Instytut Techniki Budowlanej

Nauka i wiedza ekspercka dla budownictwa przyszłości

English translation prepared by ZIEL-PLAST Sp. J. - Original version in Polish language

Title of the work: Technical opinion about the load capacity of fasteners for thermal renovation in ETICS systems

Register No: 02425/22/Z00NZK (LZK00-02425/22/Z00NZK)

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1. Subject of the opinion

The subject of the technical opinion are fasteners for thermal renovation in ETICS systems.

2. Purpose of the opinion

The purpose of the technical opinion is to determine the shear and bending resistance of fasteners in ETICS systems for the purposes of obtaining the National Technical Assessment of ITB.

3. Basis for the opinion

3.1 Formal basis for issuing the opinion

The formal basis for issuing the opinion is the order of ZIEL-PLAST Bożena Zielińska i Karolina Zielińska Spółka Jawna, registered under the number 02425/22/Z00NZK at the Instytut Techniki Budowlanej, branch in Katowice.

3.2 Basis for the opinion

The basis for issuing an opinion is the technical documentation:

- EAD 330196-01-0604 Plastic anchors made of virgin or non-virgin material for fixing of external thermal insulation composite systems with rendering,
- EAD 330232-01-0601 Mechanical fasteners for use in concrete,
- EAD 330284-00-0604 Plastic anchors for redundant non-structural systems in concrete and masonry,
- European Technical Assessment ETA-19/0573 of 17/01/2020 issued by DIBt.

4. Evaluation

Table No. 1 lists the dimensional and material data of fasteners for fixing thermal insulation in ETICS systems, while Table No. 2 ÷ 3 shows the characteristic shear and bending load capacities of the fasteners, for the purposes of obtaining the National Technical Assessment of ITB.

Table No. 1: *Dimensional and material data of fasteners for fixing thermal renovation in ETICS systems*

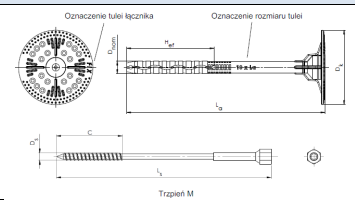
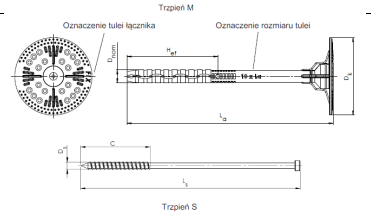
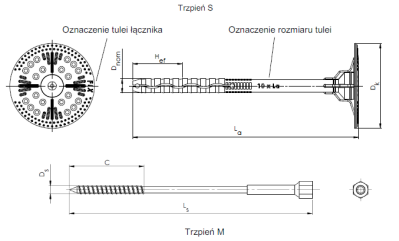
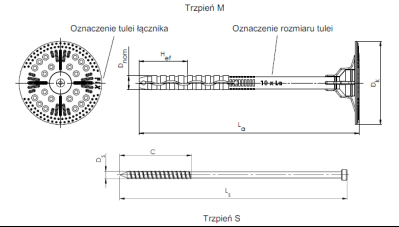
Fastener type	Material (according to the manufacturer's declaration)	
FIX-M	Anchor sleeve: polypropylene PP (color: natural) Expansion pin: galvanized steel, white passivated Fastener dimensions: d_{nom} = 10 mm, D = 60 mm, L_a = 100 ÷ 420 mm Pin dimensions: d_s = 4,4 mm, L_s = 105 ÷ 425 mm	
FIX-S	Anchor sleeve: polypropylene PP (color: natural) Expansion pin: galvanized steel, white passivated Fastener dimensions: d_{nom} = 10 mm, D = 60 mm, L_a = 100 ÷ 420 mm Pin dimensions: d_s = 4,4 mm, L_s = 103 ÷ 423 mm	
FIX-M-K	Anchor sleeve: polypropylene PP (color: natural) Expansion pin: galvanized steel, white passivated Fastener dimensions: d_{nom} = 10 mm, D = 60 mm, L_a = 100 ÷ 420 mm Pin dimensions: d_s = 4,4 mm, L_s = 105 ÷ 425 mm	
FIX-S-K	Anchor sleeve: polypropylene PP (color: natural) Expansion pin: galvanized steel, white passivated Fastener dimensions: d_{nom} = 10 mm, D = 60 mm, L_a = 100 ÷ 420 mm Pin dimensions: d_s = 4,4 mm, L_s = 103 ÷ 423 mm	

