



**Building Research Institute**

Science and expert knowledge for the construction industry of the future

## **TECHNICAL OPINION**

With regard to the assessment of the BSP System aluminium substructure with KW4 PAS brackets intended for fastening ventilated façade cladding, including those installed above 25 m and in fire separation zones, in the light of the requirements specified in § 225 of the Regulation of the Minister of Infrastructure

**03199/19/Z00NZP**

Warsaw, November 2019



(This page is intentionally left blank)



# Building Research Institute

Science and expert knowledge for the construction industry of the future

## Fire Testing Laboratory

ul. Ksawerów 21, 02-656 Warsaw  
Tel.: 22 5664284 Fax: 22 8472311  
email: fire@itb.pl

## Masovian Branch – Laboratory

ul. Przemysłowa 2, 26-670 Pionki  
Tel.: 48 3121600 Fax: 48 3121601

Study title: Technical Opinion regarding the assessment of the BSP System aluminium substructure with KW4 PAS brackets intended for fastening ventilated façade cladding, including those installed above 25 m and in fire separation zones, in the light of the requirements specified in § 225 of the Regulation of the Minister of Infrastructure

Register No.: 03199/19/Z00NZP

Ordering Party: **BSP Bracket System Polska Sp. z o.o.**  
ul. Prochowa 35 lok. 31  
04-388 Warsaw

## Contractors:

Team leader: Paweł Sulik PhD, Eng.

Scientific supervision: -

Verification: Bartłomiej Sędłak M.Sc. Eng.

Work started in: October, 2019

Work completed in: November, 2019

Made in: 3 copies

Number of annexes: -

Copy No.: 1, 2, 3 (delete as appropriate)

RESEARCH | OPINIONS | EXPERT OPINIONS

00-611 Warsaw, ul. Filtrowa 1, tel. (22) 825 04 71, email: instytut@itb.pl

[www.itb.pl](http://www.itb.pl)

## Contents

1	Formal grounds.....	4
2	Substantial basis .....	4
3	Purpose and Scope of Study .....	5
4	Technical Description .....	6
5	Analysis .....	9
5.1	Analysis within the scope of § 225 [1].....	9
5.2	The analysis of the application of the KW4 PAS passive brackets above a height of 25 m	11
6	Technical assessment .....	13
7	Final remarks .....	13
7.1	Reservations .....	14

### 1 Formal grounds

- An offer of the Building Research Institute of 14th October 2019.
- An agreement signed between the Building Research Institute and BSP Bracket System Polska Sp. z o.o. on 22nd October 2019.

### 2 Substantial basis

- [1] Regulation of the Minister of Infrastructure dated 12th April 2002 on technical conditions that must be fulfilled by buildings and their location, (Journal of Laws of 2015, item 1422 and of 2017, item 2285).
- [2] A letter of the State Fire Service Headquarters of 30th September, 2013, No. BZ-III-77/15-2/13, concerning the interpretation of the requirements for façade falling off during a fire.
- [3] Development of a European approach to assess the fire performance of façades, Lars Bostrom et al., June - 2018, EUROPEAN COMMISSION, Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs Directorate Industrial Transformation and Advanced Value Chains Unit C.I — Clean Technologies and Products.
- [4] Technical Opinion No. 02772.4/16/Z00NZZP, concerning the evaluation of the BSP system aluminium substructure for fastening ventilated façade claddings, in light of the requirements of § 225 of the Regulation of the Minister of Infrastructure, drawn up by the Building Research Institute in July, 2017.
- [5] National Technical Assessment ITB-KOT-2018/0434, edition 1, Product Kits for manufacturing BSP System substructure for fastening façade claddings, dated 21st November 2018.
- [6] Classification Report of the Building Research Institute, No. 03202/18/Z00NZZP, concerning the extent of fire propagation, according to PN-B-02867:2013-06 for the KW4 PAS passive bracket of BSP Bracket System Polska Sp. z.o.o, of 30th July 2019.
- [7] Classification Report of the Building Research Institute, No. 03202/18/Z00NZZP, concerning the reaction to fire, according to PN-EN 13501- 1:2019 for the KW4 PAS passive bracket of BSP Bracket System Polska Sp. z.o.o, of 30th July 2019.
- [8] Research Report of the Building Research Institute, No. LZP01-03202/18/Z00NZZP, according to PN-EN-ISO 11925-2:2010, regarding the KW4 PAS passive bracket of BSP Bracket System Polska Sp. z.o.o, of 30th July, 2019.
- [9] Research Report of the Building Research Institute, No. LZP02-03202/18/Z00NZZP, according to PN-EN 13823+A1:2014, regarding the KW4 PAS passive bracket of BSP Bracket System Polska Sp. z.o.o, of 30th July 2019.
- [10] Research Report of the Building Research Institute, No. LZP03-03202/18/Z00NZZP, according to PN-B-02867:2013-06, regarding the KW4 PAS passive bracket of BSP Bracket System Polska Sp. z.o.o,

