SAFEGUARDS DURING CONSTRUCTION, ALTERATION, AND DEMOLITION

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1.0 SCOPE

This data sheet examines the hazards associated with construction, alteration, and demolition operations. The following recommended precautions will greatly reduce the danger of fire, explosions, water and wind damage, and collapse.

This document also provides general site selection and guidance recommendations for permanent design loads and design considerations for achieving highly protected risk (HPR). HPR guidance focuses on various property protection concerns, which may exceed life safety concerns covered by building and fire code requirements. Other reference documents are listed in Section 4.0.

1.1 Hazards

For hazard information refer to Understanding the Hazard (UTH) publication, *Alteration, Demolition and Construction Operation* (P0309).

1.2 Changes

July 2023. Interim revision. The following changes were made:

A. Referenced data sheets that should be applied in site selection and building design.

B. Added guidance for the use of FM Approved debris barriers.

C. Referenced ASCE 37 for temporary design loads during construction.

D. Expanded guidance for bracing building framework during construction and sequencing construction connections and braces, including references to association documents for specific construction types.

E. Added guidance regarding the use of noncombustible or limited combustible construction materials.

2.0 LOSS PREVENTION RECOMMENDATIONS

2.1 Introduction

In designing a new facility or building, consider all features that affect fire and explosion safety and resistance to natural hazards. The essentials of firesafe construction are described in this section.

2.2 Site Selection and Design Considerations

2.2.1 Construction and Location

2.2.1.1 Select a location, including all its access routes, that is outside the 500-year mean return interval (MRI, 0.2% annual exceedance) flood zone, including a 1 to 2 ft (0.3 to 0.6 m) freeboard. For more information, see Data Sheet 1-40, *Flood*.

2.2.1.2 For all locations, especially where buildings will be in locations prone to tropical cyclones or tornadoes, use design guidance in Data Sheet 1-28, *Wind Design*.

2.2.1.3 Select locations that are not prone to wildland fires. For additional information, see Data Sheet 9-19, *Wildland Fire*.

2.2.1.4 Select locations that have limited exposure to seismic activity. For additional information see Data Sheet 1-2, *Earthquakes*.

2.2.1.5 Consider the location's exposure to hail. For additional information, see Data Sheet 1-34, *Hail Damage*.

2.2.1.6 Use noncombustible and fire-resistant structural framework, such as reinforced concrete or protected steel frames, in high-rise buildings (see Data Sheet 1-3, *High-Rise Buildings*) and whenever practical, in other buildings based on value or importance.

2.2.1.7 Where sprayed fire-resistive materials applied to structural members are recommended (e.g., protected steel-frame construction), ensure they meet all applicable American Society for Testing and Materials (ASTM) test standards as outlined in Section 4.0. Comparable standards available in countries outside the United States also may be used. Ensure steel surfaces are free of dirt, oil and loose scale. Provide guards and/or sheathing to protect exposed fireproofing that is subject to mechanical damage, and repair

damaged areas of coating promptly. Ensure fire-resistant material used for framing or lintels on Maximum Foreseeable Loss (MFL) fire walls is durable enough that it cannot be easily scraped off.

2.2.1.8 If construction or contents are combustible, subdivide high value contents; or separate manufacturing and storage areas with fire walls (see Data Sheet 1-42, *Maximum Foreseeable Loss Limiting Factors*) that have adequately protected openings to limit fire damage.

2.2.1.9 Provide space between important buildings and adjacent property and between individual important buildings to reduce potential fire exposure. See Data Sheet 1-20, *Protection Against Exterior Fire Exposure*, Data Sheet 1-22, *Maximum Foreseeable Loss* and Data Sheet 1-42, *Maximum Foreseeable Loss Limiting Factors*.

2.2.1.10 Provide damage-limiting construction for processes having an explosion (deflagration) hazard due to ignitable liquids, gases or combustible dust, as defined in all applicable 7-series data sheets. Design these buildings according to Data Sheet 1-44, *Damage-Limiting Construction*. This will minimize damage to the building framing and the attached sprinkler system. Blast barricades may be needed for potential detonations (see Data Sheet 7-28, *Energetic Materials*), as recommended.

2.2.1.11 For industrial occupancies, choose construction that will not contribute to the spread of fire. Do not construct important buildings (those housing valuable contents or subject to significant business interruption) with wood walls, wood joisted floors or roofs, combustible hollow spaces or quick-burning interior finishes (see Data Sheet 1-57, *Plastics in Construction*, and Data Sheet 1-60, *Asphalt-Coated Metal and Protected Metal Buildings*). Basements and crawl spaces are more conducive to fire spread, present problems of accessibility, ventilation and drainage, and have poor loss experience. Such spaces are not suitable for combustible storage, and the fire spread potential is greatly increased if ignitable liquids or gases enter. Use FM Approved ductwork and pipe insulation as listed in the *Approval Guide*. Also see Data Sheet 7-78, *Industrial Exhaust Systems*.

2.2.1.12 For the design of roof construction, see Data Sheet 1-29, *Roof Deck Securement and Above-Deck Roof Components* and 1-31, *Panel Roof Systems*. Use FM Approved roof assemblies as listed in Roof*Nav*. Roof strength and drainage should be designed for snow and rain loads as discussed in Data Sheet 1-54, *Roof Loads and Drainage*. Use wall assemblies, other than concrete or masonry, that are FM Approved (per FM 4881) and meet wind criteria as noted in Data Sheet 1-28.

2.2.1.13 Where roof mounted solar panels are planned, use FM Approved roof mounted solar assemblies as listed in Roof*Nav*; and follow design and installation guidance as noted in Data Sheet 1-15, *Roof Mounted Solar Photovoltaic Panels*.

2.2.1.14 Mass Engineered Timber (MET) and Other Wood Structures

Fire-resistive, non-combustible or limited-combustibility structures are preferred over wood structures because of the inherent fire risk of wood. When wood construction is to be used, follow the guidance in Sections 2.2.1.14.1 through 2.2.1.14.3.

2.2.1.14.1 Follow the guidance in Data Sheet 1-36, *Mass Engineered Timber*, as well as in Sections 2.2.1.14.2 through 2.1.1.14.3.

2.2.1.14.2 Sequence the construction of wood structures over three stories as follows:

A. Conduct an analysis that considers fire exposure to adjacent structures.

B. Determine the maximum number of combustible stories that can be constructed before installing passive fire protection and/or placing sprinklers in service, considering the width and height of each exposed story.

C. Consider the separation distance to other structures, and the maximum incident heat flux to which the target building can be safely exposed based on the less resistant of either the wall construction type, the type of glass windows or the roof construction. For additional information, see Data Sheet 1-20, *Protection Against Exterior Fire Exposure*.

2.2.1.14.3 Do not use torch-applied roof systems under any circumstances.

2.2.2. Protection

2.2.2.1 In multistory buildings, enclose stairs, elevator wells, conveyors and chutes with walls and doors having a fire rating as recommended for the construction on which they are installed per Data Sheet 1-3, *High-Rise Buildings*, or 1-42, *Maximum Foreseeable Loss Limiting Factors*. Alternatively, for assemblies other

than MFL subdivisions, provide water spray protection at openings to help prevent upward spread of fire and smoke from story to story. Construct balconies entirely of noncombustible or limited-combustible materials (e.g., Class 1). For existing combustible balconies, provide sprinkler protection as outlined in Data Sheets 1-12, *Ceilings and Concealed Spaces*, and 2-0, *Installation Guidelines for Automatic Sprinklers*.

