BUILDING CONSTRUCTION AND OCCUPANCY TYPES

TERMINAL OBJECTIVES

The students will be able to:

1. *Identify basic types of construction.*
2. *Identify building subsystems and their functions.*
3. *Identify different classifications of occupancy.*

ENABLING OBJECTIVES

The students will:

1. *Identify the types of buildings that contain the construction types.*
2. *Identify the types of building subsystems.*
3. *Define occupancy types.*

RELATIONSHIP BETWEEN BUILDING CONSTRUCTION AND FIRE

Having briefly examined some of the more common hazards the inspector is likely to face, it is now time to take a look at a related aspect: the constructions that often house many of these very hazards. Somewhat like the hazards themselves, these structures present risks to life and safety. The construction of a building plays a critical role in the prevention process.

The following example probably will not create a lot of controversy. A 50-year-old wooden barn 2 miles from the nearest water supply poses a much greater fire risk than a 1-year-old fire-resistive building equipped with state-of-the-art alarm and sprinkler systems. While this is a rather obvious example, it illustrates a key point: the building's construction and systems either help prevent fires or "help" fires spread once they start.

This module will look at some basic construction types and their features as these affect the job of the inspector. As has been stated already, this brief overview is just a start. A good inspector, like every other "good" professional, never stops learning.

Fire Spread

At the turn of the century, conflagrations were a common occurrence. Increased knowledge of fire behavior and building design helped to confine fires to the building of origin. Recent developments have led to fire-safe designs which confine the fire to the room or floor of origin. At present, technology can limit fires to an even smaller area, and possibly to the object of fire origin within a room.

Fire-Safe Design

The objectives of fire-safe design in building construction are **life safety, property protection, and the continuation of the building in its intended use**. The first step is to identify the occupant characteristics of the building. A design for fire safety may include various options.

- Evacuating occupants. This depends on both the availability of a path of escape and alerting the occupants.

- Defending the occupants in place. This is used when evacuation has an unacceptable likelihood of success.

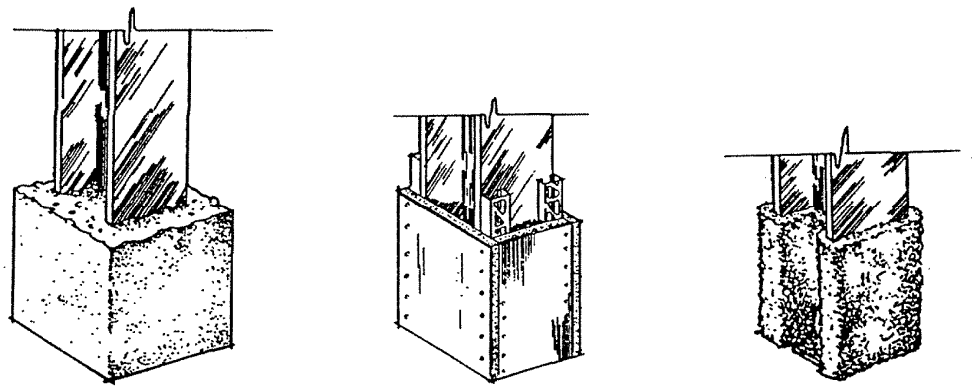
- Providing an effective area of refuge. This involves movement through the building to a safe area.

CLASSIFICATIONS OF BUILDING CONSTRUCTION

The model building codes and NFPA 220, *Standard on Types of Building Construction*, provide five major types of building construction classifications.

Noncombustible Protected (Type I)

In this type of construction the structural elements consist of noncombustible materials, usually steel or concrete, that afford a fire resistance rating that provides a given fire protection performance endurance against the effects of fire. These specific ratings are determined by the model building codes for a specific type of construction. These specific ratings apply to the roof and floor assemblies as well as any exterior or interior bearing support walls. Interior partitions are required to be constructed with approved noncombustible materials. The fire resistance ratings are provided by different designs that meet minimum performances.



