

Fire resistance of timber glazed partitions

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Abstract: This paper discusses the main issues related to the fire resistance of timber glazed partitions. Fire resistance tests methodology and the way of the classification of such elements have been presented. Technical solutions which help to achieve the expected fire resistance class have been described. Moreover, an example of the temperature rise resulting on unexposed surfaces of timber profiles in glazed partitions have been presented.

Keywords: *timber glazed partition, fire resistance, integrity, thermal insulation, radiation*

INTRODUCTION

The partition wall is a type of the inner wall in the building. It does not form the structure, and thus is designed in such a way that it is not exposed to any other loads beyond its own weight. [1] According to the regulations of European Union countries (in case of buildings for a specific purpose, e.g. hospitals, hotels) partition walls as a non-load bearing element of the building should be designed and constructed in such a way that in case of a fire it will limit the spread of the fire and smoke in the building, allowing the evacuation of users and ensure the safety of the rescue team. Therefore, in this type of building, partition walls shall fulfill the requirements of fire resistance. There are many types of fire resistance partitions commonly used in Europe, e.g. gypsum-plasterboards walls, sandwich panel walls, aluminum glazed partitions, steel glazed partitions or timber glazed partitions. Due to the subject, only the latter from the above listed partitions will be discussed in this paper. Fire resistance class of timber glazed partitions cannot be calculated or assessed in its entirety without conducting individual fire resistance tests.

Fire resistance tests and classifications [2], [3]

A fire resistance class is given to the timber glazed partition in accordance with EN 13501-2+A1:2009 [4]. Classification standard [4] defines fire resistance classes shown in Table 1.

Table 1 Fire resistance classes

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

(E – integrity, I – insulation, W – radiation, M – resistance to mechanical impact)

Classes presented in Table 1 are given on the basis of the fire resistance test performed in accordance with EN 1364-1:1999 [5].

The fire resistance test which is carried out on the test specimen – special construction fully representative of the timber glazed partition intended for the use in practice (including any surface finishes and fittings which are essential and may influence its behavior in the test) or be designed to obtain the widest applicability of the test result to other similar constructions. If the partition wall has a symmetrical cross-section, then it is sufficient to test it only from one side. In the case of asymmetrical cross-section, it is necessary to check the wall from both sides.

The heating of the test specimen is held by the standard temperature-time curve, determined by the formula 1.1, taken as an appropriate simulation to reflect the fire inside a building (fully developed, following the flashover). Example of temperature/time heating conditions in furnace during the timber glazed partition test is presented in Fig. 1.

$$T = 345 \log_{10}(8t + 1) + 20 \tag{1.1}$$

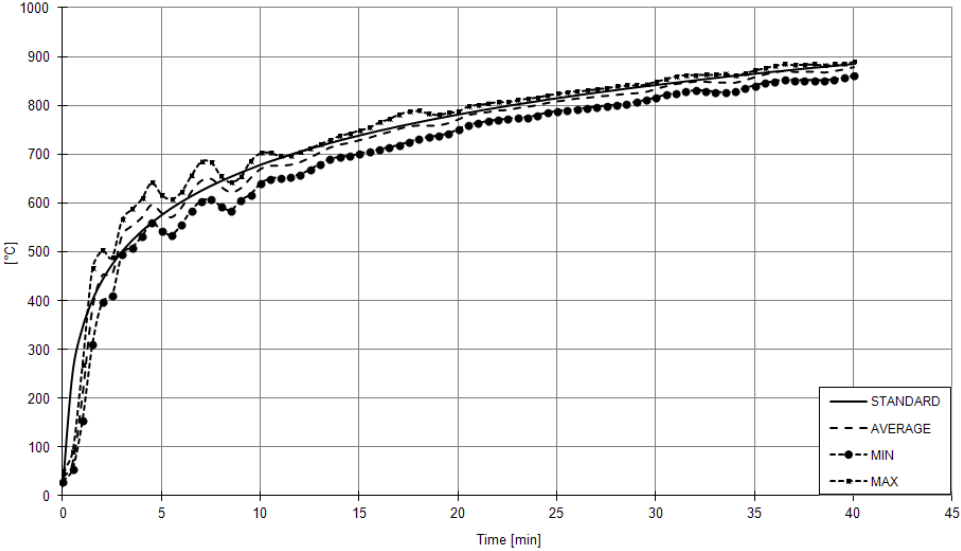


Fig. 1. Temperature/time heating conditions in furnace during the timber glazed partition test

