



Building Technology III

New York City College of Technology

Day 07

Egress & Stairs

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Step 1: Maximum Floor Area Per Occupant

For each space calculate # of occupants. $\text{Space Area} / \text{Area per Occupant} = \# \text{ Occupants Allowed}$

Egress & Stairs

- Step 1
 - Area per Occupant
- Step 2
 - Load per Exit
- Step 3
 - Egress width @stair
- Step 4
 - Width per occupant
 - Maintain 50%
- Step 5
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 - Riser & Run Calculations
- Wrap Up

1004.1.2 Number by Table 1004.1.2. The number of occupants computed at the rate of one occupant per unit of area as prescribed in Table 1004.1.2.

**TABLE 1004.1.2
MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT**

USE OF SPACE	FLOOR AREA IN SQ. FT. PER OCCUPANT
Assembly Gaming floors (keno, slots, etc.)	11 gross
Assembly with fixed seats	See Section 1004.7
Assembly without fixed seats	
Concentrated (chairs only—not fixed)	7 net
Dance floor	5 net
Dance floor (ballroom)	10 net
Standing space	5 net
Unconcentrated (tables and chairs)	15 net
Business areas	100 gross
Day Care	
Age under 6 months	50 net
Age 6 months - 2 years	40 net
Age 2 years - 6 years	30 net
Age above 6 years	50 net
Dormitories	50 gross
Educational	
Classroom area	20 net
Shops and other vocational room areas	50 net
Exercise rooms	50 gross
Gymnasiums	15 net

Industrial areas	100 gross
Institutional areas	
Inpatient treatment areas	240 gross
Outpatient areas	100 gross
Sleeping areas	120 gross
Kitchens, commercial	200 gross
Library	
Reading rooms	50 net
Stack area	100 gross
Locker rooms	50 gross
Mercantile	
Areas on other floors	60 gross
Basement and grade floor areas	30 gross
Storage, stock, shipping areas	300 gross
Parking garages	200 gross

Residential	200 gross within dwelling units
Skating rinks, swimming pools	
Rink and pool	50 gross
Decks	15 gross
Stages and platforms	15 net for performing area and 50 net remaining area
Accessory storage areas, mechanical equipment room	300 gross
Warehouses	500 gross

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Step 2: Calculate Occupant Load per Exit

Exit #1 = 20 from office + 10 from Lounge + 150 (half) from Open Office = 180

EXIT DOOR #1 DESIGN FOR 180 OCCUPANTS

(1004.1.3)

OFFICE, 20 OCCUPANTS

DOOR DESIGN FOR 150 OCCUPANTS

EXIT DOOR #2 DESIGN FOR 150 OCCUPANTS

LOUNGE 10 OCCUPANTS

OPEN OFFICE, 300 OCCUPANTS

Used when occupants egress from an accessory space to a primary space

Cumulative of both the accessory space and the primary space

EXIT DOOR #1 DESIGN:

# OF OCCUPANTS FROM OPEN OFFICE	=	150
# OF OCCUPANTS FROM BUILDING OFFICE	=	20
# OF OCCUPANTS FROM LOUNGE	=	10
TOTAL # OF OCCUPANTS (BY COMBINATION)	=	180

Courtesy of ICC

Exit #2 = 150 (half) from Open Office = 150

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Step 3: Egress width cannot decrease in stair

Stair at Point A is 60" what is required at point B? What is occupant load & width at point E?

Exiting from multiple levels (1004.4)

Stair Enclosure

200

150

240

First floor does not enter stairway

Exit door from stair enclosure 'E'

Basement

150

1004.4

Courtesy of ICC

Exit Stair	Occupant load served	Required width
Stair point A	200	60"
Stair point B	150	?
Stair point C	240	72"
Stair point D	150	45"
Exit door point E	?	?

At B the 60" is still required. At E occupant load would be 240" and width would be 72"

Step 4: Egress Width Per Occupant Served

Calculate Egress Width. # Occupants Allowed x Inches Per Occupant = Inches of Egress Required

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Exception: Means of egress complying with Section 1024.

