

# EXAMPLE THERMAL SIMULATION OF MASONRY ACCORDING TO EN 1745 USING THE PHYSIBEL SOFTWARE



Title .....Example thermal simulation of masonry according to EN 1745  
.....using the Physibel software

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## INTRODUCTION

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The Physibel software allows simulating the heat transfer through masonry according to the international standard EN 1745. This report explains briefly the steps necessary to perform such simulations for an example masonry provided by the principal.

## 2. BISCO DATA PREPARATION

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Figure 1 shows the example brick as provided in dxf-format (CAD). First, dxf-drawing is converted into a coloured spot drawing with BiscoDxf (Figure 2). Also the geometry was rearranged in order to obtain a symmetry axis at left and right. The drawing is saved in 256 colours bmp format.

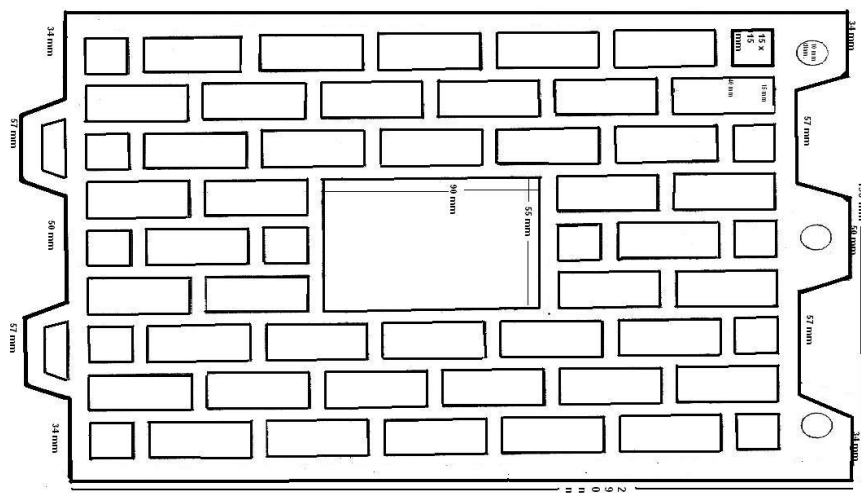


Figure 1. Line drawing of brick.

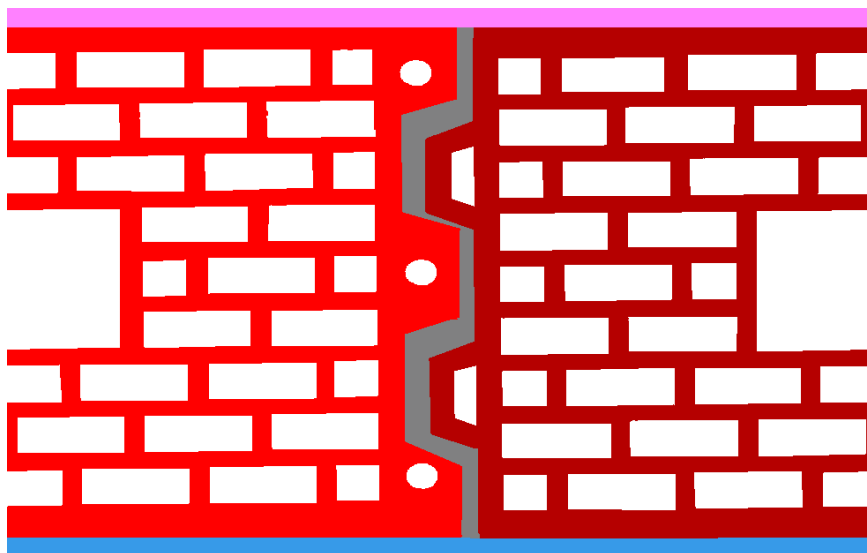


Figure 2. Coloured spot drawing of brick.

This bitmap is now imported in the program BISCO (Figure 3). Each colour is now associated with a material, with a cavity or with a boundary condition, according to the data in EN 1745. As each cavity has its own equivalent thermal conductivity, the BISCO 'split zones' function is used (Figure 4).

