

Technical Principles and Practices of Fire Prevention

**Module
Business**

**MODULE
OBJECTIVES**

The students will be able to:

- *Identify business occupancies.*
- *Identify the major fire and life safety hazards in business occupancies.*
- *Given various examples of potential hazards in business occupancies, describe the hazard and discuss methods for gaining compliance.*
- *Describe the procedures to inspect and ensure operational readiness of standpipe systems and Halon systems.*

INTRODUCTION

Our brief study of assemblies showed that there are different ways to define and to group public assemblies. We mention four: the National Fire Protection Association (NFPA), Building Officials & Code Administrators International, Inc. (BOCA), the International Conference of Building Officials, the Uniform Code (UC), and the Southern Building Code Congress International, Inc. (SBCCI).

This module will examine business occupancies. We will find a similar concept here as we did with assembly occupancies: the codes vary a bit from each other in their classification of business.

Now let's take a closer look at how each of the codes defines businesses.

WHAT IS A BUSINESS?

BOCA and International define Group B (businesses) as "all buildings and structures which are occupied for the transaction of business, for the rendering of professional services, or for other services that involve stocks of goods, wares, or merchandise in limited quantities which are incidental to office occupancies or sample purposes."

Uniform Code

The UBC says Group B occupancies "shall include buildings, structures, or portions thereof, for office, professional, or service-type transactions, which are not classified as Group H occupancies. Such occupancies include occupancies for the storage of records and accounts, and eating and drinking establishments with an occupant load of less than 50." Examples are listed in Figure B-1.

Southern Code

The SBCCI says that a Group B occupancy is "the use of a building or structure, or any portion thereof, for office, professional, or service type transactions, including normal accessory storage and the keeping of records and accounts." Examples are listed in Figure B-1.

Assembly occupancies with an occupant load of fewer than 100 persons are classified as Group B.

HAZARDS IN BUSINESSES

Business occupancies can be located in buildings that range from small wood-frame structures to some of the tallest fire-resistive edifices. Business buildings generally are considered low hazard. In most communities, they are a very small part of the fire problem; however, a fire in a large library or a highrise office can be an extremely challenging event.

Buildings divided into small office cubicles have fire issues very different from "open plan" buildings. Library stacks differ from a self-service car wash. Surgical procedures previously performed only in hospitals take place in modern outpatient clinics. At one time, search and rescue received only minimal consideration in office buildings after midnight. Today computer operators and data entry personnel are in office buildings throughout the night. Older highrise buildings without sprinkler protection have a unique set of fire problems, but a written and distributed fire and evacuation plan will help offset the longer evacuation times.

We need to look at some hazards common to businesses but also found in other occupancies.

Electrical Hazards

One of the most common hazards in business buildings is electrical. In most jurisdictions, deficiencies observed in the permanent electrical wiring of the building should be referred to the electrical inspector.

Extension cords are frequently sources of some confusion. No model code bans extension cords for appropriate temporary use. For example, if you are having a training class and the projector cord does not reach an outlet, it is acceptable to use an extension cord. On the other hand, if the problem is a desktop adding machine that is used regularly, the rule is that an extension cord cannot replace permanent wiring. Moving the adding machine or installing a new permanent outlet is required. Extension cords may supply only one portable appliance temporarily. Spliced extension cords are not acceptable.

Computer-Age Hazards

The computer age has, to some extent, blurred the rules. Many computers, printers, modems, scanners, or other devices plug into some type of strip or multioutlet box. The rule is that unapproved multiplug adapters, cube adapters, and strips are violations. Therefore, only approved devices are acceptable. An approved device normally bears the symbol of a

recognized testing agency and includes a written description of use and limitations. Special rules apply to the underfloor computer cabling found in mainframe computer rooms.

In many business buildings, the space over the drop ceiling holds cables. Often, this space also serves as a return air plenum. This means that, instead of an air duct taking air back to the air handler, the open area above the ceiling is used. This creates a special fire problem. If a fire occurs in the return air path, the air handlers will spread the smoke quickly throughout the building. Therefore, codes were changed to require any cable in a return air plenum to have insulation that is fire resistant and does not generate smoke. Some codes further require that ceiling cables do not prevent one from raising ceiling tile from below.

Flexible cables connect appliances and equipment to the outlets of a building. Flexible cables are not protected to the same degree as permanent wiring. Therefore, the NFPA 70, *National Electrical Code* (NEC) includes requirements to reduce the danger of fire or accidents.

As a rule, flexible cords cannot be run through holes in walls, floors, or ceilings; run under doors or floor covering (carpet); affixed to structure; or otherwise subject to physical or environmental damage.

Exit Design Issues

With the exception of penal institutions, hospitals, nursing homes, and a few other occupancies where occupants are incapable of free movement, exiting of structures to avoid a fire situation is a principal defense. The basic principle is that occupants have time to reach the outside or other relative secure locations safely before the fire becomes life threatening. Exiting is not an effective safeguard for people who are in close proximity to flash fires or explosions, or when their clothing is burning. The same principles apply to most occupancies. The application of the principles varies among codes.

Usually plan review of occupancies resolves most exit issues. However, you should be familiar with the basic principles. Occasionally, egress facilities in an existing structure change significantly. An inspector who knows the principles may observe the modification during inspection.

Travel Distance

One of the factors that most affects the time to exit is travel distance. Obviously, the shorter the distance, the less time it takes to walk to the exit. Codes generally establish travel distance limits based on the hazards of the occupancy and the presence or absence of automatic fire suppression systems.

High-hazard structures have the shortest permitted distance. Most codes permit increased travel distance with complete automatic fire sprinkler protection.

Travel distance is measured along the path that would be followed by someone walking to the exit from the most remote point. Remember that the exit is not necessarily an outside door. It may be the door to an interior stairway. In the case of some small rooms, the code may permit the distance to be measured from the door of the room, and not count the distance to the door within the room. Travel distance limits are to the closest exit only. The distance to the additional exits is not directly regulated.

Depending on the code, the permitted maximum travel distance may be found either on a table or within the individual occupancy sections. The codes prescribe restrictions for each type of occupancy which may be different from other occupancies. You must be careful to get the correct figure. You also need to check for any exceptions, e.g., automatic sprinkler protection, that modify the requirement.

Figure B-1 shows travel distance in an open structure. Very few structures provide unobstructed travel from every point to an exit; therefore, straight-line distances are rarely used.