**TABLE 1005.1
EGRESS WIDTH PER OCCUPANT SERVED**

OCCUPANCY	STAIRWAYS (inches per occupant)	OTHER COMPONENTS (inches per occupant)
Occupancies other than those listed below	0.3	0.2 (Doors)
Hazardous: H-1, H-2, H-3 and H-4	0.7	0.4

For SI: 1 inch = 25.4 mm.‡

1005.2 Door encroachment. Doors opening into the path of egress travel shall not reduce the required width to less than one-half during the course of the swing. When fully open, the door shall not project more than 7 inches (178 mm) into the required width.

Exception: The restrictions on a door swing shall not apply to doors within individual dwelling units and sleeping units of Group R-2 and dwelling units of Group R-3.

- 100 occupants x .3" = 30" for a stair
- 100 occupants x .2" = 20" for a door
- (minimum doors must be 32")
- 500 occupants x .3" = 150" for a stair
- 500 occupants x .2" = 100" for a door
- (2 doors openings @50" each – leaf max 48")

**SECTION BC 1005
EGRESS WIDTH**

1005.1 Minimum required egress width. The means of egress width shall not be less than that required by this section. The total width of means of egress in inches (mm) shall not be less than the total occupant load served by the means of egress multiplied by the factors in Table 1005.1 and not less than specified elsewhere in this code. Multiple means of egress shall be sized such that the loss of any one means of egress shall not reduce the available capacity to less than 50 percent of the required capacity. The maximum capacity required from any

1008.1.1.1 Door width. The minimum width of each door opening shall be sufficient for the occupant load thereof and shall provide a clear width of not less than 32 inches (813 mm). Clear openings of doorways with swinging doors shall be measured between the face of the door and the stop, with the door open 90 degrees (1.57 rad). Where this section requires a minimum clear width of 32 inches (813 mm) and a door opening includes two door leaves without a mullion, one leaf shall provide a clear opening width of 32 inches (813 mm). The maximum width of a swinging door leaf shall be 48 inches (1219 mm) nominal. Means of egress doors in an occupancy in Group I-2 used for the movement of beds shall provide a clear width not less than 41½ inches (1054 mm).

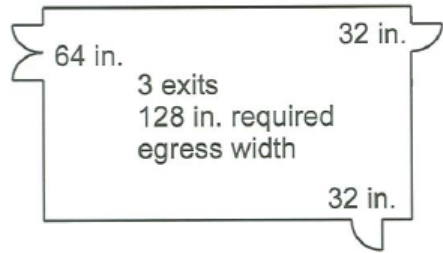
Egress & Stairs

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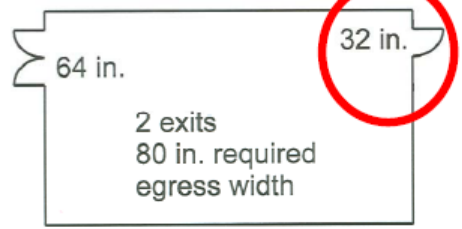
Step 4: Egress Width Per Occupant Served

Maintain at least 50% capacity of one means of egress is lost

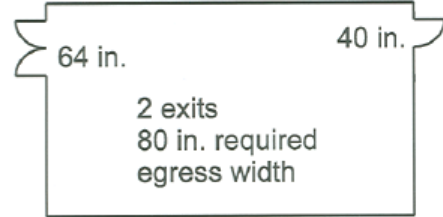
Minimum required egress width (1005.1)



OK
The loss of any single exit will not result in less than 1/2 of required width remaining



Not Permitted
Loss of single exit could result in less than 1/2 of required width remaining



OK
Although double doors give greater than 1/2 of available width, not less than 1/2 of required width would still remain

Where multiple egress is required:

Must maintain at least 50% capacity if one means of egress is lost

Courtesy of ICC

Egress & Stairs

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Step 5: Width of Corridors – Lengths of Dead Ends

Check occupancy type to confirm corridor widths. For Dead Ends - Evaluate use of sprinklers.

1016.2 Corridor width. The minimum corridor width shall be as determined in Section 1005.1, but not less than 44 inches (1118 mm).

