Fire protection 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 installed along all escape routes.

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 can be counterproductive and must be avoided.
Content

Introduction ........................................................................................................................................... 3
Basic conditions ..................................................................................................................................... 4
Practical experience ............................................................................................................................... 7
ASAtechnology ....................................................................................................................................... 7
Everything you need for comprehensive fire protection ................................................................. 7
Share the experience .............................................................................................................................. 7
Introduction

**Highlights**
- Stairways are a vital element of a safe evacuation.
- They must be kept clear at all times and should be kept smoke-free during an evacuation procedure.
- At least one out of every 12 hotels reports a structural fire each year.

As elevators must not be used in the event of a fire, the evacuation of people from a hotel must take 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.

Local building codes impose strict regulations on stairways. These are mainly concerned with structural measures; however, organizational and technical fire protection measures must also be addressed.

### Number of stairways
- 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.

### Stairway 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 out of the building.
- They must be separated from the rest of the building in a fire-proof construction with self-closing fire doors.
- Stairs, walls and ceilings 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 smoke vent.
- 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 smoke vent.

### Fire detection

Stairways must be equipped with automatic fire detectors which ensure early and reliable detection of an incipient fire.

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 ensure 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 (e.g. via pressurization fans) or which extracts the smoke from the stairway.

---

1. NFPA, U.S. Hotel and Motel Structure Fires; U.S. Fire Administration’s (USFA’s), Hotel and Motel Fires.
2. All legal requirements quoted in this document serve as examples only and may vary according to local building regulations.
Basic conditions

Objectives
- Timely alerting and evacuating of all people at risk
- Early detection of incipient fires (e.g. in electrical enclosures within the stairways)
- Ensure that stairways remain smoke-free during any evacuation procedure

Typical fire hazards
- An overload or short circuit of electrical equipment
- Easily flammable materials that should not be present in a stairway

Typical development of a fire
If no flammable materials are stored in a stairway, a fire can only start due to 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 of visible smoke and can quickly develop into an open fire. If detected early, this kind of fire can be extinguished with water or a hand-held fire extinguisher.

Critical Points
- Early fire detection in the stairway
- In case of fire, being constantly aware of the smoke situation within the stairways (e.g. 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 promptly. 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 can detect a smoldering fire at a very early stage.

The number and position of the automatic fire detectors are chosen based on the existing installations and the height of the stairway. As a basic guideline:
- A smoke detector must be installed in every electrical enclosure
- Large installation ducts must be equipped with smoke detectors
- A fire detector must be installed on the top floor ceiling of the stairway
- Where stories are separated by a door, a fire detector must be installed on the ceiling before that door
- In multi-story stairways, a fire detector must be installed on every third floor

In a small hotel, the most cost-effective solution for alerting all persons in a stairway that a fire alarm has been activated is to equip all detectors in the stairway with voice sounder beacon bases. The optical and acoustic elements ensure that all persons will be alerted. The additional voice component provides explicit instructions in two languages, which is particularly important in international hotel environments. It is also well known that people react more readily and correctly to spoken messages than to sounders that can only be interpreted intuitively.

