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Fire detection in stairways

Protection of people, business continuity and reputation

Stairways play an important role as the primary escape routes in hotel buildings, as elevators must not be used in case of fire.

As a general rule, a single smoke detector should not monitor more than three floors in a stairway and one detector is required on the top floor ceiling. In addition, a number of manual call points must be placed throughout the escape route.

In the event of a fire, alerting and evacuating all parties at risk in good time has the highest priority. A fire protection system is needed that guarantees rapid, reliable fire detection and activates both the alarm devices and the relevant fire control installations.

Early warning of a fire is essential; not only for protecting people, but also for ensuring business continuity and the reputation of the hotel. However, unnecessary evacuation activities due to false alarms must be avoided.

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Introduction

As elevators must not be used in the event of a fire, the evacuation of people from a hotel takes place via the stairways and exterior fire escapes.

Stairways must enable people to escape safely to the outside or to unaffected neighboring buildings. They also play a central role in rescuing people and in firefighting. The legislative authority, therefore, has put strict regulations into place for these areas. These mainly concern structural measures, however organizational and technical fire protection measures must also be addressed.

Highlights*

- Stairways are a vital element of a safe evacuation
- They are required by law to last for the entire evacuation procedure
- One out of every 12 hotels reports a structural fire per year

* NFPA, U.S. Hotel and Motels Structure Fires; U.S. Fire Administration's (USFA's), Hotel and Motel Fires

Number

- The number of stairways and fire escapes depends on the height of the building, the floor area of each story and the maximum number of people in the building.
- If the building is taller than 24 m, if the story area is greater than 600 m² or if more than 100 people can be present in the hotel, then (in addition to the normal stairway) an additional fire-protected stairway or an exterior fire escape is required.
- If a stairway leads to more than one basement floor, it must be separated from the stairway serving the upper floors.

Availability

- Stairways which serve as an escape route must be designated as such and they must be accessible at all times and without restrictions.
- Stairways must be cleaned regularly and kept free from any hindrances and flammable material.

Implementation

- Ideally the stairways should lead directly to the outside.
- They must be separated from the rest of the building in a fire-proof construction with self-closing fire doors.
- Stairs, walls and ceiling must be constructed using flame-retardant materials.
- Electrical installations must be built into fire-resistant enclosures.
- Lighting must be connected to an emergency power supply.
- Interior stairways must be equipped with a smoke extraction system or a smoke outlet.
- Exterior stairways above a certain height (e.g. 13 m), which have windows that can be opened, must be equipped with a smoke extraction system or a smoke outlet.

Fire detection

- Stairways must be equipped with manual call points and automatic fire detectors.

In a stairway which serves as an escape and rescue route, the fire risk must be kept to a minimum. The fire load must therefore be minimized and ignition sources must be enclosed in fire-resistant cabinets.

In order to guarantee a safe escape route, smoke must be prevented from entering into the stairway from outside. Modern hotels are therefore equipped with a ventilation system which prevents smoke from entering the stairway or which extracts the smoke from the stairway.

Even if the fire risk is very low and smoke entering from other areas can be practically excluded, manual and automatic fire detectors must be installed in the stairway. The following sections deal with issues which must be considered when designing fire detection in stairways.

Basic conditions

Objective

- Timely alerting and evacuating of all people at risk.
- Providing information concerning the usability of the stairway in case of fire (e.g. smoke-free or smoke-filled).

Typical fire hazards

- An overload or short circuit of electrical equipment.
- Easily flammable materials, which should not be in the stairway.

Typical development of a fire

If no flammable materials are stored in a stairway, a fire can only start because of an overload or short circuit of an electrical installation. Such a fire starts with a smoldering phase and progressively generates increasing quantities of visible smoke. If such an incipient fire is detected at an early stage, it can be dealt with by simple means (e.g. by disconnecting the power supply).

If easily flammable materials are stored in the stairway, despite this being prohibited, they can catch fire from an ignition source (e.g. electrical equipment or cigarette ends). Such a fire generates increasing quantities visible smoke and can quickly develop into an open fire. If detected early, this kind of fire can be extinguished with water or a fire extinguisher.

Critical points

- Early fire detection in the stairway.
- In case of fire, being constantly aware of the smoke situation within the stairways. (Which stairways can people be directed to use, during an evacuation of the building.)

Solution

A safe escape via a stairway is only possible if there is no excessive smoke concentration within that stairway. A fire in a stairway must, therefore, be detected early and smoke must be prevented from entering the stairway.

If a fire starts directly in the stairway or if a lot of smoke from another area comes into the stairway, then this must be detected early. In this application fire detectors must be used which reliably detect all types of smoke, but also respond robustly to deceptive phenomena such as cigarette smoke or dust.