Exceptions:

1. Twenty-four inches (610 mm)—For access to and utilization of electrical, mechanical or plumbing systems or equipment.
2. Thirty-six inches (914 mm)—With a required occupant capacity of 50 or less, except as otherwise required by Chapter 11.
3. Thirty-six inches (914 mm)—Within a dwelling unit in Occupancy Groups I-1 and R-1, except as otherwise required by Section 1107.
4. Thirty inches (762 mm) —Within a dwelling unit in Occupancy Groups R-2 and R-3, except as otherwise required by Section 1107.

5. Sixty-six inches (1676 mm)—In Group E serving classrooms.
6. Seventy-two inches (1829 mm)—In corridors serving surgical Group I, health care centers for ambulatory patients receiving outpatient medical care, which causes the patient to be not capable of self-preservation.
7. Ninety-six inches (2438 mm)—In Group I-2 in areas where required for bed movement.

1016.3 Dead ends. Where more than one exit or exit access doorway is required, the exit access shall be arranged such that there are no dead ends in corridors more than 20 feet (6096 mm) in length.

Exceptions:

1. In occupancies in Group I-3 of Occupancy Condition 2, 3 or 4 (see Section 308.4), the dead end in a corridor shall not exceed 50 feet (15 240 mm).
2. In occupancies in Groups B and F where the building is equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1, the length of dead-end corridors shall not exceed 50 feet (15 240 mm).
3. Dead-end length not exceeding 2.5 times the least width of the dead-end corridor.
4. In occupancies in Group R-2, the dead end in a corridor shall not exceed 40 feet (12 192 mm). However, where the corridors are completely enclosed in construction having a 2-hour fire-resistance rating with all doors opening into the corridor being self-closing and having a fire-resistance rating of 1½ hours, the length of dead-end corridor shall not exceed 80 feet (24 384 mm).

- **44" minimum**
- **66" in Group E serving Classrooms**

Step 6: Travel Distances & Number of Exits

Orthogonal Travel Distance from Farthest point of room to center of door at exit stair.

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TABLE 1015.1
EXIT ACCESS TRAVEL DISTANCE^a

OCCUPANCY	WITHOUT SPRINKLER SYSTEM (feet)	WITH SPRINKLER SYSTEM (feet)
A	See Section 1024.7	
E, F-1, I-1, M, R, S-1	150	200 ^b
B	200	300 ^c
F-2, S-2, U	200	250 ^b
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	150	200 ^c

For SI: 1 foot = 304.8 mm.

a. See the following sections for modifications to exit access travel distance requirements:
Section 402: For the distance limitation in malls.
Section 404: For the distance limitation through an atrium space.
Section 1018.2: For buildings with one exit.
Chapter 31: For the limitation in temporary structures.

b. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2. See Section 903 for occupancies where sprinkler systems according to Section 903.3.1.2 are permitted.

c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2.

SECTION BC 1018
NUMBER OF EXITS AND CONTINUITY

1018.1 Minimum number of exits. All rooms and spaces within each story shall be provided with and have access to the minimum number of approved independent exits as required by Table 1018.1 based on the occupant load of such story, except as modified in Section 1018.2. For the purposes of this chapter, occupied roofs shall be provided with exits as required for stories. The required number of exits from any story, basement or individual space shall be maintained until arrival at grade or the public way.

Exception: Unless otherwise required by other provisions of this chapter, the number of exits from ground floors discharging at grade directly to the exterior shall be determined in accordance with Table 1014.1.

TABLE 1018.1
MINIMUM NUMBER OF EXITS FOR OCCUPANT LOAD

OCCUPANT LOAD	MINIMUM NUMBER OF EXITS
1-500	2
501-1,000	3
More than 1,000	4

- For E = Education 150 or 200 with sprinklers
- Calculate occupant load per floor

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Step 7: Required Fire Resistance Ratings

