NFPA 1402

Guide to Building Fire Service Training Centers

1997 Edition

National Fire Protection Association, 1 Batterymarch Park, PO Box 9101, Quincy, MA 02269-9101
An International Codes and Standards Organization

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This edition of NFPA 1402, *Guide to Building Fire Service Training Centers*, was prepared by the Technical Committee on Fire Service Training and acted on by the National Fire Protection Association, Inc., at its Fall Meeting held November 18–20, 1996, in Nashville, TN. It was issued by the Standards Council on January 17, 1997, with an effective date of February 7, 1997, and supersedes all previous editions.

This edition of NFPA 1402 was approved as an American National Standard on February 7, 1997.

Origin and Development of NFPA 1402

In 1963, a subcommittee of the Fire Service Training Committee developed a document titled *How to Build Firemen's Training Centers*. This informative report was published and circulated as a guide and served to improve the scope and efficiency of fire fighter training.

The developments in training in the past few years indicate that more facilities will be needed to accommodate the hundreds of thousands of career and volunteer fire fighters throughout North America. This report describes some of the modern training centers now available for fire fighters seeking instruction in up-to-date techniques of fire extinguishment and fire loss control.

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James B. Straseske, Illinois Fire Service Inst., IL [U]
Phil Welch, Gaston College, NC [U]
James E. Wilson, Boardman Fire Dept., OH [E]

Alternates

Robert F. Burger, Emergency Response Mgmt. Systems, NM [SE]
(Alt. to E. W. Bent)
Carl Goodson, Fire Protection Publications, OK [M]
(Alt. to G. P. Carlson)
Kent W. Koelz, Palm Beach Fire/Rescue, FL [E]
(Alt. to V. K. Elmore)
Steven J. Williamson, AAI Corp/Symtron Systems, NJ [M]
(Alt. to R. F. Debrody)

L. Charles Smeby, Jr., NFPA Staff Liaison

These lists represents the membership at the time the Committee was balloted on the text of this edition. Since that time, changes in the membership may have occurred. A key to classifications is found at the front of the book.

NOTE: Membership on a committee shall not in and of itself constitute an endorsement of the Association or any document developed by the committee on which the member serves.

Committee Scope: This Committee shall have primary responsibility for documents on all fire service training techniques, operations, and procedures to develop maximum efficiency and proper utilization of available personnel. Such activities may include training guides for fire prevention, fire suppression, and other missions for which the fire service has responsibility.

Contents

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NOTICE: An asterisk (*) following the number or letter designating a paragraph indicates that explanatory material on the paragraph can be found in Appendix A.

Information on referenced publications can be found in Chapter 13 and Appendix B.

Chapter 1 Introduction

1-1 Scope. This guide addresses the design and construction of facilities for fire training. It covers the aspects that should be considered when planning such a facility. It should be understood that it is impractical to list every item that might be included in a training center or every type of specialty training facility that might be constructed. Therefore, the main components of a training center necessary to accomplish general fire fighter training effectively, efficiently, and safely are presented here.

1-2 Purpose. This document provides guidance for the planning of fire-fighting training facilities. Regardless of whether a particular situation requires inclusion of all the items specified, they are provided in order to provoke thought. This guide is intended to assist in the identification of those elements that are of the greatest benefit(s) to those involved in planning such a facility.

1-3 General.

1-3.1 The construction of a fire fighter training facility, regardless of its size, involves planning, design, and the expenditure of funds. In order to derive the maximum benefits from the resources available, a comprehensive assessment of current and future needs should be made. This assessment should consider the following:

(a) Current and future training needs

(b) Facilities currently available

(c) Organizations or department using the facility

(d) Viable alternatives to new construction

1-3.2 The resources available can constitute a major constraint to facility development and construction. These resources include money, land, governmental support, and private support. Questions concerning the availability of resources should be answered during the planning of a facility.

Chapter 2 Cost-Effectiveness Analysis and Considerations

2-1 General. Is a fire service training facility necessary? If the answer is yes, then the initial step is to develop a statement on the broad purpose of the facility. An example follows.

"Everchanging technologies in fire suppression and fire prevention require that today's fire fighter be knowledgeable and well trained. A proper environment for obtaining this knowledge and training is equally important. This facility provides the physical requirements of a fire training center and enhances the community's well-being through better fire protection and fire prevention."

2-2 Alternative Facilities. If a fire department requests a training facility, its existence needs to be justified. The use of existing facilities at the state or regional level should be explored. If the department is located in an industrial area, the fire training facilities of the local plants should be considered. It might be possible to use their facilities, or they might be willing to contribute to some of the cost of building a new facility.

2-3 New Facilities. If a new facility is decided upon, certain factors need to be considered.

2-3.1 Cost Considerations. Who will assume the cost? Both initial and ongoing costs such as site acquisition, legal and architectural fees, staffing, building costs, apparatus and equipment, maintenance, utilities (i.e., water, electricity, gas), and roadway systems need to be identified.

2-3.2 Cost-Effectiveness Analysis.

2-3.2.1 A cost-benefit analysis should be conducted to enable a community to determine whether the investment is cost-effective and if it is feasible to contribute to long-range financial support. This analysis should include those departments and agencies that will use the facility. State, county, and regional training agencies might wish to sponsor their programs at the facility. For example, local police share a need for driver training, physical fitness, and classroom space. Combining the training facility with an in-service fire station can satisfy two needs and reduce the total financial impact of separate facilities.

2-3.2.2 Modular construction can be considered as a cost-effective means of procuring the necessary structures. This type of construction can be particularly advantageous for administration or classroom facilities.

2-3.3 Advisory Groups. If the community accepts the need for the facility, criteria then should be established to judge how the need is to be fulfilled. It might be beneficial to organize a commission or advisory group to interface between governing bodies and the fire training agency. The group should include representatives of the agencies, organizations, and departments that will use the facility. Such a group can weigh the importance of the following potential benefits:

(a) Reduced injuries and deaths of civilians and fire fighters

(b) Reduced number of fires and property damage

(c) Increased efficiency and morale of the fire-fighting force

(d) Improved training capability and improved public image of the fire department

Chapter 3 Components and Considerations

3-1 General. This chapter lists general components that could be part of a training facility. There are other components that might be unique to a particular area of industry and that are not included. For the purpose of this guide, the buildings are discussed separately; however, combinations might be necessary or advantageous. As long as the purpose of an individual component is not compromised, each component can be located wherever it is conducive to effective training and safety. The installation of all components is not necessary for an efficient training facility. The following lists of components should be considered:

(a) *Administration and Support Facilities*

1. Offices
2. Conference areas
3. Library
4. Photo laboratory/dark room
5. Printing/copying area
6. Graphics/audiovisual aid preparation area
7. Student housing, dormitories
8. Food service facilities/kitchen, cafeteria
9. Restroom and locker facilities
10. Apparatus maintenance and repair center
11. Equipment and supply facility
12. Storage space for various materials
13. Communications center
14. Data processing area
15. Medical area/infirmary
16. Records storage

(b) *Indoor Instructional Facilities*

1. Classrooms (clean and "dirty")
2. Auditorium
3. Physical fitness area
4. Pool for water rescue training
5. Technical rescue training areas
6. Special training laboratories
   a. Simulators
   b. Automatic sprinklers
   c. Computers
   d. Pumps
   e. EMS and rescue
   f. Fire alarm systems
   g. Arson laboratory
7. Storage space for equipment and props

(c) *Outside Facilities*

1. Drill tower
2. Drafting pit
3. Burn building
4. Motor vehicle driving range
5. Flammable liquids and gases/fuel distribution area
6. Hazardous materials area
7. Outside classroom areas
8. Helicopter landing site
9. Smoke building
10. Storage space for portable equipment, vehicles, and props
11. Bleachers for outdoor classes or observation of drill tower activities
12. Fire station
13. Outside rehabilitation areas

(d) *Site/Exterior Facilities*

1. Water distribution, sewer, and other utilities
2. Parking facilities (open and covered)
3. Site maintenance equipment and facilities
4. Environmental cleanup activities

3-2 Planning Considerations. Because a training facility is a specialized facility, there are a number of specific features that should be considered. Since a training facility will probably be expected to be used for 40 or 50 years, it is desirable to rely on the experience gained by others. The remaining chapters provide some specific areas of guidance while the following general guidelines should be considered:

(a) Conflicts with the local area master plan and zoning criteria should be avoided.

(b) Possible joint use with other agencies should be investigated.

(c) Available grant funds should be explored.