During the fire resistance test of timber glazed partitions the effectiveness of the following performance criteria is verified:

- Integrity – ability of a test specimen of a separating element of building construction, when exposed to fire on one side, to prevent the passage through it of flames and hot gases and to prevent the occurrence of flames on the unexposed side. [6] In the test integrity is verified by cotton pad (used against the unexposed surface of the tested specimen, for max. of 30 sec., or until ignition, which is defined as glowing or flaming), 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) and visually (integrity fails when flaming longer than 10 sec. occurs on the unexposed surface of the tested specimen).
- Insulation – ability of a test specimen of a separating element of building construction when exposed to fire on one side, to restrict the temperature rise of the unexposed face to below specified levels. [6] The temperature rise on the unexposed surface of the tested specimen is checked with thermocouples attached with the use of heat resistant adhesive. Thermocouples are attached in the specific places given in EN 1364-1 [5]. In the case of timber glazed partitions, in order to maintain its insulation – maximum temperature rise on the timber profiles cannot be greater than 180 K and the average temperature rise on each glazing cannot be greater than 140 K.
- Radiation – the ability of the test specimen of a separating element of the building construction, when exposed to the fire on one side, to prevent the movement 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 1 m distance 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/m².

- Impact – *the fire resistance of specific classes of walls with a fire separating function can be influenced by impacts arising from the failure of other components or objects exposed to fire.*[7] Resistance to mechanical impacts is verified by hitting the partition with the impact body, total mass of 200 kg (double sheet sack, dimensions of 650 x 1200 mm when empty; filled with bags, each containing 10 kg of lead shot into diameter of 2 ÷ 3 mm and closed by a steel band) which is suspended by a steel cable, attached to a fixed point on the test apparatus. The impact energy is obtained by swinging the objects into the body of the target. A total of three impacts shall be applied to the test specimen within five minutes after the end of the classification period. After the strikes the element should not fail its integrity and insulation to get the EI-M classification.

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 field of application; and may also be important in determining the extended field of application of the test result.

The test may be terminated for one or more of the following reasons – request of the test sponsor, to attain the selected criteria, the safety of personnel or impending damage to equipment.

TECHNICAL SOLUTIONS

Timber glazed partitions are made as a framework structure in which the areas between the timber profiles (mullions and transoms) are filled with the special fire resistant glazing. The type of wood and glazing, dimensions and structure of the profiles are selected depending on the solution appropriate for the expected fire resistance class. An example of the profile cross-section is presented in Fig. 2.

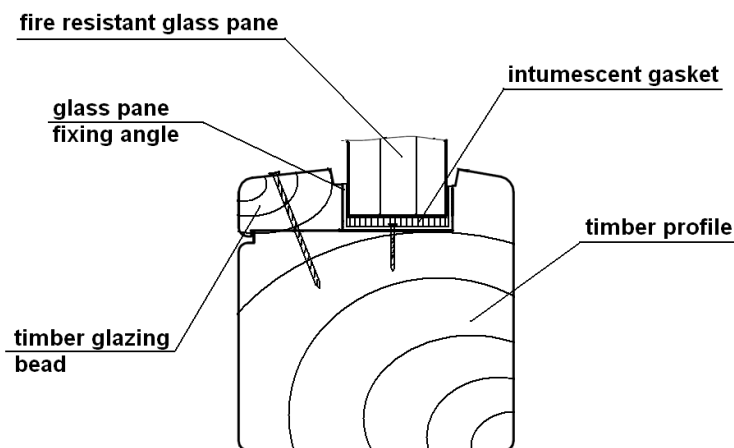


Fig. 2. Example profile cross-section

The profiles can be made as a single element (as shown in Fig. 2), or be composed of several parts glued together, consisting of different kinds of wood or divided by special inserts made of materials with superior fire resistance properties. The safe solution, is to mount the glass panes by means of steel angles – that will prevent prolapse of the glazing after the charring of the profile in the area of glazing beads. Very important elements in the structure are intumescent gaskets placed on the perimeter of the glass panes. Intumescent gaskets expands under the influence of high temperatures and close the spaces through which the fire could get to the other side of the partition.