of 30th July 2019.

- [11] Fire classification of the Building Research Institute, No. 3037.1/16/Z00NZP, in the scope of fire propagation through walls, when exposed to fire from outside, according to PN-90/B-02867:1990+Az1:2001, regarding the KW1 PAS, KW2 PAS, and KW3 PAS passive brackets of BSP Bracket System Polska Sp. z.o.o, of 4th May 2017.
- [12] Classification Report of the Building Research Institute, No. 3037.2/16/Z00NZP, concerning the reaction to fire, according to PN-EN 13501- 1+A1:2010, regarding the KWI PAS, KW2 PAS, KW3 PAS passive brackets of BSP Bracket System Polska Sp. z.o.o, of 4th May 2017.
- [13] A Technical Opinion of the Building Research Institute, concerning the fire safety of the passive brackets manufactured by BSP Bracket System Polska Sp. z o.o. and used in ventilated façade systems, at a height above 25 m, and fire separation zones, September 2017.
- [14] A report on the heat of combustion for the laminate used in the passive brackets from BSP Bracket System Polska Sp. z o.o., issued by the IGNIS REACTION TO FIRE laboratory Piotr Antonowicz, Marek Łuciuk, a general partnership from Biała Podlaska.
- [15] Decisions of the European Commission:
  - 96/603/WE dated 4th October 1996
  - 2000/605/WE dated 26th September 2000
  - 2003/424/WE dated 6th June 2003
- [16] PN-EN 13501-1:2019 –

Fire classification of construction products and building elements – Part 1: Classification based on reaction to fire tests.

- [17] Technical opinion No. 01045/15/Z00NP concerning the BSP System substructure, in light of the requirements of § 225 of the Regulation of the Minister of Infrastructure.
- [18] Technical documentation provided by the Ordering Party.

### 3 Purpose and Scope of Study

Pursuant to § 216 of the Regulation [1], the requirement set for the fastening of elements of façade cladding, as described in § 225 of the Regulation [1], in case of fire, in buildings with fire resistance class A, should be satisfied for a minimum of 120 minutes, in buildings with fire resistance class B for a minimum of 60 minutes, and in buildings with fire resistance classes C and D for a minimum of 30 minutes.

The purpose of the opinion is to assess the **KW4 PAS** passive bracket of **BSP Bracket System** Polska Sp. z.o.o., used in the erection of ventilated façades of **the BSP system**, in the context of § 225 of the Regulation [1], which requires that:

*Elements of façade cladding shall be fixed to the building's structure in such a way that they cannot fall off, in the event of fire in less time than that resulting from the required fire resistance class for an external wall, as defined in § 216(1), corresponding to the fire resistance class of the building in which they are fixed.*

The scope of the study includes: formal and substantial basis, a technical description on the basis of documentation provided by the Ordering Party, an analysis on the basis of laboratory tests, a technical assessment, and final comments.

## 4 Technical Description

Examples of types of structures and brackets made of aluminium or stainless steel, together with their assembly methods, included in the **BSP System** substructure, are shown in Fig. 1 and described in detail in 1TB-KOT-2018/0434, edition 1 [5]. Selection of the appropriate solution for the BSP System substructure and its fastening bracket depends on the results of static calculations carried out by an authorised designer, whereby the load capacity and the assembly method related to the chosen solution must comply with the conditions specified in the National Technical Assessment mentioned above [5]. In case of the KW4 PAS bracket, work is currently under way to include it in the next version of the National Technical Assessment.

