Technical Principles and Practices of Fire Prevention

Module
Public Assembly

MODULE OBJECTIVES

The students will be able to:

- *Identify public assemblies and their subclasses.*
- *Identify and classify the major fire and life safety issues in public assemblies.*
- *Given an applicable code, a floor plan, and a building description, calculate occupancy load and the number of inches of exit doorway width required.*
- *Apply the applicable code to determine requirements for decorative materials and seasonal issues in a place of assembly.*
- *Identify appropriate procedures to "field test" decorative materials.*
- *Identify typical electrical concerns in public assemblies.*
- *Given various components of a cooking, venting, and hood range system, list typical hazards and methods of inspection.*

INTRODUCTION

In this module on public assemblies, we will cover some very important life safety issues. The first is familiarity with the subclasses of public assemblies. Each code has a somewhat different classification system. It is important that you become familiar with the system used by your code. Specific requirements are detailed in the codes, based on the subclass under which the assembly falls.

Next, we will discuss hazards. Although not unique to assemblies, some of the greatest contributors to life loss in fires in assemblies are decorative materials and interior finish. This module will give you a fundamental understanding of why you must recognize the hazards of poor (or no) enforcement of code requirements related to interior finish and decorative materials. We will focus on seasonal issues regarding decorative materials.

The next area discussed will be some specific hazards found in assemblies. Although these are not unique to this occupancy, they present some different problems in assembly occupancies. Temporary and portable electrical wiring and installations, cooking and venting systems, storage in exhibit halls and for trade shows, and the use of pyrotechnics all create problems requiring specialized knowledge and judgment on the part of the inspector.

Life safety is an area of critical concern. We will devote a good part of this module to calculating occupant load and making sure that the people in the building can get out safely (egress). How many people can safely occupy a building or area, how many exits the occupants need to exit quickly, and how far it is safe to travel to an exit are important pieces of information for the fire safety inspector.

Although you won't be an expert in all of these subjects after completing this module, you will have a much better understanding of their importance to fire and life safety. You also will understand why it is so important for you to study your code carefully and to become very familiar with the requirements related to these areas.

DEFINITION OF ASSEMBLY

The National Fire Protection Association (NFPA) (1997) says that a place of assembly is a "building or portions of a building in which 50 or more people gather for such purposes as deliberation, worship, entertainment, dining, amusement, or awaiting transportation."

The Standard Building Code (SBC) (1997) defines an assembly as "the use of a building or structure, or any portion thereof, for the gathering together of persons for purposes such as civic, social, or religious functions or for recreation, or for food or drink consumption, or awaiting transportation." It must be noted that the Standard Code begins classifying assemblies at 100 persons; the others start at 50 persons.

The Building Officials & Code Administrators International, Inc. (BOCA) National Code (1999), and the International Building Code defines assemblies as "all structures which are designed or occupied for the gathering together of persons for purposes such as civic, social, or religious functions, recreation, food or drink consumption, or awaiting transportation."

The Uniform Codes (1997) define assembly occupancies to "include the use of a building or structure, or portion thereof, for the gathering together of 50 or more persons for purposes such as civic, social, religious functions, recreation, education or instruction, food or drink consumption, or awaiting transportation."

As you can see, the essential elements defining an assembly exist in each of these definitions. But, as you will learn as you become more familiar with the specific requirements for assemblies contained in each code, there are some significant differences. Your challenge as a new inspector is to study and become proficient in your knowledge of the code requirements appropriate for your jurisdiction.

TYPES OF PUBLIC ASSEMBLIES

Assembly occupancies are broken into subclasses, and also by use. The subclass breakdown may be somewhat basic (NFPA) or complex (Uniform). Let's look at each.

NFPA 101, *Life Safety Code* (1997 edition) uses three subclasses:

- Class A--more than 1,000 people;
- Class B --301 to 1,000 people; and
- Class C --50 to 300 people.

The Standard Code is nearly as basic as NFPA but adds a few other factors into its subclass designation:

- A1--Large Assembly--without a legitimate stage, occupant load more than 1,000; and

- A2--Small Assembly--with or without a stage, occupant load of more than 100, but with an occupant load less than designated for Large Assembly.

The BOCA National Code and International Building Code use five groups for assemblies:

- A1--theaters for the production and viewing of performing arts or motion pictures, and usually with fixed seats;
- A2--places with no theatrical stage accessories, designed for dance halls, nightclubs, etc.;
- A3--structures with or without an auditorium, used for amusement, entertainment, or recreation purposes without a stage other than a raised platform;
- A4--facilities used exclusively for worship or other religious purposes; and
- A5--outdoor assemblies.

As you can see, BOCA focuses on use in its subclassification system rather than on the size or number of occupants.

The Uniform Codes (UBC) appear to have the most complex classification system:

- A1--1,000 or more with a stage;
- A2--fewer than 1,000 with a stage;
- A2.1--300 or more without a stage;
- A3--fewer than 300 without a stage; and
- A4--stadiums, reviewing stands, and amusement parks **not included in other Group A occupancies**.

Both size and use are essential elements in classifying buildings as assemblies. A restaurant with an occupant load of fewer than 50 has the same use as one with the capacity for 110 persons, but the smaller one is not an assembly. Inspectors must keep this in mind because the code requirements for the nonassembly will vary greatly from those adopted to keep assembly occupants safer during times of fire, panic, or other emergencies.

These are some common assemblies found in all codes:

- amusement park buildings;
- auditoriums;
- cafeterias;
- churches;
- dance halls;

- gymnasiums;
- motion picture theaters;
- museums;
- passenger depots;
- public assembly halls;
- recreation halls;
- restaurants;
- stadiums and grandstands;
- tents for assembly (not discussed in this course);
- theaters for stage production; and
- zoos.

The codes categorize group assemblies based on size or use, or a combination. These grouping systems help establish requirements for occupant load, exiting (egress) systems, and fire and life safety protection.

This same system of classification or grouping applies to other occupancies. This system also outlines the detailed requirements for establishing occupant load, exiting, and fire and life safety protection. Although these elements are applied to assemblies in this module, they also apply to all occupancies.

The following sections of this module focus on some of the hazards inherent to assemblies. The hazards do not exist exclusively in assemblies, but due to the large numbers of people that occupy these buildings, they can have a far greater impact on fire-related injuries and life loss. We'll begin our discussion with interior finish materials.

INTERIOR FINISH

Traditionally we consider interior finish to consist of those materials or combinations of materials that form the exposed interior surfaces of walls and ceilings. In some cases, floor finish coverings (e.g., carpeting) pass as interior finish.

The types of interior finish materials include such commonly used materials as plaster, gypsum wallboard, wood, plywood paneling, fibrous ceiling tiles, plastics, and a variety of wall coverings. Collectively, these finishes serve several functions--aesthetic, acoustical, and insulating--as well as protecting against wear and abrasion. Ordinary paint, wallpaper, or other similar wall coverings that are no thicker than 1/28 inch (0.9 mm) generally are not included as interior finish, except where they are deemed to be a hazard by the Authority Having Jurisdiction (AHJ) (e.g., in Chicago and Boston).

Most building fires begin when decorative materials, furnishings, or waste accumulations ignite or when electrical systems or mechanical devices fail. Interior finishes usually are not the first items ignited, except when ignition occurs by overheated electrical circuits, careless use of plumbers' torches, or direct impingement of flame from some other source, such as a candle or match. Once a fire has started and intensified, however, the interior finish can become involved and can contribute extensively to the spread of fire.

Interior finish relates to fire in four ways. It can 1) affect the rate of fire development to flashover conditions; 2) contribute to fire extension by flame spread over its surface; 3) add to the intensity of a fire by contributing additional fuel; and 4) produce smoke and toxic gases that can contribute to life hazard and property damage.