The temperature rise of the surface of timber profiles

In order to maintain the insulation of timber glazed partition, maximum temperature rise on the surface of the timber profiles cannot be greater than 180 K. In Fig. 3 there are presented average temperature rises on pine wood profiles (cross section of ~ 90 x 90 mm) and glazing of timber glazed partition. In Fig. 4 there are presented average temperature rises on pine wood profiles and glazing in relation to the average temperature within the furnace. Timber glazed partition was tested in accordance with EN 1364-1:1999 [5] (heating from the glazing beads side).

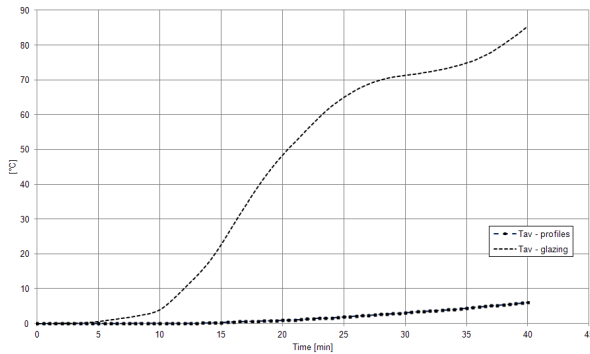


Fig. 3. Average temperature rises on pine wood profiles and glazing of timber glazed partition

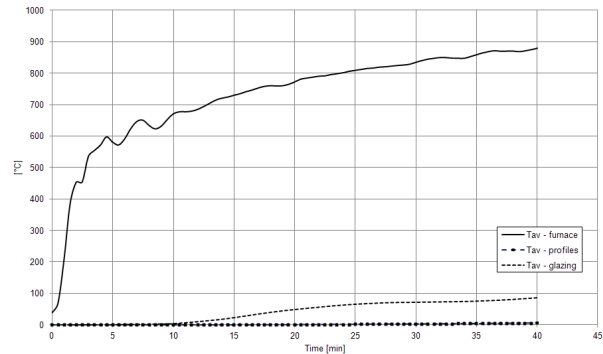


Fig. 4. Average temperature rises on pine wood profiles and glazing in relation to the average temperature in the furnace

CONCLUSIONS

Properly designed timber glazed partitions may be a barrier difficult to be overcome by the fire. In the case where the dimensions of the profiles and the type of wood are correctly selected, the temperature rise on the profiles is relatively low. The only problem that may occur is within the choice of using the appropriate glazing and the method of its fixing. Due to the fact that the fire resistance of timber glazed partitions is affected by many factors (e.g. the type of wood and glazing, the method of glaze fixing, the dimensions and structure of the glass panes and wooden profiles), the only way to determine the real fire resistance class of such elements is to carry out further tests.

REFERENCES

Journals

1. Sędłak B., 2013: Systemy przegród aluminiowo szklanych o określonej klasie odporności ogniowej, Świat szkła; R.18, nr 10, 30-33,41 (*in polish*)
2. Roszkowski P., Sędłak B., 2011: Metodyka badań odporności ogniowej przeszklonych ścian działowych, Świat szkła, R.16, nr 9, 59-64 (*in polish*)
3. Roszkowski P., Sędłak B., 2012: Klasyfikacja w zakresie odporności ogniowej przeszklonych ścian działowych, Świat szkła, R.17, nr 7-8, 54-59 (*in polish*)

European Standards

4. EN 13501-2+A1:2009 Fire classification of construction products and buildings elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services
5. EN 1364-1:1999 Fire resistance tests for non-loadbearing elements. Walls
6. EN 1363-1:2012 Fire resistance tests - Part 1: General Requirements
7. EN 1363-2:1999 Fire resistance tests - Part 2: Alternative and additional procedures

Streszczenie: W niniejszym artykule omówione zostały główne problemy związane z odpornością ogniową drewnianych przeszklonych ścian działowych. Przedstawiona została metodyka badania w zakresie odporności ogniowej oraz sposób klasyfikacji tego typu elementów. Omówione zostały rozwiązania techniczne pozwalające na osiągnięcie oczekiwanej klasy odporności ogniowej. Ponadto przedstawiono przykładowe wyniki przyrostów temperatury na nienagrzewanej powierzchni drewnianych profili przeszklonych ścian działowych.

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