LK

TEST REPORT NO. LK02–0858/10/R05NK

English version

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TESTED ELEMENT: **Polyurethane mortar TYTAN TEO designed for bricklaying on thin joints**

admitted for tests on 28.10.2010
at report no. LK01–0858/10/R05NK/a and
on 13.10.2010
at report no. LK01–0858/10/R05NK/a
in accordance with the management procedure No. 18

tested in the period from 04.11.2010 to 04.02.2011

METHOD/TEST PROCEDURE:

PN–EN 1607:1999 *Thermal insulating products for buildings applications. Determination of tensile strength perpendicular to faces.*

1. SCOPE OF TESTS

The scope of tests included:

- checking of dimensions of clay blocks (length, width),
- determination of perpendicular tensile strength of the joint,
- verification of bonding time,
- verification of open time,
- verification of correction time.

2. TESTED MATERIALS

The Employer supplied for tests:

a) 12 containers of polyurethane mortar with a capacity of 750 ml each, indicated on the label as "NT TEST SPECIMENS BRICKLAYING FOAM".

b) 3 pallets (180 pcs.) of vertically hollowed flat (plane ground) clay masonry blocks, with the following characteristics (as stated on the basis of the manufacturer's declaration):

- dimensions — 373x250x249 mm (LxWxH)
- dimensional tolerances — deviation category Tm
span category Rm
surface flatness 0.3 mm
parallelism of planes 0.6 mm
- shape and construction — group 2 according to EN 1996−1−1
- gross density in dry state — 800 kg/m^3, deviation category D1
- compressive strength — average (category I): 13.1 MPa (⊥ laying surface),
standard (strength class) 15.0 MPa
- freeze resistance — freeze proof (F1, test acc. to PN−70/B−12016),

intended for use in protected structures;

c) a gun for application of the mortar and a cleaning agent.

Materials specified in sections a) and c) above were also used for preparation of specimens for tests, results of which was included in test reports no. LK01−0858/10/R05NK, LK03−0858/10/R05NK and LK10−0858/10/R05NK.

3. SPECIMEN PREPARATION

For the needs of the study two sets of specimen were prepared:

- under laboratory conditions,
- in temperature of −5°C.

Each specimen consists of two flat clay blocks connected with polyurethane mortar.

3.1. Preparation of specimens under laboratory conditions

Components used in the preparation of specimens:

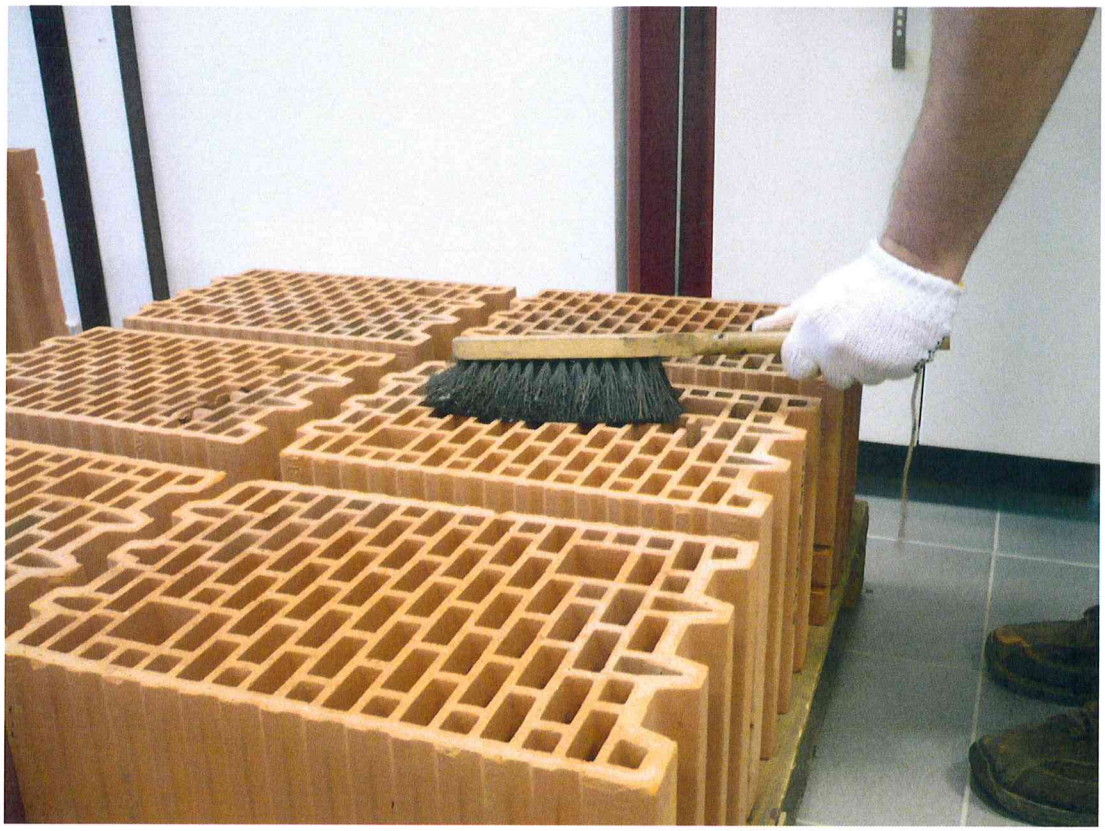
- polyurethane mortar "NT TEST SPECIMEN OF BRICKLAYING FOAM", seasoned for 24 hours under laboratory conditions,
- flat clay blocks, with characteristics acc. to section 2b, seasoned for 24 hours under laboratory conditions.