In the electrical enclosures and the installation ducts, sensitive smoke detectors are used which detect a smoldering fire at a very early stage.

If the smoke spreads throughout a large area in the stairway, people in the hotel will be warned accordingly. This is to prevent people from trying to escape via a stairway where there is already a high concentration of smoke.

In addition to the automatic fire detectors, manual call points are also installed in a stairway so that a fire alarm can be triggered manually.

The number and position of the automatic fire detectors are chosen based on the existing installations and the height of the stairway. The following applies as a guideline:

- A smoke detector must be positioned in every electrical enclosure.
- Large installation ducts must be equipped with smoke detectors.
- A fire detector must be installed in the stairway on the top floor ceiling.
- If individual stories are separated by a door, a fire detector must be installed on the ceiling before every door.
- In high stairways, a fire detector must be installed on every third story.

Details	Comments/Notes
Electrical installations: Smoke detector	Early detection of smoke-generating fires <ul style="list-style-type: none"> • Parameter set with sensitive behavior
Stairway: ASA neural fire detection	Early detection of all types of fire and robust behavior toward deceptive phenomena <ul style="list-style-type: none"> • Parameter set with a high sensitivity
Manual call points:	Manual call points <ul style="list-style-type: none"> • Single or double action (depending on local regulations)
Positioning of the detectors: (see Figure 1)	Automatic fire detectors <ul style="list-style-type: none"> • In the middle of the ceiling Manual call points <ul style="list-style-type: none"> • Next to the escape door which leads outside or to a safe area • At a height of 1.4 m ± 0.2 m.
Related measures	<ul style="list-style-type: none"> • A manual call point must be installed next to every escape door which leads to the stairway, so that a fire alarm can be manually triggered outside the stairway in the event of a fire. • To prevent people being directed into a stairway where there is already an excessive concentration of smoke, the data from the individual fire detectors must be evaluated. If two detectors in the stairway report a fire alarm, then this indicates that a large part of the stairway is already filled with smoke and an alternative escape route should be used.

