Basic Calculation for Hall / Room Safe Occupancy Figures

Two calculations, in conjunction with the type of event being held, need to be used to establish the number of persons the hall will accommodate and evacuate safely:

(1) Exit Capacity, which is the number and width sizes of exit doors and the time it would take for persons to pass through them.

(2) Occupant Capacity, which is the capacity of the hall in relation to its size and type of event being held.

Both calculations need to be undertaken with the **lower number** calculated used as the maximum occupancy figure.

Designated fire exits should be as widely spaced as possible so as to allow occupants to turn their backs on the fire and to proceed in the opposite direction to a place of safety. Exits from the premise should lead via distinct and separate routes; a number of exits that discharge into a common area cannot be regarded as alternative to each other. In all but the smallest premises a minimum of two well-spaced exits are normally required.

Fire exit separation is generally defined by the 45-degree rule. If from any point in a room, two exits cannot be included within a 45-degree angle, then they may be viewed as being well separated. If from any point in a room, two exits can be included within a 45-degree angle, then they are not well separated. In other words the two exits must be far enough apart so that a fire could not make them both unusable.

The example calculations set out below are relevant to premises of a good standard of construction, with sound foundations supporting walls of block, brick, stone, or modern insulated treated wood construction, supporting a substantial roof of traditional construction.

The internal walls, floors and ceilings are to be sound, and covered by non-combustible surface coverings. Doors should be substantial and well fitting. The services and equipment should be to the required certificated standards, being tested and maintained.

Should the premises not be to these standards it may be necessary to assess that a fire could spread through the premises more quickly, therefore the time given for the evacuation of persons could be reduced. A reduction in the time to evacuate a premises or room will effect the overall occupancy limit provided.

With this in mind a premises with less than an adequate standard of construction should have the occupancies restricted by as much as 20% from the calculations shown below.

Safe Occupancy Rules

In order for the capacities to be correctly calculated there are a number of rules that must be followed:

Rule 1
Any calculation should allow for a complete evacuation of the hall directly to the outside within 2½ minutes.

Rule 2
All exit doors must allow at least 40 people to exit within 1 minute.

Rule 3
The minimum width of an exit door should be no less than 0.750m. Door widths less than 0.750m should not be included in any calculation.

Rule 4
Exit doors that do not lead directly to the outside must not be used in the calculation except the main entrance door, which can be used.

Rule 5
When calculating the exit capacity it must be assumed that during a fire situation the fire will block one door. As there is no way of determining which door will be affected, in the interest of public safety it must assumed that this will be the largest door, therefore you have to exclude the largest exit width (door) when making the calculation.

Rule 6
Where there is only 1 exit/access point, you are limited to a maximum of 60 people, irrespective of floor size, exit width or hall use. This figure is reduced if the occupancy capacity is lower than 60.

Rule 7
Always round part figures down e.g. 385.3 would be rounded down to 385.

Rule 8
Both calculations must be undertaken with the **lower number** calculated used as the maximum occupancy figure.

Rule 9
Premises with less than an adequate standard of construction should have the occupancies restricted by up to 20%.

Rule 10
Revolving or sliding doors should not be considered in the calculation of available exit widths

Rule 11
Exits must be well separated. In this context ‘well separated’ is taken to mean that two exits are far enough apart so that a fire could not make them unusable. However it should be noted that the 45-degree rule would always apply with respect to separation of fire exits.

Rule 12
An external exit door in a corridor can be used providing, that it is a final exit door, leads to a place of safety and is opposite the hall door, this door should be the one used in the calculation not the hall door.

Rule 13
Fire exits must never be locked. All exit doors should be easily opened from within, must never require a key to open and open in the direction of escape.

Rule 14
Final exits should lead to a place of ultimate safety i.e. not an enclosed yard or garden.

Rule 15
Exit doors that may be utilised by wheelchair users require a minimum width of not less than 900mm

Rule 16
Travel distances to a final exit should not exceed 18metres in one direction or 45metres where an alternative is provided.

Rule 17
An Evacuation route from a hall through a kitchen area cannot be considered, as these areas are not a ‘protected escape route’ and can be extremely hazardous.

Rule 18
In a hall with a stage, whether fixed or portable, the stage should be calculated separately.

Calculating the Exit Capacity

To establish the number of persons the hall will accommodate in relation to the number of exit doors (i.e. the exit capacity) the following steps must be carried out:

- Measure and add together the widths of all the exit doors (in metres):
- Divide by 0.750m (minimum single door width):
- Multiply by 40 (maximum number of persons exiting per minute): and;
- Multiply by 2.5 (minutes to evacuate).

Example 1

The hall has 5 final exit doors, each door width measures:
(Remember! Any door less than 0.750m wide should not be included in the calculation)

Exit Door 1 1.0m
Exit Door 2 0.65m
Exit Door 3 0.75m
Exit Door 4 1.0m
Exit Door 5 <u>1.14m</u>

Exit Door 2 is less than 0.750m wide and must be excluded under Rule 3 above.
Exit Door 5 is the largest exit door and must be excluded under Rule 5 above.

