ORIGINAL

BELLSOUTH TELECOMMUNICATIONS, INC.

DIRECT TESTIMONY OF W. KEITH MILNER

BEFORE THE FLORIDA PUBLIC SERVICE COMMISSION

DOCKET NOS. 981834-TP and 990321-TP

October 28, 1999

Q. PLEASE STATE YOUR NAME, ADDRESS, AND POSITION WITH BELLSOUTH TELECOMMUNICATIONS, INC.

A. My name is W. Keith Milner. My business address is 675 West Peachtree Street, Atlanta, Georgia 30375. I am Senior Director - Interconnection Services for BellSouth Telecommunications, Inc. ("BellSouth"). I have served in my present role since February 1996 and have been involved with the management of certain issues related to local interconnection, resale, and unbundling.

Q. PLEASE SUMMARIZE YOUR BACKGROUND AND EXPERIENCE.

A. My business career spans over 29 years and includes responsibilities in the areas of network planning, engineering, training, administration, and operations. I have held positions of responsibility with a local exchange telephone company, a long distance company, and a research and development laboratory. I have extensive experience in all phases of telecommunications network planning, deployment, and operation

(including research and development) in both the domestic and international arenas.

I graduated from Fayetteville Technical Institute in Fayetteville, North Carolina in 1970 with an Associate of Applied Science in Business Administration degree. I also graduated from Georgia State University in 1992 with a Master of Business Administration degree.

Q. HAVE YOU TESTIFIED PREVIOUSLY BEFORE ANY STATE PUBLIC SERVICE COMMISSION? IF SO, BRIEFLY DESCRIBE THE SUBJECT OF YOUR TESTIMONY.

A. I testified before the state Public Service Commissions in Alabama, Florida, Georgia, Kentucky, Louisiana, Mississippi, South Carolina, the Tennessee Regulatory Authority, and the Utilities Commission in North Carolina on the issues of technical capabilities of the switching and facilities network regarding the introduction of new service offerings, expanded calling areas, unbundling, and network interconnection.

Q. PLEASE DESCRIBE THE PURPOSE AND ORGANIZATION OF YOUR TESTIMONY BEING FILED TODAY?

A. My testimony will address collocation issues identified by the Florida Public Service Commission's Staff resulting from the Competitive Carrier's and ACI Corporation's petitions for a generic collocation proceeding and

establishment of procedures and consolidation of Docket Nos. 981834-TP and 990321-TP. Specifically, I will address issues 3-4, 9-12, 16, and 20.

Q. WHAT IS BELLSOUTH'S BASIC POSITION REGARDING THE ISSUES DISCUSSED BETWEEN BELLSOUTH AND PARTIES OF RECORD IN THIS PROCEEDING REGARDING COLLOCATION?

A. Because the overall purpose of the 1996 Act is to open telecommunications markets to competition, facilities, such as collocation, are available as a result of the obligations imposed upon BellSouth under Sections 251 and 252 and as a result of the FCC's Order and this Commission's orders in the arbitration proceedings between BellSouth and certain Alternative Local Exchange Carriers (ALECs). BellSouth has worked in good faith to fulfill its obligations. BellSouth stands ready to provide all of the items in both its interconnection agreements and collocation agreements with ALECs.

Q. PLEASE SUMMARIZE THE COLLOCATION REQUIREMENTS PLACED ON INCUMBENT LOCAL EXCHANGE CARRIERS ("ILECs") BY THE TELECOMMUNICATIONS ACT OF 1996 ("ACT").

A. Section 251(c)(6) of the Act establishes "The duty to provide, on rates, terms, and conditions that are just, reasonable, and nondiscriminatory, for physical collocation of equipment necessary for interconnection or access to unbundled network elements at the premises of the local exchange

carrier, except that the carrier may provide for virtual collocation if the local exchange carrier demonstrates to the State commission that physical collocation is not practical for technical reasons or because of space limitations."

Q. PLEASE SUMMARIZE THE PHYSICAL COLLOCATION REQUIREMENTS THE FCC PLACED ON ILECs IN FCC's FIRST REPORT AND ORDER 96-325.

A. Generally, the FCC's First Report and Order 96-325 requires Incumbent Local Exchange Carriers (ILECs) to:

1. Offer physical collocation, with the collocator paying for central office floorspace.
2. Provide space to interested parties on a first-come first-served basis.
3. Provide virtual collocation when space for physical collocation is exhausted.

Q. DOES BELLSOUTH MEET EACH OF THESE REQUIREMENTS?

A. Yes. First, as of September 21, 1999, in Florida, BellSouth had provisioned 208 physical collocation arrangements with an additional 167 in progress and has provisioned 113 virtual collocation arrangements with an additional 24 in progress. Elsewhere across BellSouth's nine-state region during this same time, 419 physical collocation arrangements were provisioned with an additional 409 in progress and 277 virtual collocation

arrangements were provisioned with an additional 46 in progress. BellSouth offers collocation at the same cost-based rates as this Commission determined at an earlier arbitration. Second, BellSouth's policy is to offer space on a first-come, first-served basis. Third, BellSouth offers virtual collocation as a collocator's first choice rather than only when space for physical collocation is exhausted. In other words, a collocator may request and BellSouth will provide virtual collocation even in those BellSouth central offices which can accommodate physical collocation because space is not exhausted. Thus, BellSouth has met all the requirements set out in the FCC's First Report and Order.

Q. PLEASE SUMMARIZE THE COLLOCATION REQUIREMENTS THE FCC PLACED ON ILECs IN ITS RECENT ORDER FCC 99-48 ISSUED MARCH 31, 1999.

A. In its Order, the FCC placed new requirements on incumbent LECs. These new requirements include the following:

- Allow shared cage collocation.
- Allow "cageless" collocation.
- When space is not available for physical collocation, allow collocation in adjacent Controlled Environmental Vaults (CEVs) and similar structures to the extent technically feasible.
- Allow collocation of all types of equipment used or useful for interconnection or access to unbundled network elements (UNEs).
- Allow requesting parties to tour central offices after having been

informed that space is not available to accommodate request for physical collocation.

- Provide lists of central offices within which no space is available for physical collocation.
- Remove obsolete, unused (retired) equipment in order to accommodate requests for physical collocation.
- Allow a collocator access to its equipment with the same level of security as that of an ILEC.
- Allow a collocator direct access to its equipment without the requirement for a physical separation between the collocator's equipment and the equipment of other collocators or the equipment of the ILEC.
- Allow a collocator to place as little as a single rack of equipment in its collocation arrangement.
- Allow any other collocation arrangement that has been made available by another ILEC unless the ILEC rebuts before the State commission the presumption that such an arrangement is technically feasible.

Q. DOES BELLSOUTH MEET EACH OF THESE REQUIREMENTS?

A. **Yes.** In the following paragraphs, I discuss each of the collocation issues identified in this proceeding, and I will explain how BellSouth's policies are consistent with the requirements of the FCC's Order.

Q. WHO DETERMINES WHERE IN THE BELLSOUTH CENTRAL OFFICE A

GIVEN COLLOCATOR'S ARRANGEMENT IS PLACED?

A. BellSouth will assign space to an ALEC within the central office, as opposed to allowing the ALEC to simply select space in a potentially inefficient manner. The FCC's Order made clear that the intent underlying the new collocation rules is to allow ALECs access to collocation space without artificially increasing their costs or delaying their time of entry. BellSouth interprets the rule to continue to permit ILECs to establish reasonable space assignments within a central office to ensure that space is efficiently used consistent with this intent.

Q. WHAT FACTORS ARE CONSIDERED BY BELLSOUTH IN ASSIGNING SPACE WITHIN THE CENTRAL OFFICE?

A. There are numerous technical factors that must be considered in determining where within a BellSouth central office physical collocation of an ALEC's equipment should occur such as:

- **Overall cable length**: Cable congestion and related expense can be avoided or at least minimized by careful consideration of existing and future equipment requirements of both the collocating ALEC and others that have or will later collocated there. Orderly equipment growth, *i.e.*, grouping like equipment together, allows economic efficiencies while reducing excessive cable rack congestion and resultant re-routing of cables.

- **Distance between related equipment**: Some equipment components, *e.g.*, switch call processors, must be placed so that cable length between the components does not exceed a pre-determined amount.
- **Grouping of equipment into families of equipment**: Families of equipment, *e.g.*, switching equipment or transmission equipment, must be placed together for technical reasons such as electrical grounding, which is discussed next, as well as to maximize the contiguous space within a given central office recovered when existing equipment is replaced by more modern equipment. Having all equipment located in the same part of the central office allows the recovery of larger "blocks" of floorspace rather than smaller parcels of floorspace interspersed among other racks of equipment.
- **Electrical grounding requirements**: Switching equipment typically requires an "isolated grounding" source while transmission equipment typically requires an "integrated grounding" source. Safety codes require that equipment served by different grounding sources be physically separated in order to avoid technicians receiving electrical shocks or being electrocuted because they simultaneously contact dissimilar grounding sources.
- **"Holes" in existing equipment line-ups**: "Holes" in equipment line-ups are spaces intentionally left empty to accommodate future growth and still assure adherence to the principles described above. In some cases, cables and framework are modular in nature and economic efficiency results from pre-assembly and provision of such cables and

framework.

BellSouth believes that consideration of these factors as part of BellSouth's space assignment process will not increase the ALECs' cost of collocating, nor delay its placement of equipment in the central office. The end result will be the most effective use of available space by all parties.

Q. DOES BELLSOUTH OFFER SHARING OF COLLOCATION CAGES BETWEEN TWO OR MORE CARRIERS?

A. Yes. Even before the FCC issued its recent Order, BellSouth's policy was to allow the sharing of collocation arrangements between two or more carriers in those cases where space is unavailable for physical collocation. The FCC's Order goes beyond BellSouth's earlier offer and requires sharing of collocation "cages" without the precondition of a space exhaust situation. BellSouth complies with this requirement.

Q. WHAT IS MEANT BY THE TERM "CAGELESS" COLLOCATION?

A. The FCC's recent Order does not specifically define "cageless" collocation. In paragraph 42, however, it may be implied that what the FCC refers to as "cageless" collocation is met by the requirement that "incumbent LECs must allow competitors to collocate in any unused space in the incumbent LEC's premises, without requiring the construction

of a room, cage, or similar structure, and without requiring the creation of a separate entrance to the competitor's collocation space." While there is no industry accepted definition of this term, heretofore BellSouth has used the term "cageless" collocation to mean a physical collocation arrangement that is not separated by walls or other structures from the physical collocation arrangements of other collocators. However, BellSouth retains its right to take reasonable steps to protect its own equipment including enclosing the equipment in its own cage.

Q. WHY IS BELLSOUTH ALLOWED TO HAVE A WALL OR SIMILAR STRUCTURE SEPARATING ITS EQUIPMENT FROM EQUIPMENT OF OTHER COLLOCATORS?

A. While the FCC's Order requires ILECs to make cageless collocation arrangements available to requesting carriers, the Order also allows the ILECs to take reasonable steps to protect its own equipment, such as enclosing BellSouth's equipment in its own cage, and other security measures as discussed later in this testimony.

Q. DOES BELLSOUTH PROVIDE CAGELESS COLLOCATION AND, IF SO, WHAT TYPES OF CAGELESS COLLOCATION DOES BELLSOUTH PROVIDE?

A. Yes. As I mentioned earlier, the FCC's recent Order did not specifically define the term "cageless collocation." BellSouth believes the term to be

synonymous with the term "unenclosed physical collocation." BellSouth provides cageless collocation where local building codes permit the placement of unenclosed arrangements. These unenclosed arrangements will be located in the area designated for physical collocation within the BellSouth premise. There is no minimum square footage requirement for unenclosed collocation space, which allows the collocator to request only the amount of space required for its equipment. This is consistent with the FCC's Order at Paragraph 43 requiring ILECs to "...make collocation space available in single-bay increments...." In Florida, as of October 20, 1999, BellSouth had provided 54 cageless arrangements to ALECs with an additional 88 in progress.

Q. DOES BELLSOUTH BELIEVE THERE ARE MINIMUM SIZE REQUIREMENTS FOR ENCLOSED ("CAGED") COLLOCATION ARRANGEMENTS?

A. Yes. The applicable building codes and safety codes establish the effective minimum square footage that must be provided in enclosed collocation arrangements in addition to the floor space "footprint" of the collocated equipment itself. Therefore, BellSouth is willing to allow enclosed physical collocation without regard to minimum size so long as applicable building and safety codes are met.

Q. DOES BELLSOUTH PROVIDE FOR ADJACENT COLLOCATION WHEN SPACE FOR PHYSICAL COLLOCATION IS LEGITIMATELY

EXHAUSTED?

A. Yes. BellSouth meets the requirements of the FCC's Order pertaining to those situations where space is not available for physical collocation.

Q. BY WHAT MEANS DOES BELLSOUTH PROVIDE ADJACENT COLLOCATION IN CASES WHERE SPACE FOR PHYSICAL COLLOCATION IS LEGITIMATELY EXHAUSTED?

A. BellSouth's policy is to allow collocators to construct or otherwise procure Controlled Environmental Vaults (CEVs) and similar structures on BellSouth's property in cases where space for physical collocation is legitimately exhausted. The FCC's rules require BellSouth to accommodate such a request to the extent technically feasible "...when space is legitimately exhausted in a particular LEC premises...." FCC Order in CC Docket 98-147, paragraph 44.

Q. WHAT IS A "CEV"?

A. The term "CEV" stands for Controlled Environmental Vault. It is a separate, stand-alone structure containing equipment to regulate the "environment" within it such as air temperature. The CEV, in some cases, is buried with an entryway at ground level for ingress and egress. In this context, the CEV is used to house telecommunications equipment outside a central office building. It is called a vault because it is often constructed

of steel reinforced, poured concrete wall, floor, and ceiling members.

Q. DOES BELLSOUTH ALLOW COLLOCATORS TO PROCURE OR OTHERWISE PROVIDE CEVs OR SIMILAR STRUCTURES ON BELLSOUTH'S PROPERTY WHEN SPACE FOR PHYSICAL COLLOCATION IS NOT LEGITIMATELY EXHAUSTED?

A. No. BellSouth believes it has no obligation to provide for such adjacent collocation absent a legitimate space exhaust situation.

Q. DOES BELLSOUTH MEET THE FCC's REQUIREMENT TO ALLOW COLLOCATION OF ALL TYPES OF EQUIPMENT USED OR USEFUL FOR INTERCONNECTION OR ACCESS TO UNBUNDLED NETWORK ELEMENTS (UNEs)?

A. Yes. Paragraph 28 of the FCC's March 31, 1999 Order requires the collocation of Digital Subscriber Line Access Multiplexers (DSLAMs), routers, Asynchronous Transfer Mode (ATM) multiplexers, and Remote Switching Modules (RSMs). BellSouth had heretofore allowed collocation of all of these equipment types plus "stand-alone" switching equipment. "Stand-alone" switching equipment is also referred to as "host" switching equipment. The term "host" is a switching technology that provides the capability to remotely serve customers via a Remote Switching Unit (RSU), which is essentially an extension of the host switching system. Given that the FCC's Order in paragraph 30 does not require collocation

of equipment used solely to provide enhanced services, BellSouth believes it already is and has been in compliance with the FCC's requirements.

Q. DOES BELLSOUTH ACCOMMODATE TOURS OF CENTRAL OFFICES IN WHICH A REQUESTING PARTY HAS BEEN DENIED SPACE FOR PHYSICAL COLLOCATION?

A. Yes. As this Commission is aware, BellSouth has hosted a number of tours for parties who requested physical collocation in a given BellSouth central office but were denied due to space exhaustion. The FCC's recent rules require BellSouth to conduct such a tour within ten (10) days of the denial of space. BellSouth asks simply that it be notified within five (5) days of its denial of space that the denied party wishes a tour in order to reach an agreeable date and time within the FCC's ten day "window".

Q. WHAT IS BELLSOUTH'S POLICY REGARDING PRODUCTION OF LISTS OF CENTRAL OFFICES WITHIN WHICH SPACE IS NOT AVAILABLE FOR PHYSICAL COLLOCATION?

A. BellSouth will maintain on its Interconnection Services website a notification document indicating all central offices that are without space. BellSouth will update this document within ten (10) business days of the date of the first Denial of Application that causes space to become exhausted. At BellSouth's Interconnection Services website, ALECs may

subscribe to an automatic e-mail notification process, which will include, among other notices, a notice that the space exhaust list has been updated. BellSouth will also post a document in its Interconnection Services website that contains a general notice indicating where space has become available in a central office previously on the space exhaust list.

Q. WHAT IS BELLSOUTH'S POLICY REGARDING THE REMOVAL OF OBSOLETE, UNUSED (RETIRED) EQUIPMENT IN ORDER TO ACCOMMODATE REQUESTS FOR PHYSICAL COLLOCATION?

A. First of all, BellSouth believes the FCC intended to use the terms "obsolete" and "unused" together to avoid disagreements regarding an incumbent LEC's obligations to modernize its network to replace older vintage but still functional equipment. BellSouth uses the term "retired" to describe such equipment that is removed from accounting records. The equipment is either physically removed or retired in place, if the cost of removal is too high. Otherwise, a collocator might demand that the incumbent LEC replace an analog switching system with a newer, physically smaller, digital switch in order to free up space for physical collocation. I do not believe this is what the FCC intended, or that such a requirement makes economic sense. Thus, BellSouth believes its policy heretofore is compliant with the FCC's rules in Order 99-48.

Q. DOES BELLSOUTH MEET THE FCC's REQUIREMENT THAT PERMIT

COLLOCATORS DIRECT ACCESS TO ITS EQUIPMENT WITHOUT BEING ESCORTED BY BELLSOUTH PERSONNEL AND WITHOUT THE COLLOCATOR'S EQUIPMENT BEING PHYSICALLY SEPARATED BY A WALL OR OTHER STRUCTURE FROM BELLSOUTH'S EQUIPMENT OR THE EQUIPMENT OF OTHER ALECs?

A. Yes. The FCC's Order raises serious concerns that must be addressed in order to retain the level of network reliability and security that currently exists and which end user customers and regulators have come to expect. BellSouth has addressed those concerns and is compliant with the FCC's requirements. A simple reading of today's newspaper headlines reveals the need for stringent control over the access to and operation of the public telephone network. In order to provide reasonable security measures, BellSouth requires all collocators' employees to undergo the same level of security training, or its equivalent, that BellSouth's own employees, or third party contractors providing similar functions, must undergo. Each collocator must provide its employees with picture identification, which must be worn and visible in the collocation space or other areas in and around BellSouth's central offices. Collocators are required to conduct an investigation of criminal history records for each of the collocator's employees being considered for work within or upon BellSouth's premises. Restrictions are imposed on a collocator's employees with felony or misdemeanor criminal convictions. Also, as I discussed earlier in this testimony, the FCC's Order provides for additional security by allowing BellSouth to provide a cage around its own

equipment. Thus, BellSouth is in compliance with the security provisions required by the FCC's Order.

Q. DOES BELLSOUTH MEET THE FCC's REQUIREMENT TO ALLOW ANY OTHER COLLOCATION ARRANGEMENT THAT HAS BEEN MADE AVAILABLE BY ANOTHER ILEC UNLESS THE ILEC REBUTS BEFORE THE STATE COMMISSION THE PRESUMPTION THAT SUCH ARRANGEMENT IS TECHNICALLY FEASIBLE?

A. Yes. BellSouth evaluates all requests for new forms of collocation arrangements it receives from collocators. This evaluation includes a determination of likely costs given any equipment or work required to effect such an arrangement, resultant levels of network security and reliability and technical feasibility of access to interconnection and unbundled network elements achieved via such an arrangement. BellSouth informs the requesting collocator of the results of BellSouth's analysis. BellSouth preserves its rights without waiver, however, to rebut the FCC's presumption of technical feasibility before this Commission for those proposed arrangements which, while available from another ILEC, BellSouth believes to be not technically feasible.

Issue 3: To what areas does the term "premises" apply, as it pertains to physical collocation and as it is used in the Act, the FCC's Orders, and FCC Rules?

Q. WHAT IS YOUR UNDERSTANDING OF THE FCC'S DEFINITION OF THE TERM "PREMISES" AND IN WHAT AREAS DOES IT APPLY?

A. The Telecommunications Act of 1996 does not provide a definition for the term "premises", nor is the term discussed in the legislative history. In the FCC's Order 96-325, the FCC defined the term "premises" as follows:

> We therefore interpret the term 'premises' broadly to include LEC central offices, serving wire centers and tandem offices, as well as all buildings or similar structures owned or leased by the incumbent LEC that house LEC network facilities. We also treat as incumbent LEC premises any structures that house LEC network facilities on public rights-of-way, such as vaults containing loop concentrators or similar structures. [Paragraph 573]

I believe that if the FCC intended to broaden its definition, it could have done so in its recent Order. It did not do so, instead the FCC would permit "the new entrant to construct or otherwise procure such an adjacent structure, subject only to reasonable safety and maintenance requirements."

Q. DO ADJACENT CEVs OR SIMILAR STRUCTURES FIT THE FCC's DEFINITION OF THE TERM ILEC "PREMISES"?

A. No. This is not a situation about legitimate space exhaustion but is a situation about allowing ALECs' structures on property that does not

house LEC network facilities. The FCC's definition of adjacent CEVs and similar structures is inconsistent with its own definition of "premises" and the Act's requirement for collocation within BellSouth's premises. This is because the resulting structure, whether constructed by the collocator or otherwise procured, would not be owned by BellSouth and thus would not fit the definition of being any one of the types of structures named in the FCC's definition; specifically, "LEC central offices, serving wire centers and tandem offices, as well as all buildings or similar structures owned or leased by the incumbent LEC that house LEC network facilities." Further, the resultant structure constructed or otherwise procured by the collocator (that is, the adjacent CEV or similar structure) would not fit the FCC's definition because it would not house BellSouth's "network facilities." To summarize, CEVs and similar structures are located on BellSouth's property but are not BellSouth's "premises" because the adjacent CEVs and similar structures are not BellSouth's and the equipment housed within the adjacent CEV or similar structure is not part of BellSouth's network facilities.

Q. HAVE OTHER PARTIES SOUGHT TO FURTHER BROADEN THE FCC's DEFINITION OF THE TERM "PREMISES"?

A. Yes. Some parties have suggested that buildings housing BellSouth's administrative or other support personnel and which are on parcels of land adjacent to or near BellSouth's central offices should likewise be considered "premises" under the FCC's definition. Since these buildings

do not house network facilities (that is, switches or transmission equipment, for example), they are not subject to requirements for collocation.

Q. WHAT IS BELLSOUTH'S POSITION WHEN A COLLOCATOR WANTS TO CONSTRUCT A CEV IN A LOCATION WHERE THERE IS NO CO?

A. BellSouth believes it has no obligation to permit a collocator to construct or otherwise procure a CEV or similar structure except where space for physical collocation is legitimately exhausted. BellSouth believes that, in no case, must BellSouth be required to permit collocators' CEVs or similar structures to be placed on BellSouth's property other than those housing network facilities and only in situations where there is space exhaustion within that type of property.

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should affirm that the definition as set forth in the Telecommunications Act of 1996 and the FCC's rules are sufficiently broad and that CEVs and similar structures provided by collocators should not be allowed on property that does not house LEC network facilities. Additionally, BellSouth has no obligation to provide for adjacent collocation absent a legitimate space exhaust situation.

Issue 4: What obligations, if any, does an ILEC have to interconnect with ALEC physical collocation equipment "off-premises"?

Q. WHAT IS BELLSOUTH'S BASIC POSITION REGARDING THE TYPE OF ALEC-OWNED OR ALEC-LEASED ENTRANCE FACILITIES AN ALEC MAY PLACE IN ITS COLLOCATION SPACE OR USE TO CONNECT BELLSOUTH'S PREMISES WITH A NEARBY PREMISES AT WHICH THE ALEC IS COLLOCATED?

A. First of all, my understanding is that an ALEC's equipment within its own central office would not fit the definition of ALEC physical collocation equipment "off-premises". Instead, I believe "off-premises" physical collocation is a reference to space an ALEC may rent or own that is in proximity to a BellSouth central office. The ALEC's equipment in such a situation would be interconnected to BellSouth's network in the same ways as if the ALEC's equipment were housed within the ALEC's central office. ALECs have suggested that they be allowed to bring copper cables through BellSouth's entrance facilities in order to interconnect with BellSouth's network. The trend in the telecommunications industry is for cables and equipment to be reduced in size, not increased in size. For example, yesterday's 3,600 pair copper cable required its own four inch conduit. The capacity provided by that copper cable could now easily be provided by a fiber optic cable, which is a little more than one-half inch in diameter, an eight-fold reduction. Accommodation of ALECs' requests to used BellSouth's entrance facilities to bring new copper cables into

BellSouth's central offices would accelerate the exhaust of entrance facilities at its central offices at an unacceptable rate, as compared to current technologies such as fiber optic cable.

Q. HAS THE FCC TAKEN A POSITION REGARDING A LOCAL EXCHANGE COMPANY'S OBLIGATIONS TO PROVIDE FOR SUCH NON-FIBER OPTIC FACILITIES?

A. Yes, the FCC's *First Report and Order* in CC Docket 96-98, August 8, 1996, Paragraph 565, adopted the existing Expanded Interconnection requirements, with some modifications, as the rules applicable for collocation under section 251 if the Telecommunications Act of 1996. More specifically, this issue was addressed in the FCC's *Second Report and Order, In the Matter of Expanded Interconnection with Local Telephone Company Facilities* in CC Docket 91-141, Transport Phase I, released September 2, 1993. Paragraph 69 of that Report and Order states: "LECs are not required to provide expanded interconnection for switched transport for non-fiber optic cable facilities (e.g., coaxial cable). In the Special Access Order, we [that is, the FCC] concluded that given the potential adverse effects of interconnection on the availability of conduit or riser space, interconnection should be permitted only upon Common Carrier Bureau approval of a showing that such interconnection would serve the public interest in a particular case. We adopt this approach for switched transport expanded interconnection."

Further, the *FCC's Report and Order, In the Matter of Expanded Interconnection with Local Telephone Company Facilities*, CC Docket 91-141, Released October 19, 1992 at Paragraph 99 states: "At least one party supported interconnection of non-fiber optic cable facilities (e.g., copper coaxial cable) provided by third parties. A number of the LECs, however, have argued that such a requirement is undesirable because it would make limited conduit and riser space available to technologies that are much less space efficient than fiber. Given the potential adverse effects of such interconnection on the availability of conduit and riser space, we [that is, the FCC] believe that interconnection of non-fiber optic cable should be permitted only upon Commission approval of a showing that such interconnection would serve the public interest in a particular case."

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should affirm that, consistent with the FCC's Rules in CC Dockets 96-98 and 91-141, BellSouth is not required to accommodate requests for non-fiber optic facilities placed in BellSouth's entrance facilities.

Issue 9: What is the appropriate demarcation point between ILEC and ALEC facilities when the ALEC's equipment is connected directly to the ILEC's network without an intermediate point of interconnection?

Q. THE FCC's ORDER INDICATES THAT AN INCUMBENT LEC MAY NOT REQUIRE COMPETITORS TO USE AN INTERMEDIATE INTERCONNECTION ARRANGEMENT IN LIEU OF DIRECT CONNECTION TO THE INCUMBENT LEC'S NETWORK IF TECHNICALLY FEASIBLE. WHAT IS YOUR REACTION?

A. BellSouth will designate the point(s) of interconnection between the ALEC's equipment and/or network and BellSouth's network. Each party will be responsible for maintenance and operation of all equipment/facilities on its side of the demarcation point. For 2-wire and 4-wire connections to BellSouth's network, the demarcation point shall be a common block on the BellSouth designated conventional distributing frame. The ALEC shall be responsible for providing, and the ALEC's BellSouth Certified Vendor shall be responsible for installing and properly labeling/stenciling, the common block and necessary cabling pursuant to the established construction and provisioning interval. For all other terminations BellSouth shall designate a demarcation point on a per arrangement basis. The ALEC or its agent must perform all required maintenance to equipment/facilities on its side of the demarcation point and may self-provision cross-connects that may be required within the collocation space to activate service requests. At the ALEC's option, a Point of Termination (POT) bay or frame may be placed in the collocation space, but this POT bay will not serve as the demarcation point.

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should affirm BellSouth's position on appropriate demarcation point between ILEC and ALEC facilities when the ALEC's equipment is connected directly to the ILEC's network without an intermediate point of interconnection as set out above.

Issue 10: What are reasonable parameters for reserving space for future LEC and ALEC use?

Q. PLEASE COMMENT ON BELLSOUTH'S SPACE UTILIZATION STANDARDS.

A. In its First Report and Order, the FCC ruled that "restrictions on warehousing of space by interconnectors are appropriate. Because collocation space on incumbent LEC premises may be limited, inefficient use of space by one competitive entrant could deprive another entrant of the opportunity to collocate facilities or expand existing space." CC 96-325, at Paragraph 586. The FCC also provides that "Incumbent LECs may not ... reserve space for future use on terms more favorable than those that apply to other telecommunications carriers seeking to hold collocation space for their own future use." CC 96-325, at Paragraph 604.

BellSouth applies to ALECs the same standards it applies to itself

regarding the reservation of space. ALECs may reserve space for a two-year total forecast. If it is apparent the space will not be utilized and BellSouth has a need for the space for itself or for another interconnector following the expiration of the two-year period, the ALEC must forfeit the use of that space. Likewise, BellSouth will forfeit any of its reserved space that will not be used within the two-year window if needed by an ALEC.

Q. PLEASE EXPLAIN BELLSOUTH'S PROCESS FOR DETERMINING PROJECTED EQUIPMENT REQUIREMENTS?

A. Currently, BellSouth projects equipment requirements for the next 12 to 18 months based on the actual demand of the past 12 to 18 months. BellSouth uses the geographically based forecast of network access line demand to determine the line peripherals required and relies heavily upon the recent trend of trunk demand to project the trunk peripherals required. BellSouth uses its professional judgment and experience in applying the trended forecast to the equipment requirements when it is aware of an unusual occurrence that has, or will, take place. A change from the past is that BellSouth is deploying hardware equipment to last approximately 18 months and deploying the expensive electronics or plug-ins as demand occurs, which is approximately every six months in volatile access tandem switches. This allows BellSouth to economically and quickly respond to interconnecting customer demand. In the past, because there was little data traffic on the voice network, BellSouth was able to correlate the trunk

demand to the access line growth, and provision trunks on a similar growth pattern. BellSouth would provision equipment for a planned 24 to 36 month period.

Q. EXPLAIN THE PROCESS THAT CAPACITY MANAGERS USE TO DETERMINE THE EQUIPMENT REQUIREMENTS FOR ACCESS TANDEMS.

A. The access tandems provide for interconnection to other carrier networks. These switches are the primary points of interconnection with other carriers - interexchange carriers, wireless carriers, ALECs, and other independent companies. It is critical that BellSouth be able to continue equipment growth in these switches in order to allow traffic to traverse from one carrier's network to another. In the South Florida area, the Switch Capacity Manager (SCM) trends the projection of trunks based on the most recent actual demand. In the North Florida area, the Circuit Capacity Manager (CCM) determines the trunk projection and provides the required circuit quantities to the SCM. Although the organizational responsibility for projecting trunk requirements is different, the end product is the same - a circuit quantity forecast (expressed in DS-1s) of switch terminations required. Trunk demand on the BST access tandems is driven by interconnection to the other carriers' networks, as well as from BellSouth's local switches to provide end users' access to other interconnect providers. When there is no forecast provided by these carriers, trending is used.

Q. EXPLAIN THE PROCESS THAT CAPACITY MANAGERS USE TO DETERMINE THE EQUIPMENT REQUIREMENTS FOR LOCAL SWITCHES.

A. The local switch provides service to the end users within the specified geographical boundaries of the wire center (central office). The equipment demand is driven by access line requirements, trunk requirements, and value-added services. For line requirements, the SCM receives a geographically based forecast of the number of lines projected for growth. The outside plant Loop Capacity Manager receives the same forecast and then forecasts the feeder growth to be served on digital systems that will be integrated into the switch, and the associated access line count. This is based on his/her knowledge of the outside plant distribution growth strategy. This forecast is provided to the SCM who calculates the remaining analog access line requirement from the overall access line projection. For trunk requirements, the projection is based on trending the most recent actual demand. Due to the recent volatility of local trunking demand driven especially by Internet service provider access and PRI-ISDN (Primary Rate Interface-Integrated Services Digital Network) hubbing arrangements, the interoffice trunk requirements are trended. The SCM or CCM determines those requirements, and the SCM turns them into trunk equipment needs. The SCM's requirements and projections are trued up based on historical data and his/her knowledge of unusual activities. In addition, the SCM considers services to be provided

such as caller ID, calling name delivery, and other value-added services and determines the equipment requirements to satisfy all those demands.

