

BUILDING CONSTRUCTION FOR THE FIRE SERVICE

INSTRUCTOR GUIDE



EMERGENCY TRAINING ASSOCIATES, LLC
P.O. BOX 2421
WEST PATERSON, NJ 07424
WWW.ETAEMERGENCYTRAINING.COM

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**BUILDING CONSTRUCTION FOR THE FIRE SERVICE
INSTRUCTOR'S OUTLINE**



INSTRUCTOR NOTES:

Begin this lesson by announcing the title of the program and add anything else that you feel would be necessary to transition into this training program.

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

OBJECTIVES

- Correctly identify the different types of building construction
- Identify the concerns associated with each type of building construction
- Identify the hazards associated with each type of building construction
- Name the collapse warning signs
- Name the collapse hazards
- Discuss hybrid construction

INSTRUCTOR NOTES:

Review the Objectives of this program from the bullet points on this slide.

KEY POINTS:

- This is a program to teach building construction as it relates to firefighting
- The characteristics, concerns, and hazards associated with each type of building construction that may or may not hamper firefighting

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

GLOSSARY

- **SPALLING** - The loss of surface material when concrete is subjected to heat. due to moisture expansion in the concrete
- **CENTER CORE CONSTRUCTION** – Building design that has all utilities ,elevators and stair ways travel to all floors through the center of the building
- **LAG TIME** – The time it takes to get to get equipment and firefighters in position to attack a high rise fire
- **ELONGATE** - To make or grow longer

INSTRUCTOR NOTES:

These are terms that will be used in this training program. Go over each term on this slide with the attendees.

KEY POINTS:

- Spalling
- Center Core Construction
- Lag Time
- Elongate

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

GLOSSARY

- **COCKLOFT** - Void space between the top floor ceiling and the roof
- **HYBRID BUILDINGS** - Incorporate materials of more than one type of building construction
- **PARAPET WALL** - The continuation of a party wall, exterior wall, or fire wall above the roof line
- **DECORATIVE CORNICE** - A structure of wood, metal or masonry that tops a wall and projects from it

INSTRUCTOR NOTES:

Here are more terms that will be used in this training program. Go over each term on this slide with the attendees.

KEY POINTS:

- Cockloft
- Hybrid Buildings
- Parapet Wall
- Decorative Cornice

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

GLOSSARY

- **STONE CORBELLING** - A bracket of stone projecting from the face of the wall and generally used to support a cornice
- **COMPOSITE MATERIAL** - Built up of different parts, pieces and materials, intended to act as one
- **ENGINEERED LUMBER** - Wood modified from its natural state

INSTRUCTOR NOTES:

Here are more terms that will be used in this training program. Go over each term on this slide with the attendees.

KEY POINTS:

- Stone Corbelling
- Composite Material
- Engineered Lumber

INTRODUCTION

WHY STUDY BUILDING CONSTRUCTION?

- To ensure safe and effective Incident Action Plan
- Enables us to recognize potential construction hazards
- Gives us the knowledge to understand the effects of fire and fire suppression on selected building materials

INSTRUCTOR NOTES:

Discuss the importance of having a thorough knowledge of building construction as it relates to firefighting

KEY POINTS:

- Ensure safe fire attack planning
- Alert firefighters to hazards associated with specific construction types
- Select the most effective suppression method for a specific type of construction

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

INTRODUCTION

All firefighters must have a general knowledge of building construction and how fire reacts in various types of buildings



INSTRUCTOR NOTES:

Go over this reason as to why the knowledge of building construction is vital to firefighting

KEY POINTS:

- A knowledge of building construction will help firefighters in conducting a safe and efficient fire ground operation

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

INTRODUCTION

This knowledge gives us an edge in planning for a safe and effective fire ground operation.



INSTRUCTOR NOTES:

Go over this reason as to why the knowledge of building construction is vital to firefighting

KEY POINTS:

- Knowledge of building construction will lead to safety on the fire ground

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

INTRODUCTION

History has shown that failure to recognize potential dangers presented by a particular type of construction can lead to deadly results.