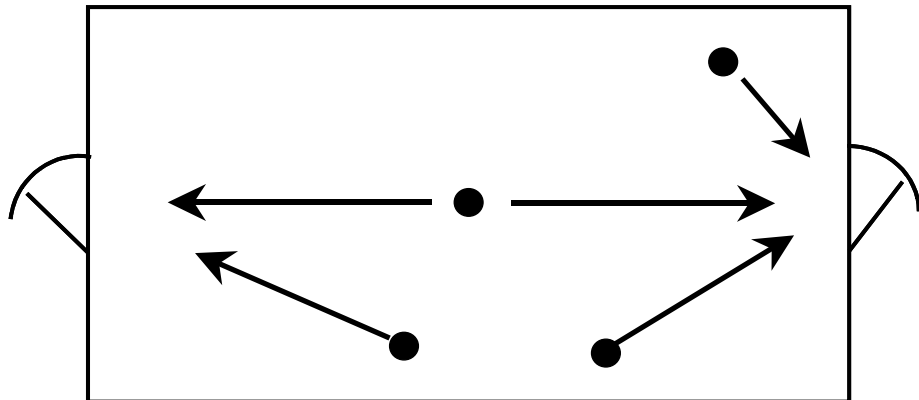


Figure B-1

Figure B-2 is more realistic: it shows measurement along the path that would be used by exiting people.

Travel distance is the distance from the most remote point in the building to an exit measured along the path of travel.

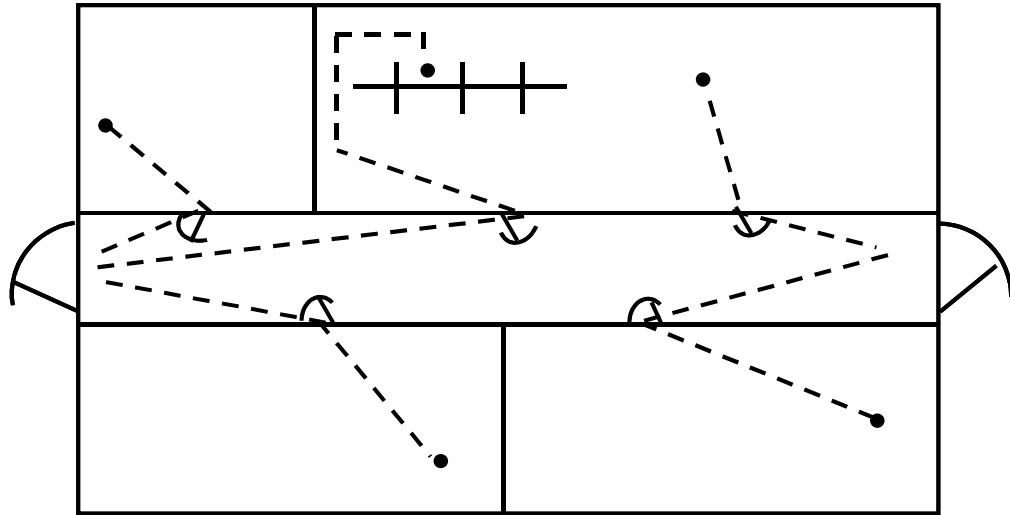


Figure B-2

One of the most important principles is that egress must be guaranteed so that no single incident can prevent people from having time to escape and having their egress route blocked by fire. Most structures require two exits, but some small buildings may have a single exit. Most codes allow very small business occupancies to have a single means of egress with very specific limitations.

If a structure needs two exits, they must be remote and independent, as defined by code. There are three ways to define remoteness and independence: dead-end corridor limits, common path of travel limits, and minimum exit separation.

Dead-End Corridor Limits

Dead-end corridors have only one way out to the exit path. If the fire moves fast and the dead-end is deep enough, people can be trapped. The limits defined by the code are dependent on the type of occupancy. High-hazard occupancies where flash fires are more likely to occur cannot have dead ends. Figure B-3 shows a typical dead-end corridor.