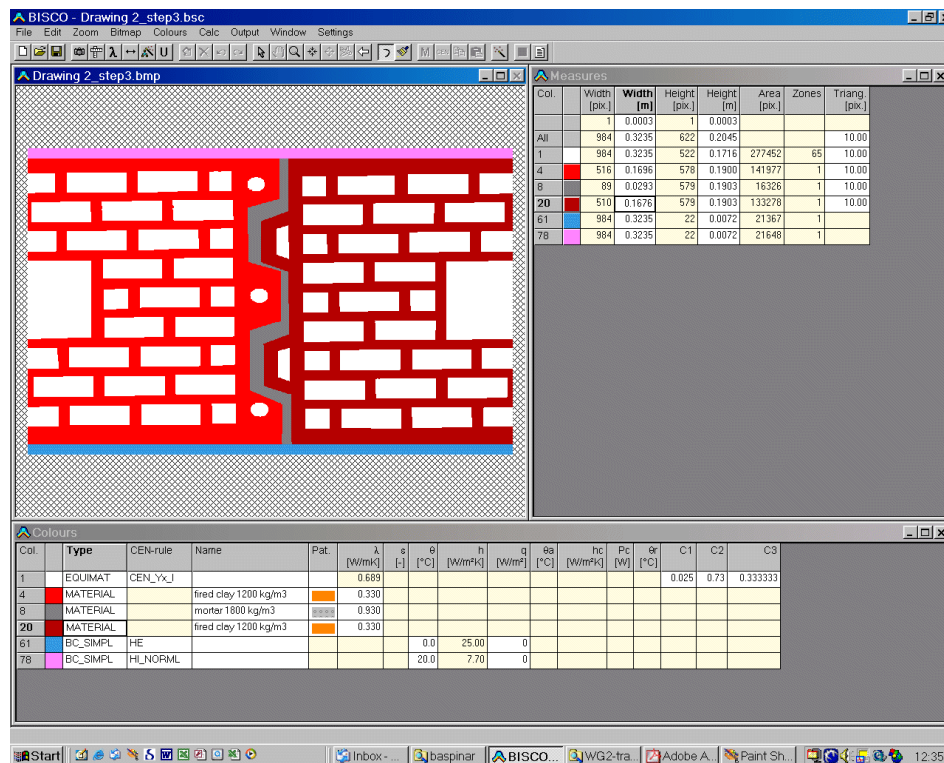


Figure 3. Program BISCO: definition of colours as materials, cavities and boundary conditions.