The flame spread rates and smoke development for interior finishes are classified into three groups, Type I (Class A), Type II (Class B), and Type III (Class C). These classifications are based on the flame-spread rating of the materials, Type I being the lowest rating and Type III being the highest rating. Some materials have a flame-spread rating that is so high it can not be used or allowed by the codes for interior finishes. The three model building codes and the NFPA *Life Safety Code* have very specific requirements for interior finishes that are determined by the occupancy type/use, occupant load, and function of the area, such as exits, stairways, corridors, or workspace.

The important point for a new inspector to remember is that it's very difficult to determine how safe an interior finish is just by looking at it. The safety evaluation of the finish normally is done as part of the plan review and installation inspection process. New inspectors need to be alert for changes in interior finish and follow up to verify its safety and permitted (if required) installation. An example would be an existing area that had sheetrock walls which were covered with new wooden wall paneling during renovation.

DECORATIVE MATERIALS

As generally defined by the fire codes, combustible decorative materials are combustible materials used for decorative effects such as curtains, draperies, streamers; surface coverings applied over building interior finishes for decorative, acoustical, or other effects; cloth, cotton batting, paper, plastics, vegetation, hay, split bamboo, straw, vines, leaves, trees, moss; and other similar materials used for decorative effect. Combustible decorative materials do not include floor coverings, ordinary window shades, interior finish materials used as surface coverings, and materials

1/28 in. (0.9 mm) or less in thickness applied directly to a noncombustible backing.

Decorative materials can play a significant role in the development and rapid spread of a fire. The MGM Grand Hotel and Casino fire in Las Vegas, Nevada, in 1980 was a clear example of how untreated decorative materials contributed to the uncontrollable rapid spread of a fire. As these materials burned, they generated overwhelming amounts of smoke and toxic gases. The Beverly Hills Supper Club fire on May 28, 1977, in Southgate, Kentucky, is another example of how untreated, decorative materials contributed to the rapid spread of a fire and significant life loss (165 deaths).

The inspector's role in dealing with decorative materials is to ensure that they have been treated with a flame retardant. The methods to verify this treatment will vary by State and even by local jurisdiction. Sometimes there will be a certificate or other document that verifies the flame-retardant treatment of various items. Some States (e.g., California) have a seal from the State Fire Marshal's Office which is affixed to or accompanies treated materials.

The key is to verify this treatment and that it is still valid. If in doubt, the inspector may choose to perform a field test. This can be done by taking a sample of the material in question, usually cut or selected by the owner, **not the inspector**, to an outside area, safe and away from other combustibles. The inspector, using a lighter or match, will hold the open flame to the material for several seconds, then remove the flame. If the material stops burning, it has been treated. If it continues to burn, it should be considered unsafe. The inspector may choose to do a second test to verify the initial results. If the outcome is the same, action, based on applicable code requirement measures, must be taken, including removal of the decorative materials.

An inspector must use extreme caution when conducting these field tests. Use NFPA 702 as a reference for conducting these tests; use a field test as a last resort for verifying flame retardancy.

Decorative materials are a concern in many occupancies, particularly in public assemblies. These occupancies tend to have a great deal of permanent decorations that need to be checked for flame retardancy when initially introduced. Assemblies also use lots of temporary and seasonal decorative materials.

Meeting and convention facilities may include numerous temporary curtains, hangings, and table coverings requiring prior treatment. These attract, as do all assemblies, a great deal of seasonal decorating--Christmas trees, Halloween decorations, Easter decorations, and the like. Constant supervision, reminders, and inspections are the keys to ensuring that these are safe and legal under your code.

As part of your inspection for decorations, you must be on the lookout for exitways obstructed or blocked by decorations or outside exit pathways blocked by snow. Candles are a seasonal safety issue. Religious services often include hand-held candles. The inspector must know the jurisdiction's code requirements in all of these areas.

ELECTRICAL CONCERNS

Electrical concerns found in assemblies are both similar to and different from those in other occupancies. The similarities are in the customary wiring and the use of outlets and extension cords common to all occupancies.

The dissimilarities come in the form of temporary and portable electrical supply of transmission units and the widespread use of high-wattage portable lighting. Many assembly occupancies, such as convention and trade show facilities, use temporary, portable electrical distribution systems. Often the wiring for these units, because of frequent use and handling, is subject to abuse and misuse. Another problem is the potential for overloading circuits.

Inspectors must carefully scrutinize wiring strung for exhibits and trade shows to ensure that it is in good condition, strung safely, and not overloaded.

Lighting is another concern due to the high wattage and significant amount of heat generated. Take care to ensure that these lights have sufficient clearance from potential combustibles.

Wiring for all electrical usage must be of sufficient size to carry the assigned current. The inspector must look for and ensure that safe, adequate backup safety systems are in place--fuses, breakers, etc. Multiple plug boxes are common, but should not be overused. Portable electrical distribution boxes are common and need checking for backup systems and safety.

You cannot know all the answers; when in doubt ask another, more experienced, inspector or the fire marshal for assistance.

If you cannot determine exactly how to resolve a concern regarding an electrical problem and there's no one in your department to help, then it may be necessary to make a referral to the electrical division of the building department. This is where the expertise lies, and it is a solid resource when you need help regarding potential electrical hazards.

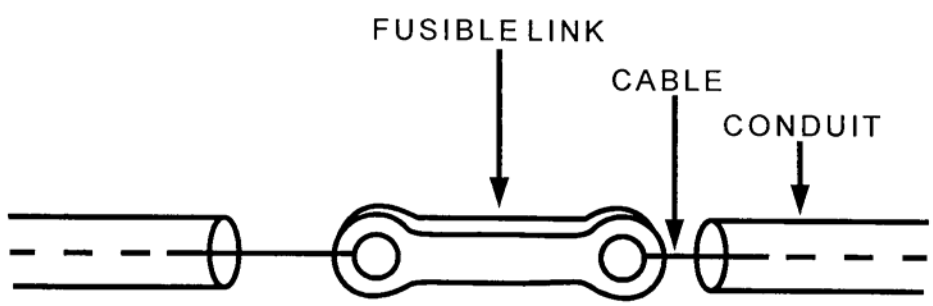
COOKING: VENTING AND HOOD SYSTEMS

Venting and hood range (extinguishing) systems are designed to provide fire protection for cooking facilities such as open-flame broilers, frying surfaces, deep fat fryers, and stoves. These systems perform essentially three functions. The first is to extinguish a fire if the cooking flame or surface presents a fire hazard. The second is to vent the heat generated by the cooking process, and the third is to control the grease-laden vapors produced by the process. Because many of these cooking facilities heat oils and grease nearly to their ignition temperature, there is a need for built-in fire protection. It is very important that these facilities are cleaned on a regular basis to limit the amount of grease buildup on adjacent surfaces, on hood filters, and in the exhaust duct. If these are not kept clean, the built-up grease can ignite easily when a fire starts, and can contribute to rapid spread. If the hood filter and exhaust duct are not clean, the fire can begin to travel up the duct work. Keeping these areas clean and regularly maintained are the keys to minimizing fire risk.

The hood range system works in one of two ways. First, it can act automatically if a fire occurs and flame and heat impingement activate the system. A bimetallic fusible link located in the exhaust hood and sometimes above the grease filters in the hood plenum usually activates the system automatically. The fusible link will melt at a specific temperature, releasing the link assembly into two separate pieces.

The second method involves a remote activation that allows for manual operation. The activation causes the discharge of an extinguishing agent over the area protected, extinguishing the fire. The purpose and location of the remote activation allow for the manual operation of the system and should be located away from the cooking equipment hazard. The manual release must be located where it is readily accessible at all times.

