TEST REPORT

SQM_384_2023

CUSTOMER

Kebe S.A.

PRODUCT NAME

NK380

TYPE OF PRODUCT

Masonry unit

TYPE OF TEST

Determination of the equivalent thermal conductivity of the block and of masonry made with it

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Ordering Kebe S.A.
Product placed on the market from Kebe S.A. - 61100 Nea Santa - Kilkis - GREECE
Data related to the sample examined Masonry unit
Sample origin sampled and provided from the Customer
Manufacturing plant Kebe S.A. - 61100 Nea Santa - Kilkis - GREECE

Estimate prot. 23217/lab of 04/14/2023
Order confirmation email of 04/18/2023
Receipt of the samples 04/18/2023
Test execution May-June 2023
Laboratory and location of test execution Certimac - via Ravegnana, 186 - Faenza (RA)

Report issued 08/06/2023
Revision n° 01 - 08/10/2023

Test executed by: Eng. Mattia Morganti
Report drafted by: Eng. Mattia Morganti
Approval: Technical director Eng. L. Laghi

This test report is part of a file in PDF format digitally signed by Luca Laghi

Chief Technical Officer
(Eng. Luca Laghi)

1. Object of the test

The following test report describes the determination of the equivalent thermal values of a masonry brick. The calculations were performed by means of a Finite Element Model implemented in Ansys 18.2 (Ref. 2-b), applied to a planar cross section (unit length), perpendicular to the holes axis and parallel to the thermal flux.

2. Reference standards and documents

The tests have been executed according to the methods defined in the following documentations and reference standards:

a. EN 1745:2012. Masonry and masonry products – Methods for determining thermal properties.
b. CertiMaC calibration report 040219-C-17/Rev01. Calibration of a two-dimensional model for the calculation of the equivalent thermal conductivity of a masonry unit.
c. EN 6946:2008. Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.

3. Input data

The technical drawing of the block and the thermal conductivity of fired clay were supplied by the client (Figure 1). All input data used for the calculation are shown in Table 1.

Figure 1. Geometry of the block

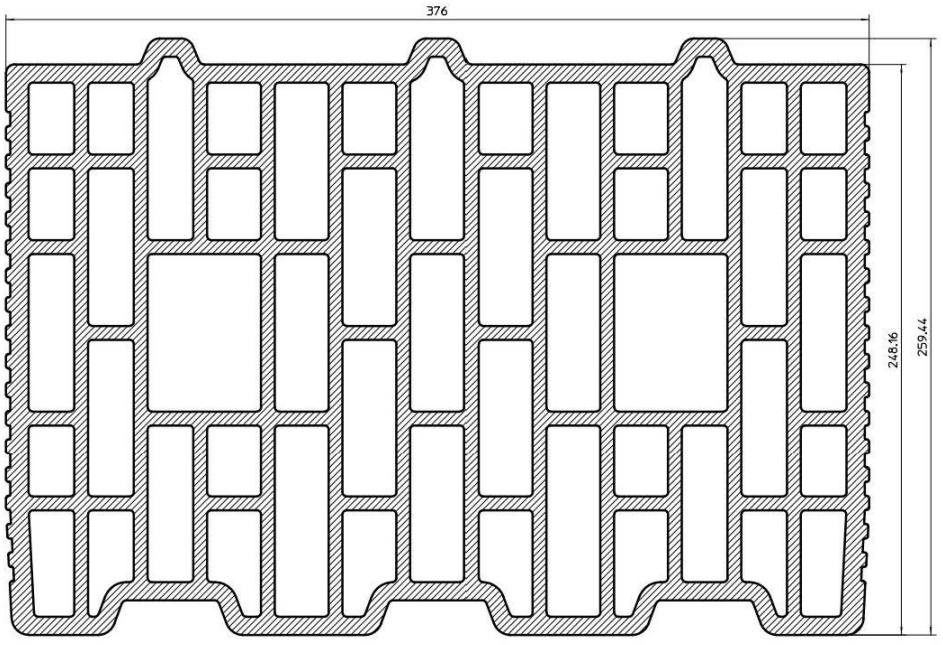
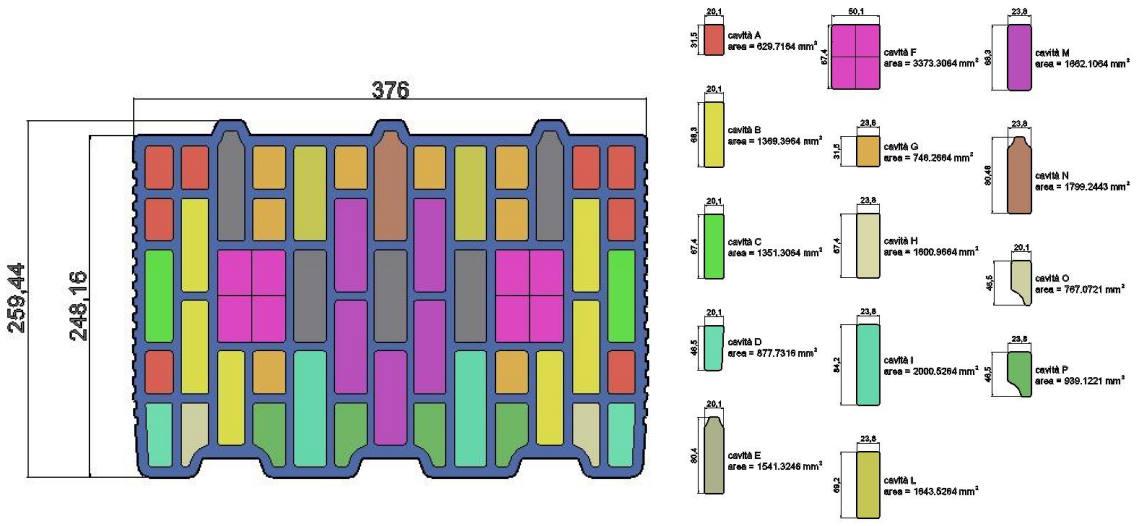


