# NFPA® 520

# Standard on Subterranean Spaces

# 2010 Edition

NFPA, 1 Batterymarch Park, Quincy, MA 02169-7471
An International Codes and Standards Organization

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**NFPA® 520**

**Standard on**

# Subterranean Spaces

**2010 Edition**

This edition of NFPA 520, *Standard on Subterranean Spaces,* was prepared by the Technical Committee on Subterranean Spaces. It was issued by the Standards Council on October 27, 2009, with an effective date of December 5, 2009, and supersedes all previous editions.

This edition of NFPA 520 was approved as an American National Standard on December 5, 2009.

## Origin and Development of NFPA 520

In 1993, a symposium was convened by the United States Fire Administration to examine the problem of fire in subterranean spaces that have been converted for commercial use. The symposium was the result of a fire in a developed subterranean space in Kansas City, Kansas, that burned from December 1991 to April 1992. The symposium examined several unique fire and life safety issues that exist in subterranean spaces, including means of egress issues such as orientation and excessive travel distances, poor ventilation, communication difficulties, and nontraditional behavior of fire. The result was a recommendation to the National Fire Protection Association to develop a standard that addresses fire and life safety in these occupancies.

For the 2005 edition, the committee made only minor revisions to the document by adding some definitions, clarifying some provisions that users had found unclear, and expanding several concepts that had been found to work well.

The committee has found that NFPA 520 has generally been an effective document over the past 15 years. For the 2010 edition, the committee again made only minor revisions, revising two definitions with appropriate extracts from other documents and clarifying the provisions of three subsections.

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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 safeguarding life and property against fire, explosion, and related hazards associated with occupancies located in subterranean spaces not addressed by other documents.

## Contents

# NFPA 520

## Standard on

# Subterranean Spaces

## 2010 Edition

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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 Annex A.

Changes other than editorial are indicated by a vertical rule beside the paragraph, table, or figure in which the change occurred. These rules are included as an aid to the user in identifying changes from the previous edition. Where one or more complete paragraphs have been deleted, the deletion is indicated by a bullet (•) between the paragraphs that remain.

A reference in brackets [ ] following a section or paragraph indicates material that has been extracted from another NFPA document. As an aid to the user, the complete title and edition of the source documents for extracts in mandatory sections of the document are given in Chapter 2 and those for extracts in informational sections are given in Annex C. Extracted text may be edited for consistency and style and may include the revision of internal paragraph references and other references as appropriate. Requests for interpretations or revisions of extracted text shall be sent to the technical committee responsible for the source document.

Information on referenced publications can be found in Chapter 2 and Annex C.

## Chapter 1 Administration

**1.1* Scope.**

**1.1.1** This standard addresses the safeguarding of life and property against fire, explosion, and related hazards associated with developed subterranean spaces.

**1.1.2** This standard does not cover the following types of subterranean spaces:

(1) Tourist caverns
(2) Wine storage caverns
(3) Gas and oil storage reservoirs
(4) Hazardous waste repositories
(5) Utility installations such as pump stations
(6) Working mines
(7) Transportation and pedestrian tunnels
(8) Aboveground buildings with belowground stories
(9) Cut and cover underground structures specifically addressed in the building code

**1.2 Purpose.** The purpose of this standard is to provide minimum requirements for the design, operation, and maintenance of developed subterranean spaces for safety to life and property from fire and similar hazards.

**1.3 Application.**

**1.3.1 General.**

**1.3.1.1** The requirements of this standard apply to newly developed subterranean spaces.

**1.3.1.2** Where specifically noted, this standard also applies to existing facilities.

**1.3.2* Modifications, Remodeling, and Additions.** Where modifications are made, remodeling is done, or additional space is created in an existing developed subterranean space, the requirements of this standard apply to those modifications, remodeling, or additions.

**1.4 Retroactivity.** When requirements of this standard apply to existing subterranean spaces, a limited but reasonable time shall be allowed for compliance that is commensurate with the magnitude of the expenditure, the disruption of services, and the degree of hazard.

**1.5 Equivalency.** Nothing in this standard is intended to prevent the use of systems, methods, or devices of equivalent or superior quality, strength, fire resistance, effectiveness, durability, and safety as alternatives to those prescribed by this standard, provided sufficient technical documentation is submitted to the authority having jurisdiction to demonstrate the system, method, or device is approved for the intended purpose and is equivalent.

## Chapter 2 Referenced Publications

**2.1 General.** The documents or portions thereof listed in this chapter are referenced within this standard and shall be considered part of the requirements of this document.

**2.2 NFPA Publications.** National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA 10, *Standard for Portable Fire Extinguishers,* 2010 edition.

NFPA 13, *Standard for the Installation of Sprinkler Systems,* 2010 edition.

NFPA 14, *Standard for the Installation of Standpipe and Hose Systems,* 2010 edition.

NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection,* 2010 edition.

NFPA 22, *Standard for Water Tanks for Private Fire Protection,* 2008 edition.

NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances,* 2010 edition.

NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems,* 2008 edition.

*NFPA 70®, National Electrical Code®,* 2008 edition.

*NFPA 72®, National Fire Alarm and Signaling Code,* 2010 edition.

NFPA 80, *Standard for Fire Doors and Other Opening Protectives,* 2010 edition.

NFPA *101®, Life Safety Code®,* 2009 edition.

NFPA 110, *Standard for Emergency and Standby Power Systems,* 2010 edition.

NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems,* 2010 edition.

NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls,* 2009 edition.

NFPA 600, *Standard on Industrial Fire Brigades,* 2010 edition.

**2.3 Other Publications.**

**2.3.1 ASTM Publications.** ASTM International, 100 Barr Harbor Drive, P.O. Box C700, West Conshohocken, PA 19428-2959.

ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, 2009.

**2.3.2 Other Publications.**

*Merriam-Webster's Collegiate Dictionary*, 11th edition, Merriam-Webster, Inc., Springfield, MA, 2003.

**2.4 References for Extracts in Mandatory Sections.**

*NFPA 72®, National Fire Alarm and Signaling Code,* 2010 edition.

*NFPA 5000®, Building Construction and Safety Code®,* 2009 edition.

## Chapter 3 Definitions

**3.1 General.** The definitions contained in this chapter shall apply to the terms used in this standard. Where terms are not defined in this chapter or within another chapter, they shall be defined using their ordinarily accepted meanings within the context in which they are used. *Merriam-Webster's Collegiate Dictionary*, 11th edition, shall be the source for the ordinarily accepted meaning.