Fusible Link

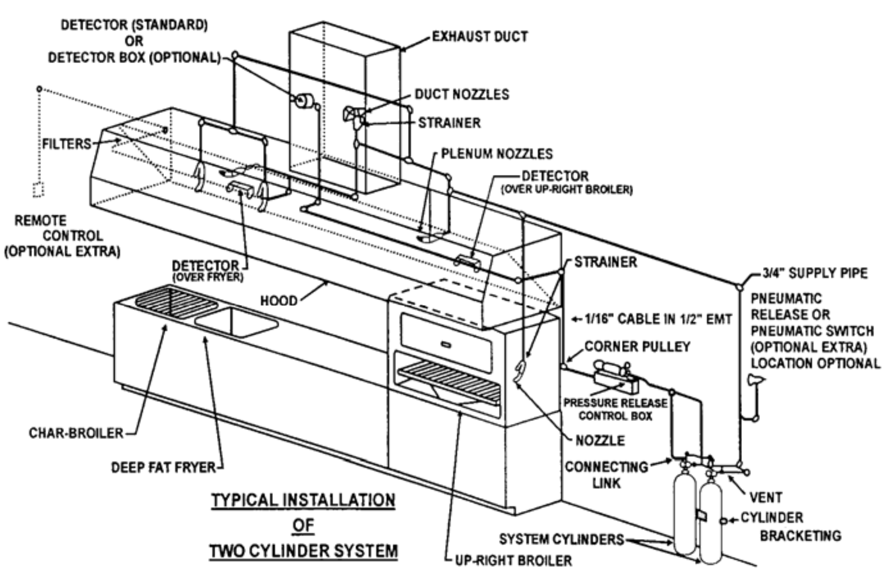


Hood range systems use a wet or a dry extinguishing agent. A dry system uses a fixed supply of dry chemical agent connected to fixed piping. Nozzles are arranged to discharge the extinguishing agent onto a burning surface. A gas, usually either carbon dioxide or nitrogen, discharges the agent under high pressure (about 350 pounds per square inch (psi)). This agent, when mixed with grease, forms a soap-like solution which helps prevent reignition.

The wet system operates essentially the same as a dry system. The difference is which wet chemical agent is used. The wet agent generally is not used other than in kitchen hoods for three reasons. It does not extinguish deep-seated fires, it wets electrical contacts, and it is corrosive. Wet chemical agents react with grease or oil to form a blanket, (saponify) reducing the release of combustible vapors. It cools the fuel and the cooking surface, reducing the possibility of a fire reflash. Systems that had been installed in the past 5 years are of the wet type. These type of systems are more effective in controlling heated grease fires.

An inspector must check all areas of the hood range system for cleanliness and operational readiness. Buildup of grease-laden vapors is dangerous. The discharge nozzles must be clean and unobstructed. The vent fan must work, and the filters and exhaust duct must be clean and well maintained. The unit must have a current inspection tag (in compliance with local code requirements). The remote activation must be far enough from the cooking area to allow safe operation.

Restaurant Range Hood Wet Chemical System



The staff of the restaurant or cooking facility should check these systems at least monthly. A fire inspector should check the same areas, using the following checklist or a similar one as a guide.

- Are nozzle caps in their proper place?
- Is grease accumulating on the fusible links and nozzles?
- Are corrosive cleaning solutions affecting links, cables, or nozzles?
- Has any new cooking equipment been added or existing equipment relocated? If so, will this require adding nozzles or relocating existing nozzles?
- Are nozzles still aiming at the surfaces they are designed to protect?
- Are manual activators unobstructed?
- Are tamper indicators and seals intact?
- Is the maintenance tag or certificate in place?
- Are pressure gauges, if provided, in the operable range?
- Has a Class K extinguisher been installed in cooking areas being protected by a wet chemical type extinguishing system?

ADDITIONAL CONCERNS

Improper Storage

Storage is a concern in all occupancies, and assemblies are no different. Of particular concern is the storage problem in exhibit and meeting facilities where the staff may use the interior exit corridors to store tables and chairs, or to keep food warmers for serving banquet meals.

Inspectors must keep a constant watch on these assembly facilities because it becomes easy and convenient to block or obstruct exit passageways with a variety of items. This also is true during exhibit and trade shows. These events usually result in large quantities of combustibles coming together in one place. An easy out-of-sight storage solution is putting materials just outside the door in the (exit) hallway.

Frequent monitoring of temporary electrical installations around exhibit booths is important because exhibitors tend to hide trash and rubbish behind the curtains in their booths and on top of the temporary electrical equipment. A small short circuit could start a serious fire. The condition of the electrical equipment and control over waste combustible accumulation are key responsibilities of the inspector.

These principles apply across the board to all occupancies, but are especially critical in assemblies because of the life safety issues.

Pyrotechnics

Another, fairly new phenomenon in assemblies is the use of pyrotechnics (fireworks). More and more rock groups use them as part of the staging to add to the glitz and enhance audience excitement.

Most jurisdictions have regulations regarding the use of pyrotechnics for all events, especially indoors. You must become familiar with these regulations so you can enforce them properly. Most often there are limits on the size and power of the display and a licensed pyrotechnician must be at the event to supervise these special effects.

Again, check your code or ask your fire marshal to ensure you are aware of the requirements in your jurisdiction.

EGRESS (EXIT) SYSTEM COMPONENTS

Egress systems are an essential part of the life safety systems in a building. Getting people out of and away from a building on fire is a key to saving lives. This applies not only to assemblies, but to all occupancies. We will discuss egress system requirements here, under assembly occupancies, because of the large numbers of people that occupy these buildings. This equates to a much greater potential for life loss under fire or other emergency conditions. Discussing egress here does not minimize its importance in any other occupancy.

Egress (exit) systems must meet code requirements and be maintained at all times. The components of these systems are critical in ensuring the safe movement of occupants to an area remote from a fire or other emergency and ultimately outside to a safe area of refuge.

There are many similarities and many differences in the egress system requirements of all the codes. This manual will not detail these differences. It is up to the inspectors to study the applicable codes so they become knowledgeable and proficient in these essential life safety requirements.

As stated earlier, assemblies are a logical occupancy for this subject due to the numbers of people in assemblies, the life safety concerns they present, and the difficulties usually met in exiting a building during an emergency. These egress systems are important because there are numerous problems in getting people out safely, such as their familiarity or lack of familiarity with the building, their ability to move about (e.g., disabled, blind, hearing impaired, semi- or nonambulatory, wheelchair bound), their age (young or old), or their limited mental capacity.

A key component in an exit is the door. Depending on code requirements, it may or may not be a fire-resistive-rated door designed to withstand a certain amount of heat and flame impingement. In virtually all cases, these doors must open in the direction of exit travel--but there are exceptions, such as some historic buildings. Again, you must study your local codes for your jurisdiction's requirements.

Exit doors must have a proper latching or locking device. Locking with chains usually is illegal, as is the need for special knowledge. There must be only one releasing action to open an exit door. An exit door must open easily--either by a single knob that turns and opens the door, or by push (panic) hardware that releases easily. The area behind and beyond the door, whether interior or exterior, must be free and clear of obstructions; there must be a clear path for exiting away from the building. Most codes require exit doors to be equipped with panic-type exit hardware when they have an occupant load that exceeds a prescribed number.

Corridors are also an integral part of an egress system. Often, but not always, these corridors are rated as fire-resistive to provide some level of protection as people move within the building to an exterior exit door. The same holds true for exit stairs. All must be clear and unobstructed.

Exit markings and signs are also essential parts of the egress system. So are illuminated exit signs posted above exit doors. Where appropriate, directional exit signs may be positioned and visible from appropriate portions of the area, room, or building. In some codes or under some State regulations, low-level exit markings and signs now are mandatory. An inspector must study and become proficient in the knowledge of the jurisdiction's requirements for egress system components.

Another egress system component is emergency lighting. Serviced by a power source separate from normal building power, either batteries or a standby generator, these lights assist in egress. Inspectors need to test these lights during routine inspections to ensure their proper operation. They do not replace regular lighting and should provide sufficient illumination for the safe evacuation of a building.

These components are code-based and depend on the number of people in a building or area. An inspector needs to know how to calculate the maximum number of people who can safely occupy a building or area of a building. The next section will focus on calculating occupant load.