Q. EXPLAIN THE PROCESS THAT CAPACITY MANAGERS USE TO DETERMINE THE EQUIPMENT REQUIREMENTS FOR TOPS (TRAFFIC OPERATOR POSITION SYSTEMS) SWITCHES.

A. TOPS switches provide for operator services requirements. The demand for equipment is driven by the need to expand or modernize the operator services network, which sometimes requires the replacement of some older technology with newer technology. These requirements are planned by BellSouth's Operator Services organization. The requirements are provided to the SCM, who places the equipment order on the vendor and oversees the implementation of the project.

Q. EXPLAIN THE PROCESS THAT CAPACITY MANAGERS USE TO DETERMINE THE EQUIPMENT REQUIREMENTS FOR SIGNAL TRANSFER POINT (STP) AND SERVICE CONTROL POINT (SCP) SYSTEMS.

A. The function of a STP is to provide the SS7 signaling necessary to complete calls across the network. The SCPs are databases that contain information regarding features and services in the network (for example, calling name, LIDB (line information database used to validate 0+ credit card calls)). These switches are planned by BellSouth's Regional

Planning and Engineering Center (RPEC), a regional center that monitors the capacity, plans relief, orders equipment, and provides the frame requirements to the Common Systems Capacity Manager.

Q. EXPLAIN THE PROCESS THAT CIRCUIT CAPACITY MANAGERS USE TO DETERMINE THE EQUIPMENT REQUIREMENTS FOR THE INTEROFFICE NETWORK.

A. Circuit Capacity Managers (CCMs) oversee the interoffice trunking network and plan the associated equipment requirements. In projecting future equipment requirements, the CCM identifies the need for additional test access, metallic repeater equipment, Synchronous Optical NETwork (SONET) equipment, digital cross-connect system growth, and associated cross-connect panels. The CCM considers interoffice message trunk growth, ISP (Internet Service Provider) trunk growth, interexchange carrier and ALEC trunk requirements. The CCM must also consider the expected growth for customer-driven SONET-based smart rings as well as interoffice SONET rings. The CCM is also an interface to the outside plant capacity manager, who provides requirements to them on the placement of equipment in this area for next-generation digital loop carrier equipment, loop multiplexers and fiber distribution frames. The CCM considers all of the above requirements and when they are requested, they provide the Common Systems Capacity Manager with an estimated equipment requirement.

Q. EXPLAIN THE PROCESS THAT POWER CAPACITY MANAGERS USE TO DETERMINE THE EQUIPMENT REQUIREMENTS FOR DC POWER AND ALTERNATE ENGINES.

A. Power Capacity Managers (PCMs) project the growth of Direct Current (DC) power equipment and alternate standby engines. DC power equipment needs for rectifiers and batteries are identified by an outside vendor and provided to the PCM. The PCM plans the replacement and upgrade of optional standby engines.

Q. EXPLAIN THE PROCESS THAT COMMON SYSTEMS CAPACITY MANAGERS USE TO RESERVED SPACE FOR CENTRAL OFFICE EQUIPMENT.

A. The Common Systems Capacity Manager (CSCM) ensures that all installed equipment is properly designated on the floor plan, outstanding equipment orders for additional equipment, as well as equipment to be removed, are reflected and space for future equipment projections is reserved.

Q. WHY DOES BELLSOUTH UTILIZE THIS PROCESS FOR DETERMINING EQUIPMENT REQUIREMENTS AND FLOOR SPACE REQUIREMENTS?

A. This process ensures that the various types of equipment are

appropriately forecasted for future growth, that capital investment is effectively utilized, and that central office space is efficiently utilized both for BellSouth's needs and all collocators' needs. This process allows BellSouth to provide timely customer service to local end users and interconnecting customers.

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should affirm BellSouth's position on reasonable parameters for reserving space for future BellSouth and ALEC use as set out above.

Issue 11: Can generic parameters be established for the use of administrative space by an ILEC, when the ILEC maintains that there is insufficient space for physical collocation? If so, what are they?

Q. WHAT IS ADMINISTRATIVE SPACE AND HOW IS IT CONSIDERED IN ALLOCATING SPACE?

A. Administrative space inside the central office is any space not directly supporting the installation or repair of both telephone equipment and customer service. Examples of this space are storerooms, break rooms, shipping-receiving rooms, and training areas. These rooms are necessary to meet code, life safety, or contractual requirements.

Administrative space can also include regular office space used by work groups performing company functions outside of the equipment support described above. BellSouth allocates space to these types of administrative groups in response to changes in the regulatory environment, increases or decreases in company manpower requirements, or in response to new service offerings.

Q. CAN GENERIC PARAMETERS BE ESTABLISHED? IF NOT, WHY?

A. No, because there are different space, equipment, building code, manpower, and other requirements unique to each central office. Not only do these central offices house telecommunications equipment (including switching, transmission, power, and ancillary equipment) but also the people, tools, and computers, used to administer, provision, maintain, and repair such telecommunications equipment.

While ALECs may argue that some or all of these purposes are not "indispensable" and argue that BellSouth must relocate or dispose of administrative space, employee break rooms and the like, all of these constitute productive use of floor space.

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should affirm BellSouth's position on the use of

administrative space by an ILEC, when the ILEC maintains that there is insufficient space for physical collocation as set out above.

Issue 12: What types of equipment are the ILECs obligated to allow in a physical collocation arrangement?

Q. THE FCC's RULES REQUIRE THAT ILECs ALLOW ALL EQUIPMENT USED OR USEFUL FOR INTERCONNECTION OR ACCESS TO UNEs TO BE COLLOCATED. WHAT TYPE OF EQUIPMENT DOES THE FCC's RECENT ORDER SPECIFICALLY REQUIRE?

A. Paragraph 28 of the FCC's March 31, 1999 Order requires the collocation of Digital Subscriber Line Access Multiplexers (DSLAMs), routers, Asynchronous Transfer Mode (ATM) multiplexers, and Remote Switching Modules (RSMs). BellSouth had heretofore allowed collocation of all of these equipment types plus "stand-alone" switching equipment. "Stand-alone" switching equipment is also referred to as "host" switching equipment. The term "host" is a switching technology that provides the capability to remotely serve customers using a Remote Switching Unit (RSU), which is essentially an extension of the host switching system. Given that the FCC's Order in paragraph 30 does not require collocation of equipment used solely to provide enhanced services, BellSouth believes it already is and has been in compliance with the FCC's requirements.

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should affirm BellSouth's position as to its obligation as to the types of equipment it is obligated to allow in physical collocation arrangements as set out above.

Issue 16: For what reasons, if any, should the provisioning interval be extended without the need for an agreement by the applicant ALEC or filing by the ILEC of a request for an extension of time?

Q. DOES BELLSOUTH HAVE TOTAL CONTROL OVER COLLOCATION PROVISIONING INTERVALS?

A. No. BellSouth has committed to intervals for all activities that are within its control. Several mitigating factors that are outside BellSouth's control, such as the permitting interval, local building code interpretation, and unique construction requirements, affect the provision interval and are properly excluded from BellSouth's provisioning interval.

Q. UNDER WHAT CONDITIONS SHOULD PROVISIONING INTERVALS BE EXTENDED?

A. There are three (3) situations where provisioning intervals should be extended. They are: 1) provisioning of collocation arrangements

encountering extraordinary conditions; 2) provisioning of collocation arrangements encountering unusual delays in the permitting process, and; 3) provisioning collocation arrangements associated with central office building additions. I will explain each of these in the following paragraphs.

Q. WHAT DO YOU MEAN BY THE TERM "EXTRAORDINARY CONDITIONS" AS IT RELATES TO PROVISIONING OF COLLOCATION ARRANGEMENTS?

A. Extraordinary conditions include, but are not limited to, major BellSouth equipment rearrangements or additions; power plant additions or upgrades; major mechanical additions or upgrades; major upgrades for ADA compliance; environmental hazard or hazardous materials abatement. Any and all of these conditions, could necessitate an unforeseen extension of the provisioning interval.

Q. PLEASE DISCUSS HOW UNUSUAL DELAYS IN THE PERMITTING PROCESS AFFECT THE OVERALL PROVISIONING PROCESS FOR COLLOCATION ARRANGEMENTS.

A. Much of the work required to provision collocation arrangements requires building permits before construction can commence. Obviously, the time required to receive permits (once BellSouth has requested a permit) is outside BellSouth's control. Further, the FCC's rules in its recent Order may inadvertently have created potential conflicts with state or local

building code ordinances.

Q. DO YOU BELIEVE THAT THE FCC's RULES IN ITS RECENT ORDER CREATE A POTENTIAL CONFLICT WITH STATE OR LOCAL BUILDING CODE ORDINANCES?

A. Yes. I do not expect all code officials to be completely familiar with the FCC's requirements pertaining to physical collocation. In the day-to-day permit request and approval process, BellSouth cannot commence certain construction work that modifies mechanical, electrical, architectural or safety factors within its central offices without first acquiring the necessary permits. While code officials at the state and local levels are implementing the FCC's rules, I am concerned that delays may be experienced as BellSouth requests necessary permits. While I am not a lawyer, I am aware that the doctrine of preemption may ultimately result in the FCC's rules taking precedence over any conflicting state or local ordinances; however, I believe it will take some time for any resulting conflicts to be resolved. BellSouth cannot knowingly violate applicable building and safety codes, and code officials cannot expect BellSouth to knowingly violate applicable FCC rules.

Q. HAS BELLSOUTH ENCOUNTERED DELAYS AS A RESULT OF THE PERMITTING AND INSPECTION PROCESSES?

A. Yes. BellSouth has experienced provisioning delays as a result of permitting and inspection intervals in certain local jurisdictions. BellSouth has also encountered delays as a result of the need to resolve local building code issues. For instance, in Florida municipalities where BellSouth has received requests from ALECs, BellSouth has experienced permitting intervals that range from 15 days to in excess of 60 days. Moreover, many municipalities require BellSouth and its contractors to permit inspection requirements at each stage of construction before the next stage can begin. This includes the sometimes-difficult task of scheduling the inspections with a limited pool of inspectors representing the municipalities.

Regarding building codes, not only have some municipalities treated collocation as a "multi-tenant" arrangement, thus requiring the construction of fire-rated enclosures, certain municipalities have withheld certificates of occupancy until BellSouth complied with unrelated work requests issued by the City/County. For one location, this included replacing a sidewalk between the BellSouth central office building and the public street before a certificate of occupancy would be issued for the collocator's space. Incidentally, the sidewalk did not lead to the collocator's entrance to the building. BellSouth has also experienced delays as a result of ALEC failure to obtain the appropriate business licenses.

Q. HAS BELLSOUTH ENCOUNTERED ANY CONFLICTS BETWEEN THE

FIRE AND LIFE SAFETY CODES, AND THE BUILDING CODES?

A. Yes. Under the National Fire Protection Act (NFPA) 101, Part 1, Section 28-141, a telephone exchange is listed as a Special Use Industrial Occupancy, which does not require fire-rated separation related to exit access corridors. The application of building codes differs throughout Florida. For example, North Florida abides by the Standard Building Code whereas South Florida abides by the South Florida Building Code. The Standard Building Code and South Florida Code refer to telephone exchanges as Group B – Business or Group G – storage that requires fire-rated exit access corridors. The NFPA does not define the term "tenant". Both the Standard and South Florida Codes do define the term "tenant". They also define special requirements for tenant situations. The South Florida Building Code (section 507.2) and the Standard Building Code (section 704.3) require a fire-rated separation between tenants and common areas (which includes corridors). The building official can choose which sections of the codes that he/she wants the BellSouth plans and specifications to meet when there are conflicts. For example, the Fire Marshal of Ft. Lauderdale at the Main Relief central office and the Cypress central office, has insisted that BellSouth meet the separation requirements of the South Florida Building Code, and the 50 foot common path of travel requirement of NFPA 101. Under NFPA 101, Special Use Industrial Occupancy, the corridor would not be required to have rated walls. However, since the building official is picking and choosing between codes, he/she can require that the corridor from the building be

constructed of fire-rated wall construction (according to the South Florida Building Code). **Copies of the South Florida Building Code, Dade County edition, the Standard Building Code, and other related building and fire code documentation are attached to my testimony as exhibit WKM-1.**

Q. DO YOU HAVE OTHER EXAMPLES?

A. Yes, there are numerous examples of incidents where the requirements of local code officials have significantly contributed to the interval for providing collocation space to the ALECs. A particular facility where the code officials have made constant requests for changes is the Ft. Lauderdale Main Relief central office. BellSouth has been required to build fire-rated walls around the collocators' collocation arrangements and the common area. Also, they required the construction of fire-rated corridors through equipment areas and out of the building. In providing this egress for the collocators, BellSouth had to relocate equipment, build hallways under cable racks, and cut a new door through the exterior wall. Since the new doorway was several feet above grade, a new ramp was also constructed. Additionally, the fire inspector required that strobe lights be installed on the fire alarm system at the doors.

There are numerous other municipalities that have required significant fire alarm system upgrades as a result of the collocation activity. While some code officials were satisfied with additional strobe lights, others requested

that BellSouth sign a letter agreeing to replace high-voltage fire alarm systems within the next two years (Jacaranda central office, Sunrise central office, and Allapattah central office). Other fire inspectors across BellSouth's nine-state region have approved projects with the same high-voltage fire alarm systems, but these officials want the systems replaced.

Accessibility additions have proven to be another area where the code officials have required changes to plans before they would issue a permit. BellSouth has had to make changes to restroom stalls and hardware as a result of the Americans with Disabilities Act (ADA) requirements. On another instance, a code official requested that BellSouth add an elevator to a facility. However, BellSouth was successful in getting the code official to remove this requirement.

Other incidents that BellSouth has encountered include the following:

- A request for a survey and street elevations for the second floor, interior collocation project at the Hialeah central office.

- The City of Coral Springs will only allow one building permit in a facility at one time (i.e. if there is a project underway in a facility, another permit will not be granted until the certificate of completion is issued for the project that is underway). This requirement can result is a significant delay if the existing project has a long completion interval.

- On a collocation project at the Cypress central office, the city would not issue the Certificate of Occupancy until BellSouth performed some landscaping work.

- The City of Jacksonville would not issue a permit for a San Marco central office collocation project until BellSouth either performed landscaping requirements on the facility, or obtained approval on a variance from the landscaping provisions. Since the landscaping provisions would eliminate several of the limited number of parking spaces, it was decided that it was in both BellSouth's and the collocators' best interests to file the variance. A survey had to be completed showing the existing conditions, with an alternate plan showing the landscaping in accordance with City regulations. The variance was then filed, and a public hearing was held the following month. After the variance was approved at a public hearing, the City would not issue a permit until the public had 15 days to comment on the approval. It took about six months to obtain the permit for this project. The City has changed their interpretation of the requirements for a landscaping review for any project involving 50% of the building value. In the past, the City considered all projects cumulatively. They now consider the 50% rule on a "per project" basis.

Q. HOW IS BELLSOUTH DEALING WITH THESE UNEXPECTED ISSUES?

A. As to the majority of these issues, BellSouth has attempted to refine its processes to accommodate the issues that may arise as a result of various government agencies' involvement. BellSouth has been increasingly successful in working with the various governmental agencies in reducing the permit approval interval. Further, BellSouth is communicating with the ALECs so that they have a good understanding of the issues faced in processing a collocation request. In addition, BellSouth may, at is sole discretion, agree to an equipment installation date prior to the completion of its infrastructure work, provided the area is properly secured. For these exceptions, BellSouth will report this date as the "Space Available for Occupancy Date". In these cases, the collocator must sign a liability waiver before such work may begin.

Q. HOW DO BUILDING ADDITIONS AFFECT THE OVERALL PROVISIONING INTERVAL FOR COLLOCATION ARRANGEMENTS?

A. In the case where provisioning a collocator's arrangement is contingent on substantial completion of a building addition, work cannot commence towards fulfilling a collocator's request for collocation until that addition is largely completed. Building additions are very long lead-time projects, often encompassing several years between initial planning and completion of the project. Thus, building addition planning and construction times should not be included as part of the provisioning interval for collocation arrangements.

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should affirm that upon firm order by an applicant carrier, the provisioning interval of 90 calendar days for physical collocation and 60 calendar days for virtual collocation should exclude the time spent obtaining any needed permits and should exclude extraordinary situations or conditions as well.

Issue 20: What process, if any, should be established for forecasting collocation demand for CO additions or expansions?

Q. WHAT IS THE PROCESS FOR FORECASTING COLLOCATION DEMAND FOR CO ADDITIONS OR EXPANSIONS?

A. In its First Report and Order (FCC 96-325, Released August 8, 1996), the Federal Communications Commission ("FCC") states the following:

> "We [FCC] further conclude that LECs should not be required to lease or construct additional space to provide physical collocation to interconnectors when existing space has been exhausted." That Order further stated "...we conclude that incumbent LECs should be required to take collocator demand into account when renovating existing facilities and constructing or leasing new facilities, just as they consider demand for other services when

undertaking such projects." (¶ 585, FCC 96-325)

With this in mind, BellSouth includes forecasted space for collocation in its central office additions or expansions. BellSouth provides for collocation space based on forecasts derived from the following sources: space currently allocated for collocation, the amount of space requested in either current applications or collocators on a waiting list for that central office, and the amount of collocation space in central offices in the surrounding area. BellSouth encourages ALECs to provide forecasts periodically for a planning horizon of two years such that BellSouth can take ALEC forecasts into account as one factor when planning for central office additions, expansions or replacements. Should this Commission issue any requirements regarding forecasting demand for central office additions or expansions, it should encourage ALECs to provide forecasts periodically for a planning horizon of two years to be used as a factor for planning purposes. BellSouth is not privy to the business plans of its competitors, and can only estimate their future collocation needs.

Q. **IS THE NEED FOR A PROCESS FOR FORECASTING COLLOCATION DEMAND FOR CO ADDITIONS OR EXPANSIONS DIFFERENT THAN IT WAS IN THE PAST? IF SO, WHY?**

A. Yes. In the past, the design of the network was relatively stable, being primarily used for voice traffic. BellSouth relied heavily on forecasts of line growth and interexchange carrier access growth. There was a direct

correlation between the interoffice trunk growth and the access line growth. However, the process for projecting equipment requirements has been revised to take into account various new or changed factors. Those are: 1) the increased use of the Internet and the resulting increased demand on the telecommunications network; 2) the introduction of ALEC networks and the need to interconnect those networks; and 3) the increased demand for wireless interconnection. As a result, the demand on the network is no longer stable or predictable. Therefore, a lack of a stable forecast information reflecting these influences has forced BellSouth Capacity Managers to rely heavily on trended demand to determine capacity exhaust and equipment relief timing.

Q. HOW WILL THIS NEW PROCESS IMPACT FUTURE CENTRAL OFFICE ADDITIONS OR EXPANSIONS?

A. This process ensures that the various types of equipment are appropriately forecasted for future growth, that capital investment is effectively utilized, and that central office space is efficiently utilized. Space must be reserved for equipment growth to allow sufficient time to expand a central office when space is exhausted. The planning, design, permitting, and construction activities associated with a building addition take approximately two to three years. This process allows BellSouth to provide timely customer service to local end users and interconnecting customers.

Q. HOW DOES BELLSOUTH WANT THE COMMISSION TO RESOLVE THIS ISSUE?

A. This Commission should encourage ALECs to provide forecasts periodically for a planning horizon of two years such that BellSouth can take ALEC forecasts into account as one factor when planning for central office additions, expansions or replacements.

Q. DOES THIS CONCLUDE YOUR TESTIMONY?

A. Yes.

SOUTH FLORIDA BUILDING CODE 1998

DADE COUNTY EDITION

Chapter: 05 Section: 00

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Chapter: 05 Section: 01

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0501.1

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The intent of this Code is that buildings shall be of one type of construction required for the occupancies contained therein.

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0501.2

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No building or structure shall be erected nor any lot or portion of a lot be subdivided or sold nor any lot line moved by sale of land or otherwise in such a manner as to eliminate, nullify or reduce any required spaces for light and ventilation or means of egress or in any way to create violations of any of the provisions of this Code.

Chapter: 05 Section: 02

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0502.1

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(a) Every building or portion thereof, whether existing or hereafter erected, shall be classified by the Building Official according to its use or the character of its occupancy, as a building of Group A, B, C, D, E, F, G, H, I or J Occupancy, as defined in Chapters 6, 7 ,8 ,9, 10 ,11 ,12 ,13 ,14 , and 15 respectively.

(b) (1) Where minor accessory uses do not occupy more than 10 percent of the area of any floor of a building, nor more than 10 percent of the basic area permitted by occupancy, the major use of the building shall determine the occupancy classification.

(2) In buildings of Group G. Division 1 Occupancy, rooms for storing, sorting and unpacking goods held for retail sales shall be considered and classified the same as retail sales display areas.

(c) Minor accessory buildings not exceeding 10 percent of the area of the ground floor of the primary building, nor 1500 sq. ft., whichever is larger, and constructed of unprotected incombustible materials may, where complying with Subsection 1701.6 herein, be constructed without changing the limiting areas based on group of occupancy classification.

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0502.2
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Any occupancy not specifically mentioned shall be classified by the Building Official in the Group it most nearly resembles.

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0502.3
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Unless otherwise classified, accessory buildings shall conform to the requirements of the occupancy to which the building is accessory.

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0502.4
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When an occupancy is located in an unusual structure, such as within a vehicle or vessel, or a structure which is windowless or underground, the occupancy and the applicable portions of this Code and NFPA 101, including chapter 30 of NFPA 101.

Chapter: 05 Section: 03

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0503.1
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No change in the character of occupancy of a building shall be made except as set forth in Subsection 104.7.

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0503.2
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No change in the character of occupancy of a building shall be made without a Certificate of Occupancy, as required in Section 307 of this Code.

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0503.3
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Buildings in existence at the time of the passage of this Code shall comply with Subsection 104.8 herein.

Chapter: 05 Section: 04

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0504.1
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The occupant load shall be computed as set forth in Paragraph 3102.2(d) of this Code.

Chapter: 05 Section: 05

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0505.1
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Adjoining units of different occupancies within a fire division shall be separated by a separation at least as fire-resistive as set forth in Section 508 of this Code.

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0505.2
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Two or more units of different occupancy may be contained within a fire division, but all such units shall conform to the provisions of Chapters 6 through 15 of this Code for the most restrictive of the occupancies so contained except as otherwise set forth

in Subsection 502.1 hereinabove.

Chapter: 05 Section: 06

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0506.1
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Where in this Code and particularly in Chapters 6 through 15 of this Code, specific maximum allowable areas are set forth, the building may be separated into fire divisions and each such fire division shall be considered a separate building and be of the maximum allowable area provided the fire division separation walls (fire barriers) comply with this section.

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0506.2
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(a) Fire division separation walls shall be not less than 4-hour fire barriers in buildings of Type I, 3-hour fire barriers in buildings of Type II, and 2-hour fire barriers in buildings of Types III, IV, and V Construction.

(b) The total width of all openings in such walls shall not exceed 25 percent of the length of the wall in each story.

(c) Openings shall be protected as required in Section 1807 and Chapter 31, both of this Code.

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0506.3
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Fire barriers used for division separation need not extend to the outer edge of horizontal projecting elements such as balconies, roof overhangs, canopies, marquees, or ornamental projections provided that the exterior wall at the termination of the fire division separation wall and the projecting elements are not less than 1-hour fire resistive construction for a width equal to the depth of the projecting elements, but such fire protection need not extend more than 10'-0" on either side of the termination. Wall openings within such widths shall be protected by not less than 3/4-hour fire-resistive assemblies.

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0506.4
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Fire division separation walls shall extend from the foundation to a point at least 30" above the roof.

EXCEPTIONS:

1. 4-hour and 3-hour fire division separation walls may terminate at the bottom of the roof deck provided the roof deck is of incombustible construction for the area within 40 feet on each side of the wall.

2. 2-hour fire division separation walls (other than townhouses) may terminate at the underside of roof deck provided that the roof is of at least one-hour fire resistive construction on each side of the fire division separation wall termination.

3. 2-hour fire division separation walls for townhouses shall extend a minimum of 10" above the finished roof surface provided that the roof is of at least one-hour fire resistive construction on each side of the fire division wall. Instead of the 10" extension, the Building Official may accept such other method of design or construction which allows for the independence of the sheathing, structural and roof components of adjacent townhouse units.

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0506.5
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Where a fire division separation wall separates portions of a building having different heights, such wall may terminate at a point 30" above the lower roof level provided the exterior wall for a height of 10'-0" above the lower roof is one hour fire-resistive construction with openings protected by 3/4 hour fire-resistive assemblies.

EXCEPTION: The fire division separation wall may terminate at the deck of the lower roof provided the lower roof is a of at least one-hour fire-resistive construction for the width of 10'-0", without openings, measured from the wall.

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0506.6

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Fire dampers in ducts passing through fire division separation walls shall be required as set forth in Section 4905 of this Code.

Chapter: 05 Section: 07

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0507.1 EXTERIOR WALLS:

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Subject to the applicable legal provisions of common ownership, a wall may be used as a PARTY WALL when conforming to the following requirements.

(a) Where the Type or Types of Construction used and/or combined floor areas of an existing and a proposed building are such that a separation into fire divisions is required, such walls shall meet the requirements for fire walls under this Code.

(b) Where not required as a fire wall but used to separate Occupancies, such wall shall conform with the requirements for separations of Occupancies under this Code.

(c) Such wall in all its parts shall conform to the engineering regulations of this Code or shall be made to conform therewith.

(d) Party walls used as common walls between separately owned buildings shall be incombustible and rated a minimum of two hours and shall meet the provisions of Subsection 506.4 hereinabove.

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0507.2 SEPARATION BETWEEN TENANTS:

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(a) In any building where rooms or spaces are occupied by separate tenants, not less than 1-hour fire-resistive construction shall be provided between tenants and between tenants and common areas.

EXCEPTIONS:

(1) As otherwise permitted for the group of occupancy by Chapter 31 of this Code.

(2) Fire separation will not be required between tenants or between tenants and common areas of Group A, B, F, G, Division 1, H, and J Occupancies where walls or partitions are omitted or where visual intercommunication through separation walls or partitions is provided for 50 percent or more of the area of the wall or partition.

(3) Group F, Division 1 tenancies 400 sq. ft. and less in area shall not be required to meet the provisions of the Subsection when one story in height provided fire division walls are constructed for each 10,000 sq. ft. of building area.

(b) Fire-resistive separation between tenants shall be continuous between fire barriers. Where exposed combustible materials are used in an attic or ceiling the separation between tenants shall be continuous to the deck above such space and shall include any eaves or overhangs.

EXCEPTION: A barrier required for an occupied space below interstitial space is not required to extend though the interstitial space provided the construction assembly forming the bottom of the interstitial space has a fire resistance rating equal to that of the fire barrier.

(c) Openings in fire-resistive separations between tenants shall be protected as set forth in Section 1807 of this Code by assemblies complying with Section 3706 of this Code and air movement openings shall be provided with smoke and/or fire dampers, as required therein.

(d) Walls or partitions required by this Code to be fire-resistive based on group of occupancy, type of construction, occupancy separation in Section 503 herein, draft stopping as set forth under types of construction, or protection of means of egress in Chapter 31 of this Code, may serve as separation between tenants where such walls and partitions also comply with this subsection.

Chapter: 05 Section: 08

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0508.1

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Occupancy separations shall be provided between the various groups and divisions of occupancies as specified herein and in Table No, 5-A, but shall be not less fire-resistive than required for the type of construction.

(Click on the "FIGURE" button to view the appropiate tables or figures associated with this Code Section)

****

0508.2 FORM OF OCCUPANCY SEPARATION:

****

Occupancy separations shall be in the form of fire barriers which may be vertical, horizontal or inclined, depending upon the geometry and relative position of the portions to be separated, and shall consist of a system of walls, partitions, floors or other construction of such materials and construction, so arranged as to provide a complete, secure and continuous firebreak of the required fire-resistive rating between the portions of the building so separated.

****

0508.3 CLASSIFICATIONS OF OCCUPANCY SEPARATION:

****

(a) Fire barrier separations between occupancies within a fire division and between fire divisions shall be classified, each classification designated by the number of hours of fire-rating as set forth herein.

(b) A four-hour fire barrier separation shall be of not less than 4-hour fire-resistive construction and openings therein shall be protected in accordance with Paragraph 506.2(c) herein.

(c) (1) A 3-hour fire barrier separation shall be of not less than 3-hour fire-resistive construction.

(2) All openings in walls of 3-hour fire barrier separations shall be protected by a fire assembly having a 3-hour fire barrier rating.

(3) The total width of all openings in any 3-hour fire barrier in any one story shall not exceed 25 percent of the length of the wall in that story and no single opening shall have an area greater than 120 sq. ft.

(4) All openings in floors forming a 3-hour fire barrier separation shall be protected by vertical enclosures extending above and below such openings . The walls of such vertical enclosures shall be of not less than 2-hour fire-resistive construction and all openings therein shall be protected by a fire assembly having a 1-1/2 hour fire protection rating.

(d) A 2-hour fire barrier separation shall be for not less than 2-hour fire-resistive construction. All openings in such separation shall be protected by a fire assembly having a one and one-half hour fire protection rating.

(e) A 1-hour fire barrier separation shall be of not less than 1-hour fire resistive construction. All openings in such separation shall be protected by a fire assembly having a 3/4 hour fire protection rating

EXCEPTION: As otherwise permitted by the group of occupancy or Section 1807 of this Code.

(f) A 3/4 -hour fire barrier shall be of not less than 3/4-hour fire resistive construction and openings therein shall be protected with assemblies of not less than a 20-minute fire protection rating.

(g) A 20-minute fire barrier shall be of not less than 20-minute fire resistive construction, and openings therein shall be protected with assemblies of not less than a 20 minute fire protection rating.

****
0508.4 DESIGN AND MATERIAL OF OCCUPANCY SEPARATION:
****
Walls which form separations between occupancies or between fire divisions shall also conform with the provisions of PART VI as they pertain to design and materials.

Chapter: 05 Section: 09

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0509.1
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Protection shall be provided from any area having a degree of hazard greater than that normal to the general occupancy of the building or structure, such as storage of combustibles or flammables, heat-producing appliances, or maintenance purposes, as set forth in this section.

(a) Enclosures with construction in accordance with Section 1807 of this Code with a fire resistance rating as specified by the group of occupancy, but not less than 1 hour without windows and with doors of 3/4 -hour fire protection rating, or

(b) Protection with automatic extinguishing systems in accordance with Chapter 38 of this Code as required for the group of occupancy.

(c) Both (a) and (b) above when specified for the group of occupancy by Chapter 38 or 31 both of this Code.

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0509.2
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Where hazardous processes or storage are of such a character as to introduce an explosion potential, explosion venting or an explosion suppression system specifically designed for the hazard involved shall be provided as set forth in Chapter 41and 49 of this Code.

****
0509.3 HAZARDOUS UTILITIES:
****

(a) GENERAL: Individual feeders and shut-offs shall be provided for every separate fire division in every building.

(b) ELECTRIC: Where electricity is served to multiple tenants (more than 2), the provisions of Paragraph 4506.1 (d) of this Code shall be satisfied.

(c) GAS: Where gas is served to separated fire divisions or occupancies, there shall be individual valves, and valves and meters shall be located on the exterior of the building in a conspicuous and accessible place. Installation shall be as set forth in Chapter 47 of this Code.

(d) OTHER: Other utilities which may constitute hazards shall, in general, be governed by the provisions of this section and shall be subject to such additional requirements as the Building Official may prescribe.

Chapter: 05 Section: 10

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0510.1
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Where two or more types of occupancy occur within the same building or structure, and are so intermingled that separate safeguards are impracticable, means of egress facilities, construction, protection and other requirements shall comply with the most restrictive life safety requirements of the occupancies involved.

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0510.2
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Where two or more types of occupancy occur in different parts or separate floors of the same building, the combined width of means of egress at any floor or part, other than the first or ground floor, shall not be less than required for the specific occupancy considered separately and the occupant content of only that floor or part of the building. See also Subsection 3102.2 of this Code.

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0510.3
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Additional requirements for mixed occupancies shall be as set forth in Chapter 31 of this Code.

Chapter: 05 Section: 11

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0511.1
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The location of all buildings and/or structures shall conform to the provisions of applicable zoning.

