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FIRE RESEARCH DEPARTMENT | 02-656 Warszawa | Ksawerów 21 Str. | tel. +48 22 853 34 27 | fax +48 22 847 23 11 | fire@itb.pl | www.itb.pl

ITB CLASSIFICATION OF FIRE RESISTANCE

Classification No.: 03080/19/ZOONZP/ENG

Sponsor: Schöck Sp. z o.o.
ul. Przejazdowa 99
43-100 Tychy

Prepared by: Instytut Techniki Budowlanej
Zakład Badań Ogniwych
ul. Filtrowa 1
00-611 Warszawa

Subject of classification: Walls, columns and floors made of reinforced concrete
with Schöck Alphadock / Sconnex Typ W joints

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1. Formal basis

Schöck Sp. z o.o. order of 2019-10-02.

Agreement No. 03080/19/Z00NZP.

2. Substantive basis

- [1] EN 1990:2002. Eurokod. Basis of structural design.
- [2] EN 1991-1-2:2002. Eurocode 1. Actions on structures. General actions. Actions on structures exposed to fire.
- [3] EN 1992-1-1:2004. Eurocode 2. Design of concrete structures. General rules. Structural fire design.
- [4] EN 1992-1-2:2004. Eurocode 2. Design of concrete structures. General rules and rules for buildings.
- [5] EN 13381-3:2015-06. Test methods for determining the contribution to the fire resistance of structural members. Applied protection to concrete members.
- [6] Technical documentation of Schöck Alphadock / Sconnex Typ W delivered by the Client.

3. Technical description of the product

Schöck Alphadock / Sconnex Typ W connectors are designed for joining walls and floors or columns and floors made of concrete of strength class not lower than C20/25 according to PN-EN 206. The connection can be located either at the top or at the bottom of the wall or column.

Schöck Alphadock / Sconnex Typ W connectors are 80 mm high, 300 mm long and wide from 180 to 300 mm. The minimum spacing between the connectors is equal to the element length (300 mm), and the maximum depends on the elements of strength calculations.

Schöck Alphadock / Sconnex Typ W connectors consist of (see Fig. 1):

1. Ultra-high-performance concrete (UHPC) element, compressive strength of at least 175 N/mm². The design value of the compressive force for a single Alphadock / Sconnex Typ W element is $N_{Rd} = 760$ kN (determined for a compression surface of 100 × 150 mm).
2. Steel bars made of B500B, B550B carbon steel or B500NR stainless steel. Concrete cover of bars in a concrete element (UHPC) is 10 mm, and after installation in a reinforced concrete wall or floor is at least 30 mm.
3. Insulation material: expanded polystyrene EPS, extruded polystyrene XPS or other insulation material approved by Schöck.

Reinforced concrete elements in which Schöck Alphadock / Sconnex Typ W connectors are used shall be designed in accordance with EN 1992-1-1 [2], taking into account rules for structural fire design given in EN 1992-1-2 [4], in particular the minimum thickness

of the wall or floor, the minimum dimensions of the column and the axial distance of the reinforcement from the heated surface of the above mentioned elements. The minimum thickness of a wall or floor in which Schöck Alphadock / Sconnex Typ W elements can be used is 18 cm, and the minimum column width is 25 cm.

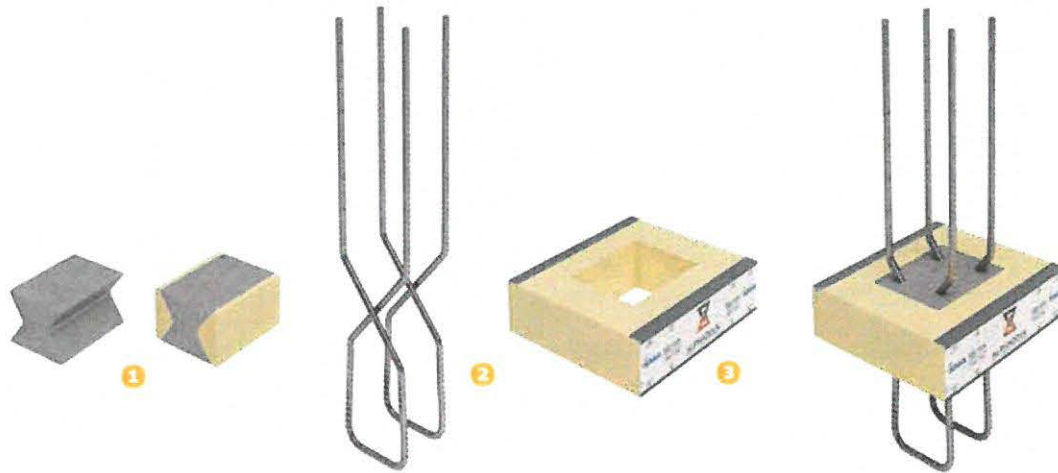


Fig. 1. Schöck Alphadock / Sconnex Typ W components

The fire protection, where required, is performed in one of the following ways:

1. with stone mineral wool slabs of density of at least 60 kg/m^3 , of a thickness at least 120 mm, a width of at least 200 mm and a length such that a minimum 200 mm overlap is formed on the concrete surface; the slabs are mechanically fastened with steel anchors, according to the instructions of the mineral wool manufacturer or glued if such solution has been assessed for adhesion to concrete in accordance with EN 13381-3 [5].
2. with stone mineral wool slabs of density of at least 150 kg/m^3 , of a thickness at least 120 mm, a width of at least 50 mm and a length such that a minimum 50 mm overlap is formed on the concrete surface; the slabs are mechanically fastened with steel anchors, according to the instructions of the mineral wool manufacturer or glued if such solution has been assessed for adhesion to concrete in accordance with EN 13381-3 [5].

In the case of external walls, depending on the required fire resistance class, it may be additionally required that the Schöck Alphadock / Sconnex Typ W joint area is insulated with stone mineral wool of density of at least 60 kg/m^3 , thickness 120 mm, width of at least 500 mm and a length such that at least 200 mm overlap is formed on the concrete surface.

In the case of floors in which Schöck Alphadock / Sconnex Typ W connectors are installed from above (i.e. at the bottom of the wall or column standing on that floor), at least the following floor layers on the reinforced concrete floor should be installed (listing from above):

1. cement screed at least 5 cm thick,
2. thermal insulation, e.g. extruded polystyrene, at least 5 cm thick.

The sections of reinforced concrete walls and floors connection without Schöck Alphadock / Sconnex Typ W elements are being filled with insulation material.

In the case of a connection at the top of the wall, when the fire separating wall function (EI) is required and when Schöck Alphadock / Sconnex Typ W elements require fire protection, this protection should be carried out continuously along the entire length of the wall.

In the case of connection at the bottom of the wall, when the fire separating wall function (EI) is required for more than 30 minutes, insulation made of stone mineral wool shall be used of density of at least 150 kg/m^3 and width of 10 cm, along the entire length of the wall.

Fire protection for connection of columns and floors with elements of Schöck Alphadock / Sconnex Typ W is made in the same way as for walls, but the insulation must be made on all surfaces exposed to heating.

The described applications of Schöck Alphadock / Sconnex Typ W connectors together with fire protection rules are presented in Figs. 2 to 7.

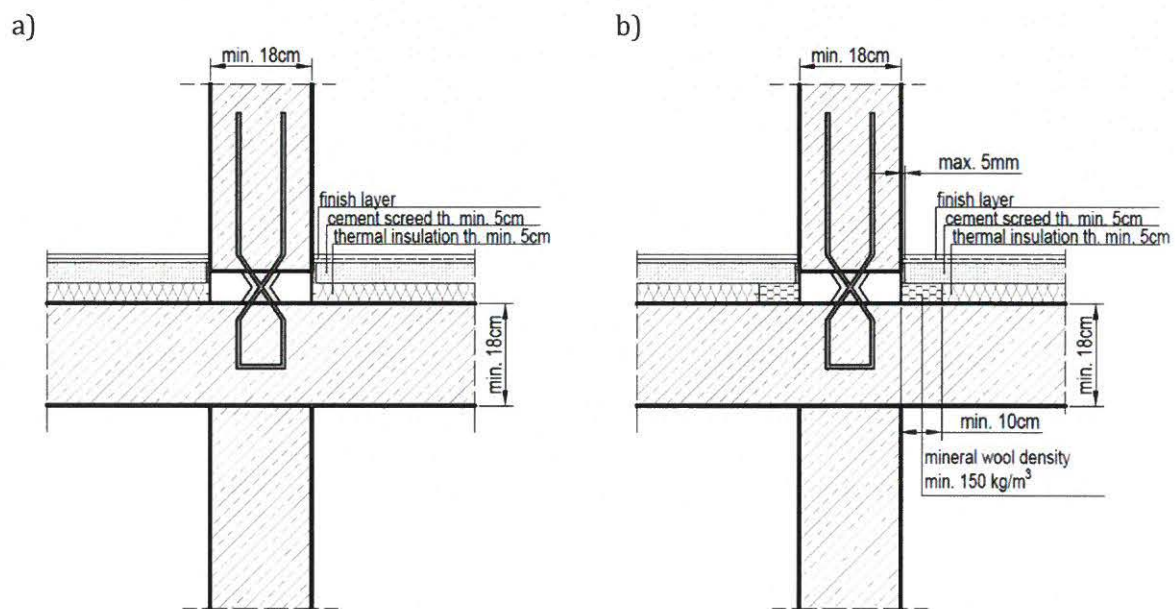


Fig. 2. Internal wall and floor connection with Schöck Alphadock / Sconnex Typ W
– connection at the bottom of the wall

- a) joint without fire protection,
b) joint protected with stone mineral wool of density min. 150 kg/m^3 and width min. 100 mm

