concrete slab-on-ground floors shall be constructed according to accepted engineering practice and in conformity with Figure 2107-1 where applicable. The concrete shall conform to the requirements of section 2101.2 and only approved air-entraining agents shall be used where required.

Slabs shall be constructed with contraction joints, having a depth of at least one-fourth (1/4) the slab thickness, and joints shall be spaced at intervals not more than thirty (30) feet in each direction and slabs not rectangular in shape shall have contraction joints across the slab at points of offset, if offset exceeds ten (10) feet.

EXCEPTION: Contraction joints are not required where 6X6--6/6 welded wire fabric or equivalent is placed at mid-depth of the slab.

TABLE 2104-4 ALLOWABLE SPAN FOR GIRDERS AND REQUIRED SIZE OF COLUMNS AND FOOTINGS TO SUPPORT ROOFS, INTERIOR BEARING PARTITIONS AND FLOORS

Size of Girder Required			Spacing of[2] Girder "S"	Type of Loading[3]			Size of Column[4] Required		Size of Footing[4] Required
Wood[1]		Steel		A	B	C	Steel	Wood	
4" x 12"	6" x 10"	5I10 7JR5.5	10' 15' 20'	5-6" 4-0" —	— — —	— — —	3" Steel Pipe	4" x 4"	2' x 2'
—	6" x 12"	S5 x 14.75 M10 x 9 6B12	10' 15' 20'	8-6" 6-0" 4-6"	5-0" 4-0" —	— — —			
—	—	S7 x 15.3 M12 x 11.8 M8 x 15	10' 15' 20'	12-0" 10-0" 8-0"	9-0" 8-0" 7-0"	8-0" 7-0" 6-0"		6" x 6"	4' x 4'
—	—	S10 x 25.4 M8 x 24	10' 15' 20'	16.0" 13-6" 12-0"	12-6" 10-6" 9-6"	11-0" 10-0" 8-0"		8" x 8"	4' 3" x 4' 3"
—	—	S14 x 22 W10 x 29	10' 15' 20'	20-0" 17-0" 15-0"	16-0" 13-6" 12-0"	13-6" 11-6" 10-0"			



Note 1: Spans for wood girders are based on No. 2 or Standard Grade lumber. No. 3 Grade may be used with appropriate design.

Note 2: The spacing "S" is the tributary load to the girder. It is found by adding the unsupported spans of the floor joists on each side which are supported by the girder and dividing by 2.

Note 3: Figures under type of loading columns are the allowable girder spans.

Note 4: Required size of column is based on girder support from two (2) sides. Size of footing is based on allowable soil pressure of two thousand (2000) pounds per square foot.

TABLE 2104-5 ALLOWABLE SPANS FOR PLYWOOD FLOOR AND ROOF SHEATHING CONTINUOUS OVER TWO OR MORE SPANS AND FACE GRAIN PERPENDICULAR TO SUPPORTS[1]

Panel Identification Index[3]	Panel Thickness (Inches)	ROOF[2]				Floor Maximum Span[4] (In Inches)
		Maximum Span (In Inches)		Load Capacity (In Pounds per Square Foot)		
		Edges[5] Blocked	Edges Unblocked	Total Load	Live Load	
12/0	5/16	12		130	100	0
16/0	5/16, 3/8	16		75	55	0
20/0	5/16, 3/8	20		55	45	0
24/0	3/8, 1/2	24	24	60	45	0
30/12	5/8	30	26	55	40	12[5]
32/16	1/2, 5/8	32[6]	28	50[7]	40	16[8]
36/16	3/4	36	30	50[7]	35[7]	16[8]
42/20	5/8, 3/4, 7/8	42	32	45[7]	35[7]	20[8]
48/24	3/4, 7/8	48	36	40[7]	40	24

Note 1: These values apply for Structural I and II, Standard Sheathing and C-C Exterior grades only. Spans shall be limited to values shown because of possible effect of concentrated loads.

Note 2: Uniform load deflection limitation: one-one hundred eightieth (1/180) of the span under live load plus dead load, one-two hundred fortieth (1/240) under live load only.

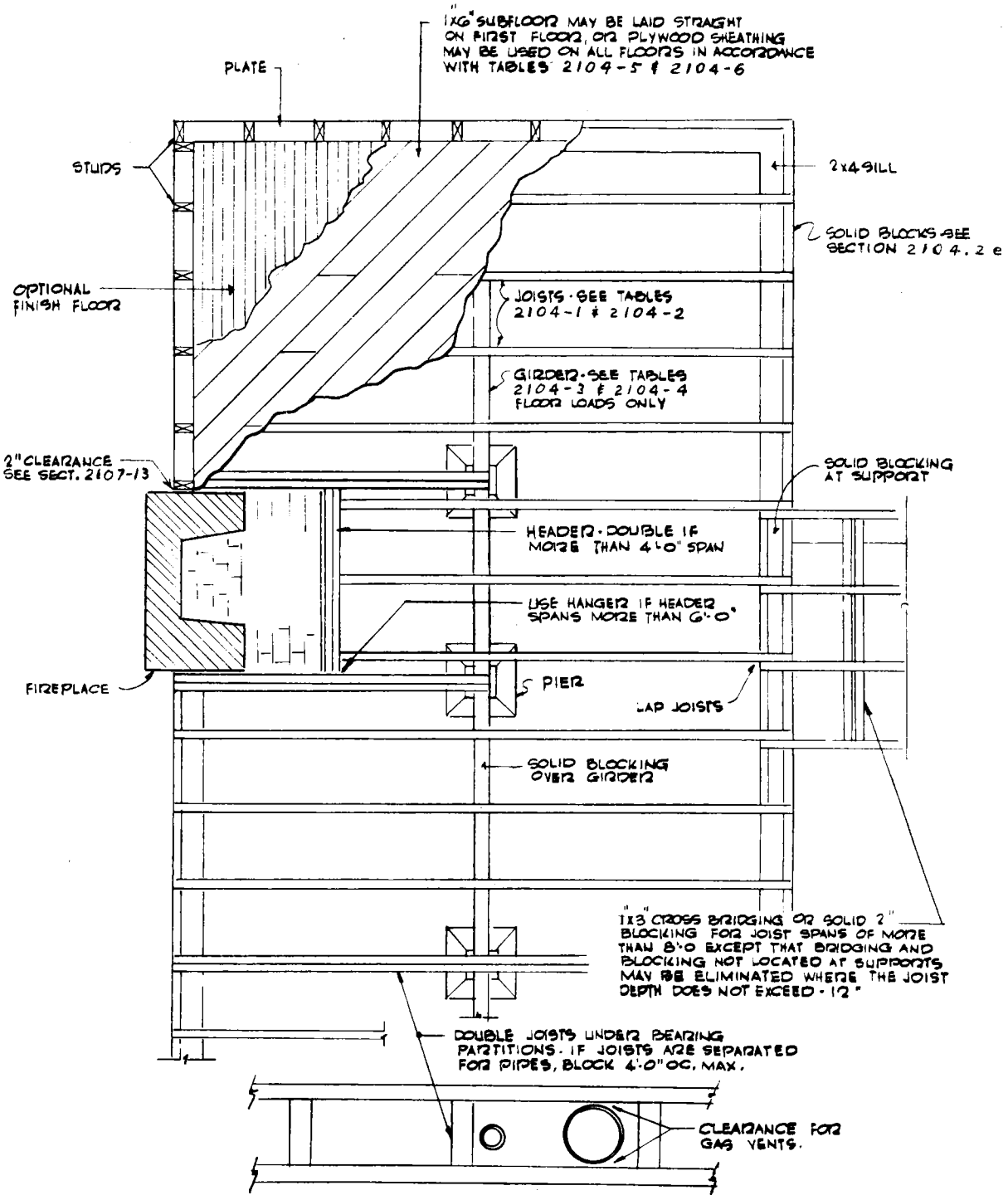
Note 3: Identification Index appears on all panels in the construction grades listed in Footnote No. 1. The numerator and denominator represent the allowable spans for roofs and floors respectively for blocked panels.

Note 4: Plywood edges shall have approved tongue and groove joints or shall be supported with blocking, unless one-quarter (¼) inch minimum thickness underlayment is installed or finish floor is twenty-five/thirty-seconds (25/32) inch wood strip. Allowable uniform load based on deflection of one-three hundred sixtieth (1/360) of span is one hundred sixty-five pounds per square foot.

Note 5: May be sixteen (16) inch if twenty-five/thirty-seconds (25/32) inch wood strip flooring is installed at right angles to joists.

Note 6: One-half (½) inch thick Structural I, when continuous over two (2) or more spans, may be laid with face grain parallel to supports provided all panel edges are blocked or other

FIGURE 2104-1 FLOOR CONSTRUCTION DETAILS



FLOOR CONSTRUCTION

forth in Tables 2104-4 and 2104-5. Exceptions shall be allowed as provided in section 2104-2.

Aluminum structural elements in floors shall be constructed of materials and designed in accordance with Reference Standard RS-21-5.

2104.5 PARTICLEBOARD: Particleboard floor underlayment shall conform to Type 1-B-1 of the standards set forth in standard RS-21-5. Underlayment shall be not less than three-quarter (3/4) inch in thickness and shall be identified by the grade mark of an approved inspection agency. Underlayment shall be installed in accordance with this code and as recommended by the manufacturer.

SECTION 2105.0 ROOF-CEILING CONSTRUCTION

2105.1 GENERAL: Roofs shall be constructed in accordance with Figures 2102-1, 2102-3, 2102-4, 2102-5, 2105-1, 2107-1, and nailed in accordance with Table 2102-1.

Conformity with the applicable material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2105.2 WOOD:

a) IDENTIFICATION: All load-bearing lumber, plywood and particleboard shall conform to applicable standards or grading rules and be identified by a grade mark, or certificate of inspection issued by an approved lumber grading or inspection bureau or agency. The grade mark for such load-bearing lumber shall provide adequate information to determine "F_b" the allowable stress in bending and "E" the modulus of elasticity.

b) GRADE: All rafters and ceiling joists shall be of No. 3 or Standard Grade lumber or equivalent. Blocking and sheathing may be of No. 4 or Utility Grade lumber or equivalent.

c) ALLOWABLE SPANS: The unsupported spans of rafters and ceiling joists shall not exceed the values set forth in Tables 2105-1, 2105-2, 2105-3, 2105-4, 2105-5, 2105-6, 2105-7, 2105-8, 2105-9, 2105-10, 2105-11, 2105-12, 2105-13, 2105-14, 2105-15, 2105-16, 2105-17, 2105-18, 2105-19, and 2105-20. The modulus of elasticity "E" and the actual stress in bending "F_b" shown in these tables shall not exceed the values as required by Section 2104.1. The values for "F_b" (engineered use) may be increased fifteen (15) percent for repetitive framing members spaced not more than twenty-four (24) inches o.c.

The allowable spans and minimum grades for plywood roof sheathing shall not exceed the values set forth in Table 2104-5. The allowable span for board type roof sheathing

shall not exceed twenty-four (24) inches and shall be five-eighths (5/8) inch minimum net thickness for solid sheathing and three-quarter (3/4) inch minimum net thickness for spaced sheathing.

d) GENERAL: The framing details required in this section apply to roofs having a minimum pitch of three (3) in twelve (12) or greater. When the roof pitch is less than three (3) in twelve (12) members supporting rafters and ceiling joists such as ridge boards, hips and valleys shall be designed as beams.

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

For the pupose of this section the tables, "Working Stresses for Joists and Rafters" issued by the National Forest Products Association, may be used to identify those stress graded woods which meet the requirements of the tables incorporated in Section 2105.0.

2105.3 METAL: Steel structural elements in roof-ceiling construction may be either hot-rolled structural steel shapes or members cold formed to shape from steel sheet strip or plate or a fabricated combination thereof. Members shall be straight and free of any defects which would significantly affect their structural performance. Steel girders, trusses or beams in roof-ceiling construction shall be designed in accordance with the application standards in this article.

Aluminum structural elements in roof-ceiling systems shall be constructed of materials and designed in accordance with the applicable reference standard of this article.

2105.4 CEILING FINISHES: Ceilings shall be installed in accordance with the requirements in Section 2104.0.

2105.5 VENTILATION: Where determined necessary by the building official due to atmospheric or climatic conditions, enclosed attics and enclosed rafter spaces formed where ceilings are applied direct to the underside of roof rafters, shall have cross ventilation for each separate space by ventilating openings protected against the entrance of rain and snow. The net free ventilating area shall be not less than one-one hundred fiftieth (1/150) of the area of the space ventilated, except that the area may be one-three hundredth (1/300) provided at least fifty (50) percent of the required ventilating area is provided by ventilators located in the upper portion of the space to be ventilated at least three (3) feet above eave or cornice vents with the balance of the required ventilation

TABLE 2105-1 ALLOWABLE SPANS FOR 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 fiber stress value shown.

HOW TO USE TABLES: Enter Table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

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

TABLE 2105-2 ALLOWABLE SPANS FOR CEILING JOISTS

20 Lbs. Per Sq. Ft. Live Load
(Limited attic storage where development of future rooms is not possible)
(Gypsum 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 fiber stress value.

HOW TO USE TABLES: Enter Table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

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	25-10 1610	26-4 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 extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE 2105-3 ALLOWABLE SPAN FOR 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 fiber stress value.

HOW TO USE TABLES: Enter Table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

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	6-10 340	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	17-0 850	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 extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE 2105-4 ALLOWABLE SPANS FOR CEILING JOISTS

10 Lbs. Per Sq. Ft. Live Load
(No attic storage and roof slope not steeper than 3 in 12)
(Gypsum 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 fiber stress value.

HOW TO USE TABLES: Enter Table with span of joists (upper figure in each square). Determine size and spacing (first column) based on stress grade (lower figure in each square) and modulus of elasticity (top row) of lumber to be used.

JOIST SIZE	SPACING (IN)	Modulus of Elasticity, "E", in 1,000,000 psi																		
(IN)		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	15-11 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 extreme fiber stress in bending, "F_b", in pounds per square inch is shown below each span.

TABLE 2105-5 ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

20 Lbs. Per Sq. Ft. Live Load
(Supporting Gypsum Ceiling)

DESIGN CRITERIA:
Strength - 15 lbs. per sq. ft. dead load plus 20 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 20 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

HOW TO USE TABLES: Enter Table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE	SPACING (IN)	Allowable 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 modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-5 (continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											RAFTER SPACING (IN)	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	2x6
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	2x8
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	2x10
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	2x12
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 modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-6 ALLOWABLE SPAN FOR LOW OR HIGH SLOPE RAFTERS

30 Lbs. Per Sq. Ft. Live Load
(Supporting Gypsum Ceiling)

DESIGN CRITERIA:
Strength - 15 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE	SPACING (IN)	Allowable 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 modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-6 (continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700		
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	
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	2x6
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	
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	2x8
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	
1 -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	
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	2x10
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	
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	2x12
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 2105-7 ALLOWABLE SPAN FOR LOW OR HIGH SLOPE RAFTERS

40 Lbs. Per Sq. Ft. Live Load
(Supporting Gypsum Ceiling)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE	SPACING (IN)	Allowable 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 2105-7 (continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700		
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 modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-8 ALLOWABLE SPANS FOR LOW OR HIGH SLOPE RAFTERS

20 Lbs. Per Sq. Ft. Live Load
(Supporting Plaster Ceiling)

DESIGN CRITERIA:

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

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE	SPACING (IN)	Allowable 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 modulus of elasticity, "E," in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-8 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).									RAFTER SPACING (IN)	SIZE (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	2x6
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	2x8
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	2x10
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	2x12
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 modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-9 ALLOWABLE SPAN FOR LOW OR HIGH SLOPE RAFTERS

30 Lbs. Per Sq. Ft. Live Load
(Supporting Plaster Ceiling)

DESIGN CRITERIA:
Strength - 15 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE	SPACING (IN)	Allowable 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 modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-9 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).									RAFTER SPACING (IN)	SIZE (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	2x6
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	2x8
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	2x10
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	2x12
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 modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-10 ALLOWABLE SPAN FOR LOW OR HIGH SLOPE RAFTERS

40 Lbs. Per Sq. Ft. Live Load
(Supporting Plaster Ceiling)

DESIGN CRITERIA:
Strength - 15 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 360.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE	SPACING (IN)	Allowable 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 modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-10 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).									RAFTER SPACING (IN)	SIZE (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	2x6
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	2x8
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	2x10
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	2x12
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 modulus of elasticity, "E", in 1,000,000 pounds per square inch is shown below each span.

TABLE 2105-11 ALLOWABLE SPAN FOR LOW SLOPE RAFTERS

Slope 3 in 12 or less - 20 Lbs. Per Sq. Ft. Live Load
(No Finished Ceiling)

DESIGN CRITERIA:
Strength - 10 lbs. per sq. ft. dead load plus 20 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 20 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi).										
		300	400	500	600	700	800	900	1000	1100	1200	1300
2x6	12.0	7-1 0.15	8-2 0.24	9-2 0.33	10-0 0.44	10-10 0.55	11-7 0.67	12-4 0.80	13-0 0.94	13-7 1.09	14-2 1.24	14-9 1.40
	13.7	6-8 0.14	7-8 0.22	8-7 0.31	9-5 0.41	10-2 0.52	10-10 0.63	11-6 0.75	12-2 0.88	12-9 1.02	13-3 1.16	13-10 1.31
	16.0	6-2 0.13	7-1 0.21	7-11 0.29	8-8 0.38	9-5 0.48	10-0 0.58	10-8 0.70	11-3 0.82	11-9 0.94	12-4 1.07	12-10 1.21
	19.2	5-7 0.12	6-6 0.19	7-3 0.26	7-11 0.35	8-7 0.44	9-2 0.53	9-9 0.64	10-3 0.75	10-9 0.86	11-3 0.98	11-8 1.10
	24.0	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
2x8	12.0	9-4 0.15	10-10 0.24	12-1 0.33	13-3 0.44	14-4 0.55	15-3 0.67	16-3 0.80	17-1 0.94	17-11 1.09	18-9 1.24	19-6 1.40
	13.7	8-9 0.14	10-1 0.22	11-4 0.31	12-5 0.41	13-4 0.52	14-4 0.63	15-2 0.75	16-0 0.88	16-9 1.02	17-6 1.16	18-3 1.31
	16.0	8-1 0.13	9-4 0.21	10-6 0.29	11-6 0.38	12-5 0.48	13-3 0.58	14-0 0.70	14-10 0.82	15-6 0.94	16-3 1.07	16-10 1.21
	19.2	7-5 0.12	8-7 0.19	9-7 0.26	10-6 0.35	11-4 0.44	12-1 0.53	12-10 0.64	13-6 0.75	14-2 0.86	14-10 0.98	15-5 1.10
	24.0	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
2x10	12.0	11-11 0.15	13-9 0.24	15-5 0.33	16-11 0.44	18-3 0.55	19-6 0.67	20-8 0.80	21-10 0.94	22-10 1.09	23-11 1.24	24-10 1.40
	13.7	11-2 0.14	12-11 0.22	14-5 0.31	15-10 0.41	17-1 0.52	18-3 0.63	19-4 0.75	20-5 0.88	21-5 1.02	22-4 1.16	23-3 1.31
	16.0	10-4 0.13	11-11 0.21	13-4 0.29	14-8 0.38	15-10 0.48	16-11 0.58	17-11 0.70	18-11 0.82	19-10 0.94	20-8 1.07	21-6 1.21
	19.2	9-5 0.12	10-11 0.19	12-2 0.26	13-4 0.35	14-5 0.44	15-5 0.53	16-4 0.64	17-3 0.75	18-1 0.86	18-11 0.98	19-8 1.10
	24.0	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
2x12	12.0	14-6 0.15	16-9 0.24	18-9 0.33	20-6 0.44	22-2 0.55	23-9 0.67	25-2 0.80	26-6 0.94	27-10 1.09	29-1 1.24	30-3 1.40
	13.7	13-7 0.14	15-8 0.22	17-6 0.31	19-3 0.41	20-9 0.52	22-2 0.63	23-6 0.75	24-10 0.88	26-0 1.02	27-2 1.16	28-3 1.31
	16.0	12-7 0.13	14-6 0.21	16-3 0.29	17-9 0.38	19-3 0.48	20-6 0.58	21-9 0.70	23-0 0.82	24-1 0.94	25-2 1.07	26-2 1.21
	19.2	11-6 0.12	13-3 0.19	14-10 0.26	16-3 0.35	17-6 0.44	18-9 0.53	19-11 0.64	21-0 0.75	22-0 0.86	23-0 0.98	23-11 1.10
	24.0	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

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

TABLE 2105-11 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).										RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400		
15-4 1.56	15-11 1.73	16-5 1.91	16-11 2.09	17-5 2.28	17-10 2.47					12.0	
14-4 1.46	14-10 1.62	15-4 1.78	15-10 1.95	16-3 2.13	16-9 2.31	17-2 2.49				13.7	
13-3 1.35	13-9 1.50	14-2 1.65	14-8 1.81	15-1 1.97	15-6 2.14	15-11 2.31	16-3 2.48			16.0	2x6
12-2 1.23	12-7 1.37	13-0 1.51	13-4 1.65	13-9 1.80	14-2 1.95	14-6 2.11	14-10 2.27	15-2 2.43		19.2	
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	24.0	
20-3 1.56	20-11 1.73	21-7 1.91	22-3 2.09	22-11 2.28	23-7 2.47					12.0	
18-11 1.46	19-7 1.62	20-3 1.78	20-10 1.95	21-5 2.13	22-0 2.31	22-7 2.49				13.7	
17-6 1.35	18-2 1.50	18-9 1.65	19-4 1.81	19-10 1.97	20-5 2.14	20-11 2.31	21-5 2.48			16.0	2x8
16-0 1.23	16-7 1.37	17-1 1.51	17-7 1.65	18-2 1.80	18-7 1.95	19-1 2.11	19-7 2.27	20-0 2.43		19.2	
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	24.0	
25-10 1.56	26-8 1.73	27-7 1.91	28-5 2.09	29-3 2.28	30-1 2.47					12.0	
24-2 1.46	25-0 1.62	25-10 1.78	26-7 1.95	27-4 2.13	28-1 2.31	28-10 2.49				13.7	
22-4 1.35	23-2 1.50	23-11 1.65	24-7 1.81	25-4 1.97	26-0 2.14	26-8 2.31	27-4 2.48			16.0	2x10
20-5 1.23	21-1 1.37	21-10 1.51	22-6 1.65	23-2 1.80	23-9 1.95	24-5 2.11	25-0 2.27	25-7 2.43		19.2	
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	24.0	
31-4 1.56	32-6 1.73	33-6 1.91	34-7 2.09	35-7 2.28	36-7 2.47					12.0	
29-4 1.46	30-5 1.62	31-4 1.78	32-4 1.95	33-3 2.13	34-2 2.31	35-1 2.49				13.7	
27-2 1.35	28-2 1.50	29-1 1.65	29-11 1.81	30-10 1.97	31-8 2.14	32-6 2.31	33-3 2.48			16.0	2x12
24-10 1.23	25-8 1.37	26-6 1.51	27-4 1.65	28-2 1.80	28-11 1.95	29-8 2.11	30-5 2.27	31-1 2.43		19.2	
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	24.0	

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

TABLE 2105-12 ALLOWABLE SPAN FOR LOW SLOPE RAFTERS

Slope 3 in 12 or less - 30 Lbs. Per Sq. Ft. Live Load
(No Finished Ceiling)