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0511.2
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The location of all buildings and the protection of certain openings shall conform to the requirements of the group of occupancy in which such building is classified in this Code, according to the use or the character of the occupancy.

****
0511.3 SEPARATION FROM THE METROMOVER:
****
New construction of buildings and structures shall not be located within 5 feet horizontal separation from the Metromover. Horizontal separation shall mean the distance from the exterior wall of such building or structure to the Metromover when projected on a horizontal plane. The Building Official and the Metro Dade Transit Agency may approve locations for new construction of buildings and structures that are less than 5 feet horizontally from the Metromover where the portions of the building and/or structure within 5 feet of the Metromover are separated by means of 4 hour fire rated walls. When openings are permitted in required 4 hour fire rated walls separating buildings and/or structures from the Metromover, they shall be protected with Class A fire door assemblies and arranged as horizontal exit separations.

Chapter: 05 Section: 12

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0512.1 WASTE STORAGE:
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Adequate permanent enclosures shall be provided for the storage of waste within the lines of the lot or lots occupied.

****
0512.2 TOILET ROOMS:
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(a) Toilet facilities shall be provided on each floor for each sex using that floor and shall be located to be readily accessible except that in a building where the two lower levels, such as a first floor and mezzanine, or the first floor and second floor where there is no mezzanine, are occupied by a single tenant and the toilet facilities are not for public use, the combined total toilet facilities required for these two levels may be located in either the first or second level. Toilet facilities in Group A or B Occupancies, such as restaurants, bars, transportation terminals and similar locations, will be permitted this two-level exception when the travel distance from the remote corner of one level to the entrance door of the toilet facility of the other level does not exceed 150'-0".

(b) Minimum toilet facilities shall be a toilet room having one water closet and one lavatory, which may serve both sexes but not more than nine persons.

(c) Water closets for public use, except within the residence or apartment of a single family, shall be of an elongated type and shall be equipped with open front seats, and shall be separated from the rest of the room, and from each other, by stalls of impervious materials. Such stalls shall be equipped with self-closing doors and shall be open at the top and at least 12" from the floor for ventilation.

(d) The floors and walls of the public toilet rooms, to a height of 5'-0", shall be tile or similar impervious materials.

(e) Toilet rooms connected to rooms where food is prepared or served to the

public shall be separated therefrom by a vestibule with close-fitting doors.

EXCEPTION: Toilet rooms, connected to rooms where food is served, that are completely enclosed, have close fitting, self-closing doors and mechanical ventilation that causes a negative pressure relative to areas of food service.

(f) Toilet rooms connected to public rooms or passageways shall have a vestibule or shall otherwise be arranged or screened to insure decency and privacy.

(g) Public toilets shall bear signs plainly indicating for which sex and/or group such room is intended.

(h) Required facilities in public buildings shall be available to employees and the public without charge.

(i) Warehouses or storage buildings renting or leasing bays or stalls of not more than 500 sq. ft. and that do not have separate electric service for the purpose of determining the required toilet facilities only, such buildings shall be considered as a single tenant. Toilet facilities shall be provided with a travel distance not to exceed 500'-0".

(j) Requirements for plumbing fixtures and systems shall be as set forth in Chapter 46 of this Code.

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0512.3 SCREENING:
****

(a) Food-storage and preparation rooms shall have outside openings screened with 18-mesh-wire screening. Screen doors shall be equipped with self-closing devices.

(b) Public dining rooms, restaurants, tearooms and similar places for serving food to the public shall be completely screened with 18-mesh wire to effectively prevent the entrance of insects. This requirement for screening or installation of fans in public dining shall not be construed to prevent the serving of food to the public in outdoor areas.

Chapter: 05 Section: 13

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0513.1 GENERAL:
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(a) Headroom shall be defined as the minimum ceiling height from the finished floor surface to the lowest point of the ceiling or other overhead obstruction. The minimum headroom in means of egress shall be 7'-6".

EXCEPTIONS:

(1) Headroom on stairs may be 6'-8", measured as specified in Paragraph 3102.1(b) of this Code.

(2) Pipes, ducts and stationary mechanical appurtenances may be permitted to reduce the headroom at a point to not less than 6'-8". For corridors serving as exit access, the term "point" shall be taken to mean a section of the ceiling not exceeding two feet in the direction of exit travel.

(3) The headroom under mechanical appurtenances with exposed moving parts, including any ceiling fan, shall be not less than 7'-0".

(b) Small storage closets, slop-sink closets, storage space under a stair and similar small areas where persons do not generally walk into shall not be limited to height.

(c) Doors connecting space where minimum ceiling heights are herein regulated shall be of not less than 6'-8" in height.

(d) The minimum height of entrances for pedestrian or vehicular traffic and for parking spaces under or within a building shall be 6'-8".

EXCEPTION: As otherwise set forth in (b), above.

(e) The ceiling height of a limited storage mezzanine or area where persons may infrequently be and only for the purpose of placing or removing stored materials shall not be limited.

****
0513.2 CEILING HEIGHTS BY SPECIFIC USE:

****

(a) Ceiling heights of residential Occupancies shall comply with Sections 1305, 1405, and 3104 of this Code as applicable.

(b) Stairways and landings shall have headroom as set forth in Subsection 3102.1 of this Code.

(c) The maximum headroom of parking garages for passenger cars, where the design is based on a reduced live load, shall not exceed 7'-6" fixed.

(d) Headroom under roof signs shall comply with Subsection 4206.4 of this Code

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Chapter: 05 Section: 14

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0514.1 BASIC FLOOR AREA:

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(a) (1) The area of a one-story building in Fire Zones 1 and 2 shall not exceed the limits set forth in Chapters 6 though 15 of this Code except as provided in Subsection 514.2 herein.

(2) Buildings in Fire Zone 3 may have basic areas of one-third more than the limits set forth in Chapters 6 through 15 of this Code and the basic areas so computed may be further increased as provided in Subsection 514.2 herein.

(b) Basements and cellars need not be included in the total allowable area provided they do not qualify as a story or exceed the area permitted for a 1-story building.

(c) The total area of all floors of a multi-story building shall not exceed twice the area allowed for one-story buildings.

(d) No single floor area shall exceed that permitted for 1-story buildings.

****

0514.2

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(a) BASIC AREA INCREASES: The basic areas provided in Subsection 514.1 hereinabove may be increased by the percentages set forth in one of the following:

(1) Where public space, streets, or yards more than 20'-0" in width extend along and adjoin two sides of a building, the basic floor area may be increased at a rate of 1-1/4 percent for each 1'-0" by which such space, street, or yard exceeds 20'-0", but such increase shall not exceed 50 percent.

(2) Where public space, streets, or yards more than 20'-0" in width extend along and adjoin three sides of a building, the basic floor area may be increased at a rate of 2-1/2 percent for each foot by which such space, street, or yard exceeds 20'-0", but such increase shall not exceed 100 percent.

(3) (aa) Where public space, streets, or yards more than 20'-0" in width extend on all sides of a building and adjoin the entire perimeter, the basic floor area may be increased at a rate of 5 percent for each 1'-0" by which such space, street, or yard exceeds 20'-0".

(bb) Such increases shall not exceed 100 percent, except as provided in Paragraph 514.2(b) herein.

(4) Floor areas so computed are the maximum allowable except where unlimited as provided in Paragraph 514.2(b) or except in buildings provided with automatic fire extinguishing systems as set forth in Paragraph 514.2(c) herein.

(b) UNLIMITED AREA:

(1) The areas of buildings of Groups F and G Occupancy shall not be limited where such buildings do not exceed 2 stories in height, are entirely surrounded by public space, streets, or yards not less than 60'-0" in width, and are provided with an approved automatic fire extinguishing system throughout as set forth in Chapter 38 of this Code.

(2) The areas of 1-story buildings of Groups F and G Occupancy Type II, Type III (Protected), or Type IV Construction shall not be limited where such buildings are entirely surrounded and adjoined by public space, streets, or yards not less than 60'-0" in width.

(c) AUTOMATIC FIRE EXTINGUISHING SYSTEMS:

(1) The basic areas provided in Subsection 514.1 hereinabove may be tripled in 1-story buildings and doubled in buildings more than 1-story where such buildings are provided with approved automatic fire extinguishing systems throughout, as set forth in Chapter 38 of this Code.

(2) In buildings of Group E occupancy, the area increases permitted in the Sub-paragraphs of paragraph 514.2 (a) hereinabove applied to the advised basic area.

(d) PUBLIC SPACE , STREETS, OR YARDS: where the width of public space, streets, or yards is used to increase floor area, such space, street or yard shall remain unobstructed to provide permanent access not less than 20'-0" in width for fire-fighting equipment to serve each building.

Chapter: 05 Section: 15

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For 515 Accessiblity Requirements please refer to F.S. 553.501-513
(Florida Americans with Disablities Accessiblity Implementation Act)
also
Portions of Fair Housing Act
Sections 760.22 (a)(b) - 760.23 (10), Florida Statues

Section 515, which covers pages 5-13 through 5-25, has been deleted in its entirety.
Please discard and replace with page 5-13 of Supplement No.2.

You can get copies of above mentioned materials by contacting:

State of Florida
Department of Community Affairs

2740 Centerview Drive
Tallahassee, FL 32399
(904) 487-1824

Chapter: 05 Section: 16

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0516.1 GENERAL:
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(a) Safeguards in and around buildings and structures such as covers, railings, stair-railings, handrails, or other safeguards as defined and provided in the regulations of the Occupational Safety and Health Administration.(OSHA)29CFR Part 1910 as applied to permanent structures, set forth in Section 402 of this Code, and as provided herein.

(b) Such safeguards shall also be designed to comply with Section 515 herein and to resist the loads set forth in Subsection 2305.7 of this Code.

****
0516.2 WALL AND FLOOR OPENINGS:
****

(a) Open or glazed wall openings; open or glazed sides of balconies, landings and other walking surfaces; unenclosed floor and roof openings; roofs used for other than services for the building or structure and, except in Groups E and F Occupancies, any other abrupt differences in level exceeding 30", including yard areas, shall be provided with safeguards not less than 42" in height.

(b) Such differences in level exceeding 30" in and around Groups E and F Occupancies shall be provided with safeguards not less than 42" in height.

(c) Safeguards may be omitted at loading docks, truck wells and similar locations where it is apparent that the edge of the higher level is for loading, and on docks, seawalls and decorative fountains where the lower level is the water surface.

(d) (1) Safeguards in and around buildings of other than Groups H and I Occupancies shall be provided with additional rails, vertical pickets, or an ornamental filler below the top rail which will reject a 6" diameter object.

(2) Safeguards in and around buildings of Groups H and I Occupancies shall provide protection for children by providing additional rails, vertical pickets, or an ornamental filler below the top rail which will reject a 4" diameter object; permitting, however, such ornamental fillers to have individual openings not exceeding 64 sq. in.in area.

(3) Where a balustrade is used to comply with the requirements of this paragraph, the maximum clearance between the bottom rail of the balustrade and the adjacent surface shall not exceed 2". For safeguards on stairs, the 2" clearance shall be measured from the bottom rail of the balustrade to a line passing through the tread nosings.

(e) Intermediate rails, balusters, and panel fillers shall be designed for a uniform horizontal load of not less than 25 lb/sq.ft. over the gross area of the guard, including the area of any openings in the

guard, of which they are a part. Reactions due to this loading need not be added to the loading specified by Subparagraph 3103.3(e)(5)(dd) of this Code in designing the main supporting members of guards.

EXCEPTION: Safety glazing will be permitted as an equal alternate to pickets, if tested by an accredited laboratory to satisfy the resistance requirements of this Code for wind, live and kinetic energy impact loading conditions.

(f) Areas in all occupancies, from which the public is excluded, requiring such protection may be provided with vertical barriers having a single rail midway between a top rail and the walking surface provided the design meets the requirements of the sub-section 2305.7 of this Code.

****
0516.3 STAIRWAYS AND RAMPS:
****
Safeguards for stairways, ramps, and landings shall also meet the requirements set forth in Subsection 3103.3 of this Code.

****
0516.4 VEHICLE SAFEGUARD BARRIERS:
****

(a) Vehicle safeguard barriers are required in parking garages whenever there is a difference in level exceeding 1' - 0".

(b) Unless separate pedestrian safeguards are provided vehicle safeguard barriers shall, in addition to the requirements of this subsection, meet all other requirements of Section 516.

(c) The requirement of Subparagraph 516.2 (d) (1) for the rejection of a 6 inch diameter object shall be met when the barrier is subjected to a horizontal load of 25 lb/sq. ft., applied as specified in 516.2 (e).

(d) Vehicle safeguard barriers shall be capable of resisting a minimum horizontal ultimate load of 10,000 lb. applied 18 inches above the floor at any point in the barrier system. This load need not be applied in combination with loads specified in 516.2 (e) and in Subsection 2305.7.

(e) Vehicle safeguard barrier systems of metal framing, concrete or masonry may be designed by allowable stress design for a concentrated horizontal load of 7500 lbs. in lieu of the 10,000 lb. ultimate load specified above.

(f) Special requirements for cable safeguard barriers:

(1) Horizontal deflection under design load shall not exceed 18 inches.

(2) The design load shall be assumed to be resisted by not more than two cables.

(3) The cable system including anchors shall be protected against corrosion.

(4) Cable tension under design load shall not exceed 90% of the yield strength of the cable.

(5) The uppermost cable shall be at least 42 inches above the adjacent surface. Cables shall not be spaced more than 6 inches apart.

(6) An installation plan prepared by the structural engineer of record shall be submitted to the Building Official for his or her approval.

(7) Installation shall be witnessed by a Special Inspector who shall certify:

(aa) That the installation has been in accordance with the approved installation plan.

(bb) That the initial tension designated by the Structural Engineer of Record has been provided in all cables.

(cc) That all anchors have been seated at a total load, including initial tension, equal to 85% of the yield strength of the cable, unless a positive locking device is provided that does not require a tension jack for the tensioning of the barrier strand.

(dd) Special inspectors shall conform with the requirement of Section 305.3 (c), (d), (e), and (f).

(8) Drawings will indicate the initial tension, the expected increase in tension under vehicular impact, and the required maximum capacity of the strand barrier syste□

TABLE 600
FIRE RESISTANCE RATINGS
REQUIRED FIRE RESISTANCE IN HOURS

STRUCTURAL ELEMENT	TYPE I	TYPE II	TYPE III	TYPE IV		TYPE V		TYPE VI	
				1-Hour Protected	Unprotected	1-Hour Protected	Unprotected	1-Hour Protected	Unprotected
PARTY AND FIRE WALLS (a)	4	4	4	4	4	4	4	4	4
INTERIOR BEARING WALLS	(l)								
Supporting columns, other bearing walls or more than one floor	4	3	2	1	NC	1 (h)	0 (h)	1	0
Supporting one floor only	3	2	1	1	NC	1	0	1	0
Supporting roofs only	3	2	1	1	NC	1	0	1	0
INTERIOR NONBEARING PARTITIONS	See 704.1, 704.2 and 705.2								
COLUMNS (q)	(l)		See 605						
Supporting other columns or more than one floor	4	3	H(d)	1	NC	1	0	1	0
Supporting one floor only	3	2	H(d)	1	NC	1	0	1	0
Supporting roofs only	3	2	H(d)	1	NC	1	0	1	0
BEAMS, GIRDERS, TRUSSES & ARCHES	(l)		See 605						
Supporting columns or more than one floor	4	3	H(d)	1	NC	1	0	1	0
Supporting one floor only	3	2	H(d)	1	NC	1	0	1	0
Supporting roofs only	1 1/2(e,p)	1(e,f,p)	H(d)	1(e,p)	NC(e)	1	0	1	0
FLOORS & FLOOR/CEILING	(l)		See 605	(n)	(n,o)	(n)	(m,n,o)		(o)
ASSEMBLIES	3	2	H (o)	1	NC	1	0	1	0
ROOFS & ROOF/CEILING ASSEMBLIES (g)	1 1/2(e,p)	1 (e,f,p)	See 605 H(d)	1(e,p)	NC(e)	1	0	1	0
EXTERIOR BEARING WALLS and gable ends of roof (g, i, j)	(% indicates percent of protected and unprotected wall openings permitted. See 705.1.1 for protection requirements.)								
Horizontal separation (distance from common property line or assumed property line).									
0 ft to 3 ft (c)	4(0%)	3(0%)	3(0%)(b)	2(0%)	1(0%)	3(0%)(b)	3(0%)(b)	1(0%)	1(0%)
over 3 ft to 10 ft (c)	4(10%)	3(10%)	2(10%)(b)	1(10%)	1(10%)	2(10%)(b)	2(10%)(b)	1(20%)	0(20%)
over 10 ft to 20 ft (c)	4(20%)	3(20%)	2(20%)(b)	1(20%)	NC(20%)	2(20%)(b)	2(20%)(b)	1(40%)	0(40%)
over 20 ft to 30 ft	4(40%)	3(40%)	1(40%)	1(40%)	NC(40%)	1(40%)	1(40%)	1(60%)	0(60%)
over 30 ft	4(NL)	3(NL)	1(NL)	1(NL)	NC(NL)	1(NL)	1(NL)	1(NL)	0(NL)
EXTERIOR NONBEARING WALLS and gable ends of roof (g, i, j)	(% indicates percent of protected and unprotected wall openings permitted. See 705.1.1 for protection requirements.)								
Horizontal separation (distance from common property line or assumed property line).									
0 ft to 3 ft (c)	3(0%)	3(0%)	3(0%)(b)	2(0%)	1(0%)	3(0%)(b)	3(0%)(b)	1(0%)	1(0%)
over 3 ft to 10 ft (c)	2(10%)	2(10%)	2(10%)(b)	1(10%)	1(10%)	2(10%)(b)	2(10%)(b)	1(20%)	0(20%)
over 10 ft to 20 ft (c)	2(20%)	2(20%)	2(20%)(b)	1(20%)	NC(20%)	2(20%)(b)	2(20%)(b)	1(40%)	0(40%)
over 20 ft to 30 ft	1(40%)	1(40%)	1(40%)	NC(40%)	NC(40%)	1(40%)	1(40%)	0(60%)	0(60%)
over 30 ft (k)	NC (NL)	NC(NL)	NC(NL)	NC(NL)	NC(NL)	NC(NL)	NC(NL)	0(NL)	0(NL)

For SI: 1 ft = 0.305 m.

NC = Noncombustible
NL = No Limits
H = Heavy Timber Sizes

Notes:

a. See 704.5 for extension of party walls and fire walls.
b. See 704.5 for parapets.
c. See 705 for protection of wall openings.
d. Where horizontal separation of 20 ft or more is provided, wood columns, arches, beams, and roof deck conforming to heavy timber sizes may be used externally.
e. In buildings not over two stories approved fire retardant treated wood may be used.
f. In one-story buildings, structural members of heavy timber sizes may be used as an alternate to unprotected structural roof members. Stadiums, field houses and arenas with heavy timber wood dome roofs are permitted. An approved automatic sprinkler system shall be installed in those areas where 20 ft clearance to the floor or balcony below is not provided.
g. See 1517 for penthouses and roof structures.
h. The use of combustible construction for interior bearing partitions shall be limited to the support of not more than two floors and a roof.
i. Exterior walls shall be fire tested in accordance with 601.3. The fire resistance requirements for exterior walls with 5 ft or less horizontal separation shall be based upon both interior and exterior fire exposure. The fire resistance requirements for exterior walls with more than 5 ft horizontal separation shall be based upon interior fire exposure only.
j. Where Appendix F is specifically included in the adopting ordinance, see F102.2.6 for fire resistance requirements for exterior walls of Type IV buildings in Fire District.
k. Walls or panels shall be of noncombustible material or fire retardant treated wood, except for Type VI construction.
l. For Group A - Large Assembly, Group A - Small Assembly, Group B, Group E, Group F, Group R occupancies and Automobile Parking Structures, occupancies of Type I construction, partitions, columns, trusses, girders, beams, and floors may be reduced by 1 hour if the building is equipped with an automatic sprinkler system throughout, but no component or assembly may be less than 1 hour.
m. Group A - Large Assembly (no stage requiring proscenium opening protection) and Group A - Small Assembly occupancies of Type V Unprotected construction shall have 1-hour fire resistant floors over any crawl space or basement.
n. For Group B and Group M occupancies of Type IV or Type V construction, when five or more stories in height a 2-hour fire resistant floor shall be required over the basement.
o. For unsprinklered Group E occupancies of Type III, Type IV Unprotected, Type V Unprotected or Type VI Unprotected, floors located immediately above useable space in basements shall have a fire resistant rating of not less than 1 hour.
p. In buildings of Group A, B, E, and R occupancies, the required fire resistance of the roof or roof/ceiling assembly including the beams, girders, trusses, or arches that support the roof only may be omitted where every part of the roof structural members have a clear height of 20 ft (6096 mm) or more above any floor, mezzanine or balcony.
q. See 701.4.

ment in a cubic-foot box, using the shoveling procedure as outlined in ASTM C 29.

703.10 Glass block. Glass block shall be labeled to conform to NFPA 257 or UL 9.

SECTION 704
FIRE RESISTANT SEPARATIONS

704.1 Occupancy separation requirements

704.1.1 The minimum fire resistance of construction separating any two occupancies in a building of mixed occupancy shall be the higher rating required for the occupancies being separated, as specified in Table 704.1.

TABLE 704.1
OCCUPANCY SEPARATION REQUIREMENTS

Large or Small Assembly	2 hour
Business	1 hour
Educational	2 hour
Factory-Industrial	2 hour
Hazardous	See 704.1.4
Institutional	2 hour
Mercantile	1 hour
Residential	1 hour
Storage, Moderate Hazard S1	3 hour
Storage, Low Hazard S2	2 hour
Automobile Parking Garages[1]	1 hour
Automobile Repair Garages	2 hour

Note:
1. See 411.2.6 for exceptions.

704.1.2 Accessory occupancies.

704.1.2.1 Portions of buildings used as accessory offices or for customary nonhazardous uses necessary for transacting the principal business in Group S and Group F occupancies need not be separated from the principal use. Group F occupancies producing, using or storing low hazard products listed in 312.2.2 need not be considered mixed occupancies. Height and area will be governed by the principal intended use.

704.1.2.2 The following occupancies need not be separated from the uses to which they are accessory:

1. A kitchen in a Group A occupancy does not constitute a mixed occupancy. A fire resistant separation is not required.
2. Assembly rooms having a floor area of not over 750 sq ft (70 m^2).
3. Administrative and clerical offices and similar rooms which, in area per story, do not exceed 25% of the story area of the major use when not related to Group H occupancies.

   Exception: Accessory uses in Group F and S occupancies conforming to 704.1.2.1.

4. Rooms or spaces used for customary storage of nonhazardous materials in Group A, Group B, Group E, Group F, Group M, and Group R, which in aggregate do not exceed one-third of the major occupancy floor area in which they are located.
5. Portions of buildings which are less than 3,000 sq ft used as accessory small businesses to and open for business simultaneously with the principal retail sales occupant, only in a Group M occupancy.

   Exception: Item 5 shall not apply to separation walls between tenants and malls in covered mall buildings.

704.1.2.3 A 1-hour occupancy separation shall be permitted in assembly rooms greater than 750 sq ft (70 m^2) but less than 2,000 sq ft (186 m^2) in area when all of the following are met:

1. The occupant content does not exceed 300 persons calculated in accordance with Table 1003.1.
2. The assembly room does not constitute the major occupancy classification of the building.
3. The assembly room is not associated with a hazardous or Group S1 occupancy.
4. The assembly room is not associated with a kitchen.
5. The assembly room is not a theater or restaurant.

704.1.3 Special occupancy separations.

704.1.3.1 Assembly and educational. Fire resistance separation shall not be required between Sunday school rooms and a church auditorium of Group A - Small Assembly occupancy, and between classrooms in day schools and auditoriums, gymnasiums, cafeterias, and libraries of small assembly occupancy, which are used only as accessory uses to the education occupancy.

704.1.3.2 Automobile parking garages. A separation between an automobile parking garage used exclusively for the storage of passenger vehicles that will accommodate not more than nine passengers and any other occupancy having a rating of 2 hours or more in Table 704.1 shall be 2 hours.

704.1.3.3 Boiler and machinery rooms

704.1.3.3.1 Every central heating boiler as defined in the Standard Mechanical Code, installed in any building other than a one or two family dwelling or Group F, shall be separated from the rest of the building by not less than 1-hour fire resistant construction.

704.1.3.3.2 A central heating boiler installed in a Group A or H occupancy shall be separated from the rest of the building by construction having a fire resistance rating of not less than 2 hours.

704.1.3.3.3 Steam boilers. Every steam boiler carrying more than 15 psi (103 kPa) pressure with a rating in excess of 10 boiler horsepower (98 kW)

installed in a building other than one of Group F occupancy, shall be located in a separate room or compartment, shall not be located under a means of egress and shall be separated from the rest of the building by construction having at least 2-hour fire resistance. This rating may be reduced in accordance with the hazard existing when in the opinion of the building official it is desirable to provide for explosion venting upward.

704.1.3.3.4 Refrigerant system machinery rooms. Where required by the Standard Mechanical Code due to refrigerant type, amount, system classification and occupancy, a Level 2 machinery room shall be of noncombustible construction. A minimum of 1-hour construction shall separate the machinery room from other occupied spaces. A minimum of 3/4-hour C-labeled doors shall be used when separating from other occupancies.

704.1.4 Hazardous occupancies

704.1.4.1 The separation of a hazardous occupancy from other occupancies shall be in accordance with Table 704.1.4.

TABLE 704.1.4
HAZARDOUS OCCUPANCY SEPARATION REQUIREMENTS

OCCUPANCY	H1	H2	H3	H4
A	NP	4	4	4
B	NP	2	2	1
E	NP	4	4	4
F	NP	2	1	1
H1	—	NP	NP	NP
H2	NP	—	1	2
H3	NP	1	—	1
H4	NP	2	1	—
I	NP	4	4	4
M	NP	2	2	2
R1,2,3, and 4	NP	4	4	4
S1,2	NP	2	2	2

Note:
NP = H1 occupancies not permitted to be attached to other occupancies or other H subclassifications.

704.1.4.2 The separation of a hazardous occupancy subclassification shall only apply to storage areas.

704.1.4.3 Building areas intended for the use, processing, manufacture or generation of materials having different hazard classifications, all of them being Group H, need not be separated further within the confines of the Group H occupancy provided the requirements for each hazard are met.

704.1.4.4 Accessory areas, other than assembly occupancies, that do not exceed 10% of the allowable area for the hazardous occupancy subclassification in Table 500 and that do not exceed 1,500 sq ft (139 m^2) shall not be required to comply with 704.1. Where accessory areas are separated from hazardous occupancies by partitions, the partitions shall be not less than 1-hour fire resistant construction with an opening protection rating not less than 3/4-hour. Opening protection shall be either self-closing or automatic-closing in accordance with 705.1.3.2.3.

704.2 Interior wall and partition fire separation requirements

704.2.1 General

704.2.1.1 This section shall apply to the fire separation requirements of interior walls and partitions for the various occupancies and types of construction. Partitions of higher fire resistance rating required by other sections of this code may also serve to meet the requirements of this section.

704.2.1.2 All partitions enclosing vertical openings such as stairways, utility shafts and elevator shafts which are required to have a fire resistance rating shall extend from floor to floor or floor to roof. These walls shall be continuous through all concealed spaces such as the space above a suspended ceiling. The supporting structure shall have a fire resistance rating equal to or greater than the fire resistance rating required for the vertical enclosure. Where the openings are offset at intermediate floors, the offset and floor construction shall be of construction having a fire resistance of not less than that required for the enclosing partitions.

704.2.1.3 All other partitions required to have a fire resistance rating shall extend from the top of the floor below to the ceiling above and shall be securely attached thereto. Where said ceiling is not a part of an assembly having a fire resistance rating at least equal to that required for the partition, the partition shall be constructed tight against the floor or roof deck above.

704.2.1.4 Corridor partitions, smokestop partitions, horizontal exit partitions, exit enclosures, and fire rated walls required to have protected openings shall be effectively and permanently identified with signs or stenciling in a manner acceptable to the authority having jurisdiction. Such identification shall be above any decorative ceiling and in concealed spaces. Suggested wording: FIRE AND SMOKE BARRIER PROTECT ALL OPENINGS.

704.2.1.5 Any required smoke barrier shall be continuous from outside wall to outside wall, from floor slab to floor slab or roof deck, from smoke barrier to smoke barrier, or a combination thereof, including continuity through all concealed spaces such as those found above suspended ceilings however, smoke barriers are not required in interstitial spaces designed and constructed with ceilings equivalent to smoke barriers. Smoke barriers shall be of 1-hour fire resistant construction. Fixed wired glass vision panels shall be permitted in such barriers provided the panels do not individually exceed an area of 1,296 sq in (0.84 m^2) and are mount-

ed in steel frames. There is no restriction on the total number of such panels in any barrier.

Exception: Smoke barriers in Group I Restrained occupancies shall be permitted to be constructed of minimum 0.10 inch (2.5 mm) thick steel.

704.2.2 Partition requirements by occupancy

704.2.2.1 Group I Restrained

704.2.2.1.1 Smoke barriers shall be constructed in accordance with 704.2.1.5.

704.2.2.1.2 All interior partitions in Type I and Type II construction shall be of noncombustible construction.

704.2.2.2 Group I Unrestrained. Smoke barriers shall have a minimum 1-hour fire resistance rating and be constructed in accordance with 704.2.1.5.

704.2.2.3 Group R Residential. Nonfire rated partitions may be constructed within small residential care/assisted living facilities (Group R4 Small Facility), one and two family dwellings and within individual dwelling units unless required by Table 600. The tenant separation in a two family dwelling shall comply with 704.3.

Exception: Shaft enclosures in Group R4 occupancies shall be enclosed and protected in accordance with the requirements of Table 705.1.2.

704.2.3 Partitions within tenant space

704.2.3.1 Partitions dividing portions of stores, offices or similar places occupied by one tenant only, which do not establish an exit access corridor serving an occupant load of 30 persons or more, and partial partitions, may be temporary or permanent and constructed in accordance with 609 without fire resistance, provided that:

1. Their location is restricted by their method of construction or by means of permanent tracks, guides or other approved methods.
2. Flammability shall be limited to materials having an interior finish classification as set forth in Table 803.3 for rooms or areas.

704.2.4 Exit access corridors. Fire resistance rating of exit access corridors shall be in accordance with Table 704.2.4.

TABLE 704.2.4
FIRE RESISTANCE RATING OF EXIT ACCESS CORRIDORS

OCCUPANCY	OCCUPANT LOAD	FIRE RESISTANCE RATING (hours)	
		Sprinklered	Unsprinklered
A,B,F,M,S	less than 30	0	0
A	30 or more	1	1
B,F,M,S	30 or more	0	1
R1,R2,R3	less than 10, Note 1	0	0
R1,R2	10 or more, Note 1	1/2	1
R4	16 or less	0	0
R4	more than 16, Note 1	0	1
E	Note 2	1	1
I Unrestrained	All	0	N/A
I Restrained	All	0	0, Note 3
H	All	1	1

Notes:
1. Corridors within guest rooms or dwelling units need not be rated.
2. Corridors need not be rated in Group E occupancies with rooms used either for instruction with at least one exit door directly to the exterior at ground level or for assembly purposes with at least one-half of the required exits directly to the exterior at ground level.
3. Unsprinklered use condition 5 shall have exit access corridors of 1-hour fire resistance.

704.3 Tenant fire separation

704.3.1 In a building or portion of a building of a single occupancy classification, when enclosed spaces are provided for separate tenants, such spaces shall be separated by not less than 1-hour fire resistance.

Exception: In Group B and Group S occupancies, partitions not rated for fire resistance may be used to separate tenants provided no area between partitions rated at 1 hour or more exceeds 3,000 sq ft (278.7 m^2).

704.3.2 In buildings with usable crawl spaces, tenant separation walls required to have a fire resistance rating shall extend from the underside of the floor to the ground below. A suitable foundation shall be provided at grade level.

Exception: The wall need not be extended when the floor above the crawl space has a minimum 1-hour fire resistance rating.

704.4 Townhouse fire separation

704.4.1 Each townhouse shall be considered a separate building and shall be separated from adjoining townhouses by a party wall complying with 704.4.2 or by the use of separate exterior walls meeting the requirements of Table 600 for zero clearance from property lines as required for the type of construction. Separate exterior walls shall include one of the following:

1. A parapet not less than 18 inches (457 mm) above the roof line.
2. Roof sheathing of noncombustible material or fire retardant treated wood, for not less than a 4 ft (1219

mm) width on each side of the exterior dividing wall.

