

Fire Inspector Certification Program

New Jersey Uniform Fire Code Inspector Training Program

Module 9 Means of Egress & Occupancy



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Welcome

Instructor introduction

- Before we get started
 - Has everyone signed in?
 - Anyone have any questions?

2

Note to Class

This specific section will address:

1. *Current Uniform Construction Code egress requirements,*
2. *Current Fire Prevention Code maintenance requirements*
4. *Retrofit Code (sub-chapter 4 UFC-NJ) egress requirements*

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Occupancy Loads/Mean of Egress

In this module we will discuss...

- Means of egress components,
- Calculating occupancy loads,
- Chapter 10 of the UCC-NJ, IBC 2015
- Chapter 10 of the UFC-NJ-IFC 2015,
- Retro-fit requirements for egress

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Mean of egress...

A continuous and unobstructed path of travel from any point in a structure to a public way. A means of egress consists of three separate and distinct parts:

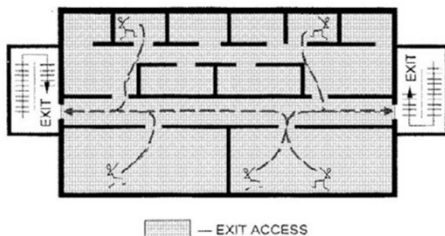
- the exit access;**
- the exit; and**
- the exit discharge.**

A means of egress comprises the vertical and horizontal means of travel and shall include: all intervening room spaces; doors; hallways; corridors; passageways; balconies; ramps; stairs; enclosures; lobbies; escalators; horizontal exits; courts and yards.

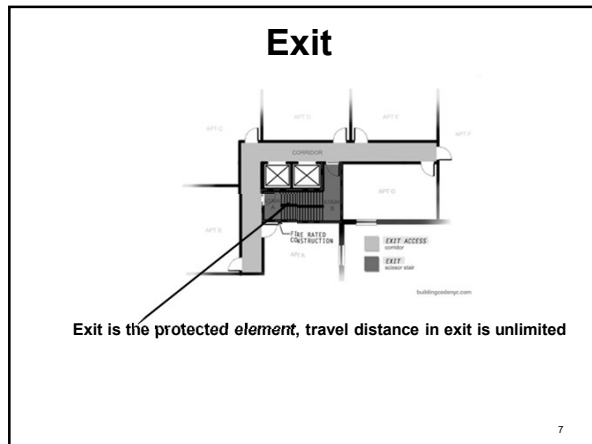
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Exit access

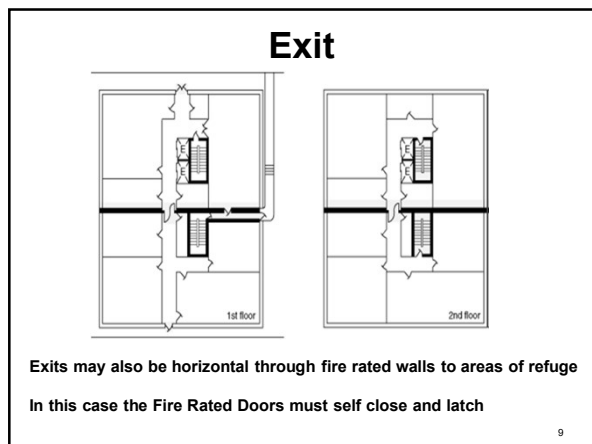
The path of travel from anywhere within the structure until you enter the exit itself.

