1. Calculating occupancy load
Note:

Net & Gross are undefined terms.

Net: small areas (occupants area) – (building elements)

Gross: large areas fixed elements are used for area calculations – shafts or courtyards

### TABLE 1003.2.2.2

MAXIMUM FLOOR AREA ALLOWANCES PER OCCUPANT

<table>
<thead>
<tr>
<th>OCCUPANCY</th>
<th>FLOOR AREA IN SQ. FT. PER OCCUPANT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Agricultural building</td>
<td>300 gross</td>
</tr>
<tr>
<td>Aircraft hangars</td>
<td>500 gross</td>
</tr>
<tr>
<td>Airport terminal</td>
<td></td>
</tr>
<tr>
<td>Concourse</td>
<td>100 gross</td>
</tr>
<tr>
<td>Waiting areas</td>
<td>15 gross</td>
</tr>
<tr>
<td>Baggage claim</td>
<td>20 gross</td>
</tr>
<tr>
<td>Baggage handling</td>
<td>300 gross</td>
</tr>
<tr>
<td>Assembly</td>
<td></td>
</tr>
<tr>
<td>Gaming floors (keno, slots, etc.)</td>
<td>11 gross</td>
</tr>
<tr>
<td>Assembly with fixed seats</td>
<td></td>
</tr>
<tr>
<td>Assembly without fixed seats</td>
<td>7 net</td>
</tr>
<tr>
<td>Concentrated (chairs only – not fixed)</td>
<td></td>
</tr>
<tr>
<td>Auditoriums, churches and chapels, dance floors, lobbies</td>
<td>5 net</td>
</tr>
<tr>
<td>Unconcentrated tables and chairs</td>
<td>15 net</td>
</tr>
<tr>
<td>Conference rooms, dining rooms, drinking establishments, gymnasiums, lounges, and stages</td>
<td></td>
</tr>
<tr>
<td>Bowling centers, allow 5 persons for each lane including 15 feet of runway, and for each additional area</td>
<td>7 net</td>
</tr>
<tr>
<td>Business areas</td>
<td>100 gross</td>
</tr>
<tr>
<td>Courtrooms– other than fixed seating areas</td>
<td>40 net</td>
</tr>
<tr>
<td>Day care (for children or the aged)</td>
<td>25 net</td>
</tr>
<tr>
<td>Dormitories</td>
<td>50 gross</td>
</tr>
<tr>
<td>Educational</td>
<td></td>
</tr>
<tr>
<td>Classroom room</td>
<td>20 net</td>
</tr>
<tr>
<td>Shops and other vocational room areas</td>
<td>50 net</td>
</tr>
</tbody>
</table>

Exercise rooms 50 gross

H-5 Fabrication and manufacturing areas 200 gross

Industrial areas 100 gross

Institutional areas

Inpatient treatment areas 240 gross

Outpatient treatment areas 100 gross

Sleeping areas 120 gross

Kitchens, commercial 290 gross

Library

Reading rooms 50 net

Stack area 100 gross

Locker rooms 50 gross

Merchandise

Basement and grade floor areas 30 gross

Areas on other floors 60 gross

Storage, stock, shipping areas 300 gross

Residential 290 gross

Skating rinks, swimming pools

Rink and pool 50 gross

Decks 15 gross

Stages and platforms 15 net

Accessory storage areas, mechanical equipment room 300 gross

Warehouses 500 gross

For SI: 1 square foot = 0.0929 m²
Occupant load = 30’ x 40’ = 1200’
1200 / 100 = 12

Occupant load = 30’ x 40’ = 1200’
1200 / 5 = 240
Occupant load = Number of fixed seats

1003.2.2.9 Fixed seating. For areas having fixed seats and aisles, the occupant load shall be determined by the number of fixed seats installed therein.

For areas having fixed seating without dividing arms, the occupant load shall not be less than the number of seats based on one person for each 18 inches (457 mm) of seating length.

The occupant load of seating booths shall be based on one person for each 24 inches (610 mm) of booth seat length measured at the backrest of the seating booth.