Assume you are providing a fully automatic sprinkler system

TABLE 1016.1.1 INTERIOR CORRIDOR FIRE-RESISTANCE RATING			
OCCUPANCY	OCCUPANT LOAD SERVED BY INTERIOR CORRIDOR	REQUIRED FIRE-RESISTANCE RATING (hours)	
		Without sprinkler system	With sprinkler system ^c
H-1, H-2, H-3	All	Not Permitted	1
H-4, H-5	Greater than 30	Not Permitted	1
A, B, E, F, M, S, U	Greater than 30	1	0
R	Greater than 10	1 ^d	0
I-2 ^a , I-4	All	Not Permitted	0
I-1, I-3	All	Not Permitted	1 ^b

a. For requirements for occupancies in Group I-2, see Section 407.3.
b. For a reduction in the fire-resistance rating for occupancies in Group I-3, see Section 408.7.
c. Buildings equipped throughout with an automatic sprinkler system in accordance with Section 903.3.1.1 or 903.3.1.2 where allowed.

TABLE 1016.1.2 PUBLIC CORRIDOR FIRE-RESISTANCE RATING	
OCCUPANCY	REQUIRED FIRE-RESISTANCE RATING (hours)
H-1, H-2, H-3	2
H-4, H-5	1
A, E, F, M, S, U	1
B	1 ^a
R (Noncombustible)	1
R (Combustible)	2 ^b
I-1, I-2, I-3, I-4	1

- Corridors are to be 1 Hour Rated
- Fire Stairs are to be 2 Hour Rated

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BTECH 3

Step 8: Calculate Stair Riser/Run & Landings

Working with the required floor to floor calculate your stairs in section.

1009.3 Stair treads and risers. Stair riser heights shall be 7 inches (178 mm) maximum and 4 inches (102 mm) minimum. Stair tread depths shall be 11 inches (279 mm) minimum. The riser height shall be measured vertically between the leading edges of adjacent treads. The greatest riser height within any flight of stairs shall not exceed the smallest by more than 0.375 inch (9.5 mm). The tread depth shall be measured horizontally between the vertical planes of the foremost projection of adjacent treads and at right angle to the tread's leading edge. The greatest tread depth within any flight of stairs shall not exceed the smallest by more than 0.375 inch (9.5 mm). Winder treads shall have a minimum tread depth of 11 inches (279 mm) measured at a right angle to the tread's leading edge at a point 12 inches (305 mm) from the side where the treads are narrower and a minimum tread depth of 10 inches (254 mm). The greatest winder tread depth at the 12-inch (305 mm) walk line within any flight of stairs shall not exceed the smallest by more than 0.375 inch (9.5 mm).

1009.2 Headroom. Stairways shall have a minimum headroom clearance of 84 inches (2134 mm) measured vertically from a line connecting the edge of the nosings. Such headroom shall be continuous above the stairway to the point where the line intersects the landing below, one tread depth beyond the bottom riser. The minimum clearance shall be maintained the full width of the stairway and landing. Projections into the required width shall not be limited above the minimum headroom height.

Sum of treads and risers. The sum of two risers plus one tread exclusive of nosing shall be not less than 24 inches (610 mm) nor more than 25 1/2 inches (648 mm).

1009.6 Vertical rise. A flight of stairs shall not have a vertical rise greater than 12 feet (3658 mm) between floor levels or landings, except that the vertical rise shall not be greater than 8 feet (2438 mm) in Group A and I occupancies.

- 2 Risers + 1 Run/Tread = 24 – 25 ½ Inches
- Maximum Riser Height = 7 inches
Minimum Riser Height = 4 inches
- Minimum Tread Depth = 11 inches
- Maximum vertical rise = 12' then a landing
- Minimum head room from nosing = 84 inches

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▪ Wrap Up

BTECH 3

Wrap Up

▪ Step by Step

- For each room determine the occupancy
- For each floor determine the occupancy
- Determine the required number of exits
- Determine the load per exit
- Determine width of stairs
- Determine width of corridors
- Check travel distances
- Determine fire ratings
- Calculate riser/run calculations for each stair and each floor to floor

- Floor Plan of Lab Building with three different layouts
- What is overall square footage of each
- Divide area into different occupancies to see how they change the egress.
- Place them in different order – stacking vertically.
- Determine number of stairs per floor.
- Determine number of exists per space and their width
- Determine corridor width
- Determine door widths for stairs