INSTRUCTOR NOTES:

Stress to the attendees that "Information Gathering" is an ongoing process through out a firefighters career

It is KEY! To stay on top of the buildings being built in you area

KEY POINTS:

- Visual signs of Building will assist you in recognition
- Fire prevention inspection reports from fire prevention bureau will give you construction information about certain buildings
- Individual observation of new construction by firefighters in their first due area will assist the with building construction info.
- Talking to senior firefighters who have a knowledge of the area

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

“KNOW YOUR ENERGY!!!!”

Brannigan, F., "Building Construction for the Fire Service", 3rd Ed., 2000



INSTRUCTOR NOTES:

A picture of a bowstring truss building first appears on the slide.

Click the mouse once and a picture of a wood truss building under construction appears.

Failure to recognize the construction type can have devastating results.

Give examples here as to what will happen if there is a failure to recognize the building construction type and there is a lack of knowledge of the hazards of the different building construction types.

KEY POINTS:

- Some of the most notable fires that have affected the fire service have involved bowstring truss construction.
- Cliffside park NJ five Firefighters were killed when a bow string truss roof on a bowling alley collapsed pushing out a wall that collapsed on the firefighters
- On August 2, 1978, six New York City firefighters were killed and 34 were injured fighting a fire in a supermarket when the roof collapsed.
- On July 1, 1988, five Hackensack, NJ, firefighters were killed while operating under a bowstring truss roof fighting a fire in an auto dealership.
- On February 11, 1998 two Chicago firefighters were killed and three were injured while fighting a fire in a automotive tire service center.
- Twenty years of time passed between these three incidents listed, it is important that we learn form the experiences of others

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE



INSTRUCTOR NOTES:

Note that Truss warning signs posted prominently at the front entrance of a building is helpful to arriving firefighters in identifying a building with Truss construction. These truss warning symbols must be prominently displayed by State Law at the front entrance of Truss constructed buildings in the State of New Jersey.

KEY POINTS:

- After the devastating roof collapse of Hackensack Ford. The State of New Jersey, has passed a law requiring buildings containing truss construction to have warning placards placed on them to alert firefighters.

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE



INSTRUCTOR NOTES:

Give an brief overview of the five types of building construction

KEY POINTS:

- There are a number of designs for each type of construction
- It is important for all firefighters to conduct in-service building inspections to make them aware of the different designs

**BUILDING CONSTRUCTION FOR THE FIRE SERVICE
INSTRUCTOR'S OUTLINE**



INSTRUCTOR NOTES:

This is a transition slide. Ask the attendees if there are any questions on any of the previous materials. After the instructor addresses all attendees questions, announce that you will now be covering Type I Building Construction.

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

TYPE I CONSTRUCTION (FIRE RESISTIVE)

PRE- WORLD WAR II

- Steel frame construction I-beams
- Floor construction steel I beams
- Fire proofing consisted of steel encased in concrete or tile
- Approx. 20 Lbs per cubic foot



POST- WORLD WAR II

- Steel frame construction I-beams
- Floor construction changed to I-beams & Steel bar joists
- Sprayed on fire proofing
- Approx. 8 Lbs per cubic foot



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INSTRUCTOR NOTES:

Discuss the characteristics of Fire Resistive Type I Construction

KEY POINTS:

- Generally fire resistance
- Resistance to fire must be 3 to 4 hrs depending on specific structural element
- Used for hi-rises
- Sporting arenas
- Other large building with a large amount of people assembling
- Rely on fire protection systems to quickly detect and extinguish fires

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

TYPE I CONSTRUCTION

Fire Resistive Construction is intended to confine the fire and its by products to a given location



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INSTRUCTOR NOTES:

Discuss the definition of Fire Resistive Type I building construction


KEY POINTS:

- HVAC systems create avenues or fire and smoke travel circumventing the desired intent of this construction
- Type one apartment buildings with individual A/C units with contain fire to a given apartment
- Type one office buildings with a central HVAC unit could lead to smoke and fire permeating through out the floor and building

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

CHARACTERISTICS OF TYPE I CONSTRUCTION

- Most resistant to collapse
- Most resistant to fire spread
- Structural components have sprayed on fire protection or encased in concrete or tile
- Structural components do not add to the fire spread in the building



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INSTRUCTOR NOTES:

Discuss the characteristics of Type I building construction

KEY POINTS:

- Keep in mind these building will most likely resist collapse but as we all know there is a collapse concern (WTC)
- Fire And Smoke Spread -----Office building or Apartment Building???
- Contents of building will create fire load
- Compartmentalization - important to recognize that most office buildings have office partitions that do not extend to the underside of the roof or floor creating a large open area

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

TYPE I CONCERNS

- Heat buildup and retention
- Security (forcible entry)
- Elevators
- Smoke movement (winter & summer ↓)
- Central HVAC unit
- Wide open floor areas (Difficulty in conducting searches)

INSTRUCTOR NOTES:

Discuss the following concerns.

KEY POINTS:

Reinforced concrete

- Has a high heat retention fires in this type of construction take a toll on firefighters

Security

- Gaining access to floors via stairwells will create some concerns
- Forcible entry will be a major concern - steel door jams encased in concrete block wall will be difficult to force

Elevators

- Gaining control of elevators
- Checking for victims in elevators
- Assigning firefighter to control the use of elevators
- Fire below seventh floor consider using the stairs

Smoke movement (stack effect)

- Take into consideration smoke movement in hi rise building
- Winter air in high rise is hotter than air outside causing air movement in the building to move upward
- Summer air inside hi rise is cooler than air outside causing downward air movement in hi rise building

HVAC

- Spreading smoke of fire through out floor or structure

TYPE I CONCERNS

- Inability to perform rapid ventilation
- Difficulty in placing hose lines in operation (lag time)
- Large Height and Area
- Auto Expos
- Curt
- Design

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INSTRUCTOR NOTES:

Discuss the following concerns:

KEY POINTS:

Inability to ventilate the building

- Windows not designed to open
- Falling glass puts firefighters and civilians in danger

Lag time

- Need to locate fire on fire floor
- Gather all equipment bring to floor below
- set up operation advance to fire floor
- confine and extinguish fire
- This is all being accomplished as fire is gaining significant headway

Height of Building

- Out of reach of ladders
- Master streams not effective

Wide open floor areas

- Conducting searches of extensive floor areas possibly 10000, 15000 sq ft. manpower intensive
- Life lines will be needed due to large area

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE



INSTRUCTOR NOTES:

Continue discussing the following concerns.

KEY POINTS:

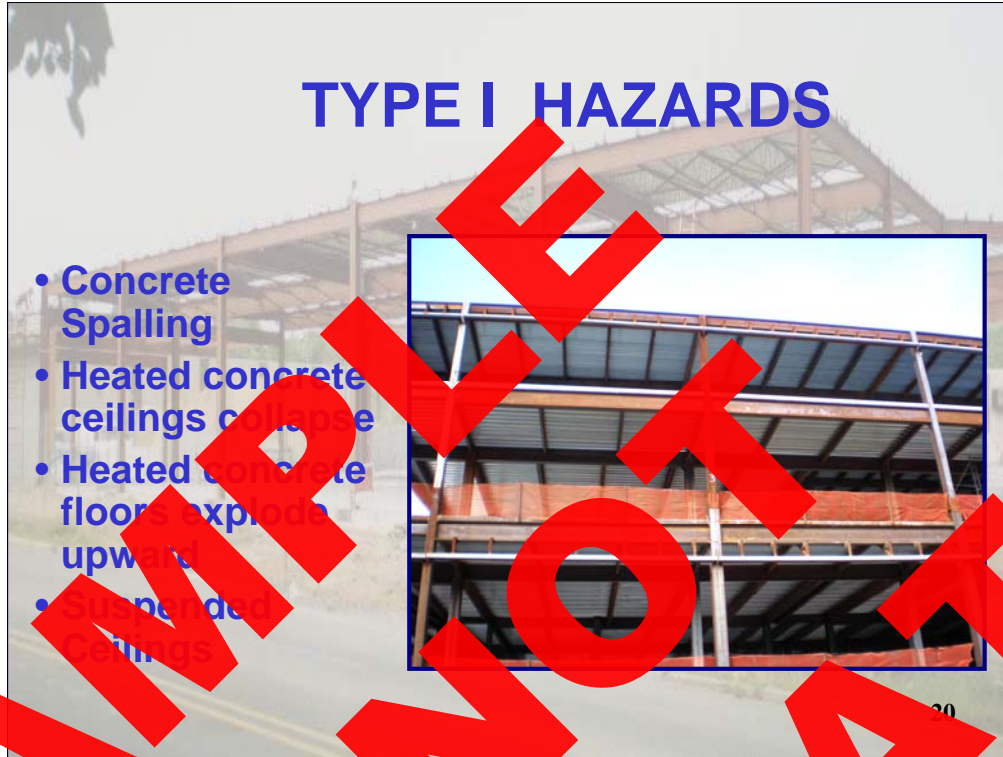
Auto exposure

- Fire venting out of windows extending to upper floors

Curtain wall design

- Modern protected steel buildings the exterior skin of walls and windows may be constructed in sections which will be attached to the structure to enclose each floor
- These are non bearing walls which are bolted to the ends of each floor assembly there is a small void space between the wall and the floor attachment which could cause fire to travel from one floor to the next floor
- Empire State Building took a direct hit from a B-25 bomber and it was a third alarm fire
- New style Structural steel building a one room burnout could escalate to a third alarm fire.

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE



INSTRUCTOR NOTES:

Discuss concrete spalling and dangers of spalling

KEY POINTS:

- When heated, the moisture in concrete expands causing the concrete surface to dislodge
- Inside from fire impingement
- Large chunks of concrete could fall from the ceiling or push the floor upward
- Outside from auto exposure
- Large chunks of building could fall to the ground

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE



INSTRUCTOR NOTES:

Discuss Center Core Construction

KEY POINTS:

Center core design

- All building utilities, elevators, and stairways travel to all floors through the center of the building
- This enables a large unobstructed area (more work space) and an all around outside view

**BUILDING CONSTRUCTION FOR THE FIRE SERVICE
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INSTRUCTOR NOTES:

This is a transition slide. Ask the attendees if there are any questions on any of the previous materials. After the instructor addresses all attendees questions, announce that you will now be covering Type V Building Construction.

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE



INSTRUCTOR NOTES:

Give an overview of Type V Building Construction

KEY POINTS:

- There are many designs of Type V construction around the country.
- Probably the most common type of construction
- Homes, small hotels, and small business are constructed with this type of construction
- You will encounter different styles of Type V Building Construction:
 - **Brace frame**
 - **Balloon frame**
 - **Platform**
 - **Lightweight wood**

CHARACTERISTICS OF TYPE V CONSTRUCTION

- Load bearing structural members are partly or entirely combustible
- Exterior walls are partly or entirely combustible



INSTRUCTOR NOTES:

Discuss the general characteristics of Type V Building Construction

KEY POINTS:

- Load bearing structural members
- If structural members are exposed to fire, it will weaken and fail causing collapse
- Fire venting out of a window or door will communicate to the combustible exterior, spreading fire

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

TYPE V CONCERNS

- Exterior wall fire spread
- Unlimited potential for fire extension within structure
- Balloon construction
- Early collapse of the lightweight wood trusses



INSTRUCTOR NOTES:

Discuss the concerns of Type V Building Construction

KEY POINTS:

- Fire spreading up exterior wall will enter windows on upper floors as well as enter soffit areas
- Open interior stairway allows unlimited fire and smoke travel within the structure
- Balloon frame construction could lead to a rapid spread of fire in the walls from the basement to the attic area
- Type V buildings are constructed with lightweight materials
- Fire entering the truss void areas will lead to an early collapse

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

TYPE V HAZARDS

- Combustible nature of a wood frame building
- Use of smaller structural members to support larger members
- Structural collapse



INSTRUCTOR NOTES:

Discuss importance of recognizing Type V Building Construction hazards

KEY POINTS:

- Fire extending to other structures is a hazard
- Structural members weakened by fire are susceptible to collapse
- Building will collapse with no warning

**BUILDING CONSTRUCTION FOR THE FIRE SERVICE
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INSTRUCTOR NOTES:

Discussed specific types of wood frame construction

KEY POINTS:

- Brace frame (Oldest)
- Balloon frame (2nd Oldest)
- Platform (Most Common)
- Engineered lumber (Light Weight)

**BUILDING CONSTRUCTION FOR THE FIRE SERVICE
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INSTRUCTOR NOTES:

Give an overview of the different designs of Type V Wood Frame Building Construction.

