

# TEST REPORT

SQM\_643\_2023

CUSTOMER

**Kebe S.A.**

PRODUCT NAME

**NK250**

TYPE OF PRODUCT

**Masonry unit**

TYPE OF TEST

**Determination of the thermal design conductivity of the block and of masonry made with it**

**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. 23436/lab of 09/01/2023

**Order confirmation** email of 09/01/2023

**Receipt of the samples** -

**Test execution** September 2023

**Laboratory and location of test execution** Certimac - via Ravegnana, 186 - Faenza (RA)

**Report issued** 09/22/2023

**Revision** n° 00

**Test executed by:** Eng. **Mattia Morganti**

**Report drafted by:** Eng. **Mattia Morganti**

**Approval:** Technical director Eng. L. Laghi

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digitally signed by Luca Laghi*

Chief Technical Officer  
(Eng. Luca Laghi)



## 1. Object of the test

The following test report describes the determination of thermal design 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. In this calculation, the input data have been modified taking into account the effect of humidity as indicated by the technical standard in Ref. 2-a.

## 2. Reference standards and documents

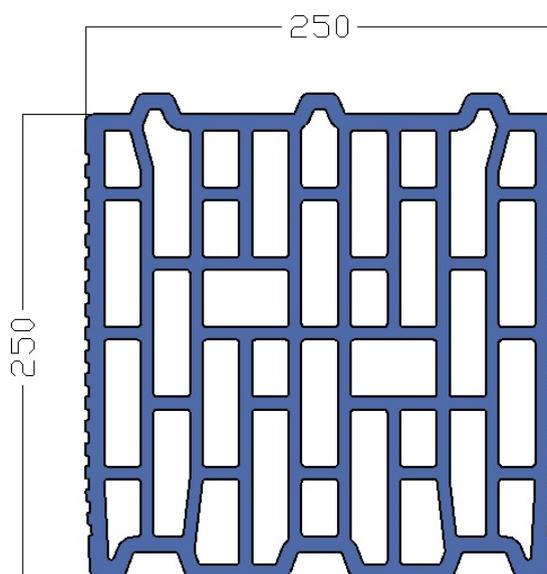
The tests have been executed according to the methods defined in the following documentations and reference standards:

- EN ISO 10456:2007. Building materials and products - Hygrothermal properties - Tabulated design values and procedures for determining declared and design thermal values (ISO 10456:2007)
- 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.
- EN 6946:2008. Building components and building elements – Thermal resistance and thermal transmittance – Calculation method.
- Test report SQM\_642\_2023, 09/22/2023 - Determination of the equivalent thermal conductivity of the block NK250 and of masonry made with it.

## 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 Tables 1 and 2.

**Figure 1.** Geometry of the block



**Table 1.** Input data

Physical quantity	Nominal value	Ref.
Material thermal conductivity $\lambda_{10,dry,mat}$	0.401 W/mK	Provided by the Customer
Equivalent thermal conductivity of voids	Test Report NK250	Ref. 2-d

**Table 2.** Input data of the masonry

Masonry n. 1	Nominal value	Ref.
Horizontal mortar joints	Thickness = 3 mm $\lambda_{mortar} = 0.87$ W/mK	Provided by the Customer
Internal plaster	Thickness = 25 mm $\lambda_{mortar} = 1.0$ W/mK	Provided by the Customer
External plaster	Thickness = 25 mm $\lambda_{mortar} = 1.0$ W/mK	Provided by the Customer

Masonry n. 2	Nominal value	Ref.
Horizontal mortar joints	Thickness = 3 mm $\lambda_{mortar} = 0.87$ W/mK	Provided by the Customer
Internal plaster	Thickness = 25 mm $\lambda_{mortar} = 1.0$ W/mK	Provided by the Customer
External plaster	Thickness = 25 mm $\lambda_{mortar} = 0.08$ W/mK	Provided by the Customer

Masonry n. 3	Nominal value	Ref.
Horizontal mortar joints	Thickness = 3 mm $\lambda_{mortar} = 0.87$ W/mK	Provided by the Customer
Internal plaster	Not present	Provided by the Customer
External plaster	Not present	Provided by the Customer

#### 4. Determination of the thermal design values

Thermal design values of the masonry are determined as defined by the standards at Ref. 2-a and 2-c, increasing the thermal conductivity of the materials in relation to the moisture content, using the following conversion coefficient (moisture content volume by volume):

$$F_m = e^{f_\psi(\psi_2 - \psi_1)}$$

The standard sets as operating conditions a temperature of 23 °C and a relative humidity of 80% (precautionary hypothesis), which is related to the test condition at 10 °C, dry.

#### 4. Results

Table 3 shows the results of the Finite Elements Analysis performed with design thermal values at Ref. 2-a.

