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SCHOOL OF MINING AND METALLURGICAL ENG.
LABORATORY OF METALLURGY

Technical Report TE 10/2017

THERMAL PROPERTIES OF THERMOBLOCK LB15

Client:

LEDRA BRICK & TILE FACTORY LTD

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1. INTRODUCTION

According to the relative order received in May 2017 from LEDRA BRICK & TILE FACTORY LTD, the Laboratory of Metallurgy undertook the performance of determining the thermal properties of one (1) thermoblock LB15. The technical specifications (geometry dimensions) of the thermoblock was received on May 17th, 2017. The methodology followed for the analysis requested and the results obtained are presented in detail in this report.

2. METHODOLOGY

2.1. Material Properties

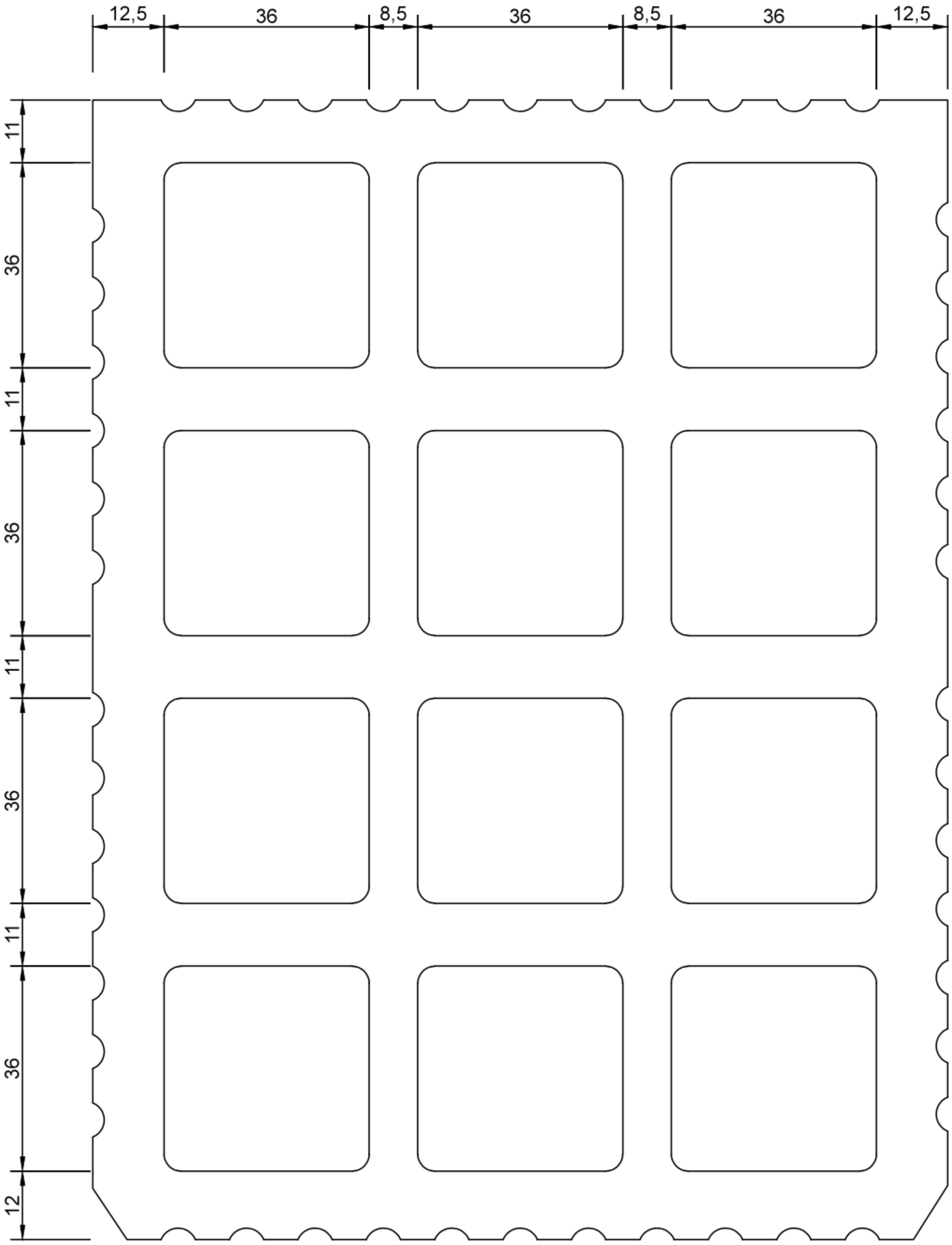
In the current study, porous clay and air are considered as homogeneous fluid continua and their properties as presented in Table 1. The thermal conductivity (W/(m·K)) of air calculated according to EN 1745:2012, ISO 10211:2007 and ISO 6946 respectively [1-3].