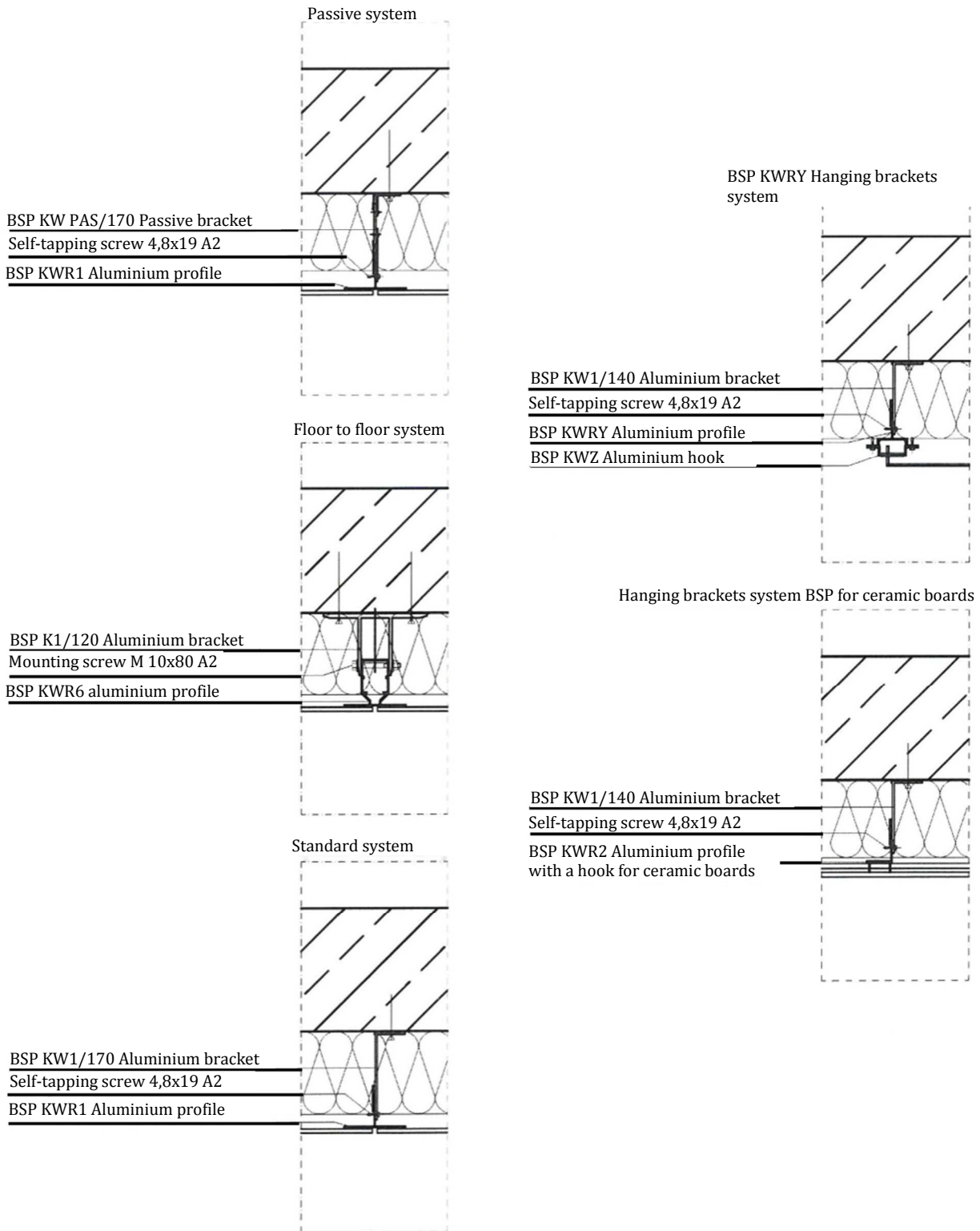


Fig. 1. Systemic solutions from BSP system KW1 (standard system), K1 (floor to floor system), KN1 (stainless steel system), and KW PAS (passive system).