This leaves:

Exit Door 1 1.0m
Exit Door 3 0.75m
Exit Door 4 <u>1.0m</u>

2.75m ÷ **0.750** = 3.6 x **40** = 144 x **2.5** = 360 persons

Total exit capacity = 360 persons

This example does not take into consideration the size of the hall and therefore the exit capacity could exceed the occupant capacity of the hall. To ensure the occupancy is not being exceeded an occupant capacity calculation is required.

Calculating the Occupant capacity

This is related to hall size and density of people within the available floor space)

When the hall is in use an occupant load factor value (*m^2* per person) is introduced, in relation to the floor area being used.

Various events, such as discos, conferences, dining facilities etc. will have different load factor values. See table below for occupant load factors.

The calculation, therefore, is the size of the hall (in square metres) divided by the occupant load factor.

Example 2

The same hall, as in example 1, is 16m long by 9m wide and a school intends holding a disco, without any tables, chairs etc.

16m x 9m = 144m^2. Divide by the occupant load factor for discos, which is 0.5.

144 ÷ 0.5 = 288

Total occupant capacity = 288 persons

The occupant capacity of 288 shown in example 2 is less than the exit capacity of 360 shown in example 1; therefore, the lower figure must be used.

So in this case, the maximum number of persons allowed for the school disco would be 288, the occupant capacity.

Occupant Load factor table

Use of Hall / Room	m^2 per person
Area for standing	0.3
Amusement arcade, assembly hall, bingo hall, club concourse, crush hall, dance hall, pop concert, queuing area etc	0.5
Bar	0.3 – 0.5 *
Bowling alley, billiard room, games & sporting activities	9.3
Conferences, dining room, restaurant etc	1.0 – 1.5 *
Studio (radio, film, television, recording)	1.4
Common room e.g. lounge, reading room, staff room, waiting room	1.0

* **Depending upon amount of seating and tables to be provided**

Example 3

In this example the hall for the disco increases in size to 20m x 10m with fire exit doors the same as in example 1.

20m x 10m = 200m². Divide by the occupant load factor for discos, which is 0.5.

200 ÷ 0.5 = 400

Total occupant capacity = 400 persons

The occupant capacity of 400 shown in example 3 is greater than the exit capacity of 360 shown in example 1; therefore, the lower figure must be used.

So in this case, the maximum number of persons allowed for the school disco would be 360, the exit capacity.

Example 4

The same Hall in example 3 is now to be used for a ‘Christmas dinner’, which will require bench style tables and chairs, gangways between etc.

20m x 10m = 200m². Divide by the occupant load factor for dining rooms with high levels of seating, which is 1.5.

200 ÷ 1.5 = 133.3

This total must be rounded down under Rule 7

Therefore the total occupant capacity = 133 persons

The occupant capacity of 133 shown in example 3 is lower than the exit capacity of 360 shown in example 1; therefore, the lower figure must be used.

So in this case, the maximum number of persons allowed for the Christmas dinner would be 133, the occupant capacity.

Aisle and Gangways

Depending on the location of the emergency exits, seating may need to be reduced to ensure aisles and gangways widths are maintained. Aisle and gangways should be at least 1.05m wide. Where tables and chairs are used there should be at least 1.5m between the backs of chairs of opposing tables.

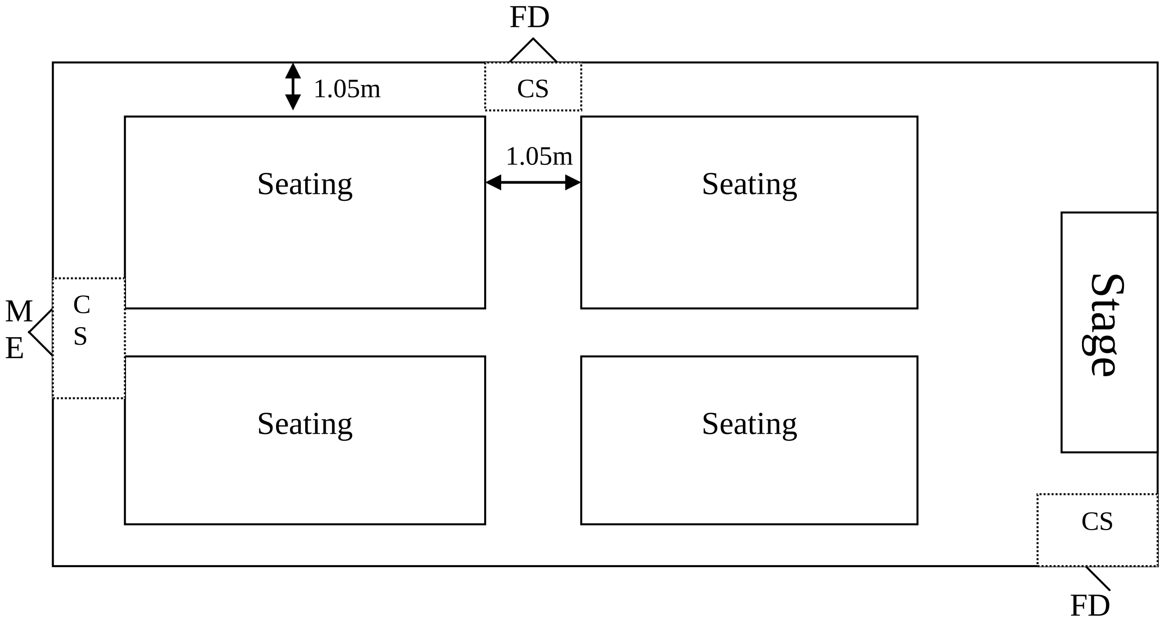
The layout of any tables, chairs equipment, etc, must be such to prevent exit doors from being blocked or obstructed. This is usually achieved by having a minimum clear space on either side and in front of the door of not less than the aisle width.