DESIGN CRITERIA:
Strength - 10 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 30 lbs. per sq. ft. live load Limited to span in inches divided by 240.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE	SPACING (IN)	Allowable Extreme Fiber Stress In Bending, "F_b" (psi).										
		300	400	500	600	700	800	900	1000	1100	1200	1300
2x6	12.0	6-2 0.15	7-1 0.23	7-11 0.32	8-8 0.43	9-5 0.54	10-0 0.66	10-8 0.78	11-3 0.92	11-9 1.06	12-4 1.21	12-10 1.36
	13.7	5-9 0.14	6-8 0.22	7-5 0.30	8-2 0.40	8-9 0.50	9-5 0.61	10-0 0.73	10-6 0.86	11-0 0.99	11-6 1.13	12-0 1.27
	16.0	5-4 0.13	6-2 0.20	6-11 0.28	7-6 0.37	8-2 0.47	8-8 0.57	9-3 0.68	9-9 0.80	10-2 0.92	10-8 1.05	11-1 1.18
	19.2	4-10 0.12	5-7 0.18	6-3 0.26	6-11 0.34	7-5 0.43	7-11 0.52	8-5 0.62	8-11 0.73	9-4 0.84	9-9 0.95	10-1 1.08
	24.0	4-4 0.11	5-0 0.16	5-7 0.23	6-2 0.30	6-8 0.38	7-1 0.46	7-6 0.55	7-11 0.65	8-4 0.75	8-8 0.85	9-1 0.96
2x8	12.0	8-1 0.15	9-4 0.23	10-6 0.32	11-6 0.43	12-5 0.54	13-3 0.66	14-0 0.78	14-10 0.92	15-6 1.06	16-3 1.21	16-10 1.36
	13.7	7-7 0.14	8-9 0.22	9-9 0.30	10-9 0.40	11-7 0.50	12-5 0.61	13-2 0.73	13-10 0.86	14-6 0.99	15-2 1.13	15-9 1.27
	16.0	7-0 0.13	8-1 0.20	9-1 0.28	9-11 0.37	10-9 0.47	11-6 0.57	12-2 0.68	12-10 0.80	13-5 0.92	14-0 1.05	14-7 1.18
	19.2	6-5 0.12	7-5 0.18	8-3 0.26	9-1 0.34	9-9 0.43	10-6 0.52	11-1 0.62	11-8 0.73	12-3 0.84	12-10 0.95	13-4 1.08
	24.0	5-9 0.11	6-7 0.16	7-5 0.23	8-1 0.30	8-9 0.38	9-4 0.46	9-11 0.55	10-6 0.65	11-0 0.75	11-6 0.85	11-11 0.96
2x10	12.0	10-4 0.15	11-11 0.23	13-4 0.32	14-8 0.43	15-10 0.54	16-11 0.66	17-11 0.78	18-11 0.92	19-10 1.06	20-8 1.21	21-6 1.36
	13.7	9-8 0.14	11-2 0.22	12-6 0.30	13-8 0.40	14-9 0.50	15-10 0.61	16-9 0.73	17-8 0.86	18-6 0.99	19-4 1.13	20-2 1.27
	16.0	8-11 0.13	10-4 0.20	11-7 0.28	12-8 0.37	13-8 0.47	14-8 0.57	15-6 0.68	16-4 0.80	17-2 0.92	17-11 1.05	18-8 1.18
	19.2	8-2 0.12	9-5 0.18	10-7 0.26	11-7 0.34	12-6 0.43	13-4 0.52	14-2 0.62	14-11 0.73	15-8 0.84	16-4 0.95	17-0 1.08
	24.0	7-4 0.11	8-5 0.16	9-5 0.23	10-4 0.30	11-2 0.38	11-11 0.46	12-8 0.55	13-4 0.65	14-0 0.75	14-8 0.85	15-3 0.96
2x12	12.0	12-7 0.15	14-6 0.23	16-3 0.32	17-9 0.43	19-3 0.54	20-6 0.66	21-9 0.78	23-0 0.92	24-1 1.06	25-2 1.21	26-2 1.36
	13.7	11-9 0.14	13-7 0.22	15-2 0.30	16-8 0.40	18-0 0.50	19-3 0.61	20-5 0.73	21-6 0.86	22-6 0.99	23-6 1.13	24-6 1.27
	16.0	10-11 0.13	12-7 0.20	14-1 0.28	15-5 0.37	16-8 0.47	17-9 0.57	18-10 0.68	19-11 0.80	20-10 0.92	21-9 1.05	22-8 1.18
	19.2	9-11 0.12	11-6 0.18	12-10 0.26	14-1 0.34	15-2 0.43	16-3 0.52	17-3 0.62	18-2 0.73	19-0 0.84	19-11 0.95	20-8 1.08
	24.0	8-11 0.11	10-3 0.16	11-6 0.23	12-7 0.30	13-7 0.38	14-6 0.46	15-5 0.55	16-3 0.65	17-0 0.75	17-9 0.85	18-6 0.96

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

TABLE 2105-12 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).										RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400		
13-3 1.52	13-9 1 69	14-2 1.86	14-8 2.04	15-1 2.22	15-6 2.41	15-11 2.60				12.0	
12-5 1.42	12-10 1.58	13-3 1.74	13-8 1.90	14-1 2.08	14-6 2.25	14-10 2.43				13.7	
11-6 1.32	11-11 1.46	12-4 1.61	12-8 1.76	13-1 1.92	13-5 2.08	13-9 2.25	14-1 2.42	14-5 2.60		16.0	2x6
10-6 1.20	10-10 1.33	11-3 1.47	11-7 1.61	11-11 1.75	12-3 1.90	12-7 2.05	12-10 2.21	13-2 2.37		19.2	
9-5 1.08	9-9 1.19	10-0 1.31	10-4 1.44	10-8 1.57	10-11 1.70	11-3 1.84	11-6 1.98	11-9 2.12	12-4 2.41	24.0	
17-6 1.52	18-2 1.69	18-9 1.86	19-4 2.04	19-10 2.22	20-5 2.41	20-11 2.60				12.0	
16-5 1.42	16-11 1.58	17-6 1.74	18-1 1.90	18-7 2.08	19-1 2.25	19-7 2.43				13.7	
15-2 1.32	15-8 1.46	16-3 1.61	16-9 1.76	17-2 1.92	17-8 2.08	18-2 2.25	18-7 2.42	19-0 2.60		16.0	2x8
13-10 1.20	14-4 1.33	14-10 1.47	15-3 1.61	15-8 1.75	16-2 1.90	16-7 2.05	16-11 2.21	17-4 2.37		19.2	
12-5 1.08	12-10 1.19	13-3 1.31	13-8 1.44	14-0 1.57	14-5 1.70	14-10 1.84	15-2 1.98	15-6 2.12	16-3 2.41	24.0	
22-4 1.52	23-2 1.69	23-11 1.86	24-7 2.04	25-4 2.22	26-0 2.41	26-8 2.60				12.0	
20-11 1.42	21-8 1.58	22-4 1.74	23-0 1.90	23-8 2.08	24-4 2.25	25-0 2.43				13.7	
19-4 1.32	20-0 1.46	20-8 1.61	21-4 1.76	21-11 1.92	22-6 2.08	23-2 2.25	23-8 2.42	24-3 2.60		16.0	2x10
17-8 1.20	18-3 1.33	18-11 1.47	19-6 1.61	20-0 1.75	20-7 1.90	21-1 2.05	21-8 2.21	22-2 2.37		19.2	
15-10 1.08	16-4 1.19	16-11 1.31	17-5 1.44	17-11 1.57	18-5 1.70	18-11 1.84	19-4 1.98	19-10 2.12	20-8 2.41	24.0	
27-2 1.52	28-2 1.69	29-1 1.86	29-11 2.04	30-10 2.22	31-8 2.41	32-6 2.60				12.0	
25-5 1.42	26-4 1.58	27-2 1.74	28-0 1.90	28-10 2.08	29-7 2.25	30-5 2.43				13.7	
23-6 1.32	24-4 1.46	25-2 1.61	25-11 1.76	26-8 1.92	27-5 2.08	28-2 2.25	28-10 2.42	29-6 2.60		16.0	2x12
21-6 1.20	22-3 1.33	23-0 1.47	23-8 1.61	24-4 1.75	25-0 1.90	25-8 2.05	26-4 2.21	26-11 2.37		19.2	
19-3 1.08	19-11 1.19	20-6 1.31	21-2 1.44	21-9 1.57	22-5 1.70	23-0 1.84	23-6 1.98	24-1 2.12	25-2 2.41	24.0	

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

TABLE 2105-13 ALLOWABLE SPAN FOR LOW SLOPE RAFTERS

Slope 3 in 12 or less - Lbs. Per Sq. Ft. Live Load
(No Finished Ceiling)

DESIGN CRITERIA:
Strength - 10 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 240.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi). 300	400	500	600	700	800	900	1000	1100	1200	1300
2x6	12.0	5-6 0.14	6-4 0.22	7-1 0.31	7-9 0.41	8-5 0.51	9-0 0.63	9-6 0.75	10-0 0.88	10-6 1.01	11-0 1.15	11-5 1.30
	13.7	5-2 0.13	5-11 0.21	6-8 0.29	7-3 0.38	7-10 0.48	8-5 0.59	8-11 0.70	9-5 0.82	9-10 0.95	10-3 1.08	10-9 1.22
	16.0	4-9 0.12	5-6 0.19	6-2 0.27	6-9 0.35	7-3 0.44	7-9 0.54	8-3 0.65	8-8 0.76	9-1 0.88	9-6 1.00	9-11 1.12
	19.2	4-4 0.11	5-0 0.18	5-7 0.24	6-2 0.32	6-8 0.41	7-1 0.50	7-6 0.59	7-11 0.69	8-4 0.80	8-8 0.91	9-1 1.03
	24.0	3-11 0.10	4-6 0.16	5-0 0.22	5-6 0.29	5-11 0.36	6-4 0.44	6-9 0.53	7-1 0.62	7-5 0.71	7-9 0.81	8-1 0.92
2x8	12.0	7-3 0.14	8-4 0.22	9-4 0.31	10-3 0.41	11-1 0.51	11-10 0.63	12-7 0.75	13-3 0.88	13-11 1.01	14-6 1.15	15-1 1.30
	13.7	6-9 0.13	7-10 0.21	8-9 0.29	9-7 0.38	10-4 0.48	11-1 0.59	11-9 0.70	12-5 0.82	13-0 0.95	13-7 1.08	14-1 1.22
	16.0	6-3 0.12	7-3 0.19	8-1 0.27	8-11 0.35	9-7 0.44	10-3 0.54	10-11 0.65	11-6 0.76	12-0 0.88	12-7 1.00	13-1 1.12
	19.2	5-9 0.11	6-7 0.18	7-5 0.24	8-1 0.32	8-9 0.41	9-4 0.50	9-11 0.59	10-6 0.69	11-0 0.80	11-6 0.91	11-11 1.03
	24.0	5-2 0.10	5-11 0.16	6-7 0.22	7-3 0.29	7-10 0.36	8-4 0.44	8-11 0.53	9-4 0.62	9-10 0.71	10-3 0.81	10-8 0.92
2x10	12.0	9-3 0.14	10-8 0.22	11-11 0.31	13-1 0.41	14-2 0.51	15-1 0.63	16-0 0.75	16-11 0.88	17-9 1.01	18-6 1.15	19-3 1.30
	13.7	8-8 0.13	10-0 0.21	11-2 0.29	12-3 0.38	13-3 0.48	14-2 0.59	15-0 0.70	15-10 0.82	16-7 0.95	17-4 1.08	18-0 1.22
	16.0	8-0 0.12	9-3 0.19	10-4 0.27	11-4 0.35	12-3 0.44	13-1 0.54	13-11 0.65	14-8 0.76	15-4 0.88	16-0 1.00	16-8 1.12
	19.2	7-4 0.11	8-5 0.18	9-5 0.24	10-4 0.32	11-2 0.41	11-11 0.50	12-8 0.59	13-4 0.69	14-0 0.80	14-8 0.91	15-3 1.03
	24.0	6-6 0.10	7-7 0.16	8-5 0.22	9-3 0.29	10-0 0.36	10-8 0.44	11-4 0.53	11-11 0.62	12-6 0.71	13-1 0.81	13-7 0.92
2x12	12.0	11-3 0.14	13-0 0.22	14-6 0.31	15-11 0.41	17-2 0.51	18-4 0.63	19-6 0.75	20-6 0.88	21-7 1.01	22-6 1.15	23-5 1.30
	13.7	10-6 0.13	12-2 0.21	13-7 0.29	14-11 0.38	16-1 0.48	17-2 0.59	18-3 0.70	19-3 0.82	20-2 0.95	21-1 1.08	21-11 1.22
	16.0	9-9 0.12	11-3 0.19	12-7 0.27	13-9 0.35	14-11 0.44	15-11 0.54	16-11 0.65	17-9 0.76	18-8 0.88	19-6 1.00	20-3 1.12
	19.2	8-11 0.11	10-3 0.18	11-6 0.24	12-7 0.32	13-7 0.41	14-6 0.50	15-5 0.59	16-3 0.69	17-0 0.80	17-9 0.91	18-6 1.03
	24.0	7-11 0.10	9-2 0.16	10-3 0.22	11-3 0.29	12-2 0.36	13-0 0.44	13-9 0.53	14-6 0.62	15-3 0.71	15-11 0.81	16-7 0.92

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

TABLE 2105-13 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).										RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400		
11-11 1.45	12-4 1.61	12-8 1.77	13-1 1.94	13-6 2.12	13-10 2.30	14-2 2.48				12.0	
11-1 1.36	11-6 1.51	11-11 1.66	12-3 1.82	12-7 1.98	12-11 2.15	13-3 2.32	13-7 2.49			13.7	
10-3 1.26	10-8 1.39	11-0 1.54	11-4 1.68	11-8 1.83	12-0 1.99	12-4 2.15	12-7 2.31	12-11 2.48		16.0	2x6
9-5 1.15	9-9 1.27	10-0 1.40	10-4 1.54	10-8 1.67	10-11 1.81	11-3 1.96	11-6 2.11	11-9 2.26	12-4 2.58	19.2	
8-5 1.03	8-8 1.14	9-0 1.25	9-3 1.37	9-6 1.50	9-9 1.62	10-0 1.75	10-3 1.89	10-6 2.02	11-0 2.30	24.0	
15-8 1.45	16-3 1.61	16-9 1.77	17-3 1.94	17-9 2.12	18-3 2.30	18-9 2.48				12.0	
14-8 1.36	15-2 1.51	15-8 1.66	16-2 1.82	16-7 1.98	17-1 2.15	17-6 2.32	17-11 2.49			13.7	
13-7 1.26	14-0 1.39	14-6 1.54	14-11 1.68	15-5 1.83	15-10 1.99	16-3 2.15	16-7 2.31	17-0 2.48		16.0	2x8
12-5 1.15	12-10 1.27	13-3 1.40	13-8 1.54	14-0 1.67	14-5 1.81	14-10 1.96	15-2 2.11	15-6 2.26	16-3 2.58	19.2	
11-1 1.03	11-6 1.14	11-10 1.25	12-2 1.37	12-7 1.50	12-11 1.62	13-3 1.75	13-7 1.89	13-11 2.02	14-6 2.30	24.0	
20-0 1.45	20-8 1.61	21-4 1.77	22-0 1.94	22-8 2.12	23-3 2.30	23-11 2.48				12.0	
18-8 1.36	19-4 1.51	20-0 1.66	20-7 1.82	21-2 1.98	21-9 2.15	22-4 2.32	22-11 2.49			13.7	
17-4 1.26	17-11 1.39	18-6 1.54	19-1 1.68	19-7 1.83	20-2 1.99	20-8 2.15	21-2 2.31	21-8 2.48		16.0	2x10
15-10 1.15	16-4 1.27	16-11 1.40	17-5 1.54	17-11 1.67	18-5 1.81	18-11 1.96	19-4 2.11	19-10 2.26	20-8 2.58	19.2	
14-2 1.03	14-8 1.14	15-1 1.25	15-7 1.37	16-0 1.50	16-6 1.62	16-11 1.75	17-4 1.89	17-9 2.02	18-6 2.30	24.0	
24-4 1.45	25-2 1.61	26-0 1.77	26-9 1.94	27-7 2.12	28-4 2.30	29-1 2.48				12.0	
22-9 1.36	23-6 1.51	24-4 1.66	25-1 1.82	25-9 1.98	26-6 2.15	27-2 2.32	27-10 2.49			13.7	
21-1 1.26	21-9 1.39	22-6 1.54	23-2 1.68	23-10 1.83	24-6 1.99	25-2 2.15	25-9 2.31	26-5 2.48		16.0	2x12
19-3 1.15	19-11 1.27	20-6 1.40	21-2 1.54	21-9 1.67	22-5 1.81	23-0 1.96	23-6 2.11	24-1 2.26	25-2 2.58	19.2	
17-2 1.03	17-9 1.14	18-4 1.25	18-11 1.37	19-6 1.50	20-0 1.62	20-6 1.75	21-1 1.89	21-7 2.02	22-6 2.30	24.0	

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

TABLE 2105-14 ALLOWABLE SPAN FOR HIGH SLOPE RAFTERS

Slope over 3 in 12 - 20 Lbs. Per Sq. Ft. Live Load
(Heavy Roof Covering)

DESIGN CRITERIA:
Strength - 15 lbs. per sq. ft. dead load plus 20 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 20 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300
2x4	12.0	3-5 0.05	4-2 0.09	4-10 0.14	5-5 0.20	5-11 0.26	6-5 0.33	6-10 0.40	7-3 0.48	7-8 0.56	8-0 0.65	8-4 0.74	8-8 0.83
	13.7	3-2 0.05	3-11 0.09	4-6 0.13	5-1 0.19	5-6 0.24	6-0 0.31	6-5 0.38	6-9 0.45	7-2 0.52	7-6 0.61	7-10 0.69	8-2 0.78
	16.0	2-11 0.04	3-7 0.08	4-2 0.12	4-8 0.17	5-1 0.23	5-6 0.28	5-11 0.35	6-3 0.41	6-7 0.49	6-11 0.56	7-3 0.64	7-6 0.72
	19.2	2-8 0.04	3-4 0.07	3-10 0.11	4-3 0.16	4-8 0.21	5-1 0.26	5-5 0.32	5-9 0.38	6-0 0.44	6-4 0.51	6-7 0.58	6-11 0.66
	24.0	2-5 0.04	2-11 0.07	3-5 0.10	3-10 0.14	4-2 0.18	4-6 0.23	4-10 0.28	5-1 0.34	5-5 0.40	5-8 0.46	5-11 0.52	6-2 0.59
2x6	12.0	5-4 0.05	6-7 0.09	7-7 0.14	8-6 0.20	9-4 0.26	10-0 0.33	10-9 0.40	11-5 0.48	12-0 0.56	12-7 0.65	13-2 0.74	13-8 0.83
	13.7	5-0 0.05	6-2 0.09	7-1 0.13	7-11 0.19	8-8 0.24	9-5 0.31	10-0 0.38	10-8 0.45	11-3 0.52	11-9 0.61	12-4 0.69	12-10 0.78
	16.0	4-8 0.04	5-8 0.08	6-7 0.12	7-4 0.17	8-1 0.23	8-8 0.28	9-4 0.35	9-10 0.41	10-5 0.49	10-11 0.56	11-5 0.64	11-10 0.72
	19.2	4-3 0.04	5-2 0.07	6-0 0.11	6-9 0.16	7-4 0.21	7-11 0.26	8-6 0.32	9-0 0.38	9-6 0.44	9-11 0.51	10-5 0.58	10-10 0.66
	24.0	3-10 0.04	4-8 0.07	5-4 0.10	6-0 0.14	6-7 0.18	7-1 0.23	7-7 0.28	8-1 0.34	8-6 0.40	8-11 0.46	9-4 0.52	9-8 0.59
2x8	12.0	7-1 0.05	8-8 0.09	10-0 0.14	11-2 0.20	12-3 0.26	13-3 0.33	14-2 0.40	15-0 0.48	15-10 0.56	16-7 0.65	17-4 0.74	18-0 0.83
	13.7	6-7 0.05	8-1 0.09	9-4 0.13	10-6 0.19	11-6 0.24	12-5 0.31	13-3 0.38	14-0 0.45	14-10 0.52	15-6 0.61	16-3 0.69	16-10 0.78
	16.0	6-2 0.04	7-6 0.08	8-8 0.12	9-8 0.17	10-7 0.23	11-6 0.28	12-3 0.35	13-0 0.41	13-8 0.49	14-4 0.56	15-0 0.64	15-7 0.72
	19.2	5-7 0.04	6-10 0.07	7-11 0.11	8-10 0.16	9-8 0.21	10-6 0.26	11-2 0.32	11-10 0.38	12-6 0.44	13-1 0.51	13-8 0.58	14-3 0.66
	24.0	5-0 0.04	6-2 0.07	7-1 0.10	7-11 0.14	8-8 0.18	9-4 0.23	10-0 0.28	10-7 0.34	11-2 0.40	11-9 0.46	12-3 0.52	12-9 0.59
2x10	12.0	9-0 0.05	11-1 0.09	12-9 0.14	14-3 0.20	15-8 0.26	16-11 0.33	18-1 0.40	19-2 0.48	20-2 0.56	21-2 0.65	22-1 0.74	23-0 0.83
	13.7	8-5 0.05	10-4 0.09	11-11 0.13	13-4 0.19	14-8 0.24	15-10 0.31	16-11 0.38	17-11 0.45	18-11 0.52	19-10 0.61	20-8 0.69	21-6 0.78
	16.0	7-10 0.04	9-7 0.08	11-1 0.12	12-4 0.17	13-6 0.23	14-8 0.28	15-8 0.35	16-7 0.41	17-6 0.49	18-4 0.56	19-2 0.64	19-11 0.72
	19.2	7-2 0.04	8-9 0.07	10-1 0.11	11-3 0.16	12-4 0.21	13-4 0.26	14-3 0.32	15-2 0.38	15-11 0.44	16-9 0.51	17-6 0.58	18-2 0.66
	24.0	6-5 0.04	7-10 0.07	9-0 0.10	10-1 0.14	11-1 0.18	11-11 0.23	12-9 0.28	13-6 0.34	14-3 0.40	15-0 0.46	15-8 0.52	16-3 0.59

