Falling parts of external walls claddings in case of fire – ITB test method – results comparison

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Abstract. Paper presents ITB methodology of testing and assessment of buildings with regard to falling of external walls claddings in case of fire. In the ITB methodology of impact on the facade (external claddings) was assumed in form of flames, generated from a specially designed propane, sand burner with a defined fuel flow rate and laminar airflow from the inside of the furnace resulting in determined temperature and height of the flame. Evaluated criterion is also discussed. Test results of several different types of claddings is analysed and presented in relation to the national Polish regulation along with some technical assessment regarding individual.

1. INTRODUCTION

In this paper methodology of testing and assessment of buildings with regard to falling of external walls claddings in case of fire is presented. Some of the test results are analysed and presented in relation to the national Polish regulation.

The necessity to ensure safety of people evacuating from the building and members of rescue teams in case of fire is one of the essential requirement concerning fire safety [7, 14, 15]. Therefore this requirement also shall apply to the risk associated with the possibility of parts falling from the exterior wall in case of fire. It is worth emphasizing, that the requirement applies not only to fire resistant parts of facades, but practically to the entire exterior wall of every construction work. For fire resistant curtain walls this problem is better recognized [5–7, 9–13] and the risk is arguably eliminated [4]. For other types of outer walls solution effective evaluation and influencing of limiting that risk is possible only with implementations of appropriate test method.

2. ITB TEST METHOD

ITB test method was developed and implemented in Fire Research Department of the Building Research Institute. After establishment of initial assumptions method was formed in the process of several calibration tests, Fig. 2. During the calibration tests, following conditions were taken into account:

- the height and temperature of the flame tip (based on EOTA Technical Report N073 [3] guidelines),
- the temperature on the lintel in correlation with standard fire curve,
- distribution and shape of the flames [8].

Figure 1. Calibration test, temperature measurements.

Figure 2. Calibration test.

Dimensions of the representative test specimens were determined, as follows:

- width: 2100–2400 mm,
- height: 2000–2500 mm.

The criterion evaluated in ITB test method for assessment of buildings with regard to falling of external walls claddings in case of fire was that the mass of falling parts cannot be greater than 5 kg.

3. INSTRUMENTATION

In the ITB methodology impact on the facade (external claddings) was assumed in form of flames, generated from a specially designed propane sand burner with a defined fuel flow rate and laminar airflow from the inside of the furnace resulting in determined temperature and height of the flame.

Figure 3. Propane burner.

Figure 4. Composite panel fixed mechanically.

The temperature rise on unexposed surface of the test specimens was measured during the calibration tests with standard plate thermocouples (type K). Results of temperature measurements on unexposed surface of the wall were used for determination of the flow rate of the propane burner designed based on EN 14390:2007 [2] standard, but of much larger size (170×800 mm). For regular fire tests the only checked value was air flow and burner fuel flow rate (with high – precision mass flow controller).

4. TEST RESULTS

After establishing of strictly defined test conditions several fire tests were performed. Tests were carried out in compliance with the adopted procedure, that tested, inter alia, solutions with facade claddings in the forms of: composite panels (Fig. 4), ceramic claddings (Fig. 6) stone claddings (Fig. 5), fibre cement plates (Fig. 7) and sandwich panels (Fig. 8) and other solutions not included in this presentation. All six fire tests selected for the presentation were conducted in Fire Testing Laboratory of Building Research Institute in Pionki.

Figure 5. Stone claddings fixed mechanically.

Figure 6. Ceramic claddings fixed mechanically.

5. DISCUSSION

Analyzing the results of selected fire tests, performed in accordance with ITB test method, it was observed that much safer solutions are those wherein the claddings are fixed mechanically in opposition to solutions that used adhesives [15]. However, in some cases, this has no relevance to the outcome of the fire test due to the behavior of some materials when heated, where ceramic claddings are perfect example (Fig. 5).

Other interesting observations is that after 30 minutes since the start of the fire test, test specimen degrades very little or nothing at all. In Polish National Regulations [1, 14–16], in terms of time, requirement applies to 60 or even 120 minutes periods in witch spandrel of external walls should

Figure 7. Fibre cement plates fixed by adhesive.

Figure 8. Sandwich panels fixed mechanically, type 1.

maintain its integrity and the fixing of the external wall claddings shall prevent its parts from falling. Regularity observed in fire test leads to the conclusion, that this parameter in Polish National Regulations seems excessive.

Established criterion (5 kg for single falling element) appears to be reasonable for buildings of height below 25 m. In case of higher buildings [16] even this, relatively low, mass seems to be too high to ignore the potential threat, as the energy of 5 kg element after a period of free-fall could be dangerous. For such buildings, careful planning of escape routes should be required to reduce the danger for people evacuating and rescue teams.

Statistically in Poland injuries sustained by people evacuating from the building in case of fire and members of rescue teams, caused by falling parts of external walls, are extremely rare. And that is despite

Figure 9. Sandwich panels fixed mechanically, type 2.

the fact, that many of the building works facades does not meet discussed requirements. Nevertheless it's very important to have a test method – engineering tool that allows reliable evaluation of different technical solutions using explicit criterion.

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