3. One layer of 5/8 inch (15.9 mm) Type X gypsum board attached to the underside of roof decking, for not less than a 4 ft (1219 mm) width on each side of the exterior dividing wall.

704.4.2 When not more than three stories in height, townhouses may be separated by a single wall meeting the following requirements:

1. Such wall shall provide not less than a 2-hour fire resistance rating. Plumbing, piping, ducts, electrical or other building services shall not be installed within or through the 2-hour wall, unless such materials and methods of penetration have been tested in accordance with 701.2.
2. Such wall shall be continuous from the foundation to the underside of the roof sheathing or shall have a parapet extending not less than 18 inches (457 mm) above the roof line. When such wall terminates at the underside of the roof sheathing, the roof sheathing for not less than a 4-ft (1219 mm) width on each side of the wall shall be of noncombustible material, or fire retardant treated wood, or one layer of 5/8 inch (15.9 mm) Type X gypsum wallboard attached to the underside of the roof decking.
3. Each dwelling unit sharing such wall shall be designed and constructed to maintain its structural integrity independent of the unit on the opposite side of the wall.

   Exception: Said wall may be penetrated by roof and floor structural members provided that the fire resistance rating and the structural integrity of the wall is maintained.

704.5 Fire wall extensions and parapets

704.5.1 Fire wall extensions

704.5.1.1 Party walls and fire walls shall extend not less than 3 ft (914 mm) above the roof.

Exception: Fire walls shall not be required to extend above the roof where the roof is:

1. Noncombustible in Types I, II and IV construction, or
2. Noncombustible or fire retardant treated wood for an area within 40 ft (12.2 m) of each side of the wall in Types III, V and VI construction.

704.5.1.2 Party walls and fire walls shall extend not less than 18 inches (457 mm) past exterior intersecting walls of combustible construction or exterior noncombustible walls with combustible projections or veneers. The party or fire wall shall extend not less than 18 inches (457 mm) past any combustible projection or veneer. Party walls or fire walls shall extend to the inside facing of the exterior surface of noncombustible construction.

704.5.1.3 Fire walls shall be in accordance with the requirements of NCMA-TEK 5-8 or equivalency in brick or poured concrete or other nationally recognized tested systems.

704.5.2 Parapet Walls

In Type III and Type V Construction, exterior walls shall extend not less than 18 inches (457 mm) above the roof.

Exceptions:

1. Walls located more than 15 ft (4.57 m) from a common property line or centerline of a public way.
2. Where the roof slopes more than 4:12 from the back of the exterior wall.

SECTION 705
PROTECTION OF OPENINGS

705.1 Protection of wall openings

705.1.1 Protection of openings in exterior walls

705.1.1.1 The provisions of 705.1.1 do not apply to Group R3 occupancies.

705.1.1.2 Every exterior wall within 15 ft (4572 mm) of a property line shall be equipped with approved opening protectives.

Exceptions:

1. Exterior walls not required by Table 600 to have a fire resistance rating.
2. Show windows fronting on a street or public space.
3. Open parking structures meeting the requirements of 411.3.

705.1.1.3 Where openings in an exterior wall are above and within 5 ft (1524 mm) laterally of an opening of the story below, such openings shall be separated by an approved noncombustible flame barrier extending 30 inches (762 mm) beyond the exterior wall in the plane of the floor or by approved vertical flame barriers not less than 3 ft (914 mm) high measured vertically above the top of the lower opening. Such flame barriers are not required when a complete approved automatic sprinkler system is installed.

705.1.1.4 Fresh air intakes shall be protected against exterior fire exposure by means of approved fire doors, dampers, or other suitable protection in accordance with the degree of exposure hazard.

705.1.2 Protection of openings in interior walls

705.1.2.1 General. Openings in interior walls and partitions shall be protected in accordance with 705.1.2 and Table 705.1.2.

Exceptions:

1. Where fire resistance is required due to type of construction only.
2. Ducts in accordance with 705.1.2.2.
3. One and two family dwellings.

TABLE 705.1.2
MINIMUM FIRE RESISTANCE OF WALLS, PARTITIONS AND OPENING PROTECTIVES[1] (hrs)

COMPONENT	WALLS AND PARTITIONS[9]	OPENING PROTECTIVES
SHAFT ENCLOSURES (including stairways, exits & elevators)		
4 or more stories	2	1 1/2
less than 4 stories	1[2]	1[2]
all refuse chutes	2	1 1/2
WALLS AND PARTITIONS		
fire walls[3]	4	3
within tenant space	See 704.2.3	
tenant space (see also 704.3)	1	3/4
horizontal exit	2	1 1/2
exit access corridors	See Note 4,5	20 min.[10]
smoke barriers	See 409.1.2	
refuse and laundry chute access rooms	1	3/4
incinerator rooms	2	1 1/2
refuse and laundry chute termination rooms	1	3/4
hazardous occupancy control areas	1	3/4
high rise buildings	See 412	
covered mall buildings	See 413	
assembly buildings	See Note 2	
bathrooms & restrooms	See Note 6	
OCCUPANCY SEPARATIONS[7]		
	Required Fire Resistance	
	4	3
	3	3
	2	1 1/2
	1	3/4
EXTERIOR WALLS[8]	All	3/4

Notes:
1. Table 600 may require greater fire resistance of walls to insure structural stability.
2. All exits and stairways in Group A and H occupancies shall be 2-hours with 1 1/2-hour door assemblies.
3. See also 503.1.2.
4. See 704.2.3 and 704.2.4.
5. See 409 for sprinklered Group I - buildings.
6. Fire rated bathroom/restroom doors are not required when opening onto fire rated halls, corridors, exit access provided:
   a. no other rooms open off of the bathroom/restroom, and
   b. no gas or electric appliances are located in the bathroom/restroom, and
   c. the walls, partitions, floor and ceiling of the bathroom/restroom have a fire rating at least equal to the rating of the hall, corridor or exit access, and
   d. the bathroom/restroom is not used for any other purpose than it is designed.
7. See 704.1.
8. See Table 600, 705.1.1 and 503.4.8.
9. See 704.2.2.3 for walls and partitions in Group R4 occupancies.
10. In Group R4 Large Facility occupancies, sleeping room doors shall resist the passage of smoke but closers are not required.

705.1.2.2 Fire dampers

705.1.2.2.1 Fire dampers, installed in accordance with manufacturers installation instructions, shall be provided in ducts penetrating walls or partitions having a fire resistance rating of one hour or more.

Exceptions:

1. Where branch ducts connect to return risers in which the air flow is upward and subducts at least 22 inches (559 mm) long are carried up inside the riser at each inlet.
2. In duct systems of any duct materials or combinations thereof allowed by Chapter 6 of the Standard Mechanical Code penetrating 1-hour walls or partitions, where the duct penetrating the rated wall or partition meets all of the following minimum requirements:
   1. the duct shall not exceed 100 sq inch (0.06 m^2),
   2. the duct shall be of 0.0217 inch (0.55 mm) minimum steel,
   3. the duct shall continue with no duct openings for not less than 5 ft (1.5 m) from the rated wall,
   4. the duct shall be installed above a ceiling, and,
   5. the duct does not terminate at a wall register in the rated wall.

705.1.2.2.2 Fire dampers shall comply with the requirements of UL 555 and shall bear the label of an approved testing agency. Closure shall interrupt any migratory air flow and restrict the passage of flame. Fire dampers shall be classified and identified for use in either.

1. Static systems that automatically shut down in the event of fire.
2. Dynamic systems that operate in the event of fire.

705.1.2.3 Smoke barriers

705.1.2.3.1 An approved damper designed to resist the passage of smoke shall be installed in accordance with the manufacturer's installation instructions at each air transfer opening or duct penetration of a required smoke barrier. The required smoke damper shall be arranged to operate automatically, controlled by a smoke detection system and manual positioning shall be permitted from a remote command station.

Adoption of the South Florida Building Code

Charter and Code of the City of Miami, Sec. 10.3

Code of the City of Coral Gables, Sec. 6-26

The Code of the City of Miami Beach, Sec. 8-1

Code of Broward County, Sec. 5-36

Monroe County Code, Sec. 6-16

Code of Ordinances of the City of Ft. Lauderdale, Sec. 9-1

Adoption of the Standard Building Code

Palm Beach County Code, Sec. 7-36

SFBC → SOUTH FLORIDA BUILDING CODE (REVISED 1994)

CHAPTER 31

MEANS OF EGRESS

3101 GENERAL

3101 GENERAL

3101.1 SCOPE This chapter adopts minimum Standards for means of egress for all buildings and structures regulated by this Code.

3101.2 APPLICATION:

(a) , Every building, structure or portion thereof shall be provided with means of egress as set forth in this Chapter.

(b) Pursuant to F. S. 633.05, the requirements of this Chapter are superseded for buildings in which the State Fire Marshal has established uniform fire safety requirements.

(c) Where conflict exists in this Code between a general provision and specific provision for an occupancy, the specific requirement shall supersede.

3101.3 STANDARDS: Pursuant to the provisions of Subsection 402.2 of this Code, the requirements for new construction of the National Fire Protection Association Life Safety Code, NFPA 101, are hereby adopted as a mandatory minimum standard for life safety.

3101.4 WORKMANSHIP: Means of egress shall be in conformance with the tolerances, quality and methods of construction, if any, specified in the Standards set forth in Subsection 3101.3 above.

SOUTH FLORIDA BLDG CODE DADE

CITY OF PORT ORANGE

BellSouth Telecommunications, Inc.
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GENERAL PLAN REVIEW COMMENTS

March 1999

THE FOLLOWING CODES ARE IN EFFECT FOR THE CITY OF PORT ORANGE

SBCCI	The Southern Building Code Congress International
SBC	The Standard Building Code 1997 edition
SMC	The Standard Mechanical Code 1997 edition
SPC	The Standard Plumbing Code 1994 edition
SGC	The Standard Gas Code 1997 edition
SFPC	The Standard Fire Prevention Code 1997 edition
NEC	The National Electrical Code 1996 edition
NFPA	The National Fire Protection Association
LS 101	The Life Safety Code 1997 edition

for exit access purposes, they do not serve 30 people or more;
5. The partitions do not block exits without providing alternate means of exiting;
6. The location of the partitions is restricted by their methods of construction or fixed by permanent tracks or guides; and
7. The flammability of the partitions is in accordance with Table 803.3.

If a corridor is established, thereby limiting access to an exit through a restricted path, and that corridor serves 30 people or more, the exit access corridor would have to be fire resistant, full height, and permanent. (See also 704.2.4.) Partitions meeting all of the other conditions, and which establish a corridor that serves less than 30 people, do not have to be fire resistant, full height, or permanent. (See also 413.3.1 and 413.4.5.) Partial partitions are not considered as forming corridors, by definition.

704.2.4 Exit access corridors. Fire resistance rating of exit access corridors shall be in accordance with Table 704.2.4.

TABLE 704.2.4
FIRE RESISTANCE RATING OF EXIT ACCESS CORRIDORS

OCCUPANCY	OCCUPANT LOAD	FIRE RESISTANCE RATING (hours)	
		Sprinklered	Unsprinklered
A,B,F,M,S	less than 30	0	0
A	30 or more	1	1
B,F,M,S	30 or more	0	1
R1,R2,R3	less than 10, Note 1	0	0
R1,R2	10 or more, Note 1	1/2	1
R4	16 or less	0	0
R4	more than 16, Note 1	0	1
E	Note 2	1	1
I Unrestrained	All	0	N/A
I Restrained	All	0	0, Note 3
H	All	1	1

Notes:
1. Corridors within guest rooms or dwelling units need not be rated.
2. Corridors need not be rated in Group E occupancies with rooms used either for instruction with at least one exit door directly to the exterior at ground level or for assembly purposes with at least one-half of the required exits directly to the exterior at ground level.
3. Unsprinklered use condition 5 shall have exit access corridors of 1-hour fire resistance.

Section 704.2.4 gives the fire resistance requirements for corridors based on occupancy and occupant load. The table also takes into account whether the building is sprinklered. For example, a corridor in a sprinklered hotel which serves more than 10 people is required to have a 1/2-hour fire resistant rating.

704.3 Tenant fire separation

704.3.1 In a building or portion of a building of a single occupancy classification, when enclosed spaces are provided for separate tenants, such spaces shall be separated by not less than 1-hour fire resistance.

Exception: In Group B and Group S occupancies, partitions not rated for fire resistance may be used to separate tenants provided no area between partitions rated at 1 hour or more exceeds 3,000 sq ft (278.7 m²).

A tenant is a person, agent, firm, or corporation who has temporary occupation or possession by lease or other rights of a building or portion of a building owned by another. Since the building or space is owned by another, the tenant may not have complete control over the tenant space and may have no control over the spaces of other tenants. Due to this lack of control, tenants are afforded protection from each other by a fire resistant separation for each tenant space. The code requires a fire resistant separation when the separate tenant spaces are enclosed. The separation includes partitions and floors or floor/ceiling assemblies. When the tenants are of the same occupancy group, a 1-hour fire resistant separation is required between the tenant spaces. When the tenants are different occupancy groups, the fire resistant separation required is determined by 704.1. A notable exception to this general rule is provided for a building of single business or storage occupancy that does not exceed 3,000 sq ft (278.7 m²) in area. In such a building, a fire resistant wall or partition is not required between the tenant spaces when the combined area of the tenant spaces does not exceed 3,000 sq ft (278.7 m²).

704.3.2 In buildings with usable crawl spaces, tenant separation walls required to have a fire resistance rating shall extend from the underside of the floor to the ground below. A suitable foundation shall be provided at grade level.

Exception: The wall need not be extended when the floor above the crawl space has a minimum 1-hour fire resistance rating.

A usable crawl space is one designed to be used for equipment or storage. (See 202, Definitions.) When a usable crawl space occurs under tenant spaces, one of the following is required:
1. The fire resistant tenant separation wall must separate the crawl space by extending through the crawl space to a foundation at grade level; or
2. The floor above the crawl space must have a 1-hour fire resistance rating. (The crawl space then does not need to be separated with fire resistant walls.)

Secs. 19-149—19-170. Reserved.

ARTICLE III. BUILDING CONSTRUCTION STANDARDS*

Sec. 19-171. Standard Building Code adopted by reference.

There is hereby adopted by the city for the purpose of establishing rules and regulations for the construction, modification, alteration, maintenance, repair, location, relocation, moving, removing, demolition, equipment, use and occupancy of or additions to buildings or structures and any accessory or related facilities or appurtenances associated with or connected or attached to such buildings or structures, including application for permit, issuance of permits, drawings and examination thereof, conditions of permits, permit fees and charges, inspections, certificates of occupancy or completion and related matters, that certain building code known as the Standard Building Code published by the Southern Building Code Congress International, as authorized by Chapter 553, Florida Statutes, as it may from time to time be amended, and Appendixes A, D, and H as they may from time to time be amended, and the same is hereby adopted and incorporated as fully as if set forth at length herein, except that the provisions of such code as amended or revised by ordinances to meet the specific needs of the city shall be controlling within the corporate limits of the city.
(Code 1966, § 7-8; Ord. No. 4289, § 18, 11-26-96)

Sec. 19-172. Amendments to Standard Building Code.

The Standard Building Code adopted in this article is amended as follows:

(a) Chapters 1, 11 and 13 are deleted in their entirety.

(b) Section 202, Definitions, is amended by adding the following definitions in their proper alphabetical order:

Accessory facility: A building or structure on the same plot as the main use building that is of secondary or subordinate importance and is not essential in itself to the main use building, but adds to the aesthetics, convenience or effectiveness of the main use building.

Accessory use: (See chapter 28 of the city Code of Ordinances.)

Agency: Means same as "applicable governing body."

Building (main use): A building that has as its primary use 1 or more of the specified permitted uses as established under the applicable zoning district regulations of the city, as distinguished from accessory facility.

Governing body: Means same as "applicable governing body."

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*Cross references—Fire prevention and protection, ch. 7; buildings or structures moved in the city must comply with the building code, § 19-381.

Forwarded by Daryl L. Scott
Fire Lieutenant at City of Boca Raton Fire Rescue Services Dept.

NFPA	85F	1988	Pulverized Fuel Systems, Installation and Operation of
NFPA	86	1990	Ovens and Furnaces
NFPA	86C	1991	Industrial Furnaces Using a Special Processing Atmosphere
NFPA	86D	1990	Industrial Furnaces Using Vacuum as an Atmosphere
NFPA	88A	1991	Parking Structures
NFPA	88B	1991	Repair Garages
NFPA	90A	1993	Air Conditioning and Ventilating Systems, Installation of
NFPA	90B	1993	Warm Air Heating and Air Conditioning Systems, Installation of
NFPA	91	1992	Exhaust Systems for Air Conveying of Materials
NFPA	92B	1991	Smoke Management Systems
NFPA	96	1994	Ventilation Control and Fire Protection of Commercial Cooking Operations
NFPA	99	1993	Health Care Facilities
NFPA	99B	1993	Hypobaric Facilities
→ NFPA	101	1994	Safety to Life from Fire in Buildings and Structures—Amended as follows: Section 19-3.5.6 is deleted
NFPA	102	1992	Assembly Seating, Tents, and Membrane Structures
NFPA	110	1993	Emergency and Standby Power Systems
NFPA	111	1993	Stored Electrical Energy Emergency and Standby Power Systems
NFPA	130	1993	Fixed Guideway Transit Systems
NFPA	170	1994	Standard Fire Safety Symbols
NFPA	211	1992	Chimneys, Fireplaces, Vents and Solid Fuel-Burning Appliances
NFPA	214	1992	Water-Cooling Towers
NFPA	220	1992	Types of Building Construction
NFPA	221	1994	Fire Walls and Fire Barrier Walls
NFPA	231	1990	General Storage
NFPA	231C	1991	Rack Storage of Materials
NFPA	231D	1994	Rubber Tires, Storage of
NFPA	231F	1987	Roll Paper, Storage of
NFPA	232	1991	Records, Protection of
NFPA	241	1993	Construction, Alteration and Demolition Operations, Safeguarding of
NFPA	251	1990	Building Construction and Materials, Standard Methods of Fire Tests of
NFPA	252	1990	Door Assemblies, Standard Methods of Fire Tests of
NFPA	253	1990	Critical Radiant Flux of Floor Covering Systems Using a Radiant Heat Energy Source, Standard Method of Test for
NFPA	255	1990	Building Materials, Method of Test of Surface Burning Characteristics of Building Materials
NFPA	256	1993	Roof Coverings, Methods of Fire Tests of

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CITY OF PALM BEACH GARDENS

10500 N. MILITARY TRAIL • PALM BEACH GARDENS, FLORIDA 33410-4698

April 6, 1999

Mr. Marcello Penso
Offerle-Lerner A I A
Architects and Planners
34 SW Fourth Street
Boca Raton, FL 33432

Dear Mr. Penso,

Per your request, this letter is to advise that the City of Palm Beach Garden adheres to the 1997 SBCCI building codes and the 1997 NFPA codes.

Sincerely,

Jack Hanson
Building Official

770· 458· 4391

Attn: Ray

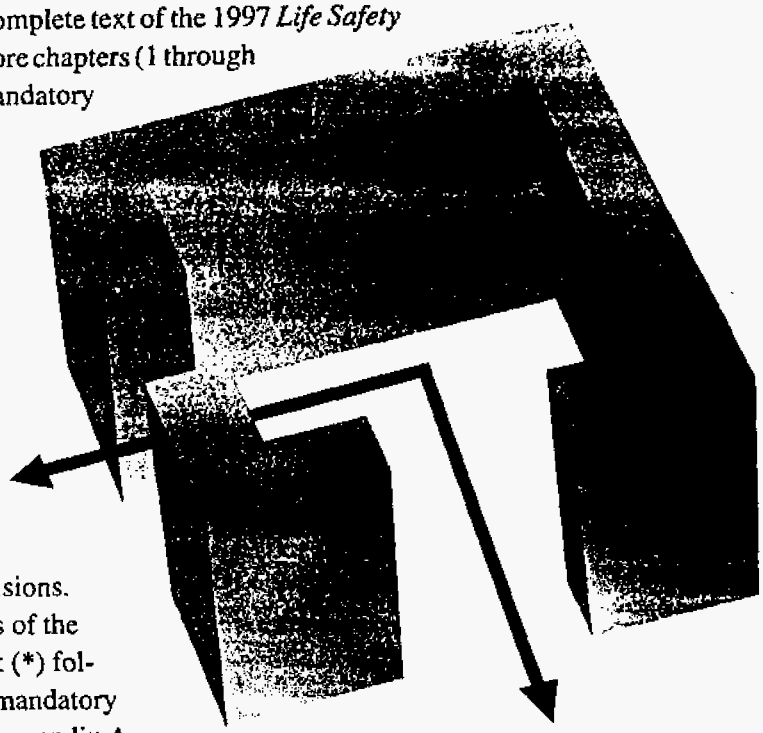
Seminole County, Florida
Model Codes in effect:
1. Standard Building Code, 1994 ed.
2. Standard Plumbing Code, 1994 ed.
3. Standard Mechanical Code, 1994 ed.
4. National Electrical Code, 1996 ed.
5. Standard Fire Prevention Code, 1994 ed.
6. Life Safety Code 1994 ed.
See County Code for AMENDMENTS

CODES INFORCED BY SEMINOLE COUNTY
RE: LAKE MARY CO.
365 INTERNATIONAL PARKWAY

JANE @ BLDG DEPARTMENT
1407-830-3919

PART ONE

Life Safety Code and Commentary



Part One of this handbook includes the complete text of the 1997 *Life Safety Code*, which is made up of mandatory core chapters (1 through 33) and nonmandatory appendix material. The mandatory *Code* provisions found in Chapters 1 through 33 were prepared by the thirteen Committees on Safety to Life within the framework of NFPA's consensus standards-development system. Because these provisions are designed to be suitable for adoption into law, or for reference by other codes and standards, the text is concise, without extended explanation.

The material found in Appendix A of the *Code* was also developed by the Committees on Safety to Life within NFPA's standards system. The appendix material is designed to assist users in interpreting the mandatory *Code* provisions. It is not considered to be part of the requirements of the *Code*; it is advisory or informational. An asterisk (*) following a *Code* paragraph number indicates that mandatory material pertaining to that paragraph appears in Appendix A. For readers' convenience in this handbook, Appendix A material has been repositioned to appear immediately following its base paragraph in the body of the *Code* text.

The explanatory commentary accompanying the *Code* was prepared by the handbook editor. The commentary immediately follows the *Code* text it discusses and is easily identified by green shading. Designed to help users understand and apply *Code* provisions, it gives detailed explanations of the reasoning behind *Code* requirements, examples of calculations, applications of requirements, and tables of useful information. Over 300 drawings and photographs show practical applications of specific *Code* provisions. Used together with the *Code*, the commentary provides a rich resource for assessing the level of life safety from fires in buildings.

CHAPTER 1

General

A-1 The following is a suggested procedure for determining the *Code* requirements for a building or structure.

1. Determine the occupancy classification. Refer to the occupancy definitions in Chapter 4 and the occupancy Chapters 8 through 31. Also see 4-1.12 for buildings with more than one use.

2. Determine if the building or structure is new or existing. Refer to the definitions in Chapter 3.

3. Determine the occupant load. Refer to 5-3.1 and the -1.7 section of occupancy Chapters 8 through 31.

4. Determine the hazard of contents. Refer to Section 4-2.

5. Refer to the applicable occupancy chapter of the *Code* (Chapters 8 through 31). Refer as necessary to Chapters 1 through 7 for general information (e.g., definitions) or as directed by the occupancy chapter.

6. Determine the occupancy subclassification or special use condition, if any. Chapters 12 and 13, health care occupancies; Chapters 14 and 15, detention and correctional occupancies; Chapters 16 and 17, hotels and dormitories; Chapters 22 and 23, residential board and care occupancies; and Chapters 24 and 25, mercantile occupancies, contain subclassifications or special use definitions.

7. Proceed through the applicable occupancy chapter verifying compliance with each referenced section, subsection, paragraph, subparagraph, and referenced codes, standards, and other documents.

8. Where two or more requirements apply, the occupancy chapter generally takes precedence over the base Chapters 1 through 7.

9. Where two or more occupancy chapters apply, such as in a mixed occupancy (*see 4-1.12*), the most restrictive requirements apply.

The steps outlined in A-1 were developed to help the user determine which *Code* requirements may apply to a given building. Because specific occupancy requirements are detailed in separate chapters, the *Code* user should first identify the proper occupancy classification of a building. This will direct the *Code* user to the appropriate chapter(s) for that occupancy.

For example, a jewelry retail sales operation (i.e., a jewelry store) occupying all of the twelfth floor of a multitenanted building uses 5000 sq ft (465 sq m), or 95 percent, of the floor area for sales purposes. Using the occupancy definitions found in Chapter 4, the jewelry store should be classified as a mercantile occupancy. By determining that the floor is a mercantile occupancy, the *Code* user narrows the range of choice of applicable occupancy chapters from Chapters 8 through 31 to the two that specifically address mercantile occupancies—Chapter 24 or Chapter 25.

Using the definition of "existing building" found in Chapter 3, the user can determine if the building is subject to the requirements for new construction or for existing buildings. If the jewelry store used in the example was occupied subsequent to the adoption of the *Code* currently being enforced, the user would determine that the life safety features required are those applicable to new construction. Thus, the user could narrow the applicable occupancy requirements to those detailed in Chapter 24, "New Mercantile Occupancies."

Next, the *Code* user would identify the subclassification of the mercantile occupancy as Class A, Class B, or Class C based on the 5000-sq ft (465-sq m) floor area used for sales purposes. Because the jewelry store occupies more than 3000 sq ft (280 sq m) but less than 30,000 sq ft (2800 sq m), it would fall into the Class B mercantile occupancy. The user would then locate the requirements of Chapter 24 that specifically

apply to Class B mercantile occupancies. The user would note that Chapter 24 does not repeat the requirements found in Chapters 1 through 7 because the *Code* mandatorily references the use of those chapters. Because the jewelry store is in the high-rise portion of the building, 24-4.2 requires compliance with a portion of the Section 32-8 high-rise building requirements of Chapter 32, "Special Structures and High-Rise Buildings"—specifically, the automatic sprinkler system provisions.

In this example, the *Code* user recognizes that the requirements of Chapters 1 through 7, Chapter 24, and a portion of Chapter 32 are applicable and must be met. This selection process is outlined in Figure 1-1.

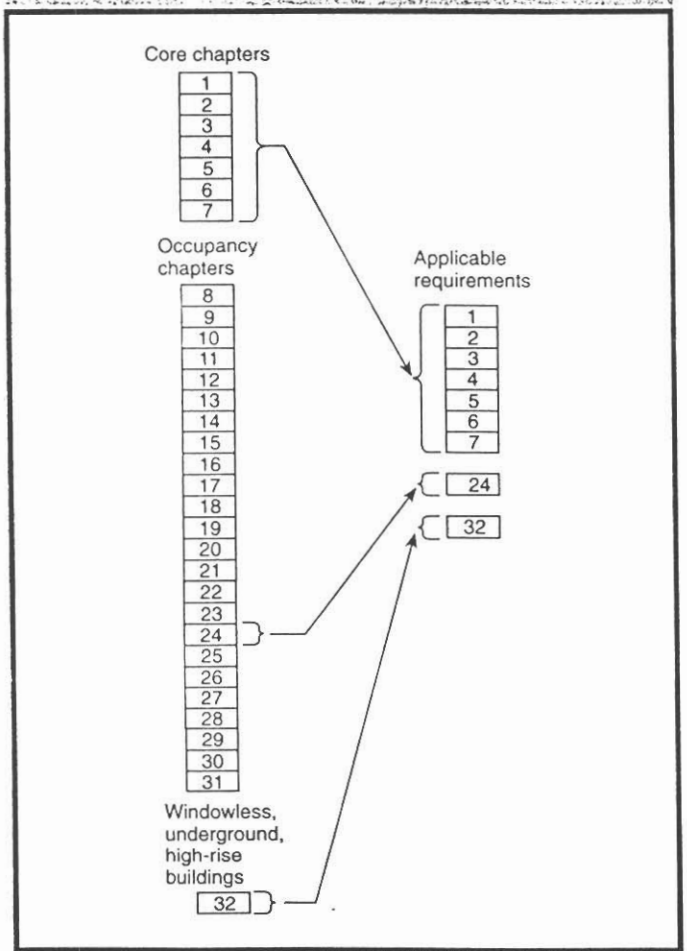


Figure 1-1 *Selecting Code requirements applicable to a given occupancy. In the example detailed in the commentary, a new jewelry store located in the high-rise portion of a building is classified as a Class B mercantile occupancy based on the floor area used for sales purposes. The new Class B mercantile occupancy is subject to the requirements of Chapters 1 through 7, Chapter 24, and a portion of Chapter 32 of the Code.*

Section 1-1 Title

1-1.1 Title.

NFPA *101*®, *Code for Safety to Life from Fire in Buildings and Structures*, shall be known as the *Life Safety Code*®, is cited as such, and shall be referred to herein as "this *Code*" or "the *Code*."

As discussed in the preface to this handbook, the name of the *Code* was changed from the *Building Exits Code* to the *Life Safety Code* in 1966. This is significant because the change in title expanded the scope of the *Code* from a specification-based code for stairs, doors, and fire escapes to a performance- and specification-based code addressing myriad factors affecting life safety in the event of fire.

Section 1-2 Scope

1-2.1

This *Code* addresses life safety from fire. Its provisions will also aid life safety in similar emergencies.

In addressing life safety from fire and similar emergencies, the *Code* delves heavily into the movement of people in an emergency. However, many of the building features that assist with safe movement of people in an emergency also provide increased safety during normal building use. For example, new stairs are required to have a maximum riser height of 7 in. (17.8 cm) and a minimum tread depth of 11 in. (27.9 cm) to reduce the potential to trip under emergency egress use. This "safe" geometry also reduces the potential to trip any time the stair is used.

1-2.2*

The *Code* addresses those construction, protection, and occupancy features necessary to minimize danger to life from fire, including smoke, fumes, or panic.

A-1-2.2 The *Code* recognizes that panic in a burning building may be uncontrollable, but deals with the potential panic hazard through measures designed to prevent the development of panic. Experience indicates that panic seldom develops, even in the presence of potential danger, so long as occupants of buildings are moving toward exits that they can see within a reasonable distance with no obstructions or undue congestion in the path of travel. However, any

uncertainty as to the location or availability of means of egress, the presence of smoke, or the stoppage of egress travel, such as may occur when one person stumbles and falls on the stairs, may be conducive to panic. Panic danger is greatest when there are large numbers of people in a confined area.

Evaluation of recent fires in occupied buildings confirms that panic is *not* a typical reaction of occupants in a burning building. Studies of building fires indicate that occupants typically exhibit altruistic behavior toward others. Human behavior in response to a threatening situation may follow one of a variety of actions. Individuals may choose to investigate, sound an alarm, assist with rescue, seek help, or flee. Each of these acts constitutes normal behavior, even when taken collectively. Most people avoid direct contact with a fire while undertaking another action.

1-2.3

The *Code* identifies the minimum criteria for the design of egress facilities so as to permit prompt escape of occupants from buildings or, where desirable, into safe areas within buildings.

Relocating building occupants to safe areas within a building includes moving them (1) into an area of refuge, (2) through doors in a horizontal exit into another fire compartment, or (3) through doors in a smoke barrier into another smoke compartment. In some cases, considering total evacuation to the exterior is not practical. Building design can be made more flexible by using arrangements that rely on relocating occupants to safe areas within the building.

1-2.4

The *Code* recognizes that life safety is more than a matter of egress and, accordingly, deals with other considerations that are essential to life safety.

There are numerous elements that impact the overall level of life safety. The *Code* addresses many of these items, including combustibility of interior finishes and preparedness of occupants in evacuation actions. There are, however, areas that are not addressed. One example is public education related to fire safety.

1-2.5

Vehicles, vessels, or other similar conveyances, as defined in Section 32-6, shall be treated as a building.

It is not uncommon to find railroad cars converted to dining or drinking establishments, ships or barges converted to hotels or restaurants, or transportation trailers used for storage or mercantile sales. Where these vehicles, vessels, or other mobile structures are in a fixed location and occupied as a building, the *Code* intends that they be regulated as a building under all applicable *Code* requirements. The fact that there are axles, wheels, and tires on a trailer or that a ship is still floating does not assure they are not in fixed locations and not occupied as buildings. The authority having jurisdiction should ensure that the vehicle or vessel is regulated by some other agency, such as the Coast Guard or Department of Transportation, before exempting it from the requirements of the *Code*.