The brackets fastening aluminium substructures, together with the epoxy glass laminate – in the case of KW1 PAS and KW3 PAS brackets and the **PC-ABS** thermal insulator – must remain inside the layer of thermal insulation made of mineral wool the minimum density of which is 48 kg/m<sup>3</sup>. The thickness of

mineral wool depends on the outreach of brackets. Mineral stone wool is fastened using plastic (with a steel core) or steel dowels designed for installing mineral wool, minimum 5 pieces per each 1 m<sup>2</sup>. The fastening structure is a brick, concrete or reinforced concrete wall with a minimum thickness depending on the type of anchor used (according to the guidelines for the the minimum mounting depth and installation method), although its thickness cannot be lower than 120 mm and its density not less than 550 kg/m<sup>3</sup>.

Various types of panels are used as façade claddings, e.g. specially profiled by bending aluminium or steel sheets, ceramic metal sheets, fibre-cement, RockPanel type, composite cladding, etc. The BSP System relies on mechanical fastening methods (screws, rivets, or hooks) and/or adhesive fastening using a systemic adhesive to fix the façade cladding, in order to fasten claddings to the substructure's subframe. The type of fastening depends on the type of cladding and the place of its installation (e.g. above the opening or next to the window opening). Both fastening methods are often combined, with the adhesive fastening method being primarily designed to transmit dynamic wind loads under normal operating conditions.

Resulting from the requirements of § 225 [1], the behaviour of the BSP System substructure during a fire has been described, among others, in the technical opinions [4,17]. As for the KW4 PAS passive bracket, it is a new element added to the fastening system of ventilated façades of BSP System. The bracket is manufactured in different sizes, depending on the requirements of individual façades. The main structural components of the bracket are made of the EN AW-AMgSi aluminium alloy. The aluminium components of the bracket are interconnected by a thermal insulator made of the PC-ABS material. The insulator has a chamber structure. The structural diagram of the KW4 PAS passive bracket is shown in Figure 2.