**3.2 NFPA Official Definitions.**

**3.2.1* Approved.** Acceptable to the authority having jurisdiction.

**3.2.2* Authority Having Jurisdiction (AHJ).** An organization, office, or individual responsible for enforcing the requirements of a code or standard, or for approving equipment, materials, an installation, or a procedure.

**3.2.3* Listed.** Equipment, materials, or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintains periodic inspection of production of listed equipment or materials or periodic evaluation of services, and whose listing states that either the equipment, material, or service meets appropriate designated standards or has been tested and found suitable for a specified purpose.

**3.2.4 Shall.** Indicates a mandatory requirement.

**3.2.5 Should.** Indicates a recommendation or that which is advised but not required.

**3.2.6 Standard.** A document, the main text of which contains only mandatory provisions using the word "shall" to indicate requirements and which is in a form generally suitable for mandatory reference by another standard or code or for adoption into law. Nonmandatory provisions shall be located in an appendix or annex, footnote, or fine-print note and are not to be considered a part of the requirements of a standard.

**3.3 General Definitions.**

**3.3.1 Building.** An area of the subterranean space that is separated from the common space or the undeveloped space by fire-resistive construction.

**3.3.2 Control Area.** An area within a building for storage and use of high-hazard materials.

**3.3.3 Exit Passageway.** An enclosed passageway that leads from the subterranean space to the exterior public way.

**3.3.4 Exterior Building Wall.** The rock surface or constructed wall that separates a building in the subterranean space from the remainder of the space.

**3.3.5 Fire Command Center.** The principal attended or unattended location where the status of the detection, alarm communications, and control systems is displayed and from which the system(s) can be manually controlled. [**72**, 2010] (SIG-PRO)

**3.3.6 Floor Area.**

**3.3.6.1** ***Gross Floor Area.*** The floor area within the inside perimeter of the outside walls of the building under consideration with no deduction for hallways, stairs, closets, and thickness of interior walls, columns, or other features. Where the term *area* is used elsewhere in this standard, it shall be understood to be gross floor area unless otherwise specified.

**3.3.6.2** ***Net Floor Area.*** The gross floor area minus the area of support columns.

**3.3.7 Hazard.**

**3.3.7.1** ***High Hazard.*** Contents that are likely to burn with extreme rapidity or from which explosions are likely.

**3.3.7.2** ***Low Hazard.*** Contents of such low combustibility that no self-propagating fire therein can occur.

**3.3.7.3** ***Ordinary Hazard.*** Contents that are likely to burn with moderate rapidity or to give off a considerable volume of smoke.

**3.3.8 Noncombustible Material.** A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion, or release flammable vapors, when subjected to fire or heat. Materials that are reported as passing ASTM E 136, *Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C*, shall be considered noncombustible materials. [**5000,** 2009]

**3.3.9 Parking Area.** An area used for parking of occupant vehicles that is not intended to serve as storage of vehicles.

**3.3.10 Portal.** A horizontal roadway or pedestrian entry to or exit from the subterranean space.

**3.3.11 Roadway.** Any passageway within the subterranean space intended for use by motor vehicles or by pedestrian traffic.

**3.3.11.1** ***Fire Department Vehicle Roadway.*** Any major thoroughfare designated for fire department apparatus.

**3.3.12 Roof.** The rock overlying the subterranean space together with any structural reinforcement in the form of rock bolts, a surface layer of shotcrete, and/or other reinforcement.

**3.3.13 Subterranean Space.** A cavern resulting from the extraction of subsurface-located material from underground areas in a manner that the surface area of the property is not disturbed except in the vicinity of the entrances and ventilation openings.

**3.3.13.1** ***Developed Space.*** An area of the subterranean space that has been altered for the use of advanced industrial capability, technological sophistication, or economic productivity.

**3.3.13.1.1** ***Common Space.*** The area of the developed subterranean space other than buildings, including but not limited to roadways, railways, loading docks, and entrances.

**3.3.13.2** ***Undeveloped Space.*** Subterranean space that has been mined but has not been altered for the use of advanced industrial capability, technological sophistication, or economic productivity.

## Chapter 4 Construction Features

**4.1 Occupancy in Subterranean Spaces.**

**4.1.1 General.** The following occupancies shall be allowed within new and existing buildings:

(1) Assembly
(2) Business
(3) Educational
(4) Detention and correctional
(5) Health care
(6) Residential
(7) Board and care
(8) Industrial
(9) Mercantile
(10) Storage

**4.1.2 Special Occupancy Requirements.** In addition to the requirements contained herein, assembly, educational, detention and correctional, health care, and residential occupancies shall comply with the provisions of NFPA *101*, *Life Safety Code*.

**4.1.3 Storage and Use of High-Hazard Materials.**

**4.1.3.1** Occupancies that contain materials that are within the maximum quantities specified in Table 4.1.3.1(a), Table 4.1.3.1(b), and Table 4.1.3.1(c) shall be permitted.

**4.1.3.1.1** The aggregate quantity in use and storage shall not exceed the quantity listed for storage in Table 4.1.3.1(a), Table 4.1.3.1(b), and Table 4.1.3.1(c).

**4.1.3.1.2** The quantities of alcoholic beverages in retail sales uses shall be unlimited provided the liquids are packaged in individual containers not exceeding 1 gal (4 L).

**4.1.3.1.3** The quantities of medicines, foodstuffs, and cosmetics containing not more than 50 percent of volume of water-miscible liquids with the remainder of the solutions not being flammable shall be unlimited in retail sales or storage occupancies when packaged in individual containers not exceeding 1 gal (4 L).

**4.1.3.1.4** Quantities of gaseous and liquefied flammable gases and flammable solids shall be permitted to be increased 100 percent in accordance with Table 4.1.3.1(a), Table 4.1.3.1(b), and Table 4.1.3.1(c) in sprinklered buildings.

**4.1.3.1.4.1** When 4.1.3.1.5 also applies, the increase for 4.1.3.1.4 and 4.1.3.1.5 shall be permitted to be applied.

**4.1.3.1.5** Quantities shall be permitted to be increased 100 percent in accordance with Table 4.1.3.1(a), Table 4.1.3.1(b), and Table 4.1.3.1(c) when stored in approved storage cabinets, gas cabinets, or exhausted enclosures.

**4.1.3.1.5.1** When 4.1.3.1.4 also applies, the increase for 4.1.3.1.4 and 4.1.3.1.5 shall be permitted to be applied.

**4.1.3.1.6** The quantities of Class III-B combustible liquids permitted in a sprinklered building shall not be limited.

**4.1.3.2** The storage and use of high-hazard materials not covered by Table 4.1.3.1(a), Table 4.1.3.1(b), and Table 4.1.3.1(c) shall be permitted when approved by the authority having jurisdiction.