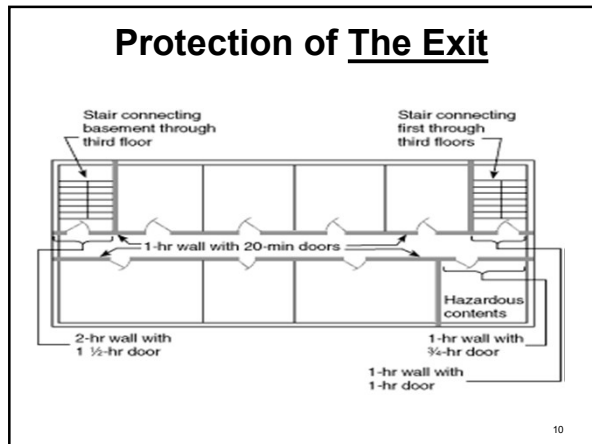


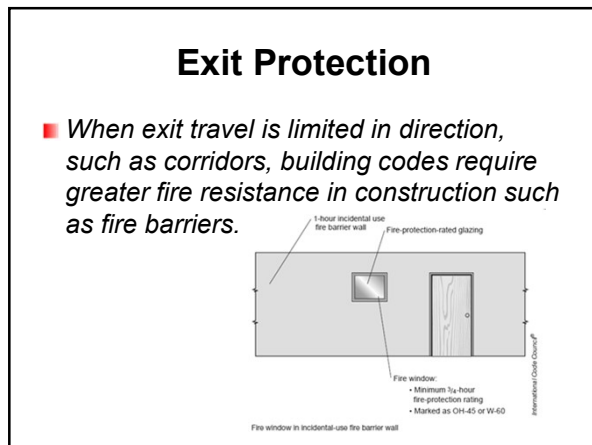
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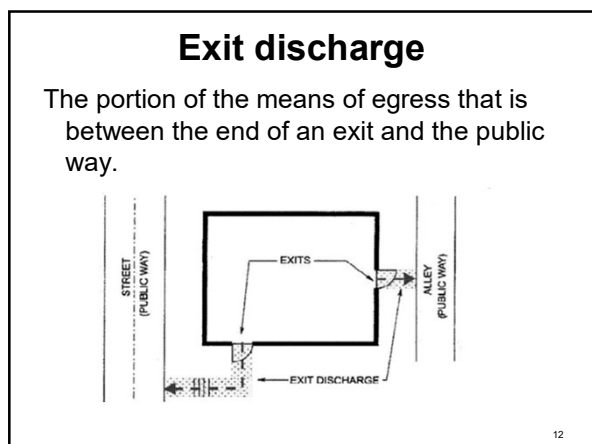


