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SAFETY OF WOODEN CONSTRUCTION

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ABSTRACT

The object of the test was based on model building wood, where conditions were simulated in the course of a real fire. It was a two-storey building of prefabricated panel construction ground size of 4.9 x 3.7 m, with a height of 5.6 meters.

Exterior walls, ceiling, roof and walls composition were designed with fire resistant building system for low-energy and passive energy-based multi-storey buildings of wood and were designed for fire resistance in three states limit (R - resistance, E - whole and I - insulation) 45 minutes. The composition of external cladding, as well as the supporting structure along the static calculation of the exact calculations "fire" according to Eurocode 5

The building stands at the end of the experiment and is stable. After cooling the interior of a Fire and Rescue Service and the findings of a static safety inspections are carried out of the building. Tiles for interior shows signs of fire burn. Statics is not disturbed, individual wooden parts of the interior are no signs of fire. Model fire was intense, all fuel burned in space at the same time, which was ignited by the initiator real fire develops less intense and not in the whole area at once.

Key words : wooden construction, fire modelling test, Eurocode 5, thermocouple, fire

INTRODUCTION

The fire according to rule 314/2001l is defined as unwanted and un-controlling burning multiple materials simultaneously. At the fire is not defined by the amount of space in which materials burn, or burn their time. Fire always acts of destruction, threatening the health and lives of people and destroying property rather quickly, which built many times over several years. Fire is a phenomenon that accompanies all forms of civilization. Wherever civilization emerged, in which a small area concentrated a lot of people to incur some form of fire protection. Fire accompanied man not only time but also all forms of its activity.
Fire is often associated with a material that is used in the building. Combustible materials, such as: wood are automatically hallmark material that causes a fire. Fire and material really represents a very close connection between them. Taking into account only this link is incorrect. This is evidenced by fig.1. In this building were not used flammable construction materials, according to designers had excellent fire protection and ... yet.

Fig. 1. Fire of 34 storey skyscraper in Dubai, United Arab emirates

The gradual deepening of the knowledge of the internal structure, chemical composition, physical properties of wood and its mechanical properties raises the intensive development of techniques and technology of processing and multi-use. It is relatively easily available, cost-saving machinable and workable. It can be linked without the help of foreign ties, but also by them, glue and various adjustments. In addition to technical and aesthetic merits, it is also beneficial wood that creates a positive human psychosomatic microclimate.

CONSTRUCTION

In the previous paragraph we argue that designers do everything to avoid creating a fire. Sometimes theoretical arguments, it accuracy can be verified only by experiment. They are used to model and laboratory experiments. Although these experiments are well statistically evaluated, but not always sufficient. Therefore, although it is not cheap, scientific validations to perform a large scale tests.

The subject of our large scale test model of the building was based on wood, where conditions were simulated in the course of a real fire. It was a two-storey building of prefabricated panel construction ground size of 4.9 x 3.7 m, with a height of 5.6 m, with carrying a wooden frame, filled with mineral wool. External walls were added to install a layer protruding before OSB - boards, also filled with mineral wool, and outside of the contact insulation sheathed system - two walls on mineral wool and the other two walls made of oriented strand board. The inner surfaces were lined with plasterboard. Tracks exterior walls, ceiling, roof and walls were designed with fire-resistant building system for the foreseeable future, low-energy and passive energy-based multi-storey buildings of wood and were designed for fire resistance in three states limit (R - resistance, E - integrity and I - insulation) 45 minutes. The composition of external cladding, as well as the supporting structure along the static calculation of the exact calculations "fire" according to Eurocode 5.

It should be noted that there was a wooden log-house or a building system, in which was a wooden frame structure directly exposed to the fire. In the buildings have been windows with standard fire resistance, placed one above the other, the effect of which was tested fire shutters to prevent spread of fire over the top of the facade of the building (a few shots of the construction of houses fig. 2-4).
Wood fuel representing the weight of 30 kg/m^2 per area, which was initiated by the incendiary substance and left the stage to a fully developed fire. It simulated course of fire interior furnished furniture, home furnishings and other combustible components of the double degree than would be standard fittings of the actual device (fig. 5).