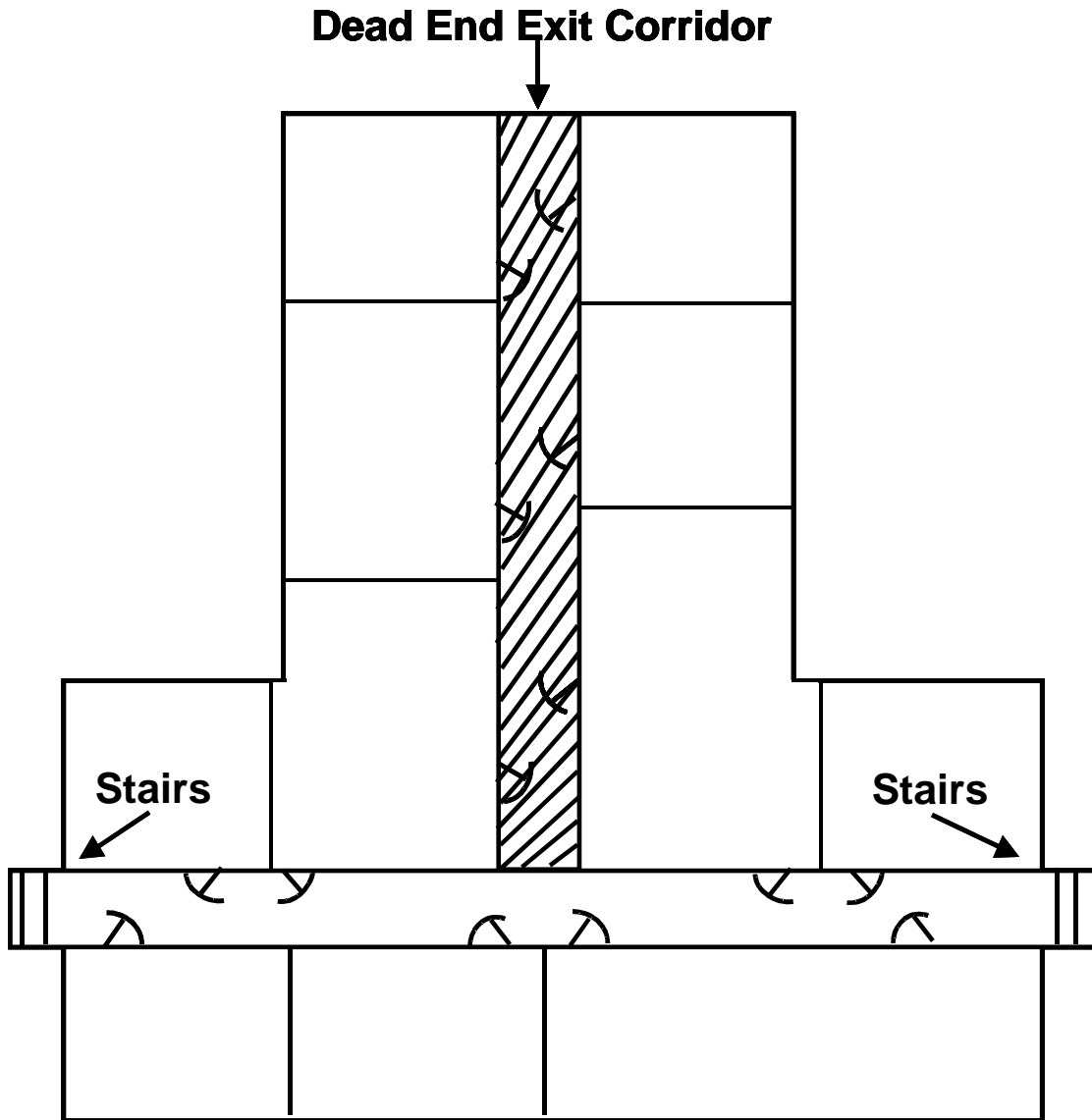


Figure B-3

Common Path of Travel Limits

A common path of travel means that the access to different exits requires travel along the same path for some distance, usually within a room or area. The same condition that occurs in a corridor is then referred to as a dead end corridor. Other obstructions also create common paths. Figure B-4 shows how room dividers can create a common path of travel. While there are many different ways to travel, they all lead back to the reception area.

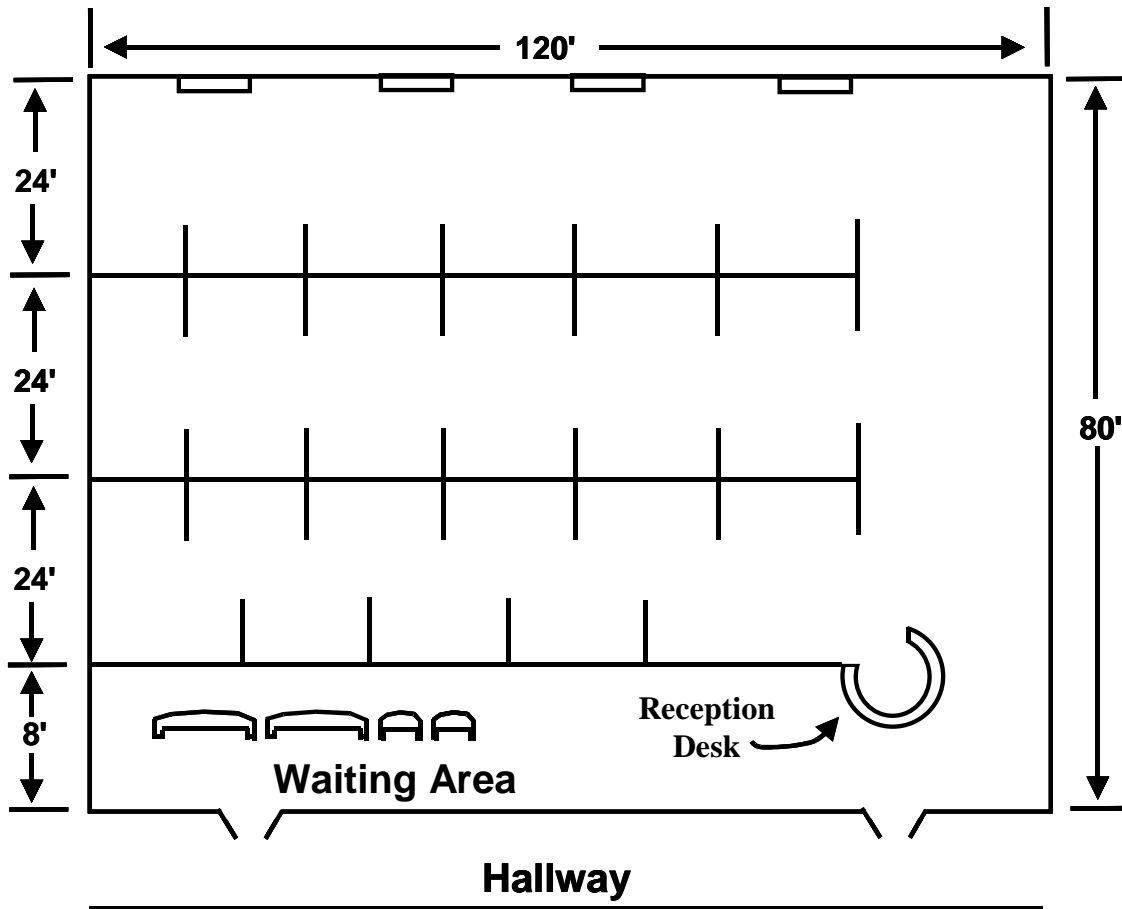


Figure B-4

Minimum Exit Separation

In some codes, exits must be separated by a minimum distance equal to one-half the diagonal of the space. You will recall that we briefly discussed this in the module on public assemblies. This rule may be modified by automatic sprinkler protection. Figures B-5, B-6, and B-7 illustrate the principle.

The back of a grocery store building is inaccessible. The building has three well-separated exit points (Figure B-5).