(d) An environmental impact statement should be developed.

(e) Existing facilities should be visited for ideas and experience; new facilities might exhibit state of the art features, while older facilities might identify operational/maintenance problems to be avoided.

(f) Weather-related problems and the effects of seasonal use should be considered.

(g) That part of the facility, if any, to be used at night should be determined.

(h) Ample space should be provided between buildings/outdoor facilities to enable simultaneous use.

(i) Ample, secured, storage space should be provided for each segment of the facility.

(j) Site landscaping that complements the training activities with minimum upkeep should be selected.

(k) Interior/exterior finishes that require a minimum of maintenance should be chosen.

(l) Heating and air conditioning equipment should be located where regular maintenance can be performed easily, but the installation of individual units in classroom areas should be avoided.

(m) Separate locker and restroom facilities should be provided for male and female occupants, and separate facilities should be provided for staff and students.

(n) The space needed for guests and visitors, staff, and future users should be identified.

(o) Slip-resistant surfaces should be specified for all stairs and well-traveled paths.

(p) Automatic sprinklers/smoke detectors should be specified for appropriate areas.

(q) Facilities should be provided for the storage of fuel used in training.

(r) Facilities should be provided for the refueling of apparatus.

(s) Communications should be provided between structures and training areas.

(t) Storage for apparatus, especially during cold weather, should be provided.

(u) Drinking water facilities should be provided at all drill sites, including those outdoors.

(v) Emergency shower and eye wash station(s) should be provided.

(w) Lighting should be provided in all areas of the structure to assist in locating personnel.

(x) An intercom system that can be used throughout the structure should be installed.

3-3 Usage Guidelines. Rules should be developed regarding the use of the facility. The components of the facility should be in use as much as possible. The needs of the prospective users should be fulfilled by proper scheduling. User insurance coverage should be verified before any use is authorized.

Chapter 4 Considerations in Locating the Facility

4-1 General. Certain factors that should be considered in determining the placement of the training facility in the community include the site, water supply, environment, security, support services, and access to utilities.

4-2 Site Considerations.

4-2.1 What land is available? Does the agency own land that could be considered for this purpose? Are there abandoned properties available? The cost of the land should be within the of the agency's budget. A sequential spending plan might allow for the purchase of the necessary land one year and the construction of certain buildings thereafter. A sequential plan could enable the community to realize its objective over an extended period of time rather than placing pressure on current resources for immediate large expenditures. On the other hand, using a bond issue to build at the current year's rate and paying off with future dollars could be more cost effective. Financial consultation is recommended.

4-2.2 There is always a possibility of a ledge formation or a high water table that poses hidden problems; therefore, a geological expert should be consulted during the planning stages, especially to determine whether borings are necessary to test subsoil consistency.

4-2.3 The area master plan, if one exists, should be taken into consideration. The site of the training facility should be located away from the center of community life to minimize negative impact on adjacent land use. Where the site has highly favorable features and a plan variance is necessary, all pertinent facts should be gathered and a presentation should be made to the planning board. If possible, the area master plan should be used to support the agency's advantage position. The voting public should be informed of the advantages of the training facility, and every effort should be made to develop public support.

4-2.4 The title to the property should be clear. Further expansion is often desirable, so the surrounding land should be surveyed. A land use determination from the planning board for fire training would be beneficial. This requires the municipality to check with the agency before allowing other types of usage. If possible, the site should be marked prominently on land maps and should be surrounded by a nonresidential area. A lawyer's guidance can be advantageous in such cases.

4-2.5 Vehicle traffic patterns should be studied, and the most convenient route to the training facility should be chosen. Heavy, noise-producing apparatus should be routed to avoid residential areas. Travel time to the facility for users should be taken into consideration. On-duty personnel who are receiving in-service training at the facility could be required to respond to emergency incidents. The facility should be located so that it is accessible to appropriate emergency response routes.

4-2.6 The size of the site should be ample for planned buildings, parking, and future expansion. Adequate separation should be planned between buildings for safety, vehicular movement, and instructional purposes. It is better to conserve on the size of structures than to overcrowd limited land.

4-2.7 Site pavement should be such that the facility can be used in all kinds of weather. Any pavement deteriorates, especially when subjected to hydrocarbons or hot exhausts. Concrete pavement withstands training facility usage with minimum maintenance.

Landscaping and site layout should take into consideration local climatic conditions. Consideration should be given to rain, snow, wind, heat, and other adverse elements that could affect facility operations. Site layout can incorporate a roadway system that is typical of the community. This can be helpful in the training of apparatus operators.

4-3 Water Supply.

4-3.1 The maximum water supply required should be estimated so that an adequate system can be installed to deliver the necessary volume and pressure of water for training activities, facility fire protection systems, and domestic water needs. Water supply estimates should include the amount of water used in attack lines, back-up lines, and drafting and pumping exercises, with an additional 100 percent included as a safety factor. A loop or grid system with properly placed valves can help to ensure an adequate water delivery. If possible, dead-end mains should be avoided; if this is not possible, compensators (surge chambers) should be considered. Valves should be placed to segregate sections of the water system to allow for repairs without complete shutdown.

4-3.2 The type of hydrant(s) installed at the training center should be representative of types found in the community. Where more than one community uses the training center and the hose threads are not uniform, a variety of fittings with appropriate threads should be provided.

4-3.3 Even where there is a hydrant system, drafting can always be an additional source. During times of water emergency, drafting might be necessary. Lakes or ponds, streams, man-made containers, and dry hydrants are potential drafting sources. Consideration should be given to supplying water from the water distribution system to maintain the water level in the drafting pit.

4-3.4 The on-site water supply needs should be determined and storage containers constructed if necessary. Either elevated, surface, or underground storage can be used. Pumps also can be used to move the water at the desired pressure.

4-3.5* For durability, the water main should be constructed with bolted flanges or steel-rodded joints. If severe turns have to be engineered into the piping, consideration should be given to thrust blocks. Both of these features help overcome the effect of water hammer. To keep a steady pressure in the water main, a compensator (surge chamber) should be installed (*see Figure 4-3.5*).

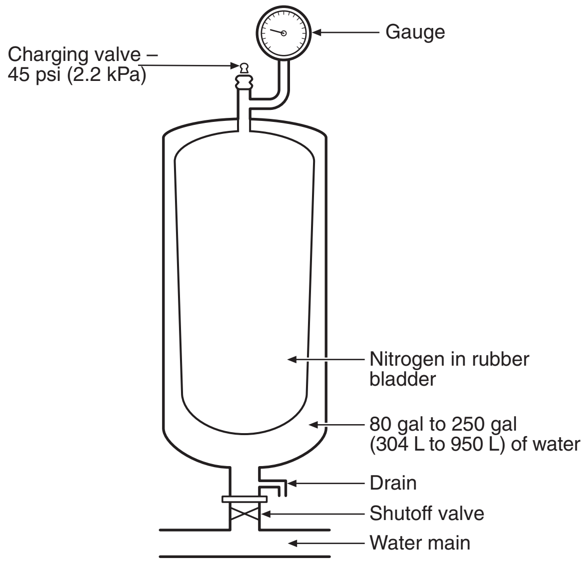

Figure 4-3.5 Compensator.

4-3.6 Tank trucks or long relays could be used to provide water for training. However, this increases the number of vehicles and personnel needed to accomplish basic evolutions, and it further increases the vehicular accident potential and maintenance cost.

4-4 Security.

4-4.1 The training facility should be secure. (*See Figure 4-4.1.*) The site should be fenced and well lighted, and, if necessary, a guard should be provided. Local police can make the training facility a part of their rounds. Security could be augmented by alarm systems with connection to appropriate monitoring stations. Buildings, elevator shafts, drafting pits, underground utility covers, and all exterior valves and cabinets should be locked.

Figure 4-4.1 Security fence. *(Courtesy of Omaha Fire Academy, Omaha, NE.)*

4-4.2 An evacuation signaling system and an automatic fire detection and alarm system should be installed throughout the facility in accordance with NFPA 72, *National Fire Alarm Code*. A central station connection should be provided where a 24-hour guard is not posted at the control/monitor center.

4-5 Environment.

4-5.1 Federal, state, and local environmental protection agencies should be consulted. The results of these consultations can facilitate procurement of the necessary permits and licenses. These consultations should address the problem of waste water (treatment and disposal) and pollution (air, water, and noise). The facts gleaned from these agency contacts can be of use when the architect is consulted.