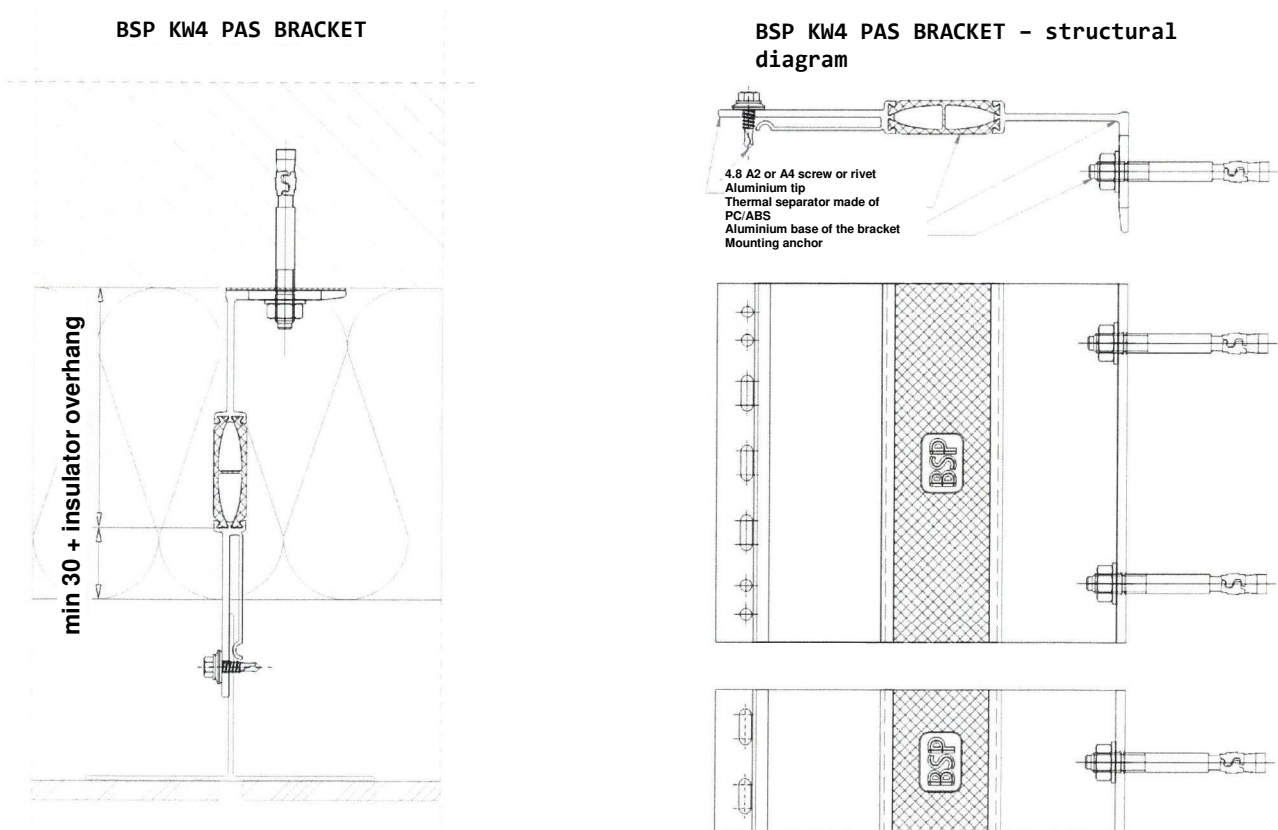


Fig. 2. The assembly and structural diagram of the BSP KW4 PAS bracket



The design of the KW4 PAS passive bracket manufactured by BSP Bracket System Polska Sp. z o.o. is similar to the previous solutions featured in KW1 PAS, KW2 PAS and KW3 PAS. The main difference is the type of insulator used. In earlier versions (KW1-3 PAS), laminate consisting of epoxy resin reinforced with layers of glass fabric was used, which was characterised by the reaction to fire class B-s3, d0 [12], and non-propagation of fire, if fire attacks from the outside [11],

The purpose of the thermal insulator used in the passive brackets from BSP Bracket System Sp. z o.o. is to eliminate the “thermal bridge” phenomenon occurring between components of a façade cladding and the wall to which the cladding is fastened. The insulator used in the KW4 PAS bracket features better insulation properties than the insulators used in the KW1-3 PAS brackets, which will allow the entire BSP system to provide higher thermal insulating power for the wall and less impact of point thermal bridges constituted by the brackets.

## 5 Analysis

### 5.1 Analysis within the scope of § 225 [1]

The purpose of the requirement resulting from the provisions of § 225 [1] is to ensure the possibility of safe evacuation, in the event of a fire, and carrying out an efficient rescue action by fire service teams. Taking into account the interpretation of the discussed provision offered by the State Fire Service Headquarters [3]:

*“... Façade fragments of any type must be considered, ... .. which could fall down on people present at the ground level, near the building*

all elements, which, if falling off, could become hazardous, must be taken into account in the assessment. Taking into account the actual technical condition of the types and variants of façades used in Poland, the very limited possibilities of meeting all the basic requirements and the requirements of § 225 [1], the State Fire Service Headquarters has stated the following in its interpretation [3]:

*“... When assessing the falling fragments of façade cladding, the energy generated by them should be taken into account, as a criterion for the assessment. The elements the size and energy of which cause injuries should be considered as dangerous for people being evacuated, as hazardous to their health.*

Such a statement means that the possibility of small size elements generating low energy, e.g. drops of molten aluminium, or small, blunt pieces of glass fragments, falling off the wall is actually taken into account, while the possibility of large and heavy façade fragments, e.g. metal, stone, concrete or ceramic panels, heavy pieces of glass (e.g. laminated glass), etc., falling off the wall, is definitely not acceptable.

Therefore, the Building Research Institute adopted the assessment criterion for low- and high-rise buildings to be 5 kg (for a single falling element), which corresponds to class F2 proposed in a document prepared for the European Commission [3]. In the case of higher buildings, each assessment is carried out individually.