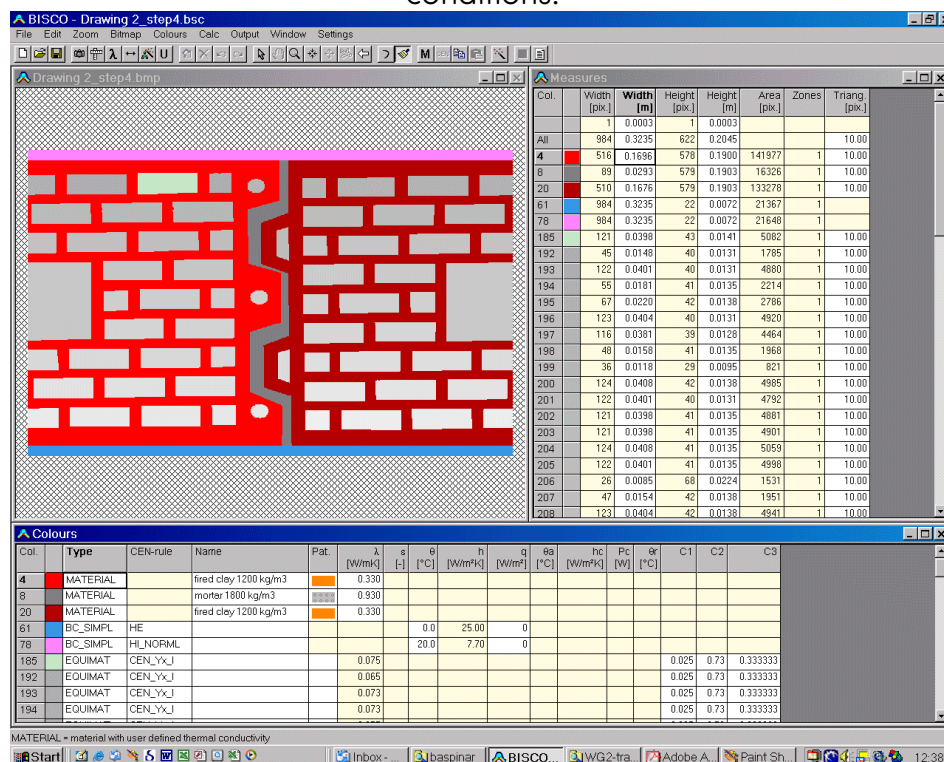


Figure 4. Program BISCO: each cavity gets its own equivalent thermal conductivity by using of the 'split zones' function.

## 2. BISCO CALCULATION AND RESULTS

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A first step in the numerical simulation is the division of the geometrical object in small elements. BISCO uses an automatic triangulation (Figure 5.).

Then a heat balance is made for each grid node, resulting in a system of equations. The solution of the system provides the node temperatures (Figure 6.) and the heat flows (Figure 7.).

The thermal transmittance of the masonry found is  $U = 0.816 \text{ W/m}^2\text{K}$ .

The thermal resistance is  $R = 1.06 \text{ m}^2\text{K/W}$  ( $R = 1/U - 0.17$ ).

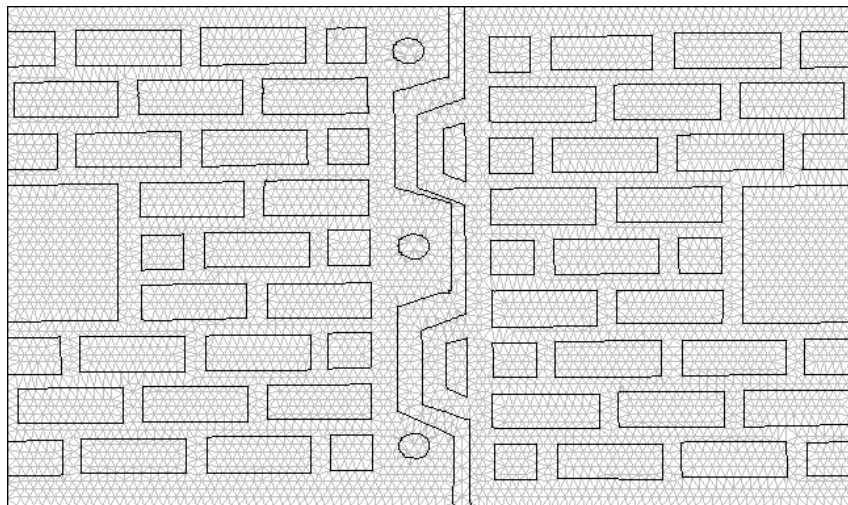


Figure 5. Triangulated object.

