

Wooden houses and fire safety rules

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Abstract: *Wooden houses and fire safety rules* In this article, basic requirements regarding fire safety of buildings, and the rules of fire classifications of building elements or products, have been presented. The specific fire properties of building products, made of wood, have been discussed. In reference to technical and legal regulations, the possibilities of fulfilling of such requirements by wood/wood based products have been presented and in this connection, the influence on the investment process.

Keywords: buildings, fire safety, Polish buildings rules

Nomenclature

Reaction to fire – contribution of product, by one’s own decomposition, in fire reaction, exposed to the defined conditions

Resistance to fire classification – conventional classification of the element of building in relation to the tested specimen’s behaviour under normalized test conditions, taking in to account load bearing capacity R, insulation capacity I, and integrity capacity R

Spreading of fire degree – conventional classification of the element of building, in relation to the tested specimen’s behaviour under normalized conditions, taking into account spreading of flame on the surface of tested specimen on inside the specimen, flameless combustion (smouldering) or thermal decomposition of material of the specimen, occurring of flaming droplets/debris

Fire load density – thermal energy, expressed in MJ that can be released during combustion of combustible material existing in the compartment, fire zone or solid materials’ storage per surface unit area of this object expressed in square meters

Building should be designed and built in this way, that in case of outbreak of fire, the evacuation should be possible, the spread of fire in the building and between buildings should be limited and the construction of the building could not undergo destruction within a specified time.

In the residential and public buildings, mainly during combustion of solid materials, the course of the fire can be divided into 3 stages. In order to assess the behavior of building products in a fire, the initiation and the first two stages of a fire are important. The initiation can be caused by a number of reasons, such as inattention, negligence, faulty installation or acted intentionally. Source of initiation has unspecified thermal parameters: like glowing cigarette, basket of garbage or burning brand.

In the first stage (the temperature up to 800°C) fire is characterized by uniform distribution of temperature, while the highest temperature occurs in the upper parts of the room. In addition to the high temperature, the smoke containing toxic and irritating substances appears. The main hazard in the first stage, besides the temperature, is fogging (due to the spread of toxic, narcotic and irritant products) hindering the visibility, and consequently the evacuation. With this stage of fire, the restrictions on the use of combustible materials are related as well as requirements for their degree of flammability (reaction to fire) and spread of fire by the elements.

In the second stage, rapid increase in temperature in the compartment (above 1000°C) occurs. In this stage the fire, combustible building materials, regardless of their classification, got burned along with other materials located in the compartment.

The degree of flammability (reaction to fire) shall be determined for combustible materials at exposure levels corresponding to the effect of a small source of flame or single burning item.

The degree of fire spread is defined for the items tested on a scale similar to the natural and is associated with the effect of the single burning items.

If we consider combustibles in a fire, it is important to differentiate between two groups:

- furnishings or materials stored in a room or building,
- building materials (including installations).

High temperature during the fire and fogging are generally caused by the combustion of the first group of materials. They have a decisive part in the group of phenomena that are associated with a fire in the compartment. The percentage of combustible construction materials in full burnt materials during a fire is relatively small. Their calorific value is not of great importance in the combustion. Fire hazard caused by the application of these materials rely not on usually a significant part in heat balance, but the possibility of the spread of fire in the building and accelerate the development of a fire. This follows from the fact that these materials could have considerable geometrical dimensions, pass through many compartments include a large plane and length. These materials occur in places where there are no furnishings and other usable materials in the building. The fire can move between storeys through the combustible facades and insulations, electrical equipment, ventilation ducts. To some extent, one can speak about the effect of "cord", i.e. of such an effect, when burning the material does not constitute an imminent threat, but may cause flashover in a distant part of the building.

The principal feature of the wood, which distinguishes this material in a fire from materials such as concrete or steel, is its flammability. As a result of combustion, a layer of charred insulation is created. Thanks to its porous structure (as a result of thermal decomposition of wood, only about 15% solids remains) the layer has low thermal conductivity, several times smaller than the conductivity of coniferous wood. This layer reduces oxygen supply to the non-charred core, and hence the temperature, which allows for a while during a fire, load bearing by the wooden construction. Due to the nature of the behavior of the wood, its burning and mechanical properties are discussed together, since they are associated closely with the load capacity of the profile.

The properties of wood in the reaction to fire are affected by the physical properties and use of fireproof impregnation or coating. The reaction to fire classification is assigned according to PN-EN 13501-1 standard [2]. In the case of wood products, wall/ceiling and floor products are classified separately.

In the technical rules of construction, products are divided on the combustible and non-combustible products. Wood, regardless of way of protection is always a combustible material. Combustible products shall be divided into non-ignitable, hardly-ignitable and ignitable. In addition to the division of products mentioned above one can divide products into: do not spreading the fire, slightly spreading the fire and strongly spreading the fire.

Currently, the classifications of combustibility (ignitability) are replaced by the classification of reaction to fire according to PN-EN 13501-1 [2]. The classification of the spread of fire through the roofs is being replaced in the classification of the resistance on the roof of the external fire PN-EN 13501-5 [3]. Relations between terms taken from the technical conditions of construction and classifications according to PN-EN are given in [1].

The spread of fire through the outer surfaces of exterior wall is determined by the current Polish standard [4] without reference to the classification according to PN-EN.

The requirements for the reaction to fire and fire spread are formulated because, under the effect of a relatively small source of ignition (i.e. burning garbage bin, a burning firebrand) building elements should not spread fire and smoke.

Wood and wood-based materials are combustible materials. But their reaction to fire classifications can be improved by using appropriate fire-retardant agents to meet the technical requirements of building regulations (and / or investor). Activity of fire protection

is to: a delay of ignition, reducing the rate of surface spread of flame, reducing the intensity of combustion. Fire retardant agents, appear in the form of salt, paint or varnish, materials to perform type of barrier layers.

In the developed fire, despite the fire-retarding, timber burns and thermal decompose.

The level of technical and regulatory requirements of the construction depends on the destination of the building or compartment (category ZL, PM, or IN), building height, number of people in the compartment, the fire load, the presence of passive fire protection means. These are mandatory requirements, the general, without reference to the type of material used. This paper does not discuss these requirements.

Fire properties in the range of fire spread on the external surfaces of the external walls and roofs have an impact on the distance between buildings (table 1) [1].

Type of building and for the "PM" building the maximum fire load density $Q, \text{MJ/m}^2$	Type of building	
	ZL (threat to humans) [m]	IN (farm building) [m]
ZL	8	8
IN	8	8
PM (industrial-storage building) $Q \leq 1000$	8	8
PM $1000 < Q \leq 4000$	15	15
PM $Q > 1000$	20	20

The distances in the table, refer to the buildings with walls and roofs non-spreading the fire; in case when one of the exterior walls that is located from the side of neighbouring building or the roofing from one of the buildings is spreading the fire, the distance in the table should be increased by 50% and, if this applies to both the external walls or roof roofs of both buildings - about 100%. If the wall or roofing does not have a specific fire classification, it is to be assumed that such element is strongly spreading the fire.

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