Rows of Seats

Rows of seats should consist of no less than 7 seats and no more than 17 with an aisle at each end. Rows with an aisle only at one end should not exceed 4 seats. Ideally, all seats should be fixed to the floor, where this is not possible they should be tied or linked together. This can be achieved using plastic cable ties around the legs of adjacent chairs or wooden battens fixed to the back of the chairs. Chairs at tables do not require fixing.

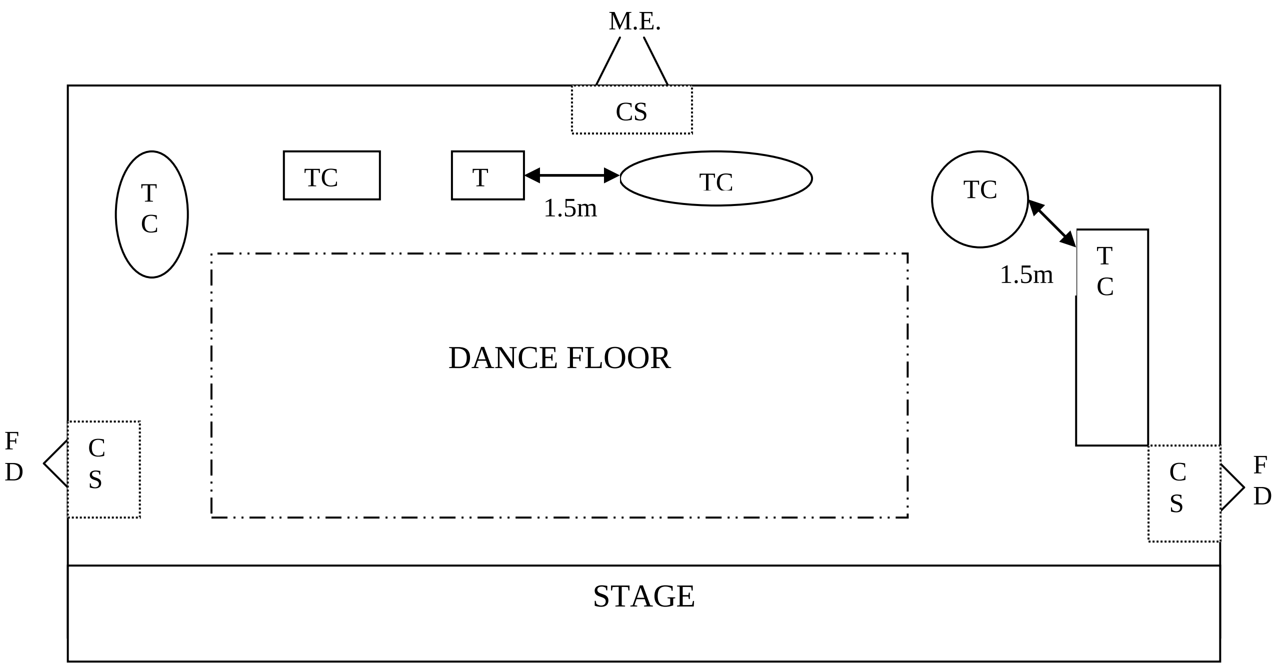
Where rows of seats are not fixed to the floor nor do they have arms, there should be a minimum of 450mm between the back of the seat and the front of the one immediately behind it.

All Seated Audience



Legend: FD = Fire Door, ME = Main Entrance, CS = Clear Space

School Disco with Tables & Chairs and Dance Floor



Legend:
FD = Fire Door, ME = Main Entrance, T or TC = Tables & Chairs, CS = Clear Space