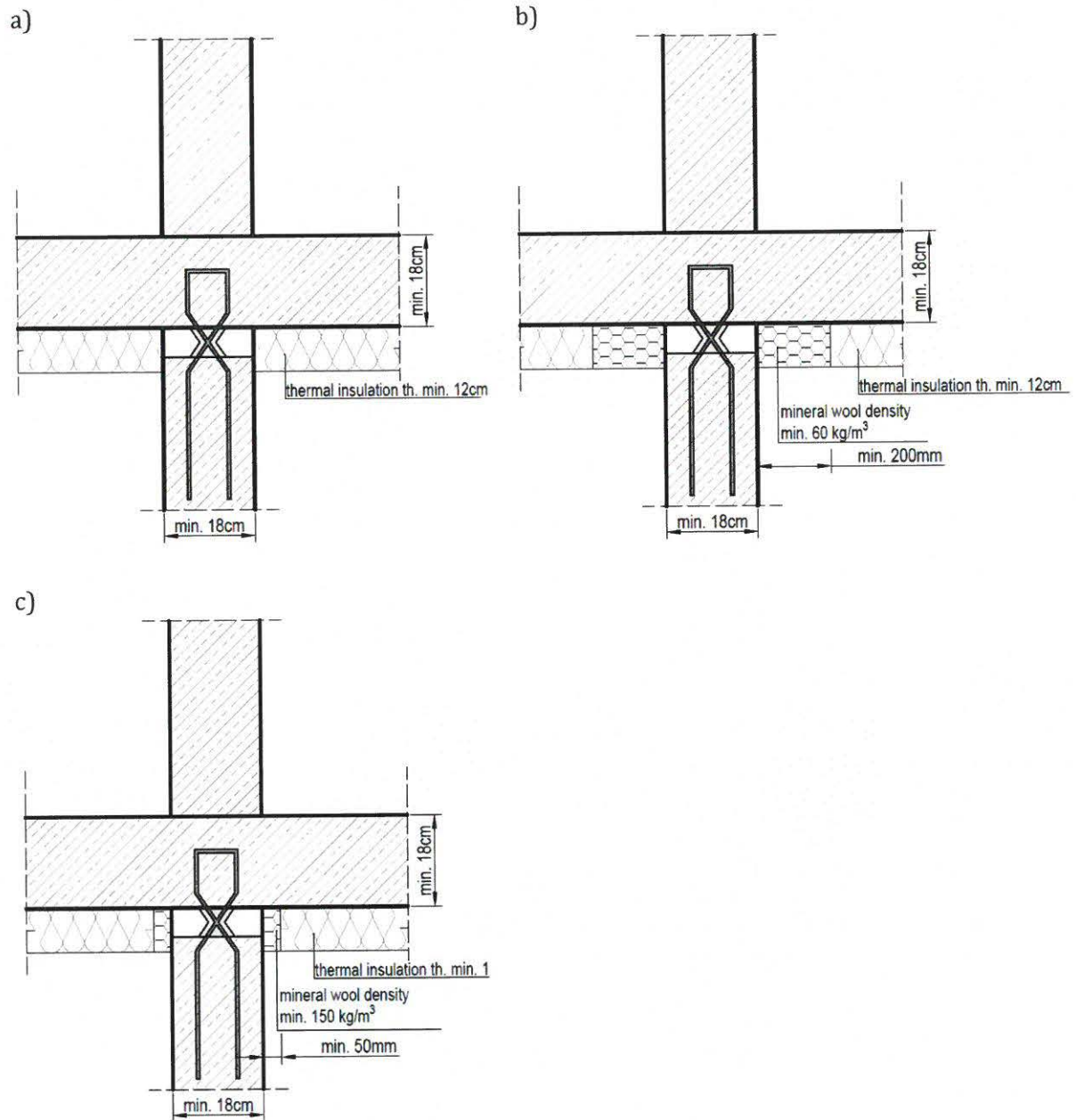


Fig. 3. Internal wall and floor connection with Schöck Alphadock / Sconnex Typ W
 – connection at the top of the wall
 a) joint without fire protection,
 b) joint protected with stone mineral wool of density min. 60 kg/m³ and width min. 200 mm,
 c) joint protected with stone mineral wool of density min. 150 kg/m³ and width min. 50 mm

