Proceedings of the 4th World Congress on Mechanical, Chemical, and Material Engineering (MCM'18)
Madrid, Spain – August 16 – 18, 2018
Paper No. HTFF 110
DOI: 10.11159/htff18.110

A Study on Improvement of Smoke Control System to Prevent Smoke from Spreading to Emergency Stair

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Extended Abstract

Emergency stair needs to be maintained safe by preventing the smoke from penetrating into the stair which serves the primary vertical evacuation route so as to allow the occupants to escape from the building when fire occurs in high-rise building. In recent study, the review to improve the performance of smoke control system on emergency stair is underway in a way of conducting the full-scale experiment and numerical analysis [1-4].

The measure commonly used in Korea for such purpose is the pressure differential system which raises the air pressure in lobby located between the accommodation and the stair, making use of the air blower for smoke control, air duct and control damper.

In this study, a field test which is intended to evaluate the performance of the pressurization smoke control system installed on emergency stair of the building was conducted in two high-rise buildings and the result from the performance test was analyzed and as a result, the separate air supply system which feeds the air for leakage and supplement separately through different channels was proposed as the enhanced alternative that will replace the existing pressurization smoke control system for emergency stair.

The parts of the result from the field test are highlighted as follows. That is, after starting operation of the pressurization system while all doors of lobby remain closed, the pressure difference between the lobby and the accommodation on the 2nd floor reached to 97 Pa. And on the 11th and 18th floor, the difference in pressure was 112 Pa and 124 Pa, respectively, which far exceeded the design requirement, 40 Pa. When the pressure difference between the lobby and the accommodation is so high, the problem with open force appears to be inevitable. But when the doors of lobby are open, pressure difference between the lobby and the accommodation on the 3rd floor was reduced to 23 Pa and on the 30th floor, it was reduced to 46 Pa. As seen above, with the existing smoke control system, the pressure in the lobby on each floor would possibly be reduced when the doors of the lobby are open.

In this study, the separate air supply system which feeds the air for leakage and supplement separately through different channels is proposed. In smoke control system with separate air supply system, it feeds the air for leakage and supplement which are independent each other in terms of function and role separately to the lobby on each floor through different channels. It feeds the air to the lobby on each floor using own air blower, air duct and damper for leakage purpose and also it feeds the air to the lobby on each floor using own air blower, air duct and damper for supplement purpose.

When introducing such separate air supply approach, appropriate air supply depending on door status could be achieved. That is, when the door of lobby is closed, the air as much as the leakage is supplied and appropriate pressure difference is maintained accordingly, avoiding excessive pressure difference between the lobby and the accommodation. And when the doors are open, the air is supplied as much as for supplement purpose so as to create the airflow for smoke control while preventing the air from leaking though the doors open.

Separate air supply system for smoke control developed in this study is expected to avoid excessive pressure between the compartments or falling-pressure which occurs with existing system as well as to effectively secure the smoke control performance necessary for safe evacuation.

Acknowledgements

This work was supported by the National Research Council of Science & Technology (NST) grant by the Korea government (Ministry of Science and ICT) (No. CRC-16-02-KICT).

References

[1] Y. Wang and F. Gao, "Test of Stairwell Pressurization Systems for Smoke Control in a High-rise Building," *ASHRAE Transactions*, vol. 110, no. 1, pp. 185-92, 2004.

[2] C. Bellido, A. Quiroz, A. Panizo, J. L. Torero, "Performance Assessment of Pressurized Stairs in High-rise Building," *Fire Technology*, vol. 45, pp. 189-200, 2009.

[3] W. Z. Black, "COSMO-software for Designing Smoke Control Systems in High-rise Building," *Fire Safety Journal*, vol. 45, pp. 337-348, 2010.

[4] R. S. Miller and D. Beasley, "On Strairwell and Elevator Shaft Pressurization for Smoke Control in Tall Building," *Building and Environment*, vol. 44, pp. 1306-1317, 2009.