How to Protect High-Rise Egress Routes?

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Recent, tragic high-rise fires have underscored a fundamental issue: the lack of protected escape routes in tall buildings. As we build a greater volume of ever-higher buildings, greater scrutiny is needed to protect those under design, as well as those already built and in use. We asked a CTBUH Expert, "What is the best way to protect egress routes in tall buildings?"

In tall buildings, our major concern today is whether fire safety in general really keeps up with architecture. Fire safety issues need to be individually addressed, since in many cases the standard technical solutions are simply not sufficient.

As buildings get taller, new tailor-made strategies need to be developed. While the latest massive fires in high-rise buildings like Dubai's The Address or London's Grenfell Tower have increased the urgency of developing more effective fire safety requirements and enforcement, many people still don't know how to behave in an emergency. We usually use elevators to move within tall buildings; many don't know that the stairwell remains the best, and usually only way out in the event of a fire.

As smoke is the major killer in building fires, one of the critical issues is to keep vertical escape routes (i.e., stairwells and elevator shafts) free of smoke, to enable safe evacuation and limit its spread inside the building. This can be achieved by means of pressure-differential systems (PDSes) that protect against the ingress of smoke by maintaining the pressure within the escape route at a higher level than that of adjacent spaces. This theoretically simple aim becomes more complex as buildings get taller. There are significant problems with the proper functioning of PDSes, even for buildings only slightly taller than 100 meters, depending on wind speeds and outside air temperatures.

Therefore, comprehensive analysis at the design stage and more advanced PDSes are indispensable. For buildings over 100 meters, the typical engineering approach using normative algebraic equations or rules of thumb is insufficient. For tall and complex building analysis, using computational fluid dynamics (CFD) or zone-modeling tools may be required to determine if a particular PDS is capable of achieving design objectives and guaranteeing a specific safety level in the event of fire. Besides the commonly known stack effect and wind influence, PDSes can be adversely influenced by many different factors, such as the air-tightness of the building façade, the airflow resistance of the stairs, and the behavior of building occupants.

Today there are many different solutions available on the market, but still no "universal" systems that can be applied to any building. PDSes should be fully functional, regardless of the building height and weather conditions, since we cannot accurately predict when or where fire will break out. Therefore, PDSes in very tall buildings should be able to counteract the negative influence of ambient conditions and compensate for the unpredictable behavior of occupants. There are different ways to achieve this goal.

One of the solutions is to use a forced-airflow modular system, counteracting stack effect and negative wind influence. Such systems use advanced, fast-acting and stable pressure-differential kits, which undertake continuous monitoring of operating parameters. Another advantage of similar technical solutions is that the stack effect can be mitigated by using the airflow resistance of the stairwell, which eliminates the need for stair partitioning. Obviously, there are certain limitations and requirements for such systems; for instance, all electronic components must be continuously monitored and automatically tested on a regular basis. As a life-safety system, the PDS should be independent from the Building Management System (BMS). It is common for the BMS to be used to control components of the PDS. But in this scenario, the BMS can be only used for basic monitoring purposes. PDS components should be certified in accordance with specific harmonized standards; but in reality, price pressure often results in using regular HVAC products that are often not appropriate for such applications.

Safety in the event of fire strongly depends on smart and reliable pressurization systems. For very tall buildings, we often need something more than a standard system. We should not be afraid of innovations and must consciously search for advanced solutions that are appropriate for the complex and demanding buildings we build. We should not depend on declarations and wishful thinking. Instead, we should do more research and assess safety levels by means of professional engineering tools and detailed acceptance tests. Otherwise, we will never truly be assured of adequate egress from tall buildings in case of fire. ■

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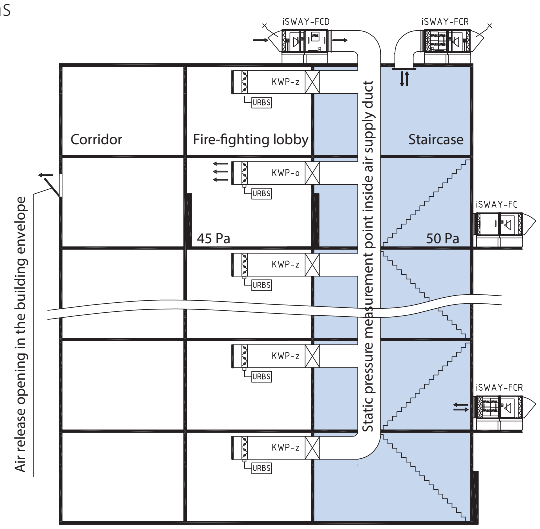

KWP-o - fire damper open, KWP-z - fire damper closed

Diagram of pressurization of high-rise building staircase with additional air supply unit on the roof.