The solution presented in this document depicts a typical solution for a small hotel. Where local codes of practice require that a voice alarm system is installed (e.g. in larger hotels), appropriate loudspeakers would be fitted in all public areas. Such systems can be better tailored to match the acoustic properties of the various areas, which could significantly improve the comprehensibility of the voice messages in stairways etc.
<table>
<thead>
<tr>
<th>Details</th>
<th>Comments/Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Electrical installations</strong></td>
<td></td>
</tr>
<tr>
<td>Smoke detectors</td>
<td>Early detection of incipient fires caused by electrical overloads or short-circuits</td>
</tr>
<tr>
<td></td>
<td>▪ Parameter set with sensitive behavior</td>
</tr>
<tr>
<td><strong>Stairway</strong></td>
<td></td>
</tr>
<tr>
<td>ASA neural fire detectors</td>
<td>Early detection of all types of fire and robust behavior toward deceptive phenomena</td>
</tr>
<tr>
<td></td>
<td>▪ Parameter set with high sensitivity</td>
</tr>
<tr>
<td><strong>Manual call points</strong></td>
<td></td>
</tr>
<tr>
<td>MCPs</td>
<td>Manual call points</td>
</tr>
<tr>
<td></td>
<td>▪ Single or double action (depending on local regulations)</td>
</tr>
<tr>
<td><strong>Warning devices</strong></td>
<td></td>
</tr>
<tr>
<td>Voice sounder beacon bases</td>
<td>All ASA neural fire detectors are fitted with voice sounder beacon bases</td>
</tr>
<tr>
<td><strong>Positioning of system elements</strong> (see Figure 1)</td>
<td>ASA neural fire detectors</td>
</tr>
<tr>
<td></td>
<td>▪ On the uppermost floor and on every third floor</td>
</tr>
<tr>
<td></td>
<td>▪ In the middle of the ceilings</td>
</tr>
<tr>
<td></td>
<td>Manual call points</td>
</tr>
<tr>
<td></td>
<td>▪ Next to the escape door which leads outside (or to a safe area)</td>
</tr>
<tr>
<td></td>
<td>▪ Adjacent to every door leading to the stairway (so that a fire alarm can be manually triggered outside the stairway in the event of a fire)</td>
</tr>
<tr>
<td></td>
<td>▪ At a height of 1.4m ± 0.2m</td>
</tr>
</tbody>
</table>

**Related measures**

- 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. Where voice alarm systems are installed, this information can be used to instruct hotel guests to use an alternative escape route.
Figure 1  Positioning of system elements

1. ASA neural fire detector with voice sounder beacon base
2. Smoke detector
3. 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 other opening. As soon as there is a dangerous concentration of smoke in the stairway, it should no longer be used as an escape and rescue route. This is particularly relevant in larger hotels with multiple stairways, where hotel guests can be informed about the developing situation and directed towards the safest escape route. This may be done by trained staff or via a voice alarm system.

Sources of fire in stairways

When stairway fires are analyzed, the cause of the fire is often found to be flammable material and objects which should not have been present 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 building regulations 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 excluded, provided that all doors to the stairway are closed. In addition, pressurization fans are often used to ensure an overpressure in the stairways.

Large stairways in hotels should also be equipped with a ventilation and smoke extraction system, so that a dangerous smoke concentration cannot occur in the stairway even if doors remain open.

Alarming and evacuation

In the majority of cases the initial fire alarm will not have been activated on the stairway itself, but on one of the floors being served by the stairway. Consequently, acoustic and optical warning devices within the stairways should maintain continuity with the warning signals activated on the individual floors and be of a similar type (e.g. voice sounder beacons).

In hotels equipped with a voice alarm system, appropriate speakers would also be installed throughout the hotel. This would enable situation dependent evacuation instructions to be transmitted to the relevant areas of the hotel from the fire-brigade panel. This can greatly improve the speed and efficiency of an evacuation and save lives, e.g. by preventing guests from trying to escape via a stairway where there is already a high concentration of smoke.

ASAtechnology

For intelligent, reliable fire detection with genuine alarm guarantee

ASAtechnology is a unique technology from Siemens that converts signals into mathematical data which is compared with programmed values in real time using intelligent algorithms. The special signal analysis process is very reliable in preventing false alarms caused by 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 website at siemens.com/firesafety-markets or contact your local Siemens organization through the online contact form.

Share the experience

With our dedicated program for consulting engineers, you can benefit from our extensive application know-how and complete portfolio. 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 our dedicated consultant page.
Smart Infrastructure intelligently connects energy systems, buildings and industries to adapt and evolve the way we live and work.

We work together with customers and partners to create an ecosystem that intuitively responds to the needs of people and helps customers to better use resources.

It helps our customers to thrive, communities to progress and supports sustainable development.

Creating environments that care. siemens.com/smart-infrastructure

Article no. SI_0056_EN (Status 07/2020)

Subject to changes and errors. The information given in this document only contains general descriptions and/or performance features which may not always specifically reflect those described, or which may undergo modification in the course of further development of the products. The requested performance features are binding only when they are expressly agreed upon in the concluded contract.