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Fire resistance tests of aluminium glazed partitions with timber insulation inserts

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Abstract: *This paper discusses the main problems related to the fire resistance of aluminium glazed partitions with timber insulation inserts, including the tests methodology and way of classification of this type of elements. Moreover, the paper presents the comparison of fire resistance test results of glazed partition with timber insulation inserts test specimens, depending on the side of fire exposure.*

Keywords: glazed partition, aluminium profile, timber insulation insert, fire resistance

INTRODUCTION

The inner walls of the building, which do not constitute the structure, and thus do not possess the loadbearing properties are referred as partitions. The main task of the elements of this type is to separate rooms in the building, therefore it should be designed and constructed in the manner that ensure, inter alia, the fulfillment of the fire safety requirements. In case of fire partition wall shall limit the spread of fire and smoke in the building, allow the evacuation of users and ensure the safety of rescue team.

There are many types of fire resistant partitions commonly used in Europe e.g. gypsum-plasterboards walls [18], sandwich panel walls [19], partitions made of glass blocks [15] steel glazed partitions [14, 17], timber glazed partitions [9, 11] or aluminium glazed partitions [10, 13]. Because of the subject only the last one from listed above will be discussed in this paper.

Aluminium glazed partitions with a specific fire resistance class have a frame (mullion – transom) structure in which the areas between the aluminium profiles are filled with special fire resistant glass panes – monolithic [21] or layered (with intumescent gel) [20]. The most commonly used in practice are three-chamber profiles made of two aluminium parts connected by means of thermal separators (eg. made of polyamide reinforced with glass fiber) [22]. In order to ensure the insulation and reduce the adverse impact of thermal effects chambers of the profiles are filled with the insulation inserts (eg. made of plasterboard, cement silicate or calcium silicate). This paper presents the test results for untypical structural solution – glazed partitions made of aluminium profiles without the thermal separator and filled with timber insulation inserts.

FIRE RESISTANCE TEST AND CLASSIFICATION [1 – 17]

Fire resistance class of glazed partitions cannot be calculated or assessed on the basis of its project or other specification. The only way to determine the real fire resistance class is to perform the fire resistance test of its fully representative specimen (including any surface finishes and fittings which are essential and may influence its behavior in the test). If the partition wall has a symmetrical cross-section, then it is sufficient to test it only from one side. In other case, it is necessary to check the wall from both sides in order to get fully assessment.

To reflect the conditions of fire inside the building the test specimen is heated by special furnace in accordance with the standard temperature-time curve, presented by the solid

line in fig. 1. This curve according to the European fire resistance testing standards [2 – 4] is taken as an appropriate to reflect the fully developed, following the flashover fire inside the building.

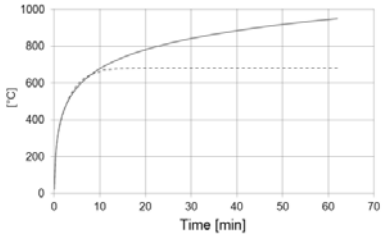

Figure 1 Temperature-time curves, solid line – standard curve, dashed line – external fire curve

During the fire resistance test of glazed partitions the effectiveness of the following performance criteria can be verified: integrity (E), insulation (I) and radiation (W). Integrity is the ability of glazed partition test specimen, when exposed to fire on one side, to prevent the passage through it of hot gases and flames and to prevent the occurrence of flames on the unexposed side. During the test integrity is verified: visually (it fails when on the unexposed surface of tested specimen flaming longer than 10 s occurs), by means of gap gauges (integrity fails if the 6 mm gap gauge can be passed through the test specimen and can be moved a distance of 150 mm along the gap, or if the 25 mm gap gauge can be passed through the test specimen such that it projects into the furnace), by means of cotton pad, which is used against the unexposed surface of tested specimen, for max. of 30 s, or until ignition (defined as glowing or flaming). Insulation is the ability of glazed partition test specimen when exposed to fire on one side, to restrict the temperature rise of the unexposed face to below specified levels. The temperature rise on the unexposed surface of tested specimen is verified with thermocouples attached with use of heat resistant adhesive or roving thermocouple. The fixed thermocouples are attached in the specific places given in the standard and the roving thermocouple can be used in every place where there is a suspicion of exceeding the insulation criteria. In case of profiled glazed partitions, in order to maintain its insulation – maximum temperature rise on the profiles cannot be greater than 180 K and average temperature rise on each glazing cannot be greater than 140 K. Radiation is the ability of a glazed partition test specimen, when exposed to fire on one side, to prevent the passage of the fire, due to the transfer of significant heat through the element or through its unexposed surface to the adjacent materials. Radiation in the test is measured with the radiometer placed in the distance of 1 m from the geometric center of the unexposed surface of tested specimen. Radiation is evaluated on the basis of the time at which the maximum radiation measured does not exceed 15 kW/m^2. Moreover, during the test deflection of the test specimen shall be measured although there are no performance criteria associated with it. The deflection of the test specimen may be important in determining the direct and/ or extended field of application field of application of the test result [5, 12].