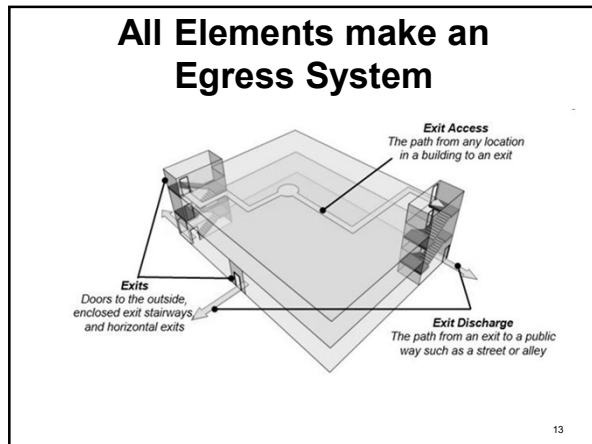


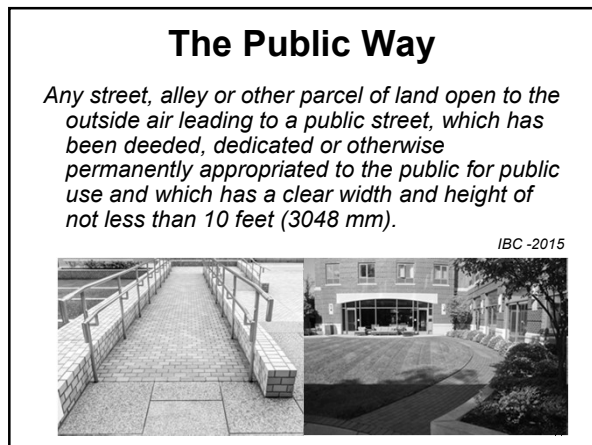


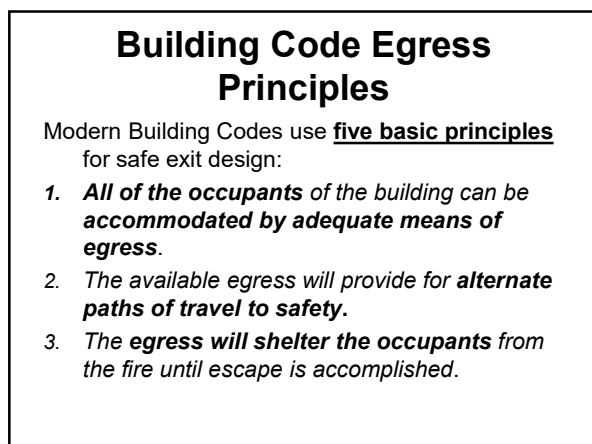












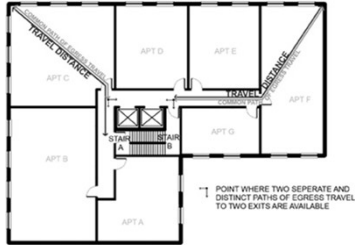
4. The means of egress will be a **well-marked, well-lit, unobstructed path of travel** to safety and will be **under the control of the user.**
5. The exit system will provide a reasonable, **risk-free path of travel during normal everyday use.**

Occupant Load per Story	Minimum number of exits from the story
1 to 500	2
501 to 1000	3
Over 1000	4

Reference IBC Table 1006.3.1

[illegible]

Common Path of Travel



How is Occupant Load Calculated?

**MAXIMUM
OCCUPANCY
282 PERSONS**

New Buildings

- Occupant load is calculated using the IBC there are four main calculations:
 1. *Design occupant load*
 2. *Cumulative occupant loads*
 3. *Maximum occupant load*
 4. *Increased occupant load*

Design Occupant Load

- *This is the maximum number of occupants a building, room, or space has exit capacity to accommodate.*
- *This number is calculated from table 1004.1.2 in the IBC and varies by use*

This definition is found in IFSTA Chapter 7 p 265 and in IBC NJ Edition Section 1004.1

IBC Table 1004.1.2

FUNCTION OF SPACE	OCCUPANT LOAD FACTOR*
Accessory storage areas, mechanical equipment rooms	300 gross
Agricultural building	300 gross
Aircraft hangars	500 gross
Airport terminal	
Baggage claim	20 gross
Baggage handling	300 gross
Concourse	100 gross
Waiting areas	15 gross
Assembly	
Gaming floors (keno, slots, etc.)	11 gross
Exhibit gallery and museums	30 net
Assembly with fixed seats	See Section 1004.4
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	7 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for additional areas	7 net
Business areas	100 gross
Courtsrooms—other than fixed seating areas	40 net
Day care	35 net
Dormitories	50 gross
Educational	

See E through W IFSTA page 243

Table Terminology

■ Gross Square Feet

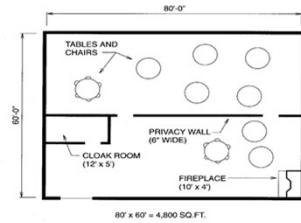
The total square footage inside the perimeter walls of a building.

Calculated by length X width for most buildings

■ Net Square feet

The actual usable floor area of a building, room or space removing the thickness of walls, or furniture such as booths, pool tables, Bars, etc.

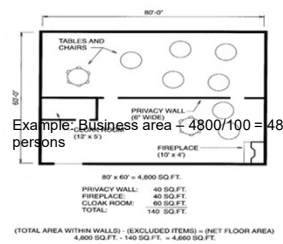
Occupant Load –Gross Sq. Ft.



Example: Business area – $4800/100 = 48$ persons

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Occupant Load –Net Sq Ft



Example: Business area – $4800/100 = 48$ persons

80' x 60' = 4,800 SQ. FT.
PRIVACY WALL: 40 SQ. FT.
FIREPLACE: 40 SQ. FT.
CLOAK ROOM: 60 SQ. FT.
TOTAL: 140 SQ. FT.

(TOTAL AREA WITHIN WALLS) - (EXCLUDED ITEMS) = (NET FLOOR AREA)
4,800 SQ. FT. - 140 SQ. FT. = 4,660 SQ. FT.

