

Popular Science Summary

Do the development of building structures and building content change the fire behaviour in a residential building? It was found that today's building structures and building content (furniture) have influence on the fire behaviour in the residential buildings. By using a case-study (fixed geometry) and a two-zone fire model, the influence of the development is determined.

Building structure for these types of buildings is changed dramatically the last decades. Due events as the energy crisis in 1970 and the Kyoto Protocol in 1997, residential buildings became better insulated. By adding an insulation layer into the wall structure, and by using double layered glazing, less heat will be lost. For energy consumption and CO₂ emission, this is a positive effect. However, during a fire situation in the building, this means that heat which is generated by the fire cannot leave the enclosure quickly. As a result of that, the fire development becomes faster and reaches higher peak values for heat release rate and temperature. Therefore, a greater risk in the residential building will be reached.

For renovated buildings, an insulation layer can be added at the inside of the enclosure. The insulation layer has a relatively low conductivity, what results in less heat transport into the structure, and heat release rate and temperature increase even more compared to the today's building structure. Today's and renovated structures can reach approximately 10% higher peak values for heat release rate and temperature (when enough oxygen supply is available) than traditional structures.

Also, the building content has changed the last decades. Modern furniture is made of different materials than before the energy crisis. In the 50s mostly natural materials were used. Modern furniture is composed primarily of synthetics. This change has a major impact of the fire behaviour of furniture. Natural products burn slower and produce less energy, than synthetics. When a building is furnished with modern furniture, and it ignites, this results in a very rapid fire development and smoke production.

The change of material in building content is the biggest threat for occupants. In the first minutes of a fire situation, the occupants must have a safe evacuation route. The safe evacuation time will be reduced dramatically in the case of modern furniture. In the case of modern furniture the evacuation time is approximately 60 – 70 seconds, for traditional furniture this is 90 – 120 seconds.

Today's building structures and building content have negative influence on, the fire behaviour, enclosure conditions and therefore also life safety. For life safety in a residential building, the change of the material in the furniture is the biggest threat. When the fire becomes fully developed, the effect of insulated structures become more evident.

These results give a clear overview, and can be useful for new developments in structure and building content. In the future new rules can be arranged for reducing CO₂ emissions from the 2015 United Nations Climate Change Conference, what can result in even thicker/better insulation layers than today. The same counts for new materials in furniture. It should be kept in mind, that these developments can dramatically affect the live safety in residential fires.