**4.1.3.3** Flammable and combustible liquids necessary for emergency power generation and other emergency equipment shall be permitted in accordance with 4.4.3.

**4.1.4 Control Areas.** Control areas shall be constructed in accordance with this subsection.

**4.1.4.1** Control areas shall be protected with a fire suppression system that is adequate to suppress fires of the material being stored and/or used and is installed in accordance with the applicable NFPA standard.

**4.1.4.2** Control areas shall be separated from each other and all other areas by a wall with at least a 2-hour fire resistance rating.

**4.1.4.2.1** The number of control areas within a building used for retail or wholesale sales shall not exceed two.

**4.1.4.2.2** The number of control areas in buildings with other uses shall not exceed four.

**4.1.4.3 Construction of Areas Containing High-Hazard Liquids.**

**4.1.4.3.1 Floors.** The floor of these areas shall be noncombustible, liquidtight construction.

**4.1.4.3.2 Sills.** All areas shall be recessed a minimum of 4 in. (10 cm) or shall be provided with a liquidtight, raised sill with a minimum height of 4 in. (10 cm) to prevent the flow of liquids to adjoining areas.

**4.1.4.3.2.1** Except for surfacing, the sill shall be constructed of noncombustible material and the liquidtight seal shall be compatible with the material being stored.

**4.1.4.3.2.2** When liquidtight sills are provided, they shall be permitted to be omitted at door openings by the installation of an open-grate trench that connects to an approved drainage system.

**4.1.4.3.3 Drainage System.** All areas shall be provided with a drainage system to direct the flow of liquids to an approved location, or the rooms, buildings, or areas shall be designed to provide secondary containment for the high-hazard materials and fire protection water.

**4.1.4.3.3.1** Drains from the areas shall be sized to carry the sprinkler system design flow rate over the sprinkler system design area.

**4.1.4.3.3.2** The slope of drains shall not be less than 1 percent.

**4.1.4.3.3.3** Construction materials for the drainage system shall be compatible with the stored materials.

**4.1.4.3.3.4** Incompatible materials shall be separated from each other in the drainage system, except when or unless they have been rendered acceptable for discharge by an approved means into the public sewer.

**4.1.4.3.3.5** Drainage of high-hazard materials and fire protection water directed to a neutralizer or treatment system shall comply with 4.1.4.3.3.5(A) and 4.1.4.3.3.5(B).

**Table 4.1.3.1(a) Maximum Quantity of High-Hazard Material in Storage[a] per Control Area[b]**

| | | Solid | | Liquid | | Gas | |
|---|---|---|---|---|---|---|---|
| **Material** | **Class** | **lb** | **kg** | **gal** | **L** | **ft³** | **m³** |
| Combustible liquid[c,d] | II | | | 120[e] | 454 | | |
| | III-A | | | 330[e] | 1,249 | | |
| | III-B | | | 13,200[e,f] | 49,963 | | |
| Combustible fiber | | | | | | | |
| Loose | | 100 ft³ | 2.8 m³ | | | | |
| Baled | | 1,000 ft³ | 28 m³ | | | | |
| Explosives | | 1[e] | 0.454 | 1 lb[e] | 0.454 kg | | |
| Flammable solid | | 125[d,e] | 56 | | | | |
| Flammable gas | | | | | | | |
| Gaseous | | | | | | 750[d,e] | 21.2 |
| Liquefied | | | | 15[d,e] | 56.7 | | |
| Flammable liquid[c,d] | I-A | | | 30[e] | 113.5 | | |
| | I-B | | | 60[e] | 227 | | |
| | I-C | | | 90[e] | 340.7 | | |
| Combination | | | | | | | |
| I-A, I-B, I-C | | | | 120[e] | 454 | | |

[a] See 4.1.3.1.1.
[b] See 4.1.4.2.
[c] See 4.1.3.1.2 and 4.1.3.1.3.
[d] See 4.1.3.1.4.
[e] See 4.1.3.1.5.
[f] See 4.1.3.1.6.

**Table 4.1.3.1(b) Maximum Quantity of High-Hazard Material in Use[a] in Closed Systems per Control Area[b]**

| | | Solid | | Liquid | | Gas | |
|---|---|---|---|---|---|---|---|
| **Material** | **Class** | **lb** | **kg** | **gal** | **L** | **ft³** | **m³** |
| Combustible liquid[c,d] | II | | | 120 | 454 | | |
| | III-A | | | 330 | 1,249 | | |
| | III-B | | | 13,200[f] | 49,963 | | |
| Combustible fiber | | | | | | | |
| Loose | | 100 ft³ | 2.8 m³ | | | | |
| Baled | | 1,000 ft³ | 28 m³ | | | | |
| Explosives | | 0.25 | 0.114 | 0.25 lb | 0.114 kg | | |
| Flammable solid | | | | | | | |
| Flammable gas | | | | | | | |
| Gaseous | | | | | | 750[d,e] | 21.2 |
| Liquefied | | | | 15[d,e] | 56.7 | | |
| Flammable liquid[c,d] | I-A | | | 30 | 113.5 | | |
| | I-B | | | 60 | 227 | | |
| | I-C | | | 90 | 340.7 | | |
| Combination | | | | | | | |
| I-A, I-B, I-C | | | | 120 | 454 | | |

[a] See 4.1.3.1.1.
[b] See 4.1.4.2.
[c] See 4.1.3.1.2 and 4.1.3.1.3.
[d] See 4.1.3.1.4.
[e] See 4.1.3.1.5.
[f] See 4.1.3.1.6.

**Table 4.1.3.1(c) Maximum Quantity of High-Hazard Material in Use[a] in Open Systems per Control Area[b]**

| | | Solid | | Liquid | |
|---|---|---|---|---|---|
| **Material** | **Class** | **lb** | **kg** | **gal** | **L** |
| Combustible liquid[c,d] | II | | | 30 | 113.5 |
| | III-A | | | 80 | 303 |
| | III-B | | | 3,300[e] | 12,490 |
| Combustible fiber | | | | | |
| Loose | | 20 $ft^3$ | 0.56 $m^3$ | | |
| Baled | | 200 $ft^3$ | 5.6 $m^3$ | | |
| Explosives | | 0.25 | 0.114 | 0.25 lb | 0.114 kg |
| Flammable solid | | | | | |
| Flammable gas | | | | | |
| Gaseous | | | | | |
| Liquefied | | | | | |
| Flammable liquid[c,d] | I-A | | | 10 | 37.8 |
| | I-B | | | 15 | 56.7 |
| | I-C | | | 20 | 75.7 |
| Combination | | | | | |
| I-A, I-B, I-C | | | | 30 | 113.5 |

[a] See 4.1.3.1.1.
[b] See 4.1.4.2.
[c] See 4.1.3.1.2 and 4.1.3.1.3.
[d] See 4.1.3.1.4.
[e] See 4.1.3.1.6.

