Assessment of the Fire Risk Levels in an Office Building and a Nightclub with Prescriptive Designs

A comparison of the risk level of an office building and a nightclub with code compliant prescriptive designs was conducted in order to evaluate whether an uniform safety level of the two occupancy types can be established. A risk assessment method using Monte Carlo simulations and 1- and 2-zone fire models and hand calculations for the egress was used for the comparison. An existing model formed the basis for the study, though with substantial new developments. For the available safe egress time (ASET) the main objective was to ensure continuity of the fire development, whereas the pre-movement time and the movement time were adjusted for the required safe egress time (RSET) of the nightclub. The number of simulations required in order to obtain reliable results was considered sufficient at 20,000. The comparison of the risk profiles of the nightclub and the office building showed significant difference in risk levels, with that of the nightclub being substantially higher. The higher risk level in the nightclub is caused by a relatively fast mean value of the fire growth rate and the high number of occupants. Hence, the requirements in the prescriptive code do not ensure a similar safety level for the two occupancy types when evaluated by the risk-based approach. In addition, a sensitivity analysis was conducted for the fire growth rate and for the fire area in the nightclub. In this analysis the increase in the standard deviation of the fire area, which was assigned a log-normal distribution, resulted in a higher risk level. In contrast, a reduction in the fire area did not have any significant affects on the risk level. Furthermore, the effect of the sprinkler system and the effects of the ventilation system were compared. The analysis showed that the sprinkler system with an RTI value of 50 m²/s² had a much more sufficient contribution to the risk level compared to a natural ventilation system and a sprinkler system of an RTI value of 100 m²/s².

The risk profiles for the two occupancy types were compared to tolerable safety levels suggested herein. One of them being an acceptance curve derived from fire statistics in the United Kingdom (UK). In this comparison the acceptance level of the office building was stricter due to the differences in the statistics of the two occupancy types. However, the office building nearly met the requirements of the acceptance curve, whereas the nightclub was far from meeting the requirements. Another suggested tolerable level herein was derived from the UK specifications by the Health and Safety Executive, which distinguish between tolerable safety level for members of the public and for workplaces. This comparison made it even more difficult for the nightclub to meet the required occupant safety level.