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

TABLE 2105-14 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).												RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700	3000		
9-0 0.93	9-4 1.03	9-8 1.14	9-11 1.24	10-3 1.36	10-6 1.47	10-10 1.59	11-1 1.71	11-4 1.83	11-10 2.09	12-7 2.49		12.0	
8-5 0.87	8-9 0.96	9-0 1.06	9-4 1.16	9-7 1.27	9-10 1.37	10-1 1.48	10-4 1.60	10-7 1.71	11-1 1.95	11-9 2.33		13.7	
7-10 0.80	8-1 0.89	8-4 0.98	8-7 1.08	8-10 1.17	9-1 1.27	9-4 1.37	9-7 1.48	9-10 1.59	10-3 1.81	10-10 2.16	11-5 2.53	16.0	2x4
7-2 0.73	7-5 0.81	7-8 0.90	7-10 0.98	8-1 1.07	8-4 1.16	8-6 1.25	8-9 1.35	8-11 1.45	9-4 1.65	9-11 1.97	10-5 2.31	19.2	
6-5 0.66	6-7 0.73	6-10 0.80	7-0 0.88	7-3 0.96	7-5 1.04	7-8 1.12	7-10 1.21	8-0 1.29	8-4 1.48	8-10 1.76	9-4 2.06	24.0	
14-2 0.93	14-8 1.03	15-2 1.14	15-8 1.24	16-1 1.36	16-7 1.47	17-0 1.59	17-5 1.71	17-10 1.83	18-7 2.09	19-9 2.49		12.0	
13-3 0.87	13-9 0.96	14-2 1.06	14-8 1.16	15-1 1.27	15-6 1.37	15-11 1.48	16-3 1.60	16-8 1.71	17-5 1.95	18-5 2.33		13.7	
12-4 0.80	12-9 0.89	13-2 0.98	13-7 1.08	13-11 1.17	14-4 1.27	14-8 1.37	15-1 1.48	15-5 1.59	16-1 1.81	17-1 2.16	18-0 2.53	16.0	2x6
11-3 0.73	11-7 0.81	12-0 0.90	12-4 0.98	12-9 1.07	13-1 1.16	13-5 1.25	13-9 1.35	14-1 1.45	14-8 1.65	15-7 1.97	16-5 2.31	19.2	
10-0 0.66	10-5 0.73	10-9 0.80	11-1 0.88	11-5 0.96	11-8 1.04	12-0 1.12	12-4 1.21	12-7 1.29	13-2 1.48	13-11 1.76	14-8 2.06	24.0	
18-9 0.93	19-5 1.03	20-0 1.14	20-8 1.24	21-3 1.36	21-10 1.47	22-4 1.59	22-11 1.71	23-6 1.83	24-6 2.09	26-0 2.49		12.0	
17-6 0.87	18-2 0.96	18-9 1.06	19-4 1.16	19-10 1.27	20-5 1.37	20-11 1.48	21-5 1.60	21-11 1.71	22-11 1.95	24-4 2.33		13.7	
16-3 0.80	16-9 0.89	17-4 0.98	17-10 1.08	18-5 1.17	18-11 1.27	19-5 1.37	19-10 1.48	20-4 1.59	21-3 1.81	22-6 2.16	23-9 2.53	16.0	2x8
14-10 0.73	15-4 0.81	15-10 0.90	16-4 0.98	16-9 1.07	17-3 1.16	17-8 1.25	18-2 1.35	18-7 1.45	19-5 1.65	20-7 1.97	21-8 2.31	19.2	
13-3 0.66	13-8 0.73	14-2 0.80	14-7 0.88	15-0 0.96	15-5 1.04	15-10 1.12	16-3 1.21	16-7 1.29	17-4 1.48	18-5 1.76	19-5 2.06	24.0	
23-11 0.93	24-9 1.03	25-6 1.14	26-4 1.24	27-1 1.36	27-10 1.47	28-7 1.59	29-3 1.71	29-11 1.83	31-3 2.09	33-2 2.49		12.0	
22-4 0.87	23-2 0.96	23-11 1.06	24-7 1.16	25-4 1.27	26-0 1.37	26-8 1.48	27-4 1.60	28-0 1.71	29-3 1.95	31-0 2.33		13.7	
20-8 0.80	21-5 0.89	22-1 0.98	22-10 1.08	23-5 1.17	24-1 1.27	24-9 1.37	25-4 1.48	25-11 1.59	27-1 1.81	28-9 2.16	30-3 2.53	16.0	2x10
18-11 0.73	19-7 0.81	20-2 0.90	20-10 0.98	21-5 1.07	22-0 1.16	22-7 1.25	23-2 1.35	23-8 1.45	24-9 1.65	26-3 1.97	27-8 2.31	19.2	
16-11 0.66	17-6 0.73	18-1 0.80	18-7 0.88	19-2 0.96	19-8 1.04	20-2 1.12	20-8 1.21	21-2 1.29	22-1 1.48	23-5 1.76	24-9 2.06	24.0	

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

TABLE 2105-15

ALLOWABLE SPAN FOR HIGH SLOPE RAFTERS

Slope over 3 in 12 - 30 Lbs. Per Sq. Ft. Live Load
(Heavy Roof Covering)

DESIGN CRITERIA:
Strength - 15 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300
2x4	12.0	3-0 0.05	3-8 0.09	4-3 0.15	4-9 0.20	5-3 0.27	5-8 0.34	6-0 0.41	6-5 0.49	6-9 0.58	7-1 0.67	7-5 0.76	7-8 0.86
	13.7	2-10 0.05	3-5 0.09	4-0 0.14	4-5 0.19	4-11 0.25	5-3 0.32	5-8 0.39	6-0 0.46	6-4 0.54	6-7 0.62	6-11 0.71	7-2 0.80
	16.0	2-7 0.04	3-2 0.08	3-8 0.13	4-1 0.18	4-6 0.23	4-11 0.29	5-3 0.36	5-6 0.43	5-10 0.50	6-1 0.58	6-5 0.66	6-8 0.74
	19.2	2-5 0.04	2-11 0.08	3-4 0.12	3-9 0.16	4-1 0.21	4-5 0.27	4-9 0.33	5-1 0.39	5-4 0.46	5-7 0.53	5-10 0.60	6-1 0.68
	24.0	2-2 0.04	2-7 0.07	3-0 0.10	3-4 0.14	3-8 0.19	4-0 0.24	4-3 0.29	4-6 0.35	4-9 0.41	5-0 0.47	5-3 0.54	5-5 0.61
2x6	12.0	4-9 0.05	5-10 0.09	6-8 0.15	7-6 0.20	8-2 0.27	8-10 0.34	9-6 0.41	10-0 0.49	10-7 0.58	11-1 0.67	11-7 0.76	12-1 0.86
	13.7	4-5 0.05	5-5 0.09	6-3 0.14	7-0 0.19	7-8 0.25	8-3 0.32	8-10 0.39	9-5 0.46	9-11 0.54	10-5 0.62	10-10 0.71	11-3 0.80
	16.0	4-1 0.04	5-0 0.08	5-10 0.13	6-6 0.18	7-1 0.23	7-8 0.29	8-2 0.36	8-8 0.43	9-2 0.50	9-7 0.58	10-0 0.66	10-5 0.74
	19.2	3-9 0.04	4-7 0.08	5-4 0.12	5-11 0.16	6-6 0.21	7-0 0.27	7-6 0.33	7-11 0.39	8-4 0.46	8-9 0.53	9-2 0.60	9-6 0.68
	24.0	3-4 0.04	4-1 0.07	4-9 0.10	5-4 0.14	5-10 0.19	6-3 0.24	6-8 0.29	7-1 0.35	7-6 0.41	7-10 0.47	8-2 0.54	8-6 0.61
2x8	12.0	6-3 0.05	7-8 0.09	8-10 0.15	9-10 0.20	10-10 0.27	11-8 0.34	12-6 0.41	13-3 0.49	13-11 0.58	14-8 0.67	15-3 0.76	15-11 0.86
	13.7	5-10 0.05	7-2 0.09	8-3 0.14	9-3 0.19	10-1 0.25	10-11 0.32	11-8 0.39	12-5 0.46	13-1 0.54	13-8 0.62	14-4 0.71	14-11 0.80
	16.0	5-5 0.04	6-7 0.08	7-8 0.13	8-7 0.18	9-4 0.23	10-1 0.29	10-10 0.36	11-6 0.43	12-1 0.50	12-8 0.58	13-3 0.66	13-9 0.74
	19.2	4-11 0.04	6-1 0.08	7-0 0.12	7-10 0.16	8-7 0.21	9-3 0.27	9-10 0.33	10-6 0.39	11-0 0.46	11-7 0.53	12-1 0.60	12-7 0.68
	24.0	4-5 0.04	5-5 0.07	6-3 0.10	7-0 0.14	7-8 0.19	8-3 0.24	8-10 0.29	9-4 0.35	9-10 0.41	10-4 0.47	10-10 0.54	11-3 0.61
2x10	12.0	8-0 0.05	9-9 0.09	11-3 0.15	12-7 0.20	13-9 0.27	14-11 0.34	15-11 0.41	16-11 0.49	17-10 0.58	18-8 0.67	19-6 0.76	20-4 0.86
	13.7	7-5 0.05	9-1 0.09	10-6 0.14	11-9 0.19	12-11 0.25	13-11 0.32	14-11 0.39	15-10 0.46	16-8 0.54	17-6 0.62	18-3 0.71	19-0 0.80
	16.0	6-11 0.04	8-5 0.08	9-9 0.13	10-11 0.18	11-11 0.23	12-11 0.29	13-9 0.36	14-8 0.43	15-5 0.50	16-2 0.58	16-11 0.66	17-7 0.74
	19.2	6-4 0.04	7-8 0.08	8-11 0.12	9-11 0.16	10-11 0.21	11-9 0.27	12-7 0.33	13-4 0.39	14-1 0.46	14-9 0.53	15-5 0.60	16-1 0.68
	24.0	5-8 0.04	6-11 0.07	8-0 0.10	8-11 0.14	9-9 0.19	10-6 0.24	11-3 0.29	11-11 0.35	12-7 0.41	13-2 0.47	13-9 0.54	14-4 0.61

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

TABLE 2105-15 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).												RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700	3000		
8-0 0.96	8-3 1.06	8-6 1.17	8-9 1.28	9-0 1.39	9-3 1.51	9-6 1.63	9-9 1.76	10-0 1.88	10-5 2.15	11-1 2.56		12.0	
7-5 0.89	7-9 0.99	8-0 1.09	8-3 1.20	8-5 1.30	8-8 1.41	8-11 1.53	9-2 1.64	9-4 1.76	9-9 2.01	10-4 2.40		13.7	
6-11 0.83	7-2 0.92	7-5 1.01	7-7 1.11	7-10 1.21	8-0 1.31	8-3 1.41	8-5 1.52	8-8 1.63	9-0 1.86	9-7 2.22	10-1 2.60	16.0	2x4
6-4 0.76	6-6 0.84	6-9 0.92	6-11 1.01	7-2 1.10	7-4 1.20	7-6 1.29	7-9 1.39	7-11 1.49	8-3 1.70	8-9 2.03	9-3 2.37	19.2	
5-8 0.68	5-10 0.75	6-0 0.83	6-3 0.90	6-5 0.99	6-7 1.07	6-9 1.15	6-11 1.24	7-1 1.33	7-5 1.52	7-10 1.81	8-3 2.12	24.0	
12-6 0.96	13-0 1.06	13-5 1.17	13-10 1.28	14-2 1.39	14-7 1.51	15-0 1.63	15-4 1.76	15-8 1.88	16-5 2.15	17-5 2.56		12.0	
11-9 0.89	12-2 0.99	12-6 1.09	12-11 1.20	13-3 1.30	13-8 1.41	14-0 1.53	14-4 1.64	14-8 1.76	15-4 2.01	16-3 2.40		13.7	
10-10 0.83	11-3 0.92	11-7 1.01	11-11 1.11	12-4 1.21	12-8 1.31	13-0 1.41	13-3 1.52	13-7 1.63	14-2 1.86	15-1 2.22	15-11 2.60	16.0	2x6
9-11 0.76	10-3 0.84	10-7 0.92	10-11 1.01	11-3 1.10	11-6 1.20	11-10 1.29	12-2 1.39	12-5 1.49	13-0 1.70	13-9 2.03	14-6 2.37	19.2	
8-10 0.68	9-2 0.75	9-6 0.83	9-9 0.90	10-0 0.99	10-4 1.07	10-7 1.15	10-10 1.24	11-1 1.33	11-7 1.52	12-4 1.81	13-0 2.12	24.0	
16-6 0.96	17-1 1.06	17-8 1.17	18-2 1.28	18-9 1.39	19-3 1.51	19-9 1.63	20-3 1.76	20-8 1.88	21-7 2.15	22-11 2.56		12.0	
15-5 0.89	16-0 0.99	16-6 1.09	17-0 1.20	17-6 1.30	18-0 1.41	18-5 1.53	18-11 1.64	19-4 1.76	20-3 2.01	21-5 2.40		13.7	
14-4 0.83	14-10 0.92	15-3 1.01	15-9 1.11	16-3 1.21	16-8 1.31	17-1 1.41	17-6 1.52	17-11 1.63	18-9 1.86	19-10 2.22	20-11 2.60	16.0	2x8
13-1 0.76	13-6 0.84	13-11 0.92	14-5 1.01	14-10 1.10	15-2 1.20	15-7 1.29	16-0 1.39	16-4 1.49	17-1 1.70	18-2 2.03	19-1 2.37	19.2	
11-8 0.68	12-1 0.75	12-6 0.83	12-10 0.90	13-3 0.99	13-7 1.07	13-11 1.15	14-4 1.24	14-8 1.33	15-3 1.52	16-3 1.81	17-1 2.12	24.0	
21-1 0.96	21-10 1.06	22-6 1.17	23-3 1.28	23-11 1.39	24-6 1.51	25-2 1.63	25-10 1.76	26-5 1.88	27-7 2.15	29-3 2.56		12.0	
19-8 0.89	20-5 0.99	21-1 1.09	21-9 1.20	22-4 1.30	22-11 1.41	23-7 1.53	24-2 1.64	24-8 1.76	25-10 2.01	27-4 2.40		13.7	
18-3 0.83	18-11 0.92	19-6 1.01	20-1 1.11	20-8 1.21	21-3 1.31	21-10 1.41	22-4 1.52	22-10 1.63	23-11 1.86	25-4 2.22	26-8 2.60	16.0	2x10
16-8 0.76	17-3 0.84	17-10 0.92	18-4 1.01	18-11 1.10	19-5 1.20	19-11 1.29	20-5 1.39	20-10 1.49	21-10 1.70	23-2 2.03	24-5 2.37	19.2	
14-11 0.68	15-5 0.75	15-11 0.83	16-5 0.90	16-11 0.99	17-4 1.07	17-10 1.15	18-3 1.24	18-8 1.33	19-6 1.52	20-8 1.81	21-10 2.12	24.0	

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

TABLE 2105-16

ALLOWABLE SPAN FOR HIGH SLOPE RAFTERS

Slope over 3 in 12 - 40 Lbs. Per Sq. Ft. Live Load
(Heavy Roof Covering)

DESIGN CRITERIA:
Strength - 15 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300
2x4	12.0	2-9 0.05	3-4 0.09	3-10 0.14	4-4 0.20	4-9 0.26	5-1 0.33	5-5 0.41	5-9 0.49	6-1 0.57	6-5 0.66	6-8 0.75	6-11 0.84
	13.7	2-7 0.05	3-1 0.09	3-7 0.13	4-0 0.19	4-5 0.25	4-9 0.31	5-1 0.38	5-5 0.46	5-8 0.53	6-0 0.61	6-3 0.70	6-6 0.79
	16.0	2-4 0.04	2-11 0.08	3-4 0.12	3-9 0.17	4-1 0.23	4-5 0.29	4-9 0.35	5-0 0.42	5-3 0.49	5-6 0.57	5-9 0.65	6-0 0.73
	19.2	2-2 0.04	2-8 0.07	3-1 0.11	3-5 0.16	3-9 0.21	4-0 0.26	4-4 0.32	4-7 0.38	4-10 0.45	5-1 0.52	5-3 0.59	5-6 0.67
	24.0	1-11 0.04	2-4 0.07	2-9 0.10	3-1 0.14	3-4 0.19	3-7 0.24	3-10 0.29	4-1 0.34	4-4 0.40	4-6 0.46	4-9 0.53	4-11 0.60
2x6	12.0	4-3 0.05	5-3 0.09	6-1 0.14	6-9 0.20	7-5 0.26	8-0 0.33	8-7 0.41	9-1 0.49	9-7 0.57	10-0 0.66	10-6 0.75	10-11 0.84
	13.7	4-0 0.05	4-11 0.09	5-8 0.13	6-4 0.19	6-11 0.25	7-6 0.31	8-0 0.38	8-6 0.46	8-11 0.53	9-5 0.61	9-10 0.70	10-3 0.79
	16.0	3-8 0.04	4-6 0.08	5-3 0.12	5-10 0.17	6-5 0.23	6-11 0.29	7-5 0.35	7-10 0.42	8-3 0.49	8-8 0.57	9-1 0.65	9-5 0.73
	19.2	3-5 0.04	4-2 0.07	4-9 0.11	5-4 0.16	5-10 0.21	6-4 0.26	6-9 0.32	7-2 0.38	7-7 0.45	7-11 0.52	8-3 0.59	8-8 0.67
	24.0	3-0 0.04	3-8 0.07	4-3 0.10	4-9 0.14	5-3 0.19	5-8 0.24	6-1 0.29	6-5 0.34	6-9 0.40	7-1 0.46	7-5 0.53	7-9 0.60
2x8	12.0	5-8 0.05	6-11 0.09	8-0 0.14	8-11 0.20	9-9 0.26	10-7 0.33	11-3 0.41	12-0 0.49	12-7 0.57	13-3 0.66	13-10 0.75	14-5 0.84
	13.7	5-3 0.05	6-6 0.09	7-6 0.13	8-4 0.19	9-2 0.25	9-11 0.31	10-7 0.28	11-2 0.46	11-10 0.53	12-5 0.61	12-11 0.70	13-6 0.79
	16.0	4-11 0.04	6-0 0.08	6-11 0.12	7-9 0.17	8-6 0.23	9-2 0.29	9-9 0.35	10-4 0.42	10-11 0.49	11-6 0.57	12-0 0.65	12-6 0.73
	19.2	4-6 0.04	5-6 0.07	6-4 0.11	7-1 0.16	7-9 0.21	8-4 0.26	8-11 0.32	9-6 0.38	10-0 0.45	10-6 0.52	10-11 0.59	11-5 0.67
	24.0	4-0 0.04	4-11 0.07	5-8 0.10	6-4 0.14	6-11 0.19	7-6 0.24	8-0 0.29	8-6 0.34	8-11 0.40	9-4 0.46	9-9 0.53	10-2 0.60
2x10	12.0	7-2 0.05	8-10 0.09	10-2 0.14	11-5 0.20	12-6 0.26	13-6 0.33	14-5 0.41	15-3 0.49	16-1 0.57	16-11 0.66	17-8 0.75	18-4 0.84
	13.7	6-9 0.05	8-3 0.09	9-6 0.13	10-8 0.19	11-8 0.25	12-7 0.31	13-6 0.38	14-3 0.46	15-1 0.53	15-10 0.61	16-6 0.70	17-2 0.79
	16.0	6-3 0.04	7-8 0.08	8-10 0.12	9-10 0.17	10-10 0.23	11-8 0.29	12-6 0.35	13-3 0.42	13-11 0.49	14-8 0.57	15-3 0.65	15-11 0.73
	19.2	5-8 0.04	7-0 0.07	8-1 0.11	9-0 0.16	9-10 0.21	10-8 0.26	11-5 0.32	12-1 0.38	12-9 0.45	13-4 0.52	13-11 0.59	14-6 0.67
	24.0	5-1 0.04	6-3 0.07	7-2 0.10	8-1 0.14	8-10 0.19	9-6 0.24	10-2 0.29	10-10 0.34	11-5 0.40	11-11 0.46	12-6 0.53	13-0 0.60

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

TABLE 2105-16 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).												RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700	3000		
7-3 0.94	7-6 1.05	7-8 1.15	7-11 1.26	8-2 1.38	8-5 1.49	8-7 1.61	8-10 1.73	9-0 1.86	9-5 2.12	10-0 2.53		12.0	
6-9 0.88	7-0 0.98	7-3 1.08	7-5 1.18	7-8 1.29	7-10 1.40	8-1 1.51	8-3 1.62	8-5 1.74	8-10 1.98	9-4 2.36		13.7	
6-3 0.82	6-6 0.91	6-8 1.00	6-11 1.09	7-1 1.19	7-3 1.29	7-6 1.40	7-8 1.50	7-10 1.61	8-2 1.83	8-8 2.19	9-2 2.56	16.0	2x4
5-8 0.75	5-11 0.83	6-1 0.91	6-3 1.00	6-6 1.09	6-8 1.18	6-10 1.27	7-0 1.37	7-2 1.47	7-6 1.67	7-11 2.00	8-4 2.34	19.2	
5-1 0.67	5-3 0.74	5-5 0.82	5-7 0.89	5-9 0.97	5-11 1.06	6-1 1.14	6-3 1.23	6-5 1.31	6-8 1.50	7-1 1.79	7-6 2.09	24.0	
11-4 0.94	11-9 1.05	12-1 1.15	12-6 1.26	12-10 1.38	13-2 1.49	13-6 1.61	13-10 1.73	14-2 1.86	14-10 2.12	15-9 2.53		12.0	
10-7 0.88	11-0 0.98	11-4 1.08	11-8 1.18	12-0 1.29	12-4 1.40	12-8 1.51	13-0 1.62	13-3 1.74	13-10 1.98	14-9 2.36		13.7	
9-10 0.82	10-2 0.91	10-6 1.00	10-10 1.09	11-1 1.19	11-5 1.29	11-9 1.40	12-0 1.50	12-4 1.61	12-10 1.83	13-7 2.19	14-4 2.56	16.0	2x6
8-11 0.75	9-3 0.83	9-7 0.91	9-10 1.00	10-2 1.09	10-5 1.18	10-8 1.27	11-0 1.37	11-3 1.47	11-9 1.67	12-5 2.00	13-1 2.34	19.2	
8-0 0.67	8-3 0.74	8-7 0.82	8-10 0.89	9-1 0.97	9-4 1.06	9-7 1.14	9-10 1.23	10-0 1.31	10-6 1.50	11-1 1.79	11-9 2.09	24.0	
14-11 0.94	15-5 1.05	16-0 1.15	16-5 1.26	16-11 1.38	17-5 1.49	17-10 1.61	18-3 1.73	18-9 1.86	19-7 2.12	20-9 2.53		12.0	
14-0 0.88	14-6 0.98	14-11 1.08	15-5 1.18	15-10 1.29	16-3 1.40	16-8 1.51	17-1 1.62	17-6 1.74	18-3 1.98	19-5 2.36		13.7	
12-11 0.82	13-5 0.91	13-10 1.00	14-3 1.09	14-8 1.19	15-1 1.29	15-5 1.40	15-10 1.50	16-3 1.61	16-11 1.83	18-0 2.19	18-11 2.56	16.0	2x8
11-10 0.75	12-3 0.83	12-7 0.91	13-0 1.00	13-5 1.09	13-9 1.18	14-1 1.27	14-6 1.37	14-10 1.47	15-5 1.67	16-5 2.00	17-3 2.34	19.2	
10-7 0.67	10-11 0.74	11-3 0.82	11-8 0.89	12-0 0.97	12-4 1.06	12-7 1.14	12-11 1.23	13-3 1.31	13-10 1.50	14-8 1.79	15-5 2.09	24.0	
19-1 0.94	19-9 1.05	20-4 1.15	21-0 1.26	21-7 1.38	22-2 1.49	22-9 1.61	23-4 1.73	23-11 1.86	24-11 2.12	26-6 2.53		12.0	
17-10 0.88	18-5 0.98	19-1 1.08	19-8 1.18	20-2 1.29	20-9 1.40	21-4 1.51	21-10 1.62	22-4 1.74	23-4 1.98	24-9 2.36		13.7	
16-6 0.82	17-1 0.91	17-8 1.00	18-2 1.09	18-9 1.19	19-3 1.29	19-9 1.40	20-2 1.50	20-8 1.61	21-7 1.83	22-11 2.19	24-2 2.56	16.0	2x10
15-1 0.75	15-7 0.83	16-1 0.91	16-7 1.00	17-1 1.09	17-7 1.18	18-0 1.27	18-5 1.37	18-11 1.47	19-9 1.67	20-11 2.00	22-1 2.34	19.2	
13-6 0.67	13-11 0.74	14-5 0.82	14-10 0.89	15-3 0.97	15-8 1.06	16-1 1.14	16-6 1.23	16-11 1.31	17-8 1.50	18-9 1.79	19-9 2.09	24.0	

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

TABLE 2105-17

ALLOWABLE SPAN FOR HIGH SLOPE RAFTERS

Slope over 3 in 12 - 20 Lbs. Per Sq. Ft. Live Load
(Light Roof Covering)