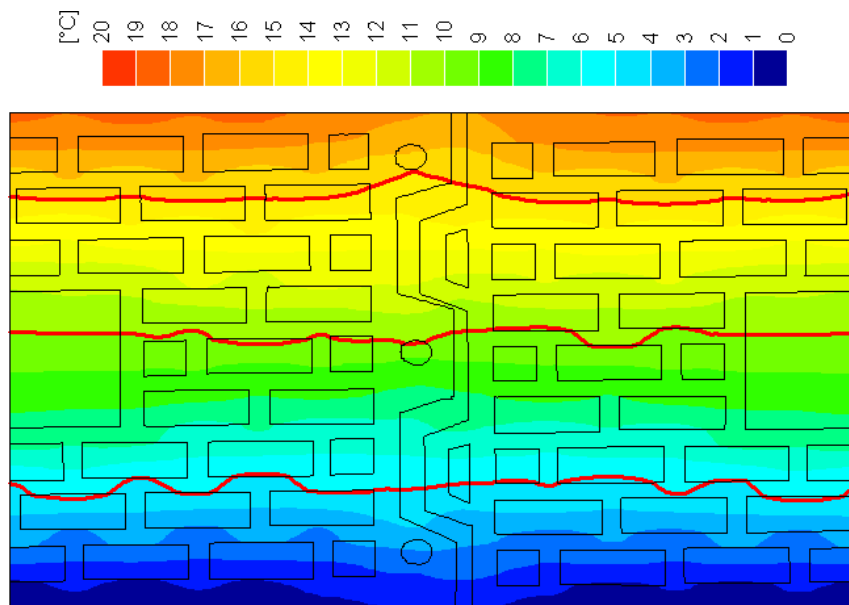


Figure 6. Isotherms (colour increment of 1 °C, line increment of 5 °C).

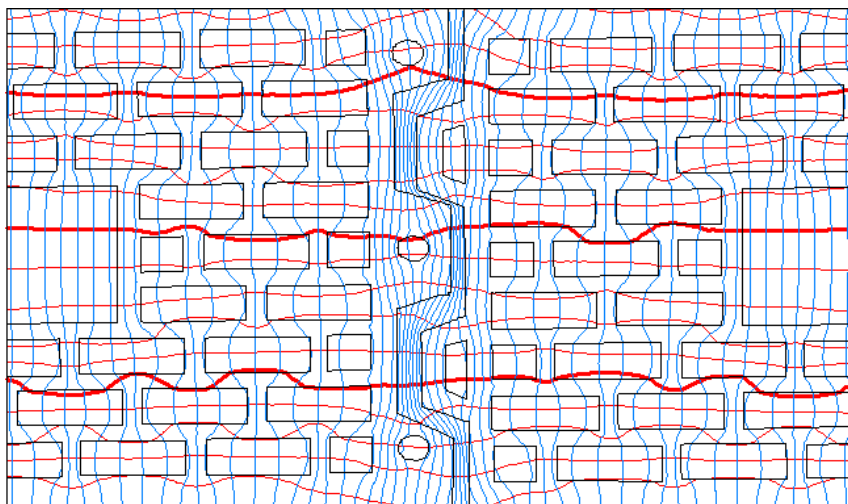


Figure 7. Isothermal lines (increments 1 & 5 °C) and heat flow lines (increment 0.1 W/m).

### 3. 3D TRISCO ANALYSIS

The thermal simulation done is a 2D simulation in which the horizontal mortar joint isn't taken into account. This joint can be considered in a 3D simulation.

Figure 8 and Figure 9 show the isotherms and the heat flow density in the masonry in which a horizontal joint is added. The results were obtained using the program TRISCO importing the BISCO data and adding a horizontal mortar joint at the bottom.

The thermal transmittance of the masonry found is  $U = 0.913 \text{ W/m}^2\text{K}$ .

The thermal resistance is  $R = 0.925 \text{ m}^2\text{K/W}$  ( $R = 1/U - 0.17$ ).

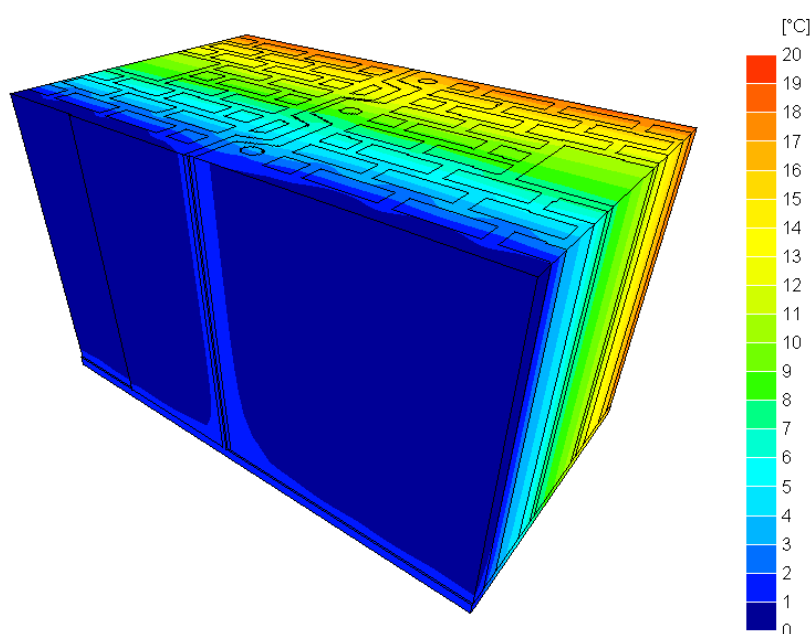


Figure 8. Isotherms (colour increment of 1 °C, line increment of 5 °C).