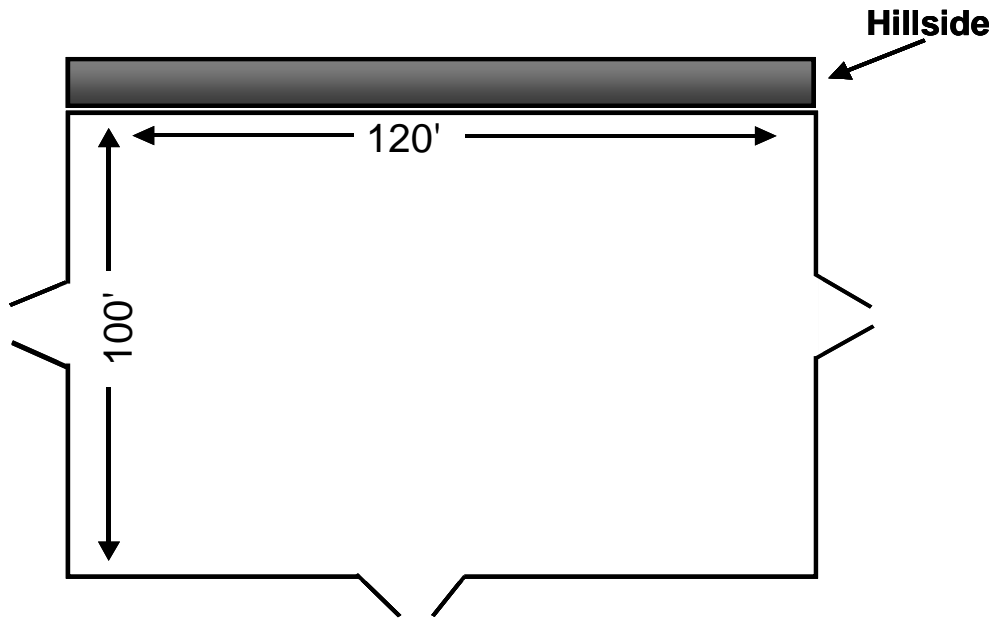


Figure B-5

The same building is split into two occupancies. Each occupancy has two remote exit points (Figure B-6).

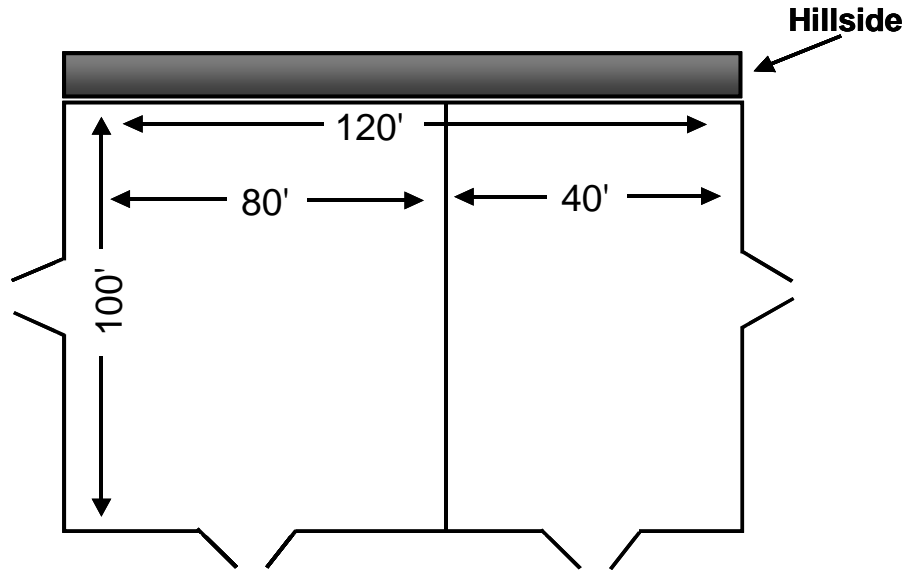


Figure B-6

There are now three occupancies in the building. The center section is narrow and deep. The fire official argues that there is a common path problem. The building owner argues that there are two separate paths 30 feet apart leading to exits as remote as possible from each other. The one-half diagonal rule is used to show that the exits are not sufficiently remote.

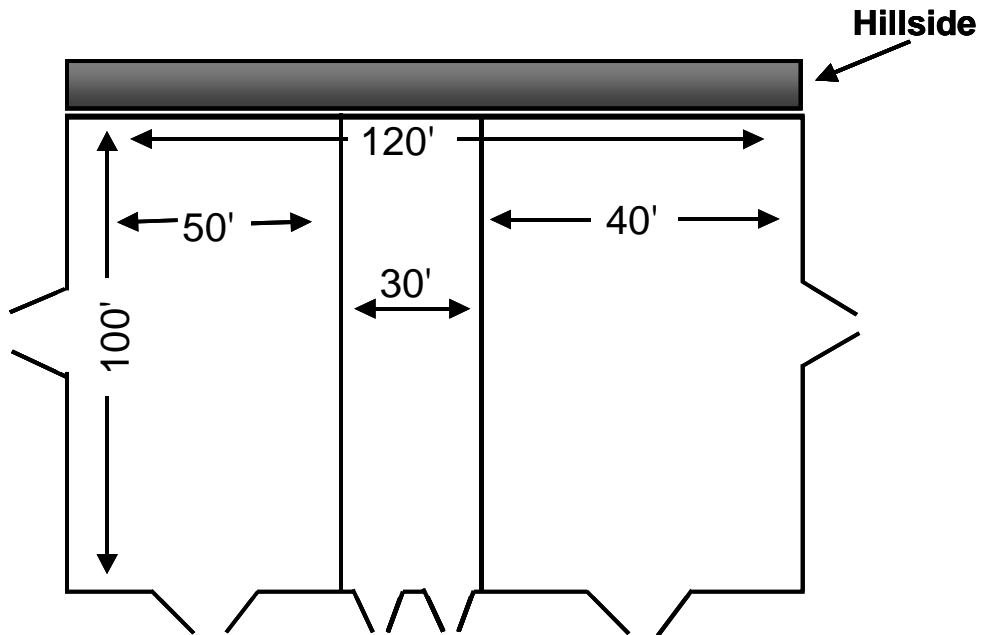


Figure B-7

The diagonal of this 100 x 30 foot space is about 104 feet. One-half the diagonal is 52 feet. This is the minimum separation.

The building owner has two ways to correct the problem, each of which requires a fire-resistive exit passageway. They appear in Figures B-8 and B-9.