Fig. 2 Construction of lower floors

Fig. 3 Finishing of second floors

Fig. 4 Completed construction

Fig. 5 Fuel for fire model

EXPERIMENT

In addition of visual observations were made temperature measurement with thermocouples at predetermined locations (see fig. 6). Several thermocouples were fixed already during the construction of the building. Using the measurement panel (fig. 7) were collected and further evaluated temperatures at selected sites. Total was docked 48 points for the measurement of temperature, which will be progressively evaluated. This article lists only some of the comparisons, the temperature in the first and second floors, the whole experiment will be evaluated in the wider publication.

Fig. 6 Fitting the construction thermocouples

Fig. 7 Measuring panel

Measured was the temperature in the area of burning wood as a fuel. The fuel cannot be completely ideal test conditions to simulate fire resistance, although the graph in fig. 8 shows the comparison of the time - temperature curve (a standard temperature curve TNK) to evaluate the fire resistance of structures inside the fire. Fuel were OSB in combination with spruce timber start burning after applying the initiator but maintain the highest temperature was keeping about 20 to 50 minute experiment. Then the temperature started to decrease, (loos the fuel), space is cooled and the experiment was in 60 minutes completed. Temperature in the 20 - 50 min. temperature reached the prescribed test for fire resistance.
Other thermocouples to measure the temperature of the source were placed as shown in fig. 9 results of measurement of temperature is shown in fig.10.

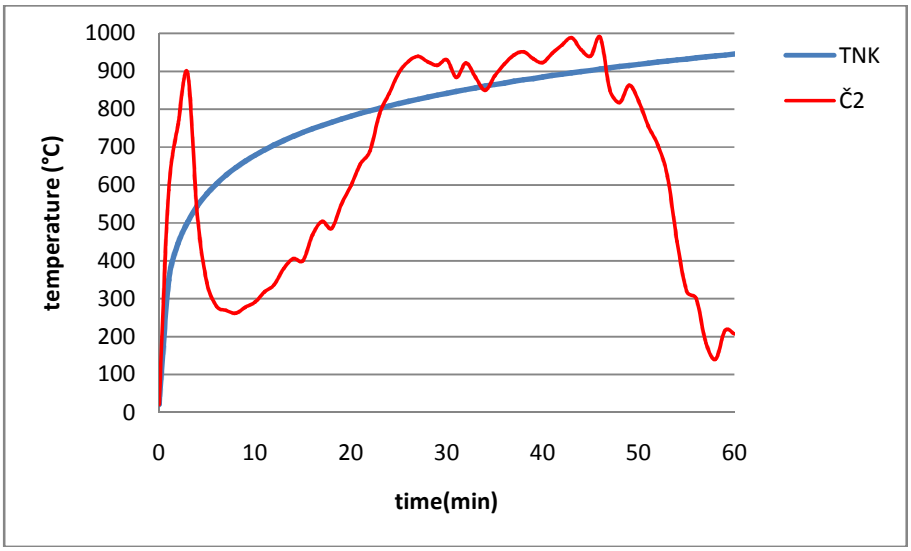


Fig. 8 The course of temperature during combustion of fuel in space (center) houses