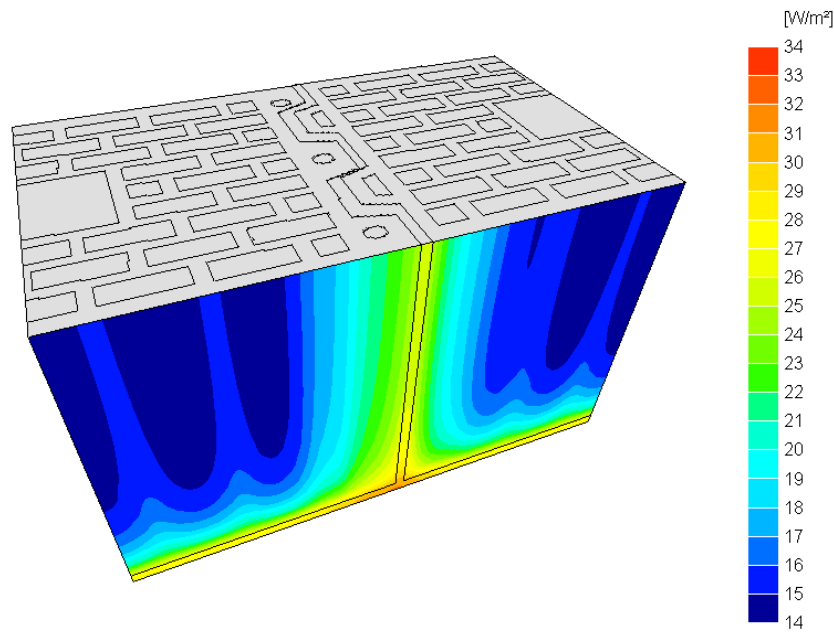


Figure 9. Isotherms (colour increment of 1 °C, line increment of 5 °C).

#### 4. SUPPLEMENTARY THERMAL ANALYSIS OPTIONS

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Instead of using TRISCO, also the program SOLIDO can be used. In this program the masonry can be defined using the 3D STL-format or by importing the BISCO data. It is also possible to perform 3D transient calculations using the program VOLTRA, for example to define the transient thermal performances of the masonry or to define the fire resistance.

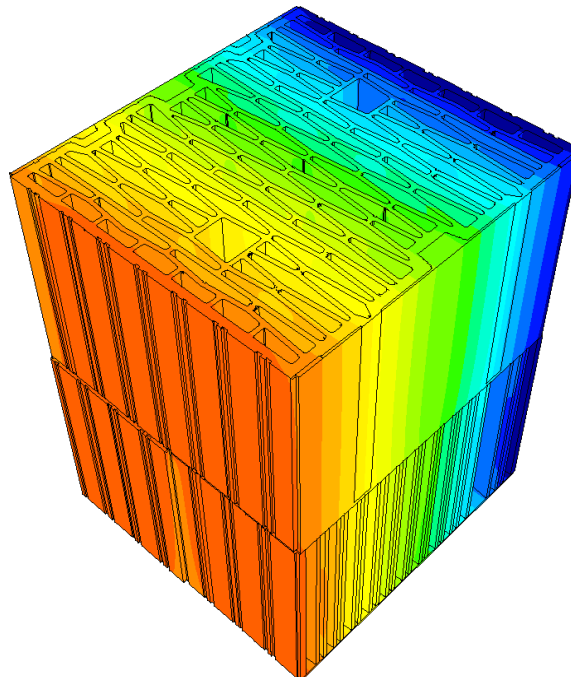


Figure 10. Sample SOLIDO simulation result (isotherms) of masonry.