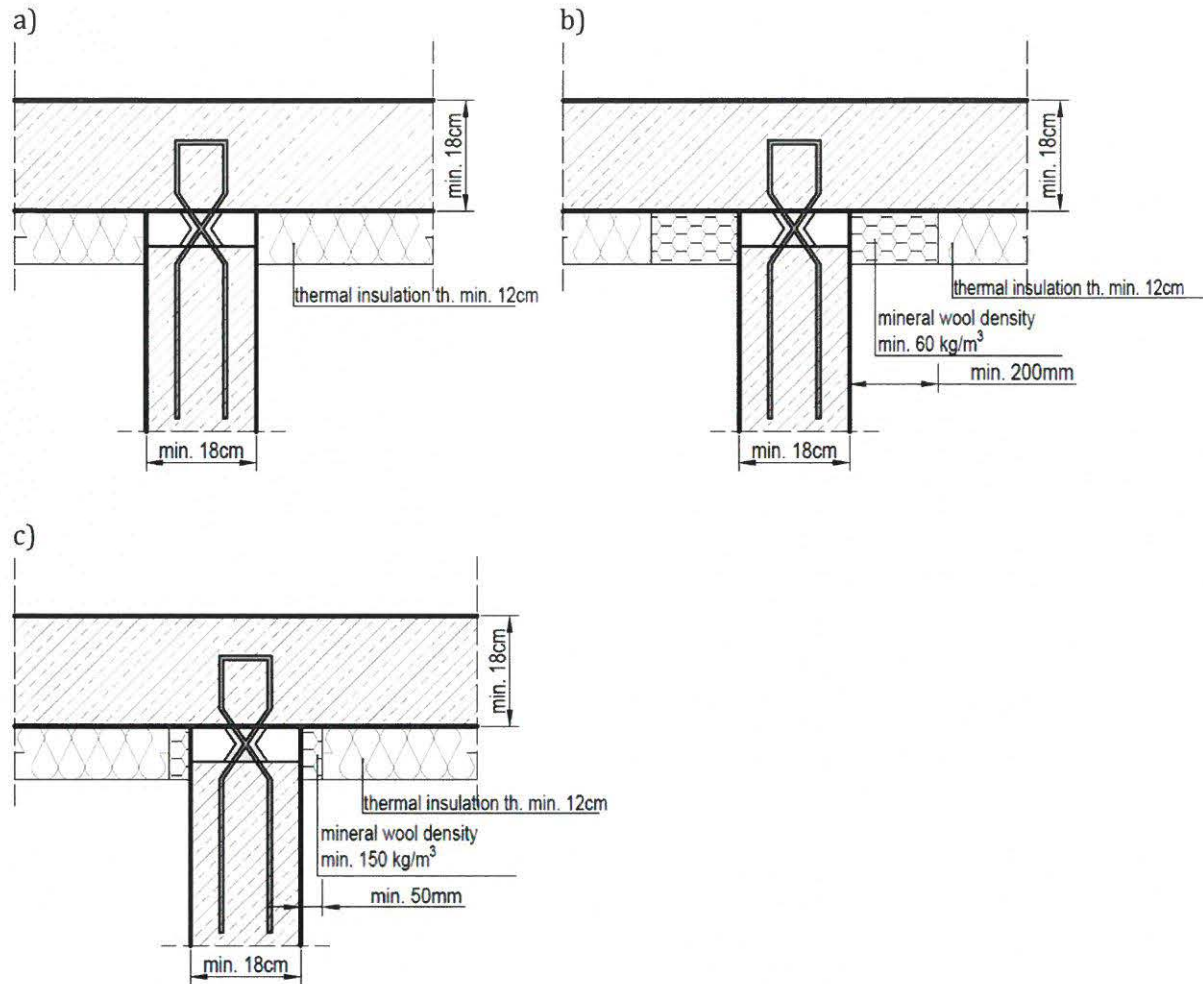


Fig. 4. Internal wall and floor/flat roof connection with Schöck Alphadock / Sconnex Typ W
– connection at the top of the wall

- a) joint without fire protection,
 b) joint protected with stone mineral wool of density min. 60 kg/m³ and width min. 200 mm,
 c) joint protected with stone mineral wool of density min. 150 kg/m³ and width min. 50 mm