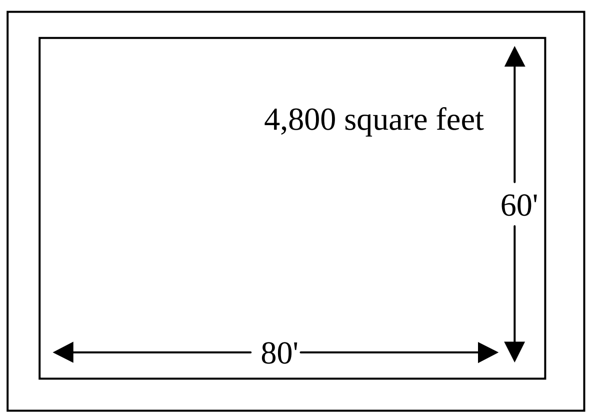
OCCUPANT LOAD

Overcrowding has been a significant factor in many major, life-loss fires. As noted earlier, there were 165 lives lost in the Beverly Hills Supper Club fire. Major contributors were overcrowding and inadequate exits.

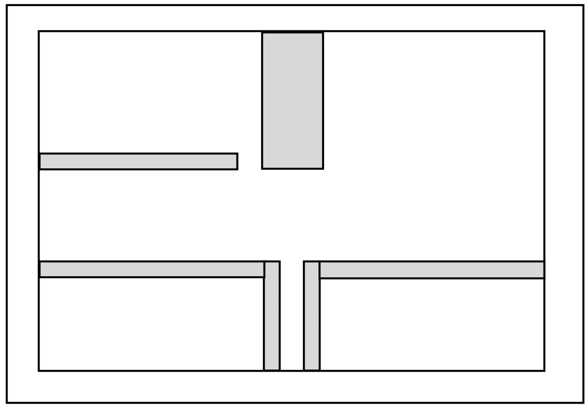
The purpose of establishing and maintaining a maximum occupant load is to help facilitate safe exiting during an emergency. Occupant load relates to number and size of exits and travel distance to exits. The certificate of occupancy, in most cases, is the document that establishes the occupant load. Check it, if available, to determine accurately the legal occupant load of the building or occupancy you are inspecting. These issues will be discussed later in this module.

There are some subtle but critical differences in the different codes. One that should be discussed immediately is the issue of gross area versus net area. In the SBC, net area is used for assemblies, whereas gross area is used for many other occupancies.

Let's explain the difference. In the SBC, gross floor area is the area within the inside perimeter of the exterior walls with no deduction for corridors, stairs, closets, thickness of walls, columns, or other features exclusive of areas open and unobstructed to the sky.



Net floor area is the area actually occupied, not including accessory unoccupied areas such as corridors, stairs, closets, thickness of walls, columns, toilet room, mechanical room, or other such features.



Net floor area is gross area minus shaded parts.

Occupant load is established generally during the plan review and construction inspection process. The building official generally assigns an occupant load at the time a certificate of occupancy is issued. But often an inspector will encounter a change in use or some other change that requires the recalculation of the occupant load. The fire official in some communities also may have the authority to post the occupant load of a area on a building depending on the adopted codes. The business may have lost or misplaced the form or certificate that established occupant load. This is where the inspector must go to work.

The basic method for calculating occupant load is essentially the same in most codes. The formula uses a factor of so many square feet per person occupying the area. This method applies to virtually all occupancies. The square feet per person factor changes, sometimes significantly, by occupancy type, but the basic formula remains the same.

$$\frac{\text{occupancy square feet}}{\text{square feet per occupant}} = \text{occupancy load}$$

A simple example will help: A small restaurant with tables and chairs has 1,240 square feet. Using the formula, we divide 1,240 square feet by 15 square feet per occupant. We come up with 82.67 people or an occupant load of 83.

The factor may vary. Some codes use 15 for assemblies of less concentrated use. That is, 15 square feet are allowed for each person. Less concentrated use facilities are conference rooms, dining rooms, drinking establishments, exhibit rooms, gymnasiums, lounges, and stages.

Most codes use a factor of seven square feet per person that applies to concentrated-use assemblies. These include auditoriums, churches and chapels, dance floors, lobby accessory to assembly occupancy, lodge rooms, reviewing stands, stadiums, and seating areas.

It is important for you to become familiar with the different factors for calculating occupant load. But do not rely totally on memory; always double check your code before calculating and establishing an occupant load for a building, business, or area. If in doubt, seek help from other inspectors, the fire marshal, or building department personnel.

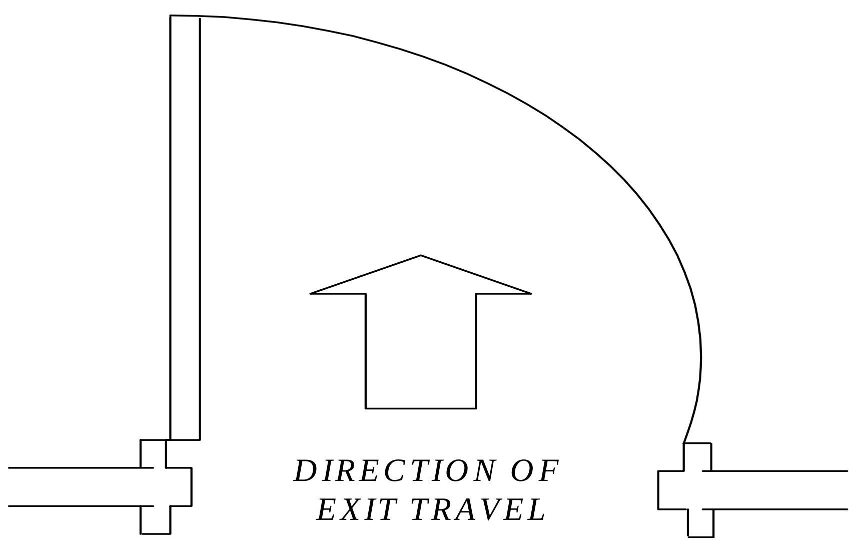
EGRESS (EXIT) SYSTEM REQUIREMENTS

By definition, an exit is a continuous and unobstructed means of egress from any point in a building or structure to a public way. According to the UBC, exits include intervening aisles, doors, doorways, gates, corridors, exterior exit balconies, ramps, stairways, pressurized enclosures, horizontal exits, exit passageways, exit courts, and yards.

Doors must swing in the direction of exit travel when the occupant load exceeds 50, or when occupants exit from a hazardous space. Again, as is so prevalent throughout the codes, there are exceptions to this rule. You must become familiar with the exceptions permitted by the code for the occupancy that you are inspecting. Don't be afraid to look it up if you are unsure of a specific requirement.

DOOR SWING

EXIT DOOR SERVING ANY HAZARDOUS AREA
OR
GENERALLY
SERVING AN OCCUPANT LOAD OF 50 OR MORE



Exiting requirements are the most critical of all requirements for places of assembly. While the probability of a fire in a place of assembly may be low, the potential for life loss once a fire occurs is very high. A fire of any size can cause a large number of injuries and deaths. Therefore it is essential that places of assembly have enough exits to accommodate the number of people likely to occupy the space, and that exits be properly located, easily accessible, and well maintained.

An exit system consists of three essential parts: an exit access, a protected exit, and an exit discharge. The exit access leads to an "entrance" to an exit which may or may not be protected. The protected exit is a fire-rated exit. The exit discharge is the space between the "end" of the exit and a public way such as a street, alley, or other public open-air space with a minimum width and height of ten feet. Public means that the area has been deeded, dedicated, or otherwise permanently appropriated to the public for its use.