**(A)** The neutralizer or treatment system shall be designed to handle the maximum worst-case spill from the single largest container plus the volume of fire protection water from the sprinkler system over the minimum design area for a period of 20 minutes.

**(B)** Overflow from the neutralizer or treatment system shall be provided to direct high-hazard materials and fire protection water to a safe location away from the area or building, material or fire protection control valve, means of egress, or other building or fire department vehicle roadway.

**4.1.4.3.4 Containment System.** All drains in the area shall be directed to a containment system or other location designed as secondary containment for the high-hazard materials and fire protection water for the building, room, or area.

**4.1.4.3.4.1** The containment system shall be designed to provide secondary containment of high-hazard materials and fire protection water through the use of recessed floors or liquidtight raised sills.

**4.1.4.3.4.2** Secondary containment shall be designed to retain the spill from the largest single container plus the design flow rate of the sprinkler systems, or the areas of the room, or areas in which the storage is located, or the sprinkler system design area, whichever is smallest.

**4.1.4.3.4.3** The containment capacity shall be capable of containing the flow for 20 minutes.

**4.1.4.3.4.4** Overflow from the secondary containment system shall be provided to direct high-hazard materials and fire protection water to a safe location away from the area or building, material or fire protection control valve, means of egress, or other building or fire department vehicle roadway.

**4.1.4.3.4.5** When secondary containment is required, a monitoring method capable of detecting high-hazard material leakage from the primary containment into the secondary containment shall be provided.

**4.1.4.3.4.6** When visual inspection of the primary containment is impractical, other approved means of monitoring shall be permitted to be provided.

**4.1.4.3.4.7** When secondary containment can be subject to the intrusion of water, a monitoring method for such water shall be provided.

**4.1.4.3.4.8** Whenever monitoring devices are provided, they shall be connected to distinct visual or audible alarms.

**4.2 Compartmentation Requirements.**

**4.2.1** Developed subterranean spaces shall be compartmented in accordance with 4.2.2.

**4.2.2** Walls separating buildings from common spaces shall be of construction with at least a 2-hour fire resistance rating.

**4.2.2.1** Glass partitions shall be permitted to be used to separate an enclosed lobby or office area from the common space provided they meet the following:

(1) The lobby or office area is low hazard.
(2) The lobby or office area is separated from the remainder of the tenant space by a wall with at least a 2-hour fire resistance rating.

**4.2.3** Walls separating buildings shall be of construction with at least a 2-hour fire resistance rating.

**4.2.4** Buildings shall be subdivided by walls with at least a 2-hour fire resistance rating into areas no larger than 360,000 net $ft^2$ (33,444 $m^2$).

**4.2.5** Walls constructed with a fire resistance rating shall be installed in accordance with NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*.

**4.2.6** Opening protection shall be installed in accordance with NFPA 80, *Standard for Fire Doors and Other Opening Protectives*.

**4.2.7** Wall penetrations for pipes, conduits, bus ducts, cables, wires, air ducts, pneumatic tubes and ducts, and similar building service equipment that penetrate exterior building walls as described in Section 4.2 shall be protected in accordance with NFPA 221, *Standard for High Challenge Fire Walls, Fire Walls, and Fire Barrier Walls*.

**4.2.8** Noncombustible materials shall be used in the construction of all new walls, fixed partitions, insulation, ceilings, and floors.

**4.2.9** Fire-retardant coating on otherwise combustible construction materials shall not be permitted.

**4.3 Interior Finish.** All new wall and ceiling finishes, along with movable partitions, shall conform to the requirements of Chapter 10 of NFPA *101*, *Life Safety Code*.

**4.4 Electrical Installations.**

**4.4.1** All new electrical and data communications cable shall comply with the requirements of *NFPA 70, National Electrical Code*.

**4.4.2** Nonmetallic conduit to address environmental conditions within common spaces shall be permitted.

**4.4.3** Rooms used to store equipment for standby or emergency power generation shall be separated from the remainder of the subterranean space by walls with at least a 2-hour fire resistance rating.

**4.5 Control of Smoke Spread.**

**4.5.1*** The movement of smoke between buildings and between buildings and common spaces shall be minimized in accordance with Section 4.5.

**4.5.1.1*** Exterior building walls as described in Section 4.2 shall be continuous from exterior wall to exterior wall and from floor to roof, including continuity through all concealed spaces, and shall provide an approved means of control of smoke spread.

**4.5.1.2** Where pillars are used, the pillar shall be considered part of the exterior wall.

**4.5.1.3** Interior smoke barriers required for specific occupancies by NFPA *101*, *Life Safety Code*, shall be provided in accordance with Section 8.5 of NFPA *101*.

**4.5.2** Doors in exterior building walls as described in Section 4.2 shall be in accordance with NFPA 80, *Standard for Fire Doors and Other Opening Protectives*, and shall be without undercuts, louvers, or grilles.

**4.5.3** Dampers and air-transfer openings penetrating exterior building walls as described in Section 4.2 shall close upon activation by an approved heat detection system, a fusible link, or an approved smoke detection system within the ducts.

## Chapter 5 Means of Egress

**5.1 Means of Egress Within the Building.**

**5.1.1** Means of egress for new and existing buildings within the subterranean space shall be in accordance with the applicable occupancy chapter of NFPA *101*, *Life Safety Code*.

**5.1.2** For the purposes of this standard, once the common space is reached, the provisions of NFPA *101*, *Life Safety Code*, shall no longer apply.

**5.1.3** Means of egress for new and existing assembly, health care, board and care, and residential occupancies shall comply with the requirements of Chapter 10 of NFPA *101*, *Life Safety Code*, and the specific occupancy chapters of NFPA *101*, both within the building and in the common space.

**5.2 Means of Egress from the Common Space.**

**5.2.1** At least two separate means of egress to the exterior from new and existing subterranean spaces shall be provided.

**5.2.2** Required exits from the subterranean space shall be separated by a distance of at least 300 ft (91 m).

**5.2.2.1** Means of egress required to be separate shall not be connected by communicating passageways, roadways, and so forth, of less than 300 ft (91 m) in length.

**5.2.2.2** Connecting passageways, roadways, and so forth, shall be permitted to be less than 300 ft (91 m) where an approved method of smoke control is provided.