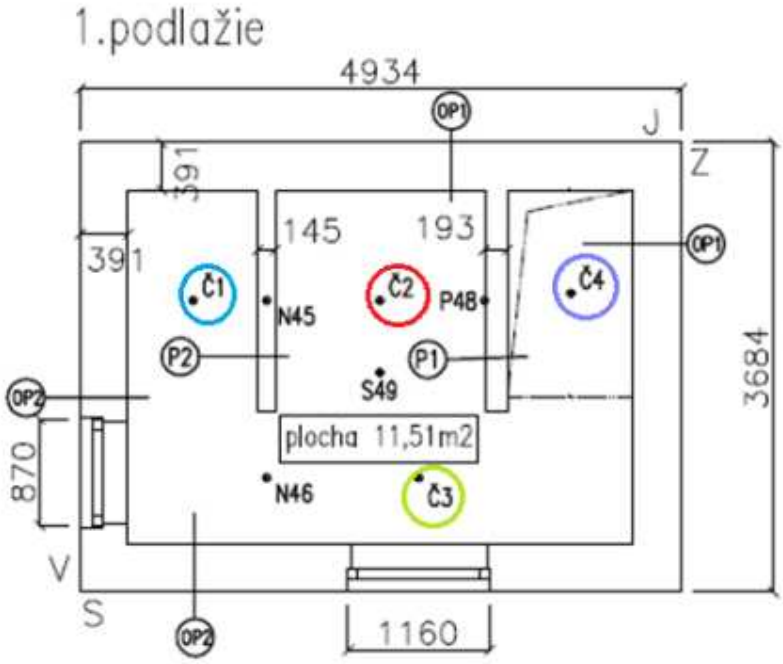
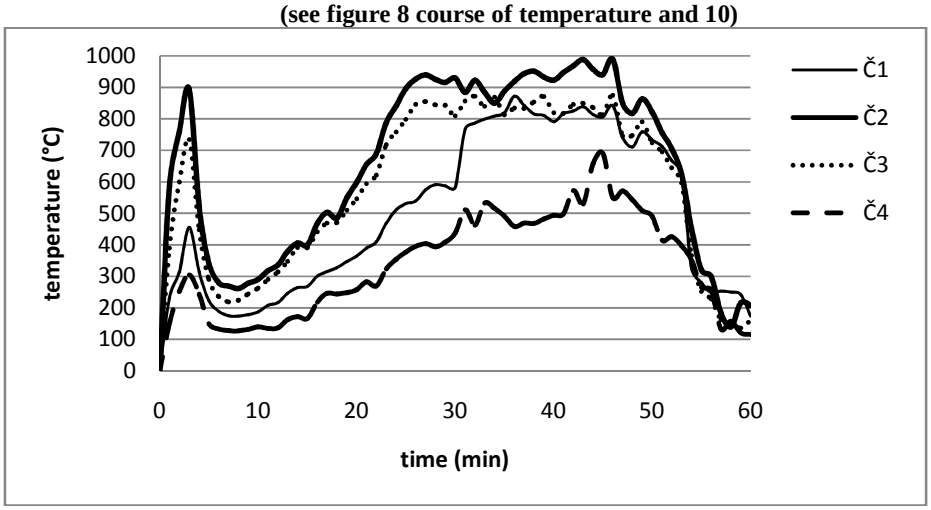


Fig. 9 Location of thermocouple no. 2 in the middle of the building above the fuel (see figure 8 course of temperature and 10)



Obr. 10 Temperatures of the burning fuel in the space of the first floor houses

Fig. 11 Side view of the building at the beginning of experiment.

Fig. 12 Front view of the building during developed fire in the interior of the lower deck.

RESULTS

The building stands. After cooling the interior of a Fire and Rescue Service, and the findings of the static security conference participants could inspect the building after the fire model. Of course along the interior wall shows signs of fire burn see fig. 13 and 14 Statics is not disturbed, individual wooden parts of the interior are no signs of fire (see fig. 15 and 16) Also the temperatures on fig. 15 measurement sites (see fig. 8) suggest that model-wooden house withstood the fire. What is the difference between a model and a real fire? The model was intense fire burned all the fuel in space at the same time, which was ignited by the initiator (15 liters of diesel). Real fire develops less intense and not in the whole space at once.

Fig.13 Smoky interior space

Fig. 14 Demage of panelig in fireplace

Fig. 15 Preserved wooden componests under paneling

Fig. 16 Preserved wooden beams and OSB board

In addition visual assessment, photographic documentation is important for temperature measurement in construction. In fig. 17 are symbols in addition to C2 and N45, N46, S49, P 48, which is the number of thermocouples placed N - the beams, P - the partitions and S - the ceiling, the wooden sheathing layer. The maximum temperature was measured in the cross member, which is in direct contact with fire and fuel, to end of the experiment 300 ° C, remaining thermocouple during the experiment does not exceed 100 ° C (see Fig. 18).