Number of Exits

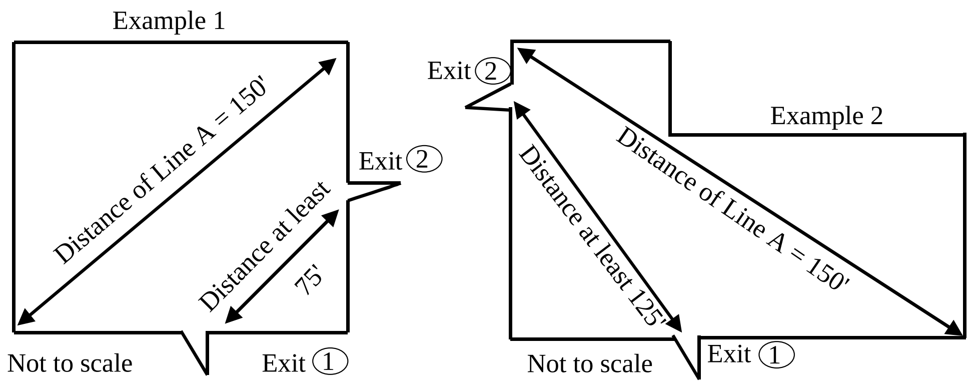
The number of people who must exit through a floor or space (based on calculated occupant load) and the travel distance to the exits determine the number of exits a building or area needs. All three model building codes and NFPA *Life Safety Code* require a minimum of two exits in all public assemblies.

When occupants of an area or room must travel through two rooms to exit, the occupant load of the second room is added to that of the first room. The same is true of multiple floors. The exception to this is where the occupants of an upper floor exit into an exit stair enclosure. In this case, the occupant load is not added to the next lower floor.

As noted above, there must be a minimum of two exits in all assembly occupancies. The arrangement or separation of these exits is a critical element in providing for the safe egress of occupants in an emergency. The general rule is that exits must be separated at least one-half the diagonal distance of the area or room. The BOCA Building Code reduces this separation to one-quarter the diagonal of the area or room and the International Building Code reduces the standard to one-third, if the building is protected with a automatic sprinkler system.

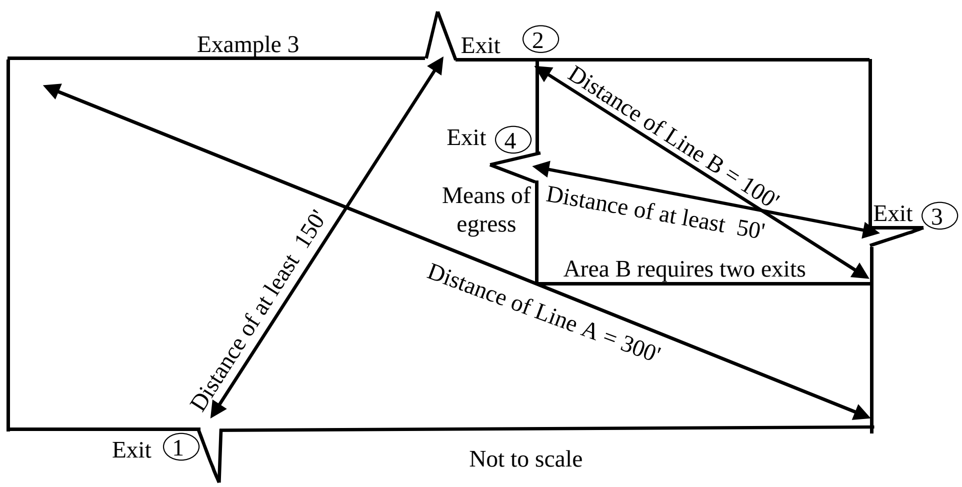
Although we will return to this point at greater length in the Business Module, we need to take a few minutes now and explain it. A simple example will help clarify.

DETERMINING REMOTE EXIT LOCATIONS FOR OCCUPANCIES REQUIRING AT LEAST TWO EXIT LOCATIONS



In example 1--the longest diagonal distance is 150 feet within the building. The second exit must be at least 75 feet or more from the front exit.

In example 2--The building has different dimensions, but the sample principle of remoteness applies.



In example 3 we have two different areas requiring two means of exiting, Area B, being a room and the other from the entire building. Both areas must follow the requirement of remoteness of the second exit.

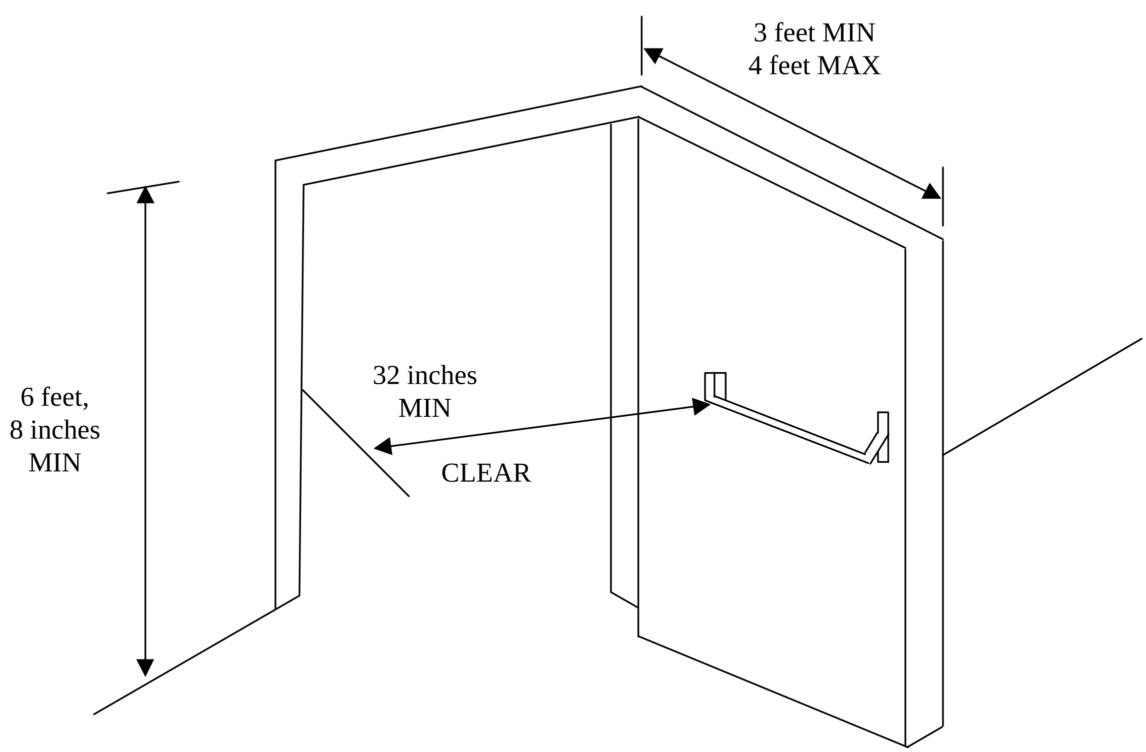
For now, this discussion suffices. In the Business Module, we will see how this principle generates various applications.

Exit Widths

The width of exits is also an important element in getting people out of a building safely. The total required width in inches is determined by taking the occupant load of an area or building and multiplying that number by a given percent of an inch for each person. This figure then is divided by 32 inches, clear width, to determine the total number of three-foot exit doors required. As a general rule, if you come up with a part of a percent, you always will round up to the next whole number. As an example, if you came up with 4.2 doors you would round the 4.2 up to the next whole number of five, 3-foot exit doors.

The UBC uses the total width of 36 inches for a standard door, and does not require any width for clear inside openings.

Minimum and maximum door widths are specified clearly in the codes, but generally a36-inches wide door will provide a 32" clear inside when fully opened, with a minimum width. The minimum clear with of an exit door is 32" and 48" maximum for a single door.



Here is how we calculate required exit width.

1. The rule is occupant load x factor = inches of exit width required.

2. Inches of exit width ÷ 12 inches = total feet of exiting required.

A factor of **0.2 inch** per person is used for traveling through doors, ramps, or corridors involving **level** travel.

A factor of **0.3 inch** per person is used when **traveling a stairway**.

These factors apply to all codes, with one exception. The BOCA Building Code, and the International Building Code reduces the requirements to 0.15 inch for doors, ramps, and corridors and to 0.2 inch for stairways in buildings equipped with automatic fire sprinklers. It is imperative that inspectors review and study the code applicable to their jurisdiction so that accurate calculations can be made.