CHARACTERISTICS OF BRACED FRAME

- Vertical timbers called posts reinforce the four corners of the structure
- Horizontal timbers called girts reinforce each floor
- Posts and girts are connected by fastenings called mortise and tenon joints

INSTRUCTOR NOTES:

Discuss the characteristics of Braced Frame construction.

KEY POINTS:

- Oldest type of wood construction
- Still causes firefighters concerns
- Braced frame construction will collapse with no warning

BRACE FRAME MORTISE AND TENON JOINTS



INSTRUCTOR NOTES:

Discuss what a mortise and tenon joint is

KEY POINTS:

- The connection of the wood structural members used in Brace Frame Construction is the mortise and tenon joint

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

BRACE FRAME COLLAPSE HAZARD

- Weak point is the mortise and tenon joint
- Weakened by age
- Weather
- Previous fire damage
- Current fire involvement
- Failure of these joints can cause complete collapse of the structure

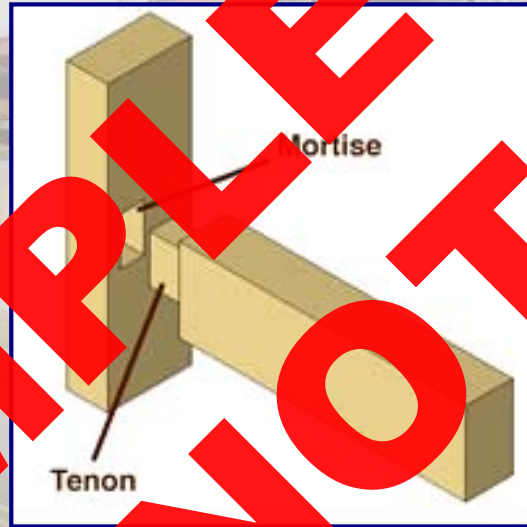
INSTRUCTOR NOTES:

Discuss the collapse hazards of a brace frame constructed structure.

KEY POINTS:

- The weak point is the mortise and tenon joint
- Shrinkage due to drying of the wood structural members and age can cause joints to become loose and separate slightly.
- Fire entering this area can weaken the connection point causing structural collapse.

BRACE FRAME MORTISE AND TENON JOINTS



INSTRUCTOR NOTES:

This is a better illustration of a mortise and tenon joint. Review the main parts and the construction of a mortise and tenon joint with the attendees.

CHARACTERISTICS OF BALLOON FRAME

- Exterior walls have studs extending continuously from the foundation sill to the top plate near the attic
- Concealed space between these studs leads to smoke, fire, and heat travel



INSTRUCTOR NOTES:

Discuss the characteristics of Balloon Frame construction

KEY POINTS:

- Second oldest type of Type V building construction
- There are no fire stops
- Walls extend from basement to attic
- Since there are no fire stops, rapid fire spread is a characteristic in fighting fires in Balloon Frame structures

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE

BALLOON FRAME FIRE SPREAD



INSTRUCTOR NOTES:

Point out to the attendees the studs in this illustration. Using this illustration, make special note to the attendees that there are no fire stops between the studs which helped spread this fire.

KEY POINTS:

- Biggest concern with this type of construction is speed of fire travel throughout the building

BALLOON FRAME COLLAPSE HAZARD

- If a non bearing wall collapses during a fire, the continuous studs will cause the wall to fall straight out in one section at a 90 degree angle
- If a bearing wall fails, it can cause a second collapse of the floors it supports

INSTRUCTOR NOTES:

Discuss the collapse hazards of a balloon frame constructed structure.

KEY POINTS:

- 90 degree wall collapse
- The floor collapses when the wall collapses

BUILDING CONSTRUCTION FOR THE FIRE SERVICE INSTRUCTOR'S OUTLINE



INSTRUCTOR NOTES:

This concludes the Building Construction for the Fire Service program. Ask the attendees if they have any comments or questions on the material that was presented in this program.

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