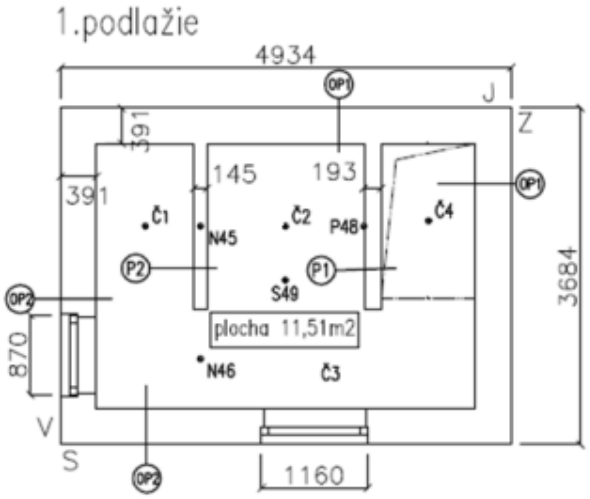


Fig. 17 Symbols of thermocouples located on the first floor

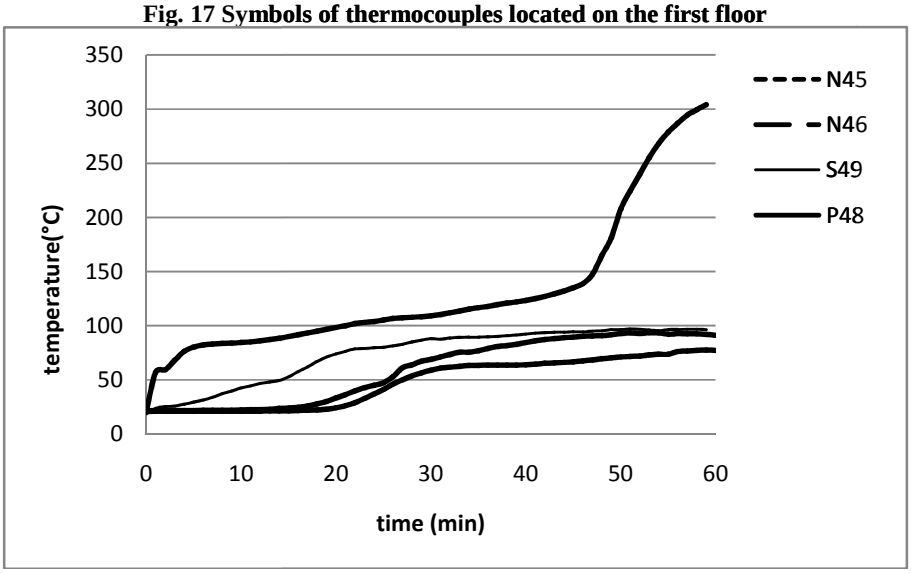


Fig. 18 The course of temperature in the wooden construction elements - the first floor.

