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Evacuation Characteristics – Is there a difference between homogeneous and mixed groups?

Janne Gress Sørensen and Anne Dederichs

Performance based fire safety codes have been implemented in many countries around the world. Implementation of these codes has induced more complex building constructions or landmarks such as Burj Khalifa in Dubai, The Shard in London or The Bird's Nest in Beijing. Also ordinary buildings such as office buildings are becoming more complex due to an increasing demand on spectacular and state of the art buildings. These complex buildings have challenged fire safety engineers because standard solutions cannot be applied. On the contrary it gives the opportunity to be innovative and develop new solutions. However the safety level in the building should still be sufficient according to current regulation. Fire safety engineering tools including various models to predict evacuation times and different software to calculate time until critical conditions occur have been developed. The majority of the data that creates the foundation for the evacuation models is based on able-bodied adults and are collected for more than 30 years ago (Fruin, 1971) (Predtechenskii & Milinskii, 1978) (Pauls, 1980). In addition characteristics of the population have changed since (Harish & Verma, 1996) (Kaya, 2002). Furthermore homogeneous groups of able-bodied adults do rarely occur in the building environment. Evacuation data on representative heterogeneous groups comprising children, able-bodied males and females, elderly people and people with impairments are therefore needed to establish a valid foundation for prediction of evacuation times.

This study attempts to clarify the differences in individual behavioral patterns and total evacuation times for a homogeneous group of able-bodied adults and a heterogeneous group with a composition corresponding to the demographic profile of Denmark.

A series of 20 full-scale evacuation experiments with varying composition of the test sample was conducted in Denmark in May 2012. The experiments were performed from an IC-3 train inside a tunnel corresponding to the rail connection between Zealand and Funen – The Great Belt link. The capacity of the train was 46 passengers, where 23 were seated and 13 were standing in the carriage and additional 10 were standing in the corridor between the entrance and the carriage. The experiments were initiated by a spoken warning message telling that smoke was observed outside the train and that passengers should evacuate immediately. The egress path was from the train to the main tunnel, from the main tunnel to the nearest transversal tunnel, and here to the safe place outside the tunnel. During the experiments participants were not exposed to any extra ordinary conditions such as smoke, heat or flames.

Results from the present study clearly show that the total evacuation time is doubled for the mixed groups compared to the homogeneous group. It is therefore evident that the composition of the population in a building matters for the total evacuation time. In addition this finding needs to be considered while designing the safety level of buildings, especially for buildings where it is probable that all types of people are present. The detected differences in individual behavioral patterns for the homogeneous and heterogeneous groups will be further explained and discussed in the proposed presentation.

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