Mortar application conditions:

- application of polyurethane mortar was carried out under controlled laboratory conditions,
- the mortar was applied on the bracket surface of the lower part of clay block cleaned (using a brush) and moistened with water (using a broad brush),
- the mortar was applied by means of a gun, applying two **6 cm** wide lines parallel to the longer edges of clay block in the distance of ca. 1/3 width from edges,
- application of the upper clay block followed immediately after application of the mortar, except specimens designed to verify the open time – cf. section 4.4,
- no corrections were made relative to the position of clay blocks to each other, apart from specimens designed to verify the correct time - cf. section 4.5.

Conditions of seasoning of specimens are shown in the description of test methods.

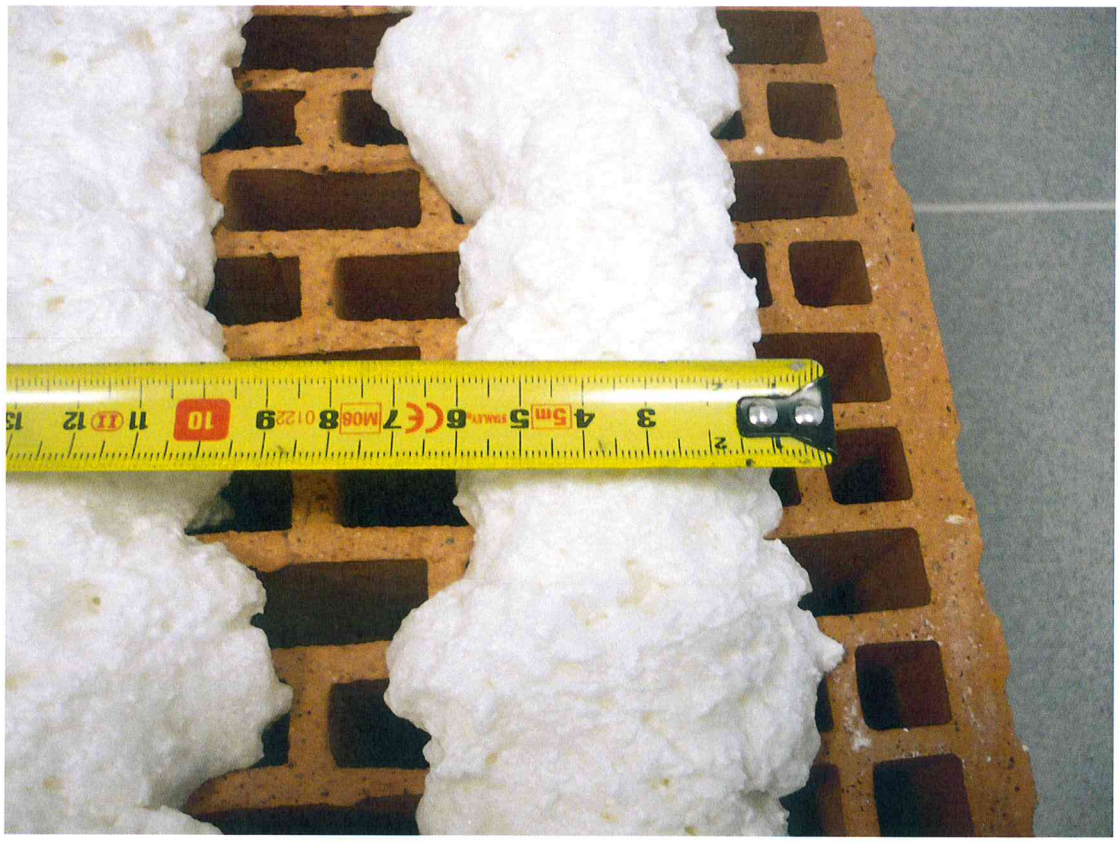
Preparation of the specimens is shown in pictures 1-3.