Table No. 2: *Shear and bending resistance of fasteners for fixing thermal renovation in ETICS systems*

Characteristic shear resistance without arm V_{Rk} [kN]	Characteristic shear resistance with bending at the arm $V_{Rk,s}$ [kN]
For concrete substrates: $V_{Rk} = 0{,}5 \cdot A_s \cdot f_{uk}$ f_{uk} - characteristic tension resistance of the pin [N/mm^2] A_s - cross-sectional area of the working part of the pin [mm^2] For masonry substrates: $V_{Rk,b} = 0{,}5 \cdot 0{,}45 \cdot \sqrt{d_{nom}} \cdot (\frac{h_{nom}}{d_{nom}})^{0{,}2} \cdot \sqrt{f_b \cdot c_1}^{1{,}5} \cdot (\frac{c_2}{1{,}5c_1})^{0{,}5} \cdot (\frac{h}{1{,}5c_1})^{0{,}5} / 1000$ d_{nom} - nominal diameter of the fastener [mm] h - substrate thickness [mm] f_b - compressive strength of the masonry base [N/mm^2] c_1 - edge distance in direction || to the direction of the force [mm] c_2 - edge distance in direction $\perp$ to the direction of the force [mm]	$V_{Rk,s} = \frac{\alpha_M \cdot M_{Rk,s}}{l}$ where: $\alpha_M = 2$ $l = e_1 + 0{,}5d$ - arm length [mm] $M_{Rk,s} = 1{,}2 * W_s * f_{uk}$ - force moment [Nm] $W_s = \frac{\pi d^3}{32}$ - strength indicator of the metal pin [mm^3] e_1 - the length of the arm to which the force is applied [mm] d - diameter of the metal pin [mm] f_{uk} - characteristic tension resistance of the pin [N/mm^2]

Fastener type	Base material	Anchorage depth	Shear and bending resistance of fasteners for fixing thermal renovation in ETICS systems		
		h_{ef} [mm]	V_{Rk} [kN]	$V_{Rk,s}$ [kN] at L_{min}	$V_{Rk,s}$ [kN] at L_{max}
FIX-M (L_{min} = 100 mm) (L_{max} = 420 mm)	Concrete C12/15 EN 206-1	70	0,30	0,25	0,02
	Concrete C20/25 ÷ C50/60 EN 206-1		0,30	0,25	0,02
	Clay brick type 20 EN 771-1		0,30	0,25	0,02
	Calcium silicate bricks type 20 EN 771-2		0,30	0,25	0,02
	Calcium silicate hollow blocks type 12 wall thickness ≥ 20 mm EN 771-2		0,30	0,25	0,02
	Vertically perforated clay bricks type 12 wall thickness ≥ 12 mm EN 771-1		0,25	0,25	0,02
	Vertically perforated clay bricks type 10 wall thickness ≥ 12 mm EN 771-1		0,10	0,10	0,02
	Lightweight aggregate concrete LAC5 EN 1520 / EN 771-3		0,30	0,25	0,02
	Autoclaved aerated concrete AAC2 EN 771-4		0,30	0,25	0,02
	Autoclaved aerated concrete AAC7 EN 771-4		0,30	0,25	0,02
FIX-S (L_{min} = 100 mm) (L_{max} = 420 mm)	Concrete C12/15 EN 206-1	70	0,30	0,25	0,02
	Concrete C20/25 ÷ C50/60 EN 206-1		0,30	0,25	0,02
	Clay brick type 20 EN 771-1		0,30	0,25	0,02
	Calcium silicate bricks type 20 EN 771-2		0,30	0,25	0,02
	Calcium silicate hollow blocks type 12 wall thickness ≥ 20 mm EN 771-2		0,30	0,25	0,02
	Vertically perforated clay bricks type 12 wall thickness ≥ 12 mm EN 771-1		0,25	0,25	0,02
	Vertically perforated clay bricks type 10 wall thickness ≥ 12 mm EN 771-1		0,10	0,10	0,02
	Lightweight aggregate concrete LAC5 EN 1520 / EN 771-3		0,30	0,25	0,02
	Autoclaved aerated concrete AAC2 EN 771-4		0,30	0,25	0,02
	Autoclaved aerated concrete AAC7 EN 771-4		0,30	0,25	0,02