Table 1. Properties of materials used in the computations.

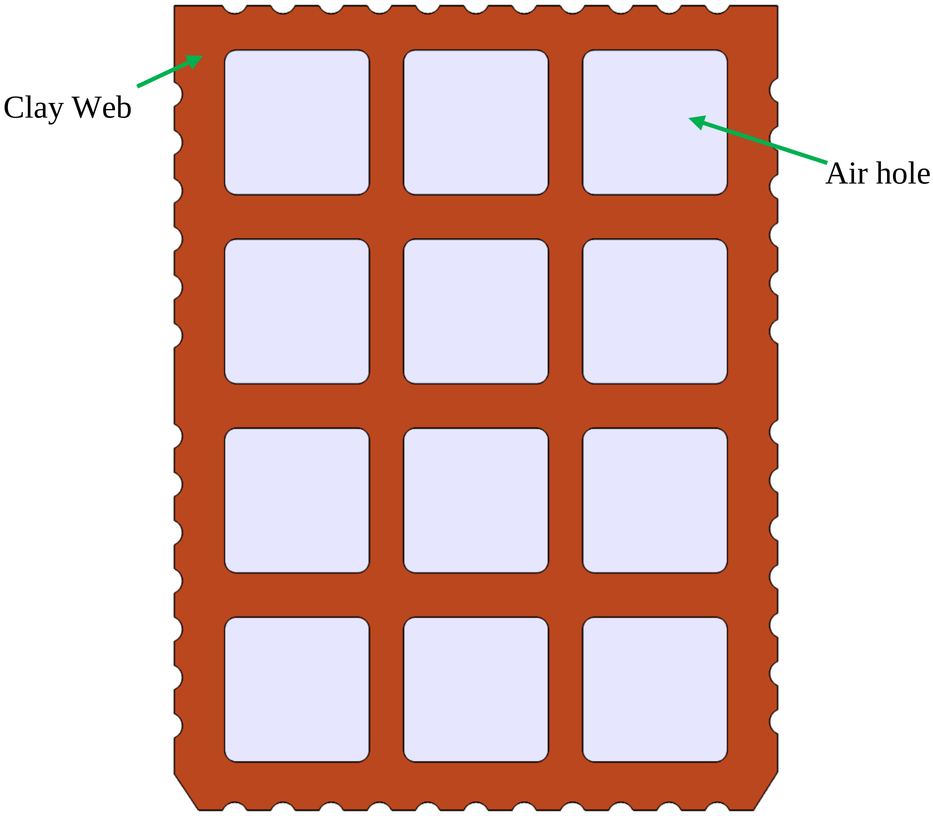
Properties	Porous Clay	Air
Density (kg/m^3)	2000	1.23
Heat Capacity (J/(kg·K))	1000	1008
Thermal Conductivity (W/(m·K))	0.35	Geometry and Temperature Dependent

2.2. Geometry and Boundary Conditions

In Fig.1a and 1b the geometry dimensions of the thermoblock and the respective domains are portrayed. As suggested by the client LEDRA BRICK & TILE FACTORY LTD, the thermoblock is insulated at the left and the right side. In the upper wall, corresponding to the external wall, a convective heat flux boundary condition was applied, with an external temperature of 0°C and a heat transfer coefficient of 25 W/(m^2·K) [1-2]. Similarly, in the bottom wall, corresponding to the inner wall, a convective heat flux boundary condition was applied, with a constant temperature of 20°C and a heat transfer coefficient of 7.69 W/(m^2·K) [1-2].



(a)

