Influence of the building envelope on fire scenario's

Ruud van Herpen[1,2], Nick Tenbült[1], Annemarie Weersink[2]
[1] Eindhoven University of technology, NL
Department built environment, unit BPS
[2] Saxion University of applied sciences, Enschede, NL
Department Building and Technology

Research and innovation

Influence of the building envelope on fire scenario's in dwellings and residential buildings

Abstract

Like in most building codes, the fire safety requirements in the Dutch building code are prescriptive. These requirements provide for each building function general measures to reach a sufficient level of fire safety. With prescriptive rules it is nog possible to anticipate on changing boundary conditions in the (near) future. Therefore, a performance based approach is needed, taking into account the public objectives of fire safety. The most important public objective is the safety of the building occupants, in this case the residents.

Boundary conditions that influence the fire safety level for residents are:

- Fuel characteristics (fire load, RHR, Mass optical densty, Combustion value etc…)
- Building characteristics (separation constructions, daylight openings, air tightness, ventilation installation, etc…)
- Building occupants characteristics (age, self-reliance, mobility, etc…)

This research focuses on the building characteristics, especially the insulation level, the mechanical quality of daylight openings and air tightness, including the ventilation installation in residential building functions.

Insulation level and daylight openings

Low-energy dwellings (such as the passive house concept or nearly Zero Energy houses) will lead to application of triple glazing. Glass fallout is an important factor that influences the fire development during an enclosure fire. A smouldering fire seems more likely when the glazing system remains intact, while a flaming fire will be more likely in a situation with major glass fallout. The experimental research uses a fire furnace and supporting simulations to generate a fire scenario as such in a highly insulated dwelling with double and triple glazing in daylight openings. The analysis of the results revealed a wide spread between temperatures and glass fallout. In general daylight openings with high thermal quality also have a high mechanical quality (less glass fallout). In that case a developing fire already is hazardous, because this pre flashover fire becomes ventilation controlled instead of fuel controlled.

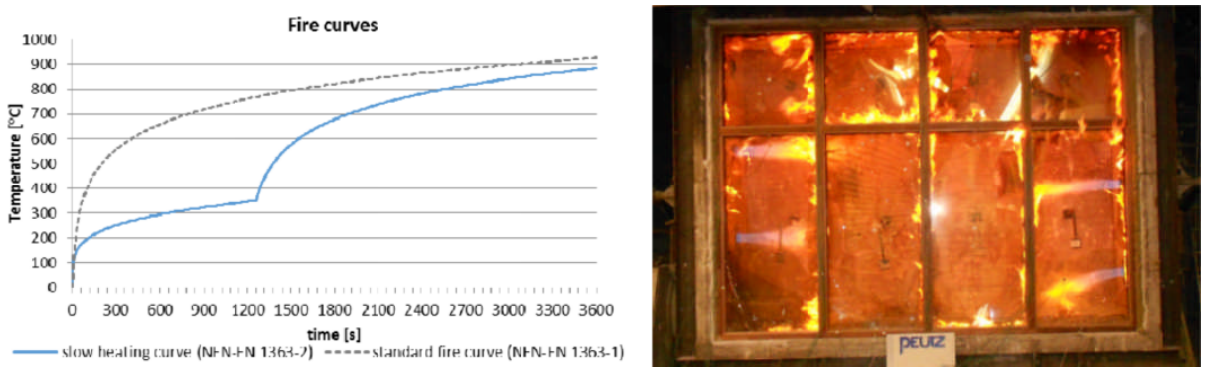

Figure: Slow heating curve, compared to standard fire curve (left) and experiment in progress (right)

Air tightness and ventilation system

In this research, the pressure increase in a residential function caused by a developing fire has been evaluated in both simulations with a zone model and experiments in a single room. In both cases the pressure increase in the first few minutes of a developing fire reaches exponential very high values of more than 500 Pa. With this pressure increase inside a residential building function it is almost impossible for residents to open the main door of their dwelling.

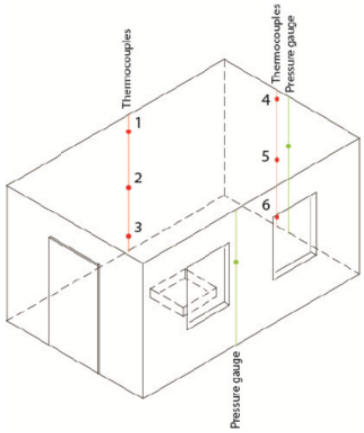

Figure: Experimental setup in a single room

However, the influence of the mechanical ventilation system is neglected in this study. With an additional research on the air-tightness of houses in which the ventilation system is included it was shown that the influence of the ventilation system is not significant. After this study conclusions from earlier studies can be upheld. Modern airtight buildings maintain a potential danger for building occupants due to high pressures which make it more difficult to escape. Smoke gas explosion and backdraft are still potential risks for fire services.

To improve the escape possibility of the residents, a pressure release valve near the front door of the dwelling might be a suitable solution.

Corresponding authors:

Ir. Ruud van Herpen FIFireE, Fellow Fire Engineering Eindhoven University of Technology
r.a.p.v.herpen@tue.nl or rhe@nieman.nl
www.fellowfse.nl

Ir.Annemarie Weersink, researcher Saxion University of applied sciences

a.s.m.weersink@saxion.nl