4-5.2 When selecting a site for a training facility, there are environmental factors to consider. It is important to ensure that the facility is environmentally safe. Factors that should be considered from an environmental aspect are water, air, and the ground (soil).

4-5.2.1 There are governmental agencies that have a jurisdictional interest in the location, design, and construction of a training facility. These include agencies at the federal level such as the Army Corps of Engineers and the Environmental Protection Agency. Each state or municipality, or both, also has regulatory agencies from which approval might be necessary prior to the construction of a facility. Most of the regulatory agencies do not have the resources or the staff to assist in planning a facility but will, in most cases, professionally review designs as described in 4-5.2.2 through 4-5.2.6.

4-5.2.2 There should be an environmental review by professional engineers, geologists, hydrologists, and environmental scientists. These professionals should develop an environmental impact study to determine what effect, if any, the training facility will have on the environment.

4-5.2.3 There are certain water-related issues that should be considered when planning a training facility. The first consideration should be the disposal of waste water from fire-fighting operations. This water varies in its degree of contamination, depending upon the evolutions that are performed. If evolutions involve flammable or combustible hydrocarbons or other potentially environmentally detrimental chemicals or compounds, provisions should be made for separating the contaminants from the runoff. (Waste water treatment can be reduced by using propane or natural gas in lieu of flammable liquid.) Separation of containments can be accomplished by oil separators, ponding, and bacteriological breakdowns. Extreme care should be taken to prevent affecting the groundwater with contaminated runoff. In addition, the facility should be designed to take full advantage of runoff to replenish supplies for training. Proper consideration also should be given to the amount of new pavement created so that excessive velocities and quantities of runoff do not affect surrounding properties. Special care should be taken to prevent damage to any wetlands in the area.

4-5.2.4 The second water-related issue to consider is the need for potable water for use by the trainees, visitors, and staff. This water can come from wells or a municipal source. The third issue is fire-fighting water, including water for automatic sprinklers for the facility buildings. The use of fresh potable water for training purposes should be discouraged because of the large volumes involved and the waste of a shrinking resource.

4-5.2.5 The prevalent wind direction and force should be considered when selecting the location of a training facility and when selecting the location of buildings at the facility. Smoke generated by the facility should not interfere with the surrounding area or buildings. The residue from extinguishing agents and the products of combustion have been found at considerable distances from training sites. A wind sock on the training ground can assist instructors in evaluating the effect of wind on the areas surrounding the training facility. Light generated by fires, particularly at night, should be considered where the facility is to be located near an airport. Noise is a factor that should be considered. The existing terrain should be used advantageously to direct noise away from populated areas.

4-5.2.6 Taking full advantage of the shape and contour of the land to develop runoff patterns and establish locations for various buildings and props so that they do not interfere with the drainage of the water during all seasons and weather conditions should be one of the goals of the designer of the training facility. The type of soil at the facility location is important. The type of soil and geology affect such factors as foundation types, bearing capacity, pavement life, and runoff both above and below the surface, and it can indicate the presence of rock, which can be expensive to remove.

4-6 Utilities.

4-6.1 The use of pumps, air compressors, simulators, and heat, ventilation, and air conditioning (HVAC) units can greatly increase power requirements. An on-site total energy system might be a practical alternative. Such systems consist of a mechanical package on site that provides utility services (e.g., electrical, heat, air) for use in buildings. The largest portion of the electrical needs are dictated by the number of buildings and their purposes.

4-6.2 The possible need for natural gas feed, computer, and telephone connections also should be considered. The distance from these services could be a determining factor in locating the facility.

4-6.3 Electrical outlets should be installed in sufficient numbers to prevent the use of long extension cords. The electrical outlets should be installed in accordance with NFPA 70, *National Electrical Code®*.

4-7 Support Services. Where housing and food services are to be provided, space should be planned for such purposes. Food service might be provided by a private vendor. The transportation of staff and trainees, housekeeping and laundry service, vending machine location, janitorial service, and ground and facility maintenance might have to be considered.

Chapter 5 Design and Construction

5-1 General.

5-1.1 The training objectives of the agency in building a fire service training center should be put in writing. Priorities should be set. A committee should be formed to assist in design features. A committee chairperson should be selected for this committee. The chairperson should act as the liaison between the department and the architect.

5-1.2 Design features for handicap access for staff and visitors should be considered.

5-1.3* All buildings should be provided with fire hose standpipe systems. Heated buildings should be provided with wet standpipe systems including 1 $^1/_2$-in. (38-mm) hose, hose reels, or hose racks.

5-2 Architects.

5-2.1 There are architects who specialize in fire service training facilities. The American Institute of Architects (AIA) can be consulted for references. There are local AIA chapters in many cities. It can be helpful to visit training facilities and meet their architects. (In Canada, provincial architectural associations for assistance.)

5-2.2 Visiting training facilities that have been in operation for 5 to 10 years should be considered in order to learn of any inherent construction or operational deficiencies. Training personnel at the facility can be asked whether they are satisfied with the architect's work and how would they improve the facility.

5-2.3 The architectural firm should be interviewed before making the final selection. The architect's responsibilities are the design of the facility, the production of working drawings, the development of facility specifications, the provision of bid documents, and, usually, the supervision of construction.

5-2.4 Steps should be taken to ensure that the architectural firm will abide by the agency's wishes and provide for declared needs.

5-2.5 Contractors build according to approved specifications and blueprints drawn by the architect. A client has little recourse in making revisions except through change orders. These orders should be approved by the architect and could be very expensive. Therefore, changes made after a contract is let should be avoided. Change orders might be necessary to reduce cost overruns. The procedure for executing a change order should be specified in the original contract.

5-2.6 A pre-bid conference with the architect is necessary to establish the building requirements. An agency representative should be present. A request-for-bids notice normally follows the pre-bid conference. The work progress should be reviewed at such junctures as 25 percent, 50 percent, 75 percent, 90 percent, and 100 percent of the project's completion.

5-2.7 As-built drawings should be provided and retained after the project has been completed for use during repairs, alterations, and future expansions.

5-3 Clerk of the Works—Owner's Project Manager.

5-3.1 A clerk of the works might be necessary, depending on the complexity of the project. The clerk should be able to read blueprints and interpret specifications. The clerk's job is to be on the project daily, checking progress, overseeing the work of the contractors, and ensuring compliance with specifications.

5-3.2 A clerk of the works is usually compensated by the building agency. At times the architect might provide on-site inspection services.

Chapter 6 Administration/Classroom Building

6-1 General.

6-1.1 This chapter addresses the many components that should be considered when a jurisdiction is planning an administration/classroom building. [*See Figure 6-1.1(a) through (c).*]

6-1.2 Certain components are needed only if the structure is to be used for administrative purposes; others are pertinent only to a classroom building. However, if the purposes are to be combined, all of the following items should be considered. Only those items needed for the individual situation should be included to produce a viable administration/classroom building.

6-2 Offices. Office space should be provided for the officer in charge, assistant administrator, instructors, and clerical personnel. Additional office space requirements are dictated by agencies housed at the facility. Properly designed open office space can add flexibility. Closet and storage space should be included.

6-3 Conference Room. A conference room can be desirable for staff meetings, for press conferences, and for the use of the commissioner or the chief of the department. A built-in projection booth can increase the versatility of the room.

6-4 Auditorium.

6-4.1 The auditorium can be used for classrooms, seminars, promotional ceremonies, and community activities. Movable chairs can increase the utility of this component. A balcony also can add to the seating capacity. Physical fitness classes could be held in the auditorium.

6-4.2 The floor and the wall coverings could be designed to withstand indoor basic training when inclement weather precludes outside activities. A public address system should be installed. Some of the features discussed in the classroom component should be installed in the auditorium.

6-5 Classrooms.