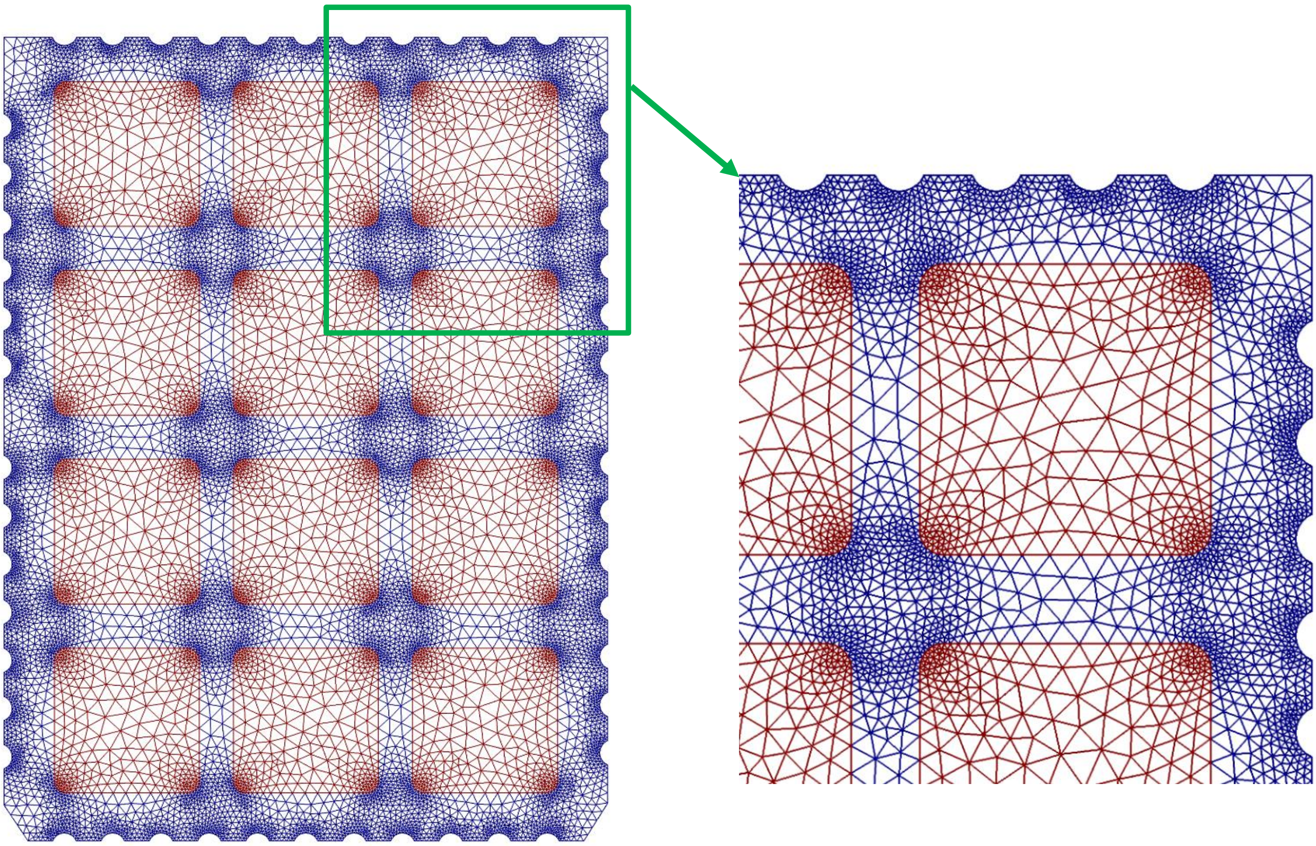


(b)

Fig. 1. (a) Thermoblock geometry dimensions in mm and (b) domains of porous clay and air holes.

2.3. Computational details

Convergence was assumed when the scaled residuals of the discretized equations fell below a preset tolerance of 10^{-6}. The thermal problem was solved with the stationary direct solver PARDISO. The grid consisted of 26.232 triangular mesh elements (see Fig.2) with the lowest element quality being equal to 0.69.