Encasement with Concrete | Encasement with Gypsum Board | Spray-on Applied Coating

Figure 1
Examples of Fire Resistance Design Methods

Structural elements are entirely of noncombustible or limited combustible materials. Totally noncombustible refers only to **structural** materials, not to interior finish and contents. Wall enclosures may be masonry, steel, aluminum, glass, or other material. Once wall coverings are in place, it may be difficult to determine if structural elements are exposed or protected.

Noncombustible Unprotected (Type II)

The same requirements that apply to noncombustible Type I construction also apply to this type of construction, with one basic difference. This type of construction may not afford any fire-resistance rating for the exposed structural elements. If any fire protection of the structural elements is provided, it is at a lesser rating than that required for Type I construction. In this type of building the structural elements are usually made of steel, bolted, riveted, or welded together. This type of construction is susceptible to expansion, distortion, or relaxation of the steel members, resulting in early collapse during a fire. Again, interior partitions are required to be constructed with noncombustible or approved limited combustible materials.

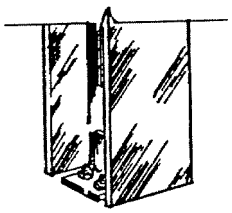
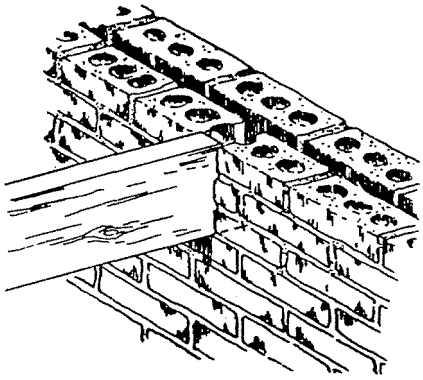


Figure 2
Noncombustible Unprotected

Combustible/Noncombustible (Type III)

In this construction type all or part of the interior structural elements may be combustible. Exterior walls are required to be constructed with noncombustible materials. They can have a fire-resistance rating, depending upon the horizontal separation and whether they are bearing or nonbearing walls. This category usually is divided into protected and unprotected subtypes. The building will have masonry exterior walls (usually brick), and wooden structural members and combustible interior construction. The building generally will not exceed six stories, and most often will be two or three stories in height; it is often called "Main Street

USA." Floor and roof supports are usually wood, but other materials, such as steel bar joists, may be found. Floor and roof decking most frequently will be plywood or composition board. Common walls between buildings may share wall sockets for floor joists and roof rafters. This type of construction was originally referred to as ordinary.



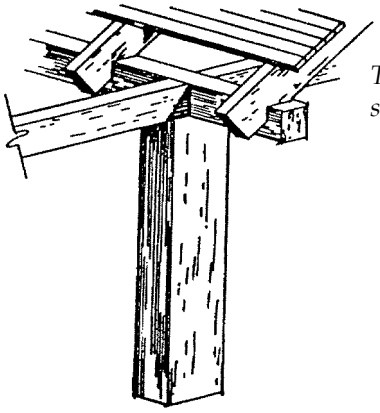
This occurs with solid masonry bearing walls. The floor or roof members are wood. It uses a fire-cut joist.

Figure 3
Combustible/Noncombustible

Heavy Timber (Type IV)

Heavy timber structural members--columns, beams, arches, floors, and roofs--are unprotected wood with large cross-sectional areas. A minimum dimension of eight inches for structural wood supports (columns, beams, arches, and girders) is required. All other exposed wood must have a minimum dimension of two inches. Concealed spaces usually are not permitted.

These buildings consist of masonry (noncombustible) exterior walls and structural members of substantial timber construction. Commonly this type of construction is found in older factories and mills. Wood floors generally will have a minimum thickness of three inches and may be oil-soaked from years of oiling heavy machinery with lubricating oils. Roof supports will be wood with minimum dimensions of four by six inches, and a minimum roof decking thickness of 1-1/8 inches.