Picture 1. Preparation of surface for application under laboratory conditions

a)

b)



Picture 2. Lines of mortar applied under laboratory conditions on wetted surfaces of flat clay blocks a) general view, b) detail

Picture 3. Series of specimens prepared under laboratory conditions

3.2. Preparation of specimens in temperature of −5°C

Components used in the preparation of specimens:

- polyurethane mortar "NT TEST SPECIMEN OF BRICKLAYING FOAM", seasoned for 24 hours under laboratory conditions,
- flat clay blocks, with characteristics acc. to section 2b, seasoned for 24 hours in climate chamber in temperature of −5°C.

Mortar application conditions:

- application of polyurethane mortar was carried out in a climate chamber in temperature of −5°C,
- the mortar was applied on the bracket surface of the lower part of clay block cleaned (using a brush) and not moistened,
- the mortar was applied by means of a gun, applying two **6 cm** wide lines parallel to the longer edges of clay block in the distance of ca. 1/3 width from edges,
- application of the upper clay block followed immediately after application of the mortar, except specimens designed to verify the open time – cf. section 4.4,
- no corrections were made relative to the position of clay blocks to each other.

Conditions of seasoning of specimens are shown in the description of test methods.

4. METHODS AND TEST RESULTS

4.1. Dimensions of clay blocks

Before principal tests were carried out measurements of length and width of randomly selected flat clay blocks were carried out to determine the average value of bracket surface. This value was assumed in further tests, as a surface of a joint to calculate the tensile strength.

The results of measurements are shown in Table 1.

Table 1

Bracket surface of flat clay blocks

No.	Length, mm	Width, mm	Bracket surface, mm^2
1	*2*	*3*	*4*
1	370	251	92,870
2	368	251	92,370
3	370	252	93,240
4	369	249	91,880
5	370	251	92,870
6	369	250	92,250
		average value	**92,580**