6-5.1 Classroom size is dictated by the number of students and the type of training to be conducted. For example, hands-on training might require more space per student than training by lecture. [*See Figures 6-5.1(a) through (c).*]

Figure 6-1.1(a) Administration building. *(Courtesy of Dover County Fire Academy, Dover County, NJ.)*

Figure 6-1.1(b) Administration building. *(Courtesy of Toronto Fire Academy, Toronto, Canada.)*

Figure 6-1.1(c) Administration building including director's office; boardroom; clerical area; instructor offices; A/V storage area; four classrooms with capacity for 50 students in each room and one double classroom with capacity for 200 students, for a total student capacity of 400; dining area; kitchen; and student lockers with restrooms. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

Figure 6-5.1(a) One of four 50-student classrooms. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

Figure 6-5.1(b) Alberta Fire School classroom. *(Courtesy of Alberta Fire School, Edmonton, Alberta, Canada.)*

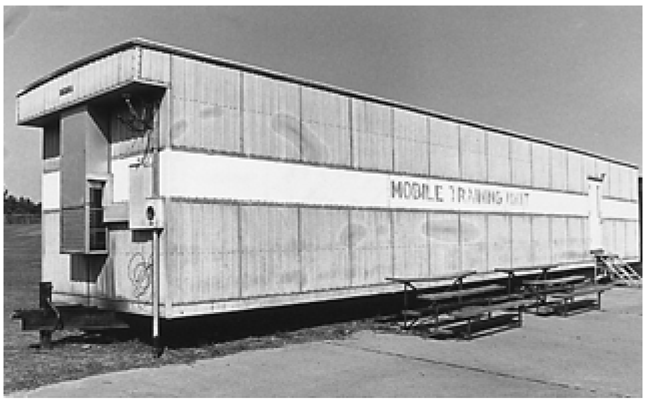

Figure 6-5.1(c) Mobile training classroom. The unit is provided with rear screen projection and will seat 50 students. *(Courtesy of Mississippi Fire Academy, Jackson, MS; photo by William Warren.)*

6-5.2 Movable soundproof walls can be used to vary classroom size. (*See Figure 6-5.2.*) Adequate aisle space is necessary for proper classroom function. Heavy-duty flooring should be installed to withstand the movement of fire fighters with soiled gear.

Figure 6-5.2 Large double classroom with capacity for 200 students, or 100 per room with divider closed. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

6-5.3 The instructor should be able to control room climate and audiovisual equipment. Good lighting is a must, and the use of both individual controls and rheostats should be considered to vary the illumination. A podium light and separate chalkboard illumination can make a presentation in a darkened room more effective. Electrical outlets in the floor and the walls should be spaced to eliminate the use of extension cords.

6-5.4 Classroom furniture should be durable. Writing surfaces for use by the instructors and students should be provided. Folding tables that are 18 in. (450 mm) wide and stacking chairs provide greater flexibility in room utilization. Experience has shown that wider tables occupy space that can be better used.

6-5.5 To decrease classroom disturbance caused by noise, the following features should be considered:

(a) Doors to the room should open and close quietly;

(b) Sanitary and refreshment facilities should be closed to the room; and

(c) Ceiling height should allow the hanging of wall screens or the placement of portable screens for good viewing. The ceiling height should be a minimum of 10 ft (3 m) as dictated by experience.

6-5.6 Air conditioning and heating units should not be installed in the classroom due to their noise.

6-5.7 There might be a need for a "dirty" room that students can enter with gear that has been exposed to the fire environment.

6-5.8 An effective sound system should be installed in all classrooms and assembly areas.

6-6 Library.

6-6.1 The library is an essential part of the fire service training program. The library should contain job-related periodicals and technical books. The fire department's regulations, procedures, history, past and present orders, and local, state, and national standards should be included in the library.

6-6.2 An index system should be maintained. The security of the library contents should be considered. The librarian should motivate retirees or people interested in the fire department to bequeath their fire department books to the library.

6-6.3 The services of a retired teacher can be secured on a voluntary basis. Most town libraries are glad to assist in starting a library and to provide advice.

6-6.4 If the library is large enough, individual carrels could be provided to allow the student to concentrate without interference. If there is a need, the library hours should include nights and weekends. The library should be located near the parking lot to decrease user travel and prevent classroom disturbance.

6-7 Kitchen and Cafeteria.

6-7.1 Kitchens could have the following available for staff and trainees:

(a) Refrigerator

(b) Stove

(c) Tables and chairs

(d) Sink

(e) Vending machine(s)

(f) Coffee maker

(g) Microwave oven

(h) Dishwasher

Where the facility is large enough, a cafeteria service line could be installed. Food service consultants might be necessary in order to design a cafeteria that services large numbers of people efficiently. (*See Figure 6-7.1.*)

Figure 6-7.1 Dining area—seating capacity of approximately 85. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

6-7.2 Fire protection for cooking equipment should be provided according to standards. It might be desirable to have a separate eating area or facility for the faculty. The dining area could also be used as a classroom.

6-7.3 It might be more effective to use an outside vendor to provide meals. Vendors might provide packaged meals that are prepared off site or at the facility.

6-8 Audiovisual Area.

6-8.1 To allow the instructor to take advantage of various media, the following equipment should be available:

(a) Chalkboard (liquid chalk is highly desirable)

(b) Felt board

(c) Hook and loop

(d) Magnetic board

Cameras and associated equipment can be major assets in bringing realism to the classroom, and portable video cameras, recorders, and video-editing machines can be used efficiently. A television monitor can also be useful.

6-8.2 Projectors fall into the following categories:

(a) 16-mm movie

(b) 35-mm slide with a dissolve unit

(c) Overhead projector

Cassette tape equipment, sound sync units, portable wall or ceiling screens, and rear projectors can be beneficial adjuncts.

6-8.3 To make a professional presentation, an audio jack should be installed near any equipment use station.

6-8.4 When using audiovisual equipment, the following recommendations should be considered:

(a) An extra electrical switch with a rheostat to control illumination should be provided.

(b) The rearview screen should be protected from breakage by covering it with chalkboards.

(c) Care should be taken to avoid writing on rearview screens.

(d) Permanent writing on white boards can be avoided by providing only water soluble markers in the classrooms.

(e) The projector area should be located near a hallway so equipment can be moved easily.

(f) Adequate distance for front and rear projectors should be provided.

(g) Stepped-down ceilings should be avoided if they will interfere with projection or viewing.

(h) Heating, ventilation, and air conditioning (HVAC) should be provided in the projection room to ensure a comfortable worker environment and to avoid thermal shock to expensive electrical projector bulbs.

(i) Audiovisual equipment, lighting, and sound with remote controls should be provided.

(j) Electrical receptacles should be installed in the floor to eliminate the use of extension cords.

6-9 Darkroom.

6-9.1 The department's photographic needs might include a darkroom facility. Sufficient space should be allowed for the necessary equipment, for storage, and for future expansion. The storage room also could be used as a projection booth; however, the applicable fire safety regulations should be considered.

6-9.2 When taking the cost factor into account, it might be more economical to send material to outside vendors for processing. Fewer personnel and less space will be needed. The disadvantage of this option is the time required to send material outside and to receive the finished product. In addition, it is necessary to establish a procedure to document every step of the photographic process in order to maintain the chain of evidence of photos involved in legal matters.

6-10 Printing Room.

6-10.1 The facility should furnish provisions for the reproduction of printed materials. Space for a copier, mimeograph machine, offset duplicator, collator, binding machine, transparency maker, and computers should be available. This might necessitate special electrical services. This equipment might also be noisy, so the location of the printing room should be considered carefully.

6-10.2 Proper storage for flammables and an exhaust system should be considered during the design stages. Space to store supplies and printed materials is essential.

6-11 Graphic Unit. A room for the preparation of graphics and other aids should be considered and should be located in a quiet area. In addition, space should be planned for instructor preparation of audiovisual programs (e.g., slide, tape, video).

6-12 Simulator Facility. If simulation in training is desired, space should be provided. Consideration should be given to simulation methods such as flat board mock-ups, actual equipment, videotape, simple to complex computer arrangements, and rear screen projection.

6-13 Locker and Shower Facilities. See Figure 6-13.

Figure 6-13 One of two student locker rooms with showers and restroom facilities. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

6-13.1 Locker and shower facilities are necessary. Separate areas should be provided for males and females. This area should include a shower room(s), sinks with mirrors, and toilets. There should be an emphasis on ventilation to reduce the water vapor accumulation from the showers.

6-13.2 Locker space is needed for instructors/staff, long-term students (e.g., recruits), short-term students (1 to 3 days), personnel using the fitness room, and maintenance personnel. Separate areas are recommended for personnel lockers and turnout gear storage. The instructors' showers and lockers should be separate from the students' showers.

6-14 Cleanup/Drying Room. A cleanup/drying room for turnout gear is a necessity where students leave their gear at the facility or where turnout gear is maintained at the facility. This area should provide space for the students and instructors to clean their gear with water from a hose or shower. This room should be accessible from the outside and from the locker room. Gear should be stored in a well-ventilated locker that can be locked. Special rust-resistant wire cage-type lockers might be necessary.

6-15 Arson Lab. It is recommended that the agency responsible for arson investigation be included in the planning stage of the facility. The arson investigation force might want office space, room for sophisticated equipment, or a room in which to store teaching materials. Meetings between the arson force and the fire department planners are necessary to determine their needs.