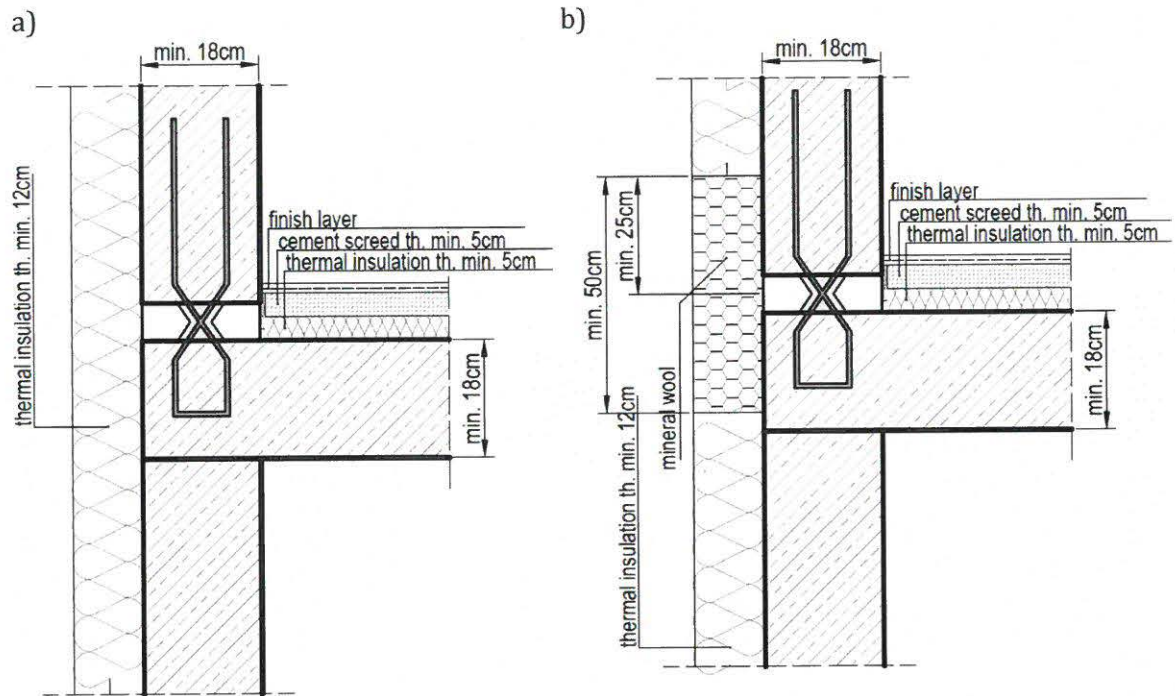


Fig. 5. External wall and floor connection with Schöck Alphadock / Sconnex Typ W
 – connection at the bottom of the wall
 a) joint without fire protection,
 b) joint protected with stone mineral wool on the external side

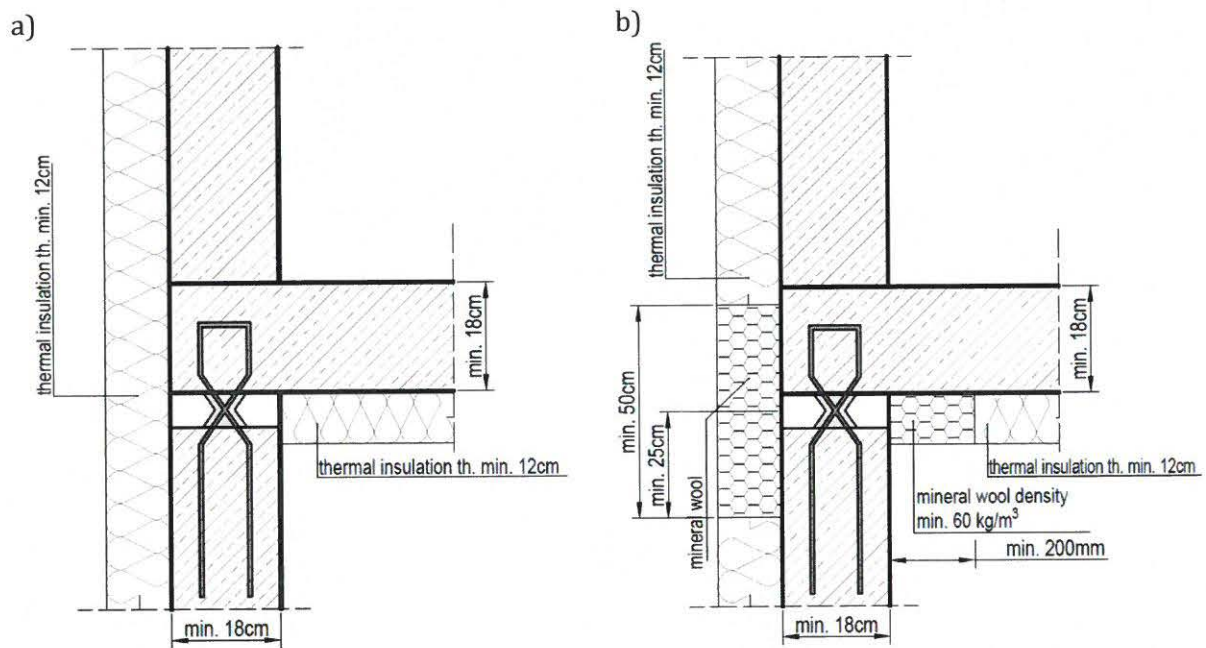


Fig. 6. External wall and floor/flat roof connection with Schöck Alphadock / Sconnex Typ W
 – connection at the top of the wall
 a) joint without fire protection,
 b) joint protected with stone mineral wool on the external side and stone mineral wool
 of density min. 60 kg/m³, width min. 200 mm on the internal side