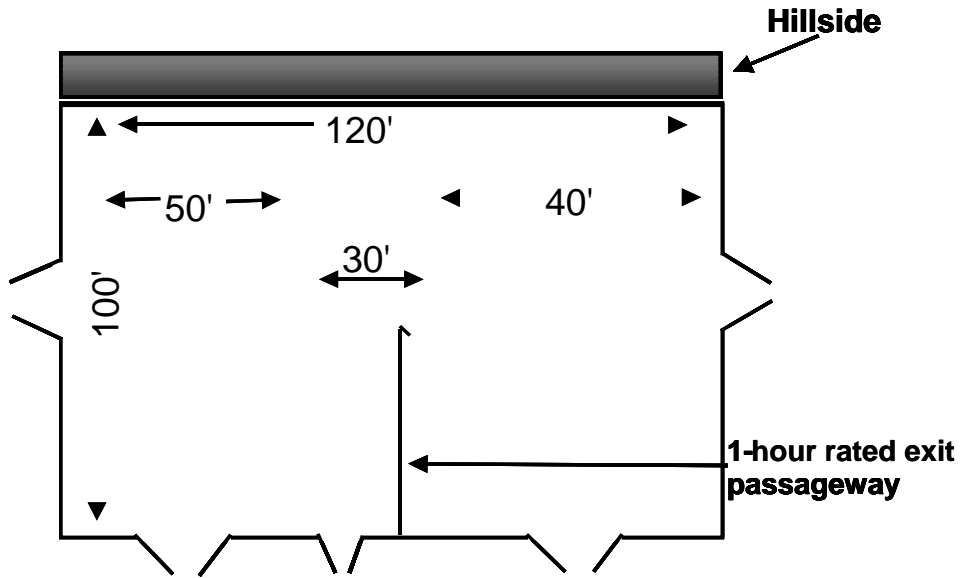


Figure B-8

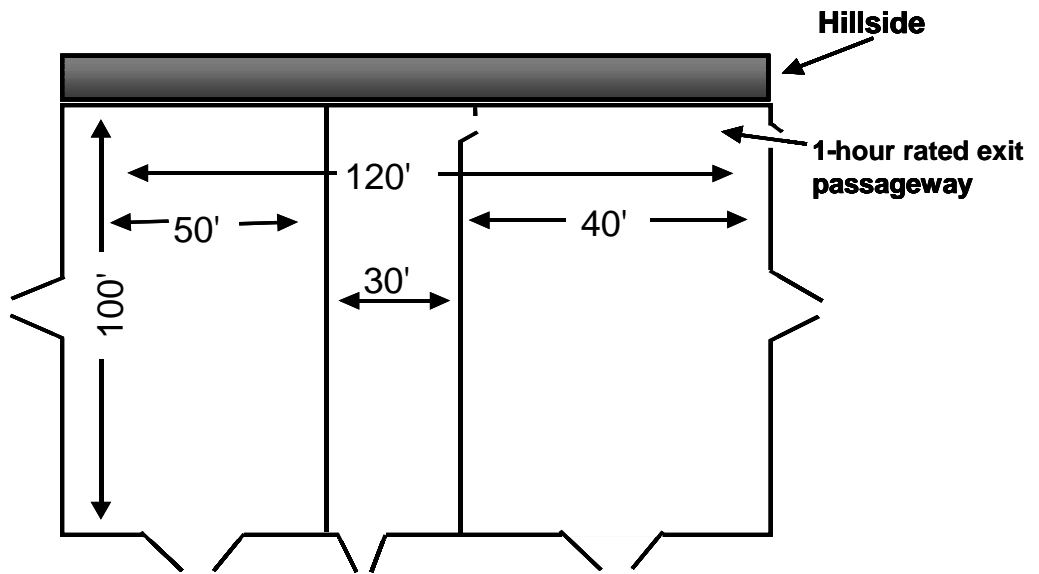


Figure B-9

Common path, dead end, and travel distance considerations are applicable to all occupancies. Allowable travel distance varies by occupancy. Some codes adjust maximum length if built-in sprinkler protection is present. Not all codes have the same requirements.

Exiting Problems

A number of common conditions can delay or impede egress at the time of a fire emergency. While fire escapes have not been permitted in new construction for many years, in many existing buildings, fire escapes are one of the required means of egress. As the existing stock of fire escapes continues to age, maintenance becomes more critical.

It also is important to keep fire escapes and other egress facilities free of obstructions of any kind. Inspectors need to check the areas at the end of a fire escape and outside exit doors to make sure snow, vehicles, trash containers, or other obstructions do not block them. Frequently, in northern areas, snow stays in front of doors used only for emergency exiting. The interior spaces and corridors used for access to exits must be clear and used for egress only. Using them for any other purpose (e.g., storage) would render them ineffective when needed for emergency egress. Doors must remain unlocked or unchained. If delay hardware is installed, it must function in accordance with the code in effect at the location.

The egress path must be well marked and easily found. Signs, decorations, mirrors, and other items that could confuse exiting occupants should not be permitted. Emergency lighting should be in good working condition and sufficient to illuminate properly.

Other Hazards

Business occupancies may have various protective systems such as alarm, standpipe, automatic suppression, smoke removal, or communication systems. In most cases, especially in large buildings, specialists conduct the design and acceptance testing, although inspectors may help. The responsibility for system testing and maintenance is assigned to the owners or their designee. The typical responsibility of the inspector is to examine the systems visually and determine that they are turned on and appear to be in good operating condition. Fire extinguishers must be installed properly, not physically damaged, and be serviced in accordance with the requirements for the type of extinguishers.

Combustible materials need to be used, stored, and disposed of properly at the end of their life cycle. Business occupancies generate considerable waste. The code generally requires that combustible waste collection, storage, and disposal methods not create a fire hazard. Paper records also can create very high fire loads. Special record storage systems are available to reduce the danger. Combustibles should not accumulate near heating equipment.

In most buildings, each floor is a separate fire compartment. Exceptions include dwelling units, some small business buildings, and other small buildings of unprotected construction. Some large buildings have atriums or other floor-to-floor openings. In the remaining conventional buildings, maintaining the integrity of the floor-to-floor fire separation is very important. This applies to business and other occupancies.

To maintain the separation, it is essential to seal or protect every shaft, hole, or other penetration through the floor. Pipe chases need sealing where pipes pass through the wall of the chase. Cable openings between floors should be sealed around the cable at every floor. In some construction, the exterior walls literally are hung from the end of the floors. These curtain walls have a gap between the wall and the floor which extends around the perimeter of the building. These openings should be sealed. Wherever sealing is required, it must be done with an approved fire-resistant material.