**Table 3.** FEM results

Heat flow [W/m]	Thermal coupling coefficient $L^{2D}$ [W/mK]	Thermal transmittance $U$ [W/m <sup>2</sup> K]	Total thermal resistance $R_T$ [m <sup>2</sup> K/W]	True thermal resistance of the masonry unit $R_t$ [m <sup>2</sup> K/W]	Equivalent thermal conductivity $\lambda_{10,dry,unit}$ [W/mK]
3.1176	0.1559	0.6235	1.6038	1.4338	0.1744

#### 5. Determination of thermal values of the masonry

Table 4 shows the thermal values of the masonry, in the three configurations described above, taking into account the effect of humidity.

**Table 4.** Results of the calculation for the masonry

Masonry n. 1	Result
Thermal resistance only of the layer $R_t$ [m <sup>2</sup> K/W]	1.4011
Equivalent thermal conductivity of the masonry $\lambda_{equ}$ [W/mK]	0.2141
Thermal resistance of the masonry including superficial thermal resistances $R_T$ (m <sup>2</sup> K/W)	1.5711
Thermal transmittance $U$ (W/m <sup>2</sup> K)	0.6365

<b>Masonry n. 2</b>	<b>Result</b>
Thermal resistance only of the layer $R_t$ [ $m^2K/W$ ]	1.6272
Equivalent thermal conductivity of the masonry $\lambda_{equ}$ [ $W/mK$ ]	0.1844
Thermal resistance of the masonry including superficial thermal resistances $R_T$ ( $m^2K/W$ )	1.7972
Thermal transmittance $U$ ( $W/m^2K$ )	0.5564

<b>Masonry n. 3</b>	<b>Result</b>
Thermal resistance only of the layer $R_t$ [ $m^2K/W$ ]	1.3451
Equivalent thermal conductivity of the masonry $\lambda_{equ}$ [ $W/mK$ ]	0.1859
Thermal resistance of the masonry including superficial thermal resistances $R_T$ ( $m^2K/W$ )	1.5151
Thermal transmittance $U$ ( $W/m^2K$ )	0.6600

## SUMMARY TABLE OF RESULTS

The tests previously described gave the following results, taking into account the effect of humidity:

<b>Product</b>	<b>Thermal design conductivity <math>\lambda_{equ}</math> [<math>W/mK</math>]</b>	<b>Thermal design transmittance <math>U</math> [<math>W/m^2K</math>]</b>
<b>block NK250</b>	<b>0.1744</b>	<b>0.6235</b>
<b>Masonry n. 1</b>	<b>0.2141</b>	<b>0.6365</b>
<b>Masonry n. 2</b>	<b>0.1844</b>	<b>0.5564</b>
<b>Masonry n. 3</b>	<b>0.1859</b>	<b>0.6600</b>

**6. List of distribution**

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

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

# TEST REPORT

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TYPE OF PRODUCT

**Masonry unit**

TYPE OF TEST

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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

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## 1. Object of the test

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## 2. Reference standards and documents

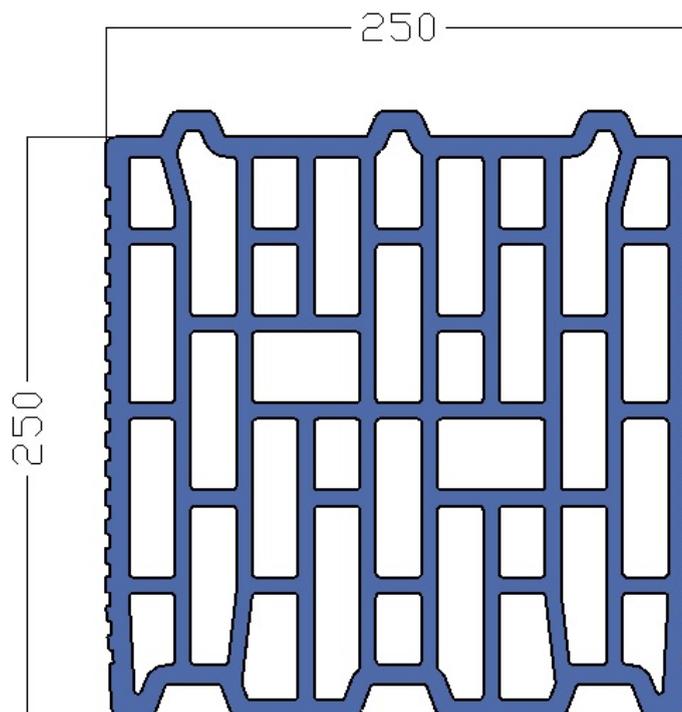
The tests have been executed according to the methods defined in the following documentations and reference standards:

- EN 1745:2012. Masonry and masonry products – Methods for determining thermal properties.
- 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.
- 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

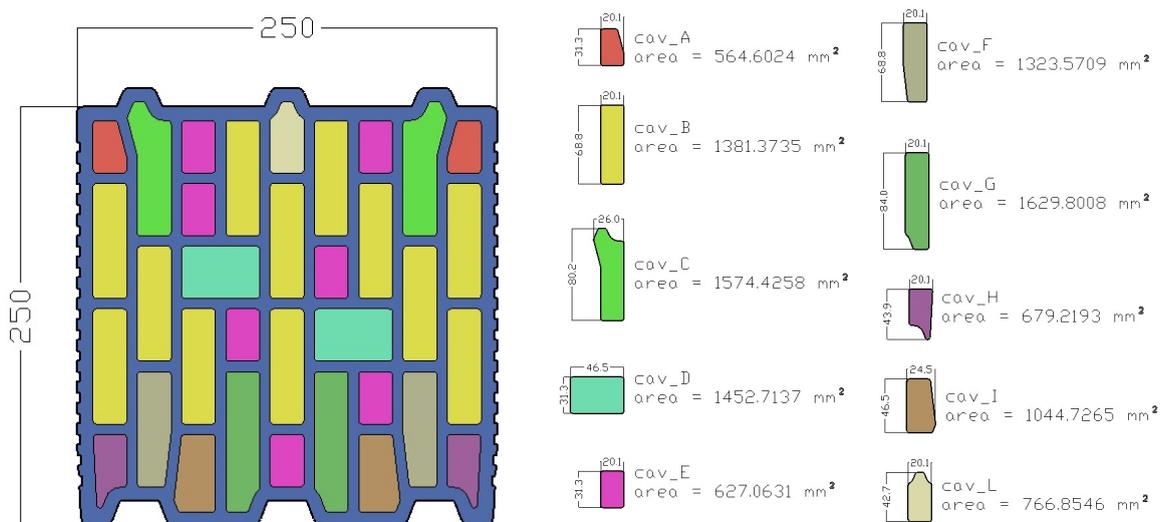


**Table 1.** Input data

Physical quantity	Nominal value	Ref.
Internal temperature $T_i$	20 °C = 293.15 K	Ref. 2-a and 2-c
External temperature $T_e$	0 °C = 273.15 K	Ref. 2-a and 2-c
Internal superficial resistance $R_{si}$	0.13 m <sup>2</sup> K/W	Ref. 2-a and 2-c
External superficial resistance $R_{se}$	0.04 m <sup>2</sup> K/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-c., approximating convective and radiative heat transfer inside the void (Figure 2).

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



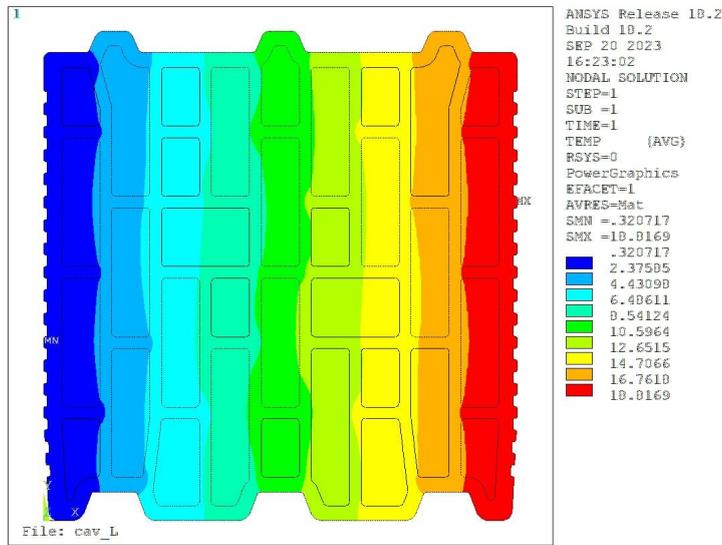
## 4. Results

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.