4.2. Perpendicular tensile strength of the joint

4.2.1. Joints made under laboratory conditions

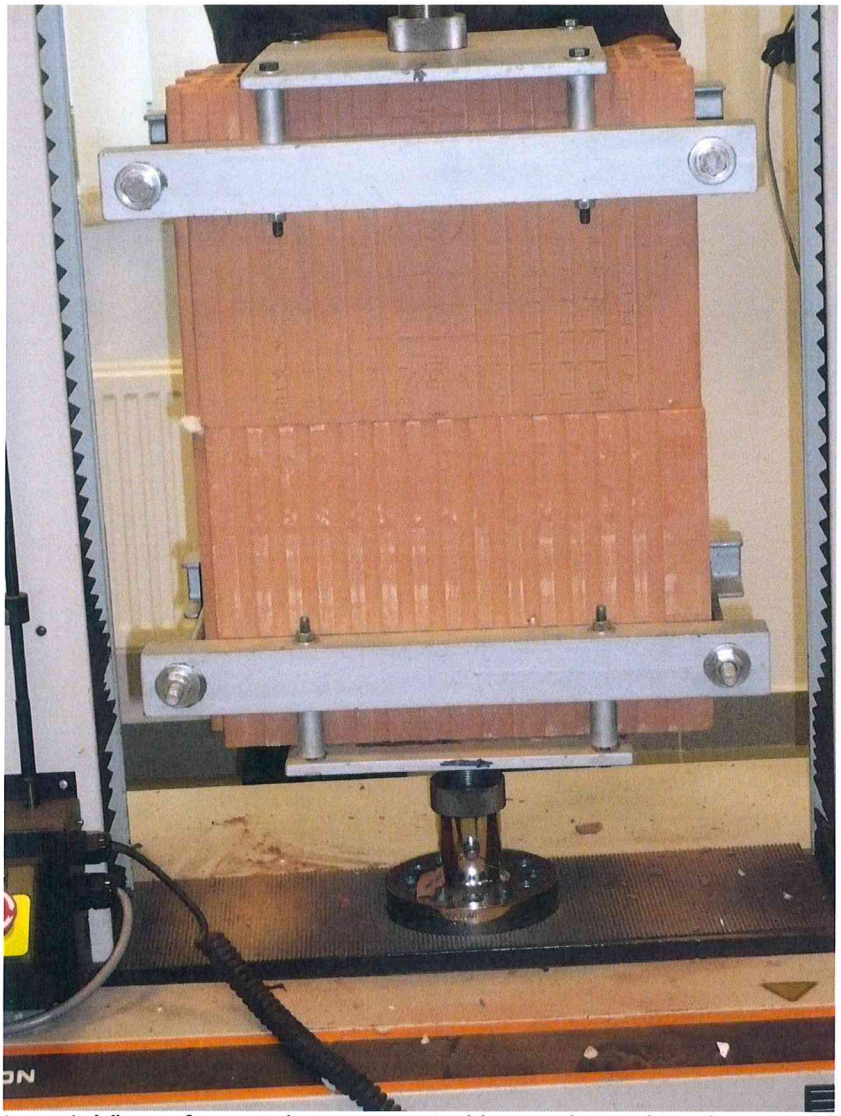
Tensile strength test of joints was performed on specimens prepared acc. to section 3.1. Tensile force was acting in direction perpendicular to the plane of the joint.

The specimens were subjected to test after 7 days of seasoning in laboratory conditions.

Loading procedure was consistent with PN–EN 1607:1999. Speed of the head shift of 10 mm/min and preload of 100N was used. The load was carried out in computer-controlled universal testing machine. The view of specimen fixed in holders was shown in the picture 4.

Strength test was performed under laboratory conditions.

Test results are given in Table 2.



Picture 4. View of a specimen mounted in a universal testing machine

Table 2

Perpendicular tensile strength of joints
performed with polyurethane mortar under laboratory conditions, after 7 days of seasoning

No.	Conditions of application and seasoning	Breaking load, kN	Tensile strength, kPa	Nature of damage
1	*2*	*3*	*4*	*5*
1	application – **lab. cond.**, joining immediately after application, no correction of position; seasoning – **7 days under laboratory conditions**	10.1	109	100% within the mortar
2		12.2	132	100% within the mortar
3		12.2	132	100% within the mortar
4		11.5	124	100% within the mortar
5		13.4	145	100% within the mortar
6		8.6	93	100% within the mortar
average		**11.3**	**122**	–
s		1.7	17	–

4.2.2. Joints made in temperature of −5°C

Tensile strength test of joints performed in temperature of −5°C was performed on specimens prepared acc. to section 3.2. Tensile force was acting in direction perpendicular to the plane of the joint.

The specimens were subjected to test after 7 days of seasoning in temp. −5°C (series I) and after 7 days of seasoning in temperature of −5°C and 7 days of seasoning in laboratory conditions (series II).