2.2.2.2 Provide complete automatic sprinkler protection in accordance with applicable data sheets for combustible construction or occupancy.

2.2.2.3 Secure the property, and provide alarm systems and programs as outlined in Data Sheet 9-1, *Supervision of Property*.

2.2.2.4 Where smoke and heat vents are required by local code, see Data Sheet 2-0 and 1-10, *Interaction of Sprinklers, Smoke and Heat Vents, and Draft Curtains*, to ensure that vents and draft curtains do not adversely affect sprinkler operation.

2.3 Safeguards During Construction and Alterations

2.3.1 Construction

2.3.1.1 Use noncombustible or limited-combustible construction for temporary trailers, sheds and offices when they are located within or near the building being constructed or renovated. When the temporary structure or its contents are combustible, locate the structure at least 50 ft (15 m) away from main buildings and at least 30 ft (9 m) apart from each other. When providing such separation is not possible, protect the temporary structures with automatic sprinklers.

2.3.1.2 Design the structure to withstand expected loads during construction in accordance with ASCE 37 (see Section 4.0), or similar standard in countries outside the United States.

2.3.1.3 Brace building framing and walls not yet tied to building framing in accordance with model and/or local building codes, as well as per recommended industry practice for the type of construction materials involved. Organizations and documents referenced in Section 4.0 may be used, but documents used need not be limited to those published. Also see Section 3.1.14.

For example:

- For bracing of wood construction – refer to APA: *The Engineered Wood Association*
- For steel framing – refer to the American Institute of Steel Construction (AISC) documents and training, including ANSI/AISC 303-22, *An American National Standard Code of Standard Practice for Steel Buildings and Bridges*

Unless a steel framework under construction is properly braced to a heavy existing structure (such as a building or retaining wall) or permanent bracing has been installed, provide temporary cable “X” bracing. Unless special design considerations exist as noted in AISC guidance, provide “X” bracing in every third bay of all column lines. Brace framework in all four directions. If connections for cable “X” bracing have not been provided, install them in the field. Ensure bracing is in the plane of column center lines. Connect all beams and girders to the columns prior to bracing.

The erector is responsible for stability during each phase/sequence of construction.

Incomplete structures may not be stable without temporary measures during construction.

For concrete masonry walls bracing guidance, see the reference in Section 4.3 by the National Concrete Masonry Association (NCMA).

For concrete walls and other general OSHA requirements, see the reference in Section 4.3.

When walls of hollow masonry units under construction do not have lateral support to resist wind, brace them in accordance with Figure 2.3.1.3 (see Section 3.1.14.4). Walls should be braced on both sides.

Brace walls of tilt-up precast concrete on both sides by lean-to steel pipe braces until their permanent securement is completed. Ensure slenderness ratio (L/r) of braces does not exceed 200, where L = length of brace and r = least radius of gyration, both in inches.

2.3.1.4 Install only as much roof insulation as can be covered with roof covering in a single working day, or prior to the expected start of inclement weather. Seal loose roof cover edges at the end of each day to minimize potential moisture damage. Asphalt or coal tar (where allowed) can be used for built-up roof (BUR)

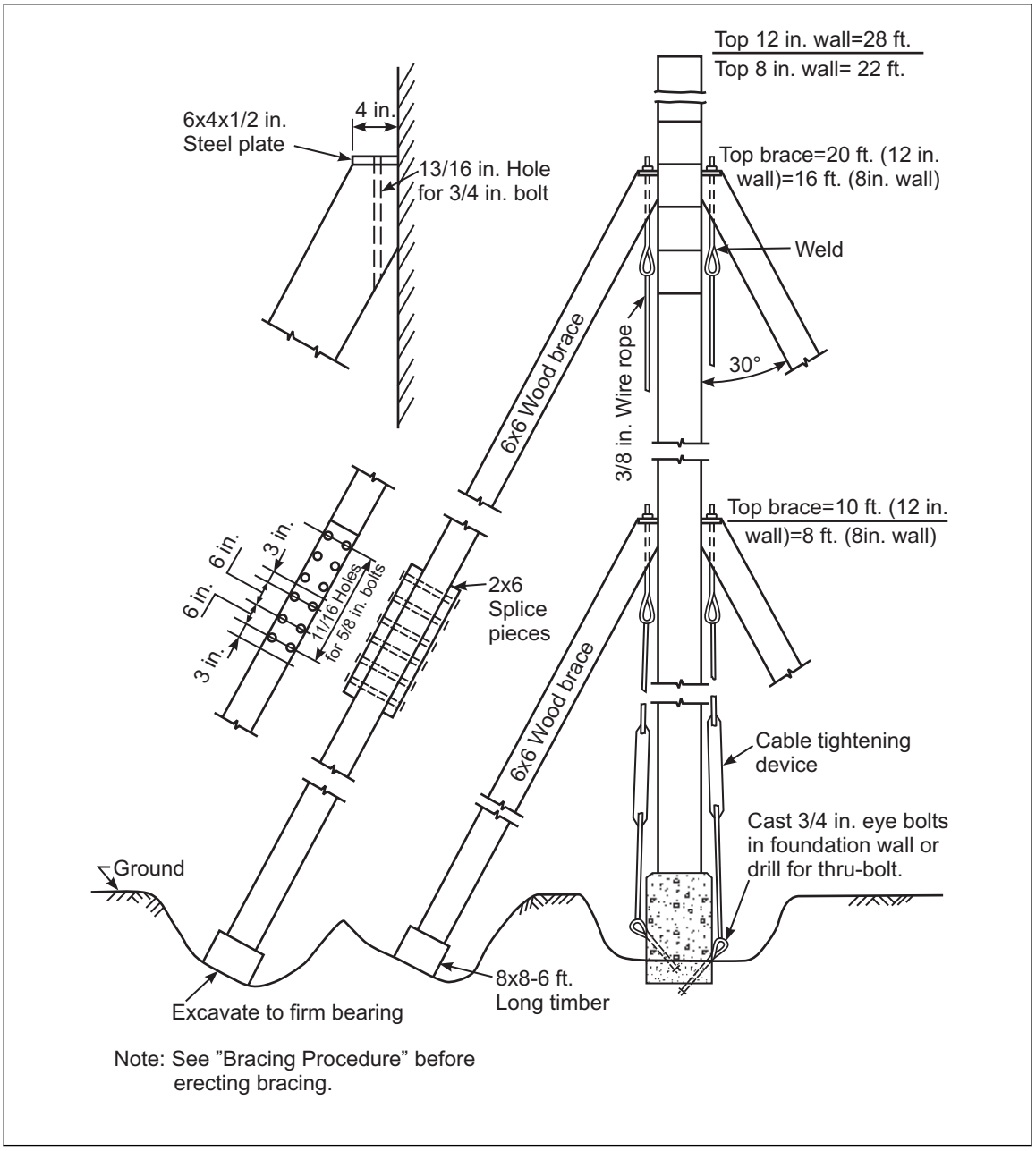

Fig. 2.3.1.3. Example of Bracing Details for an Unreinforced Masonry Wall

covers; proprietary sealers are available for single-ply roof covers. Do not allow water to run in the deck ribs under completed roof sections. Follow manufacturer's recommendations.