DESIGN CRITERIA:
Strength - 7 lbs. per sq. ft. dead load plus 20 lbs. per sq. ft. live load determines fiber stress
Deflection - For 20 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300
2x4	12.0	3-11 0.07	4-9 0.14	5-6 0.21	6-2 0.29	6-9 0.38	7-3 0.49	7-9 0.59	8-3 0.71	8-8 0.83	9-1 0.96	9-6 1.09	9-11 1.23
	13.7	3-8 0.07	4-5 0.13	5-2 0.20	5-9 0.27	6-4 0.36	6-10 0.45	7-3 0.55	7-9 0.66	8-2 0.77	8-6 0.89	8-11 1.02	9-3 1.15
	16.0	3-4 0.06	4-1 0.12	4-9 0.18	5-4 0.25	5-10 0.33	6-4 0.42	6-9 0.51	7-2 0.61	7-6 0.72	7-11 0.83	8-3 0.94	8-7 1.06
	19.2	3-1 0.06	3-9 0.11	4-4 0.17	4-10 0.23	5-4 0.30	5-9 0.38	6-2 0.47	6-6 0.56	6-10 0.65	7-3 0.76	7-6 0.86	7-10 0.97
	24.0	2-9 0.05	3-4 0.10	3-11 0.15	4-4 0.21	4-9 0.27	5-2 0.34	5-6 0.42	5-10 0.50	6-2 0.59	6-5 0.68	6-9 0.77	7-0 0.87
2x6	12.0	6-1 0.07	7-6 0.14	8-8 0.21	9-8 0.29	10-7 0.38	11-5 0.49	12-3 0.59	13-0 0.71	13-8 0.83	14-4 0.96	15-0 1.09	15-7 1.23
	13.7	5-9 0.07	7-0 0.13	8-1 0.20	9-0 0.27	9-11 0.36	10-8 0.45	11-5 0.55	12-2 0.66	12-9 0.77	13-5 0.89	14-0 1.02	14-7 1.15
	16.0	5-4 0.06	6-6 0.12	7-6 0.18	8-4 0.25	9-2 0.33	9-11 0.42	10-7 0.51	11-3 0.61	11-10 0.72	12-5 0.83	13-0 0.94	13-6 1.06
	19.2	4-10 0.06	5-11 0.11	6-10 0.17	7-8 0.23	8-4 0.30	9-0 0.38	9-8 0.47	10-3 0.56	10-10 0.65	11-4 0.76	11-10 0.86	12-4 0.97
	24.0	4-4 0.05	5-4 0.10	6-1 0.15	6-10 0.21	7-6 0.27	8-1 0.34	8-8 0.42	9-2 0.50	9-8 0.59	10-2 0.68	10-7 0.77	11-0 0.87
2x8	12.0	8-1 0.07	9-10 0.14	11-5 0.21	12-9 0.29	13-11 0.38	15-1 0.49	16-1 0.59	17-1 0.71	18-0 0.83	18-11 0.96	19-9 1.09	20-6 1.23
	13.7	7-6 0.07	9-3 0.13	10-8 0.20	11-11 0.27	13-1 0.36	14-1 0.45	15-1 0.55	16-0 0.66	16-10 0.77	17-8 0.89	18-5 1.02	19-3 1.15
	16.0	7-0 0.06	8-7 0.12	9-10 0.18	11-0 0.25	12-1 0.33	13-1 0.42	13-11 0.51	14-10 0.61	15-7 0.72	16-4 0.83	17-1 0.94	17-9 1.06
	19.2	6-4 0.06	7-10 0.11	9-0 0.17	10-1 0.23	11-0 0.30	11-11 0.38	12-9 0.47	13-6 0.56	14-3 0.65	14-11 0.76	15-7 0.86	16-3 0.97
	24.0	5-8 0.05	7-0 0.10	8-1 0.15	9-0 0.21	9-10 0.27	10-8 0.34	11-5 0.42	12-1 0.50	12-9 0.59	13-4 0.68	13-11 0.77	14-6 0.87
2x10	12.0	10-3 0.07	12-7 0.14	14-6 0.21	16-3 0.29	17-10 0.38	19-3 0.49	20-7 0.59	21-10 0.71	23-0 0.83	24-1 0.96	25-2 1.09	26-2 1.23
	13.7	9-7 0.07	11-9 0.13	13-7 0.20	15-2 0.27	16-8 0.36	18-0 0.45	19-3 0.55	20-5 0.66	21-6 0.77	22-7 0.89	23-7 1.02	24-6 1.15
	16.0	8-11 0.06	10-11 0.12	12-7 0.18	14-1 0.25	15-5 0.33	16-8 0.42	17-10 0.51	18-11 0.61	19-11 0.72	20-10 0.83	21-10 0.94	22-8 1.06
	19.2	8-2 0.06	9-11 0.11	11-6 0.17	12-10 0.23	14-1 0.30	15-2 0.38	16-3 0.47	17-3 0.56	18-2 0.65	19-1 0.76	19-11 0.86	20-9 0.97
	24.0	7-3 0.05	8-11 0.10	10-3 0.15	11-6 0.21	12-7 0.27	13-7 0.34	14-6 0.42	15-5 0.50	16-3 0.59	17-1 0.68	17-10 0.77	18-6 0.87

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

TABLE 2105-17 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square. Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											RAFTER SPACING SIZE	
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700	(IN)	(IN)
10-3 1.37	10-8 1.52	11-0 1.68	11-4 1.84	11-8 2.00	12-0 2.17	12-4 2.34	12-7 2.52				12.0	
9-7 1.28	10-0 1.42	10-3 1.57	10-7 1.72	10-11 1.87	11-3 2.03	11-6 2.19	11-9 2.36	12-1 2.53			13.7	
8-11 1.19	9-3 1.32	9-6 1.45	9-10 1.59	10-1 1.73	10-5 1.88	10-8 2.03	10-11 2.18	11-2 2.34			16.0	2x4
8-2 1.08	8-5 1.20	8-8 1.33	9-0 1.45	9-3 1.58	9-6 1.71	9-9 1.85	10-0 1.99	10-2 2.14	10-8 2.43		19.2	
7-3 0.97	7-6 1.08	7-9 1.19	8-0 1.30	8-3 1.41	8-6 1.53	8-8 1.66	8-11 1.78	9-1 1.91	9-6 2.18	10-1 2.60	24.0	
16-2 1.37	16-9 1.52	17-3 1.68	17-10 1.84	18-4 2.00	18-10 2.17	19-4 2.34	19-10 2.52				12.0	
15-1 1.28	15-8 1.42	16-2 1.57	16-8 1.72	17-2 1.87	17-7 2.03	18-1 2.19	18-6 2.36	19-0 2.53			13.7	
14-0 1.19	14-6 1.32	15-0 1.45	15-5 1.59	15-11 1.73	16-4 1.88	16-9 2.03	17-2 2.18	17-7 2.34			16.0	2x6
12-9 1.08	13-3 1.20	13-8 1.33	14-1 1.45	14-6 1.58	14-11 1.71	15-3 1.85	15-8 1.99	16-0 2.14	16-9 2.43		19.2	
11-5 0.97	11-10 1.08	12-3 1.19	12-7 1.30	13-0 1.41	13-4 1.53	13-8 1.66	14-0 1.78	14-4 1.91	15-0 2.18	15-11 2.60	24.0	
21-4 1.37	22-1 1.52	22-9 1.68	23-6 1.84	24-2 2.00	24-10 2.17	25-6 2.34	26-1 2.52				12.0	
19-11 1.28	20-8 1.42	21-4 1.57	22-0 1.72	22-7 1.87	23-3 2.03	23-10 2.19	24-5 2.36	25-0 2.53			13.7	
18-5 1.19	19-1 1.32	19-9 1.45	20-4 1.59	20-11 1.73	21-6 1.88	22-1 2.03	22-7 2.18	23-2 2.34			16.0	2x8
16-10 1.08	17-5 1.20	18-0 1.33	18-7 1.45	19-1 1.58	19-8 1.71	20-2 1.85	20-8 1.99	21-1 2.14	22-1 2.43		19.2	
15-1 0.97	15-7 1.08	16-1 1.19	16-7 1.30	17-1 1.41	17-7 1.53	18-0 1.66	18-5 1.78	18-11 1.91	19-9 2.18	20-11 2.60	24.0	
27-2 1.37	28-2 1.52	29-1 1.68	30-0 1.84	30-10 2.00	31-8 2.17	32-6 2.34	33-4 2.52				12.0	
25-5 1.28	26-4 1.42	27-2 1.57	28-0 1.72	28-10 1.87	29-8 2.03	30-5 2.19	31-2 2.36	31-11 2.53			13.7	
23-7 1.19	24-5 1.32	25-2 1.45	25-11 1.59	26-8 1.73	27-5 1.88	28-2 2.03	28-10 2.18	29-6 2.34			16.0	2x10
21-6 1.08	22-3 1.20	23-0 1.33	23-8 1.45	24-5 1.58	25-1 1.71	25-8 1.85	26-4 1.99	26-11 2.14	28-2 2.43		19.2	
19-3 0.97	19-11 1.08	20-7 1.19	21-2 1.30	21-10 1.41	22-5 1.53	23-0 1.66	23-7 1.78	24-1 1.91	25-2 2.18	26-8 2.60	24.0	

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

TABLE 2105-18

ALLOWABLE SPAN FOR HIGH SLOPE RAFTERS

Slope over 3 in 12 - 30 Lbs. Per sq. Ft. Live Load
(Light Roof Covering)

DESIGN CRITERIA:
Strength - 7 lbs. per sq. ft. dead load plus 30 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 30 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300
2x4	12.0	3-4 0.07	4-1 0.13	4-8 0.20	5-3 0.27	5-9 0.36	6-3 0.45	6-8 0.55	7-1 0.66	7-5 0.77	7-9 0.89	8-2 1.02	8-6 1.15
	13.7	3-1 0.06	3-10 0.12	4-5 0.18	4-11 0.26	5-5 0.34	5-10 0.42	6-3 0.52	6-7 0.62	6-11 0.72	7-3 0.84	7-7 0.95	7-11 -1.07
	16.0	2-11 0.06	3-6 0.11	4-1 0.17	4-7 0.24	5-0 0.31	5-5 0.39	5-9 0.48	6-1 0.57	6-5 0.67	6-9 0.77	7-1 0.88	7-4 0.99
	19.2	2-8 0.05	3-3 0.10	3-9 0.15	4-2 0.22	4-7 0.28	4-11 0.36	5-3 0.44	5-7 0.52	5-10 0.61	6-2 0.71	6-5 0.80	6-8 0.91
	24.0	2-4 0.05	2-11 0.09	3-4 0.14	3-9 0.19	4-1 0.25	4-5 0.32	4-8 0.39	5-0 0.47	5-3 0.55	5-6 0.63	5-9 0.72	6-0 0.81
2x6	12.0	5-3 0.07	6-5 0.13	7-5 0.20	8-3 0.27	9-1 0.36	9-9 0.45	10-5 0.55	11-1 0.66	11-8 0.77	12-3 0.89	12-9 1.02	13-4 1.15
	13.7	4-11 0.06	6-0 0.12	6-11 0.18	7-9 0.26	8-5 0.34	9-2 0.42	9-9 0.52	10-4 0.62	10-11 0.72	11-5 0.84	12-0 0.95	12-5 1.07
	16.0	4-6 0.06	5-6 0.11	6-5 0.17	7-2 0.24	7-10 0.31	8-5 0.39	9-1 0.48	9-7 0.57	10-1 0.67	10-7 0.77	11-1 0.88	11-6 0.99
	19.2	4-2 0.05	5-1 0.10	5-10 0.15	6-6 0.22	7-2 0.28	7-9 0.36	8-3 0.44	8-9 0.52	9-3 0.61	9-8 0.71	10-1 0.80	10-6 0.91
	24.0	3-8 0.05	4-6 0.09	5-3 0.14	5-10 0.19	6-5 0.25	6-11 0.32	7-5 0.39	7-10 0.47	8-3 0.55	8-8 0.63	9-1 0.72	9-5 0.81
2x8	12.0	6-11 0.07	8-5 0.13	9-9 0.20	10-11 0.27	11-11 0.36	12-10 0.45	13-9 0.55	14-7 0.66	15-5 0.77	16-2 0.89	16-10 1.02	17-7 1.15
	13.7	6-5 0.06	7-11 0.12	9-1 0.18	10-2 0.26	11-2 0.34	12-1 0.42	12-10 0.52	13-8 0.62	14-5 0.72	15-1 0.84	15-9 0.95	16-5 1.07
	16.0	6-0 0.06	7-4 0.11	8-5 0.17	9-5 0.24	10-4 0.31	11-2 0.39	11-11 0.48	12-8 0.57	13-4 0.67	14-0 0.77	14-7 0.88	15-2 0.99
	19.2	5-5 0.05	6-8 0.10	7-8 0.15	8-7 0.22	9-5 0.28	10-2 0.36	10-11 0.44	11-6 0.52	12-2 0.61	12-9 0.71	13-4 0.80	13-10 0.91
	24.0	4-10 0.05	6-0 0.09	6-11 0.14	7-8 0.19	8-5 0.25	9-1 0.32	9-9 0.39	10-4 0.47	10-11 0.55	11-5 0.63	11-11 0.72	12-5 0.81
2x10	12.0	8-9 0.07	10-9 0.13	12-5 0.20	13-11 0.27	15-2 0.36	16-5 0.45	17-7 0.55	18-7 0.66	19-8 0.77	20-7 0.89	21-6 1.02	22-5 1.15
	13.7	8-3 0.06	10-1 0.12	11-7 0.18	13-0 0.26	14-3 0.34	15-4 0.42	16-5 0.52	17-5 0.62	18-4 0.72	19-3 0.84	20-1 0.95	20-11 1.07
	16.0	7-7 0.07	9-4 0.12	10-9 0.19	12-0 0.26	13-2 0.34	14-3 0.43	15-2 0.53	16-2 0.63	17-0 0.74	17-10 0.85	18-7 0.97	19-5 1.09
	19.2	6-11 0.05	8-6 0.10	9-10 0.15	11-0 0.22	12-0 0.28	13-0 0.36	13-11 0.44	14-9 0.52	15-6 0.61	16-3 0.71	17-0 0.80	17-8 0.91
	24.0	6-2 0.05	7-7 0.09	8-9 0.14	9-10 0.19	10-9 0.25	11-7 0.32	12-5 0.39	13-2 0.47	13-11 0.55	14-7 0.63	15-2 0.72	15-10 0.81

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

TABLE 2105-18 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700		
8-9 1.28	9-1 1.42	9-5 1.57	9-8 1.72	10-0 1.87	10-3 2.03	10-6 2.19	10-9 2.36	11-0 2.53			12.0	
8-3 1.20	8-6 1.33	8-9 1.47	9-1 1.61	9-4 1.75	9-7 1.90	9-10 2.05	10-1 2.20	10-4 2.36			13.7	
7-7 1.11	7-11 1.23	8-2 1.36	8-5 1.49	8-8 1.62	8-10 1.76	9-1 1.90	9-4 2.04	9-7 2.19	10-0 2.49		16.0	2x4
6-11 1.01	7-2 1.12	7-5 1.24	7-8 1.36	7-11 1.48	8-1 1.60	8-4 1.73	8-6 1.86	8-9 2.00	9-1 2.28		19.2	
6-3 0.91	6-5 1.01	6-8 1.11	6-10 1.21	7-1 1.32	7-3 1.43	7-5 1.55	7-7 1.67	7-9 1.79	8-2 2.04	8-8 2.43	24.0	
13-10 1.28	14-4 1.42	14-9 1.57	15-3 1.72	15-8 1.87	16-1 2.03	16-6 2.19	16-11 2.36	17-4 2.53			12.0	
12-11 1.20	13-4 1.33	13-10 1.47	14-3 1.61	14-8 1.75	15-1 1.90	15-5 2.05	15-10 2.20	16-2 2.36			13.7	
12-0 1.11	12-5 1.23	12-9 1.36	13-2 1.49	13-7 1.62	13-11 1.76	14-4 1.90	14-8 2.04	15-0 2.19	15-8 2.49		16.0	2x6
10-11 1.01	11-4 1.12	11-8 1.24	12-0 1.36	12-5 1.48	12-9 1.60	13-1 1.73	13-4 1.86	13-8 2.00	14-4 2.28		19.2	
9-9 0.91	10-1 1.01	10-5 1.11	10-9 1.21	11-1 1.32	11-5 1.43	11-8 1.55	12-0 1.67	12-3 1.79	12-9 2.04	13-7 2.43	24.0	
18-2 1.28	18-10 1.42	19-6 1.57	20-1 1.72	20-8 1.87	21-3 2.03	21-9 2.19	22-4 2.36	22-10 2.53			12.0	
17-0 1.20	17-8 1.33	18-2 1.47	18-9 1.61	19-4 1.75	19-10 1.90	20-4 2.05	20-10 2.20	21-4 2.36			13.7	
15-9 1.11	16-4 1.23	16-10 1.36	17-4 1.49	17-11 1.62	18-4 1.76	18-10 1.90	19-4 2.04	19-9 2.19	20-8 2.49		16.0	2x8
14-5 1.01	14-11 1.12	15-5 1.24	15-10 1.36	16-4 1.48	16-9 1.60	17-2 1.73	17-8 1.86	18-1 2.00	18-10 2.28		19.2	
12-10 0.91	13-4 1.01	13-9 1.11	14-2 1.21	14-7 1.32	15-0 1.43	15-5 1.55	15-9 1.67	16-2 1.79	16-10 2.04	17-11 2.43	24.0	
23-3 1.28	24-1 1.42	24-10 1.57	25-7 1.72	26-4 1.87	27-1 2.03	27-9 2.19	28-5 2.36	29-1 2.53			12.0	
21-9 1.20	22-6 1.33	23-3 1.47	23-11 1.61	24-8 1.75	25-4 1.90	26-0 2.05	26-7 2.20	27-3 2.36			13.7	
20-1 1.22	20-10 1.35	21-6 1.49	22-2 1.63	22-10 1.78	23-5 1.93	24-1 2.08	24-8 2.24	25-3 2.40			16.0	2x10
18-4 1.01	19-0 1.12	19-8 1.24	20-3 1.36	20-10 1.48	21-5 1.60	21-11 1.73	22-6 1.86	23-0 2.00	24-1 2.28		19.2	
16-5 0.91	17-0 1.01	17-7 1.11	18-1 1.21	18-7 1.32	19-2 1.43	19-8 1.55	20-1 1.67	20-7 1.79	21-6 2.04	22-10 2.43	24.0	

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

TABLE 2105-19

ALLOWABLE SPAN FOR HIGH SLOPE RAFTERS

Slope over 3 in 12 - 40 Lbs. Per Sq. Ft. Live Load
(Light Roof Covering)

DESIGN CRITERIA:
Strength - 7 lbs. per sq. ft. dead load plus 40 lbs. per sq. ft. live load determines fiber stress.
Deflection - For 40 lbs. per sq. ft. live load. Limited to span in inches divided by 180.

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

RAFTER SIZE (IN)	SPACING (IN)	Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											
		200	300	400	500	600	700	800	900	1000	1100	1200	1300
2x4	12.0	2-11 0.06	3-7 0.12	4-2 0.18	4-8 0.25	5-1 0.34	5-6 0.42	5-11 0.52	6-3 0.62	6-7 0.72	6-11 0.83	7-3 0.95	7-6 1.07
	13.7	2-9 0.06	3-5 0.11	3-11 0.17	4-4 0.24	4-9 0.31	5-2 0.40	5-6 0.48	5-10 0.58	6-2 0.67	6-6 0.78	6-9 0.89	7-0 1.00
	16.0	2-7 0.06	3-2 0.10	3-7 0.16	4-0 0.22	4-5 0.29	4-9 0.37	5-1 0.45	5-5 0.53	5-8 0.62	6-0 0.72	6-3 0.82	6-6 0.93
	19.2	2-4 0.05	2-10 0.09	3-4 0.14	3-8 0.20	4-0 0.26	4-4 0.33	4-8 0.41	4-11 0.49	5-3 0.57	5-6 0.66	5-8 0.75	5-11 0.85
	24.0	2-1 0.05	2-7 0.08	2-11 0.13	3-4 0.18	3-7 0.24	3-11 0.30	4-2 0.36	4-5 0.44	4-8 0.51	4-11 0.59	5-1 0.67	5-4 0.76
2x6	12.0	4-8 0.06	5-8 0.12	6-7 0.18	7-4 0.25	8-0 0.34	8-8 0.42	9-3 0.52	9-10 0.62	10-4 0.72	10-10 0.83	11-4 0.95	11-10 1.07
	13.7	4-4 0.06	5-4 0.11	6-2 0.17	6-10 0.24	7-6 0.31	8-1 0.40	8-8 0.48	9-2 0.58	9-8 0.67	10-2 0.78	10-7 0.89	11-1 1.00
	16.0	4-0 0.06	4-11 0.10	5-8 0.16	6-4 0.22	6-11 0.29	7-6 0.37	8-0 0.45	8-6 0.53	9-0 0.62	9-5 0.72	9-10 0.82	10-3 0.93
	19.2	3-8 0.05	4-6 0.09	5-2 0.14	5-9 0.20	6-4 0.26	6-10 0.33	7-4 0.41	7-9 0.49	8-2 0.57	8-7 0.66	9-0 0.75	9-4 0.85
	24.0	3-3 0.05	4-0 0.08	4-8 0.13	5-2 0.18	5-8 0.24	6-2 0.30	6-7 0.36	6-11 0.44	7-4 0.51	7-8 0.59	8-0 0.67	8-4 0.76
2x8	12.0	6-1 0.06	7-6 0.12	8-8 0.18	9-8 0.25	10-7 0.34	11-5 0.42	12-3 0.52	12-11 0.62	13-8 0.72	14-4 0.83	14-11 0.95	15-7 1.07
	13.7	5-9 0.06	7-0 0.11	8-1 0.17	9-0 0.24	9-11 0.31	10-8 0.40	11-5 0.48	12-1 0.58	12-9 0.67	13-5 0.78	14-0 0.89	14-7 1.00
	16.0	5-3 0.06	6-6 0.10	7-6 0.16	8-4 0.22	9-2 0.29	9-11 0.37	10-7 0.45	11-3 0.53	11-10 0.62	12-5 0.72	12-11 0.82	13-6 0.93
	19.2	4-10 0.05	5-11 0.09	6-10 0.14	7-8 0.20	8-4 0.26	9-0 0.33	9-8 0.41	10-3 0.49	10-10 0.57	11-4 0.66	11-10 0.75	12-4 0.85
	24.0	4-4 0.05	5-3 0.08	6-1 0.13	6-10 0.18	7-6 0.24	8-1 0.30	8-8 0.36	9-2 0.44	9-8 0.51	10-2 0.59	10-7 0.67	11-0 0.76
2x10	12.0	7-9 0.06	9-6 0.12	11-0 0.18	12-4 0.25	13-6 0.34	14-7 0.42	15-7 0.52	16-6 0.62	17-5 0.72	18-3 0.83	19-1 0.95	19-10 1.07
	13.7	7-3 0.06	8-11 0.11	10-4 0.17	11-6 0.24	12-7 0.31	13-8 0.40	14-7 0.48	15-5 0.58	16-4 0.67	17-1 0.78	17-10 0.89	18-7 1.00
	16.0	6-9 0.06	8-3 0.10	9-6 0.16	10-8 0.22	11-8 0.29	12-7 0.37	13-6 0.45	14-4 0.53	15-1 0.62	15-10 0.72	16-6 0.82	17-2 0.93
	19.2	6-2 0.05	7-7 0.09	8-9 0.14	9-9 0.20	10-8 0.26	11-6 0.33	12-4 0.41	13-1 0.49	13-9 0.57	14-5 0.66	15-1 0.75	15-8 0.85
	24.0	5-6 0.05	6-9 0.08	7-9 0.13	8-9 0.18	9-6 0.24	10-4 0.30	11-0 0.36	11-8 0.44	12-4 0.51	12-11 0.59	13-6 0.67	14-1 0.76

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

TABLE 2105-19 (Continued)

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

HOW TO USE TABLES: Enter table with span of rafters (upper figure in each square). Determine size and spacing (first column) based on stress grade (top row) and modulus of elasticity (lower figure in each square) of lumber to be used.