Occupancy load = 15’ x 15’ = 225
Assembly no fixed seat = 7
225 / 7 = 32

Occupancy load = 15’ x 20’ = 300
Assembly Unconcentrated = 15
300 / 15 = 20

Total design occupancy load = 32 + 20 + 9 = 61
2. Calculating number of exits and exit access

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Per Table 1005.2.1</th>
<th>Per Section 1004.2.5</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Maximum Occupant Load w/ 1 Exit</td>
<td>Minimum No. of Occupants with 2 Exits</td>
</tr>
<tr>
<td>All</td>
<td>–</td>
<td>Up to 500</td>
</tr>
<tr>
<td>A, E</td>
<td>50</td>
<td>91-300</td>
</tr>
<tr>
<td>B, F</td>
<td>50</td>
<td>91-300</td>
</tr>
<tr>
<td>H-1, 2, 3</td>
<td>3</td>
<td>4-300</td>
</tr>
<tr>
<td>H-4, S</td>
<td>10</td>
<td>11-500</td>
</tr>
<tr>
<td>H-1</td>
<td>10</td>
<td>11-400</td>
</tr>
<tr>
<td>H-2</td>
<td>Per § 1004.2.3.2</td>
<td>1-900</td>
</tr>
<tr>
<td>H-3</td>
<td>10</td>
<td>11-900</td>
</tr>
<tr>
<td>H-4</td>
<td>10</td>
<td>11-400</td>
</tr>
<tr>
<td>M</td>
<td>50</td>
<td>51-500</td>
</tr>
<tr>
<td>R</td>
<td>10</td>
<td>11-500</td>
</tr>
<tr>
<td>S</td>
<td>30</td>
<td>31-500</td>
</tr>
<tr>
<td>U</td>
<td>50</td>
<td>51-500</td>
</tr>
</tbody>
</table>

* Tenant spaces with an occupant load of less than 30 may have a common path of egress travel up to 100 feet (30.48m).
**See illustration on page 167.
3. Calculating the location of exit access
Exits and Exit-Access Doorway Arrangement

Sec 1004.2.2 requires that all exits be obvious to the occupants and be arranged for ease of use in a rational manner.

When two exits are required, they are to be placed a distance apart equal to one-half the diagonal dimension of the space. The code does not specify where the dimensions are to be taken, but the most prudent measurement is to the centerline of the doorway.

In sprinklered buildings, the exits may be more closely spaced. Exit doors or exit-access doorways may be a minimum of one-third the diagonal dimension of the area served.

When three exits are required, two are to be placed as noted above and the third is to be arranged a reasonable distance apart so that if one becomes blocked, the other two will be available. Determination of the location of the third exit is thus open to interpretation by the building official.

EXAMPLE: Office, B Occupancy

Occupant Load Factor Per Table 10-A: 100 sf per occupant

Area: 60' x 80' = 4,800 sf

Number of Occupants: 4,800/100 = 48 occupants; greater than 30, therefore two exits are required

Separated by 1/2 the length of the diagonal distance (L)

L = 100' / L/2 = 50'

REFERENCE: SECTION 1004.2.4

FIGURE 7-19 MEASUREMENT OF DIAGONAL DISTANCES
PLAN "A"

Shown is a common corner configuration for a building's partial floor. In all these examples only a portion of a building is shown. The concept remains the same whether for a portion of a floor or the entire floor. The exits have to be separated by not less than the length of one-half the diagonal distance measured across the longest diagonal of the area served.

PLAN "B"

The shape of the area for which the separation of exits is to be determined can wrap around space outside of the area under consideration. The length of the longest diagonal may extend through the outside space. Thus, the measurement is unchanged by the configuration or the presence of outside space. The method remains the same, i.e., the longest diagonal is used.

REFERENCE: SECTION 1004.2.4

FIGURE 7-20 MEASUREMENT OF DIAGONAL DISTANCES WITHIN IRREGULARLY SHAPED SPACES
PLAN "C"

When the area served is irregular in shape with more than four sides, the longest diagonal must be used to determine the required separation of exits. Assuming $L_1 > L_2$, then 1/2 of the longest diagonal is $L_1/2$ which will set the minimum exit separation.

PLAN "D"

Room 1 exits into Room 2. In Room 1 the separation of exits uses as its longest diagonal that of the room being served. The Room 2 measurement of the separation of exits has to include Room 1 as it is part of the total area served.

For example, in a suite of offices the longest diagonal will be that which crosses the entire suite, not just that of the last area leading to a corridor. The space should be measured to include the entire area of the suite and the exits then arranged accordingly.

REFERENCE: SECTION 1004.2.4
Total design occupancy load = 61
Group B Occupancy.
Table 1005.2.1 = if more than 50 then 2 exits

4. Egress:
corridors & travel
EXCEPTIONS FOR CORRIDOR & SPRINKLERED BUILDINGS:
1 HR. FIRE RATED CORRIDORS

- There are exceptions to the exit layout for corridors and for sprinklered buildings.
- When a 1-hour fire-rated corridor is provided, the exit separation may be measured along a direct path of travel within the corridor. In this case, the exit enclosures accessed by the corridor must be a minimum of 30' (9144) apart in a direct line measurement. This provision addresses the required separation of exit enclosures, such as for stairs, in the core of office buildings.
- In such instances, the corridor connecting the tenant spaces to the exit enclosures allows placement of the exit enclosures closer together than half the diagonal distance of the floor without a corridor. However, the required separation of exit enclosures precludes the use of contiguous exit enclosures. The enclosure edges must be at least 30' (9144) apart.

