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DOORS AND MEANS OF ESCAPE

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Introduction

Doors of suitable construction may be said to be the most important elements in a building for the safety of life, should fire occur in a building. Even if the doors are of adequate fire resistance and strategically sited they are of no value during the escape period if they are left open.

Codes of Practice for fire precautions in buildings, either published or in preparation for means of escape, depend upon the fire doors as an integral part of the escape plan. Without such doors escape from fire from any building other than a small single storey building becomes impracticable.

The author has from time to time taken the opportunity to visit a number of recently completed blocks of flats, offices and large shops with the object of endeavouring to obtain some idea as to whether or not doors, when fitted for fire safety purposes, are actually shut and capable of performing their design function.

Doors for the protection of openings in walls provided for the vertical sub-division of a building are outside the scope of this paper. Such doors have little or no function in relation to normal means of escape.

Design functions of doors

Doors have a number of functions and may be divided into a series of broad categories:-

(a) Amenity.

(b) Security.

(c) Fire safety.

A door may perform all of these functions at one and the same time or it may be used for one or other purpose only.

(a) Doors for amenity purposes may be said to be those which keep out the weather, reduce draughts provide sound insulation and keep the occupants of a room or space in a reasonable standard of comfort. Many of these doors have no direct function in relation to fire, being in the main, external doors or doors of individual rooms. Indirectly they may, if closed, tend to delay the development of a fire.

(b) Doors used for security purposes may be external doors or doors to areas which are used for storage, plant and services and rarely used for personnel. The exception to this is, of course, the entrance doors to flats and maisonettes.

(c) Doors used for fire safety purposes may be further sub-divided into

(i) Doors to retard the passage of fire and required to have a degree of fire resistance, i.e. staircase enclosure doors.

These doors may have an amenity function but their primary purpose is the reduction of fire spread and they form an integral part of the escape plan for the building. They are usually described as fire-deck doors.

(ii) Doors performing the function of retarding the spread of smoke and hot gases at the initial stages of a fire.

This second group of fire doors whilst being used for amenity and possibly security, may also be sited strategically and used solely to retard the spread of fire.

Potential use of fire doors

The foregoing breakdown of door functions is introduced for the purpose of determining the incident risk that the doors, when fitted, are or are not closed.

To obtain a satisfactory survey of the use or otherwise of fire doors, it would be necessary to visit a building twice, in the winter when climatic conditions are such that for comfort reasons amenity doors are closed, and in the summer when the maximum amount of cross ventilation is desirable. This is broadly true of many occupancies, but in relation to modern office blocks and large shops where a full plenum ventilation system may be in operation, the difference between summer and winter conditions may not be so critical. It is also desirable that after a fire a check should be made to see which doors were in fact closed and how they performed these functions.

The present survey has been carried out in the early spring when conditions were much more favourable to the closing of doors for comfort reasons. In the buildings visited, fire doors were more often than not found to be in the open position. The reason for this is not hard to find, as any door which has not the function of amenity or security must, from the design aspect, be an obstruction to the normal function of the building during working hours.

Method of closure of fire doors

The fire door, as has been stated, must be maintained in the closed position at all times if it is to perform its design function. In order to achieve this, its closure cannot be left to the whim of the individual, but must be provided by some positive mechanical closing device. The simpler this can be done the better; the most obvious device is the rising butt. Such a method, however, whilst having the merit of simplicity is unfortunately not under all positions of door swing, a satisfactory device.

The method of closure usually adopted is mechanical and of three main types:-

(a) Single or double action floor springs.

(b) Overhead door closures.

(c) Spring hinges.

Whatever the function of the door may be the methods listed all suffer from similar disadvantage, e.g. mechanical failure, faulty adjustment and misuse in varying degrees.

Floor springs and overhead door closures must be set in such a manner that they can overcome the locking device and shut against the door rebate. This tends to produce unsatisfactory conditions for general use and is one of the contributing factors in causing such doors to be maintained in the open position.

Spring hinges, on the other hand, produce little resistance to opening, but close more positively in the last few inches. The disadvantage of this is the noise factor as the door comes into contact with the rebate. This results in a tendency for persons to pad the edge of the door or frame with a resilient material, often foamed plastic. This reduces the noise factor but tends to nullify the efficiency of the door as a barrier to the passage of smoke and hot gases since the door fails to close tightly against its rebate.

