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ScienceDirect

Procedia Engineering 172 (2017) 529 – 535

Procedia Engineering

www.elsevier.com/locate/procedia

Modern Building Materials, Structures and Techniques, MBMST 2016

Flame transfer through the external walls insulation of the building during a fire

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Abstract

The article contains a description of the problems of the risk associated with flammable insulation of the building external walls. According to fire statistics, 80% of lives are taken because of the smoke presence. The smoke as a basic heat conveyor in a fire poses a major threat to people because of: inhalation of toxic substances which are integral part of it and attenuation of fire spaces and adjacent spaces. Both threats simultaneously cause problems with orientation to occupants and consequently render evacuation more difficult. Fire research on insulated elevations, conducted both in Poland and abroad have shown, that wall after insulating has not changed in a significant way its behavior during the fire and it has not constituted the additional risk to people.

Peer-review under responsibility of the organizing committee of MBMST 2016

Keywords: fire, fire statistics; evacuation; insulated elevations of the building; fire risk.

1. Introduction

Periodic Reports of the State Fire Service inform that in Poland about 28% of all fires are the fires of buildings. Approximately 88% of building fires took place in public and residential buildings. About 60% of fires in residential buildings arise from cigarette and matches. European statistics of fires in residential homes shows that 56% of fires begin with the lighting of bedding, upholstered furniture and clothes. US data show that 33.8% of fires have started in the living room, 25.7% in the basement, 16.2% in the kitchen, and 12% in the bedroom. The biggest impact on the speed of development of fire, and as the threat to people have finishing materials and interior building

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Peer-review under responsibility of the organizing committee of MBMST 2016
doi:10.1016/j.proeng.2017.02.062

construction [1-7].

The main causes of fires include: intentional arson representing about 40% of the total number of causes of fires and careless handling of fire (about 30%). Other causes include: failure (short circuit) wiring, improper use and lack of proper maintenance of heating equipment (chimneys, furnaces, etc.), leaving electrical or gas equipment turned on and careless carrying out repair works (welding) and others.

Factors affecting the propagation of fires can be divided into two groups:

a) factors that characterize combustible materials present in the room,
b) factors that characterize the room in which the fire develops.

A power source of ignition plays a significant role in creating an environment of fire and consequently contributes to the propagation of the fire.

The greater the power source of ignition, the faster the fire growth after ignition. The rate of fire growth in the room also depends on the location of the source of ignition. If in a combustible system a heat source effects on the lower part of the combustion material, a burning rate and thus the rate of fire development is the greatest. One of the main factors influencing the growth rate of fire is type and amount of combustible materials inside the room.

With sufficient power generated during flame combustion indoors, especially during fully developed fire phase, flames burst through the window openings of the rooms occurs. Statistical studies of various building fires, and further experimental investigations conducted both in Poland and abroad, where the fire was transferred through the isolated elevations, have shown that the spread of fire through thermal insulation of external walls of the building does not change significantly the overall process [13,14]. Fire moving between the apartments or floors is burdened with low risk and does not pose an additional threat to people during the evacuation.

This paper describes the basic elements of a fire in the building, including the transfer of fire to combustible materials of elevation.

2. Fire in the compartment and building

Fire in building usually has its origin in a single room (Fig. 1).

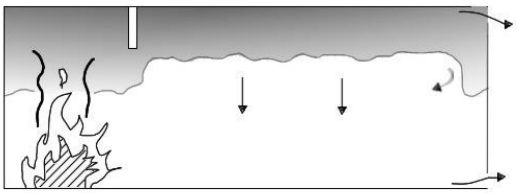

Fig. 1. A vertical section of compartment with toxic smoke layer during fire causing the greatest number of fatalities.

The biggest impact on the speed of fire growth in the room has the location of flammable finishes on the ceiling and walls of the room. Description of the typical fire in the space of the building is given in Fig. 2. At the beginning of the fire (phase I) in the room, layer of hot smoke and fire gases formed in the upper part a radiates the heat flows which reaching the flammable materials increase the speed of combustion. This means that the temperature and the thickness of the layer of hot smoke and the temperature in the upper part of the room have a big impact on the size and type of heat balance in the room, thus the speed of development of fire. The volume of this is also affected by the fire load and by the volume of the room. A flashover is a moment of transition of localized combustion (burning a single piece of furniture, carpeting) into simultaneous combustion of all combustible materials placed inside the room. This phenomenon usually takes a few seconds and its duration may vary from 5 min to 10 min from the beginning of the fire. In the second phase of a fully developed fire when the fire covers the whole room, a significant impact on the combustion rate has the amount of oxygen (air) flowing into the fire environment. In rooms with an average volume and a small amount of ventilation openings (windows, doors) in the phase of a fully developed fire, oxygen concentration decreases from 21% by volume to about 16% depending on the chemical