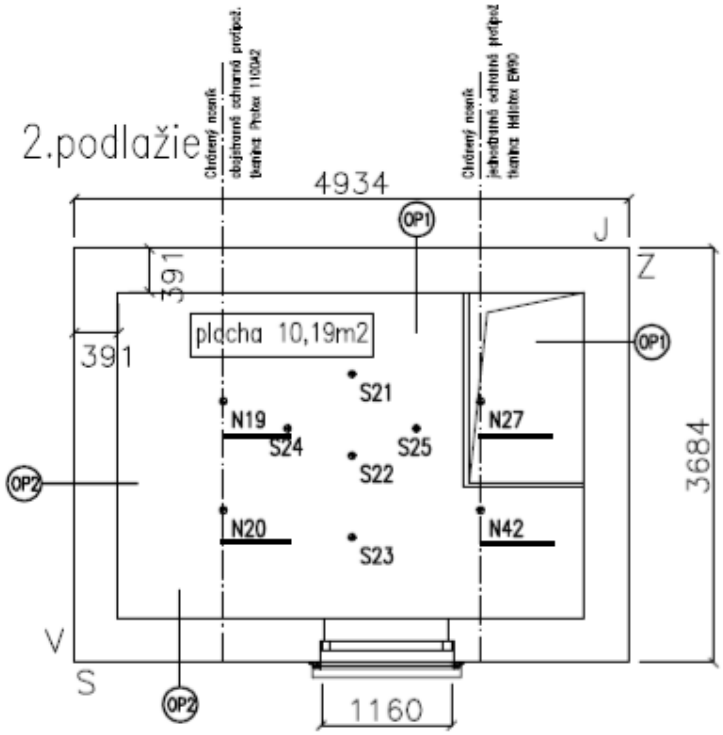


Fig. 19 Symbols of thermocouples located on the second floor

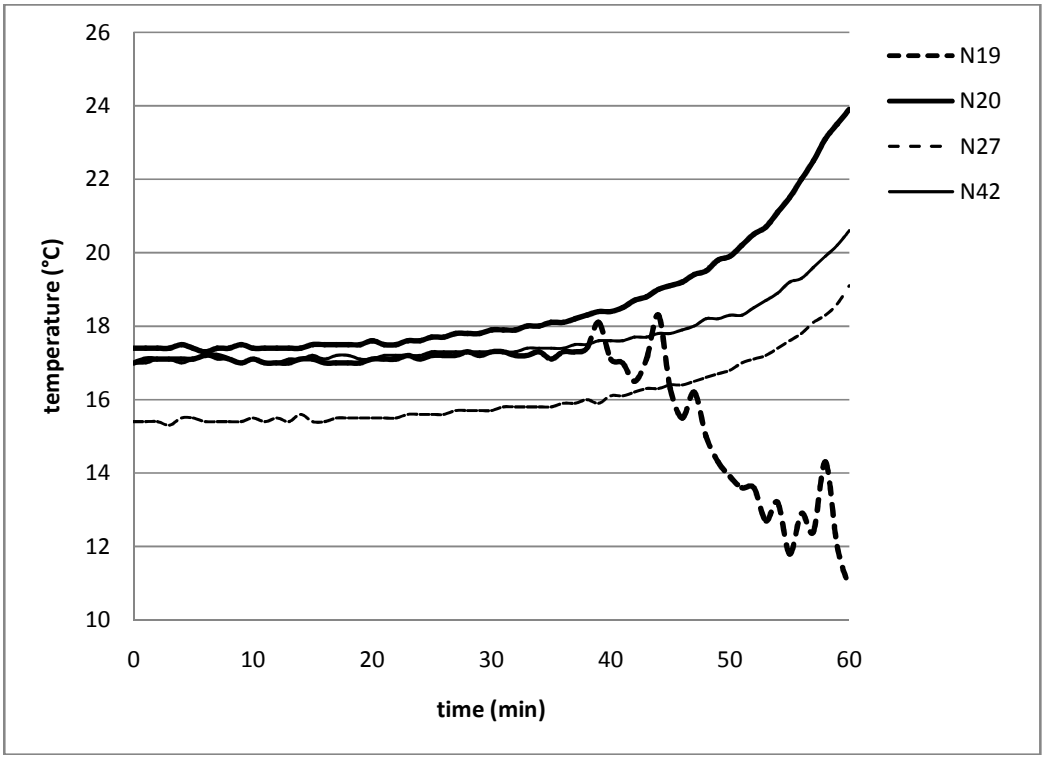


Fig. 20 The course of temperature in the wooden construction elements - the second floor.

