

**Firefighter II, Mod B
Building Construction**

FIREFIGHTER II MOD B

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2-9 BUILDING CONSTRUCTION

- 2-9.1** Identify the basic structural characteristics of the following types of building construction: (3-3.11)
 - 2-9.1.1** Fire resistive (Type I)
 - 2-9.1.2** Noncombustible (Type II)
 - 2-9.1.3** Ordinary (Type III)
 - 2-9.1.4** Heavy timber (Type IV)
 - 2-9.1.5** Wood frame (Type V)
- 2-9.2** Identify the two basic types of light wood framing.
 - 2-9.2.1** Balloon framing
 - 2-9.2.2** Platform framing
- 2-9.3** Identify the main components of lightweight framing construction.
 - 2-9.3.1** Footing
 - 2-9.3.2** Foundation
 - 2-9.3.3** Plate
 - 2-9.3.4** Stud
 - 2-9.3.5** Joist
 - 2-9.3.6** Rafter
 - 2-9.3.7** Sill
 - 2-9.3.8** Header
 - 2-9.3.9** Ridge Board
 - 2-9.3.10** Eave
 - 2-9.3.11** Fascia
 - 2-9.3.12** Soffit
 - 2-9.3.13** Interior finish
 - 2-9.3.13.1** Plaster
 - 2-9.3.13.2** Drywall
 - 2-9.3.14** Exterior finish
 - 2-9.3.14.1** Brick Veneer
 - 2-9.3.14.2** Sheathing
- 2-9.4** Identify the three, broadly classified, categories of roofs from a firefighting standpoint.
 - 2-9.4.1** Flat roofs
 - 2-9.4.2** Pitched roofs
 - 2-9.4.3** Curved roofs
- 2-9.5** Identify structural components of large structural systems.
 - 2-9.5.1** Beams
 - 2-9.5.2** Columns
 - 2-9.5.3** Arches
 - 2-9.5.4** Cables
 - 2-9.5.5** Truss
- 2-9.6** Identify the components of Truss construction.
 - 2-9.6.1** Chords
 - 2-9.6.2** Web or Diagonal members
 - 2-9.6.3** Gusset Plate

Firefighter II, Mod B
Building Construction

- 2-9.7 Identify three (3) hazards associated with truss and lightweight construction. (3-3.11)
- 2-9.8 Identify dangerous conditions created by a fire and fire suppression activities. (3-3.9, 3-3.11)
- 2-9.9 Identify the term “building collapse”. (3-3.9, 3-3.11)
- 2-9.10 Identify five (5) indicators of building collapse. (3-3.9, 3-3.11)
- 2-9.11 Identify the effects of fire and fire suppression activities on the following building materials. (3-3.9, 3-3.11)
 - 2-9.11.1 Wood
 - 2-9.11.2 Masonry
 - 2-9.11.3 Cast Iron
 - 2-9.11.4 Steel
 - 2-9.11.5 Reinforced concrete
 - 2-9.11.6 Gypsum wallboard
 - 2-9.11.7 Glass
 - 2-9.11.8 Plaster on lath
- 2-9.12 Identify the following terms as they relate to building construction: (3-3.11)
 - 2-9.12.1 Load-bearing wall
 - 2-9.12.2 Non-load-bearing wall
 - 2-9.12.3 Party wall
 - 2-9.12.4 Fire wall
 - 2-9.12.5 Partition wall
 - 2-9.12.6 Cantilever or unsupported wall
 - 2-9.12.7 Parapet wall
- 2-9.13 Identify the effects of the following items in a burning building: (3-3.9, 3-3.11)
 - 2-9.13.1 Intense heat
 - 2-9.13.2 Dense smoke
 - 2-9.13.3 Large volume of water poured into and on the structure

REFERENCES:

IFSTA, Essentials, 4th ed., Chapter 3
Delmar, Firefighter's Handbook, copyright 2000, Chapter 13
Jones & Bartlett, Fundamentals of Fire Fighting Skills, 1st ed., Chapters 6, 14, & 21

Firefighter II, Mod B
Building Construction

2-9 Building Construction

- I. Identify the basic structural characteristics of the following types of building construction: **2-9.1 (3-3.11)**
- A. Fire Resistive (Type I)
1. Structural members are noncombustible or limited combustible materials
 2. Primary hazard contents
 3. Ability to confine fire compromised by openings.
- B. Noncombustible (Type II)
1. Similar to Fire Resistive; only degree of fire resistance less
 2. In some cases, materials with no fire resistance may be used.
 3. Primary hazard contents
 4. Heat buildup, during a fire, may cause structural supports to fail.
 5. Type of roof material may contribute to fire extension.
- C. Ordinary (Type III)
1. Exterior walls and structural members are noncombustible or limited combustible materials.
 2. Interior structural members completely or partially of wood.
 3. Wood used has smaller dimensions than Heavy Timber.
 4. Primary hazard is fire and smoke spread through concealed spaces.
- D. Heavy Timber (Type IV)
1. Exterior and interior walls and associated structural members are noncombustible or limited combustible materials.
 2. Other interior structural members are made of solid or laminated wood with no concealed spaces.
 3. Wood has large enough dimensions to be considered heavy timber.
 4. Primary hazard: the combustible contents of the structural members.
 5. Because of the amount of heat given off by the structural members, the building
May pose serious exposure protection problems.