**5.2.3*** The travel distance to a portal, a refuge area, or the entrance to an exit passageway system shall be not more than 2000 ft (610 m).

**5.2.4** When the occupant load exceeds 5000, a third exit leading to the exterior of the subterranean space shall be provided.

**5.3 Occupant Load Determination.** The number of occupants for exit width calculations from the common space shall be based on either 150 percent of the highest occupant load of a building or 2000 $ft^2$ (186 $m^2$) per person net floor area, whichever is greater.

**5.4* Egress Capacity.**

**5.4.1** The egress width within the common space shall be based on 0.2 in. (0.5 cm) per person for level travel and 0.3 in. (0.8 cm) per person for travel on stairs, based on the occupant load determined in Section 5.3.

**5.4.2** Where a specific, approved life safety evaluation of the space is provided, the egress width shall be permitted to be modified.

**5.5 Exit Doors.** Any door in a required means of egress within the common space shall be operable from the inside without the use of a key or special knowledge or effort.

**5.6 Illumination in Common Spaces.**

**5.6.1** Means of egress within the common space shall have illumination providing a minimum of 1 foot-candle (10 lx) measured at the floor level at each hydrant location.

**5.6.2** Where the line of sight between hydrants is not possible, additional points of illumination shall be provided.

**5.6.3** Means of egress within the common space shall have emergency lighting complying with Section 7.9 of NFPA *101*, *Life Safety Code*, powered by a standby power supply that provides power for a minimum duration of 1½ hours.

**5.7 Marking.**

**5.7.1** All means of egress within the subterranean space shall be identified for general traffic direction and emergency purposes by signage in reflective lettering that is at least 4 in. (10 cm) high with ½ in. (1.3 cm) wide stroke.

**5.7.2** Every other pillar adjacent to roadways and railways shall be identified by name, letter, or number with a large direction arrow associated with the word EXIT in letters not less than 6 in. (15.2 cm) high with ¾ in. (1.9 cm) wide stroke pointing in the direction of nearest exit from the subterranean space.

**5.7.3 Maps.**

**5.7.3.1** All street identification and exit routing within subterranean spaces shall be shown on maps that are available to all persons using the facility, posted in all buildings, and made available to police, fire, and all other agencies with emergency jurisdiction.

**5.7.3.2** Maps shall be updated to reflect changes on an annual basis.

**5.8* Refuge Areas.**

**5.8.1** One or more refuge areas or exit passageways shall be provided in new and existing subterranean spaces where the travel distance from any building exit to the exterior of the subterranean space exceeds 2000 ft (610 m).

**5.8.2 Criteria.**

**5.8.2.1** Each refuge area shall provide 10 $ft^2$ (0.9 $m^2$) of floor area for each person it is intended to serve.

**5.8.2.2 Engineered Fresh Air System.**

**5.8.2.2.1** Each refuge area shall have an engineered fresh air system that provides fresh air through a borehole from the surface during a fire emergency.

**5.8.2.2.2** Air quantity shall be either at least 20 scfm (standard cubic feet per minute) (944 L/s) per person or the minimum required to prevent smoke infiltration, whichever is greater.

**5.8.2.3** Areas of refuge shall be provided with positive pressure of 0.05 in./wg (inches/water gauge) (12.5 Pa) relative to the adjacent space.

**5.8.2.4** Entrance and exit from the refuge area shall be through a vestibule equipped with doors that have self-closing devices.

**5.8.2.5** Refuge areas shall be provided with food, drinking water, emergency lighting, blankets, toilet facilities, and first-aid kits in quantities appropriate to the intended usage.

**5.8.2.6** Two-way voice communications to the fire command center shall be provided.

**5.8.2.7** Areas of refuge shall be separated from the remainder of the subterranean space by walls with at least a 2-hour fire resistance rating.

**5.8.3** Refuge areas shall be permitted to be used during normal operations for other purposes provided that they are always available for refuge purposes.

**5.8.4** The surface borehole shall be permitted to be an exhaust ventilation shaft provided that the direction of airflow can be reversed during an emergency by controls located in the refuge area.

**5.9 Exit Passageway.**

**5.9.1** An exit passageway or exit enclosure shall be separated from the remainder of the space by walls with at least a 1-hour fire resistance rating.

**5.9.2** An exit passageway or exit enclosure shall be supplied with outside air sufficient to provide positive pressure of 0.05 in./wg (12.5 Pa) relative to the adjacent subterranean space.

**5.9.3** Openings other than required exits from normally occupied building spaces and common spaces shall not be permitted.

**5.9.4** Penetrations other than ducts, sprinkler piping, and electrical conduit serving the exit passageway shall not be permitted.

**5.9.5** The width of an exit passageway shall be adequate to accommodate the aggregate required capacity of all exits discharging through it, but in no case shall be less than 44 in. (112 cm).

## Chapter 6 Fire Alarm, Detection, and Suppression Systems

**6.1 Fire Alarm Systems.**

**6.1.1 General.** A fire alarm system shall be provided in each newly developed subterranean space.

**6.1.1.1** A fire alarm system shall be provided in the portion of the common space used as the sole means of egress.

**6.1.1.2** Where required, the fire alarm system shall be installed and maintained in accordance with *NFPA 72, National Fire Alarm and Signaling Code.*

**6.1.2 Initiation.**

**6.1.2.1** Initiation shall be by manual means or by any required automatic fire detection or suppression system.

**6.1.2.2** Buildings without fire suppression systems or fire detection systems that are required to have a fire alarm system shall be provided with manual initiation in accordance with *NFPA 72, National Fire Alarm and Signaling Code.*

**6.1.2.3** An automatic fire detection system shall be installed in a new building, including loading docks, unless such areas are provided with an automatic suppression system.

**6.1.3 Notification.**

**6.1.3.1** Notification of the fire alarm system shall be by general alarm throughout a building or space.

**6.1.3.1.1*** Where total evacuation of occupants is impractical due to the configuration of the building, only the occupants in the affected zones shall be initially notified.

**6.1.3.1.2** Provisions shall be made to selectively notify occupants in other zones to afford orderly evacuation of the entire building.

**6.1.3.2** The fire alarm system shall transmit an alarm signal to the fire command center.

**6.1.4* Fire Command Center.** A fire command center shall be located near the entrance of the subterranean space unless the facility maintains a 24-hour interior structural fire brigade meeting the requirements of NFPA 600, *Standard on Industrial Fire Brigades.*

**6.1.4.1** An annunciator panel shall be provided.

**6.1.4.2** Audible and visual signals shall be provided for each zone.

**6.1.4.3** An approved map of the subterranean space shall be located at or near the annunciator panel.

**6.1.4.4** The map shall identify, by letter, name, or number, each pillar adjacent to a roadway or railway, each building, or tenant space.