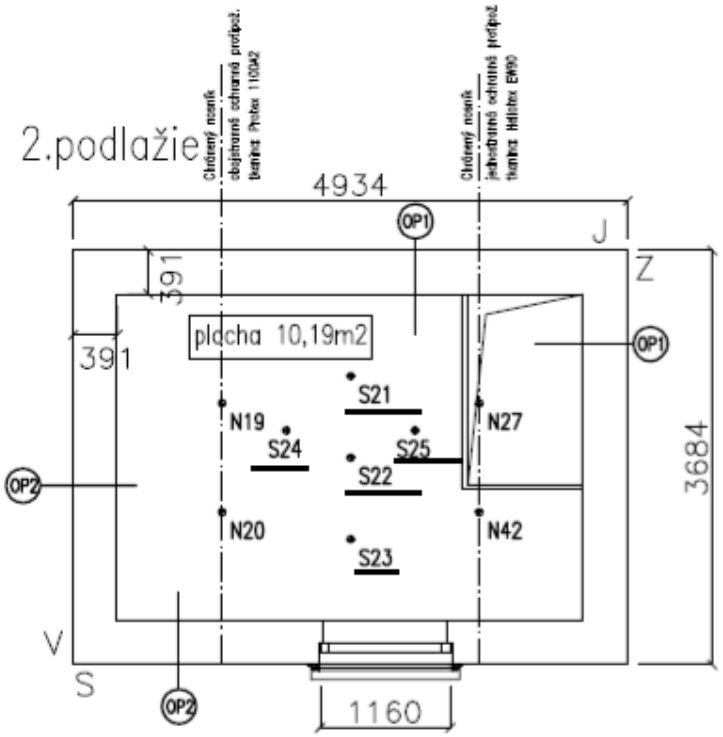


Fig. 21 Symbols of thermocouples placed on the ceiling of the second floor

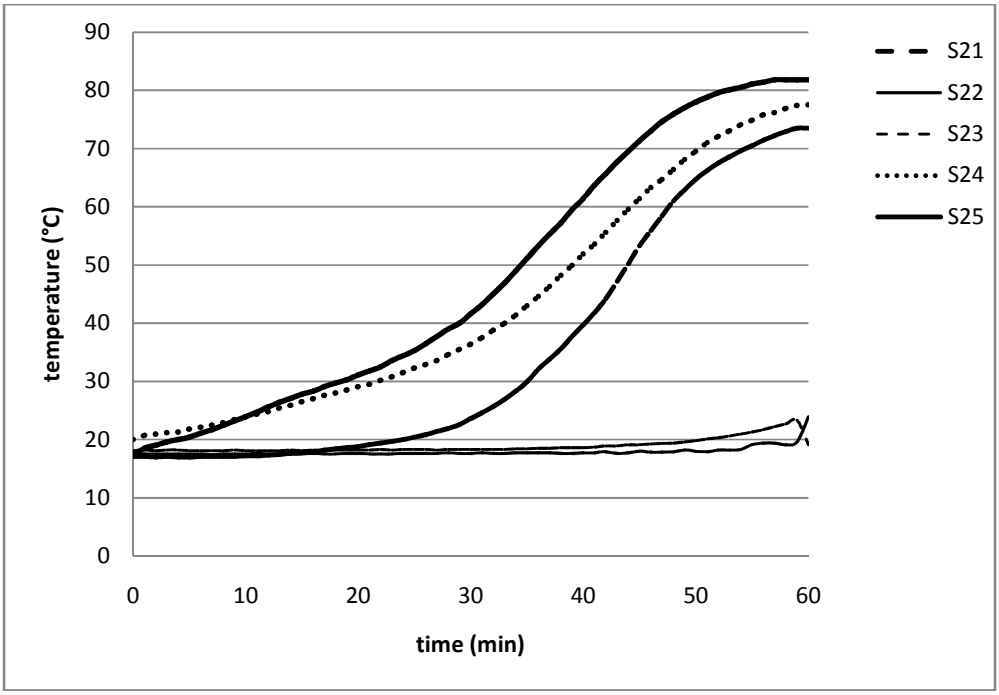


Fig. 22 Temperatures on the second floor ceiling

Thermocouple N19 failure stop about 40 min to measure. Ambient temperature was 13.5 ° C, the fire protection to the beams in the second floor does not exceed 24 ° C. The ceiling did not reach 90 ° C in thermocouples to measure the interior (ceiling) of the second floor and about 20 ° C for thermocouples that were lining the second floor ceiling. It should

be noted that the second floor was the first "connected" fictive staircase (see figure 9). Fourth position of the thermocouple this is confirmed by the course of temperature in fig. 10, where the thermocouple is even above the fuel is the lowest temperature because it is cooled by flowing air. Through the doors that were opened during the test airflow and combustion products into the second floor. The fire from the first floor, which has sufficient strength, could ignite the second floor wooden structure. It should be noted that the wooden structure was converted for fire resistance according to Eurocode 5 to 60 min. This calculation, as well as the material composition was verified by experiment outsized.

CONCLUSION

The question "Is it possible to build a wood structure that can withstand fire?" Should be answer. Can you ask counter-"What do statistics fires?" Every building of any material can be subject to fire. The scope of fire intensity is always the initiator, layout construction, poor quality of work carried out and a number of other human weaknesses that always reveals the fire. Reiterates in every building of any material. If you use quality materials, be subject to quality craftsmanship, applied to the elements of fire protection and multi-storey wooden house is fire safe.

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