6-16 Emergency Medical Room.

6-16.1 Safety should be the foremost consideration in facility design. Accidents and illnesses do occur, however, and one or more properly designed first aid rooms should be provided. Space should be provided so temporary care can be administered to victims suffering from burns, cuts, cardiac distress, smoke inhalation, heat exhaustion, and other injuries or illnesses.

6-16.2 A parking area for an ambulance should be provided during major training programs. Transportation for multiple victims should be considered. Communications with a local hospital might help provide resources for design as well as a personnel pool for staffing.

6-16.3 Physical examinations can be conducted in the emergency medical room.

6-17 Building Maintenance.

6-17.1 The material used as a finish for the facility should be attractive and easy to maintain; durable material can cut down on replacement and refinishing costs. Custodial space is needed for deep sinks, mops and wringers, and cabinets for the storage of cleaning materials and other equipment.

6-17.2 Electrical outlets should be provided in the hallways for the use of buffers and vacuum cleaners.

6-18 Observation/Control Tower.

6-18.1 Consideration should be given to the need for an observation/control tower in order to monitor various training functions from one location. (*See Figure 6-18.1.*) This might include communications systems, fire temperature sensors, remote annunciator panels, and remote cameras. This should enable overall monitoring of activities and enhance operational safety. Designers should be aware of space and utility needs for control equipment associated with automated systems.

Figure 6-18.1 Training area control tower. From the control tower, the safety officer can observe all field training. The first floor area can be used as a first aid station. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

6-18.2 The observation/control towers work well where they are elevated and located adjacent to the training tower. Some training centers have designed this feature as the second floor above the administrative area and classroom.

6-18.3 Consideration should be given to adequate window space for full observation of the drill area, including observations of units responding to the drill building from off site.

6-19 Sprinkler Laboratory. The need for a laboratory from which sprinkler systems can be operated, demonstrated, and inspected should be considered. An area where fires can be ignited to fuse sprinkler heads connected to a water supply should be included.

6-20 Alarm System Laboratory. Consideration should be given to an area where several different types of operable fire alarm systems can be located.

6-21 Fire Extinguishing Systems. Consideration should be given to providing an area that allows the installation of fire extinguishing systems for demonstration purposes.

6-22 Miscellaneous.

6-22.1 Public telephones should be provided.

6-22.2 A break area in which students can congregate between classes should be provided.

Chapter 7 Drill Tower

7-1 General. See Figures 7-1(a) through (d).

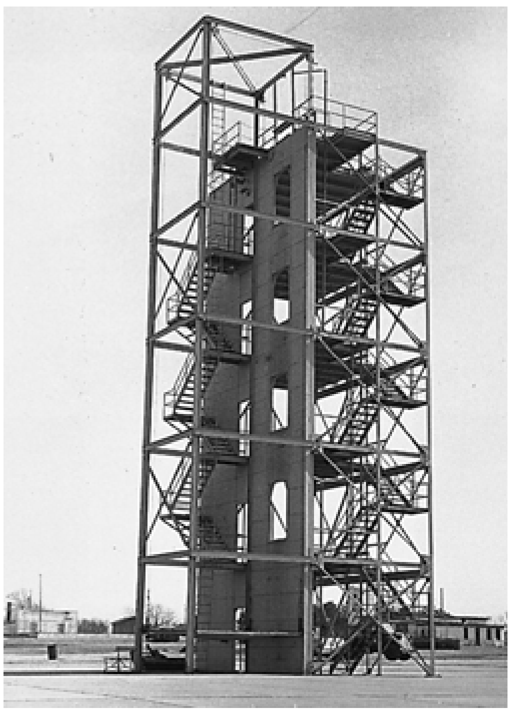

Figure 7-1(a) Drill tower. *(Courtesy of University of Kansas, Lawrence, KS.)*

7-1.1 The main purpose of the drill tower is to train fire fighters in the basic evolutions using pumper and ladder equipment. Using this tower can instill confidence in the trainees and further their ability to work at various heights in a skilled manner. Some law enforcement agencies ask training centers for permission to use the tower to train in rappel or other skills. (*See Figure 7-1.1.*)

7-1.2 While some training towers are designed for actual training fires, this is not a recommended practice. It is expensive to build such large structures with sufficient fire resistance to withstand intense heat. Soot and dirt resulting from such fires soon impair the tower for normal use. It is preferable to use the tower for training evolutions and to conduct interior fires in a separate building.

Figure 7-1(b) Drill tower. *(Courtesy of Toronto Fire Academy, Toronto, Canada.)*

Figure 7-1(c) Drill tower. *(Courtesy of New York Fire Department Academy, New York, NY.)*

7-2 Height. The height of the tower should be typical of the buildings found in the locale. However, consideration should be given to future community development. A six-story tower is considered optimum when evolutions involving the exterior of the tower are being considered.

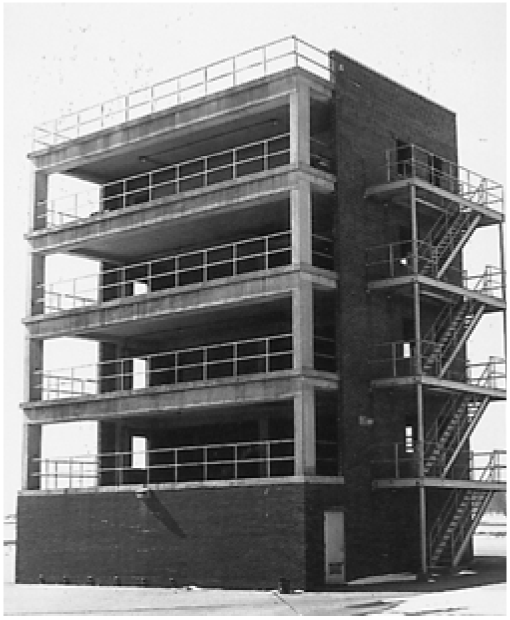

Figure 7-1(d) Drill tower. *(Courtesy of Burlington County Fire Academy, Burlington County, NJ.)*

Figure 7-1.1 Fire department training facility used by 10 departments weekly for mutual aid training. Other departments can use it by renting it at a reasonable price. *(Courtesy of Pleasanton Fire Department, Pleasanton, CA.)*

7-3 Construction. The materials used in the construction of the tower can be wood frame, reinforced concrete, steel, or of other durable material. Both interior and exterior walls of the drill tower should be structurally sound; this should provide for the safety of personnel in training and for withstanding the force of master streams. (*See Figure 7-3.*)

7-4 Dimensions.

7-4.1 The tower should be at least 20 ft × 20 ft (400 ft^2 of floor area) [6 m × 6 m (36 m^2)]. This should accommodate interior stairwell openings and allow room for fire companies to maneuver hoselines.

Figure 7-3 Ladder training tower. *(Courtesy of Dover Township Fire Academy, Ocean County, NJ.)*

7-4.2 A square configuration might be easier to construct, but a rectangular design can allow for an exterior enclosed stairway and a fire escape to provide two means of entrance or egress. The rectangular design can provide more interior floor space for hose stretching practice. [*See Figures 7-4.2(a) and (b).*]

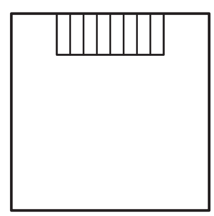

Figure 7-4.2(a) Square drill tower.

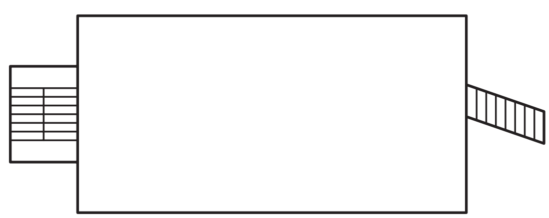

Figure 7-4.2(b) Rectangular drill tower.

7-5 Stairways.

7-5.1 Stairways in the drill tower might be either interior stairways or exterior stairways, or both. Stairways should provide not only a means of access between floor levels but also should simulate fireground conditions. A variety of types, widths, and situations should be realistically represented. Stairways included in the tower should be located to maximize available interior floor area. All stairway treads in the tower should be slip resistant; open grate treads can prevent water accumulation. The size of all stair landings should be carefully planned to provide for personnel and equipment that must be maneuvered around corners. Floor numbers should be indicated on all landings.

7-5.2 In the case of outside stairways, railings should be of sufficient height and strength to ensure safety during training evolutions.