Table 1. Input data

Physical quantity	Nominal value	Ref.
Internal temperature Ti	20 °C = 293.15 K	Ref. 2-a and 2-c
External temperature Te	0 °C = 273.15 K	Ref. 2-a and 2-c
Internal superficial resistance Rsi	0.13 m^2K/W	Ref. 2-a and 2-c
External superficial resistance Rse	0.04 m^2K/W	Ref. 2-a and 2-c
Material thermal conductivity $\lambda_{10,dry,mat}$	0.401 W/mK	Provided by the Customer

Equivalent thermal conductivity values of air voids were determined according to the methodology outlined in Ref. 2-a and 2-f., approximating convective and radiative heat transfer inside the void (Figure 2).

Figure 2. Cross section of the block and air voids data



4. Results

Table 2 shows the results of the Finite Elements Analysis; Figures 3 and 4 graphically show the distribution of the isotherms and the vector state of the heat flow.

Table 2. FEM results

Heat flow [W/m]	**Thermal coupling coefficient** L^{2D} [W/mK]	**Thermal transmittance U** [W/m^2K]	**Total thermal resistance** R_T [m^2K/W]	**True thermal resistance of the masonry unit** R_t [m^2K/W]	**Equivalent thermal conductivity** $\lambda_{10,dry,unit}$ [W/mK]
2,11292	0.1056	0.4257	2.3490	2.1790	0.1726

Figure 3. Distribution of isotherms in the block [°C]

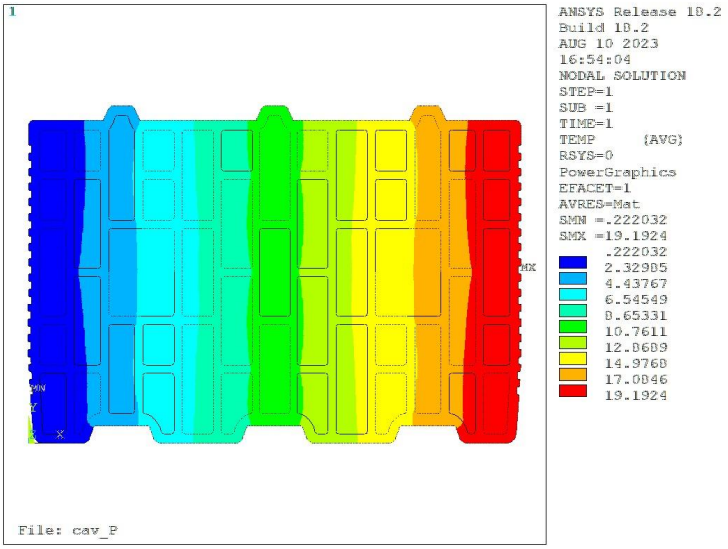
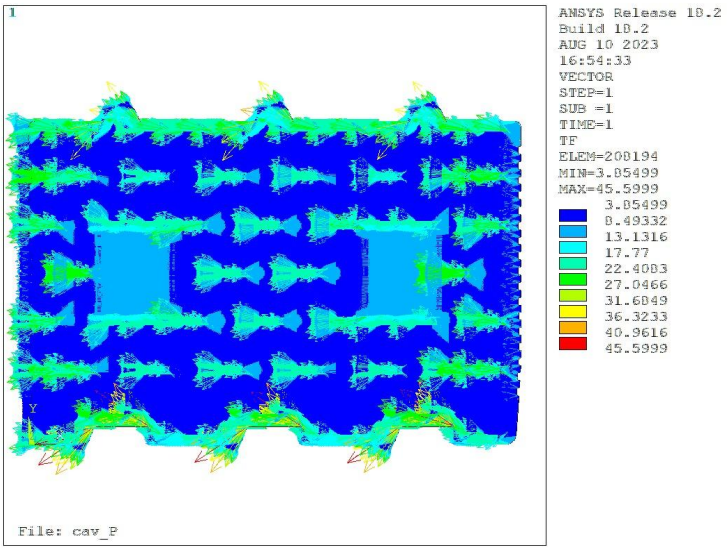