Distribute temporary storage of all materials on the roof awaiting installation to prevent overloading the roof in localized areas (e.g., gravel, paver blocks).

Complete the installation of all permanent roof covers, flashing, walls, and other openings prior to the start of any interior work that may be damaged by rain, moisture or mildew. Such interior work includes, but is not limited to, fire protective coatings, gypsum board, ceiling tiles, interior finish materials, and materials or equipment related to the occupancy, etc. Where water or moisture has entered the building, ensure it is thoroughly cleaned and dried prior to the start of interior work.

2.3.1.5 Use only metal (see Section 3.1.7) formwork or scaffolding, or limited quantities of combustible formwork or scaffolding, unless used or stored in areas protected by automatic sprinklers.

2.3.1.6 Ensure formwork used to temporarily support cast-in-place concrete is designed by a qualified civil or structural engineer to prevent excessive sagging or collapse prior to setting of the concrete.

To minimize wind damage to roof coverings under construction, install the perimeter flashing assembly as soon as possible after the perimeter section of the roof cover has been installed. If the edge of the insulation and covering must be exposed for short periods of time, weight all temporary edges with closely spaced concrete blocks, or equivalent, until the flashing is completed.

2.3.1.7 As soon as practical after the building envelope has been enclosed, construct proposed fire walls. Install fire-resistant seals for pipe, cable and duct penetrations, and expansion and control joints in floors and fire walls.

2.3.1.8 Take precautions with temporary ditches. Provide earthen diking at edges of the ditch to help prevent adjacent yard area runoff from entering the ditch. Of particular concern are buildings that have basements and frequently undergo expansions (such as hospitals). Provide temporary waterproofing at building entrances. Temporary diking within the ditch may be needed depending on its area, expected rainfall intensity and slope. Use extreme caution when excavating near existing underground utilities such as gas, water or electrical lines. Ensure equipment operators are assisted by personnel on the ground in such cases.

2.3.1.9 Whenever a trash chute is used for debris removal, install it on the outside of the building. Ensure its construction is noncombustible. Ensure the main artery of the chute is as straight as possible to help prevent accumulations or clogging within the chute.

2.3.1.10 Concrete Shell Structures

The following recommendations apply to the construction of concrete shell structures (see Figure 2.3.1.10 and Section 3.1.15.

Fig. 2.3.1.10. Concrete shell structures

2.3.1.10.1 Cover the entire fabric membrane evenly with polyurethane foam. Ensure mixing and application of the polyurethane foam is done only by experienced mechanics. Adjust the spray equipment regularly according to temperature changes to provide proper composition and density.

2.3.1.10.2 Provide adequate reinforcement as determined by an experienced structural engineer.

2.3.1.10.3 Use an airlock with doors at each end of the entrance to the fabric membrane. Use double blowers for reliability in pressurization of the fabric membrane. Provide a diesel or gasoline engine backup to electric motors to prevent collapse during power failure.

2.3.1.10.4 Apply the concrete at proper pressures. Even application in the proper thickness is essential.

2.3.1.10.5 Do not start construction when high wind, heavy rain, or snow is expected. This can deform the fabric membrane and may cause vibrations resulting in the separation of freshly placed concrete.

2.3.1.10.6 Careful design is necessary with large structures to avoid failure during construction. Cables may be needed to brace some fabric membranes, particularly those of 280 ft (85 m) or more in diameter.

The following applies to structures more than 150 ft (45 m) in diameter:

- Ensure the design considers the necessary air pressure needed and the maximum allowable working stress the coated fabric membrane can withstand
- Ensure the density of the polyurethane foam is 2 to 3 lb/ft^3 (32 to 48 kg/m^3) and complies with the referenced ASTM E-108 listing.

2.3.1.10.7 Do not restrain the shells, such as by attachment to interior walls/partitions. This could result in cracking when thermal expansion of the shell occurs.

2.3.1.10.8 Ensure the exposed outer surface of the shell structure has adequate resistance to exterior fire exposure. Ensure the assembly has an ASTM E-108 rating for an unlimited slope or 5 in./ft (23 degrees) slope as recommended in Data Sheet 1-29, *Above-Deck Roof Components*. Ensure the polyurethane foam has a flame spread of 75 or less based on the ASTM E-84 test (see Data Sheet 1-4, *Fire Tests*); however, ensure the flame spread does not exceed that listed for the respective ASTM E-108 rating needed.

2.3.2 Occupancy

2.3.2.1 Store compressed flammable gases in portable cylinders as outlined in Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage* . When used on site, secure cylinders well to prevent them tipping or falling from upper floors or roofs. Ensure ignitable liquid storage and use complies with Data Sheets 7-29, *Ignitable Liquid Storage in Portable Containers*, and 7-32, *Ignitable Liquid Operations*.

2.3.2.2 Ensure construction-related electrical wiring and equipment for light, heat, and power is in accordance with National Fire Protection Association (NFPA) Standard No. 70, *National Electrical Code*.

2.3.3 Protection

2.3.3.1 Install and activate automatic sprinkler and standpipe protection as soon as possible after the building shell has been constructed and before combustibles are introduced.

2.3.3.2 Extend capped standpipes with hose connections upward as the various floors are constructed. Ensure a conspicuously marked fire service pumper connection is available outside of the building at street level. Notify the public fire service of the connection's existence as soon as it is in service.

2.3.3.3 Install cooling tower sprinkler systems as soon as possible during new construction and leave in service whenever maintenance or alterations are in process. When this is not practical, provide charged hose lines.

2.3.3.4 When alterations such as roofing operations are conducted where there is an existing sprinkler system, and debris barriers are to be installed to shield the occupancy below from debris, all the following apply:

A. Use an FM Approved Debris Barrier tested in accordance with FM 4652 and installed as listed in the *Approval Guide*. The thickness of the barrier should not exceed that in the listing.

B. Install the debris barrier below the underside of roof framing members, such that the distance between the debris barrier and the sprinkler deflectors is between 1.5 and 10 ft (0.46 and 3.0 m). Debris barriers should be located at least 8 ft (2.4 m) above the floor).

C. Debris barriers should only be used over occupancies with limited combustible loading. This includes the HC-1 and HC-2 occupancies as defined Table 2.2.2 and Appendix C of Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*.

D. Use the debris barrier under roofs with a maximum slope of 10°.

E. The debris barrier is only for temporary use (less than 180 days) and should be removed as soon as work above the sprinklers that would impact the occupancy below is completed.

2.3.3.5 Store containers and aerosol cans used in construction and alteration that have ignitable liquid contents in FM Approved storage cabinets for ignitable liquids.

2.3.4 Operation and Maintenance

2.3.4.1 Where cranes are used, refer to FM Data Sheet 1-62, *Cranes*.

2.3.5 Human Element

2.3.5.1 Appoint an individual to supervise all loss prevention measures and conduct at least one inspection round at the end of the working day. Appoint someone to contact the fire service immediately upon notice of fire. Contact the fire service to establish a pre-fire plan.