The ventilated façade system of BSP Bracket System Polska Sp. z o.o., in its different configurations and comprised of different claddings, has been repeatedly verified experimentally, resulting from § 225 of the Regulation [1]. The results of these examinations were described, among others, in document No. 2772.1-10/16/Z00NZP drawn up by the Building Research Institute. For example, on 14th June 2017, at the Fire

Testing Laboratory of the Building Research Institute in Pionki, a test was carried out in respect of façade elements

falling off, in the event of a fire (Fig. 3, 4). Among the many types of façade claddings, fibre-cement sheets have been tested, according to *EN 12467 Fibre-cement flat sheets - Product specification and test methods*, HPL panels, according to *PN-EN 438-7 High-pressure decorative laminates (HPL) - Sheets based on thermosetting resins (usually called laminates) - Part 7: Compact laminate and HPL composite panels for internal and external wall and ceiling finishes*; quartz sinter panels, according to *EN 14411 Ceramic tiles - definition, classification, characteristics, assessment and verification of constancy of performance and marking*; Rockpanel panels; steel and aluminium sheets, and composite panels.

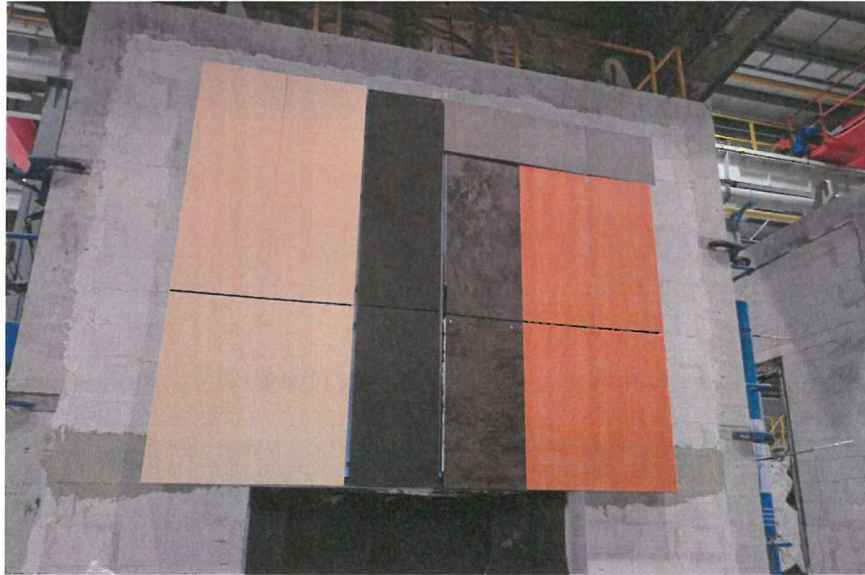


Fig. 3. The tested element before examination [4],



Fig. 4. The tested element after examination [4].

Both during this examination [4] and in other examinations referred to above, no problems with the brackets were observed, whatsoever, including the passive brackets which were covered with mineral wool, each time.

This was also confirmed by the results of the examination described in the opinion [17]. The subject of

the opinion [17] was, among others, the aluminium substructures using passive brackets from BSP Bracket System Polska Sp. z o.o. The opinion [17] states that the aluminium substructures from the BSP System meet the requirements of § 225 of the Regulation [1] in the event of a fire lasting 60 minutes. In Fig. 5, we see a passive bracket with a thermal insulator featuring the reaction to fire class **B-s3, d0**, after a test carried out for the purpose of the opinion [17].



Fig. 5. A passive bracket after tests carried out for the purpose of the opinion [17].