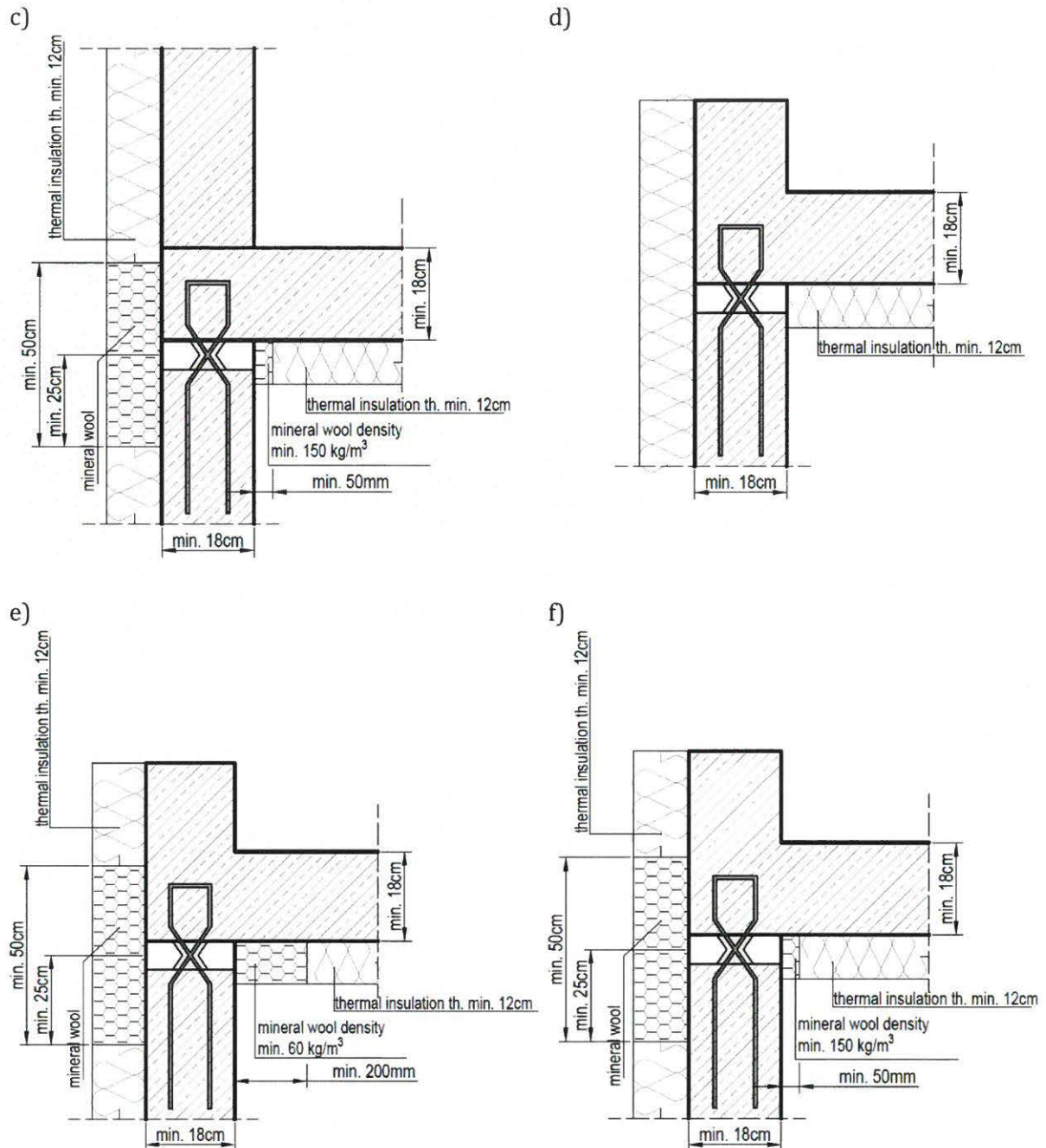


Fig. 6 (cont.). External wall and floor/flat roof connection with Schöck Alphadock / Sconnex Typ W
– connection at the top of the wall

- c) joint protected with stone mineral wool on the external side and stone mineral wool of density min. 150 kg/m^3 , width min. 50 mm on the internal side
- d) joint without fire protection,
- e) joint protected with stone mineral wool on the external side and stone mineral wool of density min. 60 kg/m^3 , width min. 200 mm on the internal side
- f) joint protected with stone mineral wool on the external side and stone mineral wool of density min. 150 kg/m^3 , width min. 50 mm on the internal side