2.3.5.2 Supervise contractors. Ensure they thoroughly understand all policies, procedures, and precautions prior to working on site. Monitor their work and assign a company employee to oversee each group. Ensure contracts mandate compliance with company policies (and pertinent recommendations in this document) and hold the owner harmless from loss caused by contractor negligence.

2.3.5.3 Remove combustible waste, dust, and debris from structures and their immediate vicinity as often as necessary and practical-at a minimum, at the end of each work shift This also includes materials subject to spontaneous ignition, such as oily waste and rags soaked with paint, linseed oil, or other ignitable liquids. Strip and remove combustible formwork from the structure as soon as concrete has reached sufficient strength.

2.3.5.4 Use extreme caution when installing a torch-applied roof system. Refer to Data Sheet 1-33, *Safeguarding Torch-Applied Roof Installations*. Do not use torch-applied roofs on tall wood structures.

2.3.5.5 Minimize temporary combustible storage (such as combustible roof insulation) in the yard or on the roof; limit stacks to 6 ft (1.8 m) in height and one or two pallets in width. Where space permits, make the separation distance between adjacent storage piles and structures at least 20 ft (6 m), 25 ft (8 m) or 30 ft (9 m), for exposing storage widths of 4 ft (1.2 m), 6 ft (1.8 m) and 8 ft (2.4 m) respectively. For valuable and important equipment, also refer to Section 3.1.6.

2.3.5.6 Provide security and alarms and address related items (such as the means of fire service notification and location accessibility) as outlined in Sections 3.1.1 and 3.1.11.

2.3.5.7 Provide fencing and lighting around the entire property, including yard storage areas.

2.3.5.8 Ensure the area is kept clean during construction, alterations, and demolition operations, and that precautions (including the use of the FM Hot Work Permit System) are taken against fires from hot work operations such as cutting, heating of materials, welding, temporary space heaters, and other ignition sources. Provide reasonable temporary fire protection and place permanent protective systems in service before the building is occupied.

2.3.6 Ignition Source Control

2.3.6.1 Provide safe temporary heaters (See 3.1.8).

2.3.6.2 Use FM Approved welding pads, blankets, and curtains as applicable for hot work activities. For a list of FM Approved products, see Chapter 15 of the *Approval Guide,* a publication of FM Approvals.

2.3.6.3 Perform hot work in accordance with Data Sheet 10-3, *Hot Work Management*. Remove combustible materials within a 35 ft (10 m) radius of hot work operations (or within room boundaries, if smaller) or cover with an FM Approved welding blanket. Use a Hot Work Permit and employ a fire watch with suitable extinguishers or charged small fire hose. Take similar precautions when hot work is conducted above open metal grating as sparks or molten metal may shower down through the grating. For additional comments, see Section 3.1.4.

2.3.6.4 Prohibit smoking in areas where combustibles are stored, where ignitable liquids are stored or dispensed, near piles of debris, and on the roof. Post “No Smoking” signs. Permit smoking only in designated areas equipped with proper receptacles.

2.3.6.5 Avoid flame cutting in combustible buildings. Do not employ this technique when cutting through combustible walls, floors or roofs.

2.3.6.6 Locate tar and asphalt kettles in a safe place. Locate them outside buildings on the ground with bitumen pumped to the roof. A less desirable location would be on a noncombustible roof without combustible roof covering or insulation below or nearby. Constantly supervise kettles to prevent them from boiling over and igniting. Check thermometers on kettles for accuracy, and closely control temperatures. Provide steel covers of at least 14 ga. (0.075 in. [2 mm]) thickness to close by gravity and smother flames in case of fire. Check kettles in use at the end of each day.

2.4 Demolition

Recommendations 2.4.1 through 2.4.4, as well as those in Section 2.3 apply to structures undergoing demolition.

2.4.1 Occupancy

2.4.1.1 Drain ignitable liquids from tanks, piping, and machinery in a safe manner and remove the residue from the building. Remove the tanks also.

2.4.2 Protection

2.4.2.1 Keep automatic sprinklers in service as long as possible or as long as conditions necessitating sprinklers exist (combustible construction or contents). In cold weather, where wet pipe sprinkler systems are provided, maintain heat in sprinklered areas or install dry pipe valves where practical. Take sprinkler piping out of service section by section, to the extent practical, and cap as demolition progresses.

Limit sprinkler control valve operation to authorized personnel who will notify concerned parties. Check the sprinkler control valve at the end of each workday to ensure it is open.

2.4.2.2 Where standpipes for fire hose are provided, maintain them in service as described above in Section 2.5.1.1. Use charged hose lines in areas where sprinklers are out of service, near temporary combustible debris accumulations, roofing operations, cooling towers, and cutting operations.

2.4.2.3 If explosives are used, such as in demolition by implosion, provide 1 ½ in. to 2 ½ in. (38 mm to 64 mm) charged hose lines capable of reaching all areas in the vicinity of the demolition site.

Ensure demolition by implosion is performed only by engineers and contractors who are experienced in this work.

Consider the effects of building debris impacting on the ground. In some cases, and especially with multi-story buildings, the placement of sand at streel level surrounding the structure may be needed to dampen the force of impact with the ground.

Analyze the exposure to adjacent buildings and provide protection as necessary. Isolate underground services in the area during the implosion. Ensure the demolition engineer determines if seismic activity in the area should be monitored throughout the implosion to help determine if the impact had the potential to cause damage to underground services or adjacent structures.

2.4.2.4 Keep horizontal and vertical fire subdivisionand fire doors intact until demolition progresses to them; this helps limit potential fire-spread and retains heat.

2.4.2.5 To the extent practical, protect remaining structures from flying debris during demolition, such as by temporarily covering nearby windows with plywood.

2.4.3 Human Element

2.4.3.1 Notify the fire service of demolitions prior to the start of work.

2.4.4 Utilities

2.4.4.1 Shut off and cap gas supplies at a point outside the building prior to the start of demolition.

2.4.4.2 Reduce electrical service to a minimum and mark to identify which circuits are energized. Physically disconnect and positively lock out discontinued lines.

3.0 SUPPORT FOR RECOMMENDATIONS

3.1 General Safeguards

The danger of a fire is greater while a building is being constructed, altered, or demolished than after work is completed and the fire protection equipment and passive fire protection is in service. As work progresses, accumulations of combustible building materials, wooden forms and scaffolding, scrap lumber, paper and plastic packing and wrappings and other refuse appear at construction sites daily. The fire danger is increased further by the presence of many ignition sources such as hot work; carelessly discarded matches or cigarettes; temporary heaters and lights; and roofers' tar kettles, heating guns and torches.

Many serious fires have occurred during the construction period, destroying valuable property and delaying completion of a project. Close follow-up throughout the construction period is required to ensure that safeguards are put into practice and are strictly enforced by the contractor.

3.1.1 Human Element and Fire Alarms

Ensure one person is made responsible for the protection of property from all perils including fire, wind, explosion, vandalism and theft. This person will ensure the proper procedures for controlling fire hazards are set up and must have full authority to enforce them. Ensure this individual makes at least one round each working day.