Another critical factor in exiting is the number of exits required. The 1997 UBC, 1997 SBC, the 1999 BOCA Building Code, the International Building Code, and the NFPA *Life Safety Code* all require two exits up to 500 occupants, three exits from 501 to 1,000 occupants, and four exits minimum for 1,001 and over. Larger facilities must have exiting consistent with these standards.

Let's look at a basic floor plan and calculate the number of exit feet required for a less concentrated assembly. You have an area 100 feet x 128 feet. This equals 12,800 square feet divided by 15 square feet per person = 854 occupants.

It's all on one level so you need a factor of 0.2 to find the number of inches of exiting required for an unsprinklered. 854 (occupant load) x 0.2 (level travel factor) = 170.8 inches of exiting width. 170.8 inches ÷ 32" minimum clear width = 5.6 doors. Rounded up to six doors. Remember a standard door only has 32 inches clear width opening. The UBC would divide the 170.8 inches by 36 to determine the total number of doors.

Number of Doors

Another element of the codes now comes into play. All three building codes require that the exiting at the main entrance for public assembly, and the NFPA *Life Safety Code* must be designed to accommodate at least one-half of the occupant load. With six 3-foot doors required, three of the exit doors must be at the main entrance to handle 50 percent of the occupant load, and the remaining exits must handle the rest.

Because all codes require three exits for an occupant load of 501 or more, at least one of the other two exits must meet the criteria determined above for remoteness, one-half of the diagonal of the area served (unless under BOCA or International Building Code, and fully fire sprinklered). When evaluating exit separation, you must consider all of these factors.

Travel Distance

Another safety concern in exiting is travel distance. The maximum travel distance to an exit from any area or room in a building is 150 feet. Some codes allow 200 feet in buildings equipped with an automatic fire sprinkler system. This distance is to an exit which may be a protected corridor or stairwell which, under all the codes, is an exit.

Again, some of these factors vary by code so you must study your applicable code for all requirements **and exceptions** to make sure you are enforcing the appropriate code provisions.

The methods for calculating occupant load are the same for all occupancies. The only differences are the factors--the number of square feet allowed per occupant.

To sum up this section, let's walk through a scenario and review how to calculate each issue critical to exiting.

A restaurant (less concentrated use) has a usable space of 85 by 65 feet, and the building has no sprinkler protection. .

Step 1: Determine square footage.
85' x 65' = 5,525 square feet.

Step 2: Determine occupant load.
5,525 square feet ÷ 15 sq. ft. (less concentrated occupant factor) = 368 occupants.

Step 3: Determine inches of exiting width.
368 x 0.2 (level factor) = 73.6 inches.

Step 4: Determine clear travel exiting door width.
73.6 ÷ 32 = 2.3 doors, rounded up to 3 doors.

Remember each 36-inch door only provides 32inches of clear exit width. It can be assumed that a minimum of three, 3-foot doors are required. Some schools of thought round up and say three 3-foot doors are required. The total width of exiting would be required at two exit locations with each exit handling 50 percent of the occupant load, properly separated at least 53.5 feet (1/2 diagonal of 107 feet).

SUMMARY

This module has explained some of the critical issues found in public assembly occupancies. We focused on assemblies because of the many life safety issues presented by the high occupant loads that exist in them.

There are several keys to safety in assemblies. First and foremost is to minimize the fire hazards found in these buildings. Proper storage practices, minimizing the amount of combustibles, and keeping ignition sources under control are keys to a safe occupancy. The inspector must make sure that there is a proper exiting system in the building and that the exits are properly marked and maintained. The inspector also must be sure that decorative materials are safe and properly treated, and that changes in interior finish have been evaluated for fire safety.

Some of the major life safety hazards encountered in assemblies include obstructed or illegally locked exits, improper or unsafe storage, and poorly maintained temporary electrical systems.

An inspector must be diligent in making inspections of assemblies and be alert to even the most subtle life safety hazards. Life safety must be the inspector's foremost concern.

Assemblies can be part of other occupancies. Restaurants are still assemblies, even though located on the twelfth floor of a highrise office building (classified as a "B" occupancy), or in convention and meeting facilities contained in an "R" occupancy hotel.

The principles learned here apply to other occupancies. There are occupant load factors, exiting factors, and travel distance requirements for almost all occupancies. The concepts are the same; the factors or numbers may be different. Again, study, research, and asking questions of more experienced inspectors will produce the answers.

The inspector must study and understand the codes and their application when dealing with these "mixed occupancy" scenarios. One should not try to do it alone, but ask for help. No one has ever learned these complex issues overnight.

When in doubt, ask a more experienced inspector.

Activity PA.1

Identify Types of Assemblies

Purpose

To differentiate among the various types and subclasses of public assemblies based on use and size.

Directions

1. As a large group, name some public assemblies in your area by type and size (e.g., large, small, church, theater, restaurant, etc.). The instructor will record the responses on an easel pad.

2. In small groups, using the easel pad list, you will categorize the list by subclass.

   Example:

Type	Size	Subclass
small church	180	A3 (UBC)

3. Be aware that although types of assemblies are the same (e.g., church), they change by subclass due to size (150=A3, 800=A2.1).

4. Each group will select a spokesperson to report on its results.

Activity PA.2

Hazards in Public Assemblies

Purpose

To identify the fire and life safety hazards inherent in public assemblies.

Directions

1. Working in the same groups from Activity PA.1, develop a list of fire and life safety hazards for each of two assemblies assigned to your group by the instructor. Use an easel pad.

2. Choose a spokesperson to report for your group.

Activity PA.3

Decorative Materials

Purpose

To identify problems related to decorative materials that can occur in public assemblies during different holidays.

Directions

1. Working in small groups, list on an easel pad hazards and unsafe conditions involving decorative materials that can occur during different holidays.

2. Use your code to identify specifically why these are hazards. List the code reference next to the hazard, and how it can be corrected.

3. Select a spokesperson to present your group's report.

Activity PA.4

Life Safety Factors in Public Assemblies

Purpose

Given an applicable code or a local code, a floor plan, and a building description, calculate occupant load, the number and size of the required exits, and the exit separation requirements to determine if there are potential hazards.

Directions

1. Working in small groups and using your assigned scenario, determine

    a. The available square foot area of the assembly.

    b. Occupant load.

    c. Inches of exiting required.

    d. Number of exits required (Scenarios 1 and 2 only).

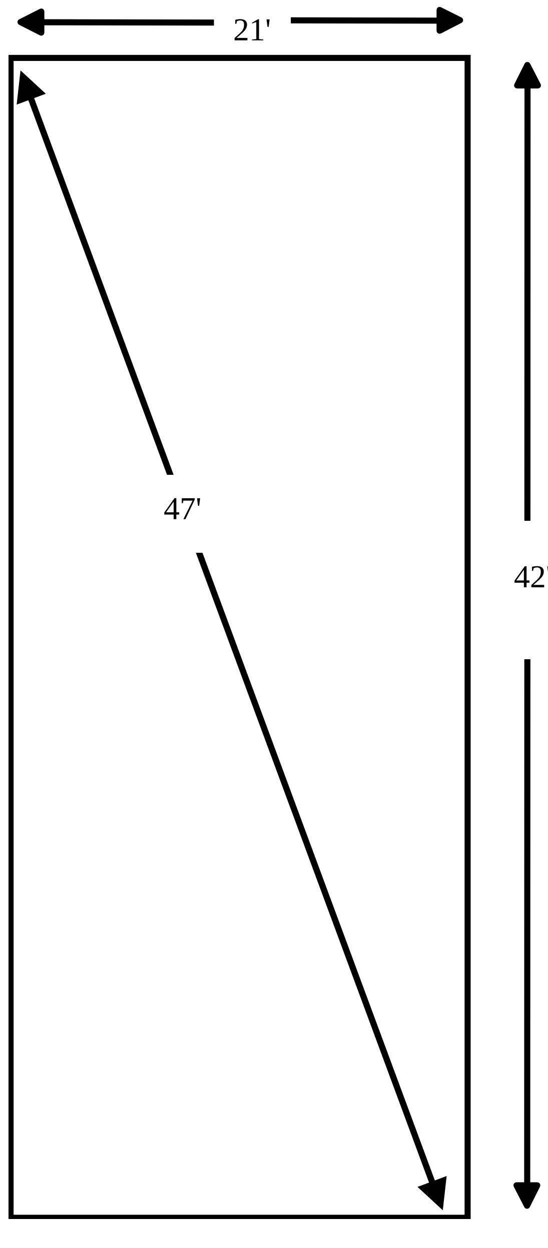
    e. Minimum separation distance between exit locations.

