

Life Safety Code

- Explain the difference between building codes and the Life Safety Code
- Describe the general layout of NFPA 101
- Select the appropriate chapter for finding general information



Historic Fire

- Iroquois Theater



The NFPA Manual of Style

- First chapter: administrative information
- Second chapter: referenced publications
- Third chapter: definitions
- Appendix A: explanatory material

说明材料



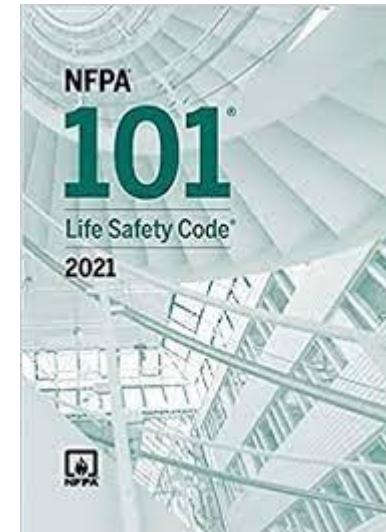
Also

- A vertical line in the margin indicates a change in the standard before 2015
 - Shaded text in 2018- N, Δ, text
- An asterisk * in front of a section indicates additional info in Annex A
- A bullet indicates something was deleted (not 2015)
- First numeral of a section number indicates the chapter



Codes

- Minimum requirements
 - Can exceed
- Not a limit on what can be done 对可以做的事
情没有限制
- Based on consensus 基于共识
 - Best practices



Chapter 1

Administration

- Minimize danger to life from fire
 - Construction protection and occupancy features
 - Egress facilities from building or to safe area
 - Protective systems, building services, operating and maintenance features
- Not a building code or fire prevention code
- Will not provide protection from acts of negligence
- Preserving property not an objective
- Intended for fire
 - Might be beneficial in similar situations



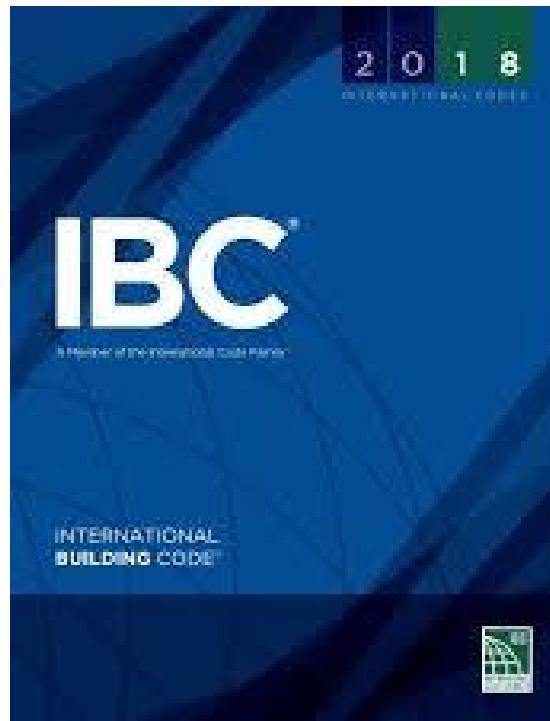
保护财产不
是目的



NFPA101 and IBC

- Both have Life Safety requirements
- IBC also has structural requirements
- Many differences
 - Terminology
 - Gray areas
 - Some requirements
- Adoption
 - Federal
 - State

术语
灰色地带
一些要求



Chapter 1

- Application
 - New and existing buildings
 - Vehicles and vessels immobile and used for human occupancy
- Equivalency
 - Not intended to prevent systems equal or superior alternatives
 - Technical documentation required
 - AHJ approves alternate approaches in compliance with code



不打算阻止系统采用同等或更优的替代方案



Chapter 2

Mandatory References

强制性参考

- Documents referenced by LSC as mandatory requirements and considered part of the code
- Impractical to continually upgrade existing buildings 不断升级现有建筑是不切实际的
- Existing buildings that do not comply shall be permitted to continue service
 - If nonconformity does not present a serious hazard to occupants

如果不合格不会对乘员造成严重危害



Chapter 3

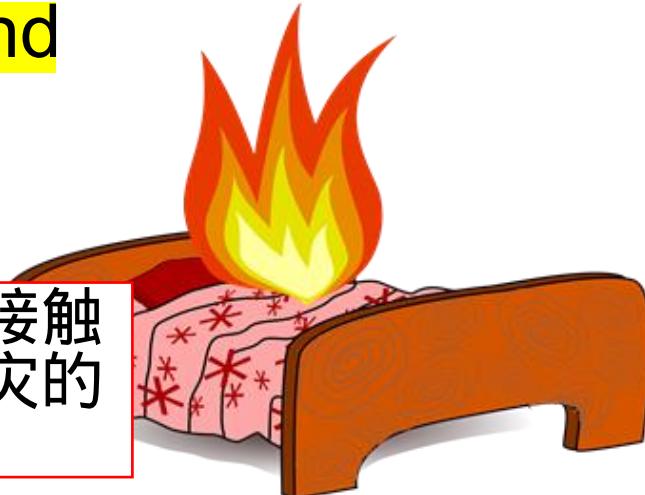
- Contains **important definitions** used in the industry and throughout this course
 - Learn the NFPA definitions (you need them for all codes)
 - Others learn as they are used
 - Never assume standard dictionary definition



Chapter 4

General

- Goals
- Reasonable safety from fire and similar emergencies
- Protection of occupants not intimate with initial fire 保护未接触初始火灾的乘员
- Improve survivability of occupants intimate with fire
- Reasonably safe emergency/nonemergency crowd movement



Chapter 4

- **Objectives**

- Protect occupants not intimate with fire for time necessary to evacuate, relocate, or defend in place
- Structural integrity maintained for time necessary to evacuate, relocate, or defend in place
- Systems shall be designed and maintained to meet goals

- Assumptions

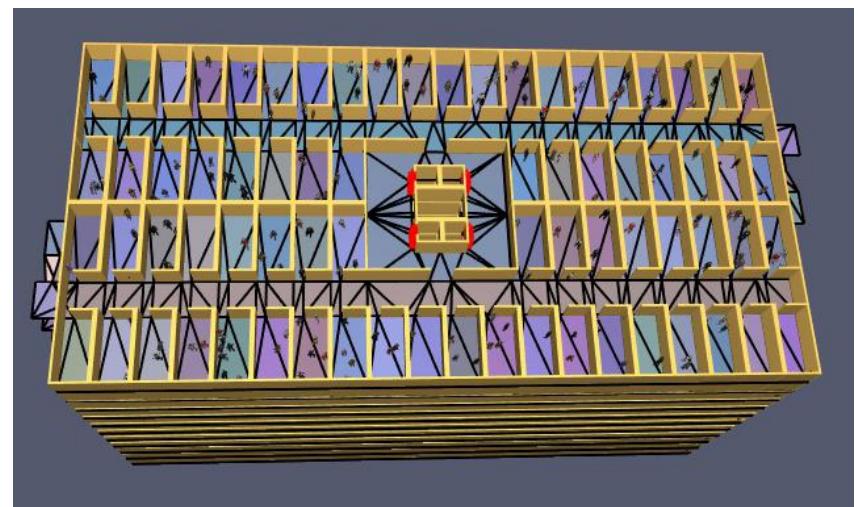
- Single fire



Chapter 4

Compliance options

- Prescriptive Based Option
 - General chapters (1-4, 6-11, 43)
 - Occupancy chapters
 - AHJ has final determination
- Performance-based option
 - Chapter 5



Chapter 4

- Must have multiple safeguards
 - Cannot rely on single safeguard
- Appropriateness of safeguards
 - Character of occupancy
 - Capabilities of occupants
 - Number of occupants
 - Fire protection provided
 - Capabilities of response personnel
 - Height and type of construction
 - Other factors providing safety

占用性质
居住者的能力
居住人数
提供消防设施
应急人员的能力
建筑高度和类型
其他安全因素



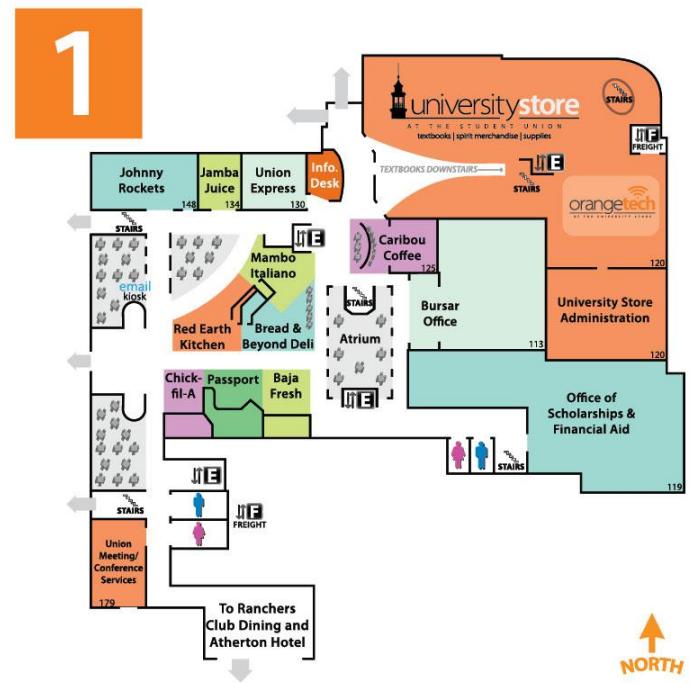
Chapter 6

- Final determination by AHJ
- Can be for entire building or portion of building
- Specific minimum number of people or activities
- Classifications (examples):
 - Assembly: special amusement or 50+ gathering
 - Very common
 - Education: through 12th grade
 - Residential: provides sleeping
 - Mercantile: stores



Chapter 6

- Mixed
 - Exit access combined
 - Use most restrictive criteria
- Separated
 - Rated wall assembly between
 - Reduced requirements with automatic sprinklers
- Incidental use
 - Limited
 - Can use predominant



Chapter 6

- Hazards based on fire, smoke, and explosion threat to people
- AHJ has final say
- Use most restrictive in building unless separated
- Classifications
 - Low: No self-propagation
 - Ordinary: Moderate burning, lots of smoke
 - High: Rapid burning or explosion



General Requirements

- Chapter 7: Means of Egress
- Chapter 8: Features of Fire Protection
- Chapter 9: Building Services and Fire Protection Equipment
- Chapter 10: Interior Finish, Contents, and Furnishings
- Chapter 11: Special Structures and High-Rise Buildings



Occupancy Chapter Layout

- X.1 General Requirements
 - Similar information to chapters 1 to 4
- X.2 Means of Egress Requirements
 - Similar information to chapter 7
- X.3 Protection
 - Similar information to chapters 8, 10, and part of 9
- X.4 or X.6 Special Provisions
 - Something unique to that type of building
- X.5 Building Services
 - Similar information to part of chapter 9
- X.7 Operating Features
 - Reserved sections



NFPA 170

- Chapter 4
- Chapter 6



Features of Fire Protection

- Identify requirements for penetrations of fire walls and barriers
- Explain how fire stopping assemblies work
- Discuss the limitations on vertical openings in buildings



Historic Fire

- Baghdad Hospital



Construction

- Applies to existing and new construction
- References NFPA 220 construction types
- Requirements of least resistive construction
 - 2-hr rated fire wall



Passive Fire Protection

被动防火

- The concepts from the first lecture codified
 - Compartmentation
 - Fire barriers
 - Fire doors
 - Vertical openings
 - Smoke barriers
 - etc.

分隔
防火屏障
防火门
垂直开口
烟幕



Fire Resistance

- Typically using assemblies from standard tests
 - ASTM E 119 or ANSI/UL 263
- Can do performance-based design
 - Need to use standard methods or approval
- Permanently identified in concealed space
 - Within 15 ft of end
 - Every 30 ft

可以进行基于
性能的设计



Fire Barriers and Walls

- Fire barriers must go from wall to wall
 - 3-hour, 2-hour, 1-hour, or 0.5-hr
 - Limitations on width openings do not apply
- Fire walls
 - ASTM E 119 or ANSI/UL 263
 - Non-symmetrical evaluated from both sides

从两侧评估非对称性

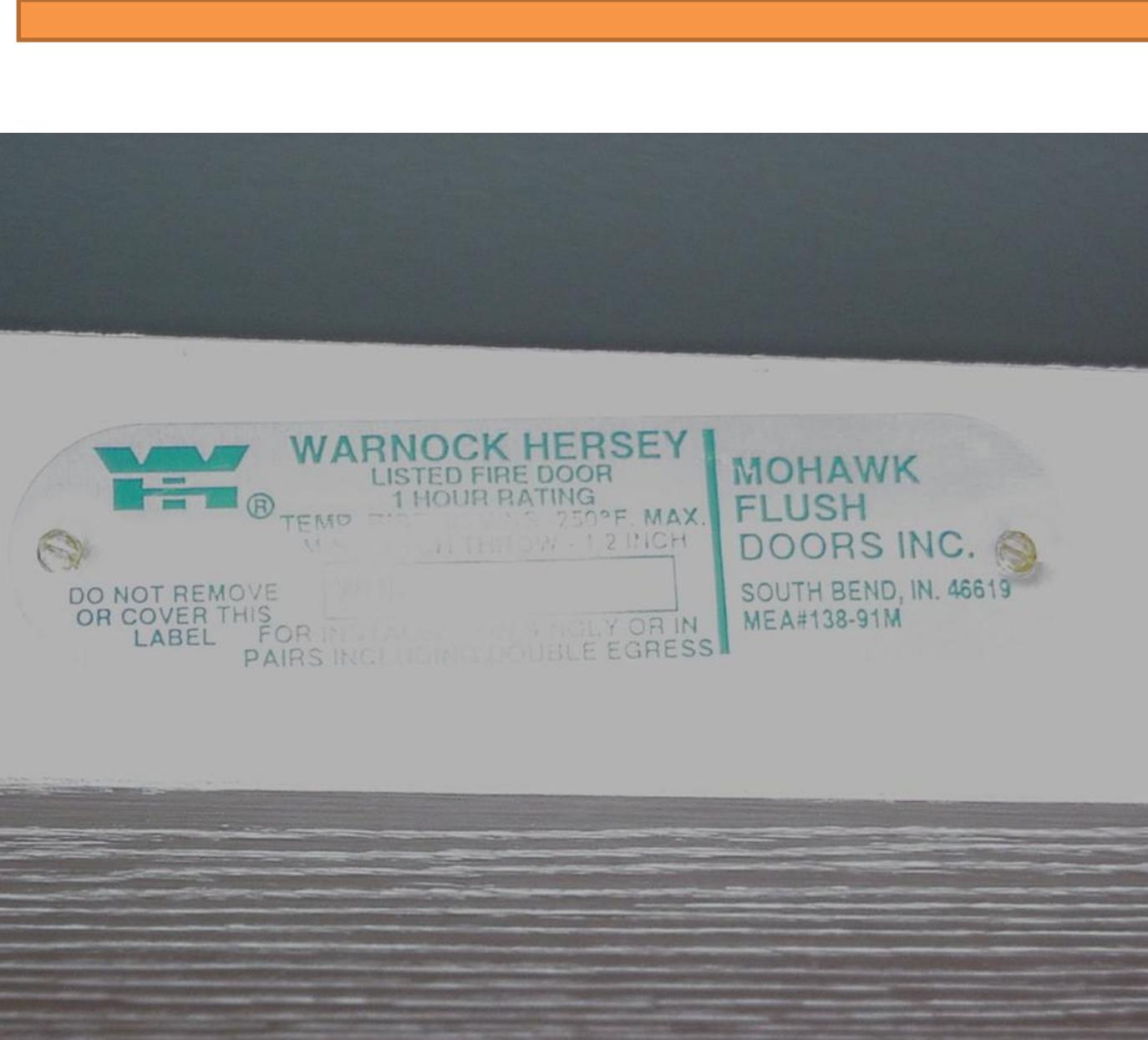


Doors

- All components listed, labeled
- Maximum leakage 3 cfm/ft²
 - Tested at 0.10 inH₂O
- Minimum ratings
 - Standard tests
- Self-closing or automatic-closing
- $\frac{3}{4}$ -hour doors can be used in existing buildings where 1 hr is required
 - Other requirements differ for existing buildings



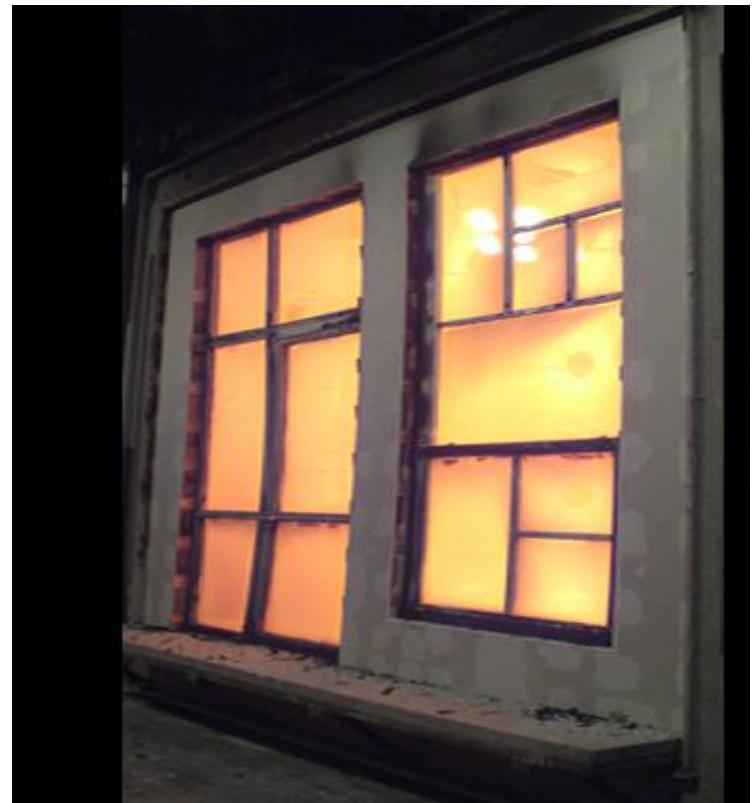
Labeled Doors



Windows

- Allowed in fire doors
 - Existing installation
 - Wired glass
 - 0.25 in
 - New installation
 - Listed, labeled

8.3.3.6.11 Existing installations of wired glass of $\frac{1}{4}$ in. (6.3 mm) thickness and labeled for fire protection purposes shall be permitted to be used in approved opening protectives, provided that the maximum size specified by the listing is not exceeded.



Glazings

玻璃窗

- Allowed in walls, windows, and doors
 - Asymmetrical tested on both sides
- Must meet requirements of standard tests
- Typically limited to 25%

8.3.3.6.10 The total combined area of glazing in fire-rated window assemblies and fire-rated door assemblies used in fire barriers shall not exceed 25 percent of the area of the fire barrier that is common with any room, unless the installation meets one of the following criteria:

Table 8.3.3.12 Marking Fire-Rated Glazing Assemblies

Fire Test Standard	Marking	Definition of Marking
ASTM E119, or ANSI/UL 263 ^a NFPA 257	W	Meets wall assembly criteria
	OH	Meets fire window assembly criteria, including the hose stream test
NFPA 252	D	Meets fire door assembly criteria
	H	Meets fire door assembly hose stream test
	T	Meets 450° F (232°C) temperature rise criteria for 30 minutes
	XXX	The time, in minutes, of fire resistance or fire protection rating of the glazing assembly

^aASTM E 119, *Standard Test Methods for Fire Tests of Building Construction and Materials* and ANSI/UL 263, *Standard for Fire Tests of Building Construction and Materials*.



Openings in Fire Rated Assemblies

- Protect other side from smoke and fire

Table 8.3.4.2 Minimum Fire Protection Ratings for Opening Protectives in Fire Resistance-Rated Assemblies and Fire-Rated Glazing Markings

Component	Walls and Partitions (hr)	Fire Door Assemblies (hr)	Door Vision Panel Maximum Size (in ²) ^a	Minimum Side Light/Transom Assembly Rating (hr)		Fire-Rated Glazing Marking Side Light/Transom Panel			Fire Window Assemblies ^{b,c}	
				Fire Protection Resistance		Fire Protection Resistance		Fire Protection Resistance (hr)		
				Door Vision Panel	Fire Protection Resistance	Door Vision Panel	Fire Protection Resistance	Fire Protection Resistance (hr)		
Elevator hoistways	2	1½	155 in. ² ^d	D-H-90 or D-H-W-90	NP	2	NP	D-H-W-120	NP	W-120
	1	1	155 in. ² ^d	D-H-60 or D-H-W-60	NP	1	NP	D-H-W-60	NP	W-60
	½	½	85 in. ² ^e	D-20 or D-W-20	½	½	D-H-20	D-W-20	NP	W-30
Elevator lobby (per 7.2.13.4)	1	1	100 in. ² ^b	≤100 in ² , D-H-T-60 or D-H-W-60 ^f	NP	1	NP	D-H-W-60	NP	W-60
				>100 in ² , D-H-W-60 ^f						
Vertical shafts, including stairways, exits, and refuse chutes	2	1½	Maximum size tested	D-H-90 or D-H-W-90	NP	2	NP	D-H-W-120	NP	W-120
	1	1	Maximum size tested	D-H-60 or D-H-W-60	NP	1	NP	D-H-W-60	NP	W-60
Replacement panels in existing vertical shafts	½	½	Maximum size tested	D-20 or D-W-20	½	½	D-H-20	D-W-20	NP	W-30

(continues)

Table 8.3.4.2 *Continued*

Component	Walls and Partitions (hr)	Fire Door Assemblies (hr)	Door Vision Panel Maximum Size (in ²) ^a	Fire-Rated Glazing Marking Door Vision Panel		Minimum Side Light/Transom Assembly Rating (hr)		Fire-Rated Glazing Marking Side Light/Transom Panel		Fire Window Assemblies ^{h,i}
				Fire Protection Resistance	Fire Protection Resistance	Door Vision Panel	Fire Protection Resistance	Fire Protection Resistance	Fire Protection Resistance (hr)	
Fire barriers	3	3	100 in. ² ^b	≤100 in ² , D-H-180 or D-H-W-180 ^h	NP	3	NP	D-H-W-180	NP	W-180
				>100 in ² , D-H-W-180 ^h						
	2	1½	Maximum size tested	D-H-90 or D-H-W-90	NP	2	NP	D-H-W-120	NP	W-120
	1	¾	Maximum size tested ^f	D-H-45 or D-H-W-45	¾ ^f	¾ ^f	D-H-45	D-H-W-45	¾	OH-45 or W-60
	½	½	Maximum size tested	D-20 or D-W-20	½	½	D-H-20	D-W-20	½	OH-20 or W-30
Horizontal exits	2	1½	Maximum size tested	D-H-90 or D-H-W-90	NP	2	NP	D-H-W-120	NP	W-120
Horizontal exits served by bridges between buildings	2	¾	Maximum size tested ^f	D-H-45 or D-H-W-45	¾ ^f	¾ ^f	D-H-45	D-H-W-45	¾	OH-45 or W-120
Exit access corridors ^g	1	½	Maximum size tested	D-20 or D-W-20	¾	¾	D-H-45	D-H-W-20	¾	OH-45 or W-60
	½	½	Maximum size tested	D-20 or D-W-20	½	½	D-H-20	D-H-W-20	½	OH-20 or W-30
Smoke barriers ^g	1	½	Maximum size tested	D-20 or D-W-20	¾	¾	D-H-45	D-H-W-20	¾	OH-45 or W-60
Smoke partitions ^{g,k}	½	½	Maximum size tested	D-20 or D-W-20	½	½	D-H-20	D-H-W-20	½	OH-20 or W-30

NP: Not permitted.

^aNote: 1 in² = .00064516 m².

^bFire resistance-rated glazing tested to ASTM E 119, *Standard Test Method for Fire Tests of Building Construction and Materials*, or ANSI/UL 208, *Standard for Fire Tests of Building Construction and Materials*, shall be permitted in the maximum size tested. (See 8.3.3.7.)

^cFire-rated glazing in exterior windows shall be marked in accordance with Table 8.3.3.12.

^dSee ASME A17.1, *Safety Code for Elevators and Escalators*, for additional information.

^eSee ASTM A17.3, *Safety Code for Existing Elevators and Escalators*, for additional information.

^fMaximum area of individual exposed lights shall be 1296 in.² (0.84 m²) with no dimension exceeding 54 in. (1.37 m) unless otherwise tested. [80: Table 4.4.5, Note b, and 80.4.4.5.1]

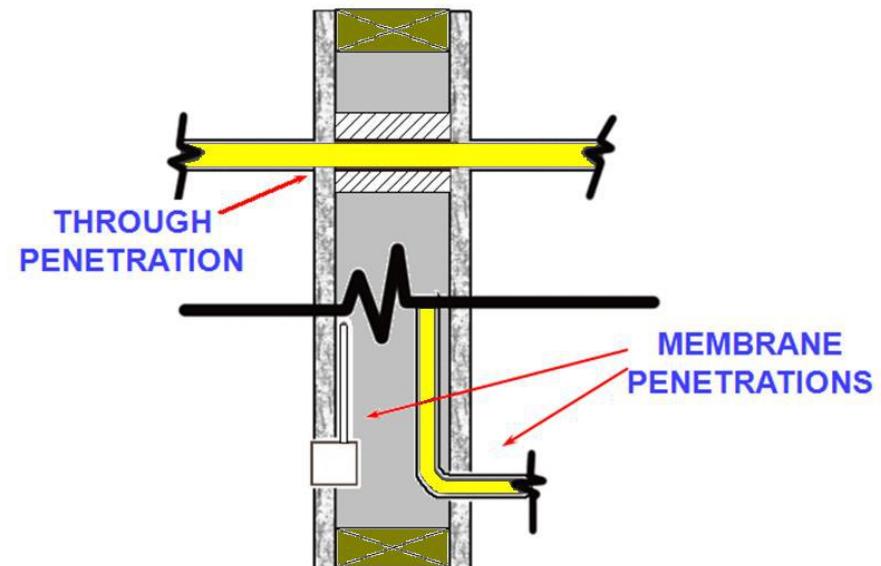
^gFire doors are not required to have a hose stream test per NFPA 252, *Standard Methods of Fire Tests of Door Assemblies*; ASTM E 2074, *Standard Test Method for Fire Tests of Door Assemblies, Including Positive Pressure Testing of Side-Hinged and Pivoted Swinging Door Assemblies*; ANSI/UL 10B, *Standard for Fire Tests of Door Assemblies*; or ANSI/UL 10C, *Standard for Positive Pressure Fire Tests of Door Assemblies*.

^hFor residential hoist and cage, see 33.2.3.1 and 33.2.3.1.

Penetrations

贯穿件

- Must be firestopped
 - ASTM E 814 or ANSI/UL 1479
 - Tested under pressure
 - 1 hr F and T ratings minimum
 - Otherwise equal to assembly penetrated
- Same basic rules for fire rated assemblies and membranes



N 8.3.4.2.3 F Ratings. Firestop systems and devices shall have an F rating of not less than 1 hour, and not less than the required fire resistance rating of the fire barrier penetrated.

8.3.4.2.4 T Ratings.

N 8.3.4.2.4.1 Penetrations in fire resistance-rated horizontal assemblies shall have a T rating of not less than 1 hour, and not less than the fire resistance rating of the horizontal assembly.



Joints

- Must be protected from smoke spread
- Testing to be representative of installation
- If on fire barrier must protect against flames
- ASTM E 1966 or ANSI/UL 2079
 - Under pressure
- Curtain walls
 - ASTM E 2307
 - F rating equal to floor assembly



Smoke Partitions

防烟隔板

- Full height
- Doors
 - Cannot contain louvers
 - Self-closing or automatic-closing
- Penetrations protected
- Joints to have limited smoke spread
- Dampers
 - ANSI/UL 555S
 - Class II, 250 °F
 - Close upon smoke alarm



Smoke Barriers

- Full height and width
- Can also be a fire barrier
- Doors
 - Similar requirements to smoke partitions
 - Maximum $\frac{3}{4}$ in clearance on bottom
 - Latching hardware required
- Dampers
 - Similar requirements to smoke partitions
 - Access for testing and inspection
- Penetrations and joints



Vertical Openings

- Every floor must be smoke barrier
- Openings through floors should be enclosed
- Shafts can end in a room associated with use
 - e.g. elevator machine room
- 4 or more stories connected = 2 hr
- Less than 4 stories = 1 hr
- Existing buildings = $\frac{1}{2}$ hr
- Communicating spaces allowed with many restrictions

竖井可以在
与使用相关
的房间中结
束



Atriums

中庭

- Fire barrier of 1 hr
 - Glass walls can sometimes be used
- Low or ordinary hazard contents
- Entire building protected by automatic sprinklers
- Engineered design to keep smoke above occupants



Convenience Stairs

- Can only connect two floors
- Separated from other openings, corridors, and fire and smoke compartments
- Cannot serve as a means of egress
- Entire building protected by automatic sprinklers



Elevators and Escalators

电梯和升降机

- Hoistways shall be enclosed
 - Three or fewer cars in building = can share hoistway
 - Four or more cars in building = at least two hoistways
 - No more than four in one hoistway
- Escalators used as means of egress enclosed like stairs
- Otherwise openings still typically protected

8.6.9.4除现有建筑物中的现有井道外，位于建筑物内的电梯轿厢应按照以下要求封闭：

跟随：

- (1) 如果建筑物内有三个或三个以下的电梯轿厢，则应允许它们位于同一井道外壳内。
- (2) 如果建筑物内有四个电梯轿厢，则电梯轿厢的划分方式应确保至少提供两个独立的井道外壳。
- (3) 如果建筑物内有四个以上的电梯轿厢，则位于单个井道外壳内的电梯轿厢数量不得超过四个



Mezzanines

- Must be less than 1/3 of area
- All portions open and unobstructed



Special Hazards

- Protection
 - Separation
 - Sprinklers
 - Both
- Explosion protection
- Hazardous materials
- Alcohol-based hand-rub dispensers
 - Size limitations
 - Limited locations
 - Discharge limitations



Interior Finish, Contents, and Furnishings

- Select appropriate interior finish, contents, and furnishings

室内饰面、内容物和家具



Historic Fire

- The Station



Why to Consider Interior Finishes

- People do not want to live in concrete boxes
- Can lead to fire spread
- Add to fuel load
- Combustion products
 - Toxicity
 - Visibility



Interior Finish

- Includes

- Fixed/movable walls/partitions

固定/活动墙/隔墙

镶板

墙垫

防撞垫

易燃材料储物柜

- Paneling

- Wall pads

- Crash pads

- Lockers of combustible materials

- Applied as

- Structure/decoration

结构/装饰

声学的

绝缘

- Acoustical

- Insulation



Testing

- Under conditions simulating actual installations
- Up to 1/28 in, exempt
 - Class A
 - Existing
- Class A, B, or C as specified
 - Can use better class
 - Sprinklers reduce level by one class



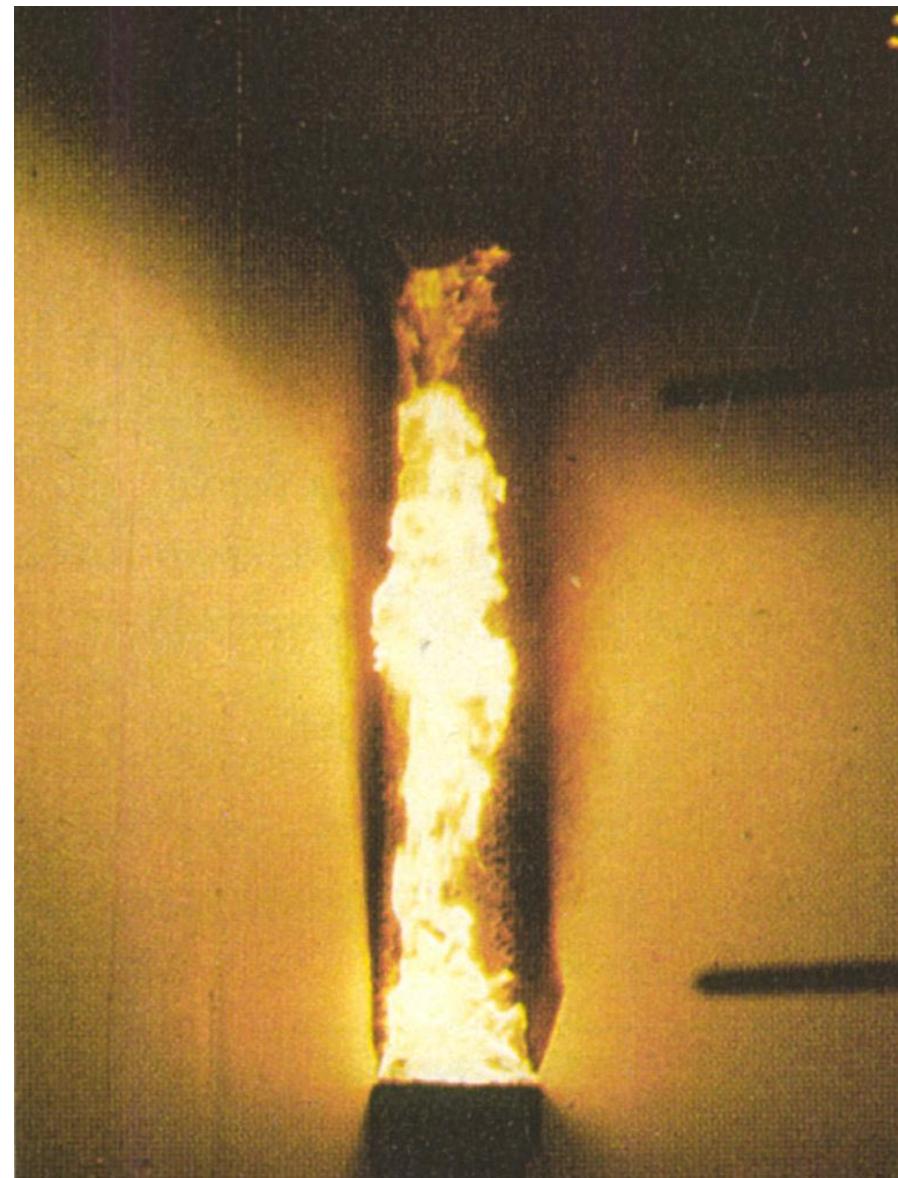
Product	FS	SD
Cement Mineral Board	0	0
Gypsum Board	15	0
Protected Metal	35	80
Mineral Ceiling Tile	10	10
Wood Fiber Ceiling Tile	160	105
Treated Wood Fiber Ceiling Tile	20	0
Painted Glass Fiber Ceiling Tile	10	10
Untreated Fir Plywood	138	60
Fire Retardant Treated Plywood	15	0
Fiberboard	300	55
PVC Plastic Panels	25	Over 500
Glass Fiber Reinforced Plastic Pnls	25	Over 500
Red Oak	100	100

Refer to specific Listings and Classifications in Manufacturer's Literature,
or Building Materials Directory



Room Corner Test

- More realistic assessment of hazard
- 8 ft high, 8 ft wide, 12 ft long, single opening
 - Larger tests as well
- Simulated ceiling
- Diffusion burner
- Heat release and smoke release
- Visual observation of flame spread



Specific Materials

- Textiles

纺织品

N 10.2.4.4* Textile Wall Coverings. Where used as interior wall finish materials, textile materials shall be tested in the manner intended for use, using the product mounting system, including adhesive, and shall comply with the requirements of either, 10.2.3.1, 10.2.4.4.1, or 10.2.4.4.3.

N 10.2.4.4.1* Products tested in accordance with NFPA 265 shall comply with the criteria of 10.2.4.4.2.

N 10.2.4.4.2* The interior finish shall comply with all of the following when tested using method B of the test protocol of NFPA 265:

(1) During the 40 kW exposure, flames shall not spread to the ceiling.

(2) The flame shall not spread to the outer extremities of the samples on the 8

ft × 12 ft (2440 mm × 3660 mm) walls.

(3) Flashover, as described in NFPA 265, shall not occur.

(4) For new installations, the total smoke released through-out the test shall

not exceed 1000 m².

× N 10.2.4.4*织物墙面覆盖物。当用作内墙饰面材料时，应使用产品安装系统（包括粘合剂）以预期使用的方式对纺织材料进行测试，并应符合10.2.3.1、10.2.4.4.1或10.2.4.4.3的要求。

N 10.2.4.4.1*根据NFPA 265测试的产品应符合10.2.4.4.2的标准。

N 10.2.4.4.2*当使用NFPA 265测试协议的方法B进行测试时，内部饰面应符合以下所有要求：

(1) 在40 kW暴露期间，火焰不得蔓延至天花板。

(2) 火焰不得蔓延至8 ft × 12 ft (2440 mm × 3660 mm) 墙壁上样品的外端。

(3) 不得发生NFPA 265中所述的闪络。

(4) 对于新装置，通过试验释放的总烟量不得超过1000 m²。

- Vinyl

乙烯基

- Limitations

- Plastics

- Most not to be used without large-scale tests

- Limitations when used as trim

用作装饰时的限制



Trim and Incidental Finish

- Less than 10%
 - Bulletin boards, etc. 20%
- Can be Class C
- Wall base 6 in



Flooring

- Class I: 0.45 W/cm^2
- Class II: 0.22 W/cm^2
- Critical radiant flux 0.1 W/cm^2
- Can use higher class
 - Automatic sprinklers reduce by one class



10.2.7.4.1 Class I Interior Floor Finish. Class I interior floor finish shall have a critical radiant flux of not less than 0.45 W/cm^2 , as determined by the test described in 10.2.7.3.

10.2.7.4.2 Class II Interior Floor Finish. Class II interior floor finish shall have a critical radiant flux of not less than 0.22 W/cm^2 , but less than 0.45 W/cm^2 , as determined by the test described in 10.2.7.3.



Contents and Furnishings

- Draperies, curtains 窗帘
- Upholstered furniture and mattresses 软垫家具和床垫
 - Resist cigarette ignition
 - Limited char length
 - Differences if sprinklered
- Explosive or highly flammable not allowed
- Combustible decorative vegetation 可燃装饰植物
 - Electrical equipment
 - Open flames
- Outdoor furniture
 - 2 ft



Building Service and Fire Protection Equipment

- Identify the appropriate building service and fire protection equipment
- Explain the commissioning process and integrated testing



Historic Fire

- One Meridian Plaza



Chapter Design

- Requirements for systems used in building
- Most requirements are to other codes
 - Those codes are then part of NFPA 101



Utilities 公用事业

- Emergency power
 - Will be required elsewhere in code
 - NFPA 110
 - Generator running, fault, not in automatic



Air Movement

- HVAC and other ventilation
 - Other codes
- Smoke control
 - Automatic activation
 - Engineer of record certifies intent and method
 - Special inspector

自动激活

记录工程师证明意图和方法
特别检查员



Elevators

- Unless in accordance with 7.2.13 only exit access
- Specific signage in non evacuation elevator lobbies 非疏散电梯大厅中的特定标志
- Available for fire fighter emergency operations
 - Elevator machine room limits



Elevators

- Cannot open to an exit enclosure



Chutes

滑槽

- Connect multiple levels
- Must be in designated room



Detection and Alarm Systems

- NFPA 70 and NFPA 72
- Alarm out of service > 4 hr = notify AHJ
 - Evacuation
 - Fire watch
- Smoke detection to protect system
- Must notify fire department



Detection and Alarm Systems

- **Initiation**

- **Pull station**

- Within 60 in of doorways
 - Within 200 ft of all locations
 - Occupancy chapters might only require one in building



- **Smoke/heat detector**

- Sleeping areas
 - Interconnected
 - Local



- **Suppression system**

- Equal or greater than single sprinkler



Detection and Alarm Systems

- **Notification**

- Audible and visual
 - Must be heard above ambient, distinct, take precedence
 - Must be synchronized
- Detection away from occupied = no notification
- Delay to “trained” staff
- Notification to entire evacuation zone
- Private operating mode allowed
- 520 Hz in sleeping areas



Detection and Alarm Systems

- Alarm zones
 - Each floor
 - Maximum 22,500 ft²
 - 300 ft in one direction
 - Can align with sprinkler system zones
- CO detection
- Risk analysis
 - Where required
 - MNS not explicitly required
- Two-way radio enhancement



Detection and Alarm Systems

- Voice Alarms
 - Intelligibility and audibility
 - Vulnerable populations
 - More information
 - Less confusion
 - Required in some buildings
- Mass Notification
 - Relatively new in the codes
 - Wide range of applications
 - Not required



Detection and Alarm Systems

- Relation to other systems

- Hold-opens
- Pressurization
- Smoke management/control
- Door locks
- Elevator recall
- HVAC



Suppression Systems

- Where required
- Accordance with NFPA installation standards



Commissioning and Integrated Testing

调试和综合
测试

- People involved
 - Owner
 - AHJ
 - System designer
 - General contractor
 - Subcontractor
 - Fire protection engineering consultants
 - Test and balancing technicians
- Integrated testing

所有者
AHJ
系统设计师
总承包商
分包商
消防工程顾问
测试和平衡技术人员



Commissioning

委托

- Approved plan
- Sequence of operations
- Inspection of components
- Design parameters
- Testing of system operation
 - Emergency, normal, and change of power status
 - Performance criteria
 - Test all related systems



Special Inspector

- Must check all performance criteria
- Special training and equipment
- Iterative process



Institutional Occupancies

- Determine what differentiates this type of occupancy from others
- Identify the key provisions that are different from the general chapters



Historic Fire

- Ohio State Penitentiary



People

- Types of people present
 - Familiarity
 - Abilities
 - Activities



Occupancy Classifications- Institutional



- I-2 Medical care
 - 24-hour care
 - More than 5 people
 - 1-5 people: R-3
- **Condition 1:** Nursing and medical, no emergency, surgery, obstetrics, **psychiatric/ detoxification**
- **Condition 2:** Could provide all medical services
- **NFPA101 > 3 occupants**



Evacuation Strategy

- Minimize the need for evacuation
- Consider occupants
- Compartmentation
- Horizontal exits 

 - Wide corridors
 - Wide doors without mullion

- Fewer restrictions on passing through spaces 



Suites

- Hospitals generally divided into suites
- Separated
- Move towards less hazard
- Directly to corridor or horizontal exit (100 ft)
- Smoke detection
- Limitations on decorations
- Limitations on heaters



Related Issues

- Life support equipment
 - Emergency power requirements
- Cooking
 - Limitations on size, type, and control
- Alcohol-based hand-rub dispensers
 - Limitations on size and locations
- HVAC
 - Limitations on types and locations
- Rehabilitation of nonsprinklered smoke compartments
- Sprinklers without exceptions
- Locking of doors



Drills and Fire Alarm

- Must have emergency evacuation plan
- Staff must be informed of duties
- Quarterly drills for each shift
 - Do not have to evacuate patients
- Code phrases 
- Alarms can be visible only in critical care
- Pull station at nurse's station



Ambulatory Health Care

门诊保健

- Outpatient care
 - 4 or more
 - Similar requirements
 - More flexibility



Occupancy Classifications- Institutional

- I-1 Supervised living
 - 16+ people, excluding staff
 - 6-16 people: R-4
 - 1-5 people: R-3
 - 24-hour care
 - Condition 1: Can self-evacuate
 - Condition 2: Limited assistance



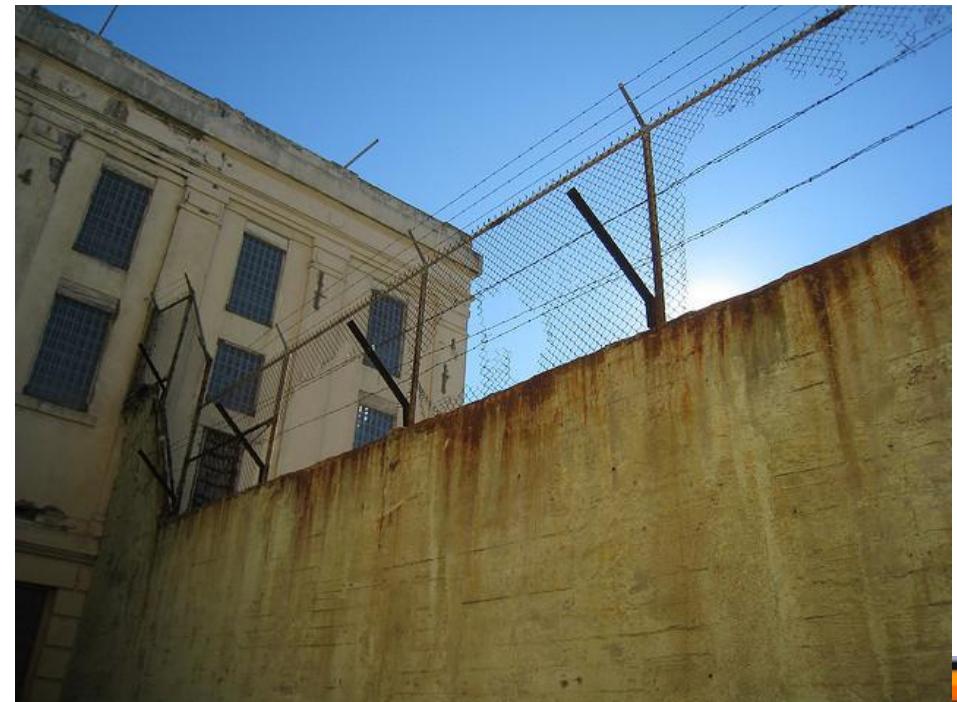
Occupancy Classifications- Institutional

- I-3 Restrained
 - More than 5 people
 - Condition 1: Can freely evacuate to exterior
 - Condition 2: Can freely move to another smoke compartment
 - Condition 3: Can freely move within smoke compartment
 - Condition 4: No free movement, remote-controlled release
 - Condition 5: No free movement, manual release



Egress

- **Doors**
 - Sliding
 - Remote controlled
 - 50 lb force
- **Compartments**
- **Enclosed areas**
- **Staff actions**
- **Sprinklers**



Educational Occupancies

- Determine what differentiates this type of occupancy from others
- Identify the key provisions that are different from the general chapters

确定此类入住与其他类型入住的区别
确定与一般章节不同的关键条款



Historic Fire

- Our Lady of Angels



People

- Types of people present
 - Familiarity
 - Abilities
 - Activities



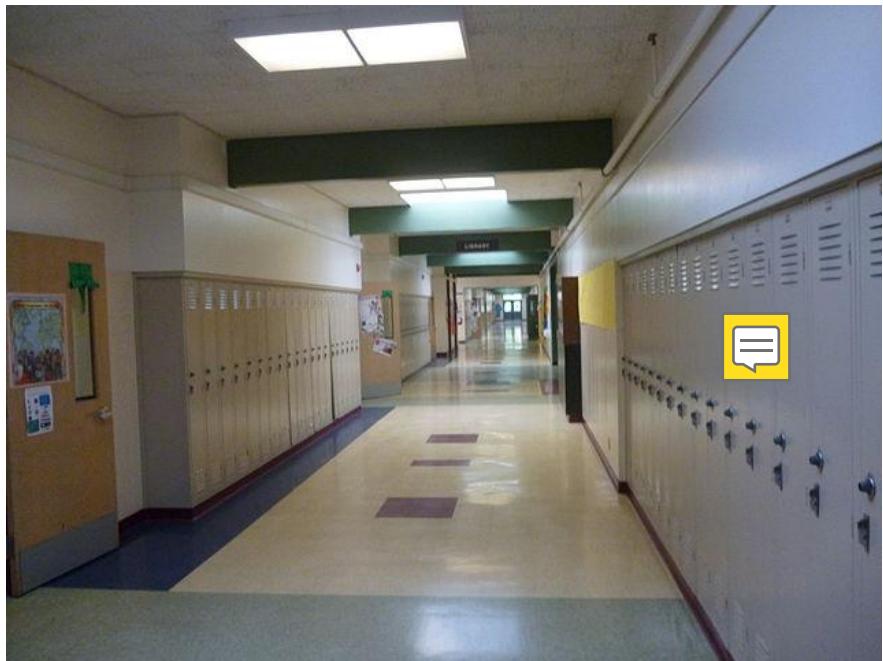
Educational

- Not every class
 - Grade
 - Number of students
 - Hours/day
 - Total hours
 - Incidental
- Limitations on room locations



Means of Egress

- Wider corridors
- Shorter distances
- Daily inspections
- Lockers and bulletin boards
- Classroom door locking
- Windows for rescue
 - Sprinklers
 - Exit door from room
 - 4+ stories



Fire Protection

- Monthly drills
 - Exceptions
 - All participate
- Fire alarm bells
- Sprinklered
- CO detection
- Risk analysis
- Limits on art work
- Open flames (labs)



Day Care

- Day Care
- Day care homes
- Adult
- Children



Day Care

- I-4 Day care
 - More than 5 people in IBC
 - 1-5 people: Primary occupancy
 - < 24 hour care
 - Adult
 - Child
- Oklahoma
 - 7 children
 - 8-12 Residential with sprinklers
- LSC
 - More than 3 people



Assembly Occupancies

- Determine what differentiates this type of occupancy from others
- Identify the key provisions that are different from the general chapters



Historic Fire

- King's Cross Station



People

- Types of people present
 - Familiarity
 - Abilities
 - Activities

熟悉度
能力



Occupancy Classifications- Assembly

- A-1 Theaters with fixed seating
- A-2 Food and drink
- A-3 Worship, recreation, amusement, and general
- A-4 Indoor sporting events
- A-5 Outdoor sporting events



for the exam. I do expect you to know the difference between them and be able to apply them correctly. remember 123 is important



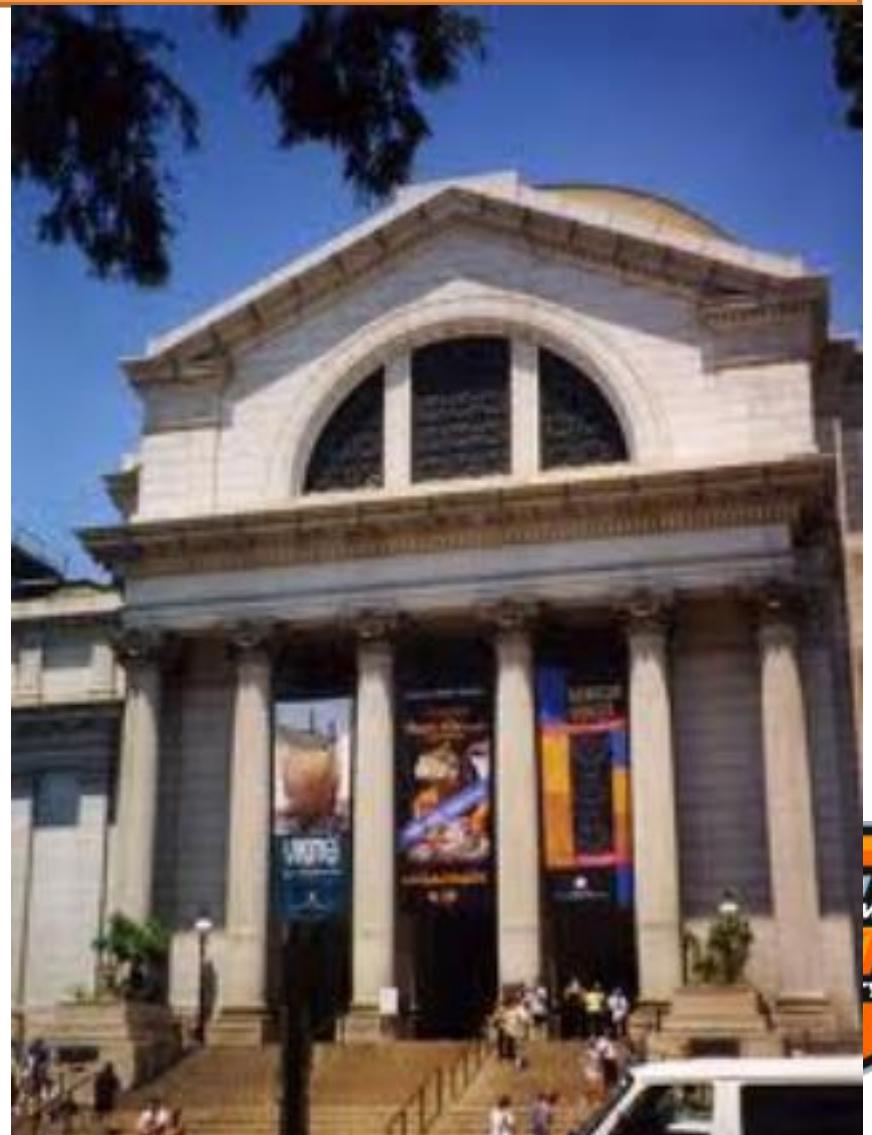
Life Safety Evaluation

- Occupant load exceeds 6000 persons
- AHJ must approve of plan
 - Annual review of written report
- 10 criteria:
 - Nature of event
 - Medical emergencies
 - Structural systems
 - Earthquakes
 - Haz mat incidences
 - Access and egress
 - Fire hazards
 - Severe weather
 - Civil disturbances
 - Stakeholder relations



Main Entrance/Exit

- Required consideration of assembly occupancies
- At level of discharge
 - Stair down is fine
- Accommodate 50% of the population in most buildings
 - 67% in dance halls, discotheques, nightclubs, occupancies with festival seating
- Other exits 50%
 - As far away as practical



Construction Type

- Will depend on height

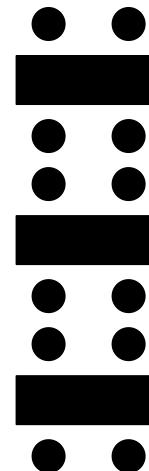
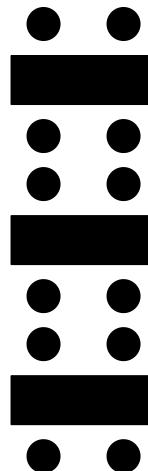
Table 12.1.6 Construction Type Limitations

Construction Type	Sprinklered ^a	Stories Below	Stories in Height ^b				
			1	2	3	4	≥5
I (442) ^{c, d, e}	Yes	X	X	X	X	X	X
	No	NP	X4	X4	X4	X4	X4
I (332) ^{c, d, e}	Yes	X	X	X	X	X	X
	No	NP	X4	X4	X4	X4	X4
II (222) ^{c, d, e}	Yes	X	X	X	X	X	X
	No	NP	X4	X4	X4	X4	X4
II (111) ^{c, d, e}	Yes	X1	X	X	X	X3	NP
	No	NP	X4	X4	X4	NP	NP
II (000)	Yes	X2	X	X4	NP	NP	NP
	No	NP	X4	NP	NP	NP	NP
III (211) ^d	Yes	X1	X	X	X	X3	NP
	No	NP	X4	X4	X4	NP	NP
III (200)	Yes	X2	X3	X4	NP	NP	NP
	No	NP	X4	NP	NP	NP	NP
IV (2HH)	Yes	X1	X	X	X	X3	NP
	No	NP	X4	X4	X4	NP	NP
V (111)	Yes	X1	X	X	X	X3	NP
	No	NP	X4	X4	X4	NP	NP
V (000)	Yes	X2	X3	X4	NP	NP	NP
	No	NP	X4	NP	NP	NP	NP



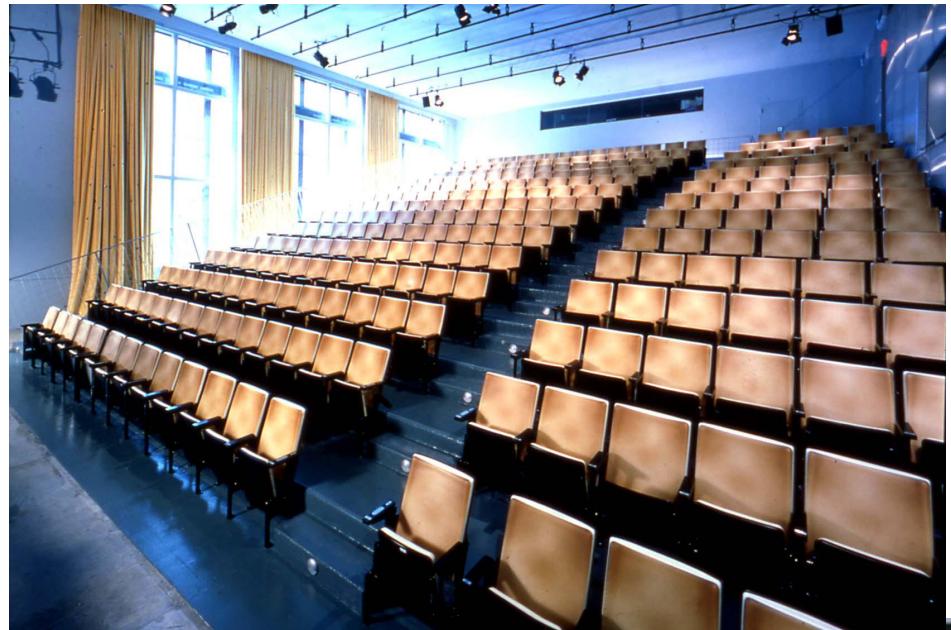
Means of Egress

- Typically Chapter 7
- No turnstiles in means of egress
 - Most often in places of assembly
 - Options:
 - Gate
 - Fold recessed
 - 44 in wide corridors if >50 people
- Seating at tables
 - Aisle
 - Aisle access
- Approval of layouts



Theater Seating

- Stairs: $0.3 \times A \times B$ in/seat
 - If riser height > 7in:
 $A=1+(R-7)/5$
 - If handrail > 30 in away:
 $B=1.25$
- Passageways, doors, ramps: $0.22 \times C$ in/seat
 - If ramp slope > 1 in 10:
 $C=1.10$
- Aisle access width between seats: 12 in to 22 in
- 100 seats/row



Auditoriums and Arenas

- Seating
- Floor area
 - 50 % not exit through seating
- Festival seating
 - 250 people
 - Maintained egress routes
- Waiting spaces



Management and Systems

- Crowd managers
 - Mass movement of people
 - Staff assigned just to keep order
 - 1 for every 250 people
- Drills
 - Must be held to train
 - Employees taught to use extinguishers
- Rules typically based on size
 - 300 persons
 - Alarms
 - Constantly monitored
 - Visual and audible
 - Voice
 - CO detection
 - Sprinklers
 - Risk analysis



Special Provisions

- Smoke-protected seating
 - Smaller egress components for large populations
- Limited access or underground buildings
 - Smoke
- Stages and platforms
 - Fire load
- Projection rooms
 - Fire load
- Special amusement buildings
 - Life safety
 - Grandstands
 - Fire load
 - Life safety
- Folding and telescopic seating
 - Airport loading walkways
 - From planes



Open Flames

- **Cooking**
 - Open flames
- **Pyrotechnics**
 - Typically not allowed



Residential Occupancies

- Determine what differentiates this type of occupancy from others
- Identify the key provisions that are different from the general chapters



Historic Fire

- Winecoff Hotel



People

- Types of people present
 - Familiarity
 - Abilities
 - Activities

The key thing here to remember that we're dealing with people that are asleep and the complications with that of need to get them keeping them safe as we saw in the case of the wine cock hotel. It took them longer and so we needed to keep them longer time safe inside their areas and somewhat more passive protection requirements for that reason



Occupancy Classifications- Residential

Sleeping

R-1: Transient people 流动人口

R-2: Permanent people

More than two units

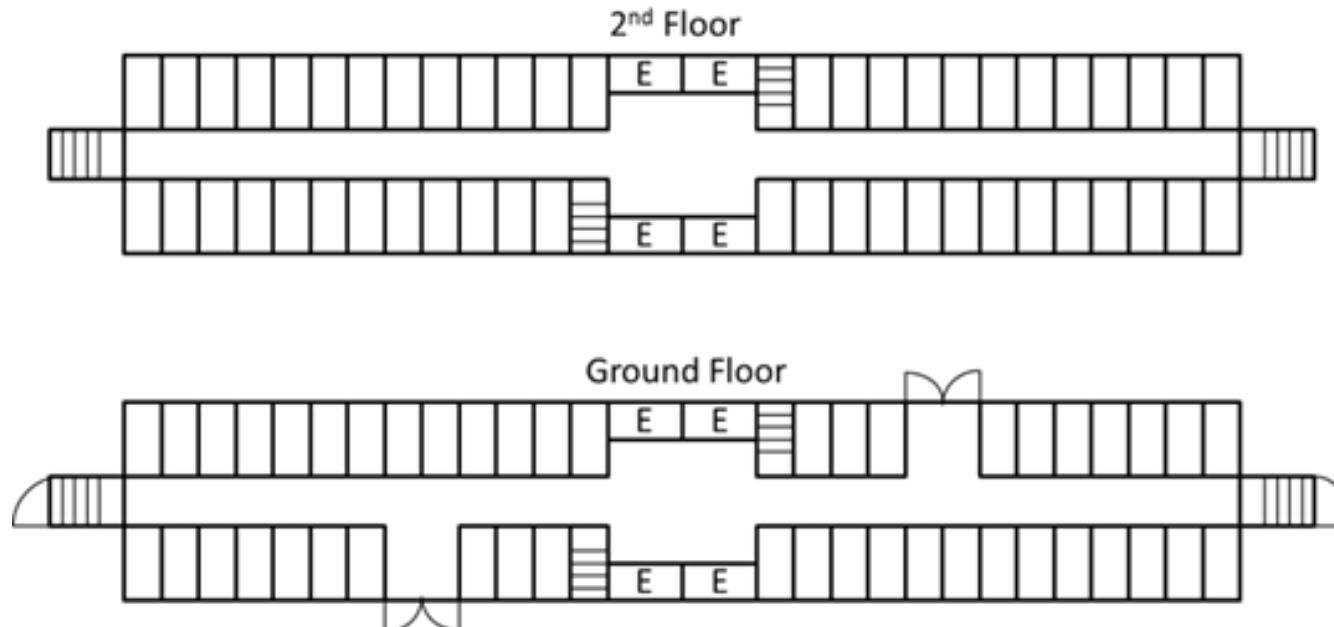


Hotels and Dormitories

NFPA 101



- Means of escape
- Remoteness rules do not apply
 - No common path outside of rooms
- Internal discharge
- Travel distance and common path requirements



Detection and Suppression

- Corridor smoke detection
- Local smoke alarms in rooms
- CO detection
- Voice alarms can be required
- Some guest rooms with strobes
- Generally, sprinkler systems
 - All rooms exit to outside
 - Portable fire extinguishers
- Grab bars



Drills and Emergency Plans

- Emergency plans provided
- Hotels: Employees drilled quarterly on duties
 - Must start annunciation
 - Must notify fire department
- Dormitories: Drills frequently enough, at times of peak occupant load 1 year
 - Risk analysis for dorms



Apartments

- Means of egress similar to Hotels
- Less fire alarm requirements
- Annual instructions to each dwelling unit



Homes

- R-3
- Single family
 - Three outsiders
- Means of escape
- Lesser requirements
 - 28" doors
 - 36" stairs
 - 7' ceiling height
- Unlock bathroom doors from outside 从外面打开浴室门
- Grab bars
- Smoke alarms
- CO detection
- Sprinklers
- Existing chapter reserved



Lodging or Rooming Houses

宿舍出租公寓住房

- 16 or fewer people
- R-2
- Similar requirements as homes
- Additional fire and smoke spread limitations
- Interior finish requirements
- Fire alarm
 - Strobes
- Existing chapter reserved



Occupancy Classifications- Residential IBC

R-4: Custodial care 监护

6-16 people

Condition 1: Can self-evacuate

Condition 2: Any person needs limited assistance



Residential Board and Care

NFPA 101

住宿委员会和护理

Small Facilities

- R-4: Custodial care
 - 6-16 people
 - Condition 1: Can self-evacuate
 - Condition 2: Any person needs limited assistance

Large Facilities

- I-1 Supervised living
 - 16+ people, excluding staff
 - 24-hour care
 - Condition 1: Can self-evacuate
 - Condition 2: Limited assistance



Chapter Structure

- 32.1 General Requirements
- 32.2 Small Facilities
- 32.3 Large Facilities
- 32.4 Suitability of Apartment Buildings
- 32.7 Operating Features



Places of Work Occupancies

- Determine what differentiates this type of occupancy from others
- Identify the key provisions that are different from the general chapters



Historic Fire

- World Trade Center 2001



People

- Types of people present
 - Familiarity
 - Abilities
 - Activities

employees : both that are adults They're awake, able to they have moved. They can effectively move throughout the building. Some people maybe in wheel chair especially in the office space, but they'll be elevators. They're already the refuge for them. anyone under the implicit drugs and alcohol We're gonna assume no.

restriction so we get to industrial and storage . It's even less. Why is that because an industrial storage? They have on appropriate PPE So we'll talk about things like we cannot put graded stairs in a business, but you want to put great stairs(大楼梯) in a factory. That's perfect.



Occupancy Classifications- Business

- Office, professional, or service transactions
- Occupancies that do not quite meet definitions



Changes to Occupant Load Factor

- 2012: 100 ft²/person
- 2015: Concentrated Business 50 ft²/person
- 2018: 150 ft²/person, collaborative rooms



Comparisons to Other Occupancies

- Means of egress
 - Less restrictive than most other occupancies
- Fire protection systems
 - Less restrictive
- Risk Analysis
 - Colleges and universities
- Suppression
 - Extinguishers
- Drills
 - Not required if <500 persons or <100 persons above/below street floor
 - Conducted periodically



Combined Parking Structures

- 2 hr Fire barrier
- Openings do not need protection
 - Openings <25 %
 - Public entrance
 - Sprinklered business
 - Means preventing spilled fuel from accumulating
 - Vehicles always >10 ft away
 - Smoke partition



Factory

- Industrial buildings for assembling, disassembling, fabricating, finishing, manufacturing, packaging, repairing, or processing
 - F-1 moderate-hazard
 - F-2 low-hazard



Industrial Occupancies

- No existing building chapter
- Occupant load calculation gross
 - Exclude spaces not subject to occupancy due to machinery or equipment 不包括因机械或设备而受占用的空间
- Fire alarm typically required
 - Occupant notification
 - Audible and visual in constantly attended location 
- Reduced requirements for furniture, mattresses, and soiled linen/trash receptacles
减少对家具、床垫和脏亚麻布/垃圾桶的需求



Subclassifications

子分类

- General
 - Ordinary or low hazards, conventional design
 - Multistory, potentially different tenants (different processes)
- Special purpose
 - Ordinary or low hazard, only suitable for certain operations
 - Low population density
- High hazard
 - Can be incidental and not basis for design 可以是偶然的，而不是设计的基础



Means of Egress

- Typically Chapter 7
- Can have noncombustible grated stairs 
- Fixed industrial stairs for fire escape ladders
- Slides can account for 100% of capacity
 - Must be regularly used in drills
- Dead-end corridors: typically 50 ft
- Common path of travel: typically 100 ft or 50 ft
- Travel distance: varies up to 400 ft

可以有不燃的格栅楼梯



Aircraft Hangars

飞机库

- Industrial?
- Storage?
- 150 ft exit spacing along exterior
- 100 ft horizontal exit spacing



Occupancy Classifications- Storage

S-1 Moderate-hazard

Not classified as S-2

S-2 Low-hazard

Noncombustible materials
with negligible plastic



Storage

- No existing occupancy chapter
- Limited fire alarm requirements
- No extinguishment requirements
- Parking garages
 - Dead ends 50 ft
 - Travel distance up to 400 ft



Occupancy Classifications- High Hazard

H-1爆炸危险

- Physical or health hazard
 - Minimum quantities
 - Manufacturing, processing, generation, or storage
- IFC/NFPA 1 typically referenced
- Multiple hazards
 - Meet each
- H-1 Detonation hazard
爆燃危险或加速燃烧
- H-2 Deflagration hazard or accelerated burning
- H-3 Materials that readily support combustion or pose a physical hazard
- H-4 Health hazards
- H-5 Semiconductor fabrication

半导体制造