Design of fire door

Doors for the sub-division of the building which may be termed fire resisting doors, are outside the scope of this paper. The fire door forming an integral part of the escape plan requires careful consideration bearing in mind its function to retard the passage of smoke and hot gases. It is usually considered that these doors should provide a period of fire resistance, the minimum recognized at the present time being $\frac{1}{2}$ hour.

It is doubtful whether in fact such a period of fire resistance is in many cases necessary provided they are reasonably smoke tight, bearing in mind the generally accepted period of evacuation of $2\frac{1}{2}$ minutes from many buildings. In buildings of large floor area, or in very tall buildings, where complete evacuation is not generally envisaged and fire fighting becomes a complex problem, fire resistance may well become critical.

Before discussing the deficiencies of door design as a fire stop, it is necessary to consider where fire resistance is required in doors other than those in division walls.

Fire resistance requirements

Fire resistance requirements for doors should be considered under the following heads:-

(a) Staircase enclosures.

(i) Single protection.

(ii) Double protection, i.e. lobby approach.

(b) Corridor approach.

(c) Lift enclosures

(d) Flat doors.

(e) Areas of high fire hazard.

(a)

(i) Staircases serve the purpose for means of escape and also for access for fire-fighting. It is necessary, therefore, that the enclosing walls require a standard of fire resistance equal to that of the floors through which they pass. In many buildings over 50 feet in height the fire resistance requirements are 1 hour or more. Logically to prevent fire spread, from floor to floor, the doors should have a comparable standard of fire resistance. From the standpoint of escape it is usually accepted, in the majority of buildings, that $\frac{1}{2}$ hours fire resistance is adequate. Reference the Fire Grading of Buildings No. 29, part III.

(ii) In high buildings and in those of large cubical extent where compartmenting into fire-tight cells is envisaged, the doors to a staircase enclosure become increasingly important. The use of 1 or 2 hour doors in a staircase enclosure is not generally practicable by virtue of their construction.

It is, therefore, necessary to consider the use of two doors, at each floor level. Such an arrangement of doors, if provided in a ventilated lobby, facilitates fire fighting by forming a space from which fire fighting may be carried out in comparative safety. Where the fire resistance standards for the building, as a whole, is 2 hours, the use of automatic fire shutter doors, in addition to normal access doors, must be considered.

(b)

An alternative means of escape is an ideal to be aimed at in any building and in theory it should be possible for a person to escape from any part of a floor of a building to a smoke-free area by turning his back on the fire. To achieve this it is necessary to cut off by means of doors, staircases or other means of exit to the open air, one from another. Such doors have, therefore, a limited function of providing on any one floor a smoke-free atmosphere during the time that evacuation is envisaged. Assuming this premise to be right, a less onerous requirement than a minimum fire resistance of $\frac{1}{2}$ hour would seem to be a practical possibility.

(c)

Lift enclosures, or for that matter, any vertical shaft, are a potential source of vertical fire spread and must be protected in a similar manner to that of the staircase enclosure. The problem of providing adequate fire resistance in lift doors is, by virtue of the usual method of closure, less difficult to achieve than a door which must be manually operated.

(d)

Doors to flats, maisonettes and individual occupancies within a single building, all constitute a separate and independent risk. It is recognized that one individual must not jeopardise the saftey of his neighbour, either from a fire in one building to another or from one section of a building to another. Fire resistance of any separation must, therefore, be related to that of the occupancy at risk. In the case of flats for a fire to spread via the door from one flat to another, the fire must pass through two doors across the common circulation space. As in staircase enclosures the $\frac{1}{2}$ hour door is recognized as being adequate for means of escape, but such doors are deficient as a barrier to fire.

(e)

Doors to high hazard areas, such as boiler houses, transformer chambers and storage areas, to mention but a few, would appear to require doors having a standard of fire resistance not less than the walls enclosing that area. This is logical if it is required that the doors in division walls should have the same standard as that required for the walls. In areas where the fire risk is high and the fire load possibly substantial, the fire resistance necessary to enclose a fire, should it occur, may be two hours or more. Doors in such walls, if required to have the same standard as the wall, may become heavy and unweildy, for daily use. It may, therefore, in certain circumstances be necessary to fit a fire-check door in addition to the door required for fire resistance.