Most projects consist of new buildings or additions to an existing facility. In such cases, the fire safety supervisor should be appointed by the owner. Where an entirely new facility is being constructed, the owner should ensure that specifications for new buildings contain a clause stating that the ‘‘contractor will take all reasonable precautions against fire, explosion, wind, vandalism and theft in accordance with good loss prevention practice.’’

Responsibility for loss prevention rests with the owner. However, loss prevention recommendations are normally implemented by the contractor. To ensure recommendations are carried out promptly, the owner's assistance may be needed. The building management and contractor should conduct joint briefings and walking tours and documentation should be provided to verify that individual workers have been trained regarding pertinent safety practices. During alterations at existing facilities, management should supervise the work of on-site contractors.

Arrange for at least one fire alarm box or telephone on or near the premises, and inform personnel as to their location and use. Post the number of the public fire service near all telephones. Make sure the public fire service is familiar with the premises and special fire hazards, and that firefighters have ready access to all parts of the construction project. Clear access roads promptly after snowstorms.

3.1.2 Automatic Sprinklers

Expedite installation of automatic sprinklers. Provide underground mains, hydrants, and a source of water in the earliest stages of construction.

Consider potential exposure to freezing temperatures. For more information, see Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

Place sprinklers in service ahead of a combustible occupancy and immediately following combustible construction. Many serious fires have occurred only a few days before the anticipated completion of a sprinkler system. Submit sprinkler plans promptly for review, comment, and acceptance prior to ordering materials. Order all materials in advance of construction to ensure delivery when needed. Closely coordinate construction sequences of various trades.

After installation, inspect control valves and check valves to ensure they are open and installed in the proper direction.

3.1.3 Use of Noncombustible or Limited Combustible Materials

The use of noncombustible or limited combustible materials is always recommended for use in the buildings under construction or for construction sheds used to store equipment or building materials. The following are various test criteria that can be used to qualify these materials:

Noncombustible – a material that has passed ASTM E136 or ASTM E2652. Materials that are inherently noncombustible, such as steel, concrete, masonry and glass, do not need to be tested.

Limited Combustible – materials or assemblies that meet one of the following criteria:

a) Are FM Approved as Class 1 based on an FM Approval Examination Standard

b) Has a potential heat value ≤ 3500 BTU/lb. per NFPA 259 and has a Flame Spread Index (FSI) ≤ 25 based on the ASTM E84 test

c) Has a potential heat value ≤ 3500 BTU/lb per NFPA 259, has a structural base of noncombustible material and a surfacing ≤ 1/8 in. (3.2 mm)thick and having a FSI ≤ 50 based on the ASTM E84 test

d) When tested to ASTM E2965 with an incident heat flux of 75 kW/m^2 for 20 minutes, has a peak heat release rate that does not exceed 150 kW/m^2 for longer than 10 seconds, and a total heat release not exceeding 8 MJ/m^2.

3.1.4 Hot Work

Sparks from hot work cause more construction fires than any other ignition source. It is essential to have the person in charge of loss prevention supervise these operations and make sure adequate precautions are taken.

At some locations, it may be unsafe to use a torch regardless of the precautions taken. Conditions may change abruptly; a cutting operation may be safe in the morning and hazardous that same afternoon because combustible materials have been moved into the area.

In some situations, such as where conveyor belts or combustible coated electrical cables are present below or adjacent to a welding operation, it is impractical to remove combustibles. Directly covering the equipment or materials might necessitate shutting down an important manufacturing operation. In such cases, an acceptable alternative may be to suspend an FM Approved welding pad below the welding area and above the exposed object or equipment or to place FM Approved welding curtains between adjacent areas.

For further information on this subject, refer to Data Sheet 10-3, *Hot Work Management*.

3.1.5 Construction Sheds

About as many fires have occurred in temporary construction sheds as in main buildings. Some fires have been unnecessarily large because sheds have been grouped closely together or because they exposed the main building under construction.

3.1.6 Equipment Storage

Arrange temporary storage of valuable and important equipment during construction in the following order of preference: (1) under sprinkler protection; (2) if no sprinklers, then subdivided in moderate amounts in noncombustible buildings; and (3) if in combustible, unsprinklered buildings, provided with watch service, fire hose and extinguishers, heated by safe methods, and separated from other ignition sources. Subdivision in (2) above can be by walls with noncombustible sheathing or by clear separation distances ≥ 50 ft (15 m). When space and storage is limited, closer separation can be tolerated as outlined in Section 2.0.

3.1.7 Material Storage and Use

Arrange the temporary storage of combustible construction materials in the same order of preference as described for equipment storage. Do not locate combustible storage in areas where specified fire-resistive coatings for structural steel have not been completed. Do not store foamed-plastic materials in buildings under construction unless protected by sprinklers and piled no higher than 5 ft (1.5 m).

3.1.8 Temporary Heaters

Provide safe temporary heaters. Unsafe heaters cause many construction fires.

Where steam is available, steam unit heaters are a desirable method of heating. Do not fire temporary heaters with scrap. Use safely arranged portable gas-fired (natural gas or propane), electric or kerosene heaters. Safeguards for compressed gases are given in Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage*. Place temporary heaters on a solid base so they will not overturn. Locate them away from

woodwork. Secure them if exposed to wind, and keep the floor around them free from all combustible material. Secure combustible material so wind does not blow it against heaters and cause ignition. Check temporary heaters to ensure they are turned off at the end of the work day. If intended for continuous operation, have the heaters checked at least hourly if watch service is provided.

Locate portable kerosene heaters with built-in fans to circulate heated air outside buildings under construction and far away from combustible material. Ensure a capable employee operates and maintains the heaters, following all safeguards recommended by the manufacturer. Locate a minimum 15 lb (6.8 kg) portable dry chemical extinguisher near all entrances to heated areas. Kerosene heaters are much safer than those burning gasoline, which are prohibited by some fire regulations and not recommended. Gas-fired, electric, or steam heaters are preferred.

3.1.9 Weather Enclosures

Use flame-resistant tarpaulins and plastic sheeting to enclose buildings temporarily, and fasten them securely to avoid their being blown against temporary heaters by the wind. One good arrangement is to provide vertical timbers spaced about 4 ft (1.2 m) on centers to serve as a rigid frame to which the tarpaulins or sheeting can be secured. Do not use tarpaulins that appear to have lost their fire-retardant qualities through leaching (i.e., if they look weathered). Ensure flame-resistant materials meet the requirements of ‘‘Test No. 2’’ as noted in NFPA 701.

3.1.10 Hose and Extinguishers

Provide adequate temporary fire protection. Order a supply of fire hose and nozzles in advance so they will be available as soon as hydrants are ready. Connect hose lines in areas where construction, alteration, or demolition is in progress. The use of fire hoses is preferred to fire extinguishers as the quantity, type, or arrangement of combustibles often lends itself to possible rapid firespread in which the capabilities of a typical fire extinguisher would be exceeded. Hoses can also be used for combustible dust control.