Example: Dining area – $4660/15 = 310$

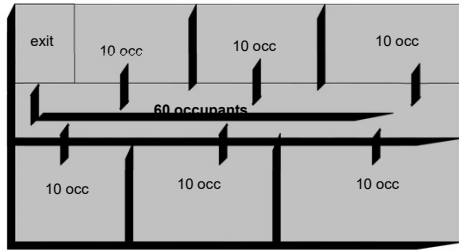
Note: Only one exit so 49 is maximum occupant load

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Cumulative Occupant Loads

- Intervening spaces or accessory areas that utilize the same exits and pathways as other rooms requires that the design occupants loads be combined.
- Exit component size must be based upon the cumulative occupant loads of the connected spaces

Cumulative Occupant Load



Increased Occupant Load

- *Designers may increase the occupant load above the minimum number in Table 1004.1.2 for design occupant loads, provided all other code requirements based upon occupant load are met.*
- *Designers may not exceed the Maximum of 1 occupant per 5 square feet.*

Maximum Occupant Load

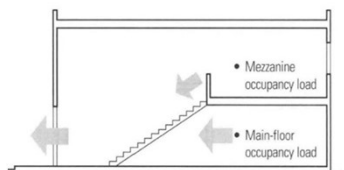
- *The IBC establishes the maximum occupant load of any building, room or space at 1 occupant per 5 square feet.*



Maximum Occupant Load

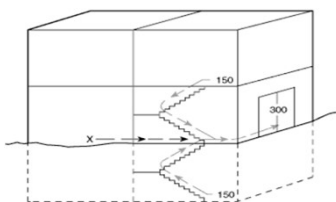
- *The London Transportation Studies determined occupant flow is at a shuffle at 1 occupant per 3 square feet.*
- *Below 3 sq.ft. is the JAM point where motion ceases*
- *The Codes establish maximum occupant load at 1 occupant per 5 sq.ft. to stay above the JAM point*

Other Considerations



- *Mezzanines: the occupant load shall be added to the floor below*

Other Considerations

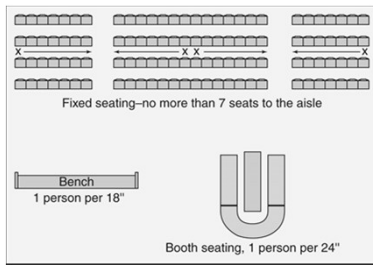


- *Adjacent stories: stories are not cumulative unless they converge from separate stories.*

Fixed Seating

- Designers may also count occupants by fixed seating.
 - Benches – 1 occupant per 18 inches
 - Booths – 1 occupant per 24 inches
 - Seats – 1 occupant per seat

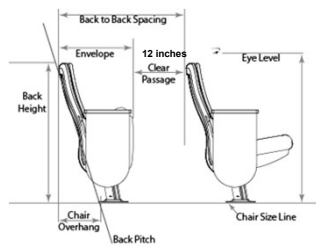
Benches & Booths



Courtesy of "Principles of Code Enforcement" – J. Foley

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Fixed Seating



Fixed and Self-Rising Seats

Fixed Seats Catchments

EXIT CAPACITIES BASED ON CATCHMENT AREAS

NOTE: FOR MINIMUM AISLE WIDTHS SEE SECTION 1012.2.6.
EXIT A IS DESIGNED FOR OCCUPANTS
IN CATCHMENT AREA (CIRCLED)

○ INDICATES A CATCHMENT AREA

Figure 1012.2
TYPICAL AISLE CATCHMENTS
Courtesy BOCA 1991, Inc.

Egress use is divided into catchments areas based upon the closest Exit to the seating area

Posted Occupant Load

The total number of persons that are permitted to occupy a building or portion thereof at any one time.

This definition is the same in both the NJIBC & NJIFC

Calculating exit capacity...

Two methods:

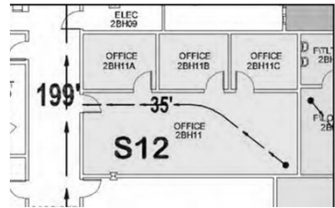
1, ICC IBC 2015
International Building Code editions with NJ changes.
(edition adopted at time of construction)

2, NJAC 5:70-4.11
For buildings constructed prior to the enactment of the UCC.
(01/01/1977)

Occupant Loads & Means of Egress Capacity

The occupant load, determines the minimum exit capacity for all elements of egress:

- Doors
- Corridors
- Ramps
- Stairs



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IBC vs. 5:70-4.11

- Egress capacity under the building code is determined in "Inches Per Occupants"
- Egress capacity under the Retrofit Fire Safety Code is calculated using "Units of Egress Width"
- These provide different flow capacities through the same size egress elements.
- NJAC 5:70-4.11 should only be applied to buildings constructed prior to 1/1/1977

Inches per Occupant

- Inches per occupant are based on research from the Canada Evacuation Studies by Jake Paul.
- They determined that people have a Halo effect around them that is 24" across and 18" inches wide.
- Maximum flow rates down stairs were determined to be 27 persons per 22" inches of stair
- This was also identified in the evacuation of the World Trade Center towers on 9/11

Inches per Occupant Table IFSTA P 269

Occupancy	Without Sprinkler System		With Sprinkler System	
	Minimum Width per occupant	Maximum Width per occupant	Minimum Width per occupant	Maximum Width per occupant
Assembly other than theater, concert hall, etc.	0.2	0.2	0.2	0.15
Day care, school, kindergarten and 1-2	0.7	0.4	0.3	0.2
Hotel, motel, apartment, etc.	NA	NA	0.3	0.2

NA = Not Applicable

A. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.2.1.1 or 903.2.1.2.

*Minimum egress width shall be based on the 2003 International Building Code.

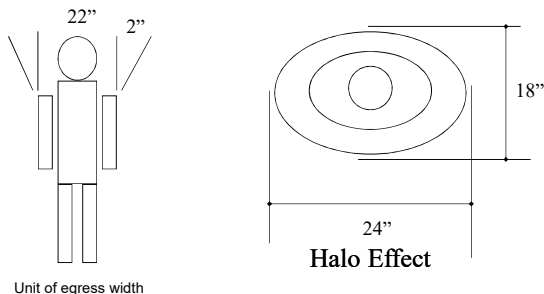
Adapted from International Code Council® International Building Code® (2003, Table 1003.2)

Presence of sprinkler increases the capacity in both methods

Unit of Egress Width Only Retrofit buildings

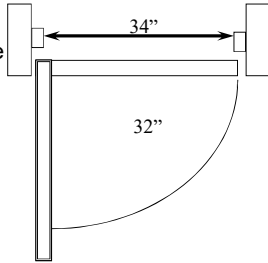
- Was based upon the average size of a person at 18" inches plus 4 "inches of body sway.
- Whole UEW's are based on 22" inches
- Half UEW's are based upon 12" inches or more
- Flow rates were determined to be:
 - 45 persons per minute down stairs
 - 60 persons per minute through doors

Unit of Egress Width



Measuring Clear Width

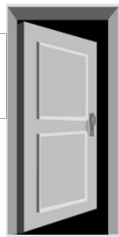
■ Measuring
elements of egress
are based upon the
clear of useable
width of the
element.



Measuring Components IBC -2015



34" Clear Width
- 34" / 0.2" per occ.
Total: 170 occ.



32" Clear Width
32" / 0.2 " per occ.
Total: 160 occ.

Measuring Components NJAC 5:70-4.11



34" Clear Width
- 22" = 1.0 UEW
12" = 0.5 UEW
Total: 1.5 UEW

150 occupants



32" Clear Width
- 22" = 1.0 UEW
10" = 0.0 UEW
Total: 1.0 UEW

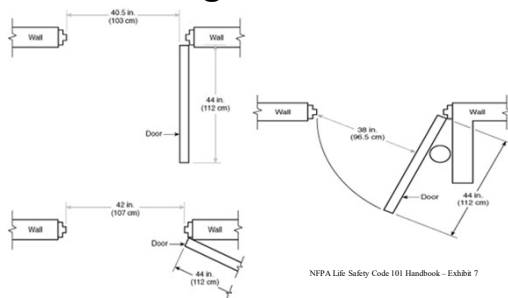
100 occupants

Capacity of Doors

- The UCC establishes minimum door sizes under the building code:
 - Minimum clear width of 32" inches
 - Maximum width of a swing door leaf is 48 inches
 - Doors shall be 80" inches in height
 - Doors serving more than 50 occupants shall swing in the direction of egress

