Source: www.primetower.ch

Reference
Prime Tower, Zurich

„Safety and Exclusivity“

Prime Tower, Zurich

There is one condition that has to be met for the tallest building in Switzerland: Whether in summer or winter, the 'smoke control in the stairwell' safety objective has to been achieved in all climatic conditions!

The skylines of our cities have changed drastically over the last couple of years. The cityscape is being changed with ever taller buildings and tower blocks. Due to the height of these buildings, they represent specific challenges in terms of fire control. When a fire breaks out in such a tower block, the rescue and fire fighting measures are very difficult for the fire brigade/emergency teams. In addition, the evacuation of people in the structure is made difficult due to the complexity of the building. In order to ensure the safety objective of early evacuation of people from the building, the structural conditions in tower blocks often have to be supplemented or compensated using system-specific measures. This also applies to the tallest building in Switzerland, the Prime Tower which, in the course of last year, achieved its full capacity.

Symbolically, the Prime Tower represents the rise of Zurich's western district and has quite a lot to offer, not just in terms of size (Fig. 2). With its height of 126 m, 36 storeys, a rental area of 40,000m², the place of employment for 2,000 people and overall costs of 355 million CHF, it is the largest and most expensive construction project that Switzerland has seen over the past 6 years: A real challenge for all the trades that worked on this construction project.

Particular attention has been paid to the differential pressure system that is used in order to control smoke in the three interior stairwells within the Prime Tower, as well as the fact that 2,000 people work in the building day in and day out, and that well known trading companies, lawyers and banks ensure a constant high volume of visitors.

The differential pressure system in the Prime Tower has been planned in accordance with the DIN EN 12101-6 provision for differential pressure systems. In connection with this, the differential pressure system's control time for opening and closing doors in the stairwell is 3 seconds. This time must be strictly adhered to. In the event of a fire, positive pressure is triggered in order to prevent the penetration of smoke in

Fig. 1: Prime Tower

Fig. 2: View of Zurich with the Prime Tower

the Prime Tower's three safety stairwells. This is limited to 50 Pa. The door opening force on the doors to the stairwell must not exceed 100N. In order to fulfil the high technical requirements related to structural safety, attention must be paid in particular to the following points in terms of the controls to the system:

- Safety air discharge in the incendiary shell must be ensured, i.e. the flow of air from the safety stairwell must be allowed to pass unhindered to the outer facade.
- Depending on the time of year, there are different interior and exterior air temperatures which lead to significant and not negligible natural draft flows and/or downforce flows in the stairwell and as a result, demonstrably change the pressure situation. This phenomenon must be compensated for.

In order to ensure safety air discharge, openings have been built into the in exterior facade, whereby, this represents further special feature of the Prime Tower. The entire building has a shell which is exclusively made up of window elements. In all, 4,400 window elements have been installed with a weight of 400 kg per window. The windows are opened parallel to the outer facade (Fig. 3).

The differential pressure system receives information from the fire alarm centre about the storey where there is a fire and then, on that storey, the relevant windows open in order to allow the smoke to flow out. At the same time, all other windows in the building are closed. This ensures that on the storey where there is a fire, air can flow out from the safety stairwell, through the storey, to the outer facade. The size of the extracted air openings has been calculated using 12 windows with a 0.54 m² pane and can be adjusted accordingly by the extent to which the window is opened. To ensure the outward flow of

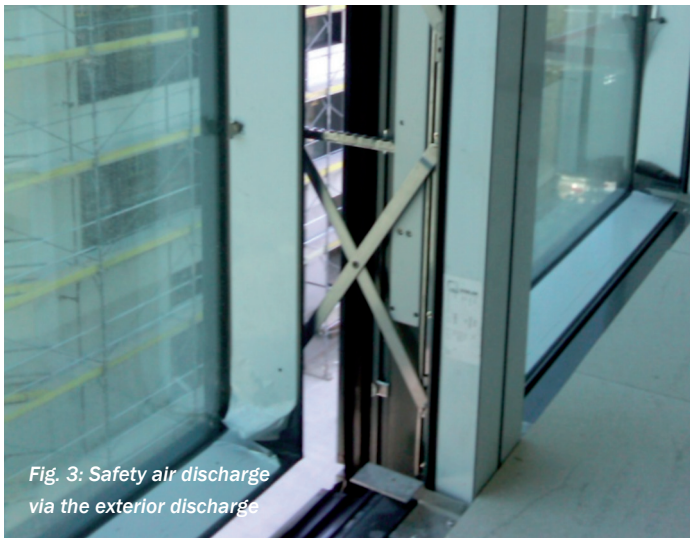

Fig. 3: Safety air discharge via the exterior discharge

air, the control unit of the differential pressure system must similarly take command over barriers, such as office doors curtains and sun blinds. In order to ensure these functionalities, an internalised intelligent control unit must be used on each storey, which communicates with the master control unit and as such, it represents a decentralised network.

