

Dimensioning of egress stairs

The responsibilities for fire evacuation are spread over many different levels, which make the matter quite complex. Depending on the specific situation, many different and sometimes conflicting conditions may apply. We will try to describe "the best practices" through all legal texts, standard and technical specifications. These specifications always have to be verified by the local authorities.

1. Number of individuals to be evacuated

- The dimensioning of the egress stair has to correspond to the number of individuals to be evacuated. Conventionally, this number is determined in function of the surface area of the compartment:
 - **1 person per 10 m²** for buildings that are not publicly accessible
 - **1 person per 3 m²** for buildings that are publicly accessible
 - Exception if the fixed furniture provides another occupation

2. Number of escape routes

- In general, one desires **at least two independent escape routes** (not intersecting routes)
- For compartments with 500 or more individuals:
 - 500 - 999 persons: 3 escape routes
 - 1000 - 1999 persons: 4 escape routes
 - 2000- 2999 persons: 5 escape routes
 - Etc.
- In theory, one single escape route can suffice in following cases:
 - Buildings ≤ 10 m and less than 100 persons
 - Buildings between 10m and 25m and less than 50 persons with an accessibility for fire ladders on the street side

Even in these cases, the fire department (and caution) often requires also a second escape route.

- In general, the fire department can always ask additional escape routes.

3. Location of the emergency stairs

- The steps are provided in the **opposite areas** of the compartment
- The **maximum distance from the escape route to the stair** is fixed. This amounts (excluding technical areas):

	Use of the building	
	Only during the day	Also at night
To the path that connects the two stairs	≤ 30 m	≤ 20 m
To the closest stair	≤ 45 m	≤ 30 m
To the second closest stair	≤ 80 m	≤ 60 m

- Maximum distance from a dead-end route is ≤ 15 m

4. Access

- Access to emergency stair through a **door or hallway**:

- Access door has to be $R_f \geq 1/2h$ for a building $\geq 25m$
- The doors cannot be locked in the direction of the evacuation
- **Counterbalanced flight** or paneling/enclosure of the lower flight is allowed
- The stairs of buildings $\geq 25m$ also must **provide access to the roof** (in case of a flat roof)

5. The useful width (UW)

- The useful width is determined by **the number of persons to be evacuated** from the compartment with the largest number of persons. The sum of the UW of all descending stairs has to be at least equal to the number of persons to be evacuated from the largest compartment **times 1.25cm** ($\Sigma UW = \text{number} \times 1.25cm$)
- The minimum UW is 80cm, which corresponds to an evacuation of 64 persons ($80/1.25$). Further, one foresees UWs in multiples of 60cm (the so called transit unit):
 - UW of 80cm for max 64 persons per compartment and per stair
 - UW of 120cm for 65 to 96 persons per compartment and per stair
 - UW of 180cm for 97 to 144 persons per compartment and per stair
 - Etc.
- In practice, however there are **often exceptions** to the above rule:
 - For medium and high buildings ($>10m$), a minimum UW of 60cm can suffice (to verify with the authorized fire department)
 - Depending on the available space and the number of persons to be evacuated, in practice often UWs of 90cm, 101cm and 110cm are used
 - In schools and day cares a UW of 120 is provided, even when the number of persons to be evacuated per compartment is less than 64
- Different stairs of the same compartment must have the same UW, plus or minus 60cm
- The value of 1.25cm per person applies with descending stairs. For **rising stairs 2cm per person** is provided and for flat escape routes 1cm per person

6. Configuration

- The stair must be at least 1m **away from the wall opening** (with $\leq R_f 1h$)
- At least one side must permit the free flow of air
- **Spiral stairs** are generally **discouraged** and for tall buildings ($\geq 25m$) even prohibited. A spiral stair must have a tread of at least 24cm on the walk line, located on min 0.4m and max 0.6m from the handrail or the spindle and on at least 0.35m from the outer edges of the steps

7. Inclinations

- Usually, an **inclination of 37°** is requested (or about 75%)
- For medium and high buildings ($> 10m$), **an inclination of 45°** can be accepted (to confirm with the authorized fire department) Sometimes it requires in such cases that the stair is used by persons with a good mobility. For a rising staircase an inclination of 45° is accepted
- Inclinations **greater than 45°** must be **avoided**

8. Steps

- The tread "a" and the riser "o" must meet the following formula:
 $600mm \leq a + 2o \leq 660mm$)
- Risers are not necessary
- A lower flight may have maximum 17 steps. If a greater height must be bridged, an intermediate landing must be provided

9. Guardrails

- Always provide **two guardrails per staircase**
 - Exception: one guardrail is sufficient for stairs with UW <120cm, low buildings (<10m) and when there is no risk of falling
- **Minimum height** for escape stairs: 1.0m on the landings and 0.9m on the stair flights, measured on the stair nose
- When used by **children** (schools, nurseries, ...):
 - The maximum gap between the vertical bars is $\leq 80\text{mm}$ ($\leq 70\text{mm}$ in Wallonia)
 - No horizontal elements to avoid that children use it as a step
 - Height of 1.1m instead of 1m
 - Second guardrail at the height of the children (below the main guardrail)

10. Materials

- Materials of **class A0** (Nonflammable material, such as aluminum, steel or concrete)
- No fire resistant requirements for outdoor stairs
- Stable material, without aging or gradual disappearance

11. Stability requirements

- The stair can carry a **uniformly distributed load of 102 lb/ft² or 500 Kg/m²** on the flights (on the surface projected on the horizontal plane) and landings. Also a point load of 200Kg applied anywhere on the steps or the landing deck can be supported by the stair.
- The guardrails will withstand a horizontally applied uniform load of 100 Kg/m without permanent deformation.