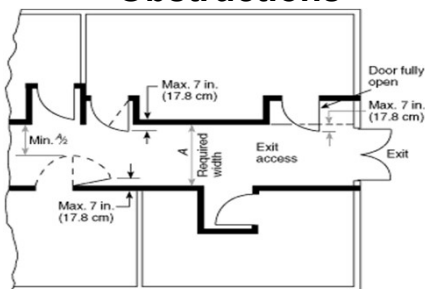
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Clear Egress Width



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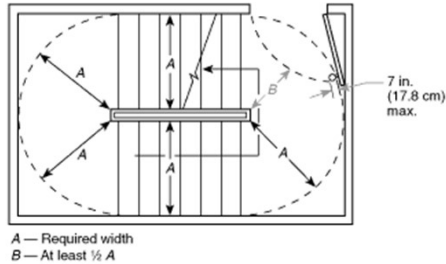
Allowable Egress Obstructions



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Egress Width

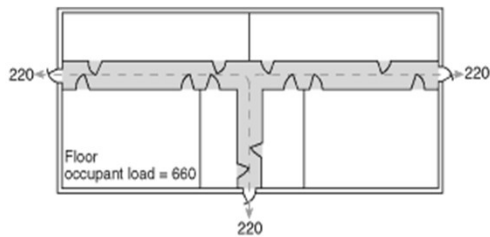
Required width must be maintained through all elements of Egress



NFPA Life Safety Code 101 Handbook - Exhibit 7.

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Corridor capacity



Capacity must accommodate all occupants on the floor of the building

NFPA Life Safety Code 101 Handbook - Exhibit 7.63

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Travel Distance

- When assessing the adequacy of exits you not only assess how many people will use the exits, you also assess how far the people have to travel to exit the structure.

"All exits shall be so located that the maximum length of exit access travel, measured from the most remote point to an approved exit along the natural and unobstructed line of travel, shall not exceed the distances given in table 1017.2."

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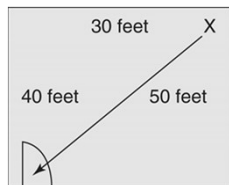
IBC Table 1017.2 Exit Access Travel Distance •

Occupancy	W/O Sprinkler System (feet)	With Sprinkler System (feet)
A, E, F-1, M, R, S-1	200	250 ^b
B	200	300 ^c
F-2, S-2, U	300	400 ^c
H-1	Not permitted	75 ^c
H-2	Not permitted	100 ^c
H-3	Not permitted	150 ^c
H-4	Not permitted	175 ^c
H-5	Not permitted	200 ^c
I-2, I-3, I-4	NOT PERMITTED	200 ^c
I-1	NOT PERMITTED	250