1-2.6

The *Code* does not attempt to address all those general fire prevention or building construction features that are normally a function of fire prevention and building codes.

The *Code* is not intended to be either a building code or a fire prevention code. However, in the interest of public safety, the *Code* does contain provisions typically associated with a fire prevention or building code. For example, although construction requirements are typically considered the domain of a building code, Chapters 12 and 13 provide minimum, fire-rated construction requirements for buildings housing health care occupancies. This is done to ensure structural integrity of the building for the period of time required for staff to evacuate those occupants incapable of self-preservation.

Similarly, although preventative measures are typically associated with a fire prevention code, the operating features sections located at the end of most of the occupancy chapters contain requirements that (1) limit the flammability of contents introduced into certain occupancies, (2) regulate smoking, and (3) require the training of facility employees. These operational items, when combined with egress and other specific occupancy chapter requirements, provide an appropriate life safety package.

The *Code* intentionally excludes traditional building code issues such as wind loads, seismic considerations, and exterior exposure protection.

1-2.7

The prevention of personal injuries incurred by an individual's own negligence, and the preservation of property from

loss by fire have not been considered as the basis for any of the provisions of this *Code*.

Although the *Code* requirements were developed to provide life safety from fire, adherence to its requirements may assist in property conservation and prevention of personal injuries. For example, the automatic sprinkler systems required for life safety purposes provide substantial property protection benefits as well.

Section 1-3* Application

A-1-3 It is the intent of this section that a building addition, or alteration designed to meet the requirements of a prior edition of the *Code* be required to meet those requirements for the life of the building. Requirements for existing buildings in this edition of the *Code* would apply if those requirements are more restrictive.

There are some cases where the requirements for new construction are less restrictive, and it might be justified to allow an existing building to use the less restrictive requirements. However, extreme care needs to be exercised when making this allowance, because the less restrictive provision might be the result of a new requirements elsewhere in the *Code*. For example, in editions of the *Code* prior to 1991, corridors in new health care occupancies were required to have a 1-hour fire resistance rating. Since 1991 these corridors have been required only to resist the passage of smoke. However, this is based on the new requirement that all new health care facilities must be protected throughout by automatic sprinklers.

1-3.1 New and Existing Buildings.

The *Code* applies to both new construction and existing buildings. In various chapters there are specific provisions for existing buildings that might differ from those for new construction.

In order to provide a minimum level of life safety to all occupancies in all structures, the *Code* must be applicable to both new construction and existing buildings. There are provisions throughout the *Code* that specifically apply to existing buildings. Also there are requirements for new construction that have been modified to apply differently to existing buildings. The modifications were made to limit the resulting disruption and financial impact on existing buildings to those modifications necessary to provide the minimum level of life safety. The requirements applicable to new construction are often more stringent than those for existing buildings, because providing appropriate life safety requirements is considered less disruptive and more cost-effective during construction. If no modification for existing buildings appears within a *Code* requirement, the same provision applies for new construction and existing buildings.

If the current edition of the *Code* is adopted and supersedes a previous edition, it is the *Code*'s intent that existing buildings be brought into compliance with the provisions for existing buildings found in the current edition.

See also 1-3.2, 1-3.4, 1-3.7, 1-3.10, and the definitions of *building, existing* and *existing* in Section 3-2.

1-3.2 Time Allowed for Compliance.

A limited but reasonable time shall be allowed for compliance with any part of this *Code* for existing buildings commensurate with the magnitude of expenditure, disruption of services, and degree of hazard.

In some cases, appreciable costs—in terms of actual monetary expenditures and disruption of daily activities—may be involved in immediately bringing an existing building into *Code* compliance. Where this is true, it would be appropriate for the operator or owner of the facility to formulate a schedule, approved by the authority having jurisdiction, that allows suitable periods of time for correcting various deficiencies. However, the degree of hazard is an important consideration in this instance and, if the degree of hazard is serious enough, it may be necessary to close the building to occupancy while renovations are made to bring the building features associated with the serious hazard into compliance. Once the building is reoccupied, the authority having jurisdiction might allow some reasonable, additional time for bringing the remaining deficient features into code compliance with the requirements specifically applicable to existing buildings.

1-3.3 Authority Having Jurisdiction.

The authority having jurisdiction shall determine the adequacy of means of egress and other measures for life safety from fire in accordance with the provisions of this *Code*.

This requirement gives the authority having jurisdiction the final determination of whether or not adequate life safety is provided in a building. When the

authority having jurisdiction determines the *Code* has not specifically addressed the situation encountered, the authority can supplement the requirements in the *Code* to address the specific situation. This is an important responsibility because the *Code* cannot anticipate every type of building and occupancy configuration.

1-3.4* Modification of Requirements for Existing Buildings.

The requirements for existing buildings shall be permitted to be modified if their application clearly would be impractical in the judgment of the authority having jurisdiction, but only where it is clearly evident that a reasonable degree of safety is provided.

A-1-3.4 In existing buildings, it is not always practical to strictly apply the provisions of this *Code*. Physical limitations may require disproportionate effort or expense with little increase in life safety. In such cases, the authority having jurisdiction should be satisfied that reasonable life safety is ensured.

In existing buildings it is intended that any condition that represents a serious threat to life be mitigated by application of appropriate safeguards. It is not intended to require modifications for conditions that do not represent a significant threat to life, even though such conditions are not literally in compliance with the *Code*.

This provides the authority having jurisdiction latitude in applying the *Code* to existing buildings. The *Code* recognizes there may be situations where applying the requirements to existing situations would not be practical so it gives the authority having jurisdiction the authority to modify those requirements. However, the *Code* reemphasizes that a reasonable degree of safety must be provided.

Paragraph 1-3.4 also allows the authority having jurisdiction some flexibility in dealing with historically preserved buildings. These buildings may have numerous design defects, such as open stair shafts or highly combustible interior finishes. Rather than waiving requirements, the authority having jurisdiction might require that the facility attain an equivalent level of safety. The authority having jurisdiction might require the use of sprinkler systems, smoke detection systems, voice alarm systems for staged evacuation, smoke control systems, or other appropriate features to overcome the existing life safety defects. This would be done in lieu of rebuilding the structure to the written specification requirements, which might totally destroy the historical character of the structure. The alternatives used in such an instance may actually raise the level of safety to many times over that which is already present in the existing building.

1-3.5 Referenced Publications.

Existing buildings or installations that do not comply with the provisions of the referenced standards contained in this document (*see Chapter 33*) shall be permitted to be continued in service provided the lack of conformity with these standards does not present a serious hazard to the occupants as determined by the authority having jurisdiction.

1-3.6 Additions.

Additions shall conform to the provisions for new construction.

Although the addition must conform to the requirements for new construction, the existing portion of the building is generally permitted to conform to the requirements for existing buildings. The exception to this rule involves assembly and mercantile occupancies. For example, mercantile occupancies further subclassify the occupancy into Class A, Class B, and Class C based on floor area used for sales purposes. If consideration of the combined space created by the addition and the existing portion of the building results in a reclassification from Class C to Class B or from Class B to Class A, the existing portion of the building must also meet the requirements applicable to new construction. For assembly occupancies, the same concept exists, but its application criteria are specified differently given that assembly occupancies no longer use the subclassification scheme (i.e., Class A, Class B, and Class C). If the addition creates sufficient space for the occupant load of the combined existing and new assembly spaces to increase from less that 500 to more than 500 occupants and require a third exit, or from less than 1000 to more than 1000 and require a fourth exit, the existing portion of the building must also meet the requirements applicable to new construction. See also 1-3-10, 9-1.1.3 and its reference to 5-4.1.2, and 25-1.1.3.

1-3.7* Modernization or Renovation.

Any alteration or any installation of new equipment shall be accomplished as nearly as practicable with the requirements for new construction. Only the altered, renovated,

or modernized portion of an existing building, system, or individual component shall be required to meet the provisions of this *Code* applicable to new construction. If the alteration, renovation, or modernization adversely impacts required life safety features, additional upgrading shall be required. Existing life safety features that do not meet the requirements for new buildings, but exceed the requirements for existing buildings, shall not be diminished further. In no case shall the resulting life safety features be less than those required for existing buildings.

A-1-3.7 The following is an example of what is intended by 1-3.7. In a hospital that has 6-ft (1.8-m) wide corridors, these corridors cannot be reduced in width even though the requirements for existing hospitals do not require 6-ft (1.8-m) wide corridors. However, if a hospital has 10-ft (3-m) wide corridors, they may be reduced to 8 ft (2.4 m) in width, which is the requirement for new construction. If the hospital corridor is 3 ft (0.9 m) wide, it would have to be increased to 4 ft (1.2 m). If alterations require replacement of a portion of a hospital corridor wall, this portion of the corridor would not be required to be increased to 8 ft (2.4 m) in width unless it was practical to do so.

Only those existing building features, systems, or components undergoing change or alteration must conform with the *Code* provisions applicable to new construction. For example, in an occupancy that requires 1-hour fire resistance–rated corridors for new construction but permits existing ½-hour fire resistance–rated corridors to remain in use, a renovation project is undertaken to replace existing doors in the corridor walls. There is no requirement that the renovation project be expanded in scope to include replacing the existing, code-complying, ½-hour fire resistance–rated corridor walls with walls having the minimum 1-hour fire resistance rating required for new construction.

Conformance with the provisions applicable to new construction may not be practical if the existing structure involved cannot reasonably accommodate the feature required for new construction. For example, a hospital might have an existing corridor 6 ft (183 cm) wide that, if replaced, would normally be required to be 8 ft (244 cm) wide as specified for new construction. However, if the building's column spacing is 7 ft by 7 ft (213 cm by 213 cm), there is no easy and effective way to achieve an 8-ft (244-cm) corridor width. The authority having jurisdiction would judge if a 6-ft (183-cm) wide or even a 7-ft (213-cm) wide corridor is adequate or if additional provisions are required to permit a corridor less than 8 ft (244 cm) in width to be rebuilt.

Where renovations or alterations are made, they must comply with the requirements for new construction to the extent practicable. For example, it is practical to install carpeting meeting the requirements for new interior floor finish. Similarly, where a corridor wall is to be rebuilt, it may not be practical to widen the corridor to meet the minimum width requirements for new corridors, but most likely it will be practical to rebuild it to the required fire resistance rating for new construction.

Another example is the installation of a new smoke barrier in an existing hospital. A smoke barrier can be made to meet nearly all the requirements for a new smoke barrier. However, if the corridor that the smoke barrier extends across is not sufficiently wide to install two 41.5-in. (105-cm) clear width doors, the requirement for two 41.5-in. (105-cm) clear width doors would have to be modified. The authority having jurisdiction would judge such a modification and might permit a set of doors or possibly a single door of a width that the corridor could accommodate. The requirement to perform renovations as nearly as practicable with the requirements for new construction may seem arbitrary, but it is necessary to allow evaluation on a case-by-case basis.

The last sentence of 1-3.7 captures an important, but elusive, concept. In applying the requirements for new construction to a renovated component or system, one needs to compare the requirements for new construction to those for existing buildings. This is done to assure that the level of safety afforded by compliance with the requirement for new construction is not less than that provided by complying with the corresponding requirement applicable to existing buildings. For example, Chapter 16 for new hotels/dormitories includes no requirement for smoke barriers because all new hotels/dormitories must either be protected by automatic sprinklers or provide direct exterior exit access from all guest rooms. During renovation of a floor in an existing, nonsprinklered hotel that utilizes inside corridors for exit access from guest rooms, the Chapter 16 exemption of smoke barriers must not be applied to the existing building. Rather, the requirements of 17-3.7 for cross-corridor smoke barriers would apply. See also A-1-3 for another example of the same concept.

1-3.8 Priority of Chapter Requirements.

Where specific requirements contained in Chapters 8 through 32 differ from general requirements contained in Chapters 1 through 7, the requirements of Chapters 8 through 32 shall govern.

The *Life Safety Code* is formatted such that the first seven chapters contain administrative provisions and fundamental requirements establishing minimum acceptable criteria for all types of occupancies. Chapters 8 through 31 of the *Code* establish criteria for life safety based upon the characteristic needs of specific occupancies. Chapter 32 further modifies those provisions if unusual situations exist or the building is windowless, underground, or high rise. Where requirements differ between the general provisions of Chapters 1 through 7 and the more specific provisions of Chapters 8 through 32, the requirements contained in Chapters 8 through 32 take precedence.

To avoid conflicts, if an occupancy chapter exempts itself from a requirement of a core chapter, the core chapter will usually contain an exception allowing the deviation. For example, although 5-2.2.3.3 requires treads of stairs and landing floors to be solid, the Exception to 5-2.2.3.3 permits noncombustible grated stair treads and landings in various specified occupancies including industrial occupancies as provided in Chapter 28. Exception No. 1 to 28-2.2.3.1 confirms the exemption for noncombustible grated stair treads and landings in industrial occupancies. See also the commentary following A-1-3.12.

1-3.9 Provisions in Excess of Code Requirements.

Nothing in this *Code* shall be construed to prohibit a better type of building construction, additional means of egress, or otherwise safer conditions than those specified by the minimum requirements of this *Code*.

Although the *Life Safety Code* is a minimum code, it does not prohibit the use of a design that exceeds the provisions of the *Code*. In practice, however, economic considerations usually discourage the use of a design that exceeds minimum requirements.

However, there have been instances where money was saved or additional money generated when *Code* provisions were exceeded. For example, a hotel was constructed with full automatic sprinkler protection although such protection was not required by the code in effect at the time. By sprinklering the building, a third stairway was permitted to be eliminated because of the increased travel distance allowed in a sprinklered building. The construction cost of the stair was saved, and additional revenue-producing guest rooms were built in the space the stair otherwise would have occupied.

1-3.10 Conditions for Occupancy. No new construction or existing building shall be occupied in whole or in part in violation of the provisions of this *Code*.

Exception: Buildings shall be permitted to remain in use, provided that

(a) A plan of correction has been approved, and
(b) The occupancy classification remains the same, and
(c) No serious life safety hazard exists as judged by the authority having jurisdiction.

From an enforcement standpoint, this paragraph is probably one of the most important in the *Code*, because it states that a building, whether it be new or existing, may not be occupied if it is in violation of the provisions of the *Code*.

Because the *Code* applies retroactively, 1-3.10 prohibits the use of existing nonconforming facilities. However, the Exception to 1-3.10 permits the building to continue to be used provided the occupancy classification remains the same and there is no serious life safety hazard, as judged by the authority having jurisdiction, that would constitute an imminent threat. This does not exempt the building from compliance with the *Code* but permits it to continue to be used. A plan, as prescribed by 1-3.2, for bringing the building into compliance with the *Code* to the extent deemed necessary by the authority having jurisdiction under 1-3.4 must be established and fulfilled.

1-3.11 Construction, Repair, and Improvement Operations.

1-3.11.1* Buildings or portions of buildings shall be permitted to be occupied during construction, repair, alterations, or additions only if all required means of egress and all required fire protection features are in place and continuously maintained for the portion occupied.

A-1-3.11.1 Fatal fires have occurred when a required stair has been closed for repairs or removed for rebuilding, when a required automatic sprinkler system has been shut off to change piping, etc.

The provisions of 1-3.11.1 help to control a relatively common practice—the occupation of completed portions of a partially completed structure. To permit such occupation, the *Code* requires that all egress features for the portion occupied be complete and maintained usable. In many cases the egress facilities, although completed, are not usable because they are

blocked with stored building materials and equipment needed for the ongoing construction, or doors are locked to limit access to parts of the building still under construction. In such cases occupancy should be prohibited.

To permit occupation of completed portions of a partially completed structure, the *Code* also requires all fire protection features to be in place and continuously maintained. The incidence of fire is more frequent, and therefore more likely, during construction, alterations, and repairs. Extra caution and concern need to be exercised to ensure adequate egress capacity and arrangement during periods of construction in any occupied building.

1-3.11.2* In buildings under construction, adequate escape facilities shall be maintained at all times for the use of construction workers. Escape facilities shall consist of doors, walkways, stairs, ramps, fire escapes, ladders, or other approved means or devices arranged in accordance with the general principles of the *Code* insofar as they can reasonably be applied to buildings under construction.

A-1-3.11.2 See also NFPA 241, *Standard for Safeguarding Construction, Alteration, and Demolition Operations.*

1-3.11.3 Flammable or explosive substances or equipment for repairs or alterations shall be permitted in a building of normally low or ordinary hazard classification while the building is occupied only if the condition of use and safeguards provided do not create any additional danger or impediment to egress beyond the normally permissible conditions in the building.

1-3.12* Changes of Occupancy.

In any building or structure, whether necessitating a physical alteration or not, a change from one occupancy classification to another, or from one occupancy subclassification to another subclassification of the same occupancy, shall be permitted only if such structure, building, or portion thereof conforms with the requirements of this *Code* applying to new construction for the proposed new use.

Exception: Where specifically permitted elsewhere in the Code, existing construction features shall be permitted to be continued in use in conversions.

A-1-3.12 Examples of changes from one occupancy subclassification to another subclassification of the same occupancy could include a change from a Class B to a Class A mercantile occupancy. Hospitals and nursing homes are both health care occupancies and are defined separately, but they are not established as separate suboccupancies; thus, a change from one to the other does not constitute a change of occupancy subclassification.

For example, a building was used as a hospital but has been closed for four years. It is again to be used as a hospital. As long as the building was not used as another occupancy during the time it was closed, it would be considered existing.

Hotels and apartments, although both residential occupancies, are treated separately, and a change from one to the other constitutes a change of occupancy.

Although 1-3.12 requires that the provisions for new construction be applied to an existing building upon change of occupancy, Chapter 22, "New Residential Board and Care Occupancies," applies special rules to conversions. For example, if an existing hotel is converted to a large board and care facility, existing corridor walls are exempted from the ½-hour fire resistance rating requirement of 22-3.3.6.3. See the Exception to 22-3.3.6.3. See also the definition of *conversion* in 22-1.3. This is another example of an occupancy-specific requirement taking precedence over a general core chapter requirement as explained in the commentary following 1-3.8.

1-3.13 Maintenance and Testing.

1-3.13.1 Whenever or wherever any device, equipment, system, condition, arrangement, level of protection, or any other feature is required for compliance with the provisions of this *Code*, such device, equipment, system, condition, arrangement, level of protection, or other feature shall thereafter be continuously maintained in accordance with applicable NFPA requirements or as directed by the authority having jurisdiction.

Paragraph 1-3.13.1 emphasizes the importance of maintaining items required by the *Code*. It is useless to have an egress door that will not open, a self-closing device that does not close the door, or a sprinkler system with no water.

1-3.13.2* Existing life safety features such as, but not limited to, automatic sprinklers, fire alarm systems, standpipes, and horizontal exits, if not required by the *Code*, either shall be maintained or removed.

A-1-3.13.2 The presence of a life safety feature, such as sprinklers or fire alarm devices, creates a reasonable expectation by the public that these safety features are functional. When systems are inoperable or taken out of service, but the devices remain present, they present a false sense of safety. Also, before taking any life safety features out of

service, extreme care needs to be exercised to ensure that the feature is not required, was not originally provided as an alternative or equivalency, or is no longer required due to other new requirements in the current *Code*. It is not intended that the entire system or protection feature be removed. Instead components such as sprinklers, initiating devices, notification appliances, standpipe hose, and exit systems should be removed to reduce the likelihood of relying on inoperable systems or features. Alternatively, signage could be provided to indicate that a system is no longer operable.

The *Code* directs that nonrequired life safety features either be maintained or removed to prevent false expectations or a false sense of security by building occupants. For example, if the water supply to a nonrequired wet standpipe system were permanently shut off because the system piping leaked but the hose and nozzle for occupant use were left attached to the standpipe, an occupant could be endangered while attempting to use the system. If the nonrequired standpipe system were turned off and abandoned, it would be necessary, as a minimum, to remove all hoses and nozzles and place prominent signage at each outlet station advising that the system was out of service. The standpipe system piping, however, would not have to be removed.

1-3.13.3 Equipment requiring periodic testing or operation to ensure its maintenance shall be tested or operated as specified elsewhere in this *Code* or as directed by the authority having jurisdiction.

1-3.13.4 Maintenance and testing shall be under the supervision of a responsible person who shall ensure that testing and maintenance are made at specified intervals in accordance with applicable NFPA standards or as directed by the authority having jurisdiction.

Section 1-4 Purpose

1-4.1

The purpose of this *Code* is to provide minimum requirements, with due regard to function, for the design, operation, and maintenance of buildings and structures for safety to life from fire. Its provisions will also aid life safety in similar emergencies.

This *Code* specifies the minimum requirements that collectively help to ensure safety to occupants from fires and similar emergencies to the degree specified by the objective stated in 1-4.2. However, it is not the *Code*'s intent to prevent the user from exceeding the specified minimum requirements. See also 1-3.9.

1-4.2*

An objective of this *Code* is to protect the occupants not intimate with the initial fire development from loss of life and to improve the survivability of those who are intimate with the fire development.

A-1-4.2 The phrase "intimate with the initial fire development" refers to the person(s) at the ignition source and not to all persons within the same room or area. *Code* provisions aimed at protecting occupants not intimate with the initial fire development may also protect those who are intimate with the initial fire development.

The performance-oriented language used in this edition of the *Code* specifies its purpose as protecting the occupants not intimate with the initial fire development from loss of life, while also improving the survivability of those who are intimate with the fire. The objective stated in 1-4.2 was developed first and the occupancy chapter requirements were revised as necessary to accomplish the objective.

1-4.3*

Protection of occupants is achieved by the combination of prevention, protection, egress, and other features with due regard to the capabilities and reliability of the features involved.

A-1-4.3 The level of life safety from fire is defined through requirements directed at the

(a) Prevention of ignition,
(b) Detection of fire,
(c) Control of fire development,
(d) Confinement of the effects of fire,
(e) Extinguishment of fire,
(f) Provision of refuge and/or evacuation facilities,
(g) Staff reaction, and
(h) Provision of fire safety information to occupants.

The occupancy chapters make varying use of any or all of the features enumerated in subparts (a) through (h). A business occupancy located in a single-story building uses fewer of the features to accomplish the intended minimum level of life safety than a health care occupancy does. The health care occupancy

accomplishes its minimum level of life safety by extensively applying features (a) through (g) using a defend-in-place strategy. This strategy recognizes that the occupants are both incapable of self-preservation and difficult to move, particularly vertically to other floors or to the exterior of the building.

1-4.4

The *Code* endeavors to avoid requirements that might involve unreasonable hardships or unnecessary inconvenience or interference with the normal use and occupancy of a building, but provides for fire safety consistent with the public interest.

Buildings are normally designed to accommodate a specific functional need. The *Code* considers the normal occupancy of a building and attempts not to interfere with its regular use or to set requirements that would cause unreasonable hardship or unnecessary inconvenience to its normal functioning. For example, although self-closing devices on doors help to assure continuous fire- and smoke-compartmentation, the health care occupancy provisions of this *Code* do not require self-closing devices on patient room doors because of the day-to-day functional need for staff to monitor conditions while doors remain open. The health care occupancy chapters achieve the intended minimum level of life safety, without unduly interfering with normal operation of the facility, by combining other features and protection schemes.

Section 1-5 Assumption

1-5.1

The protection methods assume a single fire source.

Section 1-6 Equivalency

Section 1-6, Equivalency, presents a powerful design alternative that transforms what would otherwise be a typical specification code into a goal-oriented performance code where state-of-the-art life safety system design is permitted and encouraged.

1-6.1*

Nothing in this *Code* is intended to prevent the use of calculation methods, test methods, systems, methods, or devices effectiveness, durability, and safety as alternatives to those prescribed by this *Code*, provided technical documentation is submitted to the authority having jurisdiction to demonstrate equivalency and the system, method, or device is approved for the intended purpose.

A-1-6.1 Before a particular mathematical fire model or evaluation system is used, its purpose and limitations need to be known. The technical documentation should clearly identify any assumptions included in the evaluation. Also, it is the intent of the Committee on Safety to Life to recognize that future editions of this *Code* are a further refinement of this edition and earlier editions. The changes in future editions will reflect the continuing input of the fire protection/life safety community in its attempt to meet the purpose stated in this *Code*.

With each new edition, the *Code* continues its evolution from a specification code into what is intended to be a performance-oriented document. Paragraph 1-6.1 recognizes that, although the written specification language is presented as a basis for enforcement, it should not inhibit the use of alternate or equivalent systems or design approaches to comply with *Code*-specified performance criteria. It is stipulated, however, that equivalency must be demonstrated by appropriate technical documentation. The evaluation and approval of equivalencies is the responsibility of the authority having jurisdiction.

The *Code* contemplates several forms of equivalency:

Code-specified alternative—The *Code* presents a written requirement and then provides an alternate method of obtaining the desired level of protection, usually via an exception. For example, for new educational occupancies, paragraph 10-3.6 requires that interior corridors be constructed of 1-hour fire resistance–rated assemblies. However, Exception No. 2 to 10-3.6 allows the 1-hour rating requirement to be reduced to that of a nonrated smoke-resisting assembly if the building is protected throughout by an approved, supervised automatic sprinkler system. Thus, the *Code* has judged the combination of smoke-resisting corridor partitions and sprinkler protection to be the equivalent of 1-hour fire resistance–rated corridor walls for new educational occupancies.

NFPA 101A Equivalency Methodologies—NFPA 101A, *Guide on Alternative Approaches to Life Safety*,[1] provides a set of equivalency methodologies that may be used to assess equivalency for health care occupancies, detention and correctional occupancies, board and care occupancies, and business occupancies.

Each system awards positive point values for strong life safety and fire protection features of a building and assesses negative point values for unsafe conditions. Factors are weighted with respect to their impact on life safety principles. Positive point values are permitted to offset negative point values. The completed evaluations are presented to the authority having jurisdiction for review and approval.

In addition to the fire safety evaluation systems, NFPA 101A contains an alternate method of calculation for stair widths, and a procedure for determining evacuation capability for board and care occupancies. Use of each of these methods is subject to the review and approval of the authority having jurisdiction.

More recent edition of the Code—As explained in A-1-6.1, future editions of the *Code* are considered refinements of earlier editions because they clarify intent with respect to the revised topics. Use of a newer edition in its entirety should be considered as equivalent to use of an earlier edition.

Caution must be exercised when applying this concept. One must recognize that specific provisions are part of a carefully crafted set of requirements that result in a desired level of life safety. A revision to one portion of the *Code* may be a part of, or the result of, changes to other *Code* sections. Therefore, it would be inappropriate to refer only to a specific section of a more recent edition of the *Code* that reflects a less stringent requirement than previous editions, without taking into account whatever associated provisions that may have become more stringent to compensate for the more relaxed subject provision. See also A-1-3 for an example illustrating this point.

It is not the intent of the *Code* to limit the user to the three specified methods of judging equivalency. It is the intent to allow emerging technology to be used to satisfy the prescribed performance requirements. Fire modeling has developed to the stage that authorities having jurisdiction are routinely approving equivalency on such basis. Additionally, results of fire tests and other documented forms of engineering analysis have received the approval of authorities having jurisdiction.

In an effort to move the 1997 edition of the *Code* toward a performance-based code, an advisory appendix chapter, Appendix C, Proposed Structure for a Performance-Based Design Option, was written. Although the proposed appendix was rejected by the association membership for inclusion in the *Code*, the draft document contains useful information warranting presentation here. It appears in its entirety as Figure 1-2, without edits, as it originally appeared in the 1996 Fall Meeting Report on Comments.

1-6.2*

Alternative systems, methods, or devices approved as equivalent by the authority having jurisdiction shall be recognized as being in compliance with this *Code*.

This emphasizes that there is more than one way to achieve *Code* compliance. The building either follows the specification criteria or achieves equivalency. When one implements an alternative approach to life safety, and that alternative is judged by the authority having jurisdiction as providing equivalency to the *Code* requirements, the building is considered to be *Code* compliant. Compliance via equivalency is different from a waiver that permits continued use of a noncomplying building.

A-1-6.2 An equivalent method of protection is one providing an equal or greater level of safety. It is not a waiver or deletion of a *Code* requirement.

Section 1-7* Fire Exit Drills

A-1-7 The term "fire exit drill" is used to avoid confusion between drills held for the purpose of rapid evacuation of buildings and drills of fire-fighting practice that from a technical viewpoint are correctly designated as "fire drills," although this term is by common usage applied to egress drills in schools, etc.

The purpose of fire exit drills is to educate the building occupants in the fire safety features and the egress facilities available. Speed in emptying buildings, while desirable, is not the only objective.

The usefulness of a fire exit drill and the extent to which it can be carried off depends on the character of the occupancy; fire exit drills being most effective in occupancies where the occupant load of the building is subject to discipline and habitual control. For example, schools offer possibilities of more highly developed and valuable fire exit drills than other types of occupancy.

In buildings where the occupant load is of a changing character and not subject to discipline, such as hotels or department stores, no regularly organized fire exit drill, such as that which may be conducted in schools, is possible. In such cases, the fire exit drills must be limited to the regular employees, who can, however, be thoroughly schooled in the proper procedure and can be trained to properly direct other occupants of the building in case of fire. In occupancies such as hospitals, regular employees can be rehearsed in the proper procedure in case of fire; such training always is

(Log #CC78)
Committee: FUN

101- 507 - (Appendix C): Accept
SUBMITTER: Technical Committee on Fundamentals
COMMENT ON PROPOSAL NO: 101-639
RECOMMENDATION: Replace proposed Appendix C with the following:

APPENDIX C
PROPOSED STRUCTURE FOR A PERFORMANCE-BASED DESIGN OPTION

This Appendix is not part of the requirements of this NFPA document, but is included for informational purposes.

NOTICE: This appendix provides guidance on features that will be needed when a complete performance-based design option is added to the *Code*. It is not complete and is not intended for regulatory use at this time. It is intended solely to introduce the subject for informational purposes and solicit proposals for further development.

NOTICE: Supplemental, advisory text that might not be suited for future placement within the body of the *Code* is presented within this appendix but is preceded by paragraph numbers that begin with the word "Appendix". Such text is further delineated by placing it within square brackets [ ].

Introduction

Future editions of this *Code* are expected to provide explicit fire safety goals and performance objectives. The purpose of these fire safety goals and objectives is to clearly identify the intent of the prescribed fire safety measures and facilitate the use of engineered fire safety alternatives in meeting the goals and objectives (i.e., a performance-based alternative).

This appendix has been prepared as a means to introduce the concepts of fire safety goals and objectives as they might apply to the Life Safety *Code* in the future. In addition, some basic concepts of performance-based fire safety design have been included to promote the development, advancement and acceptance of the concepts throughout the building and fire community. It should be noted that these concepts are not fully developed, and that the approach, definitions, concepts and criteria provided herein are provided as examples only in order to stimulate further discussion. It is not the intent of this appendix to in any way prohibit the application of performance-based design approaches that differ from the concepts introduced within this appendix.

This appendix introduces this approach, defines its structure, and presents elements in as much detail as the work to this point permits. It is the intent of the committee to encourage development of elements of this option in the peer reviewed fire protection engineering literature. The objective is to include a complete performance-based design option in the *Code*.

This proposed structure follows the guidelines in the July 1995 document "NFPA's Future in Performance-Based *Codes* and Standards: Report of the NFPA In-House Task Group".

Creating the Two Options.

It is anticipated that Chapter 1 of the *Code* will include a new section titled "Design Options" that will state certain chapters of the *Code* apply to a performance-based design option and certain chapters apply to a prescriptive-based design option. *Code* compliance is achieved if either option is used. Because the performance-based design option is an elaboration of the existing and established concept of equivalency, the new section on design options will appear next to the section on equivalency or will be combined with it.

The proposed performance-based design option is not intended to be restrictive. The equivalency concepts of Section 1-5 would apply to both the prescriptive-based and performance-based design options.

It has not yet been determined whether the performance-based design option will use the traditional occupancy structure of the *Code*. If it does not, it will be because it has been determined that occupancy categories are not needed to specify the fire safety goals, fire scenarios, and assumptions relevant to a particular building design. If the occupancy structure is used, then the performance-based design option, like the current prescriptive-based approach, will rely on both general chapters and occupancy chapters to specify requirements.

An example of a design option section not employing the occupancy structure would be as follows:

SECTION 1-x DESIGN OPTIONS

1-x.1 Performance-Based Design Option. A design in accordance with Chapters 1 through 3 and the performance-based criteria of Chapter 4 (Performance-Based Designs) shall be considered as meeting the objectives of this *Code*.

1-x.2 Prescriptive-Based Design Option. A design in accordance with Chapters 1 through 3 and the prescriptive criteria of Chapters 5 through 33 shall be considered as meeting the objectives of this *Code*.

