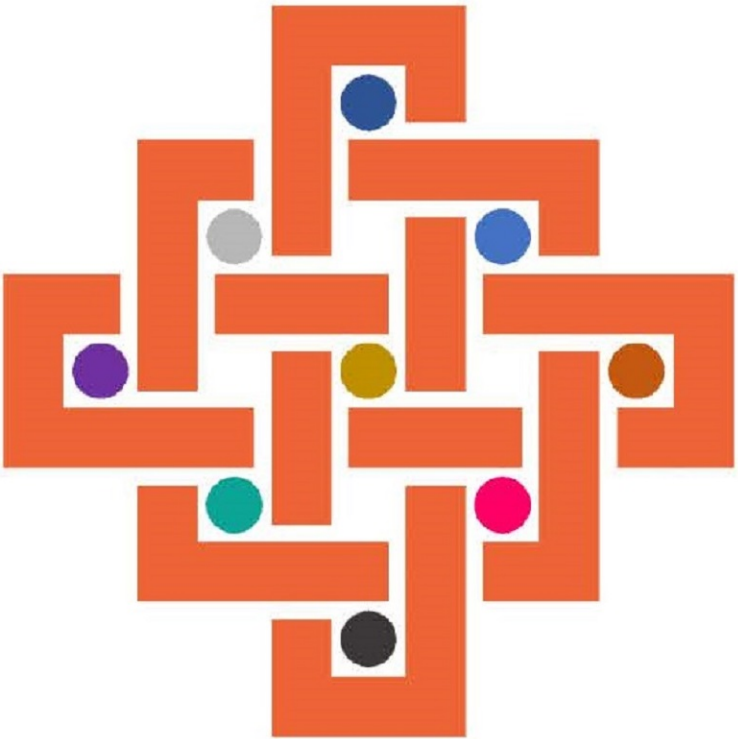
„EUROCODES - GATE TO EUROPE“



ДГКМ

ДРУШТВО НА ГРАДЕЖНИ КОНСТРУКТОРИ НА МАКЕДОНИЈА

MASE

MACEDONIAN ASSOCIATION OF STRUCTURAL ENGINEERS

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EUROPEAN AND NATIONAL ASSESSMENT PROCEDURE FOR THE FIRE PERFORMANCE OF FACADES

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ABSTRACT

Innovative construction systems, increasing use of combustible material in facades, less and less space between buildings, increased energy requirements; the transformation of facades in response to these changes requires the involvement of fire safety experts. As the fire incidents at Grenfell Tower, London and The Address in Dubai have demonstrated, use of combustible façade elements and lack of fire spread measures resulted in massive loss of life and property. This fire spread through the various floors in double-quick time, primarily through the façade. We need to learn from these disasters. Other incidents prove that the use of non-combustible façade products can greatly inhibit the spread of fire and give both people and fire authorities' sufficient time for evacuation and fire suppression.

In the past years EU experts are working on development of common method for assessment of the fire performance of façade systems. The classification system should be transparent and should fit within the framework of existing national regulations. The common assessment method should be applicable to the wide range of façades systems available in the market including glazed façades, green façades and other emerging technologies.

There is a progress in developing legislation on façade fire safety in non-EU countries, due to emerging fire safety problems and harmonization of regulation with EU. Fire safety of facades in Serbia is defined through several rulebooks and standards, which significantly improved requirements. This paper presents the comparative analysis of legislation on facade fire safety in Serbia and other European countries.

Keywords: Façade; Fire Safety; Regulations; Standards.

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1. INTRODUCTION

Fire safety, in the context of the façade, starts at the design stage. This must be a collaborative and coordinated process, along with the other technical disciplines and architects to ensure that the design aesthetic intent is met, with the technical performance required.

Until around 20 to 25 years ago, the spread of fire over and in facades played only a minor role. The reason for this is that the outer walls mostly comprised massive mineral materials such as brick masonry or concrete coated with a non-combustible rendering. The spread and promotion of fire over the outer surface of external walls due to the ignition of facade components can be ruled out under these conditions. The spread of a fire to another storey only occurred if flames from a fully developed fire emerging from a room impinged on the window in the storey above the location of the fire.

Many combustible materials are used today in commercial wall assemblies to improve energy performance, reduce water and air infiltration, and allow for aesthetic design flexibility. With the increased use of flammable materials in external wall cladding it became necessary to suitably evaluate their fire safety properties, considering the real demands in the case of a fire. There have been a number of documented fire incidents involving combustible exterior walls but a better understanding is needed of the specific scenarios leading to these incidents to inform current test methods and potential mitigating strategies.