When the use of a hose is impractical, distribute ample hand-extinguisher equipment throughout the premises, including contractors’ buildings. The 15-20 lb (6.8-9.0 kg) multipurpose dry chemical extinguisher is recommended. Where low temperatures are possible, use extinguishers not subject to freezing. Ensure hydrants, hose connections and other fire-fighting equipment is readily accessible at all times and never blocked by construction materials.

If there is an unavoidable delay in the completion of yard mains and hydrants, it may be possible to provide limited protection with a garden hose supplied from the piping system that furnishes water for construction uses. Sometimes, a temporary fire pump can be installed.

For additional information on hoses/standpipes and extinguishers, refer to Data Sheets 4-4N, *Standpipe and Hose Systems (NFPA)*, and 4-5, *Portable Extinguishers*.

3.1.11 Watch Service

Besides the potential for fire damage, construction and demolition sites also are often targets for vandalism, incendiarism, and theft. The problem is magnified when the site is located in a high crime-rate urban area, when the building under construction is linked to social and/or political causes, or where there are labor disputes involving the trades employed in the construction/demolition. Yard storage is very vulnerable and needs to be enclosed by fencing and well lighted.

Provide watch service at night and during nonworking days as soon as new construction is started. For large and important construction projects, ensure recorded watch service rounds include all parts of the buildings and outside areas where there are hazardous equipment or materials. Conduct rounds every half-hour for two hours after suspension of work for the day, and every hour thereafter during nights and off days.

For additional information on watch service, refer to Data Sheet 9-1, *Supervision of Property*.

3.1.12 Ignitable Liquids Handling

Large quantities of paint, thinner, asphalt, gasoline, and tar may be used in the construction of a new building, and particularly with regard to roofing operations. Follow the same precautions for safe storage and handling that apply in the completed plant as nearly as practical (see Data Sheets 7-29, *Ignitable Liquid Storage in Portable Containers*, and 7-32, *Ignitable Liquid Operations*). Store hazardous liquids in a small detached

structure or in the open, not inside main buildings. Handle low-flashpoint liquids, such as gasoline and alcohol, in maximum 5 gal (20 L), FM Approved safety cans only. Keep delivery trucks carrying ignitable liquids outside buildings.

3.1.13 Wind

The number of wind losses to buildings under construction is approximately equal to the number of fire losses. Most wind damage at construction projects has involved masonry walls, roof coverings, framework, or forms.

Plan construction so framing is adequately braced and walls can be anchored to the building framework as soon as they are erected; otherwise, temporary shoring may be necessary as recommended in Section 2.0. Proper methods of roof application are extremely important, particularly on insulated steel-deck roofs. Do not store construction materials on a roof overnight since they can be blown away by moderate winds. Ensure roofing in construction is properly secured or weighted down at the close of the day's work to prevent damage to these materials and blockage of drains that may lead to collapse or roof leakage. Construction forms should be suitably secured. Bolt the steelwork securely enough to withstand a severe windstorm. Anchor roof-mounted equipment to the structure immediately after it is set on the roof. Take extra precautions whenever severe winds are predicted, and be prepared for sudden, unpredictable storms.

3.1.14 Buildings Under Construction

During construction, building elements such as the structural frame, walls, flashings, and roof coverings are vulnerable to wind action until permanently constructed or attached.

3.1.14.1 Structural Steel Frame

Structural beam-to-column connections during erection are frequently secured by only one or two bolts. This facilitates movement of the frame so it can later be plumbed. Until the remainder of the bolts are installed and tightened, the connections are not rigid enough to resist strong winds and the frame may be severely damaged unless it has been braced (Figure 3.1.14.1).

Courtesy of Dome Systems, Inc.

Fig. 3.1.14.1. Wind damage to steel frame. This framework is only one of many that did not have adequate cable bracing.

One form of simple structure consists of two columns supporting the ends of a beam or truss. A series of these structures tied together by longitudinal beams, such as girts on walls and purlins on the roof, make up the frame (skeleton) of the building. Erection of the first structure or frame is critical, as there is no other structure of similar kind to brace against. After the columns are bolted to the foundation, bracing the erected frame by temporary struts or cables will stabilize it and prevent it from being blown over by wind forces. Other braced frames placed at right angles to the first erected frame will stabilize the framework in the other direction.

The erecting contractor is responsible for installation of some type of bracing to prevent collapse during construction. Installation of bracing is facilitated when end-connecting plates (to which the bracing will be attached) have been shop welded to the steelwork. Cable bracing can be effectively tightened by jacks or turnbuckles and is needed only in a few of the total bays.

When any column line of the structural frame has permanent diagonal bracing, installation of the bracing members as the structure is erected will be sufficient to act as temporary bracing, providing the column base plates are securely bolted down, and the beams are connected to the tops of the columns. Some column lines, however, may not have permanent bracing; so temporary bracing is needed.

Buckling of a brace or other compression member may be prevented by designing the member according to specifications by the American Institute of Steel Construction (AISC) or comparable standard.

The AISC specifications limit the L/r ratio of steel braces to a maximum of 200, where L is the length of the brace in inches and r is the smallest radius of gyration for the brace, equal to (I/A)0.5 (I = the moment of inertia, A is the area of the section). The radius of gyration may be found in structural engineering handbooks. Table 3.1.14.1 gives acceptable minimum pipe diameters based upon the above specification.

Table 3.1.14.1. Permissible Minimum Diameters for Steel Pipe Braces

Length of Brace	*Nominal Diameter*
Up to 16 ft (4.88 m)	2-½ in. (64 mm)
16 to ‹20 ft (4.88 to 6.10 m)	3 in. (76 mm)
20 to ‹22 ft (6.10 to 6.71 m)	3-½ in. (89 mm)
22 to ‹25 ft (6.71 to 7.62 m)	4 in. (102 mm)

3.1.14.2 Precast Concrete Walls

Precast and tilt-up type concrete wall panels are supported at the bottom on the foundation wall and at the top by the structural roof. Each erected panel needs temporary shoring until the roof is completed and the panel top secured to it. Lean-to steel pipe braces are often used, and in some cases have buckled when they are too slender, resulting in damage to the panels.

3.1.14.3 Concrete Block Walls

Building contractors sometimes take extreme risks by laying up hollow masonry units (such as concrete blocks) 15 to 20 ft (4.57 to 6.10 m) without lateral support. The wall then acts as a cantilever, and having low-strength uncured mortar, can be blown over by moderate winds. When the building has a steel skeleton frame, erect the frame, and then attach the concrete blocks to the frame by steel straps. Forces on the masonry will then be transferred directly to the permanent steel frame.

Steel reinforcing placed vertically in concrete-filled cores will strengthen a hollow masonry wall under construction, provided the steel is anchored into the foundation wall, but usually not enough so that bracing may be eliminated. The bracing may be unnecessary if the wall has reinforced concrete pilasters specially designed with steel reinforcing to transfer the wind load to the foundation wall.

When the hollow masonry units are of sand or stone aggregate, an 8 in. (200 mm) unsupported wall may be built safely upward without bracing to a height of 8 ft (2.44 m) and a 12 in. (300 mm) wall to a height of 10 ft (3.0 m). Hollow masonry units of lightweight aggregate such as cinders or slag have less stability. Safe heights without bracing are about two-thirds that for sand and stone aggregate masonry units.