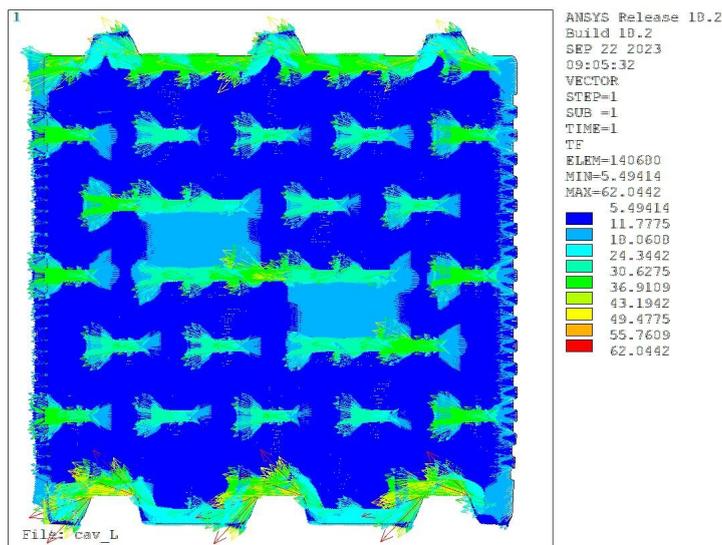
**Table 2.** FEM results

Heat flow [W/m]	Thermal coupling coefficient $L^{2D}$ [W/mK]	Thermal transmittance $U$ [W/m <sup>2</sup> K]	Total thermal resistance $R_T$ [m <sup>2</sup> K/W]	True thermal resistance of the masonry unit $R_t$ [m <sup>2</sup> K/W]	Equivalent thermal conductivity $\lambda_{10,dry,unit}$ [W/mK]
2.9891	0.1495	0.5978	1.6727	1.5027	0.1664

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



**Figure 4.** Average heat flow vectors [W/m<sup>2</sup>]



## 5. Determination of thermal values of the masonry

Because of the interlocking block geometry, only horizontal mortar joints were considered. For the evaluation of the thermal values of the masonry, three different configurations were studied. The input data for the definition of the configurations are indicated in table 3.

**Table 3.** Input data of the masonry

Masonry n. 1	Nominal value	Ref.
Horizontal mortar joints	Thickness = 3 mm $\lambda_{\text{mortar}} = 0.87 \text{ W/mK}$	Provided by the Customer
Internal plaster	Thickness = 25 mm $\lambda_{\text{mortar}} = 1.0 \text{ W/mK}$	Provided by the Customer
External plaster	Thickness = 25 mm $\lambda_{\text{mortar}} = 1.0 \text{ W/mK}$	Provided by the Customer

Masonry n. 2	Nominal value	Ref.
Horizontal mortar joints	Thickness = 3 mm $\lambda_{\text{mortar}} = 0.87 \text{ W/mK}$	Provided by the Customer
Internal plaster	Thickness = 25 mm $\lambda_{\text{mortar}} = 1.0 \text{ W/mK}$	Provided by the Customer
External plaster	Thickness = 25 mm $\lambda_{\text{mortar}} = 0.08 \text{ W/mK}$	Provided by the Customer

Masonry n. 3	Nominal value	Ref.
Horizontal mortar joints	Thickness = 3 mm $\lambda_{\text{mortar}} = 0.87 \text{ W/mK}$	Provided by the Customer
Internal plaster	Not present	Provided by the Customer
External plaster	Not present	Provided by the Customer

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 no. 1

Physical quantity	Result
Thermal resistance only of the layer $R_t$ [m <sup>2</sup> K/W]	1.4929
Equivalent thermal conductivity of the masonry $\lambda_{equ}$ [W/mK]	0.2009
Thermal resistance of the masonry including superficial thermal resistances $R_T$ (m <sup>2</sup> K/W)	1.6629
Thermal transmittance $U$ (W/m <sup>2</sup> K)	0.6013

**Table 5.** Results of the calculation for the masonry no. 2

Physical quantity	Result
Thermal resistance only of the layer $R_t$ [m <sup>2</sup> K/W]	1.7804
Equivalent thermal conductivity of the masonry $\lambda_{equ}$ [W/mK]	0.1685
Thermal resistance of the masonry including superficial thermal resistances $R_T$ (m <sup>2</sup> K/W)	1.9504
Thermal transmittance $U$ (W/m <sup>2</sup> K)	0.5127

**Table 6.** Results of the calculation for the masonry no. 3

Physical quantity	Result
Thermal resistance only of the layer $R_t$ [m <sup>2</sup> K/W]	1.4282
Equivalent thermal conductivity of the masonry $\lambda_{equ}$ [W/mK]	0.1750
Thermal resistance of the masonry including superficial thermal resistances $R_T$ [m <sup>2</sup> K/W]	1.5982
Thermal transmittance $U$ [W/m <sup>2</sup> K]	0.6257

## SUMMARY TABLE OF RESULTS

The tests previously described gave the following results:

Product	Equivalent thermal conductivity $\lambda_{\text{equ}}$ [W/mK]	Thermal transmittance U [W/m <sup>2</sup> K]
block NK250	0.1664	0.5978
Masonry no. 1	0.2009	0.6013
Masonry no. 2	0.1685	0.5127
Masonry no. 3	0.1750	0.6257

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