Stairways require floor-to-floor protection. Stairways are enclosed in walls constructed to meet or exceed the fire-resistance level specified in the building code. An approved, properly installed fire door must protect every opening in the stairway. These doors must operate correctly, including both the self-closing mechanism and the latching mechanism. They also must be free of wedges or other devices or materials that block them open. They may have approved hold-open mechanisms that release the door in the event of an emergency.

OTHER POTENTIAL HAZARDS

In low-hazard buildings (e.g., business and residential occupancies), it is important to protect the main occupancy from higher hazards within the structure, such as mechanical rooms, custodial closets, general storage, or flammable liquid storage. The solutions to this problem require fire-resistive construction, automatic fire suppression, or both. In the case of flammable liquids, this requires special storage cabinets. The construction option requires that any wall, floor, or ceiling that is common to the main occupancy meet the minimum standards for design and construction

specified in the building code. With a fire suppression system, the separation may be only a physical barrier.

STANDPIPE AND HOSE SYSTEMS

Purpose of Standpipe and Hose Systems

Standpipe and hose systems exist in buildings to facilitate manual suppression by occupants or fire service personnel. Standpipe systems are an arrangement of piping, valves, hose connections, and related equipment installed in a building in a fixed manner. The systems may or may not have hoses permanently attached. Water supplies may or may not be provided continually to standpipe systems. The class and type of system, which will be defined later, dictate these features of the standpipe system. Standpipe systems are primarily for fire department personnel who are trained in manual fire suppression methods. Many standpipe systems no longer have occupant hoselines (1-1/2-inch diameter). The fixed piping of a standpipe system in a building allows the fire service to connect its hoselines into a pressurized water source near the fire floor. This relieves firefighters of the burden of extending hoses into the building from grade level to the location (floor) of the fire. In mid- to highrise buildings, standpipe systems are extremely important for the prompt manual extinguishment of fires.

Types of Standpipe and Hose Systems

There are four types of systems available, and the type selected is based on many considerations.

- Wet systems have supply valves open, and the system is under pressure continually.
- Some dry systems have supply valves that open automatically when a hose valve is opened.
- Other dry systems have supply valves that open through the use of a remote control device located at each hose station.
- Still other dry systems have no permanent water supply connection. This type requires that the system be provided with a fire department connection used to supply the system. Such systems may be filled with water for supervision purposes.

Classes of Standpipe and Hose Systems

NFPA 14, *Standard for the Installation of Standpipe & Hose Systems*, defines three classes of standpipe systems.

Class I

Class I systems have 2-1/2-inch hose connections on the system piping. This hose size produces what is considered a heavy fire stream intended primarily for the fire service which supplies its own hoses for fighting the fire.

Class II

Class II systems have 1-1/2-inch hose fitted with a nozzle and connected to the system piping. This hose size is primarily for occupant control of a fire until the fire department arrives.

Class III

Class III systems provide both 2-1/2-inch and 1-1/2-inch hose connections for use by either the fire service or building occupants. Typically, the two hose sizes are a 2-1/2-inch connection to the system piping and a 1-1/2-inch reducer connection on the 2-1/2-inch connection. The fire service can remove the reducer easily, thus providing responders with the 2-1/2-inch connection required for manual suppression. Hose (1-1/2-inch diameter) and nozzle for occupant use also may be provided.

It should be noted that other codes such as the Uniform Building Code (UBC) also use the Class I, II, and III designations, but the classes are defined differently. Generally the model building codes will specify what class of standpipe system is to be installed, when required.

Standpipe and Hose System Standards

Where required, standpipe systems typically must meet the requirements of NFPA 14. If the system is a combined sprinkler-standpipe system, the requirements of NFPA 13, *Standard for the Installation of Sprinkler Systems* also apply.

As it does with sprinkler systems, the UBC has its own standpipe standard: *Uniform Building Code Standard No. 38-2: Standpipe Systems*.

Water Supply Requirements

Various factors determine the requirements for a standpipe system: building height, size and number of fire streams expected to be used at the same time, and the distance of the hose connection to the water supply. Systems can be designed hydraulically or by pipe schedule in a manner quite similar to sprinkler system design. The class of a system indicates the required design flow through single and multiple outlets as well as minimum design diameters of piping. For Class I and III systems, a minimum 500-gallons per minute (gpm) must flow through a single connection. If the design calls for additional connections, they must flow 250 gpm each, in addition to the first connection flowing 500 gpm. The maximum required flow of all connections combined is 1,250 gpm. The standpipe must be no less than four inches in diameter. System design may require larger pipe sizes, and there are some exceptions to these requirements. Local code requirements may cause design criteria to vary.

Location and Number of Standpipes

The number and location of standpipes needed for effective coverage depend on the fire risk posed by a particular building. The type of occupancy, the type of construction, the exterior exposures, and accessibility are all considerations when designing the system. Standpipe hose connections generally are located only in noncombustible, fire-rated stair enclosures.

Combined systems have piping that serves both the standpipe and an automatic sprinkler system within the same building. These types of systems must satisfy design requirements for both standpipe and sprinkler systems. See the section on automatic sprinklers in this module, and NFPA 13 for further information.

NFPA 14 also covers other design requirements, including hose connection, water supply, piping, valve, fittings, and hangers.

Periodic Inspection and Maintenance

Unless otherwise established in local codes, the responsibility for inspection and testing belongs to the owner. If the owner is not the occupant, the occupant or other responsible party may assume the responsibility, provided it is in writing.

The inspector should conduct a visual inspection of the condition of the components and water supply, and review required records of inspections, tests, and maintenance.

The routine inspection will ensure that the system is operational during the inspector walkthrough. The following should be inspected visually.

- All hose connections and thread are accessible, undamaged, and equipped with caps.
- Fire department connection is marked and identified, accessible and undamaged, properly drained dry to prevent freezing, clappers work properly, free of debris, and equipped with caps.
- Interior hose connections located to allow coverage of all parts of each floor in accordance with local code requirements. Beware of areas that have been remodeled with new partition arrangements that may affect coverage.
- If 1-1/2 inch hose and nozzles are provided, check that they have not been vandalized and that coupling and nozzle are attached. Look for evidence of mildew, rot damage to the hose. Lined hose shall be tested in accordance with NFPA 1962. Unlined hose shall be inspected annually. Unlined hose was allowed up to 1975. After 1975 only lined hose allowed for standpipe systems.
- For wet-type systems, make sure that all sections of the building are heated to prevent freezing.
- Check all control valves to water supply to ensure that they are fully open and supervised.
- When systems are found out of service for any reason the fire department must be notified. Systems that are out of service for a period of time must have a pressure test before being put back in service.

