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Brandteknisk projektopgave

Titel: Numerical Investigation of Pressure Development in Enclosures during Fire

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Previously the fire protection community has not considered the overpressure from enclosure fire as a potential safety risk for the occupants in the building. The phenomenon of fire-induced pressure increase is traditionally not considered a genuine risk in domestic buildings because the leakage areas in these building often are fairly large. Furthermore, normal one-layer glass in windows is expected to give in when the temperature difference is larger than 80 degree Celsius. When the glass breaks the window starts to function as a vent in the enclosure and if it is large enough the pressure increase will only be minor. But because of social and political awareness of energy consumptions in buildings, the above assumption is not valid anymore. The latest building regulations in Denmark has been focusing on reducing the energy consumptions.

An initial literature study, has revealed the following parameter as the main contributors to the pressure build-up in enclosure fires:

- Fire growth / heat release rate
- Ventilation system
- Thermal configuration of the enclosure envelope
- Leakage area of the enclosure envelope
- Geometrical configuration of the enclosure

Both the thermal and geometrical configuration of the enclosure were not investigated in further details in this study because these two parameters depend on the design of the building and they are not typically a parameter the fire safety consultant can affect. Therefore, the fire growth (heat release rate, ventilation system and the enclosure leakage are established to be the main contributors to a pressure build up in enclosure fires.

In order to perform the numerical parameter study, Fire Dynamics Simulator was chosen as the simulation software. Another literature study showed that Fire Dynamics Simulator was capable of simulating the pressure build-up in enclosure fires. Furthermore, revealed a mesh independence analysis that the optimal mesh size was 125 mm in the fire room and 250 mm cells in the rest of the domain.

The results of the parameter study revealed that both the fire growth/heat release rate and the ventilation system as expected had an impact on the pressure build up in enclosures. The results showed that with faster fire growth the magnitude of the peak overpressure increased. The results for the change in leakage area, revealed that the change in overpressure was significant.

The interpretation of the parameter study results showed a risk of smoke spread in a smoke ventilated system with only 50 Pa overpressures for all fires faster than a medium fire growth, with a leakage area of BR2015 and a running ventilation system. The findings in the parameter study also revealed that many parameters have an influence on the results, including some parameters, which it was not possible to investigate in this study. Therefore, more studies are needed in order to clarify these subjects.