General remarks
The final shear/bending resistance is given as the lower of the: plate stiffness, tension loads or shear/bending resistance. In order to determine the design load capacity, it is necessary to calculate, adopt the coefficient resulting from the steel material of the anchor pin (f_{yk}/f_{uk}).

Table No. 2: *Shear and bending resistance of fasteners for fixing thermal renovation in ETICS systems*

Fastener type	Base material	Anchorage depth	Shear and bending resistance of fasteners for fixing thermal renovation in ETICS systems		
		h_{ef} [mm]	V_{Rk} [kN]	$V_{Rk,s}$ [kN] at L_{min}	$V_{Rk,s}$ [kN] at L_{max}
FIX-M-K (L_{min} = 100 mm) (L_{max} = 420 mm)	Concrete C12/15 EN 206-1	35	0,30	0,12	0,02
	Concrete C20/25 ÷ C50/60 EN 206-1		0,30	0,12	0,02
	Clay brick type 20 EN 771-1		0,30	0,12	0,02
	Calcium silicate bricks type 20 EN 771-2		0,30	0,12	0,02
	Calcium silicate hollow blocks type 12 wall thickness ≥ 20 mm EN 771-2		0,30	0,12	0,02
	Vertically perforated clay bricks type 12 wall thickness ≥ 12 mm EN 771-1		0,25	0,12	0,02
	Vertically perforated clay bricks type 10 wall thickness ≥ 12 mm EN 771-1		0,10	0,10	0,02
	Lightweight aggregate concrete LAC5 EN 1520 / EN 771-3		0,30	0,12	0,02
	Autoclaved aerated concrete AAC2 EN 771-4		0,20	0,12	0,02
	Autoclaved aerated concrete AAC7 EN 771-4		0,20	0,12	0,02
FIX-S-K (L_{min} = 100 mm) (L_{max} = 420 mm)	Concrete C12/15 EN 206-1	35	0,30	0,12	0,02
	Concrete C20/25 ÷ C50/60 EN 206-1		0,30	0,12	0,02
	Clay brick type 20 EN 771-1		0,30	0,12	0,02
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	Vertically perforated clay bricks type 12 wall thickness ≥ 12 mm EN 771-1		0,25	0,12	0,02
	Vertically perforated clay bricks type 10 wall thickness ≥ 12 mm EN 771-1		0,10	0,10	0,02
	Lightweight aggregate concrete LAC5 EN 1520 / EN 771-3		0,30	0,12	0,02
	Autoclaved aerated concrete AAC2 EN 771-4		0,20	0,12	0,02
	Autoclaved aerated concrete AAC7 EN 771-4		0,20	0,12	0,02
General remarks					
The final shear/bending resistance is given as the lower of the: plate stiffness, tension loads or shear/bending resistance. In order to determine the design load capacity, it is necessary to calculate, adopt the coefficient resulting from the steel material of the anchor pin (f_{yk}/f_{uk}).					

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