2. Select a spokesperson to report on your scenario.

3. You also will be given a scenario to complete as homework, per the above instructions, which you will turn in at your next class.

Scenario 1

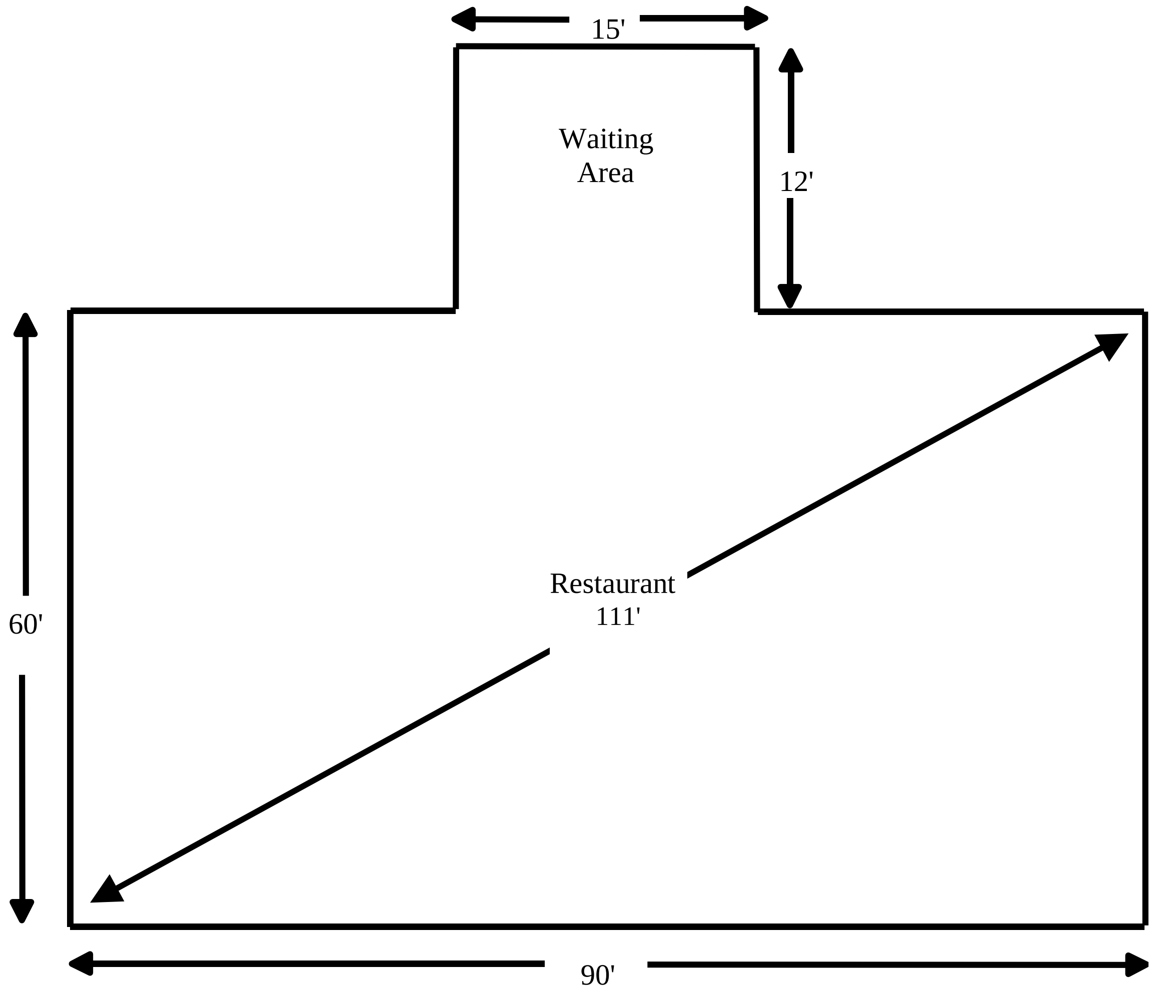
Small meeting hall (maximum occupant load **not** based on waiting area--three square feet/person). Also calculate less concentrated use occupant load. Non-sprinklered building.



____________________ Total square feet

Scenario 2

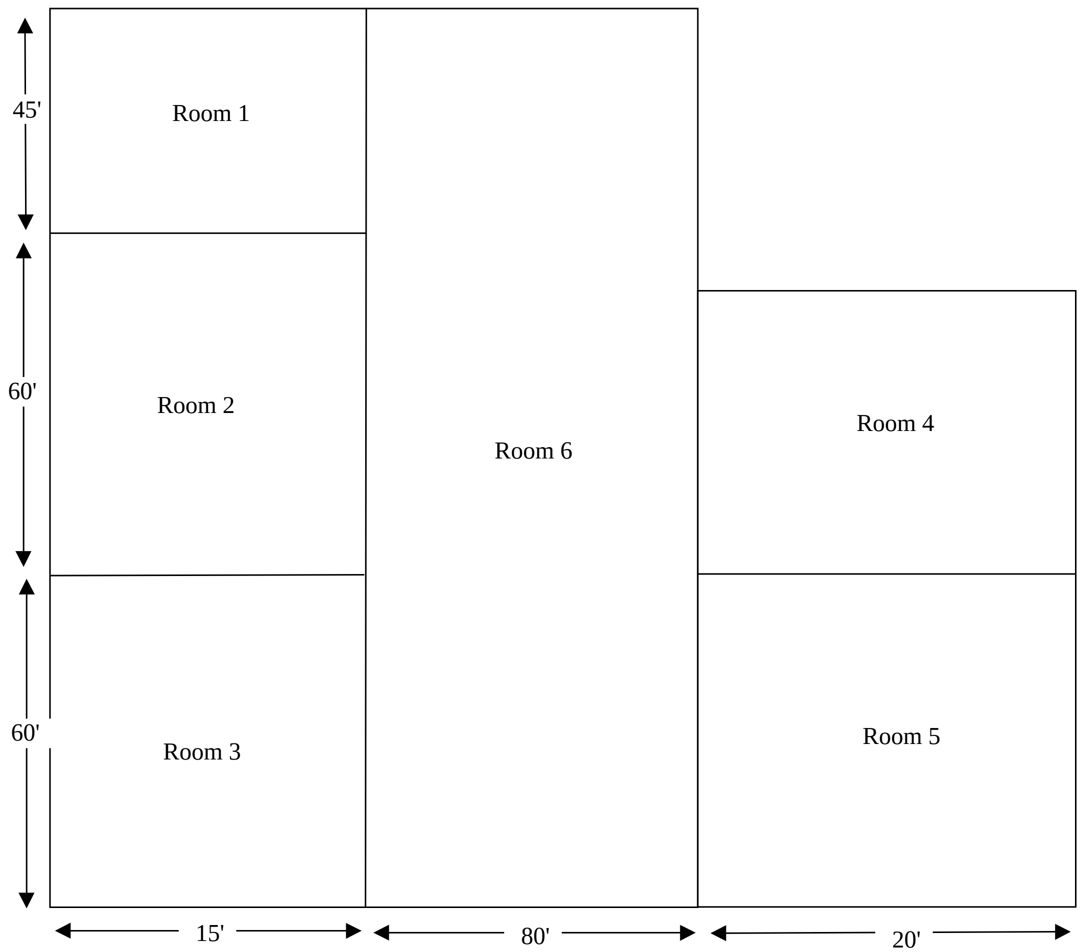
Restaurant. Tables and chairs. Less concentrated use only--no fixed seating. Small waiting area. Non-sprinklered building.