Figure 4. Average heat flow vectors [W/m^2]



5. Determination of thermal values of the masonry

In order to evaluate the thermal values of the masonry, only horizontal mortar joints were considered, without plaster layers. Because of the interlocking block geometry, the vertical joint was not considered. For the evaluation of the thermal values of the masonry, three different configurations were studied:

- 12 mm thick horizontal joints,
- 3 mm thick horizontal joints,
- no horizontal joints.

Table 3 shows the input data used for the masonry calculations.

Table 3. Input data for masonry calculations

Material	Dimensions [mm]	Thermal conductivity [W/mK]
Masonry unit	376 x 248.16 x 240	0.1726
Horizontal traditional mortar joints	Thickness = 12 – 3 – 0	0.900

Tables 4, 5 and 6 show the thermal values of the masonry, in the three configurations described above.

Table 4. Results of the calculation for the masonry with 12 mm thick horizontal joints

Physical quantity	Result
Thermal resistance only of the layer $\mathbf{R_t}$ [m^2K/W]	1.8147
Equivalent thermal conductivity of the masonry $\boldsymbol{\lambda_{equ}}$ [W/mK]	0.2072
Thermal resistance of the masonry including superficial thermal resistances $\mathbf{R_T}$ (m^2K/W)	1.9847
Thermal transmittance **U** (W/m^2K)	0.5039

Table 5. Results of the calculation for the masonry with 3 mm thick horizontal joints

Physical quantity	Result
Thermal resistance only of the layer $\mathbf{R_t}$ [m^2K/W]	2.0712
Equivalent thermal conductivity of the masonry $\boldsymbol{\lambda_{equ}}$ [W/mK]	0.1815
Thermal resistance of the masonry including superficial thermal resistances $\mathbf{R_T}$ (m^2K/W)	2.2412
Thermal transmittance **U** (W/m^2K)	0.4462

Table 6. Results of the calculation for the masonry without mortar joints

Physical quantity	Result
Thermal resistance only of the layer $\mathbf{R_t}$ [m^2K/W]	2.1790
Equivalent thermal conductivity of the masonry $\boldsymbol{\lambda_{equ}}$ [W/mK]	0.1726
Thermal resistance of the masonry including superficial thermal resistances $\mathbf{R_T}$ [m^2K/W]	2.3490
Thermal transmittance **U** [W/m^2K]	0.4257

SUMMARY TABLE OF RESULTS

The tests previously described gave the following results:

Product	Equivalent thermal conductivity λ_{equ} [W/mK]	Thermal transmittance U [W/m^2K]
block NK380	**0.1726**	**0.4257**
Masonry with 12 mm thick horizontal joints	**0.2072**	**0.5039**
Masonry with 3 mm thick horizontal joints	**0.1815**	**0.4462**
Masonry without mortar joints	**0.1726**	**0.4257**

6. List of distribution

ENEA	Archive	1 copy
Certimac	Archive	1 copy
Kebe S.A.	Archive	1 copy

In charged of technical test execution	In charged of technical report drafting	Technical director Approval
Eng. Mattia Morganti	Eng. Mattia Morganti	Ing. Luca Laghi
		

-------- End of the Test Report ------