Firefighter II, Mod B
Building Construction

- E. Wood frame (Type V)
 - 1. All walls and structural supports are made completely or partially of wood of dimensions less than Heavy Timber.
 - 2. Presents unlimited potential for fire spread.
 - 3. May present a serious exposure problem especially if exposures are of similar construction.

- II. Identify the two basic types of light wood framing. **2-9.2**
 - A. Balloon framing
 - 1. Construction can have open channels from the foundation to the attic.
 - 2. Framing is usually covered with an interior finish of plaster or drywall.
 - B. Platform framing
 - 1. Construction has each floor constructed on its own platform, reducing open channels in the wall.
 - 3. Framing is usually covered with an interior finish of plaster or drywall.

- III. Identify the main components of lightweight framing construction. **2-9.3**
 - A. Footing: That part of the building that rests on the bearing soil and is wider than the foundation wall. Also the base for a column. It spreads the weight of a wall or column and prevents settling.
 - B. Foundation: The supporting part of a wall usually of masonry or concrete and at least partially underground.
 - C. Plate: The top or bottom horizontal structural member of a frame wall or partition.
 - D. Stud: Vertical structural uprights which make up the walls and partitions in a frame building
 - E. Joist: A framing member which directly supports the floor.
 - F. Rafter: A beam that supports a roof.
 - G. Sill: The bottom rough structural member that rests on the foundation or the bottom exterior member of a window or door or other masonry below.
 - H. Head: The top of a window or doorframe.
 - I. Ridge Board: The horizontal timber or beam at the ridge of a roof, to which the upper ends of the rafters are attached.
 - J. Eave: The lower edge of a roof, usually projecting beyond the sides of a building.
 - K. Cornice: A horizontal projection that crowns or finishes the eave of a building.
 - L. Fascia: A flat vertical board located at the outer face of a cornice.

Firefighter II, Mod B
Building Construction

- M. Sofit: A lower horizontal surface such as the undersurface of eaves or cornice.
- N. Interior finish
 - 1. Plaster: A fire-resistive cementitious material that is applied over lathing, which is either a wire mesh or a gypsum board with a fibrous paper.
 - 2. Drywall: A system of interior wall finish using sheets of gypsum board and taped joints.
- O. Exterior finish
 - 1. Brick Veneer: Single thickness of brick wall facing placed over frame construction or masonry other than brick.
 - 2. Sheathing: Covering applied to the framing of a building to which siding is applied.
- IV. Identify the three, broadly classified, categories of roofs from a fire fighting standpoint. **2-9.4**
 - A. Flat roofs
 - B. Pitched roofs
 - 1. Gable roofs
 - 2. Hip roofs
 - 3. Gambrel roofs
 - 4. Mansard roofs
 - 5. Shed roofs
 - 6. Butterfly roofs
 - 7. Monitor roofs
 - 8. Saw tooth roofs
 - C. Curved roofs
- V. Identify Structural Components of large structural systems. **2-9.5**
 - A. Beams: A structural member subjected to loads perpendicular to its length
 - B. Columns: A vertical supporting member
 - C. Arches: Curved structural member in which the interior stresses are primarily compressive. Arches develop inclined reactions at their support.
 - D. Cables: Flexible structural members in which the stresses in the cable are tension stresses.
 - E. Trusses: Framed structural units made of a group of triangles in one plane.

