Frauenhof Institute for Building Physics

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Officially recognised test station for the approval of new building materials, building parts and building methods.

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Calculation of the equivalent heat conductivity, heat resistance and heat transmission co-efficiency of masonry made from Expanded Polyurethane (EPS) hard foam elements

Applicant: EUROMAC 2 S.àr.l
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1. Task

The Frauenhof Institute for Building Physics were commissioned by the applicant to calculate the equivalent heat conductivity, heat resistance and heat transmission co-efficiency of masonry made from EPS hard-foam elements, type “M 100” (normal block) with concrete filling. The calculation was made using a three-dimensional Finite-Difference mathematical method.

2. Description of the element and the masonry

The basic construction elements are 1000mm long, 340mm wide and 300mm high EPS foam structures, each with 4 integrated cavities that measure 174mm x 152mm. In between each, there are two supporting struts, with a diameter of 4mm. The elements are braced consecutively and form the cross section norm of the outer wall. Figure 1 shows a photographic view of an EPS basic construction element. Figure 2 is a plan view of this element.

3. Calculation Process

3.1 The calculations were made using a three-dimensional fixed Finite-Difference method described in [1].

3.2 Material Values

The heat conductivity of EPS hard-foam elements was measured as 0.035 W/ (m · K) (see [2]). For the remaining components of the masonry, the results of the heat conduction calculations were:

Heavy Concrete Filling	2.1 W/ (m · K)
Reinforcement Steel	60 W/ (m · K)
Plaster Beam Facing	0.7 W/ (m · K)

By the investigation of heat transmission co-efficiency (K value) in addition, an inner plaster 15mm thick gave a 0.7 W/ (m · K) of heat conductivity and a 20mm thick outer plaster resulted in 0.87 W/ (m · K) of heat conductivity.

3.3 Limiting Conditions

As limiting conditions, air temperatures and heat transmission co-efficiency on both sides of the masonry were limited as follows:

Internal Air Temperature	20 ^{0}C
External Air Temperature	0 ^{0}C
External Heat Transmission Co-efficiency	23 W/ (m^2 · K)
Internal Heat Transmission Co-efficiency	8 W/ (m^2 · K)

3.4 Calculation Results

The calculation resulted in the following findings:

Equivalent Heat Conduction of Masonry:

$$\Lambda eq = 0.070 \quad W/ (m \cdot K)$$

Heat Transmission Resistance of Masonry:

$$1/\Lambda \; 4.87 \; m^2 \cdot K/W$$

Heat Transmission Co-efficiency (K value) of the wall with internal and external plaster

$$\mathbf{k_W = 0.20\ W/(m^2 \cdot K)}$$

In the unit Kcal / (m · h · grd), accounting for the conversion factor 1 W/ (m^2 · K) = 0.860 kcal / (m^2 · h · grd) of heat transmission co-efficiency

Heat resistance of masonry
(Without layer of plaster):

$$\mathbf{1/\Lambda = 5.66\ m^2 \cdot h \cdot grd/kcal}$$

And heat transmission co-efficiency
(With layer of plaster):

$$\mathbf{k_W = 0.17\ kcal/(m^2 \cdot h \cdot grd)}$$

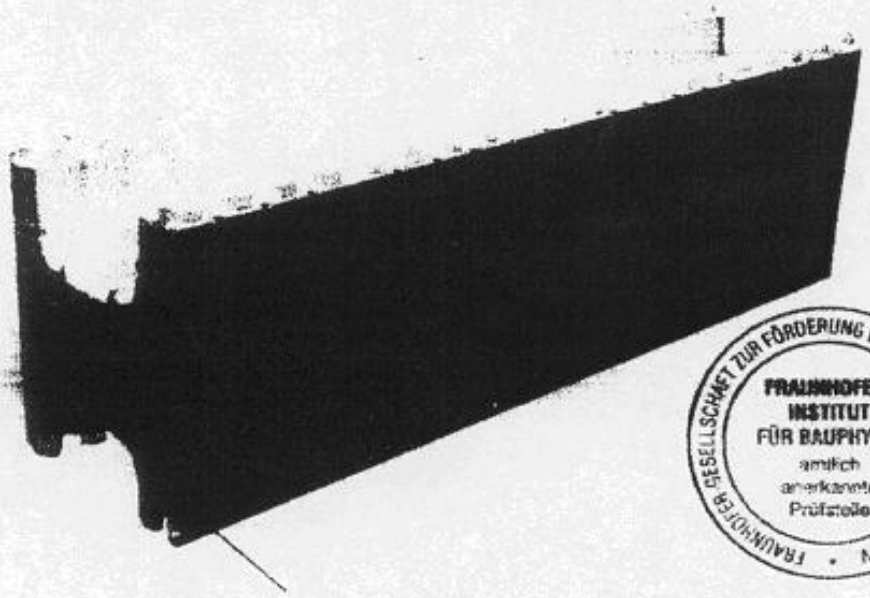
5. Literature

[1] Koenig, N., G. and Schule, M.: The effect of measurement and cavity building from hollow building blocks on the heat insulation of masonry made from pumice building materials. Research carried out under the commission of the Research Association of Rheine Pumice Industry (Rheinisvhen Bimindustrie e.V Neuwied (1984). Report BW 171/84 of the Frauenhof Institute for Building Physics (1984).

[2] Test report P1-473/ 1993 of the Frauenhof Institute for Building Physics from October 28.1993 about the appropriateness of heat conduction according to DIN regulation 52 612 (slab equipment) from EPS slabs, manufactured from EPS casing stones.

This test report consists of 4 pages and 2 figures.

Stuttgart, 06.Feb. 1995



Plaster Board

Figure 1 **Photographic View of EPS construction element Type "M 100" with external plaster board. EUROMAC 2, S.ar.l F-57730, Folschviller/France**