## 5.2 The analysis of the application of the KW4 PAS passive brackets above a height of 25 m

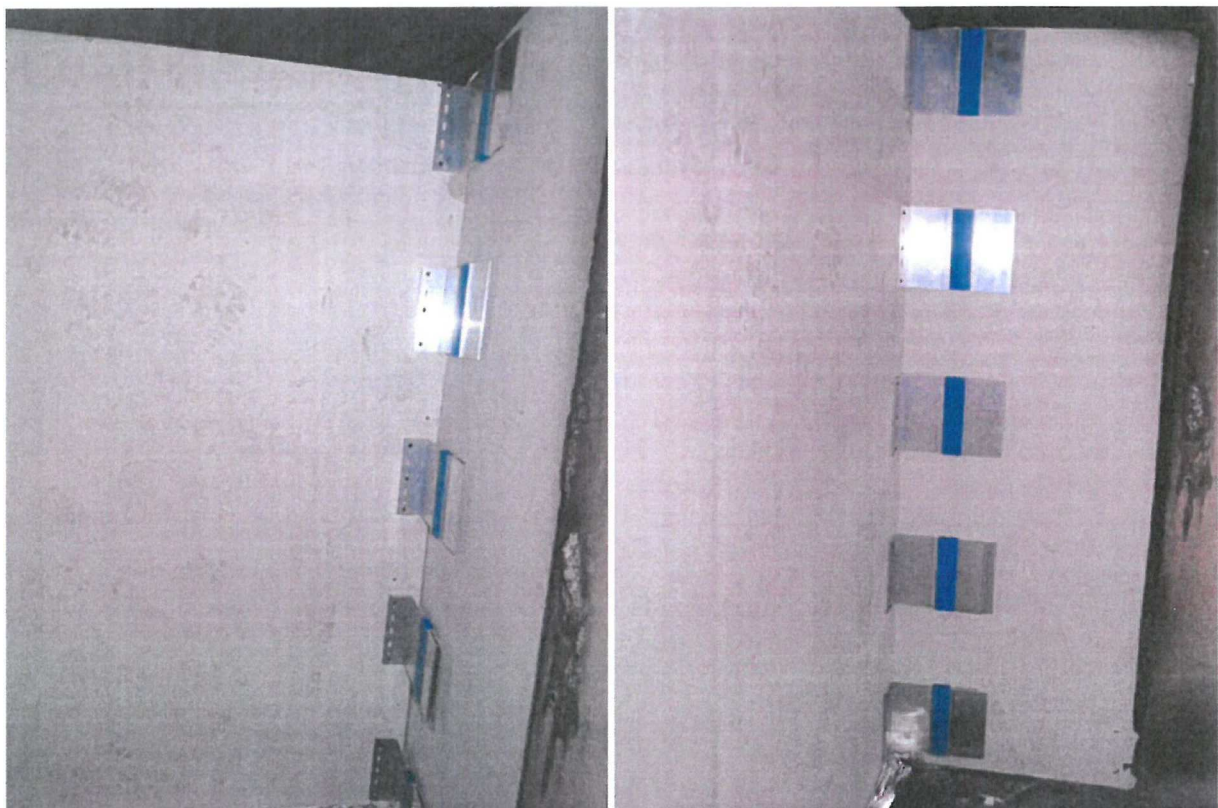


Fig. 6. A general view of the samples before SB1 tests - KW4 PAS brackets

The **KW4 PAS** passive brackets from BSP Bracket System Polska Sp. z o.o. are made of aluminium

and a plastic material, the latter of which is also used to manufacture the “thermal insulator”. In accordance with the decisions of the European Commission [15], aluminium is classified as class A1, regarding its reaction to fire, without the need to perform any tests. The insulator made of plastic (**PC-ABS**) constitutes a combustible element of the bracket. The Party ordering the opinion, i.e. BSP Bracket System Polska Sp. z o.o., commissioned the carrying out of tests of reaction to fire and assessment in this respect, according to the criteria included in the standard [16], Fig. 6. The test results and the criteria have been summarised in Table 1. Additionally, the table below contains the results of archived tests carried out for the insulators used in KW1-3 PAS brackets, for comparison purposes.

Table 1. The results of tests of reaction to fire of the KW4 PAS passive bracket manufactured by BSP Bracket System Polska Sp. z o.o., and the results of archived tests of KW1-3 PAS brackets

Parameter	Value, [7] (KW4 PAS)	Value, [12] (KW1-3 PAS)	Criterion, [16]
FIGRA <sub>0.2MJ</sub> [W/s]	73.6	47.2	≤ 120 W/s
LFS < edge [m]	Did not occur	0.1 m	≤ 1 m
THR <sub>600s</sub> [MJ]	3.5	1.9	≤ 5 m
SMOGRA [m <sup>2</sup> /s <sup>2</sup> ]	19.9	47.4	≤ 180
TSP <sub>600s</sub> [m <sup>2</sup> ]	106.7	223.5	≤ 200
Burning drops / particles	Did not occur	Did not occur	(-)

The obtained results demonstrated in Table 1 allow for classifying the KW4 PAS passive bracket from BSP Bracket System Polska Sp. z o.o. as class **B-s3, d0**, according to [16]. The obtained reaction to fire class allows, according to the Regulation [1], for evaluating the product as **not propagating fire inside the building**.