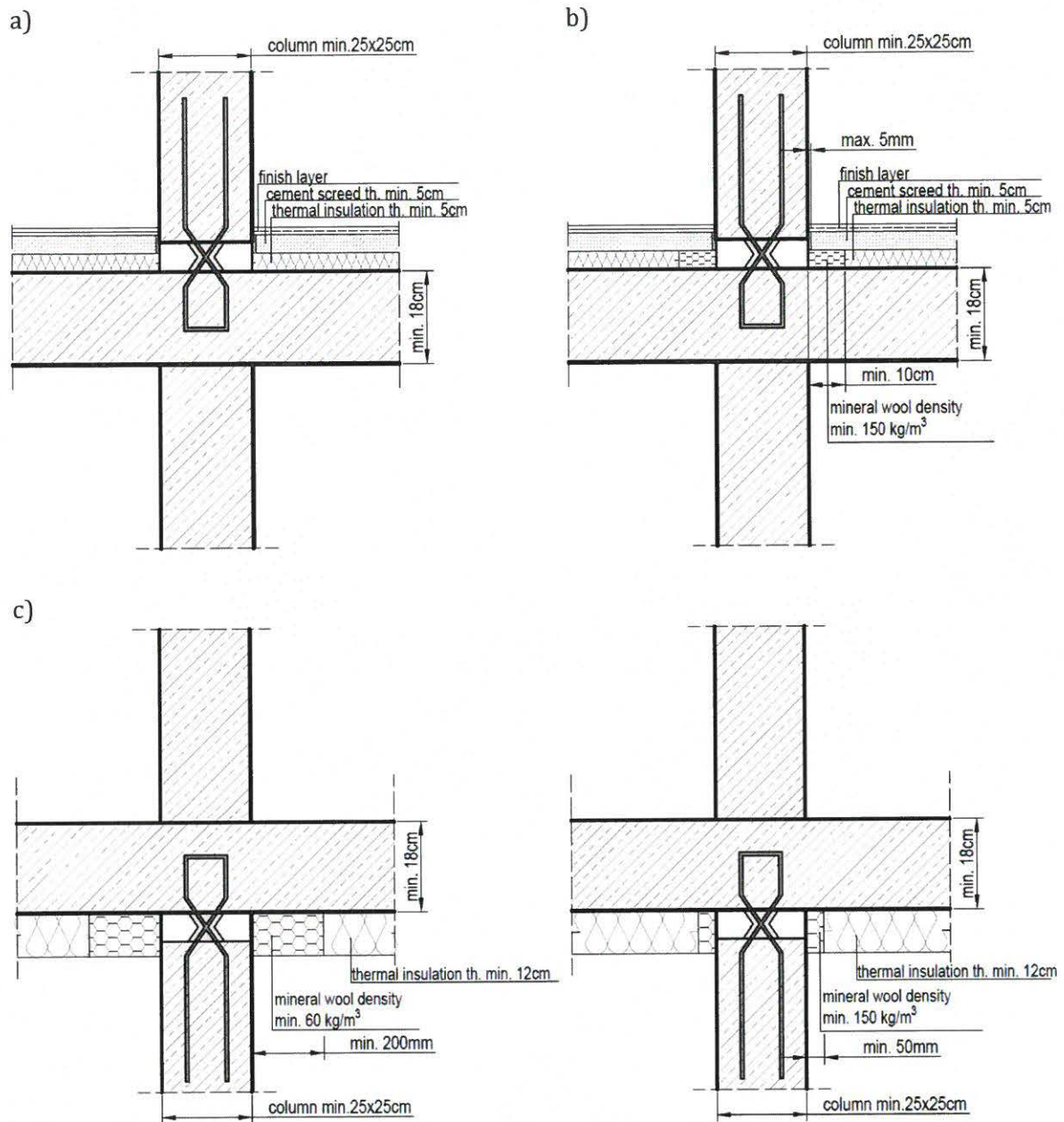


Fig. 7. Column and floor/flat roof connection with Schöck Alphadock / Sconnex Typ W