7-6 Exterior Openings.

7-6.1 All door and window openings should be fully framed and located to simulate situations existing in the field. Where safety net operations at the tower are contemplated, all openings on the side of the structure to be used for such operations should have heavy wooden sills installed to accommodate rope and pompier ladder evolutions.

7-6.2 Where it is not possible for the tower to include various types of doors and windows, a separate display mock-up including an example of each should be constructed. Those areas located near ocean or river shipping facilities should take into consideration the doors or hatches found on ships.

7-7 Fire Escapes. Fire escape configurations can be placed on the building. Railings should be high enough to safeguard a fire fighter who is operating a charged hoseline on the fire escape. The bottom of the fire escape can terminate in a straight ladder or a counterbalanced ladder. The top of the fire escape could end at the top floor or rise over the roof by means of a gooseneck ladder. Caged vertical ladders might be desirable to install if they are representative of community construction.

7-8* Sprinkler and Standpipe Connections. The drill tower should include provisions for standpipe connections at all floor levels of the facility. These connections not only provide the opportunity to develop the proper procedures for connecting to and providing a water supply for the system but also can be utilized for simulated fire attack by fire forces operating in a high-rise building. Siamese connections should be installed and identified at ground level to accommodate auxiliary water supplies. Section valves should be installed in systems at each floor, or selected locations, to enable the instructor to shut down only sections, not entire systems, for training purposes.

7-9 Roof Openings. Roof openings should be provided for the practice of ventilation procedures. Various size openings on both flat and sloped roof surfaces should be designed into the structure so that different situations and types of roof conditions can be simulated. (*See Figure 7-9.*) Normally, these practice sessions are best conducted at lower levels of the building because of safety. In all cases, safety railings should be considered for roof operations.

Figure 7-9 Both flat and sloped roofs can be designed into a burn building. *(Courtesy of Nassau County Fire Training Academy, Old Bethpage, NY.)*

7-10 Coping. Where not covered by the roof, the topmost section of the walls should have a coping. Heavy wood bolted into the structure is best for rope work and evolutions. Stone, concrete, or other material might break away in pieces or abrade equipment and personnel.

7-11 Nets. Consideration should be given to the provision of a temporary or permanent safety net on at least one exterior side of the building, especially if rappelling is contemplated. [*See Figures 7-11(a) and (b).*] A safe distance should be provided between the ground and the net to allow for movement upon impact.

Figure 7-11(a) Frame of the net. *(Courtesy of New York Fire Department Fire Academy, New York, NY.)*

7-11.1 A temporary, removable net can allow full access to the tower.

7-11.2 Removal and proper storage can prolong the serviceability of the net.

7-11.3 Springs installed between the net and the perimeter frame can increase the life of the net by lessening direct impact upon the net.

7-11.4 A ladder affixed to the tower for the mounting of the net should be considered.

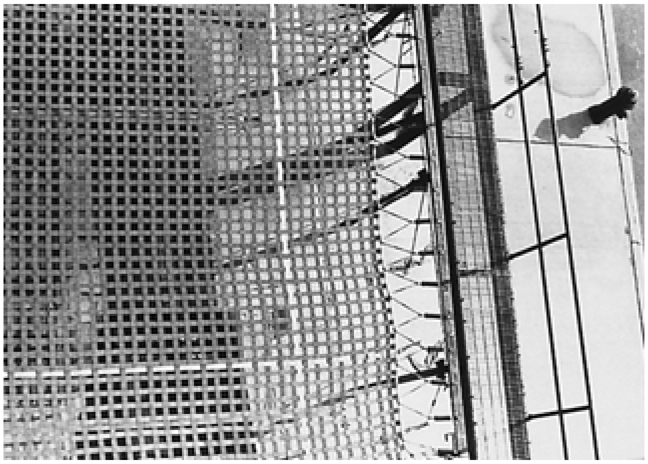

Figure 7-11(b) Texture of net and catwalk around net. *(Courtesy of New York Fire Department Fire Academy, New York, NY.)*

7-11.5 For a permanent net, a catwalk around the perimeter frame with a ladder to the ground can provide a standby area for the instructor and trainees.

7-12 Drains. Each floor of the building should be equipped with floor drains or scuppers. In areas subject to freezing temperatures, conventional floor drains might not be effective. Where scuppers are used, the water discharge should be directed to areas that will not interfere with activities below the openings. Regardless of the types of drains that are selected, their installation should ensure the quick runoff of water. (*See Figure 7-12.*)

Figure 7-12 Scuppers at work on a multiple dwelling. *(Courtesy of New York Fire Department Fire Academy, New York, NY.)*

7-13 Special Training Features. Special features can be included in the tower to accommodate local area needs. For example, a 36-in. (910-mm) diameter pipe could connect two floors for caisson and mine shaft rescue simulation. An elevator could be installed to be used in the simulation of elevator emergencies and for the movement of personnel and equipment.

Chapter 8 Burn Building

8-1 General. See Figures 8-1(a) and (b).

Figure 8-1(a) Hot drill building. This building features two buildings in one—residential and commercial. The residential side is two stories with attic and six interior rooms, all masonry. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

Figure 8-1(b) Burn building with provisions for basement fires and roof ventilation. *(Courtesy of Alberta Fire School, Edmonton, Alberta, Canada.)*

8-1.1 The purpose of the burn building is to train fire fighters safely in methods of interior fire suppression. Every room should have an exterior exit or secondary means of egress. Burn areas below grade are not recommended and should be avoided. In order to provide simulated training for the suppression of basement or cellar fires, a raised open-grid walkway can be constructed level with the second floor on the exterior of the building. *(See Figure 8-1.1.)* Fire fighters then can simulate attacking below-grade fires while working on the second floor to the ground floor and are not exposed to below-grade hazards.

8-1.2 The burn building could be designed to take into consideration fire spread, rescue, ventilation, and special problems.

Figure 8-1.1 Burn building with raised open-grid walkways level with the second floor. *(Courtesy of New York Fire Department Fire Academy, New York, NY.)*

8-1.3* When designing the facility, consideration should be given to the types of evolutions that will be conducted at the site. It is much easier, and less costly, to incorporate the necessary safety features into the design during the construction phase.

8-1.4 When designing interior fire-resistant coverings for burn buildings, consideration should be given to the durability of the material and the ease of replacing damaged sections. Fire-resistant materials are available in 4 ft × 8 ft × 1 ft (1.2 m × 2.4 m × .3 m) sheets and are rated at 1200°F (649°C). It might be advisable to place a metal edge trim on the panels and to mount them to concrete walls with metal furring strips.

8-2 Fire Temperature.

8-2.1 Walls, floors, ceilings, and other permanent features should have strong resistance to heat generated by fires. High temperature training fires can cause accelerated deterioration of the structure and expose fire fighters in training to unnecessary risk.

8-2.2 In planning a burn building, the designer, the architect, and the user should consider the problems created by fire temperatures. Where unprotected, concrete might spall and steel might distort when exposed to fire temperatures. Even in burn buildings built with adequate protection, fires should be limited to short durations. To provide high temperature protection to the burn building the following materials can be utilized:

(a) Precast modules made from poured calcium aluminate concrete with lightweight aggregate of high carbon content form a wall that has high strength and resistance to spalling.

(b) Gunning (the spraying of exposed surfaces with a cementitious concrete) provides a self-adhering joint-free surface whose usefulness can be extended by patching.

(c) Refractory blocks set in refractory mortar can be used.

(d) Panels made from fire-resistant material can be attached to the structure. (Care should be taken when choosing materials; some fire-resistant panels might crack or spall below the rated maximum temperature when fire streams are used in the area.) In order to maximize the useful life of a burn building built of conventional masonry, designs might employ liners in areas where flames impinge on masonry surfaces. The design of these liners and mounting systems should consider the durability of the material, ease of replacing damaged sections, thermal expansion and contraction, and secure mounting. Burn rooms can be successfully lined with panels of mild or weathering steel or with proprietary insulating panels. Panels are mounted to maintain an air space between the masonry wall and the back of the panel. Mounting should allow for thermal movement of the panel, while maintaining secure attachment, so personnel are not injured by falling panels or mounting hardware. The selection of panel material and thickness depends on the nature, size, and duration of the fire.

(e) Panels made of metal can be inserted into tracks on the walls and ceilings. One corner of each panel should be tack welded to keep it secure, but provision should be made for expansion and contraction.