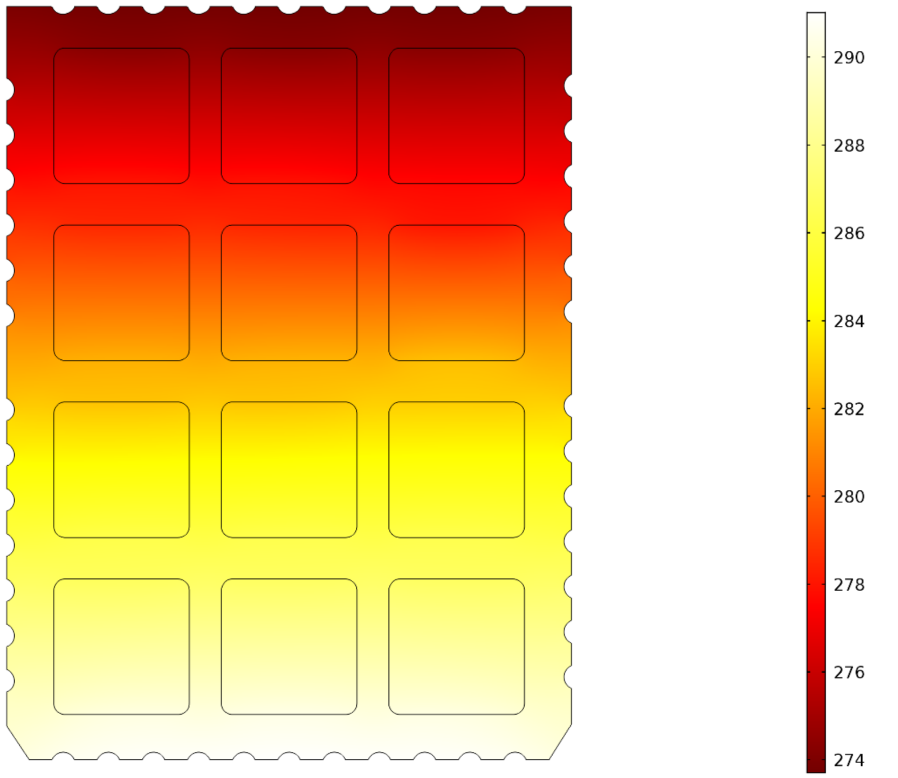
(a) (b)

Fig.2. Schematic of the computational grid used (a) in the thermoblock (b) around the air hole.

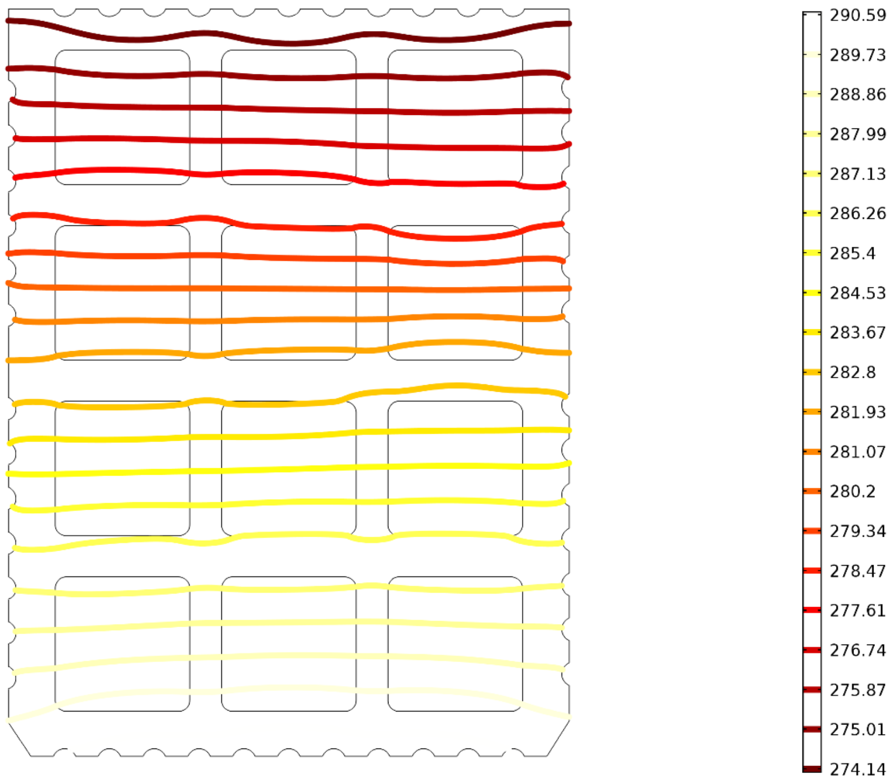
3. RESULTS

3.1. Temperature Distribution

In Figure 3a and 3b the temperature distribution and the isothermal contours are portrayed. The maximum temperature (293.15K) in the bottom wall refers to the inner boundary condition and the lowest temperature (273.15K) refers to the upper wall.



(a)



(b)

Fig3. (a) Temperature distribution in K and (b) isothermal contour in K.

3.2. Thermal Properties

Based on the finite elements calculations, the effective thermal conductivity of the thermoblock (see Fig. 1a and 1b) is $\lambda = 0.1645$ W/(m·K). The thermal transmittance of the thermoblock is $U = 0.8225$ W/(m^2·K).

4. References

1. EN 1745, Masonry and masonry products: methods for determining design thermal values, April 2000.
2. EN ISO 10211:2007, Thermal bridges in building construction: heat flows and surface temperatures, 2007.
3. EN ISO 6946, Building components and building elements: thermal resistance and thermal transmittance, Calculation method.

Scientific responsible

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