The current fire safety codes for buildings in Republic of Serbia have had a transformational effect on the fire performance of façades [1-6]. Prior to their introduction, there were many examples of inappropriate designs and materials or systems selection. We are often dealing with that legacy now. Since the latest legislation on testing the essential characteristics of construction products (reaction to fire, fire resistance and behavior in external fire – in accordance to SRPS EN 13501 standards) [6] dates from February 2022, with a year transition period. This rulebook is fully harmonized with European legislation. The previous one [7] is still in parallel use with the new one, until the end of transition period. According to [7], construction products are tested to non-combustibility, flame spread rate and fire resistance, applying a serial of Yugoslav standards (JUS).

In many European countries it is a requirement to carry out large-scale tests using full-scale test rigs to evaluate the fire performance of external wall cladding systems. The reason for this is that the laboratory test methods (e.g. those according to EN 13501-1 or national standards) used for the classification of the reaction to fire performance of building materials are unsuitable for a realistic simulation of the fire performance of external wall cladding systems.

This paper presents the comparative analysis of legislation on facade fire safety in Serbia and other European countries.

2. EUROPEAN APPROACH TO ASSESS THE FIRE PERFORMANCE OF FACADES

The European Commission financed the project [8] to provide EC Member States regulators with a means to regulate the fire performance of façade systems based on a common European approach. The project was established to provide a proposed European harmonised approach to the fire performance assessment and classification for façade systems. Several questions were asked in the enquiry regarding the test methods used nationally to verify the fire performance of façades. Figure 1 below summarises the scope and scale of the test method, four of the methods are medium scale, and the remaining eight are large scale.

Three similar medium scale tests (DIN 4102-20, ÖNORM B 3800-5 and ISO 13785-1) are based on the fire scenario of a developing fire inside the building and the impact of flames emerging the opening on the lintel and the façade immediately above the opening. The fourth medium scale test (PN-B-02867, used in Poland) addresses the fire from outside the building. The other eight tests in use are large scale tests, seven are addressing a fully developed fire inside the building with flames emerging the opening, and one test addresses the fire from outside the building. Six test methods in use have a test rig with a single wall and five have a corner configuration and one has two wings.

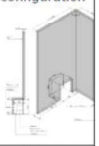
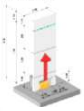
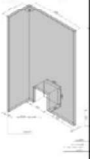
Country	Test method	Scope of test method	Field of application	Scale	Configuration
Germany Switzerland	DIN 4102-20	Complementary test of the cladding systems (each part of the system has to be low flammable according to DIN 4102-1 or DIN EN 13501-1) for classification as low flammable as a system.	Complementary test of the cladding systems (each part of the system has to be low flammable according to DIN 4102-1 or EN 13501-1) for classification as low flammable as a system.	Medium scale	Two wings (i.e. corner) configuration 
United Kingdom (England, Scotland, Wales and Northern Ireland) Republic of Ireland	BS 8414 series	Part 1 - Fire performance of external cladding systems. Test method for non-load-bearing external cladding systems applied to the masonry face of a building. Part 2 - Fire performance of external cladding systems. Test method for non-load-bearing external cladding systems fixed to and supported by a structural steel frame.	Applicable to the system as tested.	Large scale	Right angle, return wall 
Poland	PN-B-02867	Determination of fire behavior of façades without window. The test philosophy is to determine the heat and flames influence contribution of the façade's combustion on the effect of exposure of standard fire source.	All façade systems	Medium scale	Single vertical wall without openings 
Switzerland	Prüfbestimmung für Aussenwandbekleidungssysteme	The test method is used for the evaluation and proof of the fire behavior of external wall covering systems on the original scale, when exposed to fire from a simulated apartment fire with flames emerging out through a window opening.	The test method is applicable to linings and surface coatings (paints, plasters, etc.) used on exterior walls. Included are elements with limited application area. such as decorative elements, cornices and balcony railing garments.	Large scale	Single vertical wall, no wing 
France	LEPIR 2	Determination of fire behavior of façades of building with windows, test method and classification criteria	All façade systems including windows	Large scale	Single vertical wall 
Hungary	MSZ 14800-6	1. Combustible and ventilated façade solutions applied on non-combustible basis wall 2. Special façade solutions, where the vertical distance between the openings are smaller than a certain value (usually 1,3m) (For example between French windows) 3. Other façade structures with openings - solutions without non-combustible basis wall - solutions including a fire barrier - other innovative solutions	There are no provisions for extending the test results.	Large scale	Single vertical wall with two openings. 
Austria Switzerland	ÖNORM B 3800-5	This method simulates a fire from a window burnout of an apartment. The test simulates the flame height in the second floor over the fire floor (the test concept based on Kotthoff-theories). The behavior of the construction and material and the fire spread (flame spread) in the wall/cladding can be studied.	The test method described is applicable to: -ventilated façades -non ventilated façades -ETICS -(as well as for curtain walling according to Austrian building-regulations; from our point of view not possible for products according to EN 13830)	Medium scale	Vertical wall and a right angle wing 

Fig. 1. Outline and scope of the national test methods [8]

It was concluded that the main challenge will be the different compromises must be done, since there are several bodies that will be affected by a new assessment system (regulators, industry, laboratories)

The project report is focusing on keeping the BS 8414 and DIN 4102-20 methods in their original shape, and to add optional measurements for characteristics that are regulated but not covered by the methods. In addition, an alternative method is included in the report, which goes a step further and merges the two methods into one. This option would give one test method and a simple classification system. The classification system contains six different characteristics that may be included in the classification (Table 1). Only the heat exposure is mandatory, all other characteristics are optional.