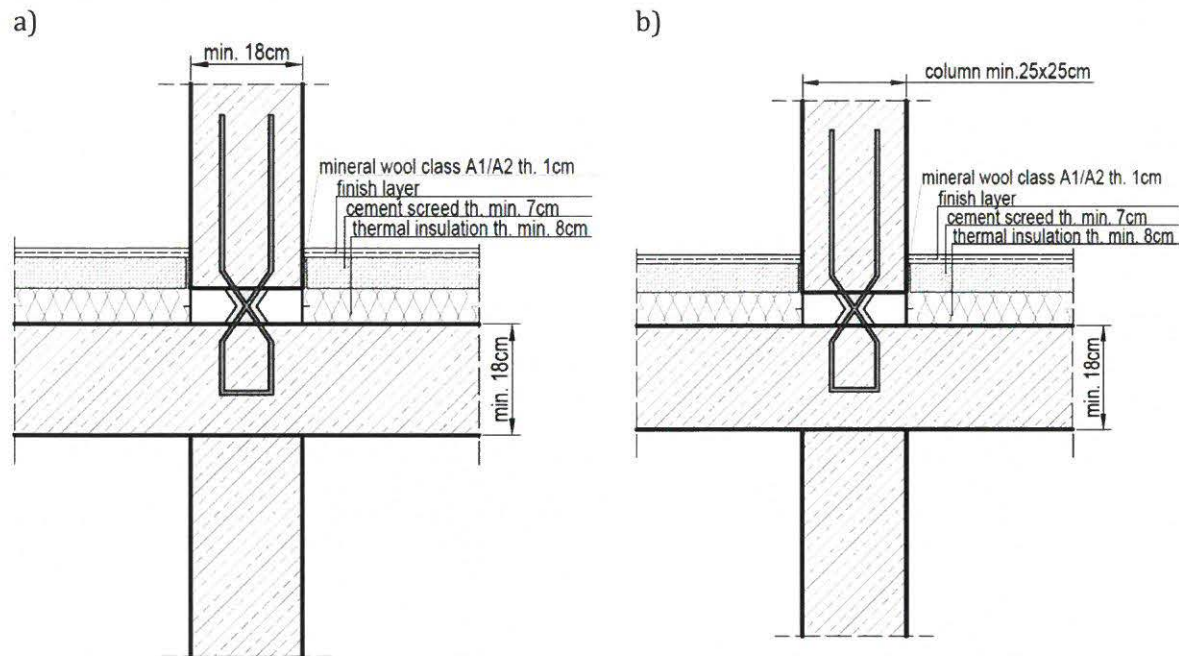


Fig. 8. Joint without fire protection, with thicker layer of cement screed and thermal insulation, and with sealing made of stone mineral wool with Schöck Alphadock / Sconnex Typ W

- a) connection at the bottom of the wall,
b) connection at bottom of the column,

4. Fire resistance analysis

4.1. Analysis criteria

The following criteria were adopted:

- average temperature rise on the unexposed surface on elements with fire separating function (EI criteria) shall not exceed 140 K and a maximum of 180 K at any point, in relation to the initial temperature of $\theta_0 = 20^\circ\text{C}$,
- temperature of the steel reinforcement in reinforced concrete elements shall not exceed 500°C ,
- temperature of the steel reinforcement and concrete (UHPC) within Schöck Alphadock / Sconnex Typ W elements shall not exceed 450°C .

Temperature values were adopted on the basis of EN 1992-1-2 [4].

4.2. Assumptions for calculations

Fire resistance analysis of the assessed solutions was carried out using computational methods, according to EN 1991-1-2 [2], with the effect of a standard fire. The calculations included:

- temperature dependent thermal properties (λ , c_w , ρ) of concrete with silicate aggregate given in EN 1992-1-2 [4],
- temperature dependent thermal properties (λ , c_w , ρ) of stone mineral wool of density from 50 to 150 kg/m³, determined on the own experience of Fire Research Department of ITB,
- initial temperature $\theta_0 = 20^\circ\text{C}$.

The calculations were made by solving two-dimensional problem, without taking into account changes in the geometrical dimensions of the modeled objects that could be caused by degradation of materials (e.g. concrete spalling, falling off and cracking of the insulation) as well as without regard to the deformations caused by thermal and mechanical loads.

The calculations were performed in the MSC.Marc 2017.1.0 program from MSC.Software.

4.3. Analysis results

The results of the analysis showed that the solutions described in section 3 meet the criteria given in point 4.2 in the fire resistance classes given in section 5.

5. Classification

Based on the results of the fire resistance analysis presented in section 4 and on the basis of EN 1992-1-2 [4], load-bearing walls, columns and floors made of reinforced concrete and in accordance with the technical description given in section 3, are classified according to the criteria of EN 1992-1-2 [4] as given in Table 1.

Table 1. Classification of elements with Schöck Alphadock / Sconnex Typ W

Connection type	Design of connection and fire protection	Fire resistance class of element with Schöck Alphadock / Sconnex Typ W
Internal wall – floor (at the bottom of the wall)	as on Fig. 2a	R 120 / REI 30
	as on Fig. 8a	R 120 / REI 60
	as on Fig. 2b	R 120 / REI 120
Internal wall – floor (at the top of the wall)	as on Fig. 3a	R 30
	as on Figs. 3b, 3c	R 120 / REI 120
Internal wall – floor/flat roof (at the top of the wall)	as on Fig. 4a	R 30
	as on Figs. 4b, 4c	R 120 / REI 120
External wall – floor (at the bottom of the wall)	as on Fig. 5a	R 30
	as on Fig. 5b	R 120 / REI 120
External wall – floor/flat roof (at the top of the wall)	as on Figs. 6a, 6d	R 30
	as on Figs. 6b, 6c, 6e, 6f	R 120 / REI 120
Columns – floor/flat roof	as on Fig. 7a	R 30
	as on Figs. 7b, 7c, 7d, 8b	R 60

6. Final remarks

The classification is valid until 2024-07-31 providing that no structural or material changes are introduced in evaluated solutions.

This classification document does not represent type approval or certification of the product.

This document constitutes an expert judgment as defined in EN 15725, p. 3.13.

Prepared by:

HEAD OF DIVISION

Fire Resistance and Fire Protection
Systems of Structural Elements



Piotr TURKOWSKI, M.Sc. Civil Eng.

Verified and approved by:

HEAD
of Fire Research Department



Bartłomiej Papis, PhD Eng.

Warsaw, 2019-10-18