**6.2 Sprinkler Systems.**

**6.2.1** A sprinkler system shall be provided throughout all developed areas of new and existing subterranean space except in the following areas:

(1) Existing freezer storage areas
(2) Common space in which roadways, railways, and parking areas are not the sole means of egress from any building of the subterranean space
(3) Areas protected by other approved fire suppression systems designed and installed in accordance with the applicable NFPA standard

**6.2.2** Required sprinkler systems shall be installed in accordance with NFPA 13, *Standard for the Installation of Sprinkler Systems*.

**6.3 Standpipe Systems.**

**6.3.1** All nonsprinklered parking areas in new subterranean spaces with travel distances greater than 500 ft (152 m) from the nearest fire hydrant shall be protected by a Class I standpipe system.

**6.3.2** All nonsprinklered parking areas in existing subterranean spaces that are not accessible by fire department apparatus shall be protected by a Class I standpipe system.

**6.3.3** All nonsprinklered railways in new and existing subterranean spaces that are used as a required means of egress and that have travel distances greater than 500 ft (152 m) from the nearest fire hydrant shall be protected by a Class I standpipe system.

**6.3.4** All nonsprinklered freezer areas in existing subterranean spaces shall be served by exterior hydrants with travel distances not greater than 500 ft (152 m) to the most remote portion of the freezer or shall be protected by a Class I standpipe system.

**6.3.5** Where required, standpipes shall be installed in accordance with NFPA 14, *Standard for the Installation of Standpipe and Hose Systems*.

**6.4 Water Supply.**

**6.4.1** All new and existing subterranean spaces shall be provided with an adequate and reliable water supply as approved by the authority having jurisdiction.

**6.4.2** Fire hydrants shall be located along developed roadways and roadways serving building-type construction at not more than 500 ft (152 m) intervals or as necessary to protect all accessible exterior building areas.

**6.4.3** Fire protection equipment and systems, where required, shall be installed in accordance with NFPA 24, *Standard for the Installation of Private Fire Service Mains and Their Appurtenances*; NFPA 22, *Standard for Water Tanks for Private Fire Protection*; and NFPA 20, *Standard for the Installation of Stationary Pumps for Fire Protection*.

**6.5 Maintenance.**

**6.5.1** All water-based extinguishing systems shall be maintained in accordance with NFPA 25, *Standard for the Inspection, Testing, and Maintenance of Water-Based Fire Protection Systems*.

**6.5.2** Where flow testing of systems or equipment is impractical, an alternative means of testing shall be permitted as approved by the authority having jurisdiction.

**6.6 Emergency Power.**

**6.6.1** For power loads classified as emergency power, the transition time from the instant of failure of the normal power source to an alternative power source shall not exceed 10 seconds.

**6.6.2** Where required, the following shall be classified as emergency power loads:

(1) Fire detection systems
(2) Fire alarm systems
(3) Exit sign illumination
(4) Emergency lighting
(5) Fire command center lighting

**6.7 Standby Power.**

**6.7.1** For power loads classified as standby power, the transition time from the instant of failure of the normal power source to an alternative power source shall not exceed 60 seconds unless there is an approved secondary, independent source of power in accordance with Article 700, Part III, of *NFPA 70, National Electrical Code*.

**6.7.2** Where required, the following shall be classified as standby power loads:

(1) Electric-driven fire pumps
(2) Mechanical air-handling systems and smoke control systems for all areas of refuge and exit passageways
(3) Standby lighting required for areas of refuge and smoke control mechanical equipment rooms
(4) Two-way communications systems

**6.8 Alternative Power Supplies.**

**6.8.1** The alternative power supply for emergency and standby power systems shall be designed and installed in accordance with NFPA 110, *Standard for Emergency and Standby Power Systems*, and NFPA 111, *Standard on Stored Electrical Energy Emergency and Standby Power Systems*.

**6.8.2** The alternative power supply shall be capable of providing power for a minimum of 1½ hours for emergency power systems and 4 hours for standby power systems.

## Chapter 7 Emergency Preparedness

**7.1 Emergency Action Plan.**

**7.1.1** The owner or the owner's representative of new and existing subterranean spaces shall establish, implement, and maintain an emergency action plan acceptable to the authority having jurisdiction.

**7.1.2** An emergency action plan shall include but not be limited to the following:

(1) A procedure to be used to communicate an alarm
(2) A procedure to be used to evacuate or relocate all building occupants
(3) A procedure to be used to conduct fire and evacuation drills and to account for all personnel
(4) A procedure for emergency control of the ventilation system
(5) A procedure for traffic control during emergencies

(6) A designated method of distribution of the plan to all personnel
(7) The method and frequency of revising the plan

**7.2 Breathing Apparatus.**

**7.2.1** Where required by the authority having jurisdiction, the owner shall supply on-site self-contained breathing apparatus and necessary equipment for the use of emergency response personnel.

**7.2.2** The location of the equipment shall be approved by the authority having jurisdiction.

**7.3 Fire Exit Drills.**

**7.3.1** Fire exit drills for new and existing subterranean spaces and new and existing building spaces shall be conducted at least annually.

**7.3.2** Each building tenant shall conduct additional drills at frequencies prescribed by NFPA *101, Life Safety Code*.

**7.3.3** The drill procedure for the subterranean space shall include but not be limited to the following:

(1) Activation of alarm communication procedures described in the emergency action plan, including notification of building occupants
(2) Evacuation of building occupants to the exterior of the subterranean space or a designated location
(3) Prior notification of the annual test to the authority having jurisdiction

**7.3.4** A written record of such drills shall be kept on the premises for 3 years and shall be readily available for inspection by the authority having jurisdiction.

**7.4 Fire Extinguishers.** Portable fire extinguishers shall be provided throughout all buildings according to the requirements of NFPA 10, *Standard for Portable Fire Extinguishers*.

## Chapter 8 Fire Department Provisions

**8.1 Communications.** The owner or the owner's representative of new and existing subterranean spaces shall provide an approved communications system for use by emergency personnel.

**8.1.1** The communications system shall be capable of communication throughout all developed spaces and shall provide communication with the fire command center.

**8.1.1.1** In existing subterranean spaces, alternative communications systems that are acceptable to the authority having jurisdiction shall be permitted.

**8.1.1.2** A subterranean space provided with a fire fighter's phone system throughout shall be permitted.

**8.1.2** Phone locations shall be at a minimum at each of the required hydrants.

**8.2* Pre-Fire Planning.** The owner or the owner's representative of new and existing subterranean spaces shall establish and maintain a written emergency response plan to be coordinated with the local emergency responders.