During the inspection the inspector should review the owner's record regarding the following required testing of standpipe systems.

- Dry-type systems are required to be hydrostatically tested at intervals of not less than 5 years.
- Systems that are equipped with pressure-regulating devices at the hose outlet connections, shall be tested at least every 5 years.

- Systems equipped with a fire pump, shall have the pump tested annually in accordance with NFPA Standard 20.

Most of the model fire codes now require that standpipe systems be inspected, tested, and maintained in accordance with NFPA 25, *Inspections, Testing, and Maintenance of Water-Based Fire Protection Systems*.

HALON SYSTEMS

NFPA 12A, *Standard on Halon 1301 Fire Extinguishing Agent Systems*, covers the design, installation, testing, and maintenance of these systems. An example of a total flooding system is in the National Fire Academy's (NFA's) fire protection lab. All required components are in operational condition. The system automatically shuts the door to the special-hazard room and activates the smoke dampers to the simulated HVAC system.

There are still many Halon systems that must be maintained until they are replaced with another type of clean agent. To this end the following inspection points are critical.

Only competent personnel should inspect and test all systems thoroughly for proper operation, and at least every six months, someone will check the system agent quantity, and the pressure of refillable containers. The following requirements need inspection.

- A loss of five percent in net weight, or ten percent in pressure, shall require the replacement or refilling of agent container.
- A tag attached to the container shall record the weight and pressure of the container.
- No one shall recharge a container without a hydrostatic test if more than five years have elapsed from the last test. The retest may consist of a complete visual inspection per the *Code of Federal Regulations* (CFR), Title 49, Section 173.34 (E) (10).
- Audible and highly visible alarms shall give positive warning of a discharge.
- There shall be warning and instruction signs at entrances to the inside protected areas.
- There shall be time delays for personnel to evacuate and to prepare the hazard area for discharge.

SUMMARY

This part of the fire inspection journey has taken us into business occupancies. We have discovered a number of things. The three major codes generally classify businesses in the same way, but there are some differences. We found that wiring, often associated with auxiliary or electronic equipment, is a major electrical hazard in these occupancies.

A significant part of the module looked at exit-related issues such as travel distance, number of required exits, exit widths, protected exits, etc. These are critical aspects of a thorough inspection, and they include a number of measurements and calculations with which the inspector needs to be familiar.

Finally, the module discussed the customary in-place protection systems that include both wet and dry standpipes, hose and coupling requirements, and water supply. A brief mention of Halon systems rounded out the module.

To repeat, the inspector must remember that the points discussed in this module may well apply to other occupancies. It is hoped that you are getting used to making that transposition every time the inspection journey takes a turn down a new road. Soon this will become second nature to you.

Activity B.1

Hazards in Businesses

Purpose

To list the fire and life safety hazards in businesses.

Directions

1. In small groups, develop a list of businesses in your areas. Choose two different occupancies from the list.
2. Identify the potential hazards.

Activity B.2

Hazard Correction

Purpose

Given a list of potential hazards in business occupancies, describe the hazard and suggest the proper method(s) for solving the problem.

Directions

1. Working individually, review the list and note any deficiencies you discover.
2. Look up each deficiency in your code book to see how it can be corrected or solved.
3. List the problem, the solution, and the code reference.
4. Be prepared to discuss your solutions with the rest of the class.

Hazards

Flexible cord under door.

No test records--Halon system.

No identifying sign on fire department connections.

Stairway door blocked open.

BUSINESS

Empty fire extinguisher.

Carbon monoxide (CO) detector unplugged.

Activity B.3

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 to complete this activity.

Scenario

As you arrive, you observe that the front of the building consists mainly of a three-bay overhead door. You continue around and park in the lot on the south side of the building. You walk around and note the trash dumpster well away from the rear of the building; a diesel pump at the rear has a small leak at a hose coupling. You continue around to the door on the north side and observe nothing unusual.