In the case of buildings such as the Prime Tower, higher requirements are placed on the planning and measurement of interior stairwells and the shafts of fire brigade lifts. These are the result of the climatic ancillary conditions outside of the building as well as the thermal and aerodynamic conditions within the safety stairwells. In connection with this, the influence of weather effects from athermal considerations is to be investigated and taken into consideration accordingly (Fig. 4).

For example, on the one hand, the effect of convection in winter generates a natural draft in one stairwell, negative pressure in the lower part of the building and on the other hand, positive pressure in the upper part of the building. This effect must be compensated for in order to achieve the safety objectives.

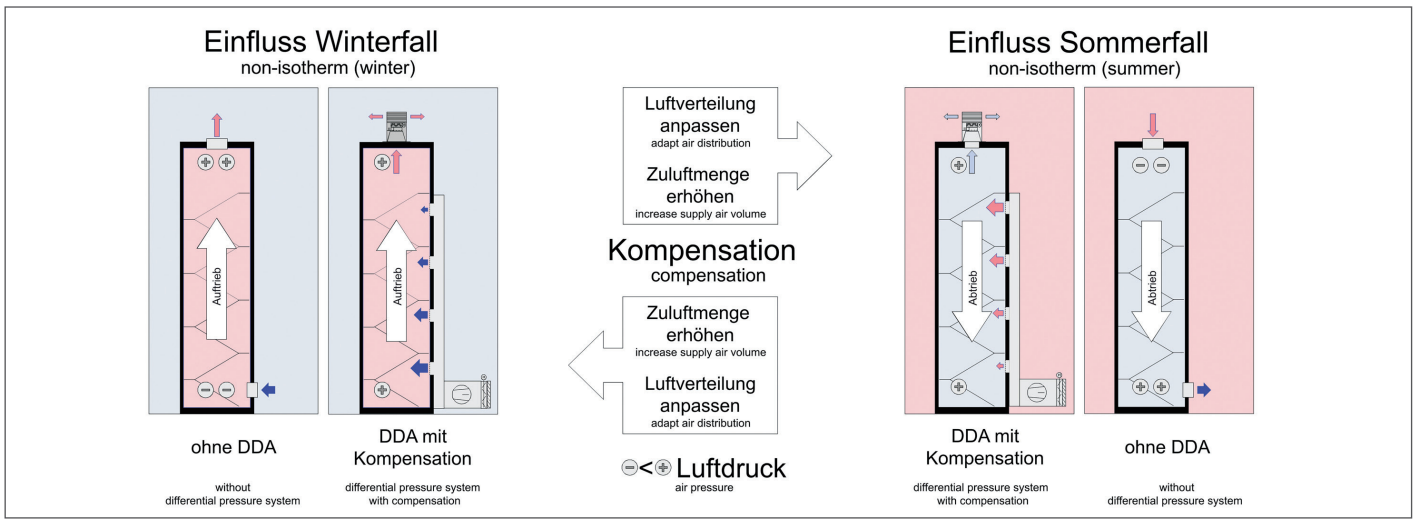

Fig. 4: Influence of summer and winter

As a result, in winter, a greater air flow has to be fed to the lower part of the building. In summer, exactly the reverse applies. The air flow has to be increased in the top half of the building. In order to accordingly adjust the flow in the Prime Tower to the environmental temperatures, a custom made valvular motor was developed with 15 adjustable interim settings (Fig. 5).

With this, the controller is now in the position to individually set the flow of supply air by measuring the outer temperature and an intelligent control system (Fig. 6) and operate the system regardless of the weather.

Fig. 5: Strulik intake air valvular motor with 15 settings

Fig. 6: Intelligent control system that operates regardless of the weather conditions

Summary:

In the future, it will no longer be sufficient to only consider the isothermal conditions when designing a differential pressure system. If, in his considerations, the designer recognises that it is necessary to carry out compensation measures for winter and summer, an individual adjustment can be carried out using intelligent control systems and the required safety objectives of ‘smoke control in the stairwell’ will be fulfilled under all climatic conditions.

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