**8.3* Fire Department Access.** Inaccessible or dead-end fire department vehicle access roadways shall be identified or marked as approved by the authority having jurisdiction.

## Annex A Explanatory Material

*Annex A is not a part of the requirements of this NFPA document but is included for informational purposes only. This annex contains explanatory material, numbered to correspond with the applicable text paragraphs.*

**A.1.1** This standard's primary focus is to safeguard life and property against fire and related hazards. Other safety concerns such as structural adequacy, plumbing, and mechanical system design, including environmental conditions, are beyond the scope of this standard. These issues are considered important, and additional requirements are expected to be enforced by the authority having jurisdiction. Where no authority having jurisdiction exists, the owner or operator should include due consideration of these items.

**A.1.3.2** Change of a tenant does not necessarily constitute a change of occupancy. If the type of occupancy, such as storage, does not change with change of ownership or tenant, the requirements of new construction might not apply.

**A.3.2.1 Approved.** The National Fire Protection Association does not approve, inspect, or certify any installations, procedures, equipment, or materials; nor does it approve or evaluate testing laboratories. In determining the acceptability of installations, procedures, equipment, or materials, the authority having jurisdiction may base acceptance on compliance with NFPA or other appropriate standards. In the absence of such standards, said authority may require evidence of proper installation, procedure, or use. The authority having jurisdiction may also refer to the listings or labeling practices of an organization that is concerned with product evaluations and is thus in a position to determine compliance with appropriate standards for the current production of listed items.

**A.3.2.2 Authority Having Jurisdiction (AHJ).** The phrase "authority having jurisdiction," or its acronym AHJ, is used in NFPA documents in a broad manner, since jurisdictions and approval agencies vary, as do their responsibilities. Where public safety is primary, the authority having jurisdiction may be a federal, state, local, or other regional department or individual such as a fire chief; fire marshal; chief of a fire prevention bureau, labor department, or health department; building official; electrical inspector; or others having statutory authority. For insurance purposes, an insurance inspection department, rating bureau, or other insurance company representative may be the authority having jurisdiction. In many circumstances, the property owner or his or her designated agent assumes the role of the authority having jurisdiction; at government installations, the commanding officer or departmental official may be the authority having jurisdiction.

**A.3.2.3 Listed.** The means for identifying listed equipment may vary for each organization concerned with product evaluation; some organizations do not recognize equipment as listed unless it is also labeled. The authority having jurisdiction should utilize the system employed by the listing organization to identify a listed product.

**A.4.5.1** This section is not intended to require a smoke barrier between buildings and between the buildings and the common space that is compliant with NFPA *101, Life Safety Code*. It is intended only to minimize the amount of smoke movement between the buildings and between the buildings and the common space.

**A.4.5.1.1** These are walls with a 2-hour fire resistance rating that separate building spaces from common spaces and are intended to provide a moderate level of smoke protection. Requirements of a fire-resistive wall provide an acceptable level of smoke resistance. As an example, required smoke/fire dampers in such walls can close upon fusible link or heat detection.

**A.5.2.3** Travel distance within a building is under the jurisdiction of NFPA *101, Life Safety Code*. The 2000 ft (610 m) travel distance was more reasonable than other existing guidelines, which range from 2640 ft to 3500 ft (805 m to 1067 m). The travel distance was established based on the compartmentation of the subterranean space, which permits the moving away from a fire or smoke hazard when entering the common space.

**A.5.4** When measuring the egress width in roadways or railways, the minimum egress width should not include the required width for vehicle traffic or railway vehicles.

A life safety evaluation is a written review dealing with the adequacy of life safety features relative to fire and behavior and of the related safety considerations. This review should be done by a person acceptable to the authority having jurisdiction. Such an evaluation includes, for example, a documented case that shows that products of combustion in all conceivable but reasonable fire scenarios will not significantly endanger occupants using means of egress in the facility (e.g., because of fire detection, automatic suppression, smoke control, large volume space, or management procedures). Moreover, means of egress facilities plus facility management capabilities should be adequate to cope with scenarios where certain egress routes are blocked for some reason.

In addition to making realistic assumptions about the capabilities of persons in the facility (e.g., an assembled crowd that includes many persons with disabilities or persons unfamiliar with the facility), the life safety evaluation should include a safety factor of at least 2 in all calculations relating hazard development time and required egress time (the combination of flow time and other time needed to detect and assess an emergency condition, initiate egress, and move along the egress routes). This safety factor takes into account the possibility that half of the egress routes cannot be used (or are unusable) in certain situations.

**A.5.8** It is the intent of NFPA 520 to provide refuge areas in large facilities where travel distances to exits would exceed 2000 ft (610 m). These refuge areas are different from "areas of refuge" for persons with extreme mobility impairments as required in NFPA *101, Life Safety Code*.

In NFPA *101*, an "area of refuge" is required to provide a safe haven for an individual with severe mobility impairment to await fire department rescue.

In NFPA 520, a "refuge area" is permitted to serve as a safe haven for all people in a subterranean space when evacuation from the space is not possible.

**A.6.1.3.1.1** In order to approve an evacuation plan to selectively notify building occupants, the authority having jurisdiction should consider several building parameters, including building compartmentation, detection and suppression system zones, occupant loads, and the number and arrangement of the means of egress.

**A.6.1.4** The fire command center can serve as a guard room, security office, or manager's office.

**A.8.2** A pre-fire plan should contain the following:

(1) Identification of tenant
(2) Types of occupancies within the subterranean space
(3) Commodity classification
(4) Hazard content
(5) Location of fire command center
(6) Location of fire department connections
(7) Location of utility shutoffs
(8) Map of the subterranean space
(9) Any other information required by the authority having jurisdiction
(10) Emergency contacts and telephone numbers

**A.8.3** Consideration should be given to vehicle turning radius, dead-end conditions, and turnarounds.

## Annex B Diagrams of Subterranean Spaces

*This annex is not a part of the requirements of this NFPA document but is included for informational purposes only.*