8-2.3 As an alternative to the high cost of fire-resistant materials, a fire in a heavy gauge metal drum, with metal plates welded above to prevent flame impingement on the structure, can be used as a smoke and heat simulation method. If used, the drum should be raised above the floor, and the floor should be protected with a steel plate. Metal drums or burn containers with steel wheels installed might be made mobile and the bottom lined with fire brick.

8-3 Instrumentation. The purpose of the instrumentation is to keep the fire within safe parameters, observe the effect of suppression agent application, and, with sophisticated equipment, observe and record the products of combustion. Thermocouples and analyzing equipment can be used to attain the first two objectives.

8-4 Built-in Safeguards.

8-4.1 One step in safeguarding staff and trainees is the proper design of the building. A ventilation system capable of removing heat and smoke should be installed in the building.

8-4.2 Open sprinklers are not reliable in a burn room because of repeated heat exposure. Other methods of applying water should be provided and coordinated with proper ventilation procedures.

8-5 Cutouts.

8-5.1 In order to perform rescue and ventilation evolutions, parts of the building should be designed to be destroyed and replaced. These expendable sections (cutouts or chopouts) can be located in walls, ceilings, or roofs. (*See Figure 8-5.1.*)

8-5.2 The cutout openings should have a safety device installed to prevent personnel or tools from falling through. Consideration should be given to the fact that the cutouts can catch on fire and cost money to replace, and manpower is needed to reconstruct them.

8-6 Gas-Fired Burn Building. The U.S. Navy has successfully used gas-fired burn buildings for several years. The specifications for these sophisticated installations are in the public domain. Several vendors manufacture and install these very safe and environmentally clean simulators.

8-6.1 Safety Considerations. The use of flammable gases in a burn building requires constant care to ensure the safety of the overall operation. Engineering expertise during design is essential, and the following safety provisions should be provided:

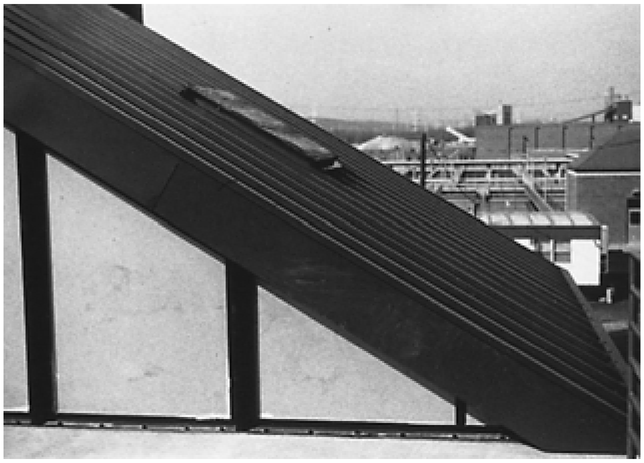

Figure 8-5.1 Pitched roof with chopout. *(Courtesy of Alexandria Fire Department, Alexandria, VA.)*

(a) All installations should comply with NFPA 54, *National Fuel Gas Code*, and NFPA 58, *Standard for the Storage and Handling of Liquefied Petroleum Gases.* System designers should determine area hazard classification for equipment rooms, burn rooms, and other spaces in order to assess electrical installation requirements.

(b) Igniters and pilots should be interlocked with fuel valves to prevent fuel from flowing without an ignition source. Commercial flame safety control systems are available.

(c) Combustible gas detection is necessary to monitor the burn area. These sensors should be interlocked with fuel delivery valves to shut down fuel flow and activate an external alarm when the level exceeds 25 percent of the lower explosive level (LEL). Ventilation system design should consider the potential accumulation of unburned gases above, below, or adjacent to the fire area.

(d) Adequate air should be provided to ensure complete combustion of the gas. Depending on the facility's configuration, mechanically assisted ventilation might be necessary. Where mechanical ventilation is provided, airflow switches, buttons, and wiring should be approved for the temperature environment.

(e) Emergency stop buttons or valves should be placed adjacent to each burn room to provide immediate shutdown in the event of an accident.

(f) A ventilation system capable of removing heat, smoke, and unburned gas should be installed in the building. Consideration should be given to interlocking the ventilation with emergency stop switches, temperature sensors, and gas monitors. A manual override should be provided in the event that the interlocking device fails.

8-6.2 Synthetic Smoke. Gas fires do not produce smoke than can obscure visibility. Synthetic smoke generators are needed where reduced visibility is a desired component of the training program. The smoke produced should not be toxic or flammable.

8-6.3 Training Mock-ups. When selecting mock-ups, the types of fires to which the props are to be exposed should be evaluated. Even with good design, mock-ups need periodic replacement.

8-7 Miscellaneous. Door stops to hold doors open should not be mounted on the floor but on the wall behind the doors to prevent hoselines from catching on them and causing damage to the hose and the door stops.

Chapter 9 Smoke Building

9-1 General. See Figure 9-1.

Figure 9-1 Smoke building. *(Courtesy of University of Kansas, Lawrence, KS.)*

9-1.1 The purpose of the smoke building is to acquaint the trainees with the skills and abilities necessary for survival in smoke-laden atmospheres. *(See Figure 9-1.1.)*

Figure 9-1.1 Smoke building with exhaust fan at roof level. *(Courtesy of Burlington County Fire Academy, Burlington County, NJ.)*

9-1.2 The building should be designed to allow for the constant surveillance of the trainees by the instructor. This can be accomplished by accompanying the trainee, by observing the trainee through windows, or by using closed circuit television (CCTV). CCTV can be used only where the smoke concentration is light or nonexistent.

9-1.3 A maze can be built as an enhancement for SCBA training. (*See Figure 9-1.3.*) It should be large enough to allow the trainees to crawl with their masks donned. This could be a simple 4-ft^2 (0.37-m^2) wooden tunnel.

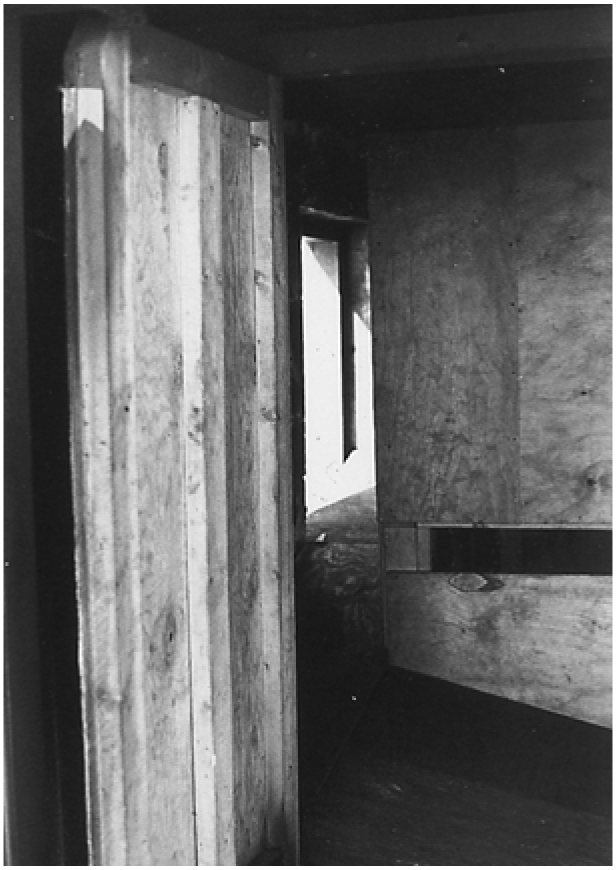

Figure 9-1.3 Maze—interior of smoke building. *(Courtesy of Burlington County Fire Academy, Burlington County, NJ.)*

9-2 Flexibility. The facility should have the ability to change the interior configuration so that various situations can be created. The use of modules or segments that can be quickly changed provides for maximum benefit at a minimum cost.

9-3 Safety.

9-3.1 The smoke building should have entry points and escape hatches at frequent intervals in case of an emergency.

9-3.2 Any area of the maze that cannot be seen and reached by the instructor should have the walls or top hinged so that any section can be opened. This allows trainees to be continually accessible to the instructor.

9-3.3 Smoke rooms can have sensors built into the floor that indicate the location of the trainees at all times.

9-3.4 Provisions should be made for the quick ventilation of the building. Consideration should be given to stopping or redirecting quickly the smoke being introduced into that section of the smoke building; this can be accomplished by the use of blowers or exhaust fans.

9-3.5 Communication capabilities between the instructor and trainees should be designed into the system. These can provide safeguards as well as the ability to transmit instructions to the trainees.

