Essentials of Fire Fighting, 5th Edition

Chapter 4 — Building Construction

Firefighter I
Chapter 4 Lesson Goal

- After completing this lesson, the student shall be able to recognize the various components of basic building construction, understand the effects of fire on common building materials, and identify the indications of imminent building collapse and construction hazards.
Specific Objectives

1. Describe common building materials.
2. Describe construction types and the effect fire has on the structural integrity of the construction type.
3. Identify the primary strengths and weaknesses of construction types.

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Specific Objectives

4. Describe dangerous building conditions created by a fire or by actions taken while trying to extinguish a fire.

5. Identify indicators of building collapse.

(Continued)
Specific Objectives

6. List actions to take when imminent building collapse is suspected.

7. Describe hazards associated with lightweight and truss construction.
Wood

- Most common building material
- Main component of variety of structural assemblies
- Used in variety of ways
  - Load bearing walls
  - Nonload-bearing walls
Wood

- Reaction to fire depends on two factors
  - Size of wood
  - Wood’s moisture content
- May be pressure treated with fire retardants
- When burning, application of water stops charring process
Wood

- Newer construction often contains materials made of wood fibers joined by glue or binders; may be highly combustible, produce toxic gases, or rapidly deteriorate under fire conditions.
Masonry

- Does not burn so a variety of masonry walls are used in construction of fire walls.
- Minimally affected by fire and exposure to high temperatures.

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Masonry

- Components
  - Bricks
  - Stones
  - Concrete blocks
  - Mortar

- Rapid cooling may cause cracking; should be inspected for damage signs.
Cast Iron

- Typically found only on old buildings
- Was commonly used as exterior covering
- Was fastened in large sections to masonry on front of buildings
Cast Iron

- Stands up well to fire and intense heat; may crack/shatter when rapidly cooled with water
- Primary concern — Connections that hold cast iron to building can fail
Steel

- Primary material used for structural support in large modern buildings
- Structural members elongate when heated
Steel

- May buckle and fail in middle
- Temperature at which specific steel member fails depends on variables
- Recommendations exist for firefighters
- Water can cool structural members and stop elongation, reducing risk of structural collapse
Reinforced Concrete

- Internally fortified with rebar/wire mesh
- Performs well under fire conditions, can lose strength through spalling
- Prolonged heating can cause failure of bond in concrete and reinforcement
- Look for cracks and spalling
Gypsum

- Inorganic product from which plaster, wallboards are constructed
- Has high water content
- Commonly provides insulation to steel/wood structural members
- Where fails, subjects exposed structural members to higher temperatures
Glass

- Not typically structural support; used in sheet form for doors/windows
- When wire-reinforced, may provide thermal protection as separation
- If heated, may crack and shatter when struck by cold fire stream
Fiberglass

- Typically used for insulation purposes
- Glass component not significant fuel; materials used to bind fiberglass may be combustible and difficult to extinguish
Type I Construction

- Maintains structural integrity during fire
- Mainly reinforced concrete with structural members protected by insulation or automatic sprinklers

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Type I Construction

- Fire-resistive compartmentation retards spread of fire through building
- Primary fire hazards — Contents of structure, interior finishes
- Fire-resistive ability can be compromised
Type II Construction

- Similar to Type I except structural components lack insulation
- Fire-resistance rating on all parts of structure
Type II Construction

• Limited use of materials with no fire-resistance rating

• Fire protection concerns
  – Contents
  – Heat buildup causing supports to fail
  – Type of roof
Type III Construction

- Requires exterior walls/structural members be noncombustible or limited combustible
Type III Construction

- Interior structural members of wood in dimensions smaller than Type IV
- Fire concerns
  - Fire/smoke spreading through concealed spaces
  - May burn through concealed spaces and feed on combustible construction materials

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Type III Construction

- Hazards reduced considerably by placing fire-stops inside concealed spaces to limit spread of combustion by-products
Type IV Construction

- Exterior/interior walls, associated structural members of noncombustible or limited combustible materials
Type IV Construction

- Other interior members of solid or laminated wood; no concealed spaces
- Rarely used in new construction except for decorative reasons

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Type IV Construction

- Use with glue-lam beams growing
- Primary fire hazard — Massive amount of combustible contents presented by structural timbers
Type V Construction

• Exterior walls, bearing walls, floors, roofs, supports completely or partially of wood of smaller dimensions than heavy-timber construction
Type V Construction

- Used for single-family residences and apartment houses up to seven stories
- Almost unlimited potential for fire extension
- Be alert for fire coming from doors/windows extending to exterior
Strengths and Weaknesses

- Type I
- Type II
- Type III
- Type IV
- Type V
Conditions Contributing to Spread/Intensity of Fire

- Fire load
- Combustible furnishings, finishes
- Roof coverings
- Wooden floors, ceilings
- Large, open spaces
Conditions Making Building Susceptible to Collapse

- Types of construction
- Age
- Exposure to weather
- Length of time a fire burns
- Fire fighting operations
Indicators of Building Collapse

- Cracks or separations
- Evidence of existing structural instability
- Loose bricks, blocks, stones falling
- Deteriorated mortar
- Leaning walls

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Indicators of Building Collapse

- Distorted structural members
- Fires beneath floors supporting extreme weight loads
- Prolonged fire exposure to structural members

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Indicators of Building Collapse

- Unusual creaks, cracking noises
- Structural members pulling away from walls
- Excessive weight of building contents
Actions When Imminent Building Collapse Suspected

- Exit building
- Inform Command
- Clear collapse zone
- Know/heed evacuation, other emergency signals
Lightweight/Truss Construction

- Increased use one of the most serious building construction hazards
- Commonly found in homes, apartments, small commercial buildings, warehouses
- Usually use lightweight steel/wooden trusses
Lightweight/Truss Construction Hazards

- If unprotected, fail after 5-10 minutes exposure to fire
- Can fail from exposure to heat alone
- Metal gusset plates can fail quickly
- Most lack fire-retardant treatments
Lightweight/Truss Construction Hazards

- Hazards also affect wooden I-beams
- Bowstring trusses found in many old buildings
- Truss construction
Lightweight/Truss Construction Precautions

• Important that firefighters know which buildings have truss roofs/floors
• Firefighters are often not allowed to enter/go onto roofs of buildings that incorporate trusses if exposed to fire conditions for 5-10 minutes.
Summary

• Failure to recognize dangers of a particular type of construction and the effects that fire may have on it can be catastrophic for firefighters. For their safety and that of fellow firefighters, firefighters must have at least a basic knowledge of building construction.

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Firefighter I
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Summary

- Firefighters need to know about construction materials, methods, and designs in general and those that are used in their area in particular.
Summary

- Knowledge of the various types of building construction and how fires react in each type give firefighters and officers information that is vital to planning a safe and effective fire attack.
Summary

- Firefighters need to know common building construction terms, materials, and methods. They also need to know how various types of construction are classified and how each type behaves in fires.
Summary

- Firefighters need to know the sights and sounds that indicate the possibility of structural collapse or other extraordinary events during interior fire fighting operations.
Review Questions

1. What are common materials found in building construction?
2. What are the five types of building construction listed in NFPA® 220?
3. What are the strengths and weaknesses of the five building construction types?

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Review Questions

4. What actions should be taken when imminent building collapse is suspected?

5. What hazards exist with lightweight and truss construction?