Allowable Extreme Fiber Stress in Bending, "F_b" (psi).											RAFTER SPACING (IN)	SIZE (IN)
1400	1500	1600	1700	1800	1900	2000	2100	2200	2400	2700		
7-10 1.19	8-1 1.32	8-4 1.46	8-7 1.60	8-10 1.74	9-1 1.89	9-4 2.04	9-7 2.19	9-9 2.35			12.0	
7-4 1.12	7-7 1.24	7-10 1.37	8-0 1.50	8-3 1.63	8-6 1.77	8-9 1.91	8-11 2.05	9-2 2.20	9-7 2.51		13.7	
6-9 1.03	7-0 1.15	7-3 1.26	7-5 1.38	7-8 1.51	7-10 1.64	8-1 1.77	8-3 1.90	8-6 2.04	8-10 2.32		16.0	2x4
6-2 0.94	6-5 1.05	6-7 1.15	6-10 1.26	7-0 1.38	7-2 1.49	7-4 1.61	7-7 1.74	7-9 1.86	8-1 2.12	8-7 2.53	19.2	
5-6 0.84	5-8 0.94	5-11 1.03	6-1 1.13	6-3 1.23	6-5 1.34	6-7 1.44	6-9 1.55	6-11 1.66	7-3 1.90	7-8 2.26	24.0	
12-3 1.19	12-8 1.32	13-1 1.46	13-6 1.60	13-11 1.74	14-3 1.89	14-8 2.04	15-0 2.19	15-4 2.35			12.0	
11-6 1.12	11-10 1.24	12-3 1.37	12-8 1.50	13-0 1.63	13-4 1.77	13-8 1.91	14-0 2.05	14-4 2.20	15-0 2.51		13.7	
10-7 1.03	11-0 1.15	11-4 1.26	11-8 1.38	12-0 1.51	12-4 1.64	12-8 1.77	13-0 1.90	13-4 2.04	13-11 2.32		16.0	2x6
9-8 0.94	10-0 1.05	10-4 1.15	10-8 1.26	11-0 1.38	11-3 1.49	11-7 1.61	11-10 1.74	12-2 1.86	12-8 2.12	13-5 2.53	19.2	
8-8 0.84	9-0 0.94	9-3 1.03	9-7 1.13	9-10 1.23	10-1 1.34	10-4 1.44	10-7 1.55	10-10 1.66	11-4 1.90	12-0 2.26	24.0	
16-2 1.19	16-9 1.32	17-3 1.46	17-10 1.60	18-4 1.74	18-10 1.89	19-4 2.04	19-9 2.19	20-3 2.35			12.0	
15-1 1.12	15-8 1.24	16-2 1.37	16-8 1.50	17-2 1.63	17-7 1.77	18-1 1.91	18-6 2.05	18-11 2.20	19-9 2.51		13.7	
14-0 1.03	14-6 1.15	14-11 1.26	15-5 1.38	15-10 1.51	16-4 1.64	16-9 1.77	17-2 1.90	17-6 2.04	18-4 2.32		16.0	2x8
12-9 0.94	13-3 1.05	13-8 1.15	14-1 1.26	14-6 1.38	14-11 1.49	15-3 1.61	15-8 1.74	16-0 1.86	16-9 2.12	17-9 2.53	19.2	
11-5 0.84	11-10 0.94	12-3 1.03	12-7 1.13	12-11 1.23	13-4 1.34	13-8 1.44	14-0 1.55	14-4 1.66	14-11 1.90	15-10 2.26	24.0	
20-7 1.19	21-4 1.32	22-0 1.46	22-9 1.60	23-4 1.74	24-0 1.89	24-8 2.04	25-3 2.19	25-10 2.35			12.0	
19-3 1.12	19-11 1.24	20-7 1.37	21-3 1.50	21-10 1.63	22-6 1.77	23-1 1.91	23-7 2.05	24-2 2.20	25-3 2.51		13.7	
17-10 1.03	18-6 1.15	19-1 1.26	19-8 1.38	20-3 1.51	20-10 1.64	21-4 1.77	21-10 1.90	22-4 2.04	23-4 2.32		16.0	2x10
16-4 0.94	16-10 1.05	17-5 1.15	17-11 1.26	18-6 1.38	19-0 1.49	19-6 1.61	19-11 1.74	20-5 1.86	21-4 2.12	22-8 2.53	19.2	
14-7 0.84	15-1 0.94	15-7 1.03	16-1 1.13	16-6 1.23	17-0 1.34	17-5 1.44	17-10 1.55	18-3 1.66	19-1 1.90	20-3 2.26	24.0	

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

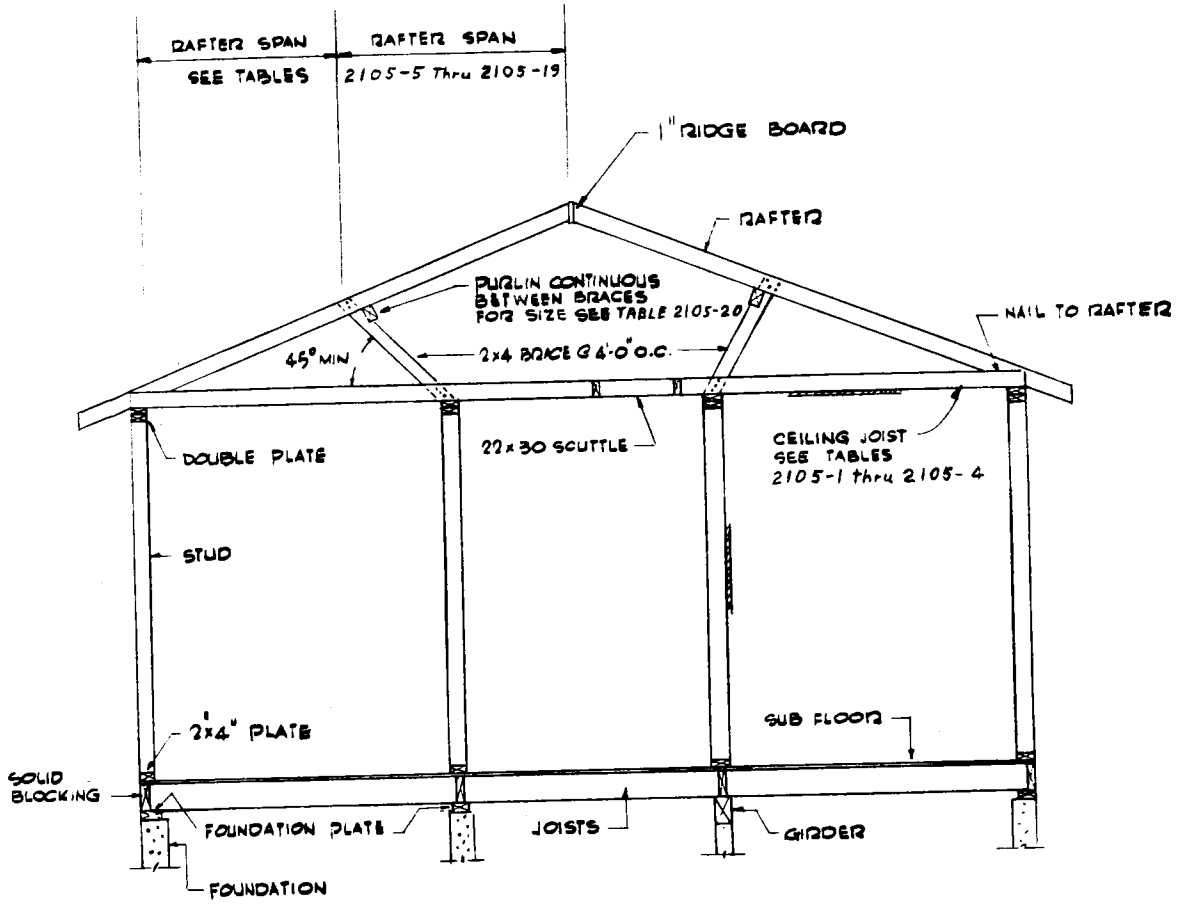
TABLE 2105-20 REQUIRED PURLIN SIZE BASED ON RAFTER SPAN

(Shown in Figure 2105-1)

SIZE OF ROOF PURLIN BRACED @ 4' o.c.	MAXIMUM ALLOWABLE RAFTER SPAN[1]	
	30 pds. per sq. ft. L.L. & D.L.	40 pds. per sq. ft. L.L. & D.L.
2" X 4"	5' - 0"	3' - 6"
2" X 6"	11' - 6"	8' - 6"

Note 1: Maximum Rafter Span is maximum distance between exterior or interior wall support and purlin, between ridge member and purlin or between purlins.

FIGURE 2105-1 ROOF AND SUPPORT FRAMING



NOTES:

1. TRUSSES MAY BE APPROVED FOR USE IN THE ROOF FRAMING SYSTEM PROVIDED THEIR DESIGN ADMITS OF A RATIONAL ANALYSIS IN ACCORDANCE WITH ESTABLISHED PRINCIPLES OF MECHANICS OR HAVE BEEN PROPERLY TESTED IN AN APPROVED MANNER
2. WHERE CEILING JOISTS RUN PERPENDICULAR TO THE RAFTERS 1"x4" COLLAR TIES SHALL BE NAILED TO THE RAFTERS NEAR THE PLATE LINE AND SPACED NOT MORE THAN 4'-0" OC.

provided by eave or cornice vents.

2105.6 ATTIC ACCESS: A readily accessible attic access opening not less than twenty-two (22) inches by thirty (30) inches shall be provided to any attic area having a clear height of over twenty-four (24) inches.

SECTION 2106.0 ROOF COVERINGS

2106.1 GENERAL: Conformity with applicable material, test, constuction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

Roofs shall be covered with Class A, B, or C roof covering.

EXCEPTION: The roof coverings set forth in Sections 2106.3, 2106.8, 2106.9, 2106.10 may be used provided the building is located in areas designated by law as permitting their use and not less than ten (10) feet are provided between buildings.

The roofing materials set forth in Sections 2106.4, 2106.5, 2106.6 and 2106.7 and concrete slabs may be accepted as Class A roof covering.

2106.2 BASE SHEET APPLICATION: Base sheets shall be applied only to solid surface roofs and shall be cemented to a suitable deck using not less than twenty-five (25) pounds of hot asphalt or not less than two (2) gallons of cold bituminous compound in accordance with the manufacturer's published specifications or thirty (30) pounds of hot coal tar pitch per roofing square, or nailed to roof sheathing using not less than one (1) nail to each one and one-third (1 1/3) square feet, or may be spot-cemented to a non-nailable deck using not less than ten (10) pounds of hot asphalt per roofing square.

Successive layers shall be cemented to the base sheets using no less cementing material than that specified for solidly cemented base sheets.

Nails for composition roofs shall be not smaller than No. 12 gauge, with heads not less than seven-sixteenths (7/16) inch and shall be long enough to penetrate into the sheathing three-quarter (3/4) inch or through the thickness of the sheathing, whichever is less. Smaller size head nails may be used provided metal discs are used with them. Exposed nails and shingle nails shall be corrosion-resistant.

2106.3 COMPOSITION ASPHALT ORGANIC FELT SHINGLES: Composition shingles shall be applied only to solidly sheathed roofs.

Compostion shingles shall not be installed on a roof having a slope of less than four (4) in twelve (12) unless approved by the building official.

Composition shingle roofs shall have an underlay of not less than fifteen (15) pound felt. applied as required for a base sheet. The underlay may be omitted over existing roofs, or where the roof slope exceeds seven (7) inches to twelve (12) inches, or where shingles are laid not less than three (3) thicknesses at any point.

Nails for composition roofs shall be not smaller than No. 12 gauge, with heads not less than three-eighths (3/8) inch in diameter for shingle application and shall be long enough to penetrate into the sheathing three-quarter (3/4) inch or through the thickness of the sheathing, whichever is less. Smaller size head nails may be used provided metal discs are used with them. Exposed nails and shingle nails shall be corrosion-resistant.

Composition shingles shall be fastened according to manufacturer's printed instructions but not less than four (4) nails per each strip shingle not more than thirty-six (36) inches wide and two (2) nails per each individual shingle less than twenty (20) inches wide.

Roof valley flashing shall be provided of not less than No. 28 galvanized sheet gauge corrosion-resistant metal and shall extend at least eight (8) inches from the center line each way, and shall have a splash diverter rib not less than three-quarter (3/4) inch high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than four (4) inches.

Roof valley flashing may be of laced composition shingles, applied in an approved manner, with an underlay of not less than thirty (30) pound felt extending ten (10) inches from the center line each way, or shall be of two (2) layers of ninety (90) pound mineral surfaced cap sheet cemented together with the bottom layer not less than twelve (12) inches wide laid face down, and the top layer not less than twenty-four (24) inches wide laid face up.

2106.4 SLATE SHINGLES: Slate shingles shall be applied in an approved manner and securely fastened with corrosion-resistant nails or corrosion-resistant nails and wire.

Slate shingle roofs shall have an underlay of not less than two (2) layers of fifteen (15) pound felt or one (1) layer of thirty (30) pound felt, applied as required for a base sheet.

Nails for slate shingle tiles shall be not less than No. 14 gauge copper or No. 14 gauge corrosion-resistant as specified and shall be long enough to penetrate into the sheathing three-quarter (3/4) inch, or through the thickness of the sheathing, whichever is less.

Roof valley flashing shall be provided of not less than No. 28 gauge galvanized sheet corrosion-resistant metal and shall extend at least eleven (11) inches from the center line each way and shall have a splash diverter rib not less than one (1) inch high at the flow line formed as part of the flashing. Sections of flashing

shall have an end lap of not less than four (4) inches.

2106.5 ASBESTOS CEMENT SHINGLES: Asbestos-cement roofing shall be applied in an approved manner. Asbestos-cement roofing shall have an underlay of not less than fifteen (15) pound felt, applied as required for a base sheet. The underlay may be omitted where the asbestos-cement shingles or sheets are applied over an existing roof covering.

Asbestos-cement roofing shall not be installed on a roof having a slope of less than three (3) in twelve (12) unless approved by the building official.

Corrugated asbestos-cement roofing not less than five-sixteenths (5/16) inch thick may be used wherever No. 24 galvanized sheet gauge corrugated steel is permitted.

Nails for asbestos-cement shingles shall be not less than No. 11 gauge corrosion-resistant and shall be long enough to penetrate into the sheathing three-quarter (3/4) inch or through the thickness of the sheathing, whichever is less.

Roof valley flashing shall be the same as required for slate shingles.

2106.6 METAL: Flat sheets or shingles shall be applied only to solidly sheathed roofs.

Metal roofing shall be applied in an approved manner.

Metal shingles shall not be installed on a roof having a slope of less than three (3) in twelve (12) unless approved by the building official.

Metal shingles shall be applied over an underlay of not less than thirty (30) pound felt, applied as required for a base sheet.

2106.7 TILE, CLAY OR CONCRETE SHINGLES: All roof tile shall be securely fastened with corrosion-resistant nails or nails and wire, or other approved means.

Tile shall not be installed on a roof having a slope of less than three (3) in twelve (12) unless approved by the building official.

Tile with projection anchor lugs at the bottom of the tile shall be held in position by means of one (1) inch by two (2) inch wood stripping, treated to resist moisture deterioration, nailed to the roof sheathing over the underlay, or other approved means.

Tile roofs shall have an underlay of not less than two (2) layers of fifteen (15) pound felt or one (1) layer of thirty (30) pound felt, applied as required for a base sheet.

Nailing and valley flashing shall be the same as required for slate shingles.

2106.8 BUILT-UP ROOFING: Mineral aggregate surfaced built-up roofing shall consist of three (3) layers of fifteen (15) pound fiber felt installed in accordance with this section on roofs having slopes not greater than three (3) in twelve (12).

Built-up roofing shall be applied only to solid surface roofs.

Base sheets shall be cemented to a suitable deck using not less than twenty-five (25) pounds of hot asphalt or not less than two (2) gallons of cold bituminous compound in accordance with manufacturer's published specifications or thirty (30) pounds of hot coal tar pitch per roofing square, or nailed to roof sheathing using not less than one (1) nail to each one and one-third (1 1/3) square feet, or may be spot-cemented to a non-nailable deck using not less than ten (10) pounds of hot asphalt per roofing square.

Successive layers shall be cemented to the base sheets using no less cementing material than that specified for solidly cemented base sheets.

Mineral aggregate surfaced roofs shall be surfaced with not less than fifty (50) pounds of hot asphalt or other cementing material in which is embedded not less than three hundred (300) pounds of gravel or other approved surfacing materials or two hundred fifty (250) pounds of crushed slag per roofing square.

Cap sheets shall be cemented to the base sheets using no less cementing material than that specified for solidly cemented base sheets.

Hot asphalt shall be applied at a temperature of not less than 375°F. nor more than 450°F. for high melt types. Low melt types shall not be applied at a temperature of less than 350°F. nor more than 400°F.

Coal tar pitch shall not be heated to a temperature above 375°F.

2106.9 WOOD SHINGLES: Wood shingles may be applied to roofs with solid or spaced sheathing. The spaced sheathing shall be spaced not to exceed four (4) inches clear nor more than the width of the sheathing board. Spaced sheathing shall be not less than one (1) inch by three (3) inches nominal dimensions.

Shingles shall be laid with a side lap of not less than one and one-half (1 1/2) inches between joints in adjacent courses, and one-half (1/2) inch in alternate courses. Spacing between shingles shall be not less than one-quarter (1/4) inch nor more than three-eighths (3/8) inch. Each wood shingle shall be fastened to the sheathing with two (2) nails only.

Shingles shall not be installed on a roof having a slope less than four (4) in twelve (12) unless they are installed over an underlay of not less than fifteen (15) pound felt, applied as required for a base sheet.

Roof valley flashing shall be provided of not less than No. 28 gauge galvanized sheet corrosion-resistant metal and shall extend eight (8) inches from the center line each way. Sections of flashing shall have an end lap of not less than four (4) inches.

Weather exposures shall not exceed those set forth in Section RS-21-9. Hip and ridge weather exposures shall not exceed those permitted for the field of the roof.

2106.10 WOOD SHAKES: Wood shakes may be applied to roofs with solid or spaced sheathing. The spaced sheathing shall be spaced not to exceed four (4) inches clear nor more than the width of the sheathing board. Spaced sheathing shall be not less than one (1) inch by four (4) inches nominal size. In snow areas, sheathing shall be solid and the shakes shall be applied over an underlay of not less than fifteen (15) pound felt, applied as required for a base sheet.

Shakes may be laid in straight or staggered courses with a side lap of not less than one and one-half (1 1/2) inches between joints in adjacent courses. Spacing between shakes shall be not more than one-half (1/2) inch.

Each wood shake shall be fastened to the sheathing with two (2) nails. The starter course at the eaves shall be doubled and the bottom layer shall be either fifteen (15) inch or eighteen (18) inch wood shakes or wood shingles. Fifteen (15) inch or eighteen (18) inch shakes may be used for the final course at the ridge.

Shakes shall be laid with not less than eighteen (18) inch wide strips of not less than thirty (30) pound felt shingled between each course in such manner that no felt is exposed to the weather below the shake butts.

Shakes shall not be installed on a roof having a slope less than four (4) in twelve (12) unless they are installed over an underlay of not less than thirty (30) pound felt, applied as required for a base sheet.

Roof valley flashing shall be provided of not less than No. 28 gauge galvanized sheet corrosion-resistant metal and shall extend at least eleven (11) inches from the center line each way and shall have a splash diverter rib not less than one (1) inch high at the flow line formed as part of the flashing. Sections of flashing shall have an end lap of not less than four (4) inches.

Weather exposures shall not exceed those set forth in Section RS-21-9. Hip and ridge weather exposures shall not exceed those permitted for the field of the roof.

TABLE 2106-1 ROOF COVERINGS

ROOF COVERING MATERIAL	FASTENER SPECIFICATIONS			Spacing Specifications[4]
	Fastener[2,3] Style	Min. O.D. Crown	O.D. Leg Lengths	
Base Sheet (Roofing Felt)	12 ga. Roofing Nail		7/8	All metal discs placed and stapled or nailed 12 inches on center
	16 ga. Staple	7/16	3/4	
Composition Shingles	12 ga. 3/8" HD Roofing Nail		1¼	(4) Nails or staples per each 36" section of shingle
	16 ga. Staple	3/4	1	
	16 ga. Staple	7/16	1¼	(6) Staples per each 36" section of shingle
Composition Ridge, Hip, Caps	12 ga. 3/8" HD Roofing Nail		1¼	A minimum of (4) nails or staples are required for ridge capping
	16 ga. Staple	3/4	1	
	16 ga. Staple	7/16	1¼	
Wood Shingles	.076 Shingle Nail		1¼	16" and 18" Shingle – (2) fasteners per shingle
	.080 T-Nail	–	1¼	
	16 ga. Staple	7/16	1¼	
	.080 Shingle Nail		1½	24" Shingle – (2) fasteners per shingle
	.080 T-Nail	–	1½	
	16 ga. Staple	7/16	1½	
Wood Shakes	.0915 – Shingle Nail		2	(2) Nails or staples per each shake
	.0915 to .099 T-Nail		2	
	16 ga. Staple	7/16	2	

Note 1: Shingles and shakes attached to roof sheathing having the underside of the sheathing exposed to visual view may be attached in these locations with nails or staples having shorter lengths than specified so as not to penetrate the exposed side of the sheathing.

Note 2: All nails and staples shall be rust-resistant (galvanized-zinc or aluminum).

Note 3: Nails may have T-heads, clipped round heads or standard heads.

Note 4: Roof coverings shall be fastened in an approved manner.

SECTION 2107.0 CHIMNEYS AND FIREPLACES

2107.1 GENERAL: Conformity with the applicable material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2107.2 SUPPORT: Masonry chimneys shall be constructed in accordance with Figure 2107-1.

2107.3 ADDITIONAL LOAD: Chimneys shall not support loads other than their own weight unless they are designed and constructed to support the additional load.

2107.4 TERMINATION: Chimneys shall extend at least three (3) feet above the highest point where they pass the roof of a building and at least two (2) feet higher than any portion of the building within ten (10) feet.

2107.5 WALL THICKNESS: Masonry chimneys shall be constructed of solid masonry units or of reinforced concrete with walls not less than four (4) inches in thickness.

2107.6 FLUE LINING (MATERIAL): Masonry chimneys shall be lined with fireclay flue liners not less than five-eighths (5/8) of an inch in thickness or with other approved liner of material that will resist, without cracking or softening, a temperature of 1800° F.

EXCEPTION: Masonry chimneys may be constructed without flue liners when walls are at least eight (8) inches in thickness.

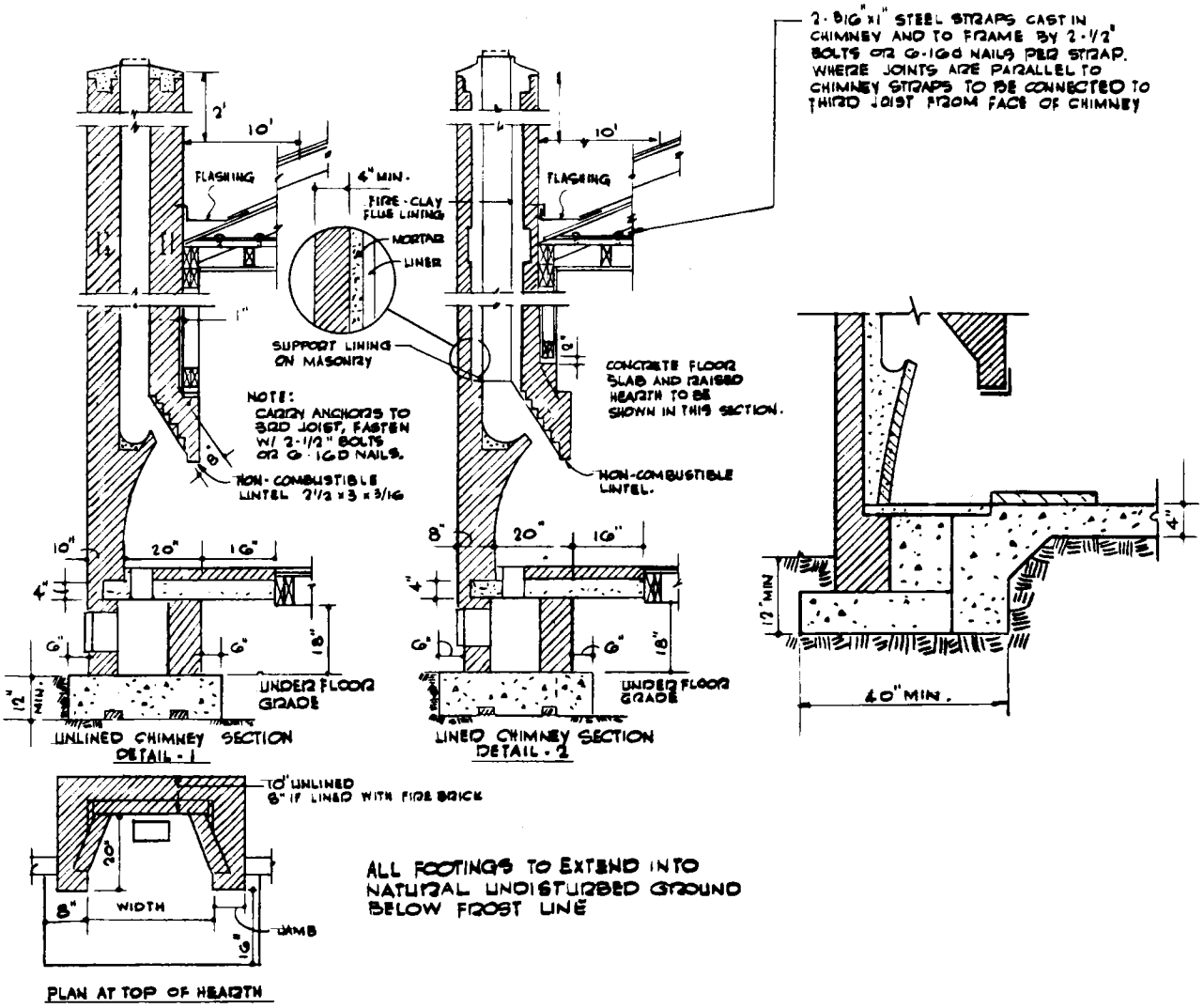
2107.7 FLUE LINING (INSULATION): Flue liners shall extend from a point not less than eight (8) inches below the lowest inlet, or in the case of fireplaces, from the top of the smoke chamber, to a point above the enclosing walls. Fireclay flue liners shall be laid with tight mortar joints left smooth on the inside.