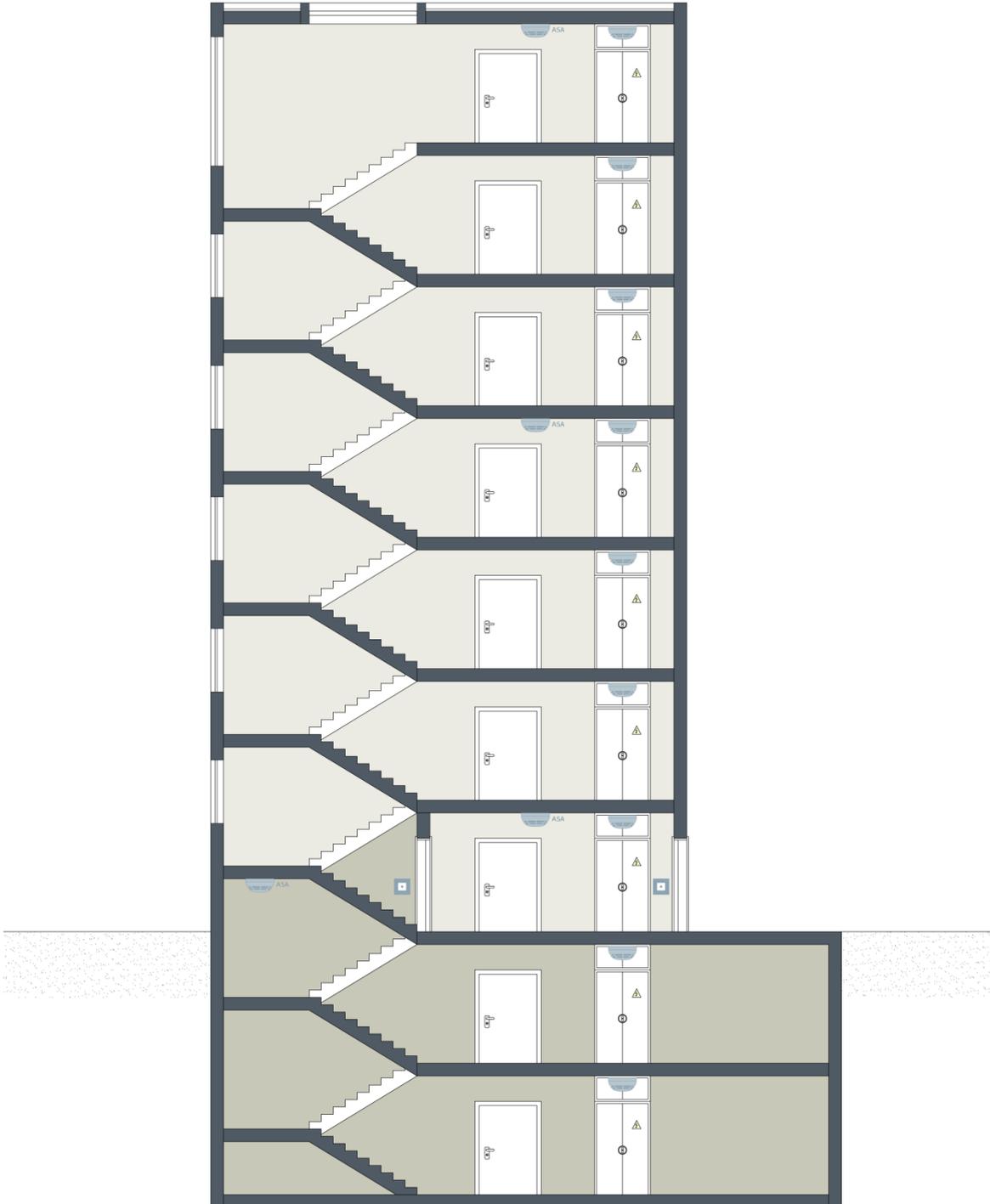


Figure 1 Positioning of fire detectors

- 
ASA neural fire detector
- 
Smoke detector
- 
Manual call point

Practical experience

During a fire in a stairway, the smoke generated will spread to the upper stories because of the chimney effect. However, smoke can also get into the stairway from outside via an open door or another opening. As soon as there is a dangerous concentration of smoke in the stairway, it can no longer be used as an escape and rescue route.

- Fire in a stairway** If fires in stairways are analyzed, the cause of the fire is often flammable material and objects which should not be in the stairway.
- For example, greasy cleaning cloths left in a cardboard box can start a fire through a chemical reaction between the unsaturated fatty acids and the oxygen in the atmosphere. Fires can also be caused by faulty electrical installations. Such fires, however, can only develop into a real danger if easily flammable materials are stored in the stairway.
- If a fire starts in an electrical cabinet, it can be detected early with a sensitive smoke detector and extinguished, long before a dangerous concentration of smoke can develop in the stairway.
- Smoke entering the stairway** If the building requirements have been complied with (such as the sealing of cable feedthroughs and the installation of suitable fire doors), the possibility of dangerous levels of smoke getting into the stairway can be practically be excluded, provided that all doors to the stairway are closed.
- Large stairways in hotels should be equipped with a ventilation and smoke extraction system, so that a dangerous smoke concentration cannot occur in the stairway even if the doors are open.
- Conclusion** If the stairway is constructed according to the building regulations, if the organizational requirements are complied with and if a reliable fire detection system is installed, the objective "permanent availability of the stairway" can be achieved.

ASATEchnology – for intelligent, reliable fire detection with genuine alarm guarantee

ASATEchnology is a unique technology from Siemens that converts signals into mathematical data which are compared with programmed values in real time using intelligent algorithms. The special signal analysis process is very reliable in preventing false alarms caused by on-site deceptive phenomena, such as steam, tobacco smoke or exhaust emissions. Find out more about [Sinteso](#) or [Cerberus PRO](#) fire detectors with ASATEchnology.

Everything you need for comprehensive fire protection

Incorporated in a concept tailored to your customers' requirements, Siemens and its Solution Partner network provide:

- Early and reliable fire detection solutions, offering an unrivalled financially backed "Genuine Alarm Guarantee"
- Fully forwards and backwards compatible systems, to ensure any system provided is equipped to integrate the latest technology Siemens has to offer
- Clear and fast alerting and evacuation processes

All these aspects are at the core of comprehensive fire protection. Only when these are fulfilled can you be assured that people in your buildings are safe and assets and business operations are protected.

In order to offer your customers peace of mind, Siemens and its Solution Partner network have a variety of service and solution offerings that can be tailored to an individual client's needs. To find out more about this, please visit our Web site at www.siemens.com/firesafety-markets or contact your local Siemens organization through [the online contact form](#).

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With Siemens, you can offer your customers comprehensive fire safety for any application and environmental condition. Your customers will appreciate this as it enables them to reliably protect people, assets and business processes from fire.

Backed by more than 160 years of experience in the field, our offerings for early detection, reliable alarming, orderly evacuation and safe extinguishing are based on innovative and unique technologies. They provide you with convincing arguments like maximized life safety or environmental friendliness, and open the door to strong, long-term customer relationships. And with Siemens, you gain a reliable partner at your side and benefit from our smart tools, in-depth trainings and personal support – wherever you are, wherever you go. For more information please visit www.siemens.com/advantage-engineering.

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