Classification of glazed partition fire resistance is prepared basing on the test results presented in test report. According to the European Union provisions the fire resistance test shall be performed in accordance with EN 1364-1:2015 and the classification shall be compiled in accordance with the requirements given in EN 13501-2:2009. Classification standard [1] defines fire resistance classes shown in table 1.

Table 1 Fire resistance classes (E – integrity, I – insulation, W – radiation) [11]

E		20	30		60	90	120		
EI	15	20	30	45	60	90	120	180	240
EW		20	30		60	90	120		

FIRE RESISTANCE TEST RESULTS COMPARISON

The comparison was made for two test specimens with the same transom – mullion structure and dimensions of 3,6 x 3,6 m. The specimens were made of symmetrical aluminium profiles, structural depth of 115 mm filled with insulation inserts made of pine timber, density of 500 kg/m^3. The areas between the profiles were filled with glazing made of special fire resistance glass pane (placed on the one side) and toughened glass pane (placed on the opposite side), except of the one area which was filled with opaque panel made of chipboard, mineral wool, plasterboard and steel sheet. In the first test the specimen was heated from the side of fire resistant glass pane and in the second the test specimen was heated from the side of toughened glass pane. The view of the unexposed surface of tested specimens is presented in fig. 2.Test results comparison made for the average temperature rises on the transoms and mullions is presented in fig. 3.

Figure 2 The view of the unexposed surface of tested specimens – a) specimen heated from the fire glass pane side, b) specimen tested from the toughened glass pane side (Source: Fire Research Department of ITB archives)

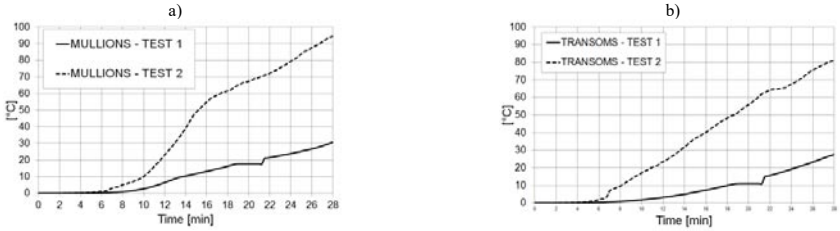

Figure 3 Comparison of average temperature rise on the unexposed surface of tested specimens depending on the side of fire exposure – a) temperature on the mullion profiles , b) temperature on the transom profiles (Source: Fire Research Department of ITB archives)

CONCLUSIONS

Fire resistance of glazed partitions depends on many factors of the system solution such as: profile material and shape, type and volume of used insulation inserts, type of glazing, glazing fixing method. Even a slight change in the structure of the glazed partition can significantly reduce its fire resistance and therefore determining the real fire resistance class of partition wall is only possible on the basis of fire resistance test results. Analyzing the test results presented in fig. 3 it can be observed the impact of the side of fire exposure for unsymmetrical elements. Observed phenomenon confirms the necessity of verifying the fire resistance of elements with unsymmetrical glazing from both sides, even then when the element structural profile is fully symmetrical.

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Streszczenie: *Badania odporności ogniowej aluminiowo-szklanych ścian osłonowych z drewnianymi wkładami izolacyjnymi*. W artykule omówione zostały główne aspekty związane z odpornością ogniową aluminiowo-szklanych ścian działowych z drewnianymi wkładami izolacyjnymi, w tym procedura badania oraz sposób klasyfikacji elementów tego typu. Ponadto w artykule przedstawione zostało porównanie wyników badań elementów próbnych aluminiowo-szklanych ścian działowych z drewnianymi wkładami izolacyjnymi w zależności od kierunku oddziaływania ognia.

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