2107.8 MULTIPLE FLUES: Where more than two (2) flues are located in the same chimney, masonry wythes shall be built between adjacent flue linings so that there are not more than two (2) flues grouped together between such wythe separation. The masonry wythes shall be at least four (4) inches thick and bonded into the walls of the chimney. Where two (2) flues adjoin each other in the same chimney with only flue lining separation between them, the joints of the adjacent flue linings shall be staggered at least seven (7) inches.

2107.9 FLUE AREA (APPLIANCE): Chimney flues shall not be smaller in area than that of the area of the connector from the appliance.

2107.10 FLUE AREA (FIREPLACE): Chimney flues for fireplaces shall not be smaller in area than the values set forth in Table 2107.1.

FIGURE 2107-1 FIREPLACE CONSTRUCTION DETAILS



NOTES

1. WHERE PLATES ARE CUT ANCHOR TO CHIMNEY BY 3/16" x 1" STEEL STRAPS HOOKED INTO CHIMNEY AND ATTACHED TO PLATES BY 2 3/8" x 3" LAG SCREWS, 2 1/2" BOLTS OR 6-16d NAILS.

2. WHERE DAMPERS ARE USED THEY SHALL NOT BE LESS THAN NO. 12 GA. METAL AND WHEN FULLY OPEN THE DAMPER OPENING SHALL BE NOT LESS THAN 90% OF THE REQUIRED FLUE AREA

NOTE: THE FIREPLACE ASHPIT AND CLEANOUT SHOWN IS OPTIONAL.

TABLE 2107-1 MINIMUM FLUE AREA FOR MASONRY CHIMNEYS CONNECTED TO FIREPLACES

TYPE OF FLUE		
Round Lined	Square or Rectangle Lined	Lined with Fire-brick or Unlined
1/12 of fireplace opening area but not less than 50 square inches	1/10 of fireplace opening area but not less than 64 square inches	1/8 of fireplace opening area but not less than 100 square inches

2107.11 INLET: Inlets to masonry chimneys shall enter from the side. All inlets shall have a thimble of fireclay, rigid refractory material, metal, or other arrangement that will prevent the connector from pulling out of the inlet or from extending beyond the wall of the liner.

2107.12 CLEANOUT OPENING: Cleanout openings shall be provided in masonry chimneys in accordance with Figure 2107-1 and shall be equipped with ferrous metal doors and frames arranged to remain tightly closed when not in use. Cleanout openings shall be located not less than two (2) feet below the lowest inlet to the flue.

2107.13 CHIMNEY CLEARANCE: Wood beams, joists, headers and studs shall not be placed within two (2) inches from the outside face of a masonry chimney built partially or entirely within the dwelling. Masonry chimneys built entirely outside of the dwelling may be placed one (1) inch minimum from combustible material.

2107.14 CHIMNEY FIRESTOPPING: All spaces between masonry chimneys and wood beams, joists, or headers shall be firestopped by placing noncombustible material to a depth of one (1) inch at the bottom of such spaces.

2107.15 FACTORY-BUILT CHIMNEYS: Factory-built chimneys shall be of an approved type.

2107.16 FIREPLACE WALLS: Masonry fireplaces shall be constructed of solid masonry units, stone, or reinforced concrete in accordance with Figure 2107-1. Where a lining of firebrick at least two (2) inches in thickness or other approved lining is provided, the total thickness of back and sides, including the lining, shall be not less than eight (8) inches. Where no lining is provided, the thickness of back and sides shall be not less than ten (10) inches.

2107.17 STEEL FIREPLACE UNITS: Steel fireplace units incorporating a firebox liner of not less than one-quarter (1/4) inch in thickness and an air chamber may be installed with masonry to provide a total thickness at the back and sides of not less than eight (8) inches, of which not less than four (4) inches shall be of solid masonry. Warm air ducts employed with steel fireplace units of the circulating air type shall be constructed of metal or masonry.

2107.18 LINTEL: Masonry over a fireplace opening shall be supported by a lintel of noncombustible material.

2107.19 HEARTH EXTENSION (MATERIAL): Masonry fireplaces at or near the floor level shall have hearth extensions of brick, concrete, stone, tile or other approved noncombustible material properly supported or reinforced to carry its own weight and all imposed loads. Combustible forms and centers used during the construction of hearth and hearth extension shall be removed after the construction is completed.

2107.20 HEARTH EXTENSION: Hearth extensions shall extend at least sixteen (16) inches in front of, and at least eight (8) inches beyond each side of fireplace opening. Where the fireplace opening is six (6) square feet or larger, the hearth extension shall extend at least twenty (20) inches in front of, and at least twelve (12) inches beyond each side of the fireplace opening.

2107.21 FIREPLACE CLEARANCE: Wood or combustible framing shall not be placed within two (2) inches of outside face of a masonry fireplace and not less than six (6) inches from inside surface of nearest flue lining. Wood framing and other combustible material shall not be placed within four (4) inches of the back surface of a masonry fireplace.

2107.22 FIREPLACE FIRESTOPPING: All spaces between masonry fireplaces and wood beams, headers, joists or trimmers shall be firestopped by placing noncombustible material to a depth of one (1) inch at the bottom of such spaces.

2107.23 COMBUSTIBLE MATERIALS: Woodwork or other combustible materials shall not be placed within six (6) inches of a fireplace opening. Combustible material within twelve (12) inches of the fireplace opening shall not project more than one-eighth (1/8) of an inch for each inch distance from such opening.

2107.24 FACTORY-BUILT FIREPLACES: Factory-built fireplaces that consist of a fire chamber assembly, one or more chimney section, a roof assembly and other parts as tested and listed as an assembly by a nationally recognized testing laboratory and approved by the State Building Code Commission may be installed when complying with all the following provisions:

a) The fire chamber assembly is installed to provide clearance to combustible materials not less than set forth in the listing.

b) The chimney sections are installed to provide clearance to combustible material not less than specified in the listing and if the fireplace chimney extends through floors and ceilings, factory-furnished firestops or firestop-spacers shall be installed. Portions of chimneys which extend through rooms or closets are to be enclosed to avoid

personal contact, contact of combustible material, and damage to the chimney.

c) Hearth extensions shall be not less than three-eighths (3/8) inch thick asbestos, hollow metal, stone, tile or other approved noncombustible material. Such hearth extensions may be placed on combustible subflooring or finish flooring. The hearth extension shall be readily distinguished from the surrounding floor.

d) Hearth extensions shall extend not less than sixteen (16) inches in front of and at least eight (8) inches beyond both sides of the fireplace opening.

2107.25 FACTORY-BUILT FIREPLACE STOVES: Factory-built fireplace stoves, consisting of a free-standing fire chamber assembly, that have been tested and are listed by a nationally recognized testing laboratory and approved by the State Building Code Commission, may be installed, in accordance with the requirements of said listing.

SECTION 2108.0 MECHANICAL, DEFINITIONS

2108.1 GENERAL: Conformity with the applicable material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2108.2 DEFINITIONS: For the purpose of the mechanical requirements the terms used shall be defined as follows and as set forth in the Basic Code.

ABSORPTION UNIT: A factory tested assembly of component parts producing refrigeration for comfort, heating or cooling by the application of heat.

BOILER, LOW PRESSURE HOT WATER AND LOW PRESSURE STEAM: A boiler furnishing hot water for air conditioning at pressures not exceeding one hundred sixty (160) pounds per square inch and at temperatures not more than 250°F., or steam at pressures not more than fifteen (15) pounds per square inch.

B.T.U. RATING: The listed maximum input capacity of any appliance, expressed in British thermal units input per hour.

CONTROL, LIMIT: An automatic control responsive to changes in liquid level, pressure or temperature for limiting the operation of the controlled equipment.

CONTROL, PRIMARY SAFETY: The automatic safety control intended to prevent abnormal discharge of oil at the burner in case of ignition failure or flame failure; barometric oil feed is not considered a primary safety control.

CONTROL, SAFETY COMBUSTION: A primary safety control responsive

directly to flame properties, sensing the presence of flame and causing fuel to be shut off in event of flame failure.

DAMPER: Any device which when installed will restrict, retard or direct the flow of air in any duct, or the products or combustion in any heat producing equipment, its vent connector, vent or chimney therefrom.

DRAFT HOOD: A device placed in and made part of the vent connector from an appliance, or in the appliance itself, which is designed to (1) insure the ready escape of the products of combustion in the event of no draft, back-draft or stoppage beyond the draft hood; (2) prevent a back-draft from entering the appliances; (3) neutralize the effect of stack action of the chimney flue upon the operations of the appliance.

DUCT SYSTEMS: All ducts, duct fittings and plenums assembled to form a continuous passageway for the transmission of air.

EVAPORATIVE COOLER: A device used for reducing the heat of air for comfort cooling by the process of evaporation of water into an air stream.

FLOOR FURNACE: A self-contained furnace suspended from the floor of the space which is being heated, with means of observing the flame and lighting the furnace from such space.

FORCED AIR TYPE CENTRAL FURNACE: A central furnace equipped with a fan or blower which provides the primary means for circulation of air. It may be of the horizontal, upflow or downflow type.

FURNACE, GRAVITY-TYPE WARM-AIR: A warm-air furnace depending primarily on circulation of air through the furnace by gravity.

This definition also shall include any furnace approved with a booster-type fan, which does not materially restrict free circulation of air through the furnace when the fan is not in operation.

LABELED: The word "labeled" refers to equipment or material bearing the inspection label of an approved inspection agency.

NONCOMBUSTIBLE: A material which will not ignite and burn when subjected to fire.

PLENUM CHAMBER: An air compartment or enclosed space to which one or more distributing air ducts are connected.

PUMP, AUTOMATIC OIL: A pump, not an integral part of a burner, stove or unit, which automatically pumps oil from the supply tank and delivers the oil by gravity under a constant head to an oil-burning appliance. The pump is designed to stop pumping automatically in case of total breakage of the oil supply line between the pump and the appliance.

REFRIGERANT; The medium used to produce cooling or refrigeration by the process of expansion or vaporization.

REFRIGERATING SYSTEM: A combination of interconnected refrigerant containing parts constituting one (1) closed refrigerant circuit in which a refrigerant is circulated for the purpose of extracting heat.

In a Direct Refrigerating System the refrigerant is in direct contact with the material or space to be refrigerated or is located in air circulating passages.

In an Indirect Refrigerating System brine is cooled by a refrigerating system and circulated to the material or space to be refrigerated or is used to cool circulated air.

ROOM HEATER: A free standing, nonrecessed, comfort heating appliance installed in the space being heated and not connected to ducts.

SEALED COMBUSTION SYSTEM APPLIANCES: Obtain all combustion air from, and all flue gases are discharged to, the outside atmosphere.

TANK, AUXILIARY: An auxiliary supply tank, having a capacity of not over sixty (60) gallons, listed for installation in the supply piping between a burner and its main fuel supply tank.

TANK, INTEGRAL: A tank which is furnished by the manufacturer as an integral part of an oil-fired appliance.

TANK, STORAGE: A separate tank which is not connected directly or be a pump to the oil-burning appliance.

TANK, VACUUM OR BAROMETRIC: A tank not exceeding five (5) gallons capacity which maintains an oil tank in a sump or similar receptacle by barometric feed. Fuel is delivered from the sump to the burner by gravity.

VENT: A passageway, vertical or nearly so, for removing vent gases to the outer air.

TYPE B GAS VENT: Listed factory-made gas vents for venting listed or approved appliances, equipped to burn only gas, except those specifically listed for use with chimneys only.

TYPE BW GAS VENT: Listed factory-made gas vents for venting listed or approved gas-fired vented recessed heaters.

TYPE L GAS VENT: Low-Temperature, Venting Systems. A venting system consisting of listed factory made piping and fittings for use with fuel burning appliances listed as exhausting low temperature flue gases and approved for use with a type L venting system.

VENT CONNECTOR: (vent connector pipe.) That portion of the vent system which connects the gas appliance to the gas vent or chimney.

VENTED DECORATIVE APPLIANCE: A vented appliance whose function lies in the esthetic effect of the flames rather than functional effects.

VENTED WALL FURNACE: Vented comfort heating appliance designed for incorporation in a permanent attachment to a wall or partition and arranged to furnish heated air by gravity or by a fan.

VENT COLLAR: The outlet opening of an appliance or draft hood provided for connection of the vent system.

VENTING SYSTEM: The gas vent or chimney and vent connector, if used, assembled to form a continuous unobstructed passageway from the gas appliance to the outside atmosphere for the purpose of removing vent gases.

WARM-AIR FURNACE: A solid, liquid or gas-fired appliance for heating air to be distributed with or without duct systems to the space to be heated.

2109.0 EQUIPMENT GENERAL

2109.1 GENERAL: Conformity with the applicable material, test, construction and design standards specified in the reference standards of this article shall be acceptable as providing compliance with the requirements of this article.

2109.2 COMMONWEALTH OF MASSACHUSETTS REGULATIONS: All installation of gas appliances must comply with the Massachusetts Code for Installation of Gas Appliances and Gas Piping established under Chapter 737, Acts of 1960. The construction, installation and operation of oil burning equipment is subject to the provisions of FPR-3, established in accordance with Chapter 148, Section 10 of the MGLA, as amended. The construction, installation, testing and inspection of boilers, air tanks, ammonia compressor valves, and refrigeration and air-conditioning systems of five (5) tons of more capacity are subject to the Rules and Regulations issued by the Board of Boiler Rules under authority of Chapter 146 of the MGLA, as amended.

2109.3 COOPERATING AGENCIES: Nothing herein contained shall be deemed to nullify the provisions of other legal statutes or regulations of the Commonwealth of Massachusetts governing the operation and maintenance of boilers and other heating appliances and equipment.

2109.4 LABELED HEATING AND COOKING APPLIANCES: Approved oil-fired warm air furnaces, floor furnaces, unit heaters, domestic incinerators, cooking and heating stoves and ranges and other heating equipment, inspected and approved by approved agencies shall be accepted by the building official when installed with the clearances pro-

vided in Tables 2109-1 and 2109-2 and in accordance with their listings.

2109.5 TYPE OF FUEL: Each comfort heating appliance shall be designed for use with the type of fuel to which it will be connected. Appliances shall not be converted from the fuel specified on the rating plate for use with a different fuel without securing reapproval from the building official and as recommended by the manufacturer of either the original equipment or the conversion equipment.

2109.6 COMMONWEALTH OF MASSACHUSETTS REGULATIONS: Oil burners and related equipment are subject to the Rules and Regulations promulgated in FPR-3, made in accordance with the provisions of Section 10, Chapter 148 of the MGLA, as amended. Unvented room heaters are prohibited by section 1011.52 of the Basic Code.

2109.7 SHUTOFF VALVE: A readily accessible approved shutoff valve shall be installed ahead of the union or other connection in the fuel piping outside and within three (3) feet of the appliance.

EXCEPTION: Shutoff valves may be accessibly located inside or under an appliance provided the appliance can be removed without removal of the shutoff valve.

2109.8 APPLIANCE INSTALLATION: Except as otherwise provided in this article or the Basic Code, the installation of comfort heating appliances shall conform to the conditions of their listing. The manufacturer's installation and operating instructions shall remain attached to the appliance.

2109.9 APPLIANCE ACCESS: Comfort heating appliances shall be accessible for inspection, service, repair and replacement without removing permanent construction.

Not less than thirty (30) inches working space and platform shall be provided in front of the appliance firebox opening of fuel-burning appliances except unit and room heaters which must have a minimum of eighteen (18) inches.

2109.10 CONTROL DEVICES: Automatic gas-burning comfort heating appliances shall be equipped with listed devices which will shut off the gas to the main burner or burners in the event of pilot failure.

EXCEPTION: The listed shutoff devices shall not be required on range or cooking tops, log lighters, lights, or other open burner manually operated appliances, or listed appliances not requiring such devices.

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

TABLE 2109-1 STANDARD INSTALLATION CLEARANCES
HEAT-PRODUCING APPLIANCES[1]

These clearances apply unless otherwise shown on listed appliances. Appliances shall not be installed in alcoves or closets unless so listed. For installation on combustion floors see footnote 2.

RESIDENTIAL TYPE APPLIANCES For Installation in Rooms Which Are Large[3]		APPLIANCE: Above Top of Casing or Appliance (Inches)	APPLIANCE: From Top and Sides of Warm-Air Bonnet or Plenum (Inches)	APPLIANCE: From Front[4] (Inches)	APPLIANCE: From Back (Inches)	APPLIANCE: From Sides (Inches)	CHIMNEY CONNECTOR (Inches)	VENT CONNECTOR[5] (Inches)
BOILERS AND WATER HEATERS[6] FUEL								
Steam Boilers–15 p.s.i. Water Boilers–250° F. Water Heaters–200° F. All Water Walled or Jacketed	Automatic Oil or Combination Gas and Oil	6	–	24	6	6	18	–
	Automatic Gas	6	–	18	6	6	–	9
	Solid	6	–	48	6	6	18	–
FURNACES–CENTRAL								
Gravity, Upflow, Downflow, Horizontal and duct Warm Air–250° F. maximum Limit Control	Automatic Oil or Combination Gas and Oil	6[7]	6[7]	24	6	6	18	–
	Automatic Gas	6[7]	6[7]	18	6	6	–	9
	Solid	18[8]	18[8]	48	18	18	18	–
	Electric	6[7]	6[7]	18	6	6	–	–
FURNACES–FLOOR								
For Mounting in Combustible Floors	Automatic Oil or Combination Gas and Oil	36	–	12	12	12	18	–
	Automatic Gas	36	–	12	12	12	–	9
HEAT EXCHANGER, SUPPLIED FROM A REMOTE SOURCE								
Steam–15 p.s.i. maximum Hot water–250° F. maximum		1	1	1	1	1	–	–
ROOM HEATERS AND ROOM HEATING STOVES BURNING SOLID FUEL								
Circulating Type Vented or Unvented	Oil or Solid	36	–	24	12	12	18	–
	Gas	36	–	24	12	12	–	9
Radiant or Other Type Vented or Unvented	Oil or Solid	36	–	36	36	36	18	–
	Gas	36	–	36	18	18	–	9
	Gas with Double Metal or Ceramic Back	36	–	36	12	18	–	9
RADIATORS, SELF-CONTAINED[9]								
Steam or Hot Water	Gas	36	–	6	6	6	–	9
RANGES–COOKING STOVES						Front Side: 24	Other Side: 18	
Vented or Unvented	Oil	30	–	–	9	6	6	18	–
	Gas	30	–	–	6	6	6	–	6
	Solid–Clay lined Firepot	30	–	–	24	24	18	18	–
	Solid unlined Firepot	30	–	–	36	36	18	18	–
	Electric	30	–	–	6	6	6	–	–
CLOTHES DRYERS								
Listed Types	Gas	6	–	24	6	6	–	1
	Electric	6	–	24	0	0 one side	–	–

Note 1: Standard clearances may be reduced in existing construction only by affording protection to combustible material in accordance with Table 2109-2.

Note 2: An appliance may be mounted on a combustible floor if the appliance is listed for such installation or if the floor is protected in an approved manner.

Note 3: Rooms which are large in comparison to the size of the appliance are those having a volume equal to at least twelve (12) times the total volume of a furnace and at least sixteen (16) times the total volume of a boiler. If the actual ceiling height of a room is greater than eight (8) feet, the volume of a room shall be figured on the basis of a ceiling height of eight (8) feet.

Note 4: The minimum dimension shall be that necessary for servicing the appliance including access for cleaning and normal care, tube removal, etc.

Note 5: The minimum dimension shall be eighteen (18) inches for gas appliances not equipped with draft hoods, except clothes dryers. The dimension may be six (6) inches for listed gas appliances equipped with draft hoods and for boilers and furnaces equipped with listed conversion burners and with draft hoods. A vent connector of listed Type B or L venting material may be used with listed gas appliances with draft hoods and may be installed at clearances marked on the material.

Note 6: Steampipes and hot-water heating pipes shall be installed with a clearance of at least one (1) inch to all combustible construction or material, except that at the points where pipes carrying steam or hot water at not over fifteen (15) pounds gage pressure emerge from a floor, wall, or ceiling, the clearance at the opening through the finish floor boards or wall ceiling boards may be reduced to not less than one-half (½) inch. Each such opening shall be covered with a plate of noncombustible material.

Such pipes passing through stock shelving shall be covered with not less than one (1) inch of approved insulation.

Wood boxes or casings enclosing uninsulated steam- or hot-water heating pipes, or wooden covers to recesses in walls in which such uninsulated pipes are placed, shall be lined with metal or asbestos millboard.

Where the temperature of the boiler piping does not exceed 160°F., the provisions of this Table shall not apply.

Coverings or insulation used on steam- or hot-water pipes shall be of noncombustible material.

Note 7: For a listed oil, combination gas-oil, gas or electric furnace this dimension may be two (2) inches if the furnace limit control cannot be set higher than 250°F., or this

NOTES FOR TABLE 2109-1 (continued)

dimension may be one (1) inch if the limit control cannot be set higher than 200°F.

Note 8: The dimension may be six (6) inches for an automatically stoker-fired forced warm-air furnace equipped with 250°F. limit control operated by draft intensity of .13-inch water gage.

Note 9: To combustible material or metal cabinets. If the underside of such combustible material or metal cabinet is protected with asbestos millboard at least one-quarter (¼) inch thick covered with sheet metal of not less than No. 28 gage, the distance may be not less than twenty-four (24) inches.

Comfort heating fuel-burning appliances whose manual fuel controls are not readily accessible from the main portion of the building being heated shall be equipped with remote controls.

Forced-air and gravity-type warm-air furnaces shall be equipped with a listed air outlet temperature limit control which cannot be set for temperatures higher than 250°F. The controls shall be located in the bonnet or plenum, within two (2) feet of the discharge side of the heating element of gravity furnaces or in accordance with the conditions of listing.

2109.11 RANGES--VERTICAL CLEARANCE ABOVE COOKING TOP: Domestic freestanding or built-in ranges shall have a vertical clearance above the cooking top of not less than thirty (30) inches to unprotected combustible material. When the underside of such combustible material is protected with asbestos millboard at least one-quarter (1/4) inch thick covered with sheet metal of not less than No. 28 U.S. gauge or a metal ventilating hood, the distance shall be not less than twenty-four (24) inches.

2109.12 RANGES--HORIZONTAL CLEARANCE TO BUILT-IN TOP COOKING UNITS: The minimum horizontal distance from the center of the burner head(s) of a top (or surface) cooking unit to surrounding top or surface shall be not less than that distance specified by the permanent marking on the unit.

2109.13 OPEN TOP BROILER UNITS: Listed open top broiler units and hoods shall be installed in accordance with their listing and the manufacturer's instructions.