Unless a wall is attached or has built-in resistance, bracing will be needed after it is built to its safe unsupported height. Once braced, the wall may be built up above the braces an equivalent distance, then

braced at that level. The process can be continued until the wall is finished. The compression force in the brace needs to be transferred to both the ground and masonry wall. Bracing is normally placed at about 30 degrees with the vertical.

3.1.14.4 Bracing Procedure

The bracing system shown in Figure 1 is capable of resisting winds of approximately 55 mph (24 m/s) from either direction.

Anchor two ¾ in. (19 mm) steel eye bolts, one on each side, in the concrete foundation wall every 16 ft (4.9 m). It is extremely important that the bolts and braces are installed directly opposite each other. If the anchors were not installed when the wall was poured, holes can be drilled through the wall for 1 in. (25 mm) diameter through bolts.

After the pair of braces is erected, install the cables on both sides and tighten simultaneously. This will create a compression force in the braces that will seat the ground timbers and also stabilize the braces. If the timbers settle an inch (25 mm) or more, shims or blocking installed at the base of the brace may be necessary to prevent the top of the brace from moving significantly downward on the wall.

Ensure spacing of both upper and lower braces is 32 ft (9.8 m). Place the upper braces halfway between the lower braces.

3.1.14.5 Roof Perimeter Flashing

This acts as a weather closure between the building wall and roof covering. The edge of the covering is protected from wind and rain by the flashing. Loss investigations have revealed many cases in which the covering had been installed long before the flashing, and intervening winds rolled back the unprotected edge.

3.1.15 Concrete Shell Structures

Older concrete shell structures were generally built with conventional formwork and rebar. Those types of structures have not been a major concern during construction (other than as noted in Section 2.0). In many cases, the construction of concrete shell structures initially uses a membrane, which is air-supported during the construction stage only, and polyurethane foam and concrete, which are spray-applied to the underside of the membrane. Loss experience is favorable for completed structures; however, some losses have occurred (not insured by FM) during construction.

These structures are popular in the agricultural industry in lieu of tanks and silos and are also being used for housing, recreational buildings, water tanks, shopping malls, and other occupancies where large column-free areas are desired.

Usually, a coated fabric membrane is inflated with air and polyurethane foam is sprayed on the inside surface in layers.

After the polyurethane foam has set, concrete (Gunite) is sprayed in stages onto the inside of the polyurethane foam. The fabric can either be removed and an FM Approved weather-resistant coating sprayed on top of the polyurethane foam, or the fabric can remain and, if necessary, be supplemented with a weather-resistant coating.

Arches can be formed for door openings or shell-to-shell connections by spraying polyurethane foam and Gunite up to the arch and later cutting away the coated fabric membrane.

A thorough and even covering of polyurethane foam over the inside surface of the membrane is necessary to prevent delamination and collapse. The proper density of polyurethane foam is also critical. A density of 2 to 3 lb/ft^3 (32 to 48 kg/m^3) is generally recommended. Lesser densities may cause structural problems and greater densities may adversely affect fire-spread across the top surface. Maintenance of proper air pressure during construction is necessary to prevent collapse until the concrete is strong enough to support itself. Air pressure depends upon the size of the structure and various material properties. The designer must specify the air pressure needed.

The shell sizes can be categorized as small (less than 80 ft [25 m] in diameter), medium (80 to 150 ft [25 to 45 m] in diameter), and large (over 150 ft [45 m] in diameter).

When conventional steel reinforcing bar (rebar) is used, employ caution during concrete spraying to prevent voids.

Ensure interior partitions are self-supporting and not rigidly attached to the shell. Any restraint caused by such attachment could result in cracking when thermal expansion of the shell occurs.

3.1.16 Excavation

Excavation adjacent to buildings has caused losses. In some cases, walls have collapsed due to the loss of stability provided by the adjacent soil. Where large ditches are to be excavated next to a structure, have a civil or structural engineer ensure that either the excavation will not adversely affect the structure or that adequate temporary bracing is provided. Ditches, particularly those dug for piping entering the adjacent building, can allow rainwater to enter the building, damaging it and its contents. Take precautions to prevent a loss due to rainwater that would directly enter the ditch or run off into the ditch and enter the building.

4.0 REFERENCES

4.1 FM

Data Sheet 1-1, *Firesafe Building Construction and Materials*
Data Sheet 1-2, *Earthquakes*
Data Sheet 1-3, *High-Rise Buildings*
Data Sheet 1-4, *Fire Tests*
Data Sheet 1-10, *Interaction of Sprinklers, Smoke and Heat Vents, and Draft Curtains*
Data Sheet 1-12, *Ceilings and Concealed Spaces*
Data Sheet 1-13, *Chimneys*
Data Sheet 1-15, *Roof Mounted Solar Photovoltaic Panels*
Data Sheet 1-17, *Reflective Ceiling Insulation*
Data Sheet 1-20, *Protection Against Exterior Fire Exposure*
Data Sheet 1-21, *Fire Resistance of Building Assemblies*
Data Sheet 1-22, *Maximum Foreseeable Loss*
Data Sheet 1-24, *Protection Against Liquid Damage*
Data Sheet 1-28, *Wind Design*
Data Sheet 1-29, *Steel Deck Securement and Above-Deck Roof Components*
Data Sheet 1-30, *Repair of Wind Damaged Single and Multi-Ply Roof Systems*
Data Sheet 1-31, *Panel Roof Systems*
Data Sheet 1-32, *Inspection and Maintenance of Roof Assemblies Data Sheet 1-33, Safeguarding Torch-Applied Roof Insulation*
Data Sheet 1-34, *Hail*
Data Sheet 1-36, *Mass Engineered Timber*
Data Sheet 1-40, *Flood*
Data Sheet 1-42, *MFL Limiting Factors*
Data Sheet 1-44, *Damage-Limiting Construction*
Data Sheet 1-49, *Perimeter Flashing*
Data Sheet 1-54, *Roof Loads and Drainage*
Data Sheet 1-57, *Plastics in Construction*
Data Sheet 1-59, *Fabric and Membrane Structures*
Data Sheet 1-60, *Asphalt-Coated/Protected Metal Buildings*
Data Sheet 1-61, *Fire-Retardant Treated Wood*
Data Sheet 1-62, *Cranes*
Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*
Data Sheet 3-26, *Fire Protection for Nonstorage Occupancies*
Data Sheet 4-4N, *Standpipe and Hose Systems*
Data Sheet 4-5, *Portable Extinguishers*
Data Sheet 7-28, *Energetic Materials*
Data Sheet 7-29, *Ignitable Liquid Storage in Portable Containers*
Data Sheet 7-32, *Ignitable Liquid Operations*
Data Sheet 7-50, *Compressed Gases in Portable Cylinders and Bulk Storage*
Data Sheet 7-78, *Industrial Exhaust Systems*
Data Sheet 7-83, *Drainage Systems for Ignitable Liquids*
Data Sheet 9-1, *Supervision of Property*
Data Sheet 9-19, *Wildland Fire*
Data Sheet 10-3, *Hot Work Management*

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4.1.1 FM Approvals

Approval Guide, an on-line publication of FM Approvals

ANSI/FM 4950, *American National Standard for Evaluating Welding Pads, Welding Blankets and Welding Curtains for Hot Work Operations*

FM 4652 Examination Standard for Debris Barriers

Roof*Nav*, an on-line resource of FM Approvals

4.2 NFPA Standards

NFPA 70, *National Electric Code*, 2023

NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations, 2022*

NFPA 259, *Standard Test Method for Potential Heat of Building Materials*, 2018

NFPA 701, *Standard Method of Fire Tests for Flame Propagation of Textiles and Films*, 2019

Note: For locations outside the United States, reference comparable international standards.