**B.1** Figure B.1(a) through Figure B.1(d) illustrate the different spaces that are identified in this standard.

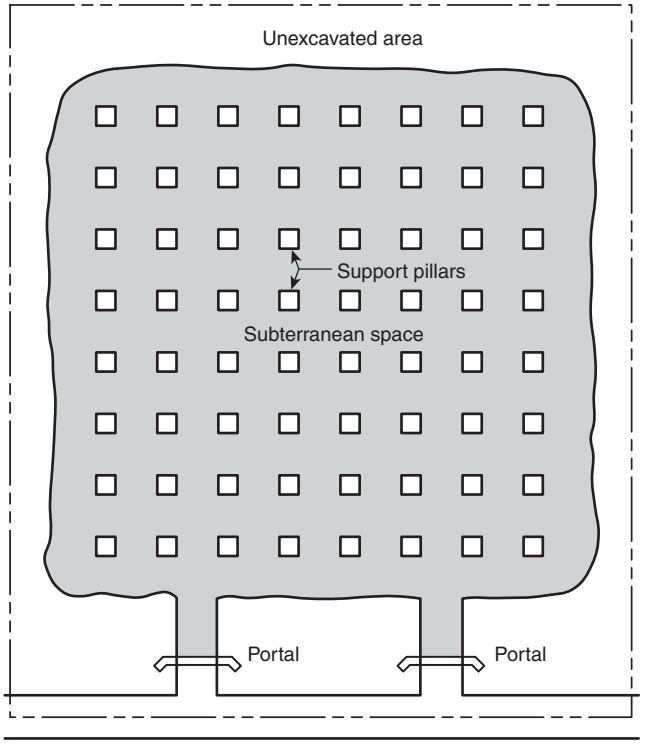


**FIGURE B.1(a) Subterranean Space.**

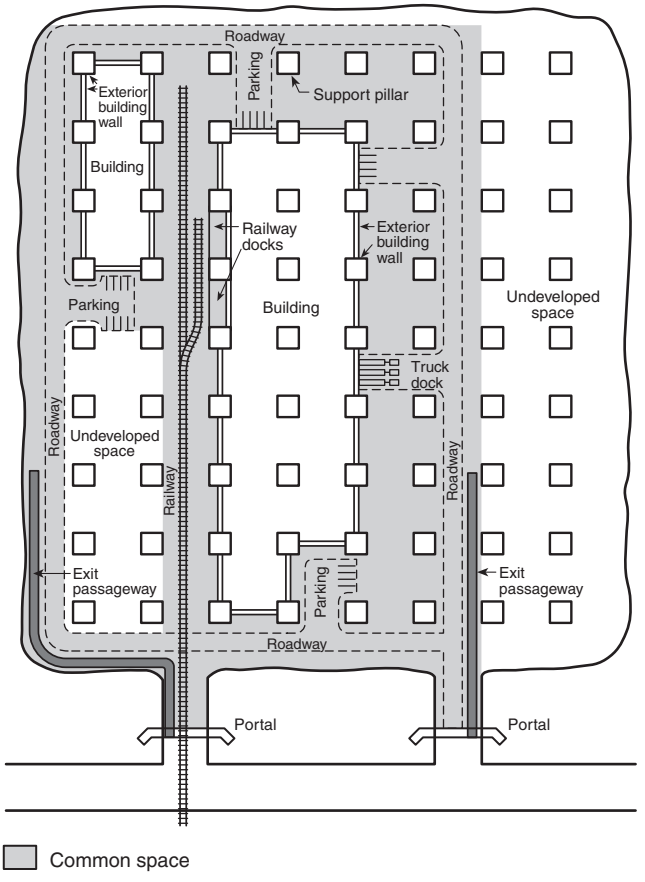


**FIGURE B.1(b) Common Space.**

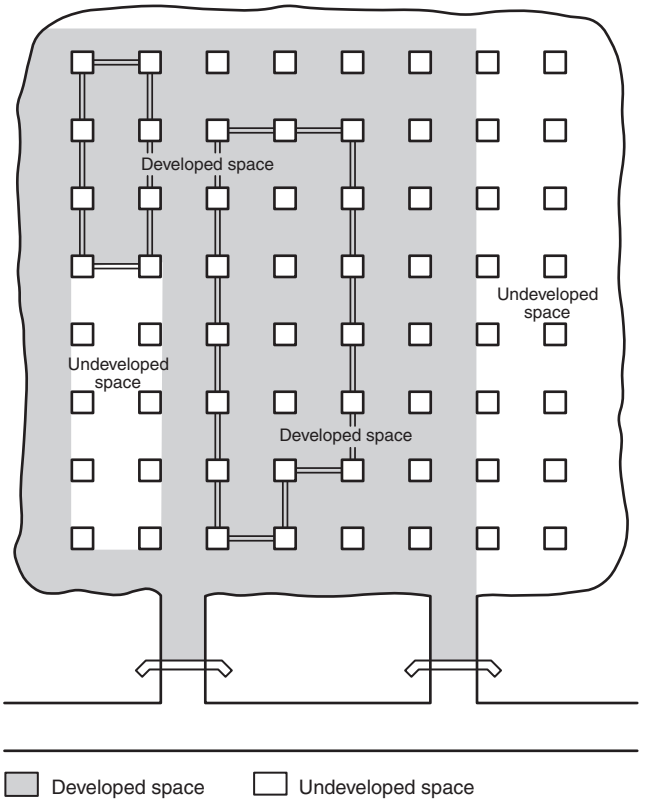


**FIGURE B.1(c) Developed and Undeveloped Spaces.**

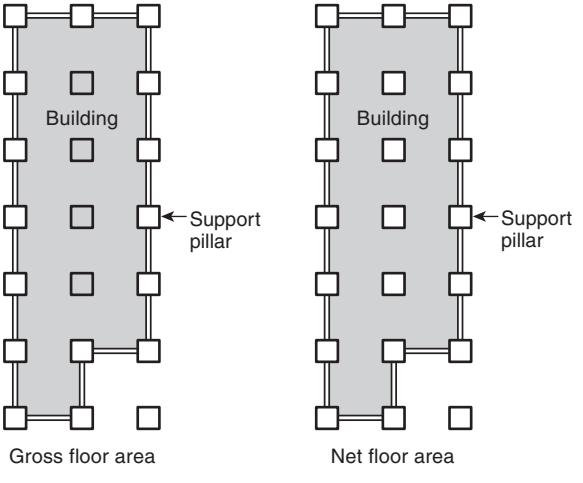


**FIGURE B.1(d) Gross and Net Floor Areas.**

## Annex C Informational References

**C.1 Referenced Publications.** The documents or portions thereof listed in this annex are referenced within the informational sections of this standard and are not part of the requirements of this document unless also listed in Chapter 2 for other reasons.

**C.1.1 NFPA Publication.** National Fire Protection Association, 1 Batterymarch Park, Quincy, MA 02169-7471.

NFPA *101®*, *Life Safety Code®*, 2009 edition.

**C.2 Informational References. (Reserved)**

**C.3 References for Extracts in Informational Sections. (Reserved)**

## Index

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