The following definitions would be added to Chapter 3, Section 3-2:

Performance-Based Design Option*. An option within a code or standard whereby compliance is achieved by demonstrating that a proposed design will meet specified fire safety goals using referenced approved methods.

[Appendix 3-2 Performance-Based Design Option More specifically, fire safety goals are translated into performance objectives and performance criteria. Fire models and other calculation methods are used in combination with the building design specifications, specified fire scenarios, and specified assumptions, to calculate whether the performance criteria are met, in which case there is compliance with the *Code* under the performance-based design option.]

Prescriptive-Based Design Option. An option within a code or standard whereby compliance is achieved by demonstrating compliance with specified construction characteristics, limits on dimensions, protection systems, or other features, but without explicit reference to how these requirements collectively achieve explicitly stated fire safety goals.

The following material would appear as a new Chapter 4, entitled Performance-Based Design Option (i.e., the letter C would be replaced with the number 4 in each paragraph number).

SECTION C-1 GENERAL

C-1.1* Application. The performance-based design option is applicable to both new and existing buildings.

[Appendix C-1.1 Application — Overview of Performance-Based Design Option The fire safety goals of the *Code* are contained within the scope, application, and purpose sections of Chapter 1. Only

Figure 1-2 Proposed Appendix C for NFPA 101 - 1997 edition as it appeared in the Safety to Life Committee's report on comments. It was initially accepted, but eventually rejected on the floor at the 1996 Fall Meeting.

in the performance-based design options section will these fire safety goals be translated into quantitative performance objectives and performance criteria suitable for quantitative calculation and assessment.

Fire scenarios provide the fire challenge or "load" against which one determines whether the performance criteria are met. Fire models and other calculation methods are used to determine whether the building design will achieve the performance criteria, given each of the fire scenarios.

The quantitative characterization of the building design needs to be sufficiently complete and in a format to support the calculations. For example, building characteristics that affect occupant behavior (e.g., a complex, maze-like layout) must be assessed.]

C-1.2 Definitions.

Computer Fire Model. A fire model that has been adapted for use on a computer.

Fire Model.* Structured approach to predicting one or more effects of a fire.

[Appendix C-1.2 Fire Model Due to the complex nature of the principles involved, models are often packaged as computer software. Attached to the fire models will be any relevant input data, assumptions and limitations needed to properly implement the model.]

Fire Safety Goal.* Overall outcome to be achieved with regard to fire.

[Appendix C-1.2 Fire Safety Goal Goals are non-specific and are measured on a qualitative basis. They should be stated in terms of conditions (like loss avoidance) that are intrinsically desirable and do not rely on any assumptions. For example, "avoidance of flashover" would not be a goal because it relies on assumptions about what kinds of fires cause harm. Goals should be stated in terms that are potentially measurable, even if the precise measurement scale is not specified. Thus, they may be stated in terms of impact on people or property, business interruption or environmental impact.]

Fire Scenario.* Specification of fire conditions under which a proposed solution is expected to meet the fire safety goals.

[Appendix C-1.2 Fire Scenario The fire scenario describes factors critical to the outcome of the fire such as ignition sources and locations, nature and configuration of the fuel, ventilation, characteristics and locations of occupants, and condition of the supporting structure and other equipment.]

Performance Criteria.* Performance objectives for individual products, systems, assemblies or areas that are further quantified and stated in engineering terms.

[Appendix C-1.2 Performance Criteria Engineering terms include temperatures, radiant heat flux, and levels of exposure to fire products. Performance criteria provide threshold values which are treated as data for calculations used to develop a proposed solution. Examples of performance criteria include limiting a structural member to a critical temperature, limiting COHb levels to less than 25%, limiting upper layer temperatures to less than 500°C above ambient, and limiting radiant flux at floor level to less than 20 kW/m^2.]

Performance Objectives.* Requirements of the fire, building, or occupants which need to be met in order to achieve a fire safety goal.

[Appendix C-1.2 Performance Objectives Examples of performance objectives include prevention of structural damage, no life loss to persons not intimate with initial fire development, separating occupants from fire effects for a specified length of time, and containing the fire to the room of origin.

In general, objectives define a series of actions necessary to make the achievement of a goal much more likely. Objectives are stated in more specific terms than goals and are measured on a more quantitative rather than qualitative basis.]

Safety Factor.* An adjustment made to reflect uncertainty in the assumptions made, the tools and methods used, and the limiting value of a parameter or item being measured.

[Appendix C-1.2 Safety Factor It should be noted that safety factors may be present in many components of an analysis or design. Careful attention should be given to both the lack of safety factors and the possibility that multiple safety factors are present.]

SECTION C-2
PERFORMANCE OBJECTIVES AND CRITERIA

C-2.1 Performance Objective. The fire safety goals of the *Code*, as stated in Chapter 1 are captured in the following quantitative performance objective:

A structure shall be designed, constructed and maintained to protect the occupants not intimate with the initial fire development from instantaneous or cumulative exposure to conditions that exceed approved survivability criteria for the period of time determined necessary.

C-2.2* Survivability Criteria. The performance objective above requires that specific survivability criteria be developed.

[Appendix C-2.2 Survivability criteria should include cumulative exposures to carbon monoxide, hydrogen cyanide, oxygen vitiation, convected heat, and radiant heat.

Note that survivability criteria are only relevant when occupants are exposed to fire conditions. Oxygen levels, for example, need not be maintained above a stated threshold in any area at any time when occupant exposure is not an issue.

The specification of survivability criteria implies a judgment on acceptable risk, just as the choices in the prescriptive-based *Code* imply such judgments. For example, there will be people whose condition before the fire is so frail that any degradation in their environment can lead to death. Survivability criteria cannot be reasonably established to save such people.

Threshold values identified in the literature are those at which it is predicted that roughly half the exposed population will be fatally affected. More conservative criteria would be needed to assure that most people will be protected from loss of life but are more difficult to set with available evidence. Data on 50 percent lethality levels are more available than data on the distribution of lethality levels.]

C-2.3* Assumptions. All assumptions that can affect design performance shall be explicitly stated.

[Appendix C-2.3 Assumptions are any conditions or features that affect the achievement or failure to achieve performance criteria but are not part of the fire scenario or the building design specifications.]

C-2.3.1* Occupant Characteristics. Assumed characteristics of the buildings occupants that affect rate of response, susceptibility to products of

Figure 1-2 Continued.

combustion, and rate of travel shall be explicitly identified.

[**Appendix C-2.3.1** Assumptions regarding occupants are needed so that the assessment can calculate for each occupant whether, and if so when, the occupant will act in response to the fire; what actions the occupant will take and how effectively, with particular attention to speed of movement; and any occupant characteristics that affect survivability, e.g., fire conditions that will lead to loss of life.

Chapter 5 in NFPA 101A, *Guide on Alternative Approaches to Life Safety*, presents one approach to assessing the evacuation capability of occupants.

Occupancy categories are another way of organizing appropriate assumptions regarding occupants.]

C-2.3.2* Building Characteristics. Assumptions regarding characteristics of the building or its contents, equipment, or operations not inherent in the design specifications, but that affect occupant behavior or the rate of hazard development shall be explicitly identified.

[**Appendix C-2.3.2** Such assumptions may be needed to determine how quickly fire and its effects will spread (e.g., doors normally open vs. normally closed). Issues of reliability are a major part of this group of assumptions.]

C-2.4 Safety Factors. Safety factors shall be used to account for uncertainty in assumptions, single-valued data, and deterministic models.

SECTION C-3 FIRE SCENARIOS

C-3.1* The choice of fire scenarios shall include the most common and the most severe fires to be reasonably expected in the building under evaluation.

[**Appendix C-3.1** The choice of the appropriate fire scenarios is a critical step in the performance-based design option. The fire is the driving force for the development of smoke, heat and other products of combustion. It is important to select a wide range of fire scenarios to represent every type of fire that will affect the building's fire safety performance in a distinctive manner.

The fire scenario heat release rate should be based upon information related to the fuel in the area. Fire test results such as found in the Appendix of NFPA 72, *National Fire Alarm Code*, and other recognized references can be used to determine the necessary information.

There are dangers if the chosen fire scenarios are too severe or not severe enough. If a fire scenario is too severe, then a building in compliance with the prescriptive-based code will fail to achieve the fire safety goals if confronted with such a fire. This will unreasonably discourage use of the performance-based design option and shed doubt unrealistically on the adequacy of the prescriptive-based design option. There are always fires too severe for the *Code* (e.g., a ground-zero explosion of a strategic nuclear weapon). The challenge is to find the boundary that meets the limits of reasonable expectations. If the fire scenarios selected do not adequately reflect reasonably severe fire conditions, the resulting performance-based design might fail to achieve the needed level of fire safety.

The three fire scenarios described below illustrate a generic approach, in which many of the specific details of the scenario either need to be provided, are referenced to a more detailed guide, or are deferred to those presenting a performance-based design proposal, who must justify the reasonableness of their detailed specifications:

(*a*) Common Scenario #1 - Ordinary Fire in Occupied Room. Common scenario #1 shall be designed to be representative of a free-burning fire in ordinary combustibles, ignited by a small open-flame source, in one of the principal occupied spaces of the occupancy under consideration, with testing and modeling specifications for the scenario as specified in (*whatever new NFPA standard is used to present and specify the standard scenarios*).

(*b*) Common Scenario #2 - Fire with Initial Smoldering Stage in Occupied Room. Common scenario #2 shall be designed to be representative of a fire started by cigarette ignition of upholstered furniture, in one of the principal occupied spaces of the occupancy under consideration, with testing and modeling specifications for the scenario as specified in (*whatever new NFPA standard is used to present and specify the standard scenarios*).

(*c*) High-Challenge Scenario #1 - Fire Originating in Means of Egress. High-challenge scenario #1 shall be designed to be representative of a free-burning fire in ordinary combustibles, ignited by a small open-flame source, in the means of egress of the occupancy under consideration, with testing and modeling specifications for the scenario as specified in (*whatever new NFPA standard is used to present and specify the standard scenarios*).

Shown below are constructive steps to be used in specifying fire scenarios.

(1) Common scenarios can be partly specified through routine statistical analysis of fire experience in similar buildings. An advantage of common or typical scenarios is that they provide a good picture of what the buildings performance will usually be if fire occurs. Such scenarios also tend to fit easily within the scope of available fire models and calculation methods. This means the authority having jurisdiction can review results for these scenarios to obtain a basic sense of the building's level of safety and the appropriateness of the calculations.

(2) High-challenge scenarios are any scenarios that pose unusual fire challenges to the building design. High-challenge scenarios can be developed by refining common scenarios (e.g., changing the area of fire origin) to create a greater challenge. Also, high-challenge scenarios can be developed by reducing the challenge in scenarios previously identified as beyond the design expectations, i.e., too severe to use as the basis for evaluation.

Shown below are illustrative techniques for developing high-challenge scenarios from common scenarios.

(1) Change the area of fire origin. Consider an area (e.g., bedroom) where occupants are likely to be in a particularly vulnerable status. Consider an area (e.g., concealed spaces, external surfaces) where fire can develop outside the effective range of key fire protection features (e.g., detectors, sprinklers). Consider an area (e.g., means of egress) that is critical to occupant movement to safety.

(2) Increase the initial size or speed of development of the fire. This may be done by adjusting parameters in a fire growth model (e.g., increasing the alpha value in a t-squared modeled fire, reflecting a fast or ultra-fast fire, increasing the peak heat release rate value for the fire) or by increasing the assumed room fuel load or decreasing the space between major combustible items.

(3) Assume common degradations in design assumptions. For example, assume doors are blocked open, allowing fire passage of fire efforts to secondary

Figure 1-2 Continued

spaces; or, assume an insufficient oxygen supply for fire growth, which could result from open doors, broken windows, or other circumstances.

Developing high-challenge scenarios from scenarios beyond design expectations will involve less challenging quantitative assumptions. For example, if the bomb used in the World Trade Center incident of 1993 is deemed too severe for a high-rise office building, how small a bomb would constitute an appropriate high-challenge test? Or, if the *Code* cannot assure protection of occupants who are intimate with initial fire development, how close can occupants be and not be considered intimate?]

SECTION C-4
FIRE MODELS AND CALCULATION METHODS

C-4.1* The models and methods used to evaluate performance shall be appropriate to the fire scenarios selected. Use and limitations of fire models shall be determined in accordance with ASTM *Standard Guide for Determining Uses and Limitations of Fire Models*.

[**Appendix C-4.1** Calculation methods are tools that permit a proposed solution to be assessed with regard to the applicable fire safety goals, assumptions and fire scenarios. Due to the complex nature of the principles and relationships involved, calculation methods are often packaged as computer software. Calculation methods contain scientific and mathematical relationships needed to model the behavior of certain aspects of a fire event, such as the growth and spread of the fire, the generation of harmful products, the response of fire protection systems, the behavior of occupants or others, or the impact of the fire on exposed people or property. Calculation methods are useful in codes and standards if they permit the user to assess whether or predict when a critical event will be reached (e.g., the achievement of the fire safety goals or the failure of the fire safety system).

Several fire models and calculation methods will typically be employed during the design and assessment process as it is unlikely that a single model will be capable of simulating all that is needed. As technology advances, it is likely that new methods will be developed to fill gaps in needed calculations or to improve on the performance of existing models. Also, existing methods are likely to be integrated into more comprehensive packages that will need to be re-evaluated in their new form.

It is not appropriate for the *Code* to prescribe specific methods by name. Instead, the *Code* should direct users to appropriate sources of accepted engineering practices for performing the needed calculations. The process of selecting and identifying fire safety goals, including objectives and criteria; assumptions about the condition and location of occupants being protected; and applicable fire scenarios will fully describe what the *Code* considers to be acceptable safety. When the performance objectives and criteria; and the input data of scenarios, assumptions, and the proposed design itself are stated explicitly and quantitatively, modeling can be used to predict performance.
It is anticipated that the fire protection engineering community will develop resources, in a form suitable for reference by the *Code*, so that a user will take from the *Code* clear guidance on the performance outcome values that need to be calculated and the input data to be developed and used, and then will take from the fire protection engineering resources clear guidance on how to predict performance outcomes from input data.

Before a particular fire model or calculation method is used, its purpose and limitations must be known. The technical documentation needs to clearly identify any assumptions included in the evaluation.]

C-4.2 Computer Fire Models.

C-4.2.1 Documentation. Computer fire models shall be documented in accordance with ASTM E 1472, *Standard Guide for Documenting Computer Software for Fire Models*.

C-4.2.2 Predictive Capability. Computer fire models shall be evaluated for their predictive capability in accordance with ASTM E 1355, *Standard Guide for Evaluating the Predictive Capability of Fire Models*. When required by the authority having jurisdiction, such evaluation shall include scenarios specific to this application.

C-4.2.3 Data. Input data for computer fire models shall be obtained in accordance with ASTM E 1591, *Standard Guide for Data for Fire Models*.

C-4.3 Sensitivity Analysis. When required by the authority having jurisdiction, a sensitivity analysis shall be conducted to study the impact of variation of assumptions or input data.

SECTION C-5
PRESCRIPTIVE REQUIREMENTS

C-5.1* Building features that have prescribed requirements in Chapters 5–33 but are not included in the model or assumptions shall comply with Chapters 5–33 as appropriate.

[**Appendix C-5.1** Some prescriptive requirements will be needed even in a performance-based design option. Some such requirements will reflect the absence of any logical alternative to the requirement (e.g., a sprinkler system requires an adequate water supply, consistent with its design). Some such requirements will be necessary to support the assumption embedded in the building design specifications (e.g., the use of listed parts assures that the building design will perform as intended) or to support other assumptions (e.g., a detector maintenance program provides assurance that an assumption of detector operability is reasonable).]

SECTION C-6 DOCUMENTATION

C-6.1* The performance-based design option shall be prepared by a person with qualifications acceptable to the authority having jurisdiction.

[**Appendix C-6.1** Qualifications should include experience, education, and credentials that demonstrate knowledgeable and responsible use of applicable models and methods.]

C-6.2 The performance-based design option shall be documented in a manner acceptable to the authority having jurisdiction.

C-6.3 Documentation submitted for design approval shall include but not be limited to:

(1) Identification of the building

(2) List of survivability criteria with sources

(3) List of assumptions about occupant characteristics

(4) List of assumptions about building characteristics

(5) List of safety factors

(6) Descriptions of fire scenarios

Figure 1-2. Continued.

known limitations

(8) List of input data

(9) Output of model or method including sensitivity analysis when required

(10) List of prescriptive requirements complied with

(11) Computer fire model documentation if required by the authority having jurisdiction

SUBSTANTIATION: The draft revision reformats the material for better presentation, responds to some of the public comments, and clarifies intent.
COMMITTEE ACTION: Accept.
NUMBER OF COMMITTEE MEMBERS ELIGIBLE TO VOTE: 8
VOTE ON COMMITTEE ACTION:
AFFIRMATIVE: 8

Figure 1-2. Continued.

advisable in all occupancies whether or not regular fire exit drills can be held.

Paragraphs 1-7.1 through 1-7.5 serve as a primer on how to conduct a fire exit drill. The *Operating Features* section (i.e., the -7 section) of some of the occupancy chapters provides fire exit drill details that directly correlate a drill with the characteristics of the occupancy. To help understand that the drill details have been matched to the needs of the occupants, compare those in 10-7.1—applicable to new educational occupancies—against those in 12-7.1—applicable to new health care occupancies.

1-7.1

Fire exit drills conforming to the provisions of this *Code* shall be conducted regularly in occupancies where specified by the provisions of Chapters 8 through 32, or by appropriate action of the authority having jurisdiction. Drills shall be designed in cooperation with the local authorities.

1-7.2*

Fire exit drills, where required by the authority having jurisdiction, shall be held with sufficient frequency to familiarize occupants with the drill procedure and to have the conduct of the drill a matter of established routine. Drills shall include suitable procedures to ensure that all persons in the building or all persons subject to the drill actually participate.

A-1-7.2 If a fire exit drill is considered merely as a routine exercise from which some persons may be excused, there is a grave danger that in an actual fire the drill will fail in its intended purpose. However, there might be some circumstances under which all occupants might not participate in a fire exit drill, for example, infirm or bedridden patients in a health care occupancy.

1-7.3

Responsibility for the planning and conduct of drills shall be assigned only to competent persons qualified to exercise leadership.

1-7.4

In the conduct of drills, emphasis shall be placed on orderly evacuation under proper discipline rather than on speed.

1-7.5*

Drills shall be held at expected and unexpected times and under varying conditions to simulate the unusual conditions that occur in the case of fire.

A-1-7.5 Fire is always unexpected. If the drill is always held in the same way at the same time it loses much of its value, and when for some reason during an actual fire it is not possible to follow the usual routine of the fire exit drill to which occupants have become accustomed, confusion and panic may ensue. Drills should be carefully planned to simulate actual fire conditions. Not only should they be held at varying times, but different means of exit should be used based on an assumption that, for example, some given stairway is unavailable by reason of fire or smoke, and all the occupants must be led out by some other route. Fire exit drills should be designed to familiarize the occupants with all available means of exit, particularly emergency exits that are not habitually used during the normal occupancy of the building.

Section 1-8 Units

1-8.1

Metric units of measurement in this *Code* are in accordance with the modernized metric system known as the International System of Units (SI).

1-8.2

If a value for measurement as given in this *Code* is followed by an equivalent value in other units, the first stated shall be regarded as the requirement. A given equivalent value may be approximate.

The metric values that appear within parentheses immediately following the U.S. Customary Units values might mistakenly appear as intentionally precise values representing the requirement rather than an approximation. For example, 5-2.1.2.2 requires that door openings in means of egress provide clear width of at least 32 in. (81 cm). Because the value 81 is not a nice round value, such as 80 or 90, it seems so precise as to be easily mistaken as the requirement. However, the value 81 is an approximation derived by multiplying 32 in. by the conversion factor of 2.54 cm per inch and rounding the resultant value of 81.28 to 81. As explained in 1-8.2, the first stated value, in U.S. Customary Units, is the requirement and the equivalent value, in metric units, is the approximation.

1-8.3

The conversion procedure for the SI units has been to multiply the quantity by the conversion factor and then round the result to the appropriate number of significant digits.

Reference Cited in Commentary

[1] NFPA 101A, *Guide on Alternative Approaches to Life Safety*, National Fire Protection Association, Quincy, MA, 1995. (Note: The 1995 edition of NFPA 101A is calibrated to measure equivalency against the requirements of the 1994 edition of the *Code*. The 1998 edition of NFPA 101A will measure equivalency against the requirements of the 1997 edition of the *Code*.)

CHAPTER 2

Fundamental Requirements

Chapter 2 outlines the fundamental concepts that are addressed in detail via the myriad requirements contained in the other chapters of the *Code*. Achieving these life safety fundamentals helps to ensure a reasonable level of life safety in building design and arrangement. The following are the fundamentals. Simply stated:

1. To provide for adequate safety without dependence on any single safeguard,
2. To ensure that construction is sufficient to provide structural integrity during a fire while occupants seek safe refuge within the building or egress to the building exterior,
3. To provide an appropriate degree of life safety considering the size, shape, and nature of the occupancy,
4. To ensure that the egress paths are clear, unobstructed, and unlocked,
5. To ensure that the exits and egress routes are clearly marked so as to avoid confusion and provide the cues needed for their effective use,
6. To provide adequate lighting,
7. To ensure prompt occupant response by providing early warning of fire,
8. To provide for back-up or redundant egress arrangements,
9. To ensure the suitable enclosure of vertical openings, and
10. To allow for design criteria that exceed the scope of this *Code* and address the normal use and needs of the occupancy in question.

2-1*

Every building or structure, new or old, designed for human occupancy shall be provided with means of egress and other safeguards sufficient to permit the prompt escape of occupants or shall furnish other means to provide a reasonable degree of safety for occupants. The design of means of egress and other safeguards shall be such that reliance for safety to life will not depend solely on any single safeguard; additional safeguards shall be provided for life safety in case any single safeguard is ineffective due to human or mechanical failure.

A-2-1 It is not always necessary to completely evacuate the building or structure to escape from a fire or other emergency. An area of refuge formed by horizontal exits, smoke barriers, other floors, or similar compartmentation often can serve as a place for the occupants to remain in relative safety until the emergency is over. In those occupancies where access to the exits is by way of enclosed corridors, particularly those occupancies with sleeping occupants, a single fire might block access to all exits, including horizontal exits and smoke barriers. In such cases, the occupants may achieve a greater degree of safety by remaining in their rooms.

2-2

Every building or structure shall be constructed, arranged, equipped, maintained, and operated to avoid undue danger to the lives and safety of its occupants from fire, smoke, fumes, or resulting panic during the period of time reasonably necessary for escape from the building or structure or for that period of time needed to defend in place.

2-3

Every building or structure shall be provided with means of egress and other safeguards of kinds, numbers, locations, and capacities appropriate to the individual building or structure, with due regard to the character of the occupancy, the capabilities of the occupants, the number of persons exposed, the fire protection available, the height and type of construction

of the building or structure, and other factors necessary to provide all occupants with a reasonable degree of safety.

2-4

In every building or structure, means of egress shall be arranged and maintained to provide free and unobstructed egress from all parts of the building or structure at all times when it is occupied. No lock or fastening shall be installed to prevent free escape from the inside of any building. Means of egress shall be accessible to the extent necessary to ensure reasonable safety for occupants having impaired mobility.

Exception: Locks shall be permitted in mental health, detention, or correctional facilities where supervisory personnel are continually on duty and effective provisions are made to remove occupants in case of fire or other emergency.

Problems with locking devices have repeatedly been a contributing factor in multiple-fatality fires in correctional facilities. Some of these problems include malfunctioning locks, an inability to locate keys in smoke or in the dark (frequently caused by smoke obscuration of lighting), locks jammed with toothpicks and chewing gum, and lock releases made inoperative from pushing against the doors. All of these problems appear in the fire record. Prior to a fire, it might often have been assumed that, in the event of an emergency, there would be effective provisions for releasing locks and that personnel would be continually in attendance. Extreme care must be exercised to ensure that locks can and will be unlocked or that alternate methods of providing life safety, that are independent of evacuation, are provided. See also "The Seminole County Jail Fire" and "Fire in Prisons."[1, 2]

2-5

Every exit shall be clearly visible, or the route to reach every exit shall be conspicuously indicated in such a manner that every occupant of every building or structure who is physically and mentally capable will readily know the direction of escape from any point. Each means of egress, in its entirety, shall be arranged or marked so that the way to a place of safety is indicated in a clear manner. Any doorway or passageway that is not an exit or a way to reach an exit, but is capable of being confused with an exit, shall be arranged or marked to prevent occupant confusion with acceptable exits. Every effort shall be taken to avoid occupants mistakenly traveling into dead-end spaces in a fire emergency.

2-6

Where artificial illumination is required in a building or structure, egress facilities shall be included in the lighting design in an adequate and reliable manner.

2-7

In every building or structure of such size, arrangement, or occupancy that a fire itself might not provide adequate occupant warning, fire alarm facilities shall be provided where necessary to warn occupants of the existence of fire. Fire alarms alert occupants to initiate emergency procedures and facilitate the orderly conduct of fire exit drills.

Several multiple-fatality fire incidents, especially in hotels, have shown that fire alarm sounding devices were inadequate to alert building occupants. This was because occupants either could not hear the alarm or did not recognize the alarm as a fire alarm signal. Confusion with sounds made by telephones or alarm clocks has been reported. Authorities having jurisdiction must ensure that sounding devices can be heard over ambient noise levels and can be recognized as fire alarm signals. See "Familiar Problems Cause 10 Deaths in Hotel Fire" and "Ten Die in Greece, New York Hotel Fire."[3, 4]

2-8

Two means of egress, as a minimum, shall be provided in every building or structure, section, and area where size, occupancy, and arrangement endanger occupants attempting to use a single means of egress that is blocked by fire or smoke. The two means of egress shall be arranged to minimize the possibility that both might be rendered impassable by the same emergency condition.

2-9

Every exit stair, exit ramp, and other vertical opening between floors of a building shall be suitably enclosed or protected, as necessary, to afford reasonable safety to occupants while using means of egress and to prevent spread of fire, smoke, or fumes through vertical openings from floor to floor before occupants have entered exits.

Unprotected or improperly protected vertical openings have repeatedly appeared in NFPA fire records as a major contributing factor in multiple-death fires. The following is a list of multiple-death fires in which unprotected vertical openings have been identified as a significant factor in these deaths:

November 20, 1980, Las Vegas, NV	85 dead[5]
January 9, 1981, Keansburgh, NJ	31 dead[6]
March 14, 1981, Chicago, IL	19 dead[7]
October 28, 1982, Pittsburgh, PA	5 dead[8]
April 19, 1983, Worcester, MA	7 dead[9]
June 14, 1983, Fort Worth, TX	5 dead[10]
August 31, 1983, Gwinnett, GA	8 dead[11]
December 31, 1986, San Juan, PR	97 dead[12]

See also the commentary on Section 6-2.

2-10*

Compliance with this *Code* shall not be construed as eliminating or reducing the necessity for other provisions for safety of persons using a structure under normal occupancy conditions. Also, no provision of the *Code* shall be construed as requiring or permitting any condition that might be hazardous under normal occupancy conditions.

A-2-10 The provisions of this *Code* will not necessarily provide a building suitable for use by physically handicapped people. Reference is made to CABO/ANSI A117.1, *American National Standard for Accessible and Usable Buildings and Facilities.*

References Cited in Commentary

[1] Richard Best, "The Seminole County Jail Fire," *Fire Journal*, Vol. 70, No. 1, January 1976, pp. 5-10, 17.

[2] David P. Demers, "Fire in Prisons," *Fire Journal*, Vol. 72, No. 2, March 1978, pp. 29-41.

[3] David P. Demers, "Familiar Problems Cause 10 Deaths in Hotel Fire," *Fire Journal*, Vol. 74, No. 1, January 1980, pp. 52-56.

[4] David P. Demers, "Ten Die in Greece, New York Hotel Fire," *Fire Journal*, Vol. 73, No. 4, July 1979, pp. 25-30.

[5] Richard Best and David P. Demers, "Fire at the MGM Grand," *Fire Journal*, Vol. 76, No. 1, January 1982, pp. 19-37.

[6] Richard Best and Steven W. Hill, "Fires in Two Boarding Facilities Kill 34 Residents," *Fire Journal*, Vol. 76, No. 4, July 1982, pp. 44-57, 106.

[7] Steven Hill, "19 Die in Chicago Hotel Fire," *Fire Journal*, Vol. 76, No. 2, March 1982, pp. 53-55, 60-61.

[8] James R. Bell, "Five Die in Pittsburgh Boarding Home Fire," *Fire Journal*, Vol. 77, No. 5, September 1983, pp. 68-71, 75.

[9] Richard Best, "Fire in Community Home Causes Seven Deaths," *Fire Journal*, Vol. 78, No. 2, March 1984, pp. 19-23, 79-80.

[10] Ron Coté, Thomas Klem, and William P. Walls, "Five Die in Fire at Texas Ramada Inn," *Fire Journal*, Vol. 78, No. 2, March 1984, pp. 55-57, 60-70.

[11] Tom Timoney, "Eight Mentally Handicapped Occupants Die in Georgia Fire," *Fire Journal*, Vol. 78, No. 3, May 1984, pp. 91-97, 134.

[12] Thomas J. Klem, Investigation Report on the Dupont Plaza Hotel Fire, NFPA LS-11, National Fire Protection Association, Quincy, MA, 1987.

CHAPTER 28

Industrial Occupancies

Section 28-1 General Requirements

Industrial occupancy is a broad classification. The following are examples of industrial occupancies:

- Factories of all kinds
- Gas plants
- Laboratories
- Refineries
- Dry cleaning plants
- Sawmills
- Power plants
- Pumping stations
- Telephone exchanges
- Laundries
- Recycling plants
- Autobody and repair shops
- Food processing plants
- Hangars (for servicing)
- Postal central sorting maintenance facilities

The national fire incident databases indicate that the classifications of industrial and manufacturing properties accounted for 27,500 structure fires per year as reported to U.S. fire departments from 1984 to 1988. These fires led to 45 civilian (non-fire-service personnel) deaths and 858 civilian injuries a year. Only one-fourth of the people who died in fires in those properties from 1980 to 1988 were outside the room of fire origin when the fire began.

Many industrial properties pose the particular hazard of rapid fire development as a result of explosion or flash fire. This fact is underscored each year in the detailed descriptions of multiple-death and large-loss fires. In the 1980s, eight industrial fires killed 10 or more people, although three of those fires took place in coal mines, which are addressed as special structures by the *Life Safety Code*. The other five consisted of two fireworks manufacturing plant incidents, one in Oklahoma in 1985 and one in Tennessee in 1983; a 1980 metal manufacturing plant incident in New York; a 1984 refinery incident in Illinois, where the 17 dead included many employees who acted as fire fighters; and a 1989 polyolefin plant incident in Texas, which also ranks as the fourth highest property loss from fire in U.S. history, after adjusting for inflation, and the highest loss to involve only one property.

28-1.1 Application.

The requirements of this chapter shall apply to both new and existing industrial occupancies. Industrial occupancies shall include factories making products of all kinds and properties used for operations such as processing, assembling, mixing, packaging, finishing or decorating, repairing, and similar operations.

Unlike most occupancies covered in the *Code*, both new and existing industrial occupancies are covered in one chapter. Where the requirements vary, it is common for exceptions that apply to existing industrial occupancies to appear or for additional requirements that are limited to new industrial occupancies to be included.

The statistics provided by the national fire incident databases demonstrate that the potential loss of life from fire in an industrial occupancy is directly related to the hazard of the industrial operation or process. Most multiple-death industrial fires are the result of flash fires caused by highly combustible material or explosions involving combustible dusts, flammable liquids, or gases.

Although industrial fire losses constitute a high percentage of the annual property loss from fire, such fires have not, as a general rule, resulted in extensive loss of life. A number of operating features common

to industrial occupancies has contributed to this favorable record. Continued emphasis on proper egress design and maintenance and day-to-day attention to industrial safety and training programs can help to perpetuate this trend.

One of the major features to be considered in the design of an industrial building's life safety system is the widespread utilization of automatic sprinkler protection. Originally developed for industrial property protection, the automatic sprinkler has also been largely responsible for an excellent life safety record in industrial occupancies. This record has been recognized by the fire protection community, as evidenced by the widespread use of automatic sprinkler systems for life safety protection in buildings with significant hazards to life. Automatic sprinkler protection in industrial occupancies has been a principal factor in ensuring safety to life through the control of fire spread. Limiting the size of a fire by means of sprinklers provides sufficient time for the safe evacuation of occupants exposed to fire. The contribution of the automatic sprinkler to safety to life can be fully appreciated only when the wide range of fire risks associated with the many processes used in an industrial facility are recognized.