Fig. 7. A general view of the sample during and after testing, according to PN-B-02867:2013-06 - KW4 PAS brackets

The Ordering Party did not present the results of combustion heat tests, which could confirm the fulfilling of the criteria for reaction to fire class A2 (< 3.0 MJ/kg) by the insulator of the KW4 PAS bracket, which rendered it impossible to assess it as non-combustible. Therefore, the KW4 PAS passive brackets from BSP Bracket System Polska Sp. z o.o. have been tested for fire propagation through external walls, according to PN-B-02867:2013-06 [10]. The examination was carried out for uncovered brackets exposed to direct fire, see Figure 7. During the examination, it was not observed that the brackets propagated fire between one another, and only those directly exposed to the source of fire were destroyed. During the test, none of the fastened brackets fell off the wall. On the basis of observing the product's behaviour during the test and the results obtained for the brackets, according to PN-B-02867:2013-06, the elements have been classified as **not propagating fire through the external walls of buildings** [6].

## 6 Technical assessment

- Based on an analysis of the obtained test results and taking into account the presented technical documentation and the analysis presented in item 5, it is estimated that the **KW4 PAS** passive brackets featuring the **PC-ABS** thermal insulator, manufactured by **BSP Bracket System** Polska Sp. z o.o., according to the description presented in item 4, which are part of a systemic substructure manufactured by **BSP Bracket System** Polska Sp. z o.o., located in an area exposed to intensive heating and outside that area, i.e. both in the area exposed to and not exposed to direct fire, will maintain their integrity with the fastening structure, in the event of fire. This means that people can be evacuated and rescue teams can work for a period of time not less than **60 minutes**, and therefore, in light of § 225 of the Regulation [1], this solution is considered to be safe.
- In extreme cases, aluminium and plastic elements of the bracket could locally melt and partially fall off, in the form of drops, in the event of an intense fire, which should not affect the evacuation of people and the work of rescue teams.
- On the basis of the tests of reaction to fire and fire propagation conducted on the **KW4 PAS** passive bracket featuring the **PC-ABS** thermal insulator, and the behaviour of similar elements (the same reaction to fire class A1 and B-s3, d0), during the test carried out for the purpose of the opinion [13 and 17], the Fire Testing Laboratory of the Building Research Institute states that the use of the **KW4 PAS** passive brackets manufactured by **BSP Bracket System** Polska Sp. z o.o., as described in item 4 of this opinion, on the external walls of buildings, at a height above 25 m, and in fire separation zones, does not pose a threat to the fire safety of buildings, provided that the insulator being part of the passive brackets manufactured by BSP Bracket System Polska Sp. z o.o. is embedded in the insulating material with a reaction to fire class A1, acc. to [16] to a depth equal to the outreach of the insulator (PC-ABS) plus 30 mm, according to Figure 2, and the thickness of the mineral wool constituting its thermal insulating layer to be at least 48 kg/m<sup>3</sup>.

## 7 Final remarks

The technical assessment remains valid for an indefinite period of time, provided that the technical solutions applied in the ventilated façade system manufactured by **BSP Bracket System** Polska Sp. z o.o. using the **KW4 PAS** passive brackets attached to walls mechanically, are not modified in terms of materials or structurally, and the classifications [6, 7] remain valid.

It is the opinion of the Building Research Institute that the proposed solutions can be considered as correct, and, in the event of a fire, they are expected **to maintain the required safety level**.

### 7.1 Reservations

- This technical opinion applies to the elements in question defined in items 4 and 5, within the scope of the qualities assessed under item 6, and does not apply to other qualities, such as fire, performance, or structure.

Prepared by:

Paweł Sulik Paweł Sulik (tel. 693350894, p.sulik@itb.pl)

Verified by:

Bartłomiej Sędłak M.Sc. Eng.

Approved by:

Warsaw, 19th November, 2019  
(last page of the study)