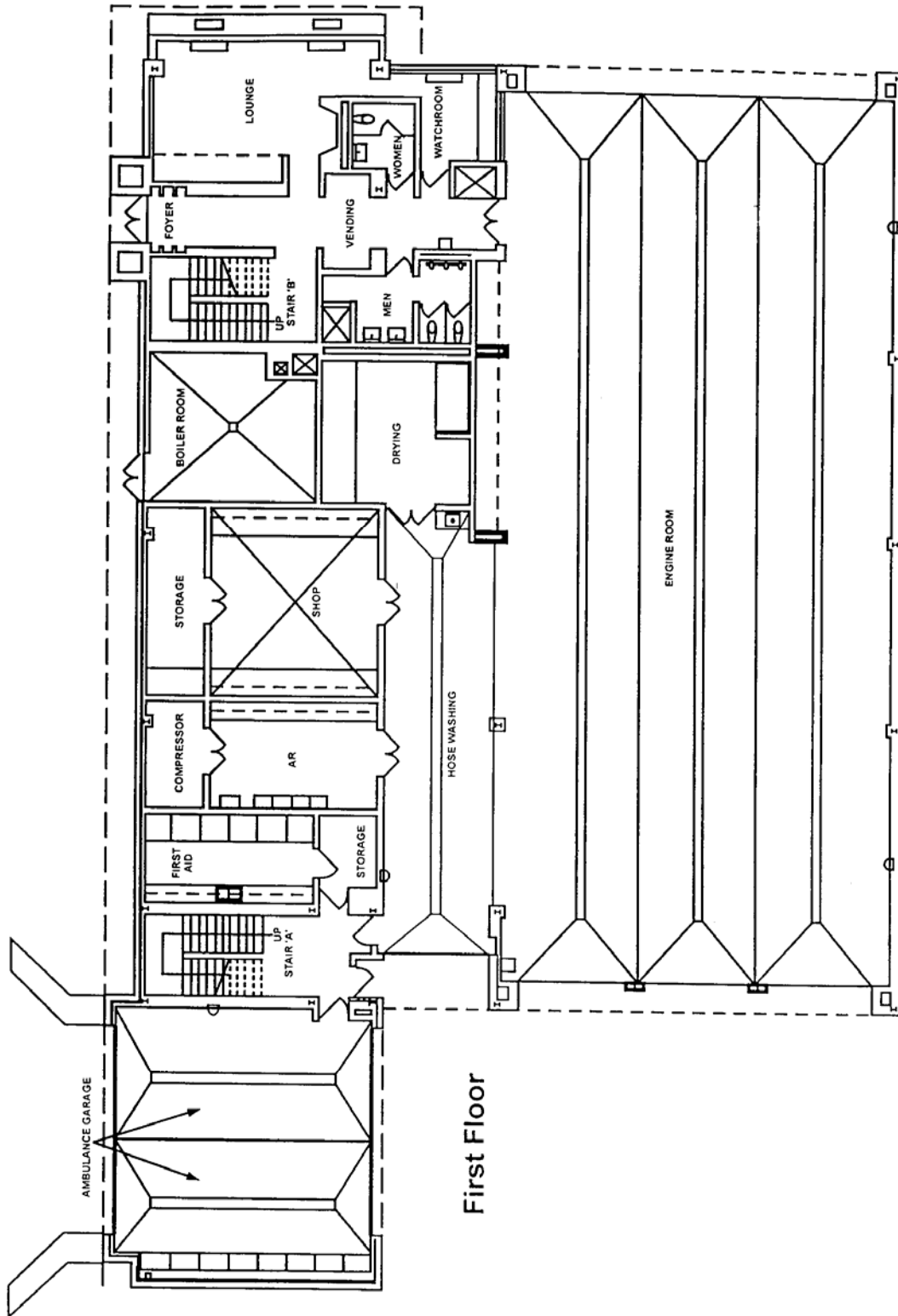
You enter the door into a hallway. The hallway is part of the enclosure of the stairway from the second floor. Doors in the hallway include those leading to the lounge, to a watch office, to two restrooms, and to the entrance to the engine room. You note that the hinge on the fire door into the engine room is sprung and the door does not close or latch. You continue through the engine room and the ancillary rooms to the side. The area is, by firehouse standards, reasonably clean and neat. You arrive at the back exit door and observe a broken exit sign over the door. Next you check the base of the rear stairway and enter the ambulance garage. A section of the garage ceiling about 1 foot wide and 20 feet long, next to one of the overhead doors, is missing. It was removed to repair the door and was not replaced. You also note that an electrical box in this area is missing a cover.

You walk up the clean, well-lit rear stairs and start the inspection of the second floor. The rear mechanical room is clean and the fire door closes and latches. All doors in the upstairs hallways are in good condition. The meeting room, pool room, storage rooms,

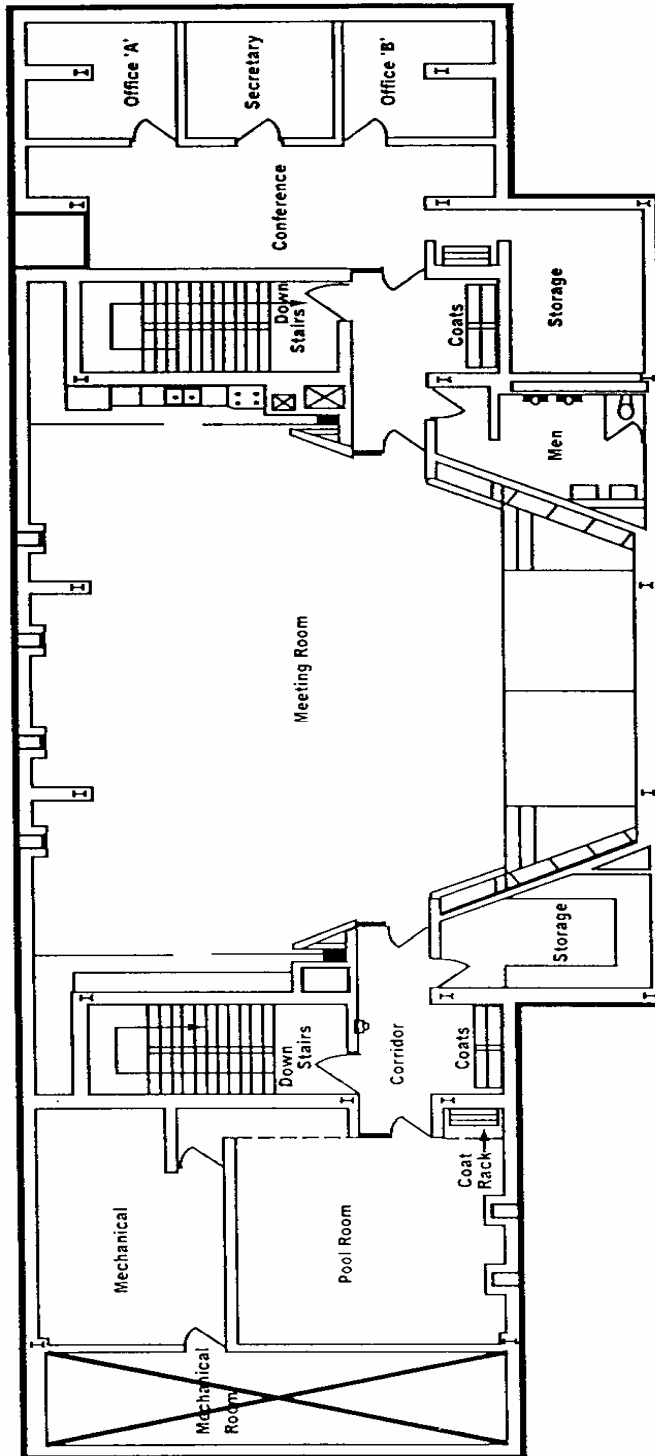
and upstairs offices are unremarkable. The stair door at the top of the front stairs is held open with a wedge. The wedge is removed while you watch.

You continue down the stairs to the point at which you started. You go outside and enter the boiler room. This room contains the boiler, hot water heater, electric panels, and an emergency generator. The room is free of unnecessary combustibles, and all fixtures and equipment appear normal. This completes your inspection.

Business Floor Plan



Business Floor Plan



Second Floor

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

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 FIRE HAZARDS CORRECTED # _____
YELLOW - Station File FIRE HAZARDS NOT CORRECTED # _____
PINK - Fire Marshal

10/75