Employees and other occupants of industrial buildings are generally ambulatory and capable of quick response to fires. They are also able to exit rapidly once properly alerted. To capitalize on this employee capability, many industrial facilities include life safety measures in their emergency preplanning. A well-conceived plan provides a valuable tool in preventing loss of life. Provisions that should be part of the emergency preplan include measures for alerting employees, identification and posting of exit access routes, establishment of group assembly areas for occupants once they have evacuated the building, and procedures for determining that all employees have safely evacuated. Responsibilities are usually established and assigned in the preplan to ensure that the tasks necessary to facilitate safe evacuation of the building are performed. The preplan should routinely be evaluated through simulated fire exercises and drills. Only through the execution of such drills can flaws in the preplan be recognized and modified.

Although the life safety record in industry has been relatively good, a major problem may be emerging in the trend toward constructing large industrial plants that house hazardous operations. The introduction of new materials, such as extensive quantities of plastics, has increased the need for additional measures to help protect employees from fire. Compared with industrial buildings of the early twentieth century, the modern industrial complex has placed a larger number of employees in a more complex and increasingly hazardous environment. This trend has increased the need for industrial management to concentrate on life safety principles, not only during the design stage, but also during day-to-day plant operations.

As part of their employee training programs, most industrial firms include education in the use of first aid fire-fighting equipment, such as in-plant standpipes, hose, and portable fire extinguishers. Industrial training of this type, where fully utilized, has resulted in a major reduction in property loss and life loss. Although first aid fire-fighting measures are primarily a property protection measure, there is also a significant life safety benefit. In any situation where the spread of a fire is checked through effective employee action, employee life safety is also provided. If fire spread is restricted to the incipient stages, there is no significant threat to life safety.

28-1.2 Mixed Occupancies.

In any building occupied for both industrial and other purposes, means of egress shall comply with 4-1.12.

In addition to requiring that the means of egress complies with 4-1.12, which covers mixed occupancies, the intent of this paragraph is that the other life safety features addressed by the *Code* comply with 4-1.12.

28-1.3 Special Definitions.

(None.)

Although no special definitions are listed in 28-1.3, industrial occupancies are subclassified and defined in 28-1.4.1(a), (b), and (c) under the labels *general industrial occupancy, special purpose industrial occupancy,* and *high hazard industrial occupancy.*

28-1.4 Classification of Occupancy.

(*See 4-1.9.*)

The method for determining the degree of hazard to life safety posed by an industrial occupancy is at best a result of personal judgment and not an exact

...ce. The authority having jurisdiction must use ...dgment based on past experience, a review of reference materials, and full discussion with third parties to evaluate the life safety measures in an industrial occupancy. The *Code* establishes broad categories of occupancy classification so that the relative risks to life safety posed by various types of buildings can be assessed.

A common error made when classifying industrial occupancies is the use of hazard categories for automatic sprinklers contained in NFPA 13, *Standard for the Installation of Sprinkler Systems,*[1] to determine the hazard to life safety. While the guidelines in NFPA 13 may not differ greatly from those of the *Life Safety Code* when classifying high hazard occupancies, the remaining categories in NFPA 13 are usually not suitable for the general industrial occupancy classification of the *Code.* This is particularly true when classifying low hazard occupancies, which are classified differently by NFPA 13 (light hazard) than by the *Life Safety Code.* The distinction is that the life safety industrial occupancy classification is concerned with determining the overall hazard to occupants in a manufacturing building for purposes of implementing an adequate means of egress system, while the NFPA 13 classification system is concerned with de...ining the hazard so that a sprinkler system can be designed to meet the challenge of the hazard.

To examine the conflicts between life safety occupancy classification and classifications in other fire codes, consider a metalworking plant using a flammable solvent in a dip tank coating operation. From a life safety standpoint, the normally ordinary hazard classification of the metalworking plant should not be changed to high hazard solely because of the presence of a dip tank coater. An adequate means of safe egress leading away from the coater is needed to ensure the safety of the occupants, but additional exits and a reduction in travel distance to an exit, as specified for a high hazard area, are not required. However, if the coater is the principal piece of equipment in a separately enclosed area, that area should be considered as a high hazard industrial occupancy.

When determining the life safety hazard classification for an industrial occupancy, the authority having jurisdiction should carefully analyze the nature of that industrial operation to ensure an accurate evaluation of the hazard to occupants. A number of resources are available as aids to properly determine the degree of risk to life safety. One aid that should not be overlooked is the expertise of the industrial plant operator. The operator has available a wealth ...f hazard information. However, the information may be treated as confidential material to prevent competitors from learning the details of an industrial process. An enforcing authority should earn the trust of the operator by carefully handling such material. It is vital that process data be kept confidential, because once an enforcing authority is known to be a source of data on industrial secrets, further cooperation will be difficult to obtain.

Another resource is the engineering department of the company responsible for a facility's insurance coverage. In addition, discussions with officials who oversee jurisdictions where similar facilities exist and a review of NFPA literature will provide further information on a particular process and its associated hazards.

To assess the risk to life safety in an industrial occupancy, a number of factors should be considered. It should be determined if the manufacturing process includes the handling of flammable, reactive, or explosive materials in quantities that could expose occupants to an initial fire or explosion. If so, the occupancy is a strong candidate for a high hazard classification.

It should also be determined whether the manufacturing process requires a large number of people or whether it is basically a large collection of machines or equipment occasionally attended by operators. In some instances, the operators may be clustered in one location, such as a control room. If a building is predominantly occupied by machinery or equipment and is used by few employees, the building can be classified as a special purpose industrial occupancy. See 28-1.4.1(b).

If an industrial building is used mostly for storage of materials (such as preparatory stock for assembly or finished goods), it might meet the requirements for classification as a storage occupancy. See Chapter 29.

Occupancy classification is dependent on the burning and explosive characteristics of the materials contained in a building, not on the quantity of combustibles. For example, there is no reason to classify a building as high hazard simply because it is associated with a manufacturing process that requires extensive quantities of ordinary combustible materials distributed in such a manner that the process would involve a high combustible load.

The classification of an industrial occupancy for life safety purposes does not depend on the type of structure housing the industrial process. The basic purpose of the hazard classification in Chapter 4 is to evaluate the risk of contents (see Section 4-2). The classification is determined by an evaluation of the

contents and other factors in a fire's development that affect the time available for safe evacuation of the occupants. Once employees are evacuated to a safe location, the extent of fire spread in the structure becomes a threat to property. As long as life safety measures are met, the threat of heavy fire damage to a building is beyond the scope of the *Life Safety Code*. Also see the commentary following 28-1.4.1(b) and 28-1.4.1(c).

28-1.4.1 Subclassification of Industrial Occupancies. Each industrial occupancy shall be subclassified according to its use as follows:

(a) *General Industrial Occupancy.* Ordinary and low hazard industrial operations conducted in buildings of conventional design suitable for various types of industrial processes. Included are multistory buildings where floors are occupied by different tenants or buildings suitable for such occupancy and, therefore, subject to possible use for types of industrial processes with a high density of employee population.

(b) *Special Purpose Industrial Occupancy.* Includes ordinary and low hazard industrial operations in buildings designed for and suitable only for particular types of operations, characterized by a relatively low density of employee population, with much of the area occupied by machinery or equipment.

It can be difficult to determine if a building qualifies as a special purpose industrial occupancy. For example, a structure is often erected to protect a large machine or equipment from weather. Once constructed, authorities might try to impose exit requirements applicable to a general industrial occupancy, despite the fact that there is to be only a handful of personnel occupying the building. Steel mills, paper plants, generating plants, and other operations with large machines are examples of the types of industrial occupancies requiring massive structures for process control and weather protection. These structures often represent minimum hazards to life safety and should be classed as special purpose industrial occupancies. In many of the more modern operations, all process control is conducted from a control room by remote means, which further reduces the number of occupants likely to be exposed to a fire.

However, the special purpose industrial occupancy classification cannot be applied to a building simply to reduce egress requirements. Economic considerations, or staffing limitations that result in occupancy by fewer employees than usual, cannot be used as justification for reducing life safety features. The full number and arrangement of exits required for a general industrial occupancy should be maintained. A reduction in aisles, doors, stairways, and other components of the means of egress cannot be justified by the temporary classification of a building as a special purpose industrial occupancy.

(c)* *High Hazard Industrial Occupancy.* Includes buildings having high hazard materials, processes, or contents. Incidental high hazard operations in low or ordinary occupancies and protected in accordance with Section 4-2 and 28-3.2 shall not be the basis for overall occupancy classification.

A-28-1.4.1(c) High hazard occupancy may include occupancies where gasoline and other flammable liquids are handled, used, or stored under such conditions as to involve possible release of flammable vapors; where grain dust, wood flour or plastic dusts, aluminum or magnesium dust, or other explosive dusts may be produced; where hazardous chemicals or explosives are manufactured, stored, or handled; where cotton or other combustible fibers are processed or handled under conditions that might produce flammable flyings; and other situations of similar hazard.

Chapter 28, Industrial Occupancies, and Chapter 29, Storage Occupancies, include detailed provisions on high hazard occupancy.

A high hazard occupancy classification is limited to those industrial buildings housing extremely hazardous operations. Incidental use of restricted quantities of flammable liquids in a building does not constitute a high hazard, although some additional life safety precautions may be required during the limited period of use. Refer to NFPA 30, *Flammable and Combustible Liquids Code*,[2] for guidance. Storage of flammable liquids, such as paint, in sealed containers does not require a high hazard occupancy classification unless the operation includes mixing or blending operations that require the containers to be opened. Mixing and blending of flammable liquids can be conducted in a separate room with a fire barrier between the storage and mixing areas. In this operation, the mixing and blending room would be considered a high hazard industrial occupancy, while the adjacent, fire-separated storage area would be considered a general purpose industrial occupancy or possibly a storage occupancy subject to the requirements of Chapter 29.

Combustible dusts released from an industrial or manufacturing process constitute a significant threat to life safety and might justify a high hazard

classification. Major loss of life has occurred in industrial occupancies that release extensive quantities of combustible dusts. Opportunity for the quick escape of employees who work in operations releasing combustible dust should be provided to prevent injury or loss of life if a dust explosion occurs. In high hazard occupancies that are subject to explosions, the provisions of 28-3.2 require special consideration of the techniques for explosion suppression or venting to ensure the life safety of occupants. Full utilization of fire protection engineering techniques should be employed in these occupancies to minimize the risk to life safety.

The industrial occupancies that clearly require classification as a high hazard are those associated with the production of explosives or highly reactive chemicals. In some especially hazardous operations, additional exits will be necessary to ensure rapid egress to prevent loss of life in the event of an explosion or fire. Where installation of the preventive or protective measures specified in 28-3.2 is not possible due to the nature of the industrial operation, consideration should be given to operating procedures that restrict access to a limited number of people during the hazardous portion of the operation. The operating procedures would limit the potential threat to those trained personnel who are fully aware of the extent of the hazard. Procedures should also include a record of personnel who have signed in or out to ensure prompt determination of the number of personnel exposed to a hazardous operation, and thus the number who may require rescue.

28-1.5 Classification of Hazard of Contents.

Classification of hazard of contents shall be as defined in Section 4-2.

28-1.6 Minimum Construction Requirements.

(No requirements.)

Some occupancy chapters, such as Chapters 12 and 13, which address the life safety needs of nonambulatory health care occupants, specify minimum building construction type requirements to help ensure structural integrity for the time period needed for a lengthy evacuation or for safe refuge within the building. There are no minimum construction requirements imposed, because industrial occupancies characteristically have ambulatory occupants and do not provide sleeping accommodations.

28-1.7* Occupant Load.

The occupant load for which means of egress shall be provided from any floor of an industrial occupancy shall be the maximum number of persons intended to occupy that floor, but not less than one person for each 100 sq ft (9.3 sq m) of gross floor area.

Exception: *In a special purpose industrial occupancy, the occupant load shall be the maximum number of persons to occupy the area under any probable conditions.*

A-28-1.7 In most cases, the requirements for maximum travel distance to exits will be the determining factor rather than numbers of occupants, as exits provided to satisfy travel distance requirements will be sufficient to provide egress capacity for all occupants, except in cases of unusual arrangement of buildings or high occupant load of a general manufacturing occupancy.

The occupant load of an industrial building is based on an average of 100 sq ft (9.3 sq m) of gross floor area per occupant. Many industrial users of the *Code* confuse this concept with the actual number of employees who use the facility. The usual complaint is that the number of potential employees calculated for egress purposes in accordance with the 100-sq ft (9.3-sq m) criterion far exceeds the anticipated or actual number of employees. Many industrial managers argue that using the larger number as a basis for egress design requires more exits, wider doors, and more passageways than are needed for emergency egress purposes, reducing productive work space and resulting in increased cost.

The concept of determining occupant load by using an occupant load factor is useful, although it does not necessarily relate directly to the actual number of building occupants. It is a means of calculating the minimum egress requirements based on the needs of an average industrial occupancy. Although actual conditions may vary in an individual location, the amount of egress width determined by the occupant load calculation will normally provide the necessary, adequate, and required means of egress for a typical industrial building with little or no penalty to the building's owner/operator.

See Figure 28-1 for examples of occupant load determination using the occupant load factor for a general industrial occupancy and using the probable number of occupants for a special purpose industrial occupancy.

In Figure 28-1, illustration (a), the general industrial occupancy must provide a means of egress for at least 2000 persons based on use of an occupant load factor of 1 person per 100 sq ft (9.3 sq m).

In Figure 28-1, illustration (b), a special purpose industrial occupancy can size its means of egress for the maximum 20 persons (actual anticipated employee population) who are apt to occupy the facility under any probable condition.

In Figure 28-1, illustration (c), the 200-person tour groups that visit this special purpose industrial occupancy on the first Monday of each month must be added to the 45 employees (actual employee population) who are normally present, for a total occupant load of 245 persons.

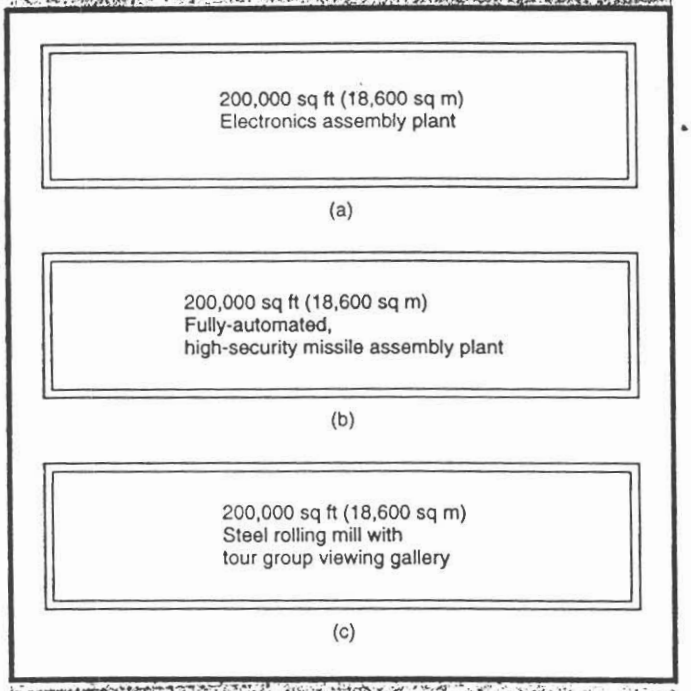


Figure 28-1. Determination of occupant load of industrial occupancies. See the commentary associated with 28-1.7.

Section 28-2 Means of Egress Requirements

28-2.1 General.

Each required means of egress shall be in accordance with the applicable portions of Chapter 5.

28-2.2 Means of Egress Components.

28-2.2.1 Components of means of egress shall be limited to the types described in 28-2.2.2 through 28-2.2.13.

28-2.2.2 Doors.

28-2.2.2.1 Doors complying with 5-2.1 shall be permitted.

28-2.2.2.2 Delayed egress locks complying with 5-2.1.6.1 shall be permitted.

Use of the delayed egress locking device covered by 5-2.1.6.1 is allowed on any door in recognition of the security needs of some industrial occupancies. In effect, the allowable 15- or 30-second delay will be experienced only under nonfire conditions or very early in a fire's growth, because the door must be usable immediately upon sprinkler operation, or smoke or heat detection, or loss of power controlling the locking mechanism. The building must be protected throughout by an approved automatic sprinkler system or automatic fire detection system.

28-2.2.2.3 Access-controlled egress doors complying with 5-2.1.6.2 shall be permitted.

The *Code* recognizes access-controlled egress doors in industrial occupancies as security measures that do not compromise the use of the means of egress system.

28-2.2.2.4 Existing horizontal sliding fire doors shall be permitted in the means of egress under the following conditions:

(a) They are held open by fusible links,
(b) The links are rated at not less than 165°F (74°C),
(c) The fusible links are located not more than 10 ft (3 m) above the floor,
(d) The fusible link is in immediate proximity to the door opening,
(e) The fusible link is not located above a ceiling, and
(f) The door is not credited with providing any protection under this *Code*.

Horizontal sliding fire doors exist in many industrial occupancies for property protection purposes. Although the *Code* normally does not recognize these doors within the required means of egress, Paragraph 28-2.2.2.4 makes a special exemption for existing horizontal sliding fire doors. By requiring the fusible link to be positioned in immediate proximity to the door opening, rated 165°F (74°C) or higher, and located not more than 10 ft (3 m) above the floor, the *Code* helps to assure that the door will remain open until rising temperatures make it unsafe to pass through the door opening. In recognition that the door will not close early in the fire development, the door cannot be credited as a fire door for life safety purposes.

owever, it might serve for property protection purposes. See Figure 28-2.

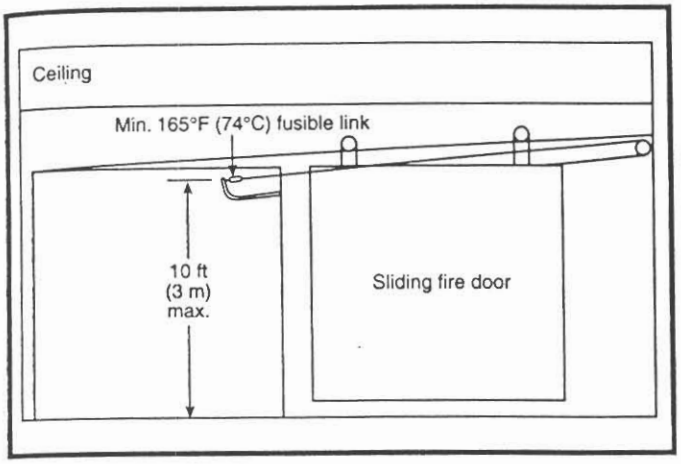


Figure 28-2. *Existing horizontal sliding fire door in accordance with 28-2.2.2.4. By requiring the fusible link to be positioned in immediate proximity to the door opening, rated 165°F (74°C) or higher, and located not more than 10 ft (3 m) above the floor, the door should remain open until rising temperatures make it unsafe to pass through the door opening.*

28-2.2.3 Stairs.

28-2.2.3.1 Stairs complying with 5-2.2 shall be permitted.

Exception No. 1: Noncombustible grated stair treads and landing floors.

Exception No. 2: Industrial equipment access in accordance with 28-2.5.6.

Exception No. 1 to 28-2.2.3.1 exempts stair treads and landings in industrial occupancies from the provisions of 5-2.2.3.3, which would otherwise require that all stair treads and stair landing floors be solid. Although the requirement for solid treads and landing floors is intended to prevent occupants from avoiding use of the stair because they become afraid when they are able to see through the openings to the floor or ground below, occupants of industrial occupancies are usually more familiar, and thus more comfortable, with grated or expanded metal treads and landings. The grated walking surfaces provide slip resistance in what can sometimes be greasy and slippery surroundings. For consistency, an exception appears in 5-2.2.3.3 to alert the user that industrial occupancies, in accordance with Chapter 28, are exempt from the solid tread and landing provisions.

Exception No. 2 serves to remind the user that 28-2.5.6 has special provisions for industrial equipment access stairs that differ from the requirements of Chapter 5. See the commentary following 28-2.5.6.

28-2.2.3.2 Spiral stairs complying with 5-2.2.2.4 shall be permitted.

Note that 5-2.2.2.4 permits spiral stairs to serve only an occupant load of five or fewer persons. Spiral stairs may be effectively used in industrial occupancies to provide exit access from small mezzanines, platforms, and equipment.

28-2.2.3.3 In existing buildings, winders complying with 5-2.2.2.5 shall be permitted.

28-2.2.4 Smokeproof Enclosures. Smokeproof enclosures complying with 5-2.3 shall be permitted.

This paragraph does not mandate the use of smokeproof enclosures. However, it does recognize a smokeproof enclosure as part of the means of egress system in an industrial occupancy only if the smokeproof enclosure meets the requirements of 5-2.3. For an example of an occupancy requiring a smokeproof enclosure, see 19-2.11 in which existing, nonsprinklered high-rise apartment buildings are required to be provided with smokeproof enclosures in accordance with 5-2.3. See 28-2.2.1.

28-2.2.5 Horizontal Exits.

28-2.2.5.1 Horizontal exits complying with 5-2.4 shall be permitted.

This paragraph does not mandate the use of horizontal exits. However, it does recognize a horizontal exit as part of the means of egress system in an industrial occupancy only if the horizontal exit meets the requirements of 5-2.4, as modified by 28-2.2.5.2. See 28-2.2.1.

28-2.2.5.2* In horizontal exits where the doorway is protected by a fire door on each side of the wall in which it is located, one fire door shall be of the swinging type as provided in 5-2.4.3.6 and the other shall be permitted to be an automatic sliding fire door that shall be kept open whenever the building is occupied.

A-28-2.2.5.2 The customary building code requirement for fire doors on both sides of an opening in a fire wall may

be met by having an automatic-sliding fire door on one side, and self-closing fire door swinging out from the other side of the wall. This arrangement qualifies only as a horizontal exit from the side of the sliding door. (*For further information, see A-5-2.4.3.8.*)

The intent of 28-2.2.5.2 is to recognize the common practice of combining a horizontal exit used for life safety with a fire barrier of significant fire resistance rating used for property protection. Opening protectives for such a fire barrier can require the use of a set of doors to achieve the required fire protection rating. It is impractical for both doors to swing in the same direction without interfering with each other; yet operation of two doors that swing in opposite directions is cumbersome for daily or common usage. One swinging and one sliding door, as shown in Figure 28-3, provide an acceptable arrangement for day-to-day functioning of the building. The open sliding door does not compromise life safety, because by the time its fusible link mechanism releases the door and allows it to close, temperatures in the vicinity of the door opening render use of the door impractical. See also the commentary on 28-2.2.2.4. The provisions of 28-2.2.2.4 also permit an existing horizontal sliding door (as depicted in Figure 28-2) to serve within the means of egress.

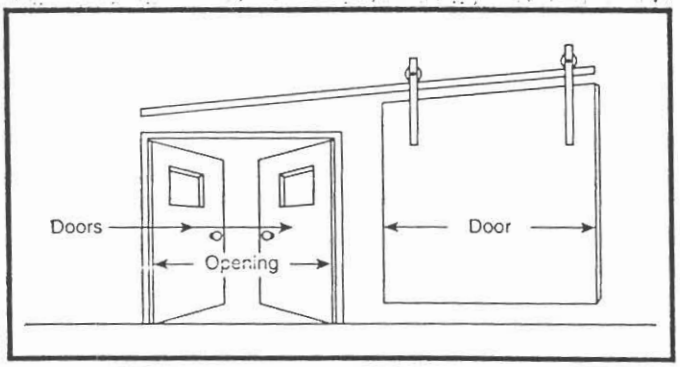


Figure 28-3. *Example of combination swinging and sliding doors allowed by 28-2.2.5.2.*

28-2.2.6 Ramps. Ramps complying with 5-2.5 shall be permitted.

Exception: Industrial equipment access in accordance with 28-2.5.6.

This paragraph does not mandate the use of ramps in industrial occupancies. However, it does recognize a ramp as part of the means of egress system only if the ramp meets the requirements of 5-2.5. See 28-2.2.1.

The Exception serves to remind the user that 28-2.5.6 has special provisions for industrial equipment access ramps that differ from the requirements of Chapter 5. See the commentary following 28-2.5.6.

28-2.2.7 Exit Passageways. Exit passageways complying with 5-2.6 shall be permitted.

This paragraph does not mandate the use of exit passageways in industrial occupancies. However, it does recognize an exit passageway as part of the means of egress system only if the exit passageway meets the requirements of 5-2.6. See 28-2.2.1.

28-2.2.8 Escalators and Moving Walks. In existing buildings, previously approved escalators and moving walks complying with 5-2.7 and located within the required means of egress shall be permitted.

Note that 5-2.7 allows existing escalators and moving walks to continue to be recognized within the required means of egress if an occupancy chapter so allows. In earlier editions of the *Code*, such escalators and moving walks may have been recognized as providing egress capacity for 75 persons. To qualify as exits, escalators and moving walks must also meet the requirements of 5-1.3.2, which addresses exit enclosures.

Note that escalators protected in accordance with the sprinkler-vent, spray nozzle, rolling shutter, or partial enclosure method do not constitute acceptable exits, but can continue to serve as exit access if previously approved as such.

28-2.2.9 Fire Escape Stairs. Existing fire escape stairs complying with 5-2.8 shall be permitted.

28-2.2.10 Fire Escape Ladders. Fire escape ladders complying with 5-2.9 shall be permitted.

Exception: Fixed industrial stairs in accordance with ANSI A1264.1, Safety Requirements for Workplace Floor and Wall Openings, Stairs and Railings Systems, minimum requirements for fixed stairs shall be permitted where fire escape ladders are permitted in accordance with 5-2.9.1.

The geometry associated with the incline angle and the size and shape of surfaces intended for foot

placement on fire escape ladders falls within the range permitted for fixed industrial stairs. However, most fixed industrial stairs meet criteria that result in a safer arrangement than that provided by the fire escape ladder detailed in 5-2.9. Therefore, the Exception to 28-2.2.10 recognizes fixed industrial stairs as substitutes for fire escape ladders.

28-2.2.11 Slide Escapes. Approved slide escapes complying with 5-2.10 shall be permitted as components in 100 percent of the required means of egress for both new and existing high hazard industrial occupancies. Slide escapes shall be counted as means of egress only where regularly used in drills so that occupants are familiar with their use through practice.

The intent of 28-2.2.11 is to allow the use of slide escapes, which are a common means of egress from areas housing explosives or other highly hazardous materials in chemical industry buildings. This provision allows consideration of slide escapes as part of the required means of egress from both new and existing high hazard industrial occupancies. In many high hazard industrial occupancies, slide escapes are the only practical means of ensuring safe egress prior to an explosion or flash fire.

28-2.2.12 Alternating Tread Devices. Alternating tread devices complying with 5-2.11 shall be permitted.

The provisions of 5-2.11, in effect, limit the use of alternating tread devices to those locations where the *Code* recognizes the use of fire escape ladders (and fixed industrial stairs). See 28-2.2.10, Exception to 28-2.2.10, 5-2.9, and 5-2.11.

28-2.2.13 Areas of Refuge. Areas of refuge complying with 5-2.12 shall be permitted.

28-2.3 Capacity of Means of Egress.

The capacity of means of egress shall be in accordance with Section 5-3.

Editions of the *Code* prior to 1991 required a minimum 44-in. (112-cm) width for corridors and passageways within the required means of egress of industrial occupancies. A corridor or passageway of that minimum width would provide egress capacity for 220 persons [that is, 44 in. / 0.2 in. per person (approximately 112 cm / 0.5 cm per person) in accordance with 5-3.3.1 for level travel components]. The prior requirement produced artificially large egress systems, when compared to the occupant load, for many industrial occupancies. The requirement was dropped, and the minimum 36-in. (91-cm) width requirement of 5-3.4.1, which addresses the width of any exit access, was made applicable to industrial occupancies. Exit access is required to be wider than 36 in. (91 cm) only if a corridor or passageway in an industrial occupancy is to provide capacity for more than 180 persons [that is, 36 in. / 0.2 in. per person (approximately 91 cm / 0.5 cm per person)].

Exception: In special purpose industrial occupancies, means of egress shall be sized to accommodate the occupant load as determined in accordance with the Exception to 28-1.7; spaces not subject to human occupancy because of the presence of machinery or equipment shall be excluded from consideration.

The Exception to 28-2.3 places practical limits on the number of required means of egress and on the arrangement of the means of egress in a special purpose industrial occupancy. There is no life safety purpose served by providing exits from the center of a large machine or equipment installation that is unoccupied under normal operating conditions. A number of industries provide weather shelter for large processes and equipment. Typical examples include steel rolling mills, paper extruders, and metalworking machines, all of which occupy a majority of the floor space in the sheltered building. In many of the more sophisticated operations, full process control is conducted from a remotely located control room. Personnel normally occupy the building only for maintenance and adjustment purposes, and then only on a limited basis. To provide exits from these special purpose industrial occupancies would serve no useful purpose and could unjustly impose an economic penalty in the name of safety.

The large areas normally enclosed by special purpose structures would require excessive egress width if the occupant load were calculated on the basis of 100 sq ft (9.3 sq m) per person. If provisions for the capacity of the means of egress in a special purpose industrial occupancy were based on the requirements specified for general industrial occupancies, the result would be extensive egress facilities for nonexistent occupants. Such arrangements might actually result in the requirement of exits from the interior of machinery and equipment installations, which

would be incompatible with the equipment's design. In many cases, these exits would originate from locations that, even under normal operating conditions, would be considered dangerous for humans. Poorly conceived exit facilities serve no life safety purpose and detract from an otherwise well-designed exit system.

28-2.4 Number of Means of Egress.

(*See also Section 5-4.*)

28-2.4.1 There shall be not less than two means of egress from every story or section, and at least one exit must be reached without traversing another story.

The provisions of 28-2.4.1, which apply to the minimum required number of means of egress for industrial occupancies clarify that, in addition to providing every story or section with access to at least two means of egress, one of the exits must be located on each floor so that the entrance to that exit (for example, a door that opens into an enclosed exit stair) can be reached without having to travel to another floor.

Exception: In low and ordinary hazard industrial occupancies, a single means of egress shall be permitted from any story or section, provided that the exit can be reached within the distance allowed as common path of travel. (See 28-2.5.3.)

This exception recognizes that there are small floors or areas in low and ordinary hazard industrial occupancies that, if provided with access to only a single exit, are no less safe than larger areas of a building that have access to two exits where an occupant must first travel through the maximum allowable common path. Where a single exit is provided, the occupant travels the 50 ft (15 m) [or 100 ft (30 m) in sprinklered buildings] of common path allowed by 28-2.5.3, enters the exit (see Figure 28-4), and is judged to have reached a point of safety. In larger buildings and larger building areas that do not meet the limited travel distance for a single exit, a minimum of two exits must be provided. By traveling to the nearer of the two exits, the occupant is permitted to travel the same 50 ft (15 m) [or 100 ft (30 m) in sprinklered buildings] of common path that the occupant of the single exit building traveled to reach the one exit, before reaching the point where travel to the two exits in different directions is possible. Although the occupant of the single-exit building has reached an exit by this point, the occupant of the multiple-exit building is then allowed an additional 150 ft (45 m) [200 ft (60 m) if building is sprinklered] of exit access travel before the safety of an exit must be reached. Therefore, the exception for the single exit provides a level of life safety at least equivalent to that of the multiple-exit building.