9-4 Smoke. Smoke used in the training facility should be nontoxic and of a known composition. Specially designed mechanical equipment can be installed in the facility to produce nontoxic smoke for training purposes.

Chapter 10 Combination Buildings

10-1 General. See Figures 10-1(a) through (c).

Figure 10-1(a) Combination building. *(Courtesy of Omaha Fire Academy, Omaha, NE.)*

Figure 10-1(b) Combination building—maximum use of minimum space with existing smoke stack for EPA considerations. This building provides for ventilation, smoke chamber, rappelling, laddering, live fire training, sprinkler laboratory, gas and electric cutoff, and forcible entry.

Figure 10-1(c) Multipurpose drill building. *(Courtesy of St. Louis Fire Department, St. Louis, MO.)*

Figure 10-1.2(a) Fire apparatus building, housing classroom. This building is approximately 100 ft (29.9 m) long with five 15-ft (4.5-m) overhead doors, classroom, maintenance area, and apparatus storage area. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

Figure 10-1.2(b) Combination building, housing classrooms, mask service unit, garage, and kitchen. *(Courtesy of Burlington County Fire Academy, Burlington County, NJ.)*

10-1.1 In some training facilities, because of a lack of available space or funds, individual structures for ladder evolutions, fires, or smoke training might not be built. In these instances, a combination building that embraces all of the desirable functions in one structure might be constructed. Consideration should be given to the detrimental effects that any single function can have on the facility, equipment, or other functions.

10-1.2 Certain combinations of functions are, by their very nature, more compatible than others. Consideration might be given to combining all functions, excluding actual fires; the fire function usually results in faster than normal deterioration of the facility. If adequate protection from water and smoke damage is provided, classroom facilities can be combined with the drill tower and smoke function. Other combinations are possible, depending on which functions are required or desired, including functions performed by other divisions of the department. Facility planners have found that the limiting factors include available space and funding. [*See Figures 10-1.2(a) and (b).*]

Chapter 11 Outside Activities

11-1 General. Ample outside space should be provided for a variety of uses, including auto extraction, ventilation, forcible entry, and salvage training problems. Specific layouts will be needed as permanent installations for training in the areas discussed in this chapter. (*See Figure 11-1.*)

11-2 Flammable Liquids and Flammable Gases. See Figures 11-2(a) through (c).

11-2.1 The flammable liquid burn area should be located as remote from the main building as possible. Fencing should be provided for safety.

11-2.2 Pits can be constructed in various sizes and shapes. Obstructions can be built into these pits to make extinguishment more difficult. Pit aprons should be made of concrete, crushed stone, or iron ore slag. *(See Figure 11-2.2.)*

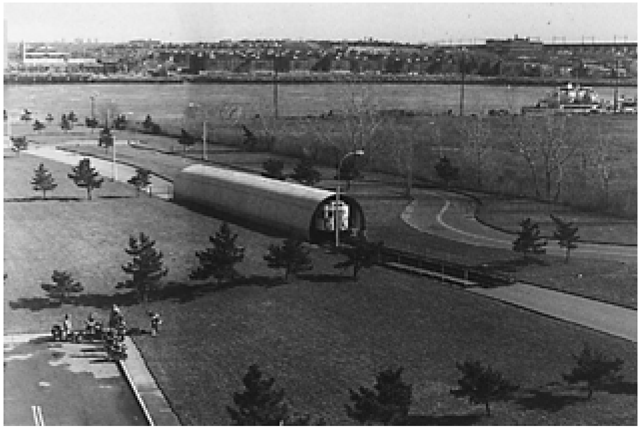

Figure 11-1 Transportation problem—train in tunnel. *(Courtesy of New York Fire Department Academy, New York, NY.)*

Figure 11-2(a) Flammable liquid burn area for fixed storage. *(Courtesy of Nassau County Fire Training Academy, Old Bethpage, NY.)*

Figure 11-2(b) Flammable liquid transportation incident. *(Courtesy of Nassau County Fire Training Academy, Old Bethpage, NY.)*

Figure 11-2(c) Flammable liquid incident. *(Courtesy of Nassau County Fire Training Academy, Old Bethpage, NY.)*

Figure 11-2.2 District of Columbia Fire Department flammable liquid pond. Note the heavy stone surrounding pond. *(Courtesy of District of Columbia Fire Department, Washington, DC.)*

11-2.3 Other props might include aboveground tanks, overhead flanges, "Christmas trees," and liquefied petroleum gas facilities. Careful consideration should be given to water supply, fuel supply, fuel pumping capability, drainage, and environmental regulations. Close coordination with environmental protection agencies is essential to ensure that the area is designed to applicable standards. Management of liquid fuels can result in lower fuel consumption as well as a lower volume of contaminated runoff. This can be accomplished by metering the quantity of fuel available and by using devices that atomize or restrict fuel flow. [*See Figures 11-2.3(a) through(g).*]

11-2.4 If flammable liquid or gas is fed to an area, the flow should be controlled by quick shutoff valves. In case of an emergency, an instantaneous shutdown might be necessary.

11-3 Electrical. Electrical safety could be taught by constructing various electrical wiring systems between poles. (*See Figure 11-3.*) Some electrical problems that might be addressed are downed wires, vaults, transformers, meters, and main disconnects. The local utility could be requested to participate in the planning phase of this section of the training facility.

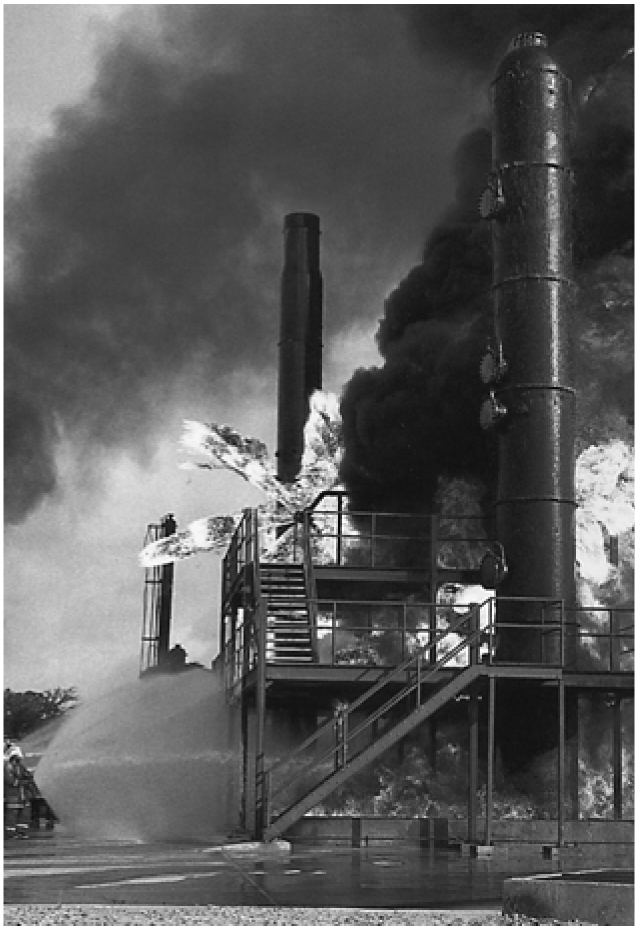

Figure 11-2.3(a) Chemical complex fire training aid. *(Courtesy of Fire Protection Training, Texas A & M University.)*

Figure 11-2.3(b) Rail car loading terminal. *(Courtesy of Fire Protection Training, Texas A & M University, College Station, TX.)*

11-4 Drafting Pit. See Figures 11-4(a) and (b).

11-4.1 A drafting pit can be desirable to facilitate the training of pump operators and to test pumper apparatus. In general, a capacity of at least 5000 gal (19,000 L) of water is necessary, assuming water will be recycled to the pit.

Figure 11-2.3(c) Portable fire extinguisher training area. Training area is 75 ft × 85 ft (23 m × 26 m). Seven training scenario areas are located on this pad. *(Courtesy of Mississippi Fire Academy, Jackson, MS.)*

Figure 11-2.3(d) The three-level chemical complex and tank farm is used to simulate fire and leak situations that could occur within a petrochemical process unit. Multiple fire objectives can be created and controlled from the training field control tower. The "pressure vessels" are equipped with remotely operated relief valves to simulate inadequate cooling and containment techniques. *(Courtesy of fire training facility, Texas Eastman Co., Longview, TX.)*

Figure 11-2.3(e) Hazardous material spill training aid. *(Courtesy of Fire Protection Training, Texas A & M University, College Station, TX.)*