Firefighter II, Mod B
Building Construction

- VI. Identify the member components of Truss construction. **2-9.6**
- A. Chords: Top and bottom horizontal members of a truss.
 - B. Web or Diagonal members: Vertical members between the chords.
 - C. Gusset Plate: Plate that is used to connect the members of a wood or metal truss.
- VII. Identify three (3) hazards associated with truss and lightweight construction. **2-9.7**
- A. Designed to support only own weight
 - B. If one fails, a domino effect usually occurs until total collapse has resulted
 - C. Rapid failure under fire conditions:
 - 1. Usually 5 to 10 minutes
 - 2. Wood: ¼ inch char
 - 3. Steel 1000⁰ F.
- VIII. Identify dangerous conditions created by fire and fire suppression activities. **2-9.8**
- A. Two primary types of dangerous conditions
 - 1. Conditions that contribute to the spread and intensity of the fire.
 - 2. Conditions that make the building susceptible to collapse.
 - B. Conditions that contribute to the spread and intensity of the fire.
 - 1. Fire Loading
 - a. Presence of large amounts of combustible materials in an area of a building.
 - b. Arrangement of combustible materials in a building.
 - 2. Combustible Furnishings and Finishes.
 - 3. Roof Coverings.
 - 4. Wooden Floors and Ceilings
 - 5. Large open spaces.
 - 6. Building collapse.
 - 7. Lightweight and Truss Construction.
 - 8. Construction, Renovation, and Demolition.

Firefighter II, Mod B
Building Construction

- IX. Identify the term “building collapse”. **2-9.9**
- A. Building collapse: resulting from damage to the structural system of the building caused by the fire or by fire fighting operations.
- X. Identify five (5) indicators of building collapse. **2-9.10**
- A. Indicators of building collapse:
1. Cracks or separations in walls, floors, ceilings and roof structures.
 2. Evidence of existing structural instability such as the presence of tie rods and
 3. Stairs that hold the wall together.
 3. Loose bricks, blocks or stones falling from the building
 4. Deteriorated mortar between the masonry.
 5. Walls that appear to be leaning in one direction or another.
 6. Structural members that appear to be distorted or pulling away from the walls.
 7. Fires beneath floors that support heavy machinery or other extreme weight loads.
 8. Prolonged fire exposure to the structural members.
 9. Unusual creaks and cracking noises.
- XI. Identify the effects of fire and fire suppression activities on the following building materials: **2-9.11**
- A. Wood
1. Reaction depends on
 - a. The size of the wood component
 - 1) The smaller the size, the more likely to lose integrity.
 - b. Moisture content of wood
 - c. Application of water has no adverse impact on

Firefighter II, Mod B
Building Construction

- B. Masonry
 - 1. Minimally affected by fire
 - 2. Mortar between masonry components subject to more deterioration and weakening from fire.
 - 3. Rapid cooling may cause some masonry components such as bricks, blocks or stone to spall.
 - 4. Masonry components should be inspected after extinguishment to determine signs of damage.

- C. Cast Iron
 - 1. Found only in older buildings
 - 2. Bolts and other fastening devices may fail when exposed to fire, permitting large sections of cast iron walls to fall.

- D. Steel
 - 1. Members elongate when heated.
 - a. 50 foot beam may elongate 4 inches when heated to 1000⁰ F.
 - 2. If ends are restrained, it will buckle or fail somewhere in the middle.
 - 3. Failure can be anticipated at 1000⁰ F.

- E. Reinforced concrete
 - 1. Loses strength and spalls
 - 2. Heat may cause failure of bond between concrete and steel reinforcement.

- F. Gypsum wallboard
 - 1. Excellent heat-resistant and fire-retardant properties.
 - 2. Will gradually break down under fire conditions.
 - 3. Members protected by gypsum could be exposed to high temperatures if gypsum fails.

- G. Glass/fiberglass
 - 1. Glass does not contribute to the fire load, but resins used in fiberglass will.
 - 2. Heated glass may crack when hit by a fire stream.

Firefighter II, Mod B
Building Construction

- H. Plaster on lath
 - 1. Similar to gypsum
 - 2. Large sections may fall during firefighting operations

- XII. Identify the following terms as they relate to building construction: **2-9.12**
 - A. Load-bearing wall: Walls that support structural weight.
 - B. Non-load-bearing wall: Walls that do not support structural weight.
 - C. Party wall: Load-bearing wall that supports two adjacent structures
 - D. Fire wall: Separates two structures, or divides a structure into smaller portions to prevent the spread of fire.
 - E. Partition wall: Non-load-bearing wall that divides two areas within a structure.
 - F. Cantilever or unsupported wall: Freestanding firewall usually found in shopping centers or churches.
 - G. Parapet wall: Low wall at the edge of a roof.

- XIII. Identify the effects of the following items in a burning building: **2-9.13**
 - A. Intense heat
 - 1. Causes access problems to firefighters during operations
 - 2. Contributes to fire spread

 - B. Dense smoke
 - 1. Hampers firefighting operations
 - 2. Proper ventilation is required to ensure:
 - a. Removal of smoke
 - b. Stability of building

 - C. Large volume of water poured into and on the structure
 - 1. Compromises integrity of construction materials
 - 2. Accumulation of water on the upper floors or roof will add to the live load of an already weakened structure