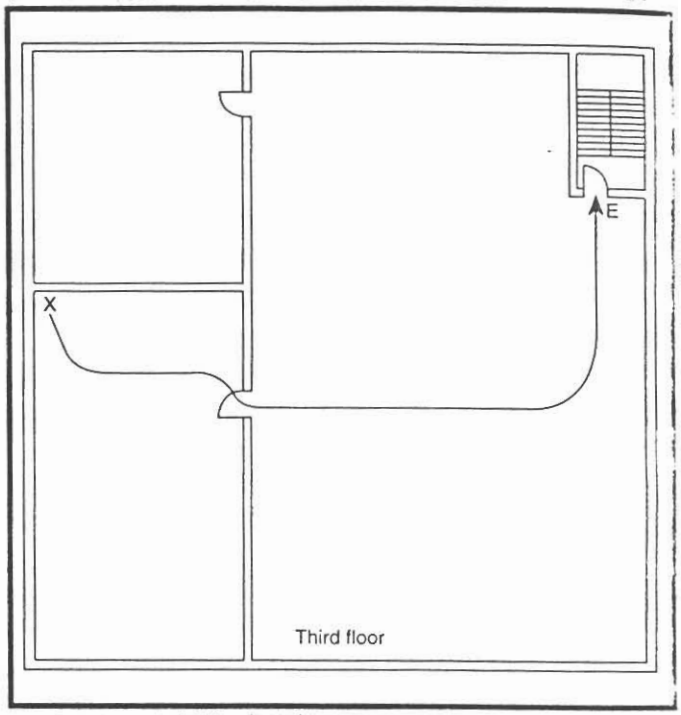


Figure 28-4. *Example of single means of egress from a story of a low or ordinary hazard industrial occupancy. This is permitted, provided the distance to the single exit (X to E) does not exceed the allowable common path of travel [50 ft (15 m), or 100 ft (30 m) if building is sprinklered, in accordance with 28-2.5.3].*

28-2.4.2 Floors or portions thereof with an occupant load of more than 500 shall have the minimum number of separate and remote means of egress specified by 5-4.1.2.

Exception: Existing buildings.

Historically, the *Code* has required more than two exits based on occupant load for assembly occupancies only. Third, fourth, and subsequent exits were provided in industrial occupancies to meet travel distance requirements or as a convenience for day-to-day use. Paragraph 5-4.1.2 extends the concept of requiring three or four exits based on occupant load to all occupancies. The exception to 28-2.4.2, in com-

pliance with the option offered by the Exception to 5-4.1.2, exempts existing buildings from the requirement for third and fourth exits to avoid forcing existing, previously complying means of egress systems into noncompliance.

28-2.4.3 Areas with high hazard contents shall comply with Section 5-11.

Section 5-11, Special Provisions for Occupancies with High Hazard Contents, includes an adequate set of provisions for high hazard areas and is referenced by this chapter to provide commensurate protection to industrial occupancies that contain high hazard areas. The provisions of Section 5-11 are vital to life safety in high hazard occupancies. The requirement for two means of egress for all high hazard occupancies recognizes that there is the possibility that a fire or explosion might block or destroy one of the two exits. Two separate and equal means of egress from high hazard areas provide a necessary redundancy to ensure the evacuation of occupants under fire or explosion conditions and to minimize the potential for injury or loss of life. The Exception to 5-11.3 recognizes that it is not necessary to require two means of egress from very small high hazard areas [maximum 200 sq ft (18.6 sq m)], with limited occupant load (maximum 3 persons), if the room door can be reached within 25 ft (7.6 m) of travel.

28-2.5 Arrangement of Means of Egress.

28-2.5.1 Means of egress shall be arranged in accordance with Section 5-5.

28-2.5.2 Dead-end corridors in general industrial and special purpose industrial occupancies shall not exceed 50 ft (15 m).

28-2.5.3 Common paths of travel in general industrial and special purpose industrial occupancies shall not exceed 50 ft (15 m).

Exception: In buildings protected throughout by an approved, supervised automatic sprinkler system installed in accordance with Section 7-7, common paths of travel shall not exceed 100 ft (30 m).

See the discussion of dead-end corridor pockets and common path of travel in 5-5-1.6 and its associated commentary.

28-2.5.4 Common paths of travel shall be prohibited in high hazard industrial occupancies.

Exception: As permitted by the Exception to 5-11.3.

28-2.5.5 Ancillary Facilities.

28-2.5.5.1* Means of egress from ancillary facilities shall be arranged to permit travel in independent directions such that both means of egress paths are not compromised by the same fire or similar emergency.

Exception: Existing facilities.

A-28-2.5.5.1 Ancillary facilities located within industrial occupancies might include administrative office, laboratory, control, and employee service facilities that are incidental to the predominant industrial function and are of such size that separate occupancy classification is not warranted.

28-2.5.5.2* Ancillary facilities in special purpose industrial occupancies where delayed evacuation is anticipated shall have minimum 2-hr fire resistance–rated separation from the predominant industrial occupancy, and shall have one means of egress that is separated from the predominant industrial occupancy by 2-hr fire resistance–rated construction.

Exception: Existing facilities.

A-28-2.5.5.2 Occupants of ancillary facilities located within special purpose industrial occupancies might be required by administrative controls to remain in the facility when a fire occurs in the predominant industrial area to perform an orderly shutdown of process equipment in order to control the spread of the fire and minimize damage to important equipment.

The presence of ancillary facilities within an industrial occupancy can create unusual challenges to life safety. For example, the means of egress for factory office workers with little knowledge of the industrial processes and operations—and their respective hazards—might require leaving the safety of the office area and traveling across the factory production floor. In other cases, safe egress is not assured to employees assigned to a control room who might have to perform orderly shutdown of certain processes—in order to control the spread of fire—before evacuating a building. The requirements of 28-2.5.5.1 and 28-2.5.5.2 are illustrated in Figure 28-5.

In Figure 28-5, control room 1—with a single means of egress—forces the occupant to travel in one direction only into the open manufacturing area; it does not meet the requirement of 28-2.5.5.1 that egress be arranged to permit travel in independent

directions such that both means of egress paths are not compromised by the same fire or similar emergency. Control room 1 appears to need a second exit access door located remotely from the first.

Control room 2 in Figure 28-5 meets the requirements of both 28-2.5.5.1 and 28-2.5.5.3. It permits egress travel in independent directions such that both means of egress paths are not compromised by the same fire or similar emergency. Further, it provides one of the two means of egress via an exit passageway-like arrangement separated from the predominant industrial occupancy by 2-hour fire resistance–rated construction. Also, control room 2 itself is surrounded by 2-hour fire resistance–rated construction. This permits occupants charged with special emergency duties to delay their egress and still be afforded adequate life safety.

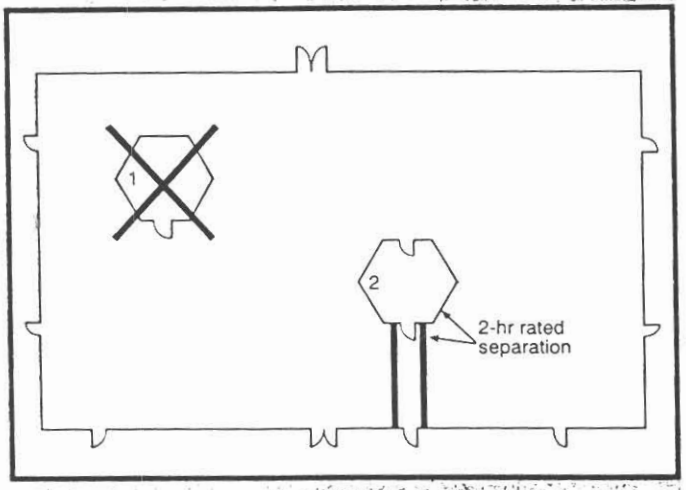


Figure 28-5. Special provisions for ancillary facilities. See the commentary following A-28-2.5.5.2.

28-2.5.6 Industrial equipment access walkways, platforms, ramps, and stairs that serve as a component of the means of egress from the involved equipment shall be permitted in accordance with the applicable provisions of Chapter 5 as modified by Table 28-2.5.6. Any such means of egress component shall not serve more than 20 people.

Paragraph 28-2.5.6 permits industrial equipment access walkways, platforms, ramps, and stairs serving not more than 20 persons to deviate from some of the usual dimensional criteria specified by Chapter 5. The dimensional criteria detailed in Table 28-2.5.6 are illustrated in Figure 28-6.

Table 28-2.5.6 Equipment Access Dimensional Criteria

Minimum horizontal dimension of any walkway, landing, or platform	22 in. (55.9 cm) clear
Minimum stair or ramp width	22 in. (55.9 cm) clear between rails
Minimum tread width	22 in. (55.9 cm) clear
Minimum tread depth	10 in. (25.4 cm)
Maximum riser height	9 in. (22.9 cm)
Maximum height between landings	12 ft (3.7 m)
Headroom, minimum	6 ft 8 in. (203 cm)

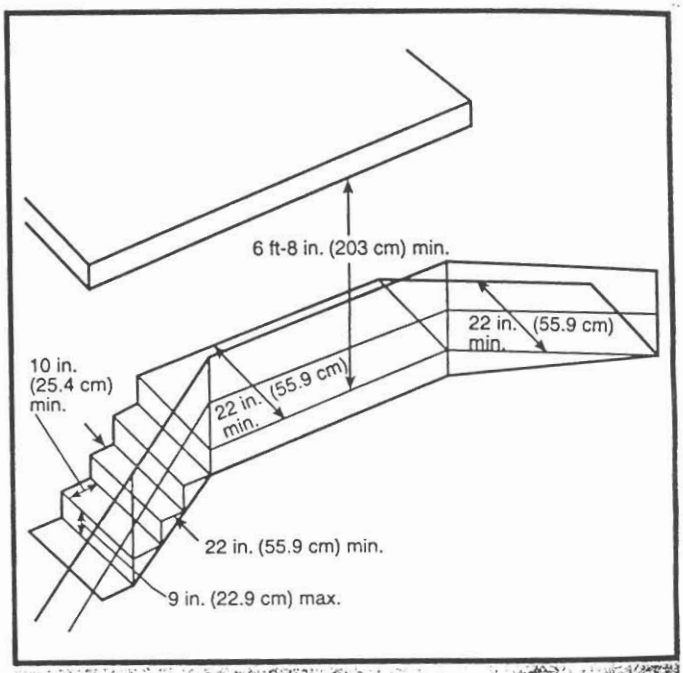


Figure 28-6. Industrial equipment access dimensional criteria. See Table 28-2.5.6.

28-2.6 Travel Distance to Exits.

28-2.6.1 Travel distance, measured in accordance with Section 5-6, shall not exceed 200 ft (60 m).

Exception No. 1: Travel distance shall not exceed 250 ft (76 m) in buildings protected throughout by an approved, supervised automatic sprinkler system installed in accordance with Section 7-7.

Exception No. 2: As permitted by 28-2.6.2.

Exception No. 3: As permitted by 28-2.6.3.

Exception No. 4: Travel distance to exits in high hazard industrial occupancies shall not exceed 75 ft (23 m).

28-2.6.2 In low or ordinary hazard general industrial occupancies, travel distance shall not exceed 400 ft (122 m) if the following additional provisions are met in full:

(a) Application shall be limited to one-story buildings.

(b)* Smoke and heat venting shall be provided by engineered means or by building configuration to ensure that occupants shall not be overtaken by spread of fire or smoke within 6 ft (183 cm) of floor level before they have time to reach exits.

A-28-2.6.2(b) Smoke and heating venting should be in accordance with NFPA 204M, *Guide for Smoke and Heat Venting.*

(c) Automatic sprinkler or other automatic fire extinguishing systems installed in accordance with Section 7-7 shall be provided. The extinguishing system shall be supervised.

The provisions of 28-2.6.2 are meant to provide flexibility in determining the layout of the means of egress system in a single-story industrial building with a large floor area that houses a low or ordinary hazard general industrial occupancy.

The construction of tunnels and elevated means of egress that originate from the center of an industrial building with an extensive floor area is rarely attempted. Only a handful of buildings have ever been provided with such egress facilities, and most were World War II airframe manufacturing buildings of massive size. In most industrial buildings, it is not practicable or economical to construct exit tunnels or overhead passageways. These special types of means of egress are not easily altered if modifications are necessary to adjust to changes in the layout of an industrial facility. In addition, the construction costs for tunnels and elevated passageways are high due to the special design features required to ensure their safety, including fire resistance–rated supports for the elevated passageways, waterproofing, and other features necessary to maintain the integrity of underground tunnels. Another negative factor in such construction is the confining nature of a tunnel or elevated passage, which tends to discourage use of these means of egress.

The use of horizontal exits that pass through fire walls is common in many industrial occupancies. Full consideration of the provisions in Chapter 5 is required to ensure the safe use of these types of exits. A common violation of the provisions of Chapter 5 is the failure to provide the proper type of fire door in a fire wall. A horizontal sliding fire door cannot be considered as an acceptable element of a means of egress (except in existing installations in accordance with 28-2.2.2.4). Because a horizontal exit may be used from both sides of a fire wall, careful consideration of the direction of door swing is necessary to ensure that the *Code* will recognize this use. In many instances, two doors swinging in opposite directions will be required so that the exit may be used as a means of egress from both sides of the fire wall. See 5-2.1.4, 5-2.4.3.6, and 28-2.2.5.

The increase in allowable travel distance to 400 ft (122 m) is often applied to exits in a general purpose industrial occupancy classified as a low or ordinary hazard, in accordance with the requirements of 28-2.6.2 (a) through (c).

Subpart (a) limits use of the increased travel distance provisions to one-story buildings. Any stairs or other impediments to the rapid movement of occupants would result in slower evacuation of the building and increase the possibility of exposure to smoke or fire.

To satisfy the intent of 28-2.6.2(b), judgment must be exercised in the design of systems for smoke and heat venting. The provisions of Appendix A of the *Code* that recommend utilization of the guidelines of NFPA 204, *Guide for Smoke and Heat Venting,*[3] should be sufficient in most instances. In addition, in accordance with the recommendations of A-7-3.1, NFPA 92B, *Guide for Smoke Management Systems in Malls, Atria, and Large Areas,*[4] can be consulted when designing buildings with ceilings of heights approximating those of covered mall buildings and atria.

The limitation on smoke accumulation in 28-2.6.2(b) is a key factor in the design of the smoke removal system. The average evacuation speed of a person who is walking is approximately 250 ft (76 m) per minute, or a little over 4 ft (1.2 m) per second. Where this evacuation speed is applied to the 400-ft (122-m) travel distance allowed by the *Code,* the maximum time required to reach an exit should not exceed 2 minutes. It is an extremely rare situation in which the smoke that accumulates in an industrial building is so extensive that it fills the structure and descends to less than 6 ft (1.8 m) above the floor level in 2 minutes. The added benefit of a properly designed system for smoke and heat venting ensures that there will be little possibility that the means of egress will be blocked by smoke.

The use of available, computerized smoke-filling and evacuation time models can provide documentation that permits a designer to meet the smoke and heat venting requirements in some buildings by providing only a high ceiling and no mechanical smoke removal equipment.

The installation of a complete automatic extinguishing system as required by 28-2.6.2(c) is intended to ensure control and extinguishment of incipient fires and ultimately minimize exposure of the occupants to a fire. It is not the intent of this paragraph to allow only an automatic sprinkler system to provide the required protection, because a number of equally effective extinguishing agents and systems may be used for specific industrial fire hazards. The importance of this provision is the requirement for automatic initiation of the fire control and extinguishing system to minimize the extent of the occupants' exposure to fire. The installed system is required to be fully supervised to ensure that it will operate when a fire occurs. Adequate procedures must be provided by the building's owner or tenant to ensure the prompt correction of any impairments to the extinguishing systems. In some facilities, the degree of fire risk during the impairment period may require limitations on hazardous operations and the number of occupants so that the level of safety to life will be equivalent to that provided when the extinguishing system is operational.

28-2.6.3 In low or ordinary hazard special purpose industrial occupancies, travel distance shall not exceed 300 ft (91 m), or if the building is protected throughout by a supervised, automatic sprinkler system installed in accordance with Section 7-7, travel distance shall not exceed 400 ft (122 m).

Low and ordinary hazard special purpose industrial occupancies, which are characterized by large, specialized equipment and low occupant load, are allowed an increase in travel distance over that allowed for low and ordinary general industrial occupancies. Paragraph 28-2.6.3 permits an increase to 300 ft (91 m) if the building is not sprinklered, and to 400 ft (122 m) if the building is protected throughout by a supervised sprinkler system, without mandating the additional requirements of 28-2.6.2.

For a summary of the various travel distance allowances for industrial occupancies, see Figure 28-7.

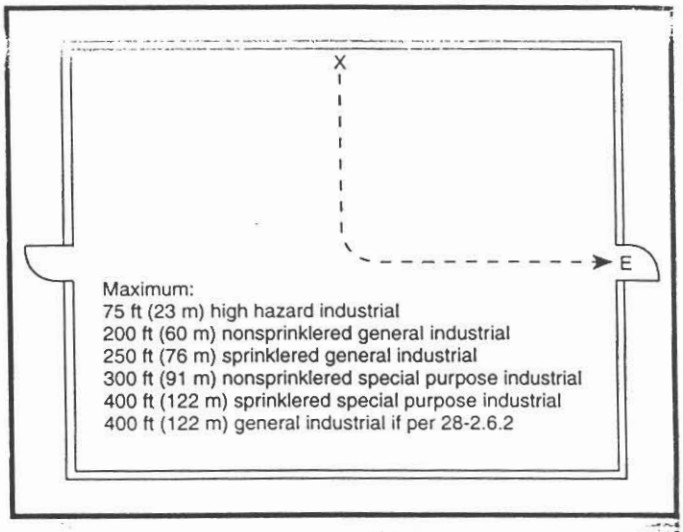


Figure 28-7. Summary of industrial occupancy travel distance options allowed by 28-2.6.1 through 28-2.6.3.

28-2.7 Discharge from Exits.

Discharge from exits shall be in accordance with Section 5-7.

The purpose of 5-7.2 is to control the arrangement of exits from upper stories that discharge to the outside through the level of exit discharge. Paragraph 5-7.2 modifies the general rule for complete enclosure of exits up to their point of discharge to the outside of the building, because the safeguards specified in 5-7.2—especially automatic sprinkler protection for the level of exit discharge—maintain reasonable safety. When the arrangement of exits is evaluated, a stairway is not considered as discharging through the level of discharge if it leads to the outside through an exit passageway in accordance with 5-2.6. This is true despite the fact there are doors—in the exit passageway walls—between the base of the enclosed stairway and the door to the outside on the level of exit discharge.

28-2.8 Illumination of Means of Egress.

Illumination of means of egress shall be provided in accordance with Section 5-8.

Exception: Structures occupied only during daylight hours, with skylights or windows arranged to provide the required level of illumination on all portions of the means of egress during these hours.

Paragraph 28-2.8 is not meant to require the installation of extensive and unneeded illumination systems in industrial occupancies. Illumination is required for the exit access, which is limited to designated aisles, corridors, and passageways that lead to an exit. There is no requirement for the provision of illumination throughout the building, which in many industrial

occupancies would involve lighting an extensive floor area. The purpose of the lighting system is to ensure that occupants are able to see the means of egress and not to illuminate the operation of production facilities.

In addition, the *Code* does not require illumination of the means of egress if the building is occupied during the daylight hours only. To meet the requirements of the Exception to 28-2.8, the building, including stairways, must have sufficient windows and skylights to ensure natural illumination. The authority having jurisdiction should make certain that the building is not occupied after daylight hours.

28-2.9* Emergency Lighting.

All industrial occupancies shall have emergency lighting in accordance with Section 5-9.

Exception No. 1: Special purpose industrial occupancies without routine human habitation.

Exception No. 2: Structures occupied only during daylight hours, with skylights or windows arranged to provide the required level of illumination on all portions of the means of egress during these hours.

Exceptions to the requirement for emergency lighting are included in the *Code* for the same reasons that illumination of the means of egress is not required (see Exception to 28-2.8). An additional exception has been made for special purpose industrial occupancies that are not routinely occupied. There is no need to install an extensive and costly emergency lighting system in an unoccupied building.

A-28-2.9 The authority having jurisdiction should review the facility and determine the "designated" stairs, aisles, corridors, ramps, and passageways that should be required to be provided with emergency lighting. In large locker rooms or laboratories using hazardous chemicals, for example, the authority having jurisdiction should determine that emergency lighting is needed in the major aisles leading through those spaces.

28-2.10 Marking of Means of Egress.

Signs designating exits or ways of travel thereto shall be provided in accordance with Section 5-10.

28-2.11 Special Means of Egress Features.

(Reserved.)

Section 28-3 Protection

28-3.1 Protection of Vertical Openings.

Every stairway, elevator shaft, escalator opening, and other vertical opening shall be enclosed or protected in accordance with Chapter 5 and 6-2.4.

Exception No. 1: Unprotected vertical openings connecting not more than three floors shall be permitted in accordance with 6-2.4.5.

Exception No. 2: Atriums in accordance with 6-2.4.6 shall be permitted.

Exception Nos. 1, 2 and 6 to 28-3.1 recognize the provisions of Chapter 6, which sanction limited (maximum three-story) vertical openings, atriums, and two-story convenience openings in industrial occupancies. See 6-2.4.5, 6-2.4.6, and 6-2.4.8.

Exception No. 3: In special purpose and high hazard occupancies where unprotected vertical openings are in new or existing buildings and are necessary to manufacturing operations, they shall be permitted beyond the specified limits, provided every floor level has direct access to one or more enclosed stairs or other exits protected against obstruction by any fire or smoke in the open areas connected by the unprotected vertical openings.

Exception No. 3 to 28-3.1 strictly limits the use of unprotected vertical openings in high hazard and special purpose industrial occupancies. Direct access to one or more enclosed stairways or to other exits is required from any areas connected by unprotected vertical openings. This provision recognizes that many high hazard and special purpose industrial occupancies require openings between floor levels to accommodate piping, conveyors, and other devices and equipment essential to the orderly operation of the facility. In most of these situations, full enclosure is not practical or feasible. In high hazard occupancies, the provision of two means of egress will, in most situations, be sufficient to comply with this exception. In special purpose occupancies, additional exits or other special arrangements will normally be required for compliance with the provision that stairways and exits be protected against obstruction from fire and smoke in open areas connected by unprotected vertical openings.

Exception: and existing escalators shall be permitted where connecting only two floor levels.

Exception No. 4 to 28-3.1 limits existing open stairways, existing open ramps, and existing escalators that are unenclosed or unprotected by permitting them to connect only two floors. An existing open stairway connecting three floors would have to be enclosed, protected, or permitted by another of the exceptions to 28-3.1.

Exception No. 5: In existing buildings with low or ordinary hazard contents and protected throughout by an approved, automatic sprinkler system installed in accordance with Section 7-7, unprotected vertical openings shall be permitted, provided the vertical opening does not serve as a required exit. All required exits under such conditions shall consist of outside stairs in accordance with 5-2.2, smokeproof enclosures in accordance with 5-2.3, or horizontal exits in accordance with 5-2.4.

Exception No. 5 to 28-3.1 recognizes that an existing industrial occupancy may contain unprotected vertical openings and still provide a reasonable level of safety to life if the building contains only low or ordinary hazards and is protected by a complete automatic sprinkler system. Smokeproof enclosures and outside stairways (the only types of vertical exits allowed by this exception) must be fully enclosed or protected against vertical fire spread and meet the requirements of Chapter 5. The unenclosed vertical openings may not serve as part of the means of egress, although they can remain as convenience openings and stairways to be used for normal operations.

While the major reason for allowing this provision is economic (enclosing all vertical openings in existing buildings is expensive), there is actually little effect on the life safety of occupants where the building houses low or ordinary hazards. However, some difficulties in fire control are created, because unprotected vertical openings can contribute to fire spread in buildings and result in extensive property damage and potential impact on occupants prior to evacuation; therefore, a complete automatic sprinkler system is required.

Exception No. 6: Two-story convenience openings in accordance with 6-2.4.8 shall be permitted.

Every high hazard industrial occupancy, operation, or process shall have automatic extinguishing systems or such other protection appropriate to the particular hazard, such as explosion venting or suppression, protecting any area subject to an explosion hazard for the purpose of minimizing danger to occupants in case of fire or other emergency before they have time to utilize exits to escape. Activation of the fire extinguishing or suppression system shall initiate the required building fire alarm system in accordance with 28-3.4.3.4. Hazardous areas in industrial occupancies protected by automatic extinguishing systems shall be exempt from the smoke-resisting enclosure requirement of 6-4.1.2.

A-28-3.2 Emergency lighting should be considered where operations require lighting to perform orderly manual emergency operation or shutdown, maintain critical services, or provide safe start-up after a power failure.

The intent of 28-3.2 is to provide for the life safety of the occupants of industrial buildings by controlling the risk associated with hazardous operations. The alternatives offered in the paragraph are not inclusive, and a proper fire protection engineering solution might not incorporate the listed provisions. The *Code* intends to allow for engineering judgment in a wide range of potentially hazardous situations, including some where protection may be limited. The intent of the paragraph is also broad in application, because, in many highly hazardous operations, an explosion may be immediately preceded by a fire or other emergency, such as an overheated reactor vessel, an exothermic reaction, or increased pressure. Because such conditions may initiate an explosion, depending upon the process and arrangement of the equipment, immediate egress from the facility may be necessary. If fire or other emergencies are likely to develop rapidly into an explosion, adequate precautions are necessary for life safety.

In many modern facilities, provisions that prove adequate for the life safety of occupants may already be included for process control and property protection, and any additional measures will not increase the life safety of operators to an appreciable degree.

Section 4, Chapters 13 and 14, of the NFPA *Fire Protection Handbook*[5] discuss the basic principles of explosion prevention, venting, and suppression. These chapters also contains an extensive bibliography on the subject. Recommendations for the design and utilization of vents to limit pressures developed by explosions are contained in NFPA 68, *Guide for Venting of Deflagrations*.[6] Standards for explosion pre-

vention systems are found in NFPA 69, *Standard on Explosion Prevention Systems.*[7] See also the NFPA *Industrial Fire Hazards Handbook.*[8]

Paragraph 6-4.1 requires that where a hazardous area is protected by automatic sprinklers, the hazardous area must be enclosed by walls and doors that are, at minimum, smoke resisting rather than enclosed with fire barriers of 1-hour fire resistance rating and doors of 45-minute fire protection rating. The last sentence of 28-3.2 exempts hazardous areas in industrial occupancies from the requirement for smoke-resisting enclosures if those areas are protected by automatic sprinklers. For consistency, similar wording appears in Exception No. 2 to 6-4.1.2.[1]

28-3.3 Interior Finish.

28-3.3.1 Interior finish shall be in accordance with Section 6-5.

28-3.3.2 Interior Wall and Ceiling Finish. Interior wall and ceiling finish complying with 6-5.5 shall be Class A, Class B, or Class C in operating areas; and interior wall and ceiling finish shall be as required by 5-1.4 in exit enclosures.

28-3.3.3 Interior Floor Finish. (No requirements.)

28-3.4 Detection, Alarm, and Communication Systems.

28-3.4.1 General. Industrial occupancies shall be provided with a fire alarm system installed in accordance with Section 7-6.

Exception: If the total capacity of the building is under 100 persons and fewer than 25 persons are above or below the level of exit discharge.

28-3.4.2 Initiation. Initiation of the required fire alarm system shall be by manual means in accordance with 7-6.2.1(a).

Exception No. 1: Initiation shall be permitted by means of an approved, automatic fire detection system installed in accordance with 7-6.2.1(b) that provides protection throughout the building.

Exception No. 2: Initiation shall be permitted by means of an approved, automatic sprinkler system installed in accordance with 7-6.2.1(c) that provides protection throughout the building.

28-3.4.3 Notification.

28-3.4.3.1 The required fire alarm system shall either

(a) Provide occupant notification in accordance with 7-6.3, or

(b) Sound an audible and visible signal in a constantly attended location for the purposes of initiating emergency

The requirements of 28-3.4.3.1 and 28-3.4.3.4 contain two separate and distinct provisions for audible alarms activated by the fire alarm system required by 28-3.4.1. In low and ordinary hazard industrial occupancies (see 28-3.4.3.1), the system may activate an evacuation alarm or it may sound an alarm in a continuously attended location for the purpose of initiating emergency action. This provision allows an interface between the alarm system and the plant's emergency organization. The alarm system may be controlled from a central security console or a similar location. The key feature is that the location from which the alarm sounds must be continuously staffed. This requirement need not be interpreted as mandating installation of supervisory service, such as that connected to a central station, but the location must be fully attended at all times when the building is occupied.

In high hazard occupancies (see 28-3.4.3.4), the alarm must be arranged to provide evacuation signals, because the safety of the occupants of these areas depends on their immediate notification of a fire.

28-3.4.3.2 A presignal system in accordance with Exception No. 1 to 7-6.3.2 shall be permitted.

28-3.4.3.3 A positive alarm sequence in accordance with Exception No. 2 to 7-6.3.2 shall be permitted.

28-3.4.3.4 In high hazard industrial occupancies as defined in 28-1.4, the required fire alarm system shall automatically initiate an occupant evacuation alarm signal in accordance with 7-6.3.

28-3.5 Extinguishing Requirements.

(None.)

28-3.6 Corridors.

The provisions of 5-1.3.1 shall not apply.

Without the exemption to the requirements of 5-1.3.1 provided by 28-3.6, all new industrial occupancy corridors serving more than 30 persons would be required to have a 1-hour fire resistance rating, with openings protected by 20-minute fire protection rated door assemblies. The exemption to 5-1.3.1

was adopted because of the ambulatory nature of occupants of industrial occupancies and the [illegible] provided.

Section 28-4 Special Provisions

28-4.1 High-Rise Buildings.

High-rise industrial occupancies shall comply with the automatic sprinkler requirements of 32-8.2.1.

Exception No. 1: Low hazard industrial occupancies.

Exception No. 2: Special purpose industrial occupancies.

Exception No. 3: Existing industrial occupancies.

This paragraph references a portion of the high-rise building provisions of Section 32-8 written to permit an occupancy chapter to mandate their use. New, high-rise, general-purpose industrial occupancy buildings classified as ordinary hazard and new high-rise industrial occupancy buildings classified as high hazard are required to be protected throughout by an approved, supervised automatic sprinkler system in accordance with 32-8.2.1. The remainder of Section 32-8 is not mandated for high-rise industrial occupancy buildings.

Section 28-5 Building Services

28-5.1 Utilities.

Utilities shall comply with the provisions of Section 7-1.

28-5.2 Heating, Ventilating, and Air Conditioning.

Heating, ventilating, and air conditioning equipment shall comply with the provisions of Section 7-2.

28-5.3 Elevators, Escalators, and Conveyors.

Elevators, escalators, and conveyors shall comply with the provisions of Section 7-4.

28-5.4 Rubbish Chutes, Incinerators, and Laundry Chutes.

Rubbish chutes, incinerators, and laundry chutes shall comply with the provisions of Section 7-5.

Section 28-6* Special Provisions for [illegible]

Section 28-6, Special Provisions for Aircraft Servicing Hangars, is nearly identical to Section 29-6, Special Provisions for Aircraft Storage Hangars. Because aircraft hangars are used for both storage and repair, corresponding requirements can be found in both Chapters 28 and 29.

A-28-6 For further information on aircraft hangars, see NFPA 409, *Standard on Aircraft Hangars.*

28-6.1

The requirements of Sections 28-1 through 28-5 shall be met, except as modified by 28-6.2 through 28-6.4.

28-6.2

Exits from aircraft servicing areas shall be provided at intervals of not more than 150 ft (45 m) on all exterior walls. There shall be a minimum of two means of egress from each aircraft servicing area. Horizontal exits through interior fire walls shall be provided at intervals of not more than 100 ft (30 m) along the wall.

Exception: Dwarf or "smash" doors in doors used for accommodating aircraft shall be permitted to be used for compliance with these requirements.

28-6.3

Means of egress from mezzanine floors in aircraft servicing areas shall be arranged so that the maximum travel distance to reach the nearest exit from any point on the mezzanine shall not exceed 75 ft (23 m). Such means of egress shall lead directly to a properly enclosed stair discharging directly to the exterior, to a suitable cutoff area, or to outside stairs.

28-6.4

No dead end shall be permitted to be more than 50 ft (15 m) deep.

Exception: No dead end shall be allowed for high hazard contents areas.

References Cited in Commentary

[1] NFPA 13, *Standard for the Installation of Sprinkler Systems*, 1996 edition, National Fire Protection Association, Quincy, MA.

[2] NFPA 30, *Flammable and Combustible Liquids Code,* 1996 edition, National Fire Protection Association, Quincy, MA.

[3] NFPA 204, *Guide for Smoke and Heat Venting,* 1997 edition, National Fire Protection Association, Quincy, MA.

[4] NFPA 92B, *Guide for Smoke Management Systems in Malls, Atria, and Large Areas,* 1995 edition, National Fire Protection Association, Quincy, MA.

[5] NFPA *Fire Protection Handbook,* 18th ed., National Fire Protection Association, Quincy, MA, 1997.

[6] NFPA 68, *Guide for Venting of Deflagrations,* 1994 edition, National Fire Protection Association, Quincy, MA.

[7] NFPA 69, *Standard on Explosion Prevention Systems,* 1997 edition, National Fire Protection Association, Quincy, MA.

[8] *Industrial Fire Hazards Handbook,* 3rd ed., National Fire Protection Association, Quincy, MA, 1990.