____________ Total square feet

Scenario 3

Multiple-use meeting facility. Calculate all areas for both concentrated and less concentrated use to determine maximum occupant load. Do not attempt to determine the number of exits required for this scenario. Non-sprinklered building.



		Concentrated	Less Concentrated
________	Square feet room 1, occupant load	___________	_____________
________	Square feet room 2, occupant load	___________	_____________
________	Square feet room 3, occupant load	___________	_____________
________	Square feet room 4, occupant load	___________	_____________
________	Square feet room 5, occupant load	___________	_____________
________	Square feet room 6, occupant load	___________	_____________
________	Total square feet, Totals =	___________	_____________
________	Total inches of exiting required based on level travel.		

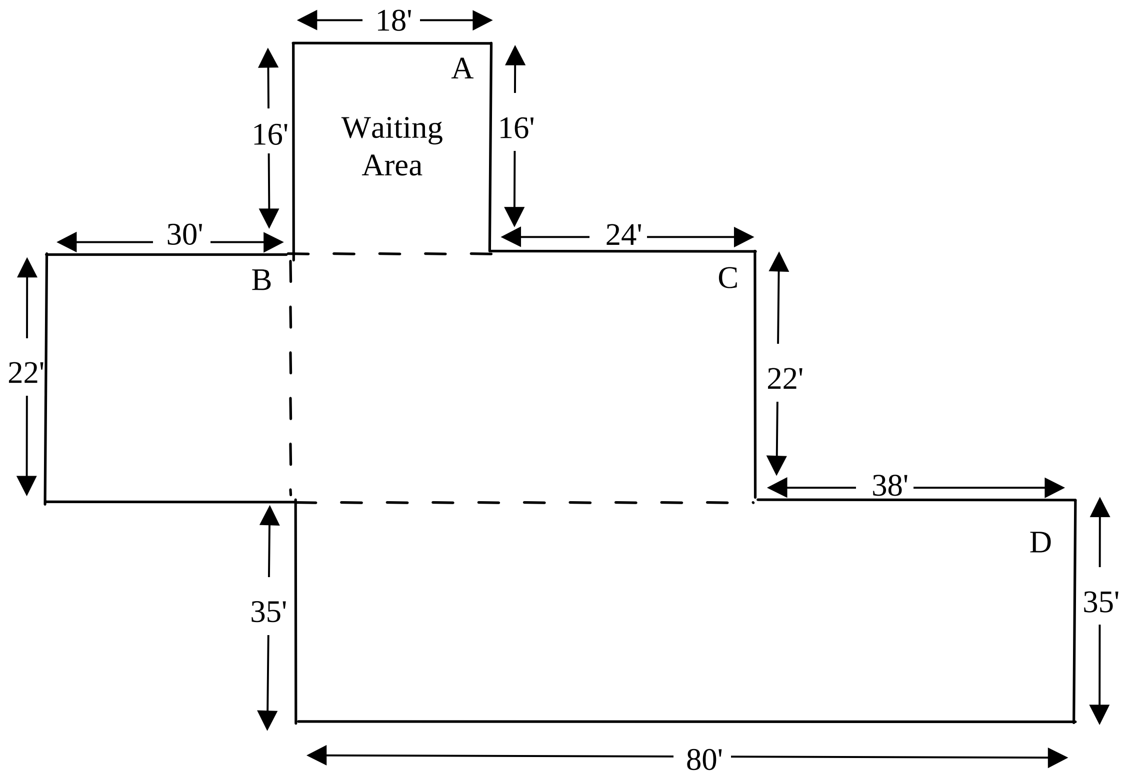
Take-Home Scenario

Multipurpose facility--Non-sprinklered.

Calculate:

Total number of square feet.
Occupant load for standing room only (waiting area).
Occupant load for concentrated use--all but the waiting area.
Occupant load for less concentrated use--all but the waiting area.
Number of inches of exiting required.

Broken lines indicate suggested areas to be calculated to determine total area.



________ Square feet section A, occupant load _________

		Concentrated	Less Concentrated
________	Square feet section B, occupant load	_________	_____________
________	Square feet section C, occupant load	_________	_____________
________	Square feet section D, occupant load	_________	_____________

________ Total inches of exiting required based on level travel.

Activity PA.5

Report Preparation

Purpose

To formulate code-based findings from an inspection into a properly formatted report document.

Directions

1. Working individually and using the code applicable to your jurisdiction, review the following inspection scenario.

2. Using the attached inspection report form or an inspection report form from your jurisdiction, complete the form, citing the hazards identified in the scenario.

3. Be sure to cite specific code references.

4. You have 60 minutes for this activity.

Scenario

You are inspecting meeting and conference rooms and a restaurant in a highrise hotel.

As you enter the lobby, you observe decorative sheets covering registration tables used for conference attendees. No one at the hotel can tell you if the sheets have been flame-retardant treated. As you enter the corridor leading to the meeting rooms, you note a number of display booths have been placed in this passageway. The passageway, originally designed to be 12 feet wide, is reduced to 4-1/2 feet due to the space taken by the booths.

You enter the main meeting room, set up for 400 attendees, and you note coffee service has been set up in front of two clearly marked side exit doors. A large video screen is positioned in front of two exit doors at the front of the room. A display board obstructs access to a fire extinguisher positioned on the west wall. You enter the back hallway where the meeting room exits and find numerous tables, chairs, and warming carts stored there.

You enter the kitchen area, which serves both the restaurant and the conference facility, and note that the hood range system has no certification tag, the hood filter is very greasy, and the protective caps on the fire protection system nozzles are missing. You go into the restaurant and find that the second exit panic hardware has a chain and padlock which are attached to an eyebolt on the wall.

You leave the facility and return to your office to prepare an inspection report.

FIRE-SAFETY SURVEY REPORT

FIRE PREVENTION…
FOR YOUR SAFETY

Building ________________________________ Owner/Mgr. ______________________________
Address ________________________________ Phone ___________________________________
________________________________ Type of Occupancy ________________________

☐ New Occupant

The _________________ Fire Department has conducted a fire safety survey of your property. The knowledge gained through this survey will enable the Fire Department to attack and extinguish fire that might occur in the building quickly and efficiently.

During this inspection, conditions affecting fire safety throughout the premises were also noted. It is requested that the items listed below be given your immediate attention in the interest of fire safety.

FIRE HAZARDS FOUND TO EXIST: ☐ NONE OBSERVED THIS INSPECTION

☐ Fire Extinguishers	☐ Housekeeping	☐ Flammable Liquids	☐ Electrical
☐ Trash	☐ Utilities	☐ Fire Protection Equip.	☐ Fire Lanes
☐ Exits	☐ Fire & Smoke Doors	☐ No Smoking Signs	☐ Other

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If at any time questions regarding fire safety arise, do not hesitate to contact the Fire Department at ______________. For an emergency call ________________ . In case of fire in your building, call the FIRE EMERGENCY NUMBER.

________________________	________________________	________________________
Property Representative	*Reporting Officer*	*Date*

Reinspection Due ________ Made By _________________ Date _________ Notified FM # _______

WHITE – Owner/Manager
YELLOW – Station File
PINK – Fire Marshal

FIRE HAZARDS CORRECTED # ________________
FIRE HAZARDS NOT CORRECTED # ___________

10/75

Notice of Violation Page __________ of _________

Building ______________________________________ Date _______________________________

Address _______________________________________ Owner/Mgr. _________________________

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PROPERTY REPRESENTATIVE REPORTING OFFICER

WHITE – Owner/Manager
YELLOW – Station File
PINK – Fire Marshal

FIRE HAZARDS CORRECTED ____________________
FIRE HAZARDS NOT CORRECTED ____________________

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