2109.14 DOMESTIC CLOTHES DRYERS: Where a clothes dryer is connected to a moisture exhaust duct, it shall be installed in accordance with manufacturer's instructions and recommendations.

A clothes dryer moisture exhaust duct shall not be connected into any vent connector, gas vent or chimney.

TABLE 2109-2 MAXIMUM REDUCED CLEARANCES (INCHES) WITH SPECIFIED FORMS OF PROTECTION[1]

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		
	Above	Sides and Rear	Chimney or Vent Connector	Above	Sides and Rear	Chimney or Vent Connector	Above	Sides and Rear	Chimney or Vent Connector	Above	Sides and Rear	Chimney or Vent Connector
(a) ¼" asbestos millboard spaced out 1"[2]	30	18	30	15	9	12	9	6	6	3	2	3
(b) No. 28 Manufacturers' Standard gage steel sheet on ¼" asbestos millboard	24	18	24	12	9	12	9	6	4	3	2	2
(c) No. 28 Manufacturers' Standard gage steel sheet spaced out 1"[2]	18	12	18	9	6	9	6	4	4	2	2	2
(d) No. 28 Manufacturers' Standard gage steel sheet on 1/8" asbestos millboard spaced out 1"[2]	18	12	18	9	6	9	6	4	4	2	2	2
(e) 1½" asbestos cement covering on heating appliance	18	12	36	9	6	18	6	4	9	2	1	6
(f) ¼" asbestos millboard on 1" mineral fiber bats reinforced with wire mesh or equivalent	18	12	18	6	6	6	4	4	4	2	2	2
(g) No. 22 Manufacturers' Standard gage steel sheet on 1" mineral fiber bats reinforced with wire or equivalent	18	12	12	4	3	3	2	2	2	2	2	2
(h) ¼" asbestos cement board or ¼" asbestos millboard	36	36	36	18	18	18	12	12	9	4	4	4
(i) ¼" cellular asbestos	36	36	36	18	18	18	12	12	9	4	4	4

Note 1: Except 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.

Note 2: Spacers should be of noncombustible material.

Ducts for exhausting moisture from clothes dryers shall not be constructed with sheet metal screws or other fastening means which extend into the duct.

In no case shall the moisture exhaust terminate beneath the building or in the attic.

Domestic clothes dryers shall be moisture exhausted to the outside in an habitable room or room containing other fuel-burning appliances.

2109.15 FUEL-BURNING APPLIANCE LABELING: Every fuel-burning comfort heating appliance shall bear a permanent and legible factory applied nameplate on which shall appear:

a) The manufacturer's name or trademark.

b) The B.t.u. rating.

c) The model and serial number.

d) Instructions for the lighting, operation and shut-down of the appliance.

e) The type of fuel approved for use with the appliance.

f) A seal indicating approval of the appliance by an approved testing agency, if acceptance is based on such approval.

2109.16 ELECTRICAL APPLIANCE LABELING: Every electric appliance listed in Table 2109-1 shall bear a permanent and legible factory applied nameplate on which shall appear:

a) Name or trademark of the manufacturer.

b) The catalog (model) number or equivalent.

c) The electrical rating in volts, amperes and phase.

d) Individual marking for each electrical component in amperes or watts, volts and phase shall appear on nameplate of that component.

2109.17 APPLIANCE: Appliances installed in garages or other areas where they may be subjected to mechanical damage shall be suitably guarded against damage.

Appliances generating a flame, glow or spark capable of igniting flammable vapors may be installed on the floor of a garage provided that a door of the garage opens to an adjacent ground or driveway level that is at or below the level of the garage floor. When this condition does not exist appliances shall be installed so that the ignition source is at least eighteen (18) inches above the garage floor.

EXCEPTION: Sealed combustion system appliances may be installed at floor level.

2110.0 COMBUSTION AIR

2110.1 GENERAL AIR SUPPLY: All fuel-burning equipment shall have a sufficient supply of air for fuel combustion. ventilation draft hood dilution.

2110.2 VOLUME REQUIRED: Additional combustion air shall be provided for fuel-burning appliances if the volume of an appliance room in cubic feet is less than one-twentieth (1/20) of the masimum input B.t.u. rating of all appliances therein.

EXCEPTION: Sealed combustion system appliances, cooking appliances, refrigerators and clothes dryers.

2110.3 AIR SUPPLY: Rooms containing fuel-burning appliances and not having the volume required in section 2110.2 shall be provided with two (2) square inches of combustion air opening for each input of one thousand (1000) B.t.u. rating with a total of not less than two hundred (200) square inches.

EXCEPTION: One (1) square inch for each input rating of one thousand (1000) B.t.u.'s may be permitted provided the compartment floor area is more than twice the floor area of the appliance and the total area if not less than one hundred (100) square inches.

One-half (1/2) of the required combustion air opening shall extend within the upper twelve (12) inches of the room and the other one-half (1/2) shall extend within the lower twelve (12) inches.

EXCEPTION: In any room containing gas or liquid burning appliances which has more than twice the floor area of all such appliances, the required combustion air supply may be reduced fifty (50) percent, but not less than one hundred (100) square inches and in all rooms larger than fifty (50) square feet the required combustion air opening may be located within the upper twelve (12) inches of the room.

2110.4 COMBUSTION AIR SOURCE: Combustion air may be obtained from interior spaces whose volume in cubic feet is equal to one-twentieth (1/20) of the input B.t.u. rating of all fuel-burning comfort and water heating appliances in the space.

Outside combustion air shall be supplied through openings or ducts of the required cross-sectional area extending to the appliance room.

The same duct shall not serve both the upper and lower combustion air supply openings. The duct serving the upper air opening must be level or extended upward from appliance room.

2110.5 ATTIC COMBUSTION AIR: Combustion air supply may be obtained from an attic area provided:

a) The attic ventilation is sufficient to provide the required volume of combustion air.

b) Circulating air supplies for blower-type furnaces shall not be obtained from the area.

2110.6 UNDER FLOOR COMBUSTION AIR: The lower combustion air supply required by Section 2110.3 may be obtained from under floor areas having unobstructed openings to the outside equivalent to not less than twice the required combustion air opening between the under floor space and the appliance room.

2110.7 OPENING REQUIREMENTS: Outside combustion air openings shall be covered with corrosion-resistant screen of one-quarter (1/4) inch mesh.

2110.8 COMBUSTION AIR DUCTS: Combustion air supply ducts shall be of corrosion-resistant material having a cross-sectional dimension of not less than three (3) inches and terminating in a space not less than six (6) inches in depth in front of, or open to, the front or firebox side of the appliance. The space shall extend from the floor to the ceiling of the appliance room.

2110.9 GRAVITY-TYPE WARM-AIR FURNACES: Gravity-type warm-air furnaces shall be provided with combustion air supply specified in this section.

TABLE 2110-1 APPLIANCE ROOM COMBUSTION AIR REQUIREMENTS IN COLD CLIMATES (TIGHT CONSTRUCTION)

TYPE OF OPENINGS	Minimum total free area of ducts or openings, where volume of compartment is less than 16 times of the appliances therein	Minimum total free area of ducts or openings, where volume of compartment is more than 16 times of the appliances therein
Direct Opening or Vertical Ducts to Outside	1 Square Inch for each 4000 B.t.u.'s	1 Square Inch for each 5000 B.t.u.'s
Horizontal Ducts to Outside	1 Square Inch for each 2000 B.t.u.'s	1 Square Inch for each 2500 B.t.u.'s
To Inside * of Building	1 Square Inch for each 1000 B.t.u.'s	1 Square Inch for each 2000 B.t.u.'s

*Combustion air shall be taken from other interior areas complying with Section 2110.2

2110.10 EXHAUST AND VENTILATION SYSTEMS: Air requirements for the operation of exhaust fans, kitchen ventilation systems, clothes dryers and fireplaces shall be considered in determining the adequacy of a space to provide combustion air requirements.

2110.11 COLD CLIMATE: Appliance rooms of unusually tight construction located in areas where temperatures prevail at lower than 20°F., may be provided with combustion air as set forth in Table 2110.1. Opening shall conform to Section 2110.3.

EXCEPTION: Sealed combustion systems.

SECTION 2111.0 WARM-AIR FURNACE

2111.1 INSTALLATION: A direct-fired furnace shall not be located downstream from a regrigerant evaporator or other air cooling coil unless the heating equipment is listed for such use.

A refrigerant evaporator or cooling coil shall not be located in the air discharge duct of a warm-air furnace except where the furnace is listed for operation at not less than 0.5-inch water column static pressure or for use with a cooling coil.

Conversion of existing furnaces for use with cooling coils shall be permitted only if approved by the building official.

2111.2 COMBUSTION AIR: Fuel-burning warm-air furnaces shall be supplied with adequate combustion air as required by Section 2110.0 of this article.

The combustion chamber opening shall be separated from the fan plenum of a forced air furnace by an airtight separation.

2111.3 WORKING SPACE: A working space not less than thirty (30) inches deep and thirty (30) inches high shall be provided to the front or firebox side of all furnaces.

A space not less than twenty-four (24) inches wide and thirty (30) inches high shall be provided to the access panel to the temperature limit control, air filter and where applicable, fuel control valve. A space not less than twenty-four (24) inches wide and eighteen (18) inches high shall be provided to the vent collar of fuel-burning furnaces.

2111.4 PROHIBITED LOCATION: Warm-air furnaces shall not be located in a bedroom, bathroom, closet or confined space with access only to such room or space.

EXCEPTIONS:

a) Access to attic or underfloor furnaces may be through a closet.

b) Sealed combustion systems.

c) Enclosed furnaces.

d) Electric furnaces.

2111.5 ROOM ACCESS: Any room containing a warm-air furnace shall have access thereto by a door and passageway of not less than two (2) feet by six (6) feet six (6) inches and large enough to permit removal of equipment.

EXCEPTION: Underfloor and attic installations.

2111.6 CLEARANCE OF WARM-AIR FURNACES: Clearances shall be provided for warm-air furnaces in accordance with the requirements of Table 2109-1 or their listing. The clearance of the combustion chamber opening side shall be not less than six (6) inches for fuel-burning appliances.

2111.7 ATTIC FURNACES: A warm-air furnace installed in an attic less than five (5) feet in height shall be listed for that location.

A passageway thirty (30) inches by thirty (30) inches minimum shall be provided from the attic opening to the furnace and its controls. The opening and passageway shall be large enough to allow replacement of any part and the attic opening shall not be located more than twenty (20) feet from the furnace measured along the center line of the passageway. The passageway shall be unobstructed and have solid flooring not less than twenty-four (24) inches wide.

2111.8 UNDERFLOOR FURNACES: Warm-air furnaces installed in the underfloor area shall comply with the following requirements:

a) An access opening and passageway shall be provided of sufficient height and width to permit removal of the furnace but not less than thirty (30) inches by thirty (30) inches and which extends to the working space in front of the furnace. The distance from the passageway opening to the heating equipment shall not exceed twenty (20) feet.

b) Furnaces supported on the ground shall rest on concrete or masonry bases extending not less than three (3) inches above the adjoining ground level.

c) Furnaces suspended from the building shall have a clearance of at least six (6) inches from the ground. Furnace excavations shall extend to a depth of not less than six (6) inches below and twelve (12) inches beyond the sides of the furnace, except that the control side shall have a clearance of not less than thirty (30) inches. Walls of excavations exceeding twelve (12) inches in depth shall be lined with concrete masonry extending not less than four (4) inches above the adjoining ground level. In flood plane areas not less than a twelve (12) inch clearance shall be provided between the furnace and finish grade.

2111.9 EXTERIOR FURNACES: Warm-air furnaces located on the roof of a building shall be listed for outdoor installation and approved for such use.

Warm-air furnaces installed on the exterior of buildings shall comply with the following requirements:

a) Unless listed for outside installation, an appliance located on the exterior of a building shall be enclosed in a weather-resistant housing. A weatherproof housing may be constructed of No. 24 gage galvanized steel or No. 22 gage aluminum. The enclosure shall have not less than a six (6) inch clearance from the furnace.

b) The appliance shall be installed on a level platform.

c) For ground installations the appliance shall be supported on a concrete or masonry base extending not less than three (3) inches above the adjoining ground level.

2111.10 CIRCULATING AIR SUPPLY--GENERAL: The circulating air supply shall be taken from outside the building or from the conditioned area inside the building or from both sources.

The circulating air supply for a forced air comfort heating system shall be conducted through ducts complying with Section 2114.0 or through concealed spaces provided vent or vent connectors do not extend into or through these spaces.

A volume damper shall not be placed in the circulating air supply inlet so as to reduce the supply to the furnace.

The outside circulating air supply inlet shall be covered with screen having one-quarter (1/4) inch openings.

2111.11 CIRCULATING AIR SUPPLY--REQUIREMENT: The unobstructed area of circulating air supply openings to a gravity-type warm-air furnace shall be not less than seven (7) inches for each input of one thousand (1000) B.t.u. rating or as required by the listing conditions of the furnace.

The unobstructed area of circulating air supply openings or ducts to a forced air warm-air furnace shall be not less than two (2) square inches for each input of one thousand (1000) B.t.u. rating of the furnaces or as required by the conditions of listing.

The total area of circulating air supply openings need not be larger than the minimum sized circulating air supply opening as required by the conditions of listing.

2111.12 CIRCULATING AIR SUPPLY--SOURCE: The circulating air supply for a comfort heating system shall not be taken from the following locations:

a) Within ten (10) feet of an appliance or plumbing vent outlet which is located less than three (3) feet above the circulating air supply inlet.

b) Areas having objectionable odors, fumes or flammable vapors.

c) Areas whose volume is less than twenty-five (25) percent of the volume served by the system and where permanent openings to supplemental areas are not provided in accordance with this section.

EXCEPTION: Openings for a warm-air furnace may be reduced to not less than fifty (50) percent of the required circulating air supply area provided the balance is taken from a room or hall having at least three (3) doors leading to other rooms served by the furnace.

d) Areas having a direct-fired fuel-burning appliance.

EXCEPTIONS:

1) A gravity-type comfort heating system.

2) A blower-type comfort heating system where the circulating air supply is taken from an area having a volume exceeding one (1) cubic foot for each ten (10) B.t.u.'s of fuel input rating of all fuel-burning appliances therein and at least seventy-five (75) percent of the conditioned air is discharged back into the area provided the circulating air supply inlet is not located within ten (10) feet of an appliance firebox or draft diverter.

2111.13 CONDITIONED AIR SUPPLY: The minimum unobstructed total area of the conditioned air ducts from a blower-type warm-air furnace shall be not less than two (2) square inches for each one thousand (1000) B.t.u. approved hourly input rating of the furnace and the minimum unobstructed total area of the conditioned air ducts from a gravity-type warm-air furnace shall be not less than seven (7) square inches for each one thousand (1000) B.t.u. approved hourly input rating or as specified by the conditions of listing of the furnace.

In no case need the total area of the conditioned air ducts be larger than the outlet plenum collar opening on the furnace.

For the purpose of this section a volume damper, grill, or register installed for the purpose of controlling the conditioned air flow shall not be considered an obstruction.

SECTION 2112.0 VENTED DECORATIVE APPLIANCES, FLOOR FURNACES, VENTED WALL FURNACES AND VENTED ROOM HEATERS

2112.1 GENERAL: A vented decorative appliance, floor furnace, vented wall furnace, or vented room heater shall not be located under a stairway.

2112.2 VENTED DECORATIVE APPLIANCES: Vented decorative appliances shall comply with the requirements for comfort heating appliances.

2112.3 PROHIBITED USE: Unvented room heaters are prohibited in accordance with Chapter 688 of the Acts of 1962 of the General Laws of the Commonwealth of Massachusetts.

2112.4 FLOOR FURNACES LOCATION: Flat floor furnaces shall be installed not less than six (6) inches from walls.

Wall register floor furnaces shall be installed not less than six (6) inches from inside room corners.

EXCEPTION: Replacement floor furnaces of the same or lesser input rating may be installed in the original location when approved by the building official.

Floor furnaces shall not be located where draperies or a door can swing within twelve (12) inches of the warm air outlet.

Floor furnaces warm air outlets shall not be installed less than sixty (60) inches below overhead projections.

A clear floor space of fifteen (15) inches shall be provided along two (2) adjoining sides of flat floor furnaces.

The floor furnace burner assembly shall not project into an occupied underfloor area.

2112.5 FLOOR FURNACE ACCESS: An opening and passageway not less than twenty-four (24) by eighteen (18) inches shall be provided to every floor furnace. The passageway shall be not more than twenty (20) feet in length from the access opening or from an underfloor area thirty (30) inches or more in height.

2112.6 FLOOR FURNACE INSTALLATION: Floor furnaces shall be supported independently of the grill and shall have not less than six (6) inches clearance from grade.

EXCEPTION: Sealed furnaces may have a grade clearance of two (2) inches minimum.

Furnace excavations shall extend not less than eighteen (18) inches beyond the control side and twelve (12) inches beyond the sides and back of the furnace. The excavation shall slope outward from the bottom to the natural grade at an angle not greater than forty-five (45) degrees from the horizontal.

Floor furnaces shall not be installed on concrete slabs on grade.

2112.7 WALL FURNACE LOCATION: Vented wall furnaces designed to be installed in a nominal four (4) inch wall shall be not less than six (6) inches from inside room corners except where listed

for reduced clearances.

EXCEPTION: Vented wall furnaces replacements approved by the building official.

Vented wall furnaces shall not be located where a door can swing within twelve (12) inches of the furnace air inlet or outlet and shall not be installed less than eighteen (18) inches below overhead projections.

2112.8 WALL FURNACE COMBUSTION AIR: Vented wall furnaces shall be provided with combustion air in accordance with Section 2110.0.

EXCEPTION: Combustion air openings may be omitted to the area in which a vented wall furnace is installed provided a cased opening or archway leads from that area into other rooms having a minimum combined volume in cubic feet equivalent to one-twentieth (1/20) of the input B.t.u. rating of the furnace.

2112.9 WALL FURNACE INSTALLATION: Ducts shall not be attached to a wall furnace. Casing extensions or boots may be installed if listed as part of the appliance.

2112.10 VENTED ROOM HEATERS: Floor mounted type unit heaters shall be installed in accordance with Table 2109-1.

2112.11 ROOM HEATERS: Vented room heaters shall be installed in accordance with Table 2109-1 or as listed.

2112.12 UNVENTED ROOM HEATERS: No unvented fuel-burning room heaters shall be installed.

SECTION 2113.0 VENTING OF APPLIANCES

2113.1 GENERAL: All fuel-burning comfort heating and comfort cooling appliances shall be vented to the outside. Venting systems shall consist of approved chimneys, approved vents or a venting assembly which is an integral part of a listed appliance or may be designed in accordance with accepted engineering practices.

Venting systems which are integral parts of vented appliances shall be installed in accordance with the terms of their listing, manufacturer's installation requirements and applicable requirements of this article.

2113.2 COMMONWEALTH OF MASSACHUSETTS REQUIREMENTS: Gas vents required for appliances or equipment using fuel gases of any kind such as natural gas, manufactured gas, undiluted liquified petroleum gases, liquified petroleum gas-air mixtures, or mixtures of any of these gases shall comply with the requirements of the Massachusetts Code for Installation of Gas Appliances and Gas Piping, established under Chapter 737, Acts of 1960.

2113.3 TYPE OF VENTING SYSTEMS REQUIRED: Gas appliances shall be vented in conformance with the regulations provided in Section 2113.2. Oil burning appliances may be used with type L ventes where so listed.

2113.4 INSTALLATION AND CONSTRUCTION: Manually operated dampers shall not be placed in chimneys, vents or vent connectors of liquid or gas-burning appliances. Fixed baffles on the appliance side of draft hoods and draft regulators shall not be classified as dampers.

Automatically operated dampers shall be of approved type designed to maintain a safe damper opening and arranged to prevent firing of the burner unless the damper is opened to a safe position.

2113.5 LOCATION: Vents shall not extend into or through an air supply duct or plenum.

EXCEPTION: Venting systems may pass through a combustion air duct.

Appliances shall not be vented into a fireplace or into a chimney serving a fireplace.

2113.6 LENGTH PITCH--CLEARANCE: Gravity vents shall not have more than two (2) offsets of more than forty-five (45) degrees from the vertical.

The horizontal run of a gravity vent and its connectors shall not be greater than seventy-five (75) percent of the vertical height of the venting system measured from the appliance outlet.

Vent connectors in gravity-type venting systems shall have continuous rises of not less than one-quarter (1/4) inch per foot of length measured from the appliance vent collar to the vent.

Single wall metal vent connectors for an appliance shall be located entirely within the room or area where the appliance is located.

2113.7 VENT TERMINATION--GENERAL: Vents shall extend above the roof surface, through a flashing and terminate in a listed vent cap.

2113.8 GRAVITY VENT TERMINATION: Gravity-type venting systems, other than Type BW or venting systems which are integral with listed appliance, shall terminate not less than five (5) feet above the highest vent collar which they serve.

2113.9 B OR BW VENT TERMINATION: Type B or BW gas vents shall terminate not less than one (1) foot above the roof nor less than four (4) feet from a portion of the building which extends at an angle of more than forty-five (45) degrees upward from the horizontal.

2113.10 L VENT TERMINATION: Type L venting systems shall terminate not less than two (2) feet above the roof nor less than four (4) feet from a portion of the building which extends at an angle of more than forty-five (45) degrees upward from the horizontal.

2113.11 SPECIAL VENT REQUIREMENTS: Venting systems shall terminate not less than four (4) feet below, four (4) feet horizontally from or one (1) foot above a door, window or gravity air inlet into a building.

EXCEPTION: Venting systems which are integral parts of listed equipment may be located closer provided the door, window or gravity air inlet is serving the same room in which the appliance is located; the venting system does not terminate less than nine (9) inches from the door, window or gravity air inlet; and the appliance does not exceed an input rating of fifty thousand (50,000) B.t.u.'s.

Venting systems shall terminate not less than three (3) feet above forced air inlets located within ten (10) feet (horizontally); nor less than four (4) feet from private property lines.

2113.12 VENT SIZE: Vent systems shall have internal cross-sectional areas of not less than the area of the vent collars but not less than seven (7) square inches except where the vents are integral parts of listed appliances.

2113.13 MULTIPLE APPLIANCE VENTING SYSTEMS: Two (2) or more listed appliances may be connected to common gravity-type venting systems provided the appliances are equipped with listed primary safety controls and listed safety shutoff devices for oil and gas fuel respectively and comply with the following requirements:

a) Appliances which are connected to common venting systems shall be located in the same story of the building, except engineered systems as set forth in Section 2113.1.

b) Two (2) or more connectors shall not enter common venting systems unless the inlets are offset so that no portion of an inlet is opposite the other inlets.

c) The venting system area shall be not less than the area of the largest vent connector plus fifty (50) percent of the areas of the additional vent connectors. An oval vent may be used provided its capacity is not less than the capacity of the round vent for which it is substituted.

2113.14 EXISTING VENTING SYSTEMS: Existing venting systems may be connected to replaced appliances in accordance with the following requirements:

a) The venting system shall have been installed in accordance with the Code in effect at that time and have no apparent defects.

b) The internal area of the venting systems shall be in accordance with Section 2113.11.

2113.15 DRAFT HOODS: Draft hoods shall be located in the same room or space as the combustion air openings of the appliances and shall be located so that the relief opening is not less than six (6) inches from any surface other than the appliance it serves, measured in a direction ninety (90) degrees to the plane of the relief opening.

2113.16 FACTORY-BUILT CHIMNEYS: Approved factory-built chimneys shall be installed in accordance with the terms of their listing, the manufacturer's instructions, and the applicable requirements of this article.

2113.17 MASONRY CHIMNEYS DESIGN: Masonry chimneys shall be designed, anchored, supported and reinforced as set forth in Section 2107.0 of this article.

SECTION 2114.0 DUCTS

2114.1 MATERIAL: Ducts conveying air from outside the building or air from evaporative coolers shall be constructed of galvanized steel or corrosion-resistive metal.