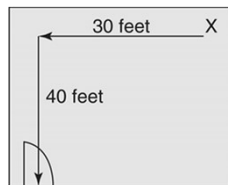
IBC 2015

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Travel Distance



Travel distance 50 feet
Incorrect measurement

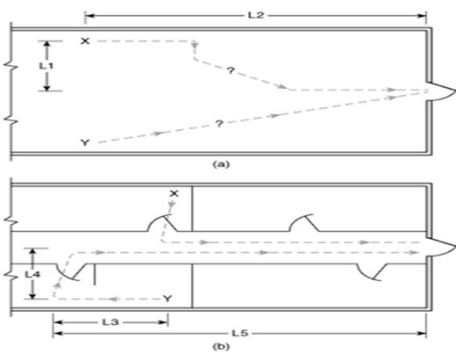


Travel distance 70 feet
Correct measurement

Principles of Code Enforcement – J. Foley

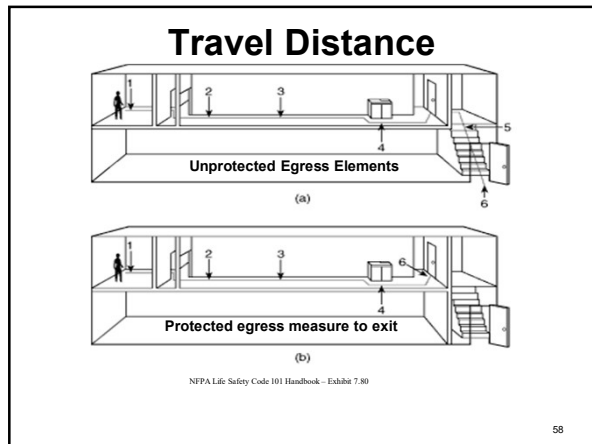
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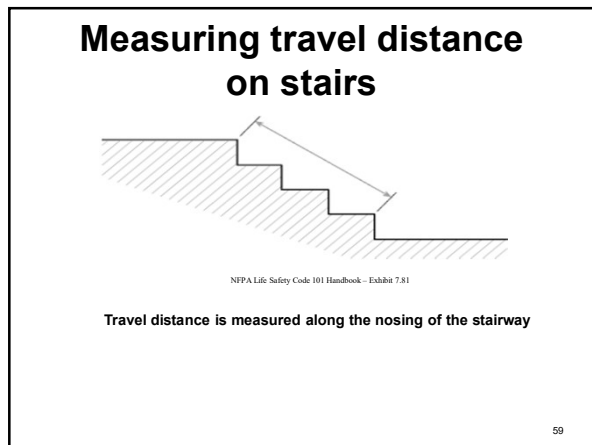
Travel Distance

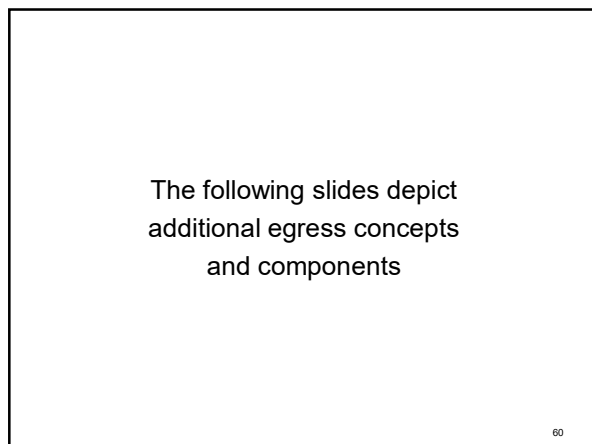


NFPA Life Safety Code 101 Handbook – Exhibit 7.82

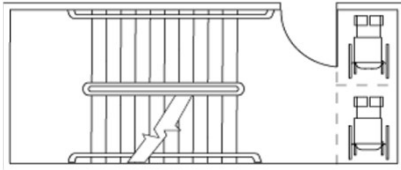
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Area of Refuge

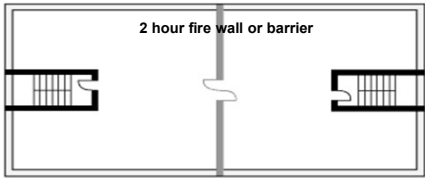


NFPA Life Safety Code 101 Handbook - Figure A.7.2.12.3.1

Non- sprinklered exit stairs must provide a location for Wheelchairs inside the stairway

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Horizontal Exits



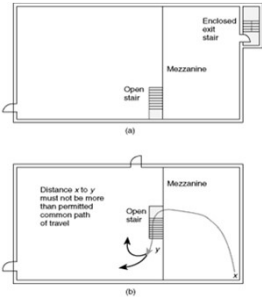
NFPA Life Safety Code 101 Handbook - Exhibit 7.5B(4)

*Horizontal Exits shall not be more than 50% of the exit capacity or width
 Refuge area is calculated at 1 occupant / 3 square feet (greater for I-uses)
 Refuge area exits are based on floor area and do not include the imposed occupant loads*

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Egress from mezzanines

- Mezzanines may not exceed 33% of the floor area below.
- Occupant loads are added to the floor below for egress
- Mezzanines may not exceed travel distance of 75 feet to closest exit

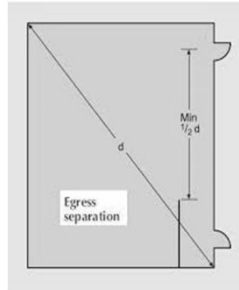


NFPA Life Safety Code 101 Handbook - Exhibit 7.6.5

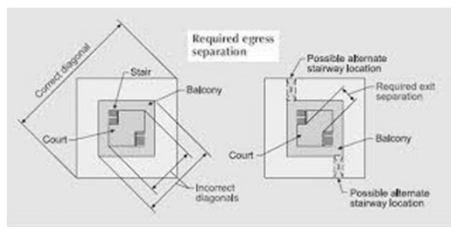
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Exit Remoteness