Loading procedure was consistent with PN−EN 1607:1999. Speed of the head shift of 10 mm/min and preload of 100N was used. The load was carried out in computer-controlled universal testing machine.

Strength test was performed under laboratory conditions, directly after seasoning.

Test results are given in Table 3.

Table 3

Perpendicular tensile strength of joints
performed with polyurethane mortar in temperature of −5°C, after 7 (14) days of seasoning

No.	Conditions of application and seasoning	Breaking load, kN	Tensile strength, kPa	Nature of damage
1	*2*	*3*	*4*	*5*
1	application – **temp. −5°C**, joining immediately after application, no correction of position; seasoning – **7 days in temperature −5°C**	10.6	114	100% within the mortar
2		14.8	160	100% within the mortar
3		12.5	135	100% within the clay block
4		8.0	86	100% within the mortar
5		14.6	158	100% within the mortar
6		11.3	122	100% within the clay block
average		**12.0**	**129**	–
s		2.6	26	–
7	application – **temp. −5°C**, joining immediately after application, no correction of position; seasoning – **7 days in temperature −5°C + 7 days in lab. cond.**	10.5	113	100% within the clay block
8		14.5	157	100% within the clay block
9		16.9	183	100% within the clay block
10		13.2	143	100% within the mortar
11		12.5	135	100% within the clay block
12		13.4	145	100% within the clay block
13		10.6	114	100% within the mortar
average		**13.1**	**141**	–
s		2.2	23	–

General view of the selected specimens was shown in the picture 5.

Picture 5. View of specimens, which were destroyed within clay block

4.3. Bonding time

4.3.1. Joints made under laboratory conditions

The ratio of the joint's perpendicular tensile strength determined after the declared bonding time (24 hours) to analogous strength tested after 7 days of seasoning under the same conditions was assumed as a measure of bonding time.

Tensile strength test of joints performed with polyurethane mortar under laboratory conditions was performed on specimens prepared acc. to section 3.1. Tensile force was acting in direction perpendicular to the plane of the joint.

The specimens were subjected to test after 24 hours of seasoning in laboratory conditions. The result was referred to the result obtained in the test described in section 4.2.1.

Loading procedure and conditions for conducting the tests were similar to those described in section 4.2.1. Strength test was performed under laboratory conditions.

Test results are given in Table 4.

Table 4

Perpendicular tensile strength of joints performed with polyurethane mortar under laboratory conditions, after 24 h of seasoning

No.	Conditions of application and seasoning	Breaking load, kN	Tensile strength, kPa	Nature of damage
1	*2*	*3*	*4*	*5*
1	application – **lab. cond.**, joining immediately after application, no correction of position; seasoning – **24 hours under laboratory conditions**	11.7	126	100% within the mortar
2		12.8	138	100% within the mortar
3		9.4	102	100% within the mortar
4		10.4	113	100% within the mortar
5		12.0	130	100% within the mortar
6		13.6	147	100% within the mortar
average		**11.7**	**126**	–
s		1.5	15	–
ratio of strength after 24 hours of seasoning to strength after 7 days of seasoning		–	**1.03**	–

4.3.2. Joints made in temperature of −5°C

The ratio of the joint's perpendicular tensile strength determined after the declared bonding time (24 hours) to analogous strength tested after 7 days of seasoning under the same conditions was assumed as a measure of bonding time.

Tensile strength test was performed on specimens prepared in accordance with section 3.2. The study was conducted in a manner analogous to that described in section 4.3.1, while the specimens were seasoned in temperature of −5°C. The result was referred to the result obtained in the test described in section 4.2.2, series I.

Strength test was performed under laboratory conditions, directly after seasoning.

Test results are given in Table 5.