Ducts or concealed spaces used for inside circulating air may be of combustible material. Where space between studs in walls or partitions is used as a duct the portions of such space so used shall be cut off from all remaining unused portions by tight-fitting stops of sheet metal or of wood not less than two (2) inches nominal thickness. Not more than one (1) firestop may be crossed.

Ducts conveying heated conditioned air shall be of noncombustible material.

Approved ducts, plenums and fittings constructed of asbestos-cement, concrete or ceramic may be installed in the ground or in a concrete slab.

Metal ducts shall conform to Table 2114-1.

Ducts constructed of gypsum products shall not be subject to air temperatures of more than 125°F.

2114.2 INSTALLATION: When required, ducts shall be insulated equivalent to Table 2114-2 and metal ducts shall be securely fastened in place at changes of direction in accordance with Table 2114-3.

Metal ducts shall not be installed within four (4) inches of the ground except when encased in not less than two (2) inches of concrete.

Rectangular metal duct supports set forth in Table 2114-3 shall be riveted, bolted or screwed to each side of the duct.

Horizontal round duct supports set forth in Table 2114-3 shall

TABLE 2114-1 GAGES OR METAL DUCTS AND PLENUMS USED FOR COMFORT HEATING OR COOLING FOR A DWELLING UNIT

	COMFORT HEATING OR COOLING		
	GALVANIZED STEEL		Approximate Aluminum B & S Gage
	Nominal Thickness (in inches)	Equivalent Galvanized Sheet Gage Number	
Round Ducts and Enclosed Rectangular Ducts 14" or less Over 14"	 0.016 0.019	 30 28	 26 24
Exposed Rectangular Ducts 14" or less Over 14"	 0.019 0.022	 28 26	 24 23

TABLE 2114-2 INSULATION OF DUCTS[1]

DUCT LOCATION		
Roof or Exposed to Outside Air	B and W	
Attics[3]	A	
Underfloor Spaces	A	
Within the Conditioned Space[2]		None Required
Cement Slab or Within Ground		None Required

Note A: One (1) inch of fiber glass or rock-wool insulation with a minimum density of 0.65 pound per cubic foot or two (2) layers of one-quarter (¼) inch air cell asbestos or air cell foil.

NOTES FOR TABLE 2114-2 (Continued)

Note B: Two (2) inches of fiber glass or rock-wool insulation with a minimum density of 0.75 pound per cubic foot or four (4) layers of one-quarter (¼) inch air cell asbestos or one-quarter (¼) inch air cell foil, or one (1) inch fiber glass insulation with a minimum density of one and one-half (1½) pounds per cubic foot.

Note W: Approved weatherproof vapor barrier.

Note 1: Insulation not required for evaporative systems.

Note 2: Insulation may be omitted on that portion of a duct which is located within a vertical wall space if the wall space is directly adjacent to the occupied portion of the building.

Note 3: Vapor barrier should be provided for cooling ducts in attics or areas of high humidity.

TABLE 2114-3 METAL DUCT SUPPORTS

DUCT TYPE	MAX. SIDE OR DIA.	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	24	Vertical	1" x 1/8" steel galvanized strap @ 12' o.c.
		Horizontal	No. 18 gage galvanized steel x 1" @ 10' o.c.
	36	Vertical	1" x 1-1/8" steel galvanized angle @ 12' o.c.
		Horizontal	1" x 1/8" steel strap galvanized @ 10' o.c.

consist of one (1) hanger installed in accordance with the following requirements:

a) The hanger shall be attached to one (1) inch wide circular bands of same gage as duct extending around and supporting ducts exceeding ten (10) inches in diameter.

b) The ducts shall be braced to prevent lateral displacement.

SECTION 2115.0 COMFORT COOLING

2115.1 COMMONWEALTH OF MASSACHUSETTS RULES AND REGULATIONS: All installations of gas appliances shall be subject to and must comply with the Massachusetts Code for Installation of Gas Appliances and Gas Piping established under Chapter 737 of the MGLA as amended. All oil-burning appliances shall be subject to the regulations made in accordance with Section 10 of Chapter 148 of the MGLA as amended, governing the construction, installation and operation of oil-burning equipment. Also, compliance shall be required with the provisions of the rules and regulations issued by the Board of Boiler Rules under the authority of Chapter 146 of the MGLA, as amended, governing the construction, installation, testing and inspection of boilers, air tanks, ammonia compressor safety valves, and refrigeration and air-conditioning systems of five (5) tons or more capacity.

2115.2 COOPERATING AGENCIES: Nothing herein contained shall be deemed to nullify the federal, state or municipal rules and regulations governing the storage and use of flammable and explosive gases and chemicals, or the requirements of the Interstate Commerce Commission or other federal statutes governing the transportation and use of hazardous gases, explosives and other flammablve substances.

2115.3 PERMITS: One and two-family dwellings shall not be required to have permits unless the refrigerating systems contain more than ten (10) pounds of refrigerants or are actuated by motors or engines of one and one-half (1 1/2) horsepower or larger.

2115.4 INSTALLATION: Group 2 refrigerants shall not be used in direct refrigerating systems.

An approved means shall be provided for the collection and disposal of condensate from the air cooling coil to outside the building or other approved locations.

Comfort cooling equipment, other than ducts and piping, shall be located not less than three (3) inches above the ground.

Electric lighting shall be provided for equipment located inside a building.

2115.5 ACCESS: Equipment requiring servicing shall be accessible by means of passageway two (2) feet by six (6) feet six (6) inches minimum.

EXCEPTION: An access opening to the attic or underfloor area may be reduced to a thirty (30) inch dimension provided the equipment can be replaced.

Equipment shall be provided with an unobstructed space thirty (30) inches by six (6) feet six (6) inches minimum on the service side.

EXCEPTION: The height of the working space may be reduce to thirty (30) inches for an air handling unit, air filter or refrigerant and brine control valves. Fan coils in drop ceilings may be serviced through combination return air grills.

2115.6 CIRCULATING AIR SUPPLY SOURCE: A positive separation shall be provided between the combustion air and the circulating air supply.

The circulating air supply source shall conform to the requirements of a blower type comfort heating system as set forth in Section 2111.10.

2115.7 RETURN AIR LIMITATION: Comfort cooling systems shall be arranged so that the circulating air from one (1) dwelling unit does not discharge into another dwelling unit.

2115.8 SCREEN: Exterior circulating air supply inlets shall be covered with screen having one-quarter (1/4) inch openings.

2115.9 REFRIGERANT PIPING: All refrigerant pipe and fittings installed within a building or structure and which may reach surface temperatures that will result in condensation forming on the piping shall be insulated.

SECTION 2116.0 ABSORPTION UNITS AND ABSORPTION SYSTEMS FOR COMFORT COOLING AND COMFORT HEATING

2116.1 GENERAL: Absorption units used for comfort heating or comfort cooling systems shall conform to the requirements of Sections 2109.0, 2110.0 and 2114.0.

2116.2 IDENTIFICATION: Fuel-burning absorption units shall bear a label containing the following information:

a) Manufacturer's name

b) Model number

c) Amount and type of refrigerant

d) Factory test pressures or pressures applied

e) Normal B.t.u. input rating

f) Cooling capacity in B.t.u.'s

g) Type of fuel

h) Symbol of the organization certifying the approval of the equipment

i) Instructions for the lighting, operation and shutdown of the system

SECTION 2117.0 FUEL SUPPLY SYSTEMS

2117.1 GENERAL: New fuel supply systems, except parts thereof controlled and maintained by a public utility, shall conform to the requirements of this section and shall not be made operative until first approved by the building official.

Fuel supply system design, construction and workmanship shall be consistent with generally accepted good practice and in conformity with nationally recognized applicable standards acceptable to the State Building Code Commission.

2117.2 LOCATION: Location of fuel supply tanks, meters, main shutoff valves, relief valves, and regulators other than integral appliance regulators shall be approved by the building official and shall conform to state and local regulations.

2117.3 AUTHORITY TO DISCONNECT: The building official is hereby authorized to order disconnected any fuel supply or appliance which does not conform to this Code or which is found to be defective and may endanger life or property.

A notice shall be attached to the piping or appliances stating the reasons for disconnection. Such notice shall not be removed nor shall the system or appliance be reconnected until authorized by the building official.

2117.4 PIPING SUPPORT: Gas piping shall be supported by metal straps or hooks at not more than six (6) feet on center for piping one (1) inch or less in size and not more than ten (10) feet on center for piping larger than one and one-quarter (1 1/4) inches. Piping shall be protected against physical damage. Buried piping shall be laid in a solid bed.

Gas piping shall not be strained or bent and appliances shall not be supported by supply piping.

2117.5 LIQUID FUEL SUPPLY: Supply piping and all related equipment serving oil-burning appliances shall be subject to the Rules and Regulations promulgated in FPR-3 made in accordance with the provisions of Section 10 of Chapter 148 of the MGLA as amended.

Reference Standards - Article 21

RS-21-1 Shower Compartment Finish

Glazed Ceramic Wall Tile installed with Portland Cement Mortar. ANSI A108.1-1967

Ceramic Tile installed with Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy-ANSI A108.6-1969

Dry-Set Portland Cement Mortar (for installation of ceramic tile)-ANSI A118.1-1967

Chemical Resistant, Water Cleanable Tile-Setting and Grouting Epoxy-ANSI A118.3-1969

Organic Adhesives for Installation of Ceramic Tile-ANSI A136.1-1967 (Type I only in Shower Compartments)
Standard Specification for Ceramic Tile-ANSI A137.1-1967

Ceramic Tile installed with Dry-Set Portland Cement Mortar. ANSI A108.5-1967

Ceramic Mosaic Tile Installed with Portland Cement Mortar. ANSI A108.2-1967

Ceramic Tile Installed with Water-Resistant Organic Adhesives. ANSI A108.4-1968

RS-21-2 Glazing Materials

Glass. F.S. DD-G 451c

Safety Glazing Materials. ANSI Z97.1-1972

RS-21-3 Foundations

Building Brick and Facing Brick. (Made from Clay or Shale.) Standard Specifications C62-58 and C216-66 of the ASTM.

Sand-Lime Building Brick. Standard Specification C73-51 of the ASTM.

Concrete Building Brick. Standard Specification C55-55 of the ASTM.

Hollow Load-Bearing Concrete Masonry Units. Standard Specification C90-59 of the ASTM.

Solid Load-Bearing Concrete Masonry Units. Standard Specification C145-59 of the ASTM.

Method of Test for Concrete Masonry Units. Standard Specification C140-63T of the ASTM.

Structural Clay Load-Bearing Wall Tile. Standard Specifications C34-62 and C112-60 of the ASTM.

Cast Stone. Specification ACI 704-44 of the American Concrete Institute.

Cold-Drawn Steel Wire for Concrete Reinforcement. Standard Specification A82 of the ASTM.

Cement, Masonry. Standard Specification C91-67 of the ASTM.

Quicklime for Structural Purposes. Standard Specification C5-59 of the ASTM.

Hydrated Lime for Masonry Purposes. Standard Specification C207-49 of the ASTM.

Processed Pulverized Quicklime. Standard Specification C51-47 of the ASTM.

Mortar for Masonry Other than Gypsum. Specifications C161-44T and C270-59T of the ASTM.

Aggregate for Masonry Mortar. Specification C144-52T of the ASTM.

Aggregates for Grout. Standard Specification C404 of the ASTM.

Sampling and Testing Brick. Standard Specification C67-60 of the ASTM.

Portland Cement. Standard Specifications C150-62 and C175-66 of the ASTM.

Portland Blast Furnace Slag Cement. Specification C205-62T of the ASTM.

Portland Pozzolan Cement. Specification C340-62T of the ASTM.

Concrete Aggregates. Specification C33-61T of the ASTM.

Concrete Proportions. ACI 613-54 and 613A-59 of the American Concrete Institute.

Concrete Reinforcement. Specifications A615-68, A616-68, A617-68 and A82-66 of the ASTM.

Steel Bar Mats. Standard Specifications A184-65, A615-68, A616-68 and A617-68 of the ASTM.

Welded Steel Wire Fabric. Specification A185-61T of the ASTM.

Admixtures for Concrete. Standard Specification C494-62T of the ASTM.

Concrete Tests. Standard Specifications C31-62, C39-61, C42-61 and C192-62 of the ASTM.

Splitting Tensile Strength. Specification C496-62T of the ASTM.

Ready-Mixed Concrete. Standard Specification C94-62 of the ASTM.

Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction. AWS D12. 1-61 of the American Welding Society.

Hollow Brick. (Hollow Masonry Units Made from Clay or Shale) Standard Specification C652-70 of the ASTM.

Building Brick and Facing Brick. (made from Clay or Shale) Standard Specifications C62-69 and C216-69 of the ASTM.

Mortar for Masonry Other than Gypsum. Standard Specification C270-68 of the ASTM.

Aggregate for Masonry Mortar. Standard Specification C144-70 of the ASTM.

Aggregate for Masonry Grout. Standard Specification C404-70 of the ASTM.

Methods of Sampling and Testing Brick. Standard Specification C67-66 of the ASTM.

Applicable Standards or Publications in Reference Standard RS-21-5.

RS-21-4 Preservatives

AWPB Standards CP-22, CP-33, CP-44, CP-55, and CP-77 for pressure treated poles.

AWPB Standards LP-2, LP-3, LP-4, LP-5 and LP-7 for pressure treated softwood lumber used above ground.

AWPB Standards LP-22, LP-33, LP-44, LP-55 and LP-77 for pressure treated softwood lumber used in contact with the ground.

RS-21-5 Wall Construction

Applicable Standards or Publications in Reference Standard RS-21-3.

Classification, Definition and Methods of Grading for all Species of Lumber. Standard D245-70 of the ASTM; American Softwood Lumber Standards PS 20-70 of the U.S. Department of Commerce.

Eastern Pine, Jack Pine, Eastern Spruce, Balsam Fire, Eastern Hemlock and Tamarack. Grading Rules, Northern Hardwood and Pine Manufacturers Association (September 1, 1970).

National Design Specification for Stress-Grade Lumber and Its Fastenings. National Forest Products Association 1970 with May 1971 Supplement.

Northeastern Lumber-Standard Grading Rules, Northeastern Lumber Manufacturers Association (September 1970).

Pine, Southern. Grading Rules, Southern Pine Inspection Bureau (September 1970).

Redwood. Specifications for Grades of California Redwood Lumber of the Redwood Inspection Service (November 1970).

Softwood Plywood. Construction and Industrial Product Standard PS 1-66 (June 1969) of the U.S. Department of Commerce, Bureau of Standards.

TPI 1970 Roof Truss Specification.

West Coast Lumber. Standard Grading Rules, West Coast Lumber Inspection Bureau (September 1, 1970).

Western Lumber. Standard Grading Rules, Western Wood Products Association (September 1, 1970).

Wood Poles. Specification and Dimensions for Wood Poles, ANSI 05.1-1963.

Plank-and-Beam Framing. Wood Construction Data No. 4, National Forest Products Association.

Fiberboard Nail-Base Sheathing and Structural Insulating Board. Standard Specifications D2277-66 and C208-66 of the ASTM.

Particleboard. U.S. Department of Commerce, Commercial Standard CS 236-66.

Material Specifications for Structural Steel. Standard Specifications A27, A36, A53, A148, A167, A235, A237, A242, A245, A252, A303, A307, A325, A354, A374, A375, A412, A440, A441, A446, A449, A490, A500, A501, A502, A514, A529, A570, A572 and A588 of the ASTM.

Standard Specification for Structural Glued Laminated Timber Using "E" Rated and Visually Graded Lumber of Douglas Fir, Southern Pine, Hem-Fir and Lodepole Pine, August 1971, American Institute of Timber Construction.

Canadian Lumber-National Lumber Grades Authority 1970 Standard Grading Rules for Canadian Lumber, by Canadian Lumber Standards Administrative Board.

Specifications for Aluminum Structures of the Aluminum Association.

Connectors other than those specified in Section 2102.0 of this Code may be used in accordance with **Table** RS-21-6.

Specification for the Design, Fabrication and Erection of Structural Steel for Buildings, American Institute of Steel Construction, 1969 Edition and Supplements Nos. 1 and 2.

RS-21-6 Wall Covering

Applicable Standards and Publications in Reference Standards RS-21-2 and RS-21-5.

Aluminum Structures. Specifications for, by the Aluminum Association (November 1967).

Plaster Liquid Bonding Agents. U.S. Government Military Specification MIL-B-19235 (Docks) (1965), and Standards Specifications of the California Lathing and Plastering Contractors Association (1965), and Recommendations of the Gypsum Association.

Adhesives for Fastening Gypsum Wallboard to Wood Framing. Specification C557-67 of the ASTM.

Perlite, Vermiculite and Sand Aggregates for Gypsum and Portland Cement Plaster. Standard Specification C35-70 of the ASTM.

Metal Lath, Wire Lath, Wire Fabric Lath and Metal Accessories. Approved Standard A42.4-1967, of the American National Standards Institute, Inc.

Gypsum Wallboard Tape and Joint Compound. Standard Specifications C475-70 and C474-67 of the ASTM.

Gypsum Backing Board. Standard Specification C442-67 of the ASTM.

Gypsum Lath. Standard Specification C37-69 of the ASTM.

Lime. Standard Specifications C206-68 and C6-49 of the ASTM.

Gypsum Plasters. Standard Specification C28-68 of the ASTM.

Gypsum Sheathing Board. Standard Specification C79-67 of the ASTM.

Gypsum Veneer Plaster. Standard Specification C587-68 of the ASTM.

Gypsum Veneer Base. Standard Specification C588-68 of the ASTM.

TABLE RS-21-6 ALTERNATE ATTACHMENTS

NOMINAL MATERIAL THICKNESS	DESCRIPTION[1,2] OF FASTENER & LENGTH	SPACING[3] OF FASTENERS	
		EDGES	INTERMEDIATE SUPPORTS
Plywood Subfloor, Roof and Wall Sheathing to Framing			
5/16"	.097 - .099 Nail 1½" Staple 15 ga. 1-3/8"	6"	12"
3/8"	Staple 15 ga. 1-3/8"	6"	12"
	.097 - .099 Nail 1½"	4"	10"
1/2"	Staple 15 ga. 1½"	6"	12"
	.097 - .099 Nail 1-5/8"	3"	6"
5/8"	.113 Nail 1-7/8" Staple 15 and 16 ga. 1-5/8"	6"	12"
	.097 - .099 Nail 1¾"	3"	6"
3/4"	Staple 14 ga. 1¾"	6"	12"
	Staple 15 ga. 1¾"	5"	10"
	.097 - .099 Nail 1-7/8"	3"	6"
1"	Staple 14 ga. 2"	5"	10"
	.113 Nail 2¼" Staple 15 ga. 2"	4"	8"
	.097 - .099 Nail 2-1/8"	3"	6"
Floor Underlayment; Plywood – Hardboard – Particleboard			
1/4" and 5/16"	.097 - .099 Nail 1½" Staple 15 and 16 ga. 1¼"	6"	12"
	.080 Nail 1¼"	5"	10"
	Staple 18 ga. 3/16 crown 7/8"	3"	6"
3/8"	.097 - .099 Nail 1½" Staple 15 and 16 ga. 1-3/8"	6"	12"
	.080 Nail 1-3/8"	5"	10"
1/2"	.113 Nail 1-7/8" Staple 15 and 16 ga. 1½"	6"	12"
	.097 - .099 Nail 1¾"	5"	10"

Note 1: Nail is a general description and may be T-head, modified round head, or round head.

Note 2: Staples shall have a minimum crown width of seven-sixteens (7/16) inch o.d. as noted.

Note 3: Nails or staples shall be spaced at not more than six (6) inches o.c. at all supports where spans are forty-eight (48) inches or greater. Nails or staples shall be spaced at not more than ten (10) inches o.c. at intermediate supports for floors.

Gypsum Wallboard. Standard Specification C36-70 of the ASTM.

Keene's Cement. Standard Specification C61-64 of the ASTM.

Gypsum Molding Plaster. Standard Specification C59-50 of the ASTM.

Gypsum Plastering. Standard Specification A42.1-1964 of the ASA.

Interior Lathing and Furring. Standard Specifications A42.4-1967 of the ASTM.

Application and Finishing of Gypsum Wallboard. Standard Specifications A97.1-65 of the ANSI.

Surface Burning Characteristics of Building Materials. Standard Method of Test E84-70 of the ASTM.

RS-21-7 Floors

Applicable Standards or Publications in Reference Standards RS-21-3 and RS-21-5.

Maximum Spans for Joists and Rafters, Technical Bulletin 2, of SFPA.

Canadian Dimension Lumber, 1971, Canadian Wood Council.

RS-21-8 Roof-Ceiling

Applicable Standards or Publications in Reference Standards RS-21-3 and RS-21-6.

Maximum Spans for Joists and Rafters, Technical Bulletin 2, of SFPA.

Canadian Dimension Lumber, 1971, Canadian Wood Council.

RS-21-9 Roof Coverings

Aluminum Sheet Metal Work in Building Construction by the Aluminum Association (October 1967).

Composition Roofing. Standard Specification 55-A (May 1967) Underwriters' Laboratories, Inc.

Roofing Asphalt. Standard Specification D312-44 of the ASTM.

Composition Roofing. Standard Specification 55-B. (April, 1962) Underwriters' Laboratories, Inc.

Sheet Metals. Standard Specifications A245-62aT, A361-63T and B209-70 of the ASTM.

Corrosion-Resistant Metals. Standard Specifications A219-58, A239-41 and B209-70 of the ASTM.

Composition Roofing Testing. Standard Specification 790 (September, 1958), Underwriters' Laboratories, Inc.

Hand-Split Shakes. Grading and Packing Rules, Hand-Split Red Cedar Shakes 1971, Red Cedar Shingle and Hand-Split Shake Bureau.

Asbestos-Cement Shingles. Standard Specification C222-60 of the ASTM.

Slate Shingles. Standard Specification C406-57T of the ASTM.

Wood Shingles. Commercial Standard CS31-52, U.S. Department of Commerce, National Bureau of Standards. Grading and Packing Rules for Red Cedar Shingles (1971) Red Cedar Shingles and Handsplit Shake Bureau.

Wire. Standard Specifications B134-62, B211-63, and B250-62 of the ASTM.

RS-21-10 Chimney and Fireplace

Applicable Standards or Publications in Reference Standards RS-21-3 and RS-21-5.

RS-21-11 Mechanical Materials

Galvanized Sheet Metals. Standard Specification A525-64T of the ASTM.

Tank Piping and Valves for Oil Burning Appliances. Pamphlet No. 31, June, 1965, of the NFPA.

Nonmetallic Ducts. Standard No. 181 of the UL.

Refrigeration. Standard No. B9.1-1964 of the ANSI.

Wrought Steel and Wrought Iron Pipe. Standard B36.10-1959 of the ANSI.

Seamless Copper Tube, Copper Pipe and Red Brass Pipe. Standard Specifications B42-62, B43-62, B68-60, B88-66, B251-66 and B280-66 of the ASTM.

Compression (neoprene) Gaskets (including hubless piping system) for Cast Iron Piping and Fittings in Condensate Drain Lines. Standard Specification C564-70 of the ASTM, or CISPI Standards HSN-72 and 301-72.

Stainless Steel Coupling (hubless piping system) for Cast Iron Piping and Fittings in Condensate Drain Lines. CISPI Standard 301-72.

Load Calculation for Residential Winter and Summer Air Conditioning. Manual J, Third Edition, of NISC.

Installation of Gas Appliances and Gas Piping. Standard No. 54, 1969 or the NFiPA.

Installation of Gas Piping and Gas Equipment on Industrial Premises and Certain Other Premises. Standard No. 54-A, 1969 of the NFiPA.

Chimeys, Fireplaces and Venting Systems. Standard No. 211, 1970 of the NFiPA.

Installation of Residence-type Warm Air Heating and Air Conditioning Systems. Standard No. 90-B, 1971 of the NFiPA.

RS-21-12 Mechanical Equipment

Applicable Standards or Publications in Reference Standard RS-21-11.

Mechanical Ventilation. Testing and Rating Procedures of Home Ventilating Institute.

RS-21-13 Smoke/Heat Detectors

NFPA Standard No. 101 of 1971-1972

NFPA Standard No. 74 of 1971-1972