...in other words
**Travel distance**

Most occupancies have an allowable travel distance of 200' without sprinkler and 250'-300' with sprinkler.

- An increase in exit-access travel distance up to 100' (30-40') is allowed for an exterior egress balcony forming the last portion of an exit access leading to an exit per § 1004.2.4.2.

- Unsprinklered buildings in Group H occupancies are not permitted.

**Legend**
- Solid line: Without sprinkler system
- Dashed line: With sprinkler system

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**Travel distance is to be measured in a straight line along the accessible path.** The path need not take into account movable objects or fixtures such as desks or tables. The path must include distances around permanent construction such as walls or fixed partitions.

Basic travel distances are 200 feet in non-sprinklered buildings and 250 feet in sprinklered buildings.

The 100 foot corridor increase is allowable even in unrated corridors construction in accordance with the exceptions to Section 1004.3.4.3

**REFERENCE: SECTION 1004.2.5**

**FIGURE 7-24 EXIT TRAVEL ILLUSTRATED**
**Common Path of Egress Travel**

NFPA 101 defines a common-path-of-egress travel as that portion of an exit access that, once opened, is required to traverse between two separate and distinct parts of egress travel if two exits are available. As noted earlier in the table on page 129, common-path-of-egress travel are limited.

<table>
<thead>
<tr>
<th>Occupancy</th>
<th>Without sprinkler system</th>
<th>With sprinkler system</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>10.1</td>
<td>10.0</td>
</tr>
<tr>
<td>1A, 2A</td>
<td>10.2</td>
<td>10.1</td>
</tr>
<tr>
<td>2, 3</td>
<td>10.3</td>
<td>10.5</td>
</tr>
<tr>
<td>B, E, S, U</td>
<td>10.4</td>
<td></td>
</tr>
<tr>
<td>I, II, III</td>
<td>10.5</td>
<td></td>
</tr>
</tbody>
</table>

- Common path of egress travel include paths that split and merge within the same access prior to the location where multiple paths lead to separate exits.

![Diagram showing egress travel paths](image)

- A common path of egress travel is any portion of an exit access offering an occupant no choice between separate and distinct paths of egress travel to two exits. It is measured from the most remote point in a room to that point where multiple paths to separate exits are available to occupants.

![Diagram showing required egress width](image)

- Required egress width

- Minimum egress doors: 36" x 60"
- Minimum 32"

- 36" door
- 32"-29" = 29"
- 29" recess

---

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5. Exit stairs & ramps
Smoke-proof Enclosures

The escape enclosure shall comply with the requirements of § 1006.10 for fireproof or fire-resistible materials or wooden, steel, or masonry construction as exterior barrier elements.

• The enclosure shall not be a public way or an exit passageway used as a public way.
• The entry to the enclosure shall not be a shared space or a common entrance or opening with a private access.
• The enclosure shall be separated from other enclosures or other areas by an approved fire barrier.
• The enclosure shall be protected from the elements.
• The enclosure shall be accessible from the exterior.
• The enclosure shall be provided with an approved exit discharge.

Exit Passageways

§ 1006.22 requires the enclosure for exit passageways to be separated from the adjacent building by at least 10' (3048) of space, and from other buildings on the same lot or site by at least 10' (3048) of space, and from the exterior by at least 10' (3048) of space.

Exit Discharge Location

§ 1006.22 requires that the exit discharge be located and separated from the adjacent building by at least 10' (3048) of space, and from other buildings on the same lot or site by at least 10' (3048) of space, and from the exterior by at least 10' (3048) of space.

Exit Discharge Capacity

§ 1006.21 requires that the exit discharge be not less than the required discharge capacity of the exit being served.

Exit Discharge Components

Exit discharge components are assumed to be outside the building envelope and sufficiently open to prevent the accumulation of smoke or toxic gases.
EXIT PASSAGEWAYS

An exit passageway is a horizontal means of exit travel that is protected from fire in the same manner as an enclosed exit stair. An exit passageway has several uses: it may be used to preserve the continuity of enclosure for an exit stair whose location shifts laterally as it descends through the building. It may be used to eliminate excessive travel distance to an exit. And it may be used as part of an exit discharge to connect an enclosed stair to an exterior door.

The widths of passages, doors, landings, and stairs used as exits must be determined in accordance with values given by the model codes, as shown on pages 283–287 and 289–293. For detailed design requirements concerning illumination, emergency illumination, marking, finish materials, and hardware of exits, consult the appropriate building code.