Table 5

Perpendicular tensile strength of joints
performed with polyurethane mortar in temperature of −5°C, after 24 h of seasoning

No.	Conditions of application and seasoning	Breaking load, kN	Tensile strength, kPa	Nature of damage
1	*2*	*3*	*4*	*5*
1	application – **temp. −5°C**, joining immediately after application, no correction of position; seasoning – **24 hours in temp. of −5°C**	10.9	118	100% within the clay block
2		7.4	80	100% within the mortar
3		8.5	92	100% within the clay block
4		10.2	110	100% within the mortar
5		9.5	103	100% within the clay block
6		10.0	108	100% within the mortar
average		**9.4**	**102**	–
s		1.2	12	–
ratio of strength after 24 hours of seasoning to strength after 7 days of seasoning		–	**0.79**	–

4.4. Open time

4.4.1. Joints made in temperature of −5°C

The ratio of perpendicular tensile strength of a joints made with declared open time (3 minutes) to analogous strength obtained for specimens joined directly after application of the mortar was assumed as a measure of open time.

Tensile strength test was performed on specimens prepared in accordance with section 3.2, while the specimens were subjected to joining after 3 minutes from application of the mortar. The study was conducted in a manner analogous to that described in section 4.2.2. Specimens were seasoned for 7 days in temperature −5°C + 7 days under laboratory conditions. The result was referred to the result obtained in the test described in section 4.2.2, series II.

Strength test was performed under laboratory conditions, directly after seasoning.

Test results are given in Table 6.

View of selected specimens after tests were presented in pictures 6 and 7.

Table 6

Perpendicular tensile strength of joints
performed with polyurethane mortar in temperature of −5°C using 3 minutes open time

No.	Conditions of application and seasoning	Breaking load, kN	Tensile strength, kPa	Nature of damage
1	*2*	*3*	*4*	*5*
1	application **T−5°C, joining after 3 minutes from completion of application,** no correction of position, season-ing − 7 days in temperature −5°C + 7 days in lab. cond.	12.2	132	100% within the mortar
2		13.7	148	100% within the mortar
3		15.2	164	100% within the mortar
4		10.3	111	100% within the mortar
5		12.2	132	100% within the mortar
6		13.2	143	100% within the mortar
7		17.2	186	100% within the mortar
average		**13.4**	**145**	–
s		2.3	23	–
ratio of strength using 3 minutes open time to strength of specimens connected directly after application of the mortar		–	**1.03**	–

Picture 6. General view of selected specimens after the test (clay blocks more filled with polyurethane are the lower parts of the specimen)

Picture 7. Specimen after testing - polyurethane on bracket surface was applied on

4.5. Correction time

The ratio of perpendicular tensile strength of joints made with correction of position (horizontal movement) of clay block relative to each other after 30 seconds from their formation to analogous strength obtained for specimens joined without correction of position was assumed as a measure of correction time.

Tensile strength test of joints performed with polyurethane mortar under laboratory conditions was performed on specimens prepared acc. to section 3.1.

The specimens were subjected to test after 7 days of seasoning in laboratory conditions. The result was referred to the result obtained in the test described in section 4.2.1.

Loading procedure and conditions for conducting the tests were similar to those described in section 4.2.1. Strength test was performed under laboratory conditions.

Test results are given in Table 7.

Table 7

Perpendicular tensile strength of joints,
performed with polyurethane mortar under laboratory conditions,
with correction of position after 30 seconds

No.	Conditions of application and seasoning	Breaking load, kN	Tensile strength, kPa	Nature of damage
1	*2*	*3*	*4*	*5*
1	application – **lab. cond.**, joining immediately after application, **correction of position after 30 seconds,** seasoning – **7 days under laboratory conditions**	6.9	75	100% within the mortar
2		6.0	65	100% within the mortar
3		5.2	56	100% within the mortar
4		5.6	60	100% within the mortar
5		4.6	50	100% within the mortar
6		7.2	78	100% within the mortar
average		5.9	**64**	–
s		1.0	10	–
ratio of strength using 30 seconds of correction time to strength of specimens without correction of position		–	**0.52**	–

Responsible for testing:	Person authorizing the report
Ewa Sudoł, MSc Eng.	**Marzena Jakimowicz, MSc Eng.**
..... Signature	..... Signature
Warsaw, on	

Head of Laboratory LK

Paweł Sulik, PhD Eng.

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