4.3 Other Standards

American Iron and Steel Institute (AISC): ANSI/AISC 303-22, *An American National Standard Code of Standard Practice for Steel Buildings and Bridges*, 2022

American Society of Civil Engineers: ASCE 37, *Design Loads on Structures During Construction*, 2014 (R-2019)

American Society of Testing and Materials:

ASTM E-84-23a, *Standard Test Methods for Surface Burning Characteristics of Building Materials*

ASTM E-108-20a, *Standard Test Methods for Fire Tests of Roof Coverings*

ASTM E 119—20, *Method for Fire Tests of Building Construction and Materials*

ASTM E 136—22, *Standard Test Method for Assessing Combustibility of Materials in a Vertical Tube Furnace at 750°C*

ASTM E 605/E605M-19, *Standard Test Methods for Thickness and Density of Sprayed Fire-Resistive Material Applied to Structural Members*

ASTM E 736/E736M—19, *Test Method for Cohesion/Adhesion of Sprayed Fire-Resistive Materials Applied to Structural Members*

ASTM E 759/E759M—92 (2020), *Test Method for Effect of Deflection of Sprayed Fire-Resistive Material Applied to Structural Members* (**Note:** Laboratory test for SFRM applied to the underside of roof decks and structural members)

ASTM E 760/E760M-92 (2020), *Test Method for Effect of Impact on Bonding of Sprayed Fire-Resistive Material Applied to Structural Members* (**Note:** Laboratory test for SFRM applied to the underside of roof decks and structural members)

ASTM E 761/E761M-92 (2020), *Test Method for Compressive Strength of Sprayed Fire-Resistive Material Applied to Structural Members* (**Note:**) Laboratory procedure

ASTM E 859/E859M—93 (2020), *Test Method for Air Erosion of Sprayed Fire-Resistive Materials Applied to Structural Members* (**Note:** Laboratory procedure)

ASTM E2652 – *Standard Test Method for Assessing Combustibility of Materials Using a Tube Furnace and a Cone-shaped Airflow Stabilizer at 750°C*

ASTM E2965 – *Standard Test Method for Determining Low Levels of Heat Release Rate for Materials and Products Using an Oxygen Consumption Calorimeter*

APA: The Engineered Wood Association, APA System Report SR-102E, *APA Simplified Wall Bracing Method Using Wood Structural Panel Continuous Sheathing*, April 2020

National Concrete Masonry Association (NCMA)

TEK 03-04C, *Bracing Concrete Masonry Walls Under Construction*, revised 2014

Occupational Health and Safety Association (OSHA),

OSHA Title 29, *Code of Federal Regulations*, Standard 1926.704

Precast/Prestressed Concrete Institute (PCI), *Precast Insulated Sandwich Panels*, (FIB-84-17)

Note: For locations outside the United States, reference comparable international standards.

APPENDIX A GLOSSARY OF TERMS

Fire-Resistive Construction: Consists of materials that will withstand fire and limit heat transmission for the rated period without structural failure.

FM Approved: reference to ‘‘FM Approved’’ in this data sheet means the product or service has satisfied the criteria for Approval by FM Approvals. Refer to the *Approval Guide*, a publication of FM Approvals, for a complete list of products and services that are FM Approved.

Hotwork: Any work involving burning, welding, or similar operation that is capable of initiating fires or explosions, including cutting, welding, brazing, soldering, grinding, thermal spraying, thermal welding, thawing pipe, torch-applied roofing, or any other similar activity.

Limited-Combustible Construction: Consists of materials that will not release sufficient fuel to allow a self-propagating fire. See also Section 3.1.3.

Mass Engineered Timber Construction: Engineered wood meeting minimum sizes established by codes and regulations. Generally, the minimum component size is 6 in. (150 mm) in width and 8 in. (200 mm) in depth.

Noncombustible Construction: Consists of materials that will not allow for a self-propagating fire, contribute a negligible amount of fuel but are not necessarily fire resistive. See also Section 3.1.3.

Plank-On-Timber Construction: Also known as ‘‘heavy timber’’, ‘‘mill’’ or ‘‘slow-burning construction’’. It consists of large wood members. This differs from mass timber construction in that the timbers are a solid piece of wood from a very large tree, whereas mass timbers are multiple layers of wood that have been glued or laminated together.

APPENDIX B DOCUMENT REVISION HISTORY

The purpose of this appendix is to capture the changes that were made to this document each time it was published. Please note that section numbers refer specifically to those in the version published on the date shown (i.e., the section numbers are not always the same from version to version).

July 2023. Interim revision. The following changes were made:

A. Referenced data sheets that should be applied in site selection and building design.

B. Added guidance for the use of FM Approved debris barriers.

C. Referenced ASCE 37 for temporary design loads during construction.

D. Expanded guidance for bracing building framework during construction and sequencing construction connections and braces, including references to association documents for specific construction types.

E. Added guidance regarding the use of noncombustible or limited combustible construction materials.

January 2020. Interim revision. Minor editorial chages were made.

April 2012. Terminology related to ignitable liquids has been revised to provide increased clarity and consistency with regard to FM Global’s loss prevention recommendations for ignitable liquid hazards.

May 2010. Replaced all references to Data Sheet 2-8N, *Installation of Sprinkler Systems (NFPA)*, with references to Data Sheet 2-0, *Installation Guidelines for Automatic Sprinklers*.

May 2009. A slight revision to recommendation 2.1.1.3 was made.

January 2007. Correction was made to Appendix B, Document Revision History.

January 2006. Added information on FM Approved welding pads, blankets, and curtains for use during hot work activities. Added wall bracing guidelines, previously published in obsolete Data Sheet 1-7.

September 2001. Changes were made to Recommendation 2.1.1.2. Hot Work Permit forms were updated.

January 2000. This revision of the document has been reorganized to provide a consistent format.

January 1999. The term "cutting and welding" was changed to the more inclusive *hot work*. The new Hot Work Permit has been included, as well as a new recommendation for contractor supervision.

APPENDIX C COMPARISON WITH NFPA STANDARDS

NFPA 241, *Safeguarding Construction, Alteration, and Demolition Operations*, is similar to this data sheet.

Criteria for spacing combustible sheds from main building areas are slightly different.

Data Sheet 1-0 also covers natural hazards.

NFPA 241 does not address concrete shell structures, as potential problems relating to their construction are mostly structural and not fire-related. In some other areas, NFPA 241 contains additional details, including a section on torch-applied roofing that is in general agreement with Data Sheet 1-33, *Safeguarding Torch-Applied Roof Installations.*