Table 1. Proposed classification system – Proposed test method. [8]

Feature	Classification	Comment
Heat exposure	LF, MF	LF when a large size fire has been used MF when a medium size fire has been used
Junction	J	Junction between façade and floor
Secondary opening	W	If secondary opening was present and the test successful
Smouldering	S	If smouldering has been considered and the test is successful
Falling parts	F1, F2	If falling parts have been considered and the test has been successful • F1: No part larger than 1 kg and 0.1 m² • F2: No part larger than 5 kg and 0.4 m²
Burning debris	D0, D1	If burning debris have been considered and the test has been successful • D0: No burning debris at all • D1: Limited duration burning debris < 20 s

3. FIRE PERFORMANCE OF FACADES TESTING IN SERBIA

Intensive harmonization of technical regulations with EU legislation is underway in Serbia, and significant changes have been made in the areas of planning and construction of buildings and fire protection. The basic requirements that construction products and buildings have to meet in order to be usable are established. The same requirements must be met when renovating buildings.

The European regulations classify construction products in terms of fire safety according to EN 13501-1, which defines the property of the reaction to fire. The standard was adopted in 2019 and in Serbia its designation is SRPS EN 13501: 2019 Fire classification of construction products and building elements - Part 1: Classification using data from reaction to fire tests [9]. This document provides the reaction to fire classification procedure for all construction products, including products incorporated within building elements.

For the composition of the outer wall with respect to the system or the individual components of the system, the construction products must be applied with the minimum fire response characteristics according to SRPS EN 13501-1 in accordance with [5]. During designing and executing the façade of high-rise buildings, the application of appropriate regulations is necessary [4]. The latest adopted rulebook on testing the fire performance of construction products, including facade systems [6], is fully harmonized with European legislation. The products are considered in relation to their application in real conditions. A reaction to fire is the response of a product, in terms of its contribution to its own decomposition, to a fire to which it is exposed under specific conditions.

Non-combustible building materials are materials of class A1 and A2 according to SRPS EN 13501-1. Combustible building materials are materials of class B, C, D, E and F according to the same standard.

The smoke production during the combustion of materials is being tested according to SRPS EN 13823 (SBI test), according to SMOGRA and TSP600 criteria, and evaluated according to SRPS EN 13501-1. The classes are s1, s2 and s3.

Flaming droplets are parts of material that are separated from the sample during fire tests according to SRPS EN 13823 (SBI test). They are evaluated according to SRPS EN 13501-1 and classes are d0, d1 and d2.

The previous legislation, dating from 1990 [7], considers non-combustibility (Figure 2), flame spread rate (Figure 4) and fire resistance testing (Figure 3) as mandatory testing for construction products. Standard JUS U.J1.090 dating from 1986 regulates testing the fire resistance of walls and standard JUS U.J1.092 regulates the fire resistance testing of fire division walls and non-load-bearing external walls. Additional fire performance of construction products, smoke production and flaming droplets, are not the subject of testing. This overcome legislation will be in parallel use with the new rulebook in one year transition period. It is on construction product producer to decide which test will be applied.

Fig. 2. Fire resistance test of walls (SRPS U.J1.090)

Fig. 3. Non-combustibility test (SRPS U.J1.040)

Fig. 4. Testing of surface spread of flame (SRPS U.J1.060)

4. CONCLUSIONS

There have been numerous fires involving buildings with combustible cladding not just in the Europe, but internationally. In most cases, the extent of damage to the building has been significant, and unfortunately in a few instances, there has been the loss of life. The consequences of such fires are extensive where occupants are displaced and need to seek alternative accommodation. There can also be disputes over the rebuilding costs and who is responsible especially where buildings have multiple owners and tenants. Combustible exterior wall systems may present an increased fire hazard during installation and construction prior to complete finishing and protection of the systems.

Fire safety legislation in Serbia is in process of harmonization with EU legislation. After one year transition period, testing methods for the fire performance of construction products and building elements will in full application.

During the past years the essential fundamentals of a test approach had been worked out by a European task group for a realistic assessment of the fire performance of external wall cladding systems. The scenario of a fully-developed fire in a room adjacent to an external wall and the exposure of a façade to the effects of flames venting through an opening of this room can be considered as the reference fire scenario accepted in Europe by a majority for the test approach. This fire scenario as worst-case also covers the other possibilities of fire exposure of a façade through burning of an adjacent building or burning outside the building directly in front of the façade. The new testing method for facades is proposed, to be harmonized at EU level. This option would give one test method and a simple classification system.

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