Construction of fire doors

The foregoing portion of the note has indicated the types of doors necessary in buildings, their position, functions and the desirable standards of fire resistance. It is now necessary to consider the types of doors which will in fact provide the necessary protection for fire resistance.

British Standard 459 : Part III - 1951, "Fire-Check Flush Doors and Frames" with amendments covers two types of doors, one with ½ hour and the other with 1 hour's fire resistance, together with wood and metal frames but these are only examples of ways in which a door of the desired standard of fire resistance may be made. The Standard covers materials and construction of both doors and frames. The Standard is merely a deemed to satisfy specification and is of little practical value the method of construction being designed at a time when materials were in short supply which is not valid today.

A solid timber door can, in itself, provide a standard of fire resistance of ½ hour and by the addition of non-combustible sheet materials, either as a facing or within the body of the door itself the fire resistance can be increased to 1 hour or more. Failure of any but the thinnest door is generally first manifest by the appearance of flame at the top edge of the door. It is necessary, therefore, to ensure that the fit of the door in its frame is adequate and that the rebates are of sufficient depth. It is possible by the use of fire retardant treatments, at the rebate, to reduce the tendency for flaming to occur at the edges.

Many doors for reasons of safety and amenity require to be glazed. Substantial areas of glazing even if of wired glass tend to reduce or nullify the efficiency of the door as a fire barrier. British Standards code of Practice 152 : 1962 "Glazing and Fixing of Glass for Buildings" accepts 2 sq. ft of wired glass in a ½ hour door as the maximum permissible.

The doors described above are in all cases single leaf doors closing against a substantial rebate. In order to provide adequate width for means of escape purposes and for amenity, it is necessary to admit the use of double doors. The problem of ensuring that the doors close against a rebate necessitates a severe restriction on movement through the doors and at one and the same time presents a complex problem in the synchronization of a closing mechanism to ensure a smooth sequence of closing and to prevent jamming. It is, therefore, almost inevitable that where double doors are fitted a double swing door without rebates must be accepted.

Whilst the value of a double swing door as a barrier to the passage of smoke and hot gases is at present unknown, certain basic constructional requirements are obviously necessary if the door is to have any value at all. The majority of double swing doors have a very substantial gap between the meeting stiles of the door. Some gap must be provided to any door the "penny fit" being the traditional accepted standard of crackage around its perimeter. The fact that it is necessary to "round off" the meeting stiles with double doors aggravates the gap condition.

A more satisfactory design from the fire safety point of view may be achieved by providing a rebate at the sides and head of the frame, the door opening in the direction of escape.

The single leaf timber glazed door used for fire purposes, is usually deficient in its fit and method of closure. The frames often have planted ½ in stops in place of the normally accepted standard that the rebate should be not less than 1 in deep. It is open to doubt whether the rebate is significant when the majority of doors, accepted as being suitable, have such extensive areas of glazing. Bearing in mind the accepted B.S. code of practice recommendation of 2 sq. ft of glazing in the door, the majority of them must be considered defective in fire safety provisions. Many of

these fully or semi-glazed doors are required to perform the important function of protecting the staircase enclosure where their efficiency as a fire barrier may be of first importance.

Conclusion

In very general terms it may be said that the function of a door for the reduction of the spread of fire is not normally recognized by the general public. It is, therefore, desirable that wherever possible a door should be designed to perform a multiple function. If this is done the chances of it being closed will be greater than where it performs no other function than to form a barrier to the unrestricted spread of smoke and fire.

It is the opinion of the author that it is always preferable to provide a method of retaining any door which has a fire function in the open position by means of a quick release device, rather than to permit the use of improvised devices which will inevitably make their appearance sooner or later. The fact that doors which are designed and marked to be kept closed at all times are not, in many cases, so used and maintained, is, however, no argument for not adopting adequate cut-offs wherever the design of the building calls for such doors.

This report is intended only as a preliminary study of the subject. Attempts are now being made to obtain further information on the use of fire doors and on their effectiveness in fire.

References

British Standard 459 : Part 3 : 1951
Fire-check flush doors and frames

British Standard Code of Practice C.P. 152 : 1960
Glazing and fixing of glass for buildings

British Standard Code of Practice C.P. 151 : Part 1 : 1957.
Doors and windows including frames and linings. Part i. Wooden Doors.