- **Exits in room must be remote from each other.**
- **Non-sprinklered**
 - 1/2 diagonal distance
- **Sprinklered**
 - 1/3 diagonal distance



Access to exits in core-type multi-tenant buildings

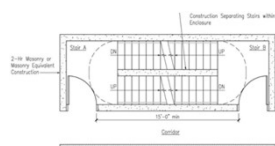


Core buildings must meet the test for remoteness

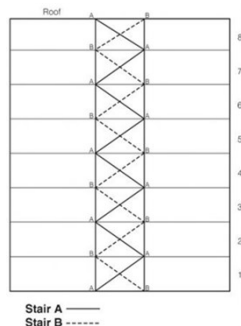
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Scissors stairs

Stair A and B must meet the Test for remoteness in core construction



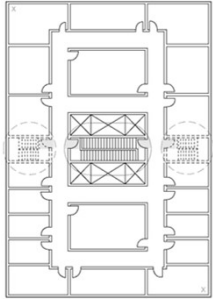
Stairs are separated by 2-hour fire wall



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Scissors stairs contrasted with conventional exit stairs

Scissor stairs conserve Exterior space for units By centralizing exits and elevators



NFPA Life Safety Code 101 Handbook – Exhibit 7.73

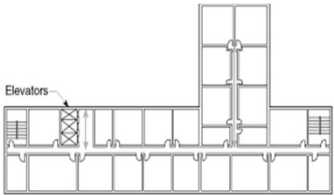
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1020.1 Corridors

Occupancy	Occupant load	Non-sprinklered	Sprinklered (c)
H-1,H-2,H-3	ALL	NOT PERMITTED	1 HOUR
H-4,H-5	> 30	NOT PERMITTED	1 HOUR
A,B,E,F,M,S	>30	1 HOUR	0 HOUR
R	>10	1 HOUR	30 MINUTES
I-2(a) ,I-4	ALL	1 HOUR	0 HOUR
I-3,I-1	ALL	NOT PERMITTED	1 HOUR (b)

EXCEPTIONS:
 a. section 408.8
 b. sections 407.2.2 & 407.2.3,
 c. section 903.1.1.2 & 903.1.2.3

Dead end corridors



NFPA Life Safety Code 101 Handbook – Exhibit 7.74

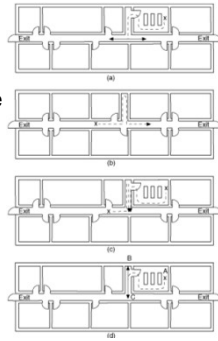
The IBC limits dead end corridors to 20 feet with several exceptions
 •I-3 conditions 2,3,4 not greater than 50 feet
 •B,F,I-1,M,R-1,R-2,R-4,S & U –automatic sprinklers < 50 feet
 •Not limited where length < 2.5 times the width

Section 1020.4 See exceptions

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Common paths of travel and dead-end corridors

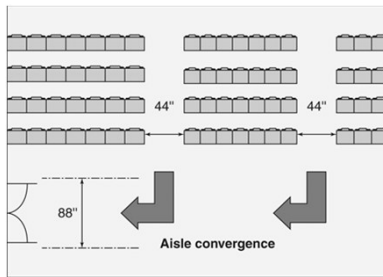
Common path of travel
Is the distance traveled
Prior to having two or more
Available paths to an exit



NFPA Life Safety Code 101 Handbook - Figure A.7.5.1.6

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Converging Aisles

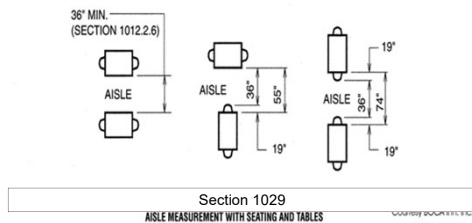


Converging aisles are cumulative to the exit

Courtesy of Principles of Code Enforcement - J.Foley

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Aisle Measurement Tables/Chairs



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