This is often laminated or solid wood beams.

Figure 4
Heavy Timber

Combustible (Type V)

This type of construction uses structural members entirely of combustible materials, usually wood, and is divided into two subgroups:

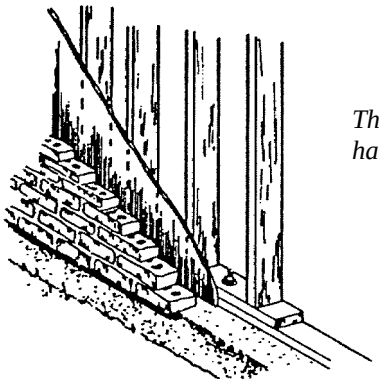
- protected--structural elements protected as required; or
- unprotected--no fire resistance requirement.

Walls, floors, and roof structure are usually wood frame using different construction methods. **Post-and-beam** construction has a wood frame of substantial dimension and is sided with a lightweight covering such as wood boards, or plywood covered with aluminum or PVC siding. This type of construction is commonly used for barns, sheds, and other storage buildings but also may occur in dwellings and other occupancies.

In **balloon frame** construction, studs run from the foundation to the attic. This type of construction was common in many parts of the country until the late 1930s for residential and light commercial buildings. This provides a continuous air space from top to bottom. Floor joists are tied into the wall, allowing for fire extension in any direction. Firestopping was not a common practice.

In **platform frame** construction the walls of each successive story are built on a platform formed by the preceding floor. The joists for the deck may be full-dimension lumber or lightweight materials. Once the floor or

deck is in place, walls are placed on it with a sill at the bottom of the wall and a plate at the top. Platform frame construction provides a natural fire barrier for vertical extension within the walls, but openings in walls for water, sewer, ventilation, or heating/air conditioning pipes can create a void for fire extension.



This type may or may not have veneer finish.

Figure 5
Combustible (Frame)

BUILDING SUBSYSTEMS

Building subsystems provide for the practical use of a structure. These components include electrical, heating, ventilating, and air conditioning (HVAC), plumbing, and transportation.

A basic knowledge of these subsystems and their relationship to the structure helps to understand how they may affect fire safety. These subsystems may be considered separately, but it must be understood that each subsystem is only one part of the total building system.

Electrical Systems

If properly designed, installed, and maintained, electrical systems are both convenient and safe; otherwise they may cause both fire and injury. When an electric circuit carrying current is interrupted intentionally or unintentionally, arcing or heating results. Fire protection standards are requirements intended to prevent arcing and overheating or accidental contact, which may cause electric shock.

Heating, Ventilating, and Air Conditioning (HVAC)

Heating, ventilating, and air conditioning treat air to control its temperature, humidity, quality, and distribution simultaneously. The system of ducts usually associated with ventilation systems presents the possibility of spreading fire, fire gases, and smoke throughout the area served.

Duct work penetrations through rated wall partitions and floors/ceilings must be protected with fire dampers. Vertical chases for these systems must be fire rated in order to limit the vertical spread of fire, smoke, and heat. It is important that these chases and wall penetrations be maintained in compliance with the codes and, when additions or modifications to the building occur, that the integrity of these elements of construction not be violated.

Plumbing

Plastic pipe must be protected to prevent the spread of fire and is usually accepted when a chase or enclosure is provided. Other aspects of plumbing usually are not considered to be fire spread hazards, except when piping penetration openings have not been properly sealed to maintain a required fire-resistive rating.

Transportation

Building transportation systems such as elevators and escalators make modern buildings possible. Special precautions must be taken to prevent elevator use during fires. Signs prohibiting the use of elevators in the case of fire are widely posted. Modern elevator systems usually are designed to operate in a special emergency mode during a fire. Some of these systems will return the elevator cars to a predesignated floor, should a fire occur and the building occupants not be able to use the elevator for egress. The fire service can use elevators during a fire by activating special keyed switches in the elevator car and on the master elevator control panel, if one is provided.

Openings for escalators must be protected to prevent the spread of smoke and fire from one floor to another.

OCCUPANCY CLASSIFICATIONS

Just as structures fall into categories based on their construction, they also fall into classes based on their use. We need to look briefly at eight or nine of the more common occupancy classifications with which an inspector is likely to deal.

Assembly

Assembly occupancies generally are easy to identify because they are places we go for entertainment, dining, instruction, and worship. They fall into many different uses under most of the codes used today. The fire inspector first must be able to identify that the building is classified as an assembly, then determine the building use and the capacity of the building.

To identify an assembly occupancy properly, look at how it is used. Such occupancies include churches, auditoriums, nightclubs, restaurants, movie theaters, coliseums, gymnasiums, etc.

The capacity (occupant load) also will greatly affect the requirements for an assembly occupancy within the various code organizations. A building's capacity and use will greatly affect minimum fire safety requirements. A general grouping used is 50 to 300, 301 to 1,000, and over 1,000 capacity. These groupings may vary with the different code organizations.

For the beginning inspector, simply walking into the building and looking at the posted occupant load can be the easiest way to make the determination. When there is no posted occupant load sign, the seating system, number of exit doors, its ordinary use, as well as the inspector's knowledge of the building will help in making this determination.

Mercantile

Mercantile structures are some of the most common occupancies in many communities. These are places we go to spend our money. There is a display of merchandise for sale. Department stores, grocery stores, portions of shopping centers, and any other place designed for the display and sale of merchandise are examples of mercantile occupancies.

Storage

Storage occupancies are structures used for providing shelter for goods, merchandise, products, vehicles, or even animals.

It is simple to identify most storage facilities because of their basic use. Some structures included in this group are warehouses for most goods, barns, hangars (storage only, no work performed), bulk oil storage buildings, parking garages (no work performed), cold storage warehouses (freezers), truck terminals, grain elevators, etc.

Storage occupancies simply are storage facilities and are used in connection with most occupancies. All occupancies will have storage areas or rooms connected to them, or even inside them. A janitorial closet in an assembly occupancy would be called a storage room, but the primary use of the building would not be called storage. Likewise, most department stores classified as mercantile would have a large storage area away from the sales floor where merchandise is prepared for sale and stored until it is needed. But, again, this does not change the overall occupancy.

Storage occupancies are unique because they often are repositories for various types of commodities; this can create many types of hazards or mixes of different hazards. It is for the inspector to determine what the storage contains and the method of storage.

Health Care

It sometimes is confusing to fire inspectors to classify a building in the health care category. Nursing homes, hospitals, limited care facilities, and ambulatory health care centers are easy to classify.

The doctor's or dentist's small office used primarily for diagnostic and simple medical care would be classified as a business occupancy even though it might seem appropriate to classify it as health care.

Medical facilities where outpatient care is the primary function, and practices where other than simple diagnostic functions are performed, would be classified as health care.

Detention and Correctional

These occupancies also tend to be easy to determine. They include jails that are used by the local jurisdiction as well as large prisons operated by the state or federal government.

There are many city halls and county courthouses that have on-site holding cells used for short periods of time. These buildings usually are classified as businesses and the fact that they do detain prisoners for a short period of time does not change their overall classification; however, inspectors must consider the requirements for detention occupancies.

Residential

Residential occupancies are places where people reside, and include everything from single-family dwellings to large hotels. Motels, apartments, dormitories, lodging or rooming houses, board and care, and facilities that fall in between are residential.

Residential occupancies also are where most of our fire deaths occur. This should serve as a warning to know the proper classification of a building so that the inspector can apply proper fire prevention and building codes.

Business

Business occupancies include office buildings, medical offices (doctors' offices), banks, government offices, city halls, courthouses, and some college and university buildings.

Most communities have what are commonly referred to as strip shopping centers. These are made up of many different individual occupancies and are considered mixed occupancy.

Educational

Elementary schools, middle or junior high schools, high schools, kindergartens, etc., are classified as educational. Classroom buildings of universities and colleges would be considered educational.

Unless otherwise classified by state or local laws, day-care centers and nursery schools are included in this occupancy.

Industrial or Manufacturing

This occupancy classification includes many facilities that are designed for the manufacture of a specific product. Also included are those facilities that are involved in the repair or servicing of vehicles, airplanes, boats, etc. Dry cleaning plants, laundromats, post offices, sawmills, food processing plants, gas plants, etc., also are included in this occupancy.

Special Occupancies

Some structures will not fit any of the above-listed specifications for classification. These include open structures, towers, underground structures, vehicles, vessels, water-surrounded structures, and even windowless buildings. The inspector can see that these occupancies all tend to be very difficult to inspect and will cause him/her to check the codes to help know the exact occupancy classification.

SUMMARY

Knowledge of buildings, their construction, and their classification is necessary to protect the lives and property of the public. This knowledge also is necessary to allow firefighters to control fires efficiently and effectively. Inspection of buildings to maintain built-in fire protection is essential.

By looking at all of the various classifications, the inspector can see the importance of knowing the proper occupancy classification. Each of the model codes in use today (and some special codes that local jurisdictions and governments have adopted) also will require that occupancy classification of the structure be done before the inspector can know which code section to apply to achieve life safety.

Activity 1

Building Construction Classification

Purpose

To identify the construction classification of a building and to be able to predict paths of smoke, heat, and fire travel.

Directions

Large-Group Walk-Through Scenario

1. View the slides.
2. Listen to the scenario description your instructor will read to you.
3. Answer the questions that follow as part of the class discussion.
    a. What is the building construction classification?

    b. What problems might you expect regarding building subsystems?

    c. Do there appear to be any significant construction deficiencies?

    d. What factors could be considered concerns?

    e. What factors could be considered strengths?

    f. What avenues of fire, smoke, or heat travel would you expect?

Small Group

1. View the slides for scenarios 1 and 2.

2. As a small group answer the questions on the worksheet for the scenario assigned to your group.

3. Be prepared to report your group's work.

Scenario 1

The structure is a storage barn, approximately 30' by 30'. It was constructed in 1934 with materials and techniques appropriate for that time. The barn currently is used for storage of fertilizer, seed, and pesticides.

Questions

1. What is the building construction classification?

2. What problems might you expect regarding building systems?

3. Do there appear to be any significant construction deficiencies?

4. What factors could be considered concerns?

5. What factors could be considered strengths?

6. What avenues of fire, smoke, or heat travel would you expect?

Scenario 2

The grocery store was constructed in 1976 and is 250' by 350' with an attached loading dock. The building has the typical fixtures and equipment expected for a full-service grocery store.

Questions

1. What is the building construction classification?

2. What problems might you expect regarding building systems?

3. Do there appear to be any significant construction deficiencies?

4. What factors could be considered concerns?

5. What factors could be considered strengths?

6. What avenues of fire, smoke, or heat travel would you expect?

Activity 2

Determining Occupancy Classifications

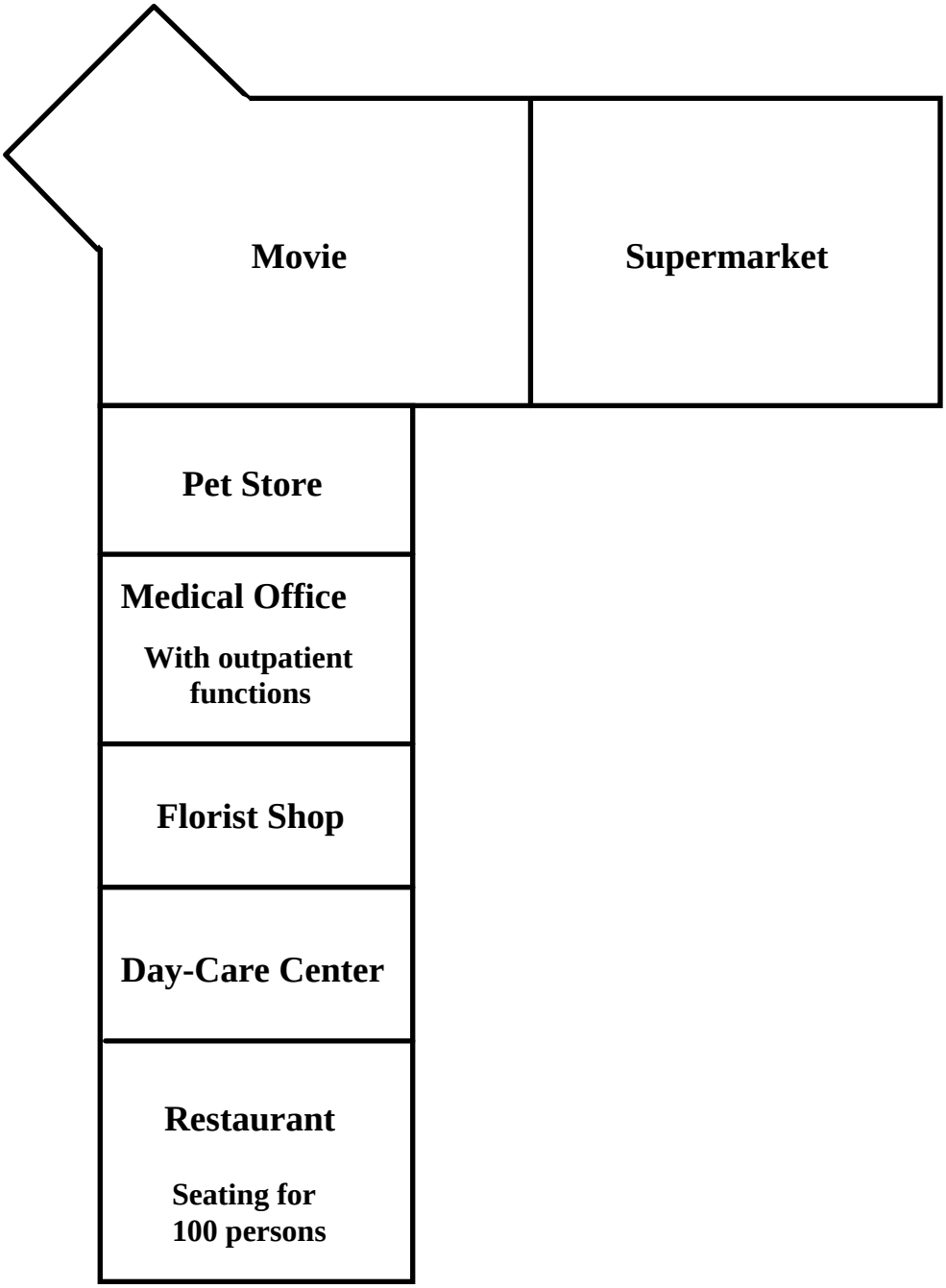
Purpose

To determine occupancy classification.

Directions

Identify the most appropriate occupancy classification using the information from this module and the plan on the next page.

	Use		Occupancy Classification
1.	Restaurant	1.	_____
2.	Day-Care Center	2.	_____
3.	Florist Shop	3.	_____
4.	Medical Office	4.	_____
5.	Pet Store	5.	_____
6.	Movie	6.	_____
7.	Supermarket	7.	_____


Movie
Supermarket
Pet Store
Medical Office
With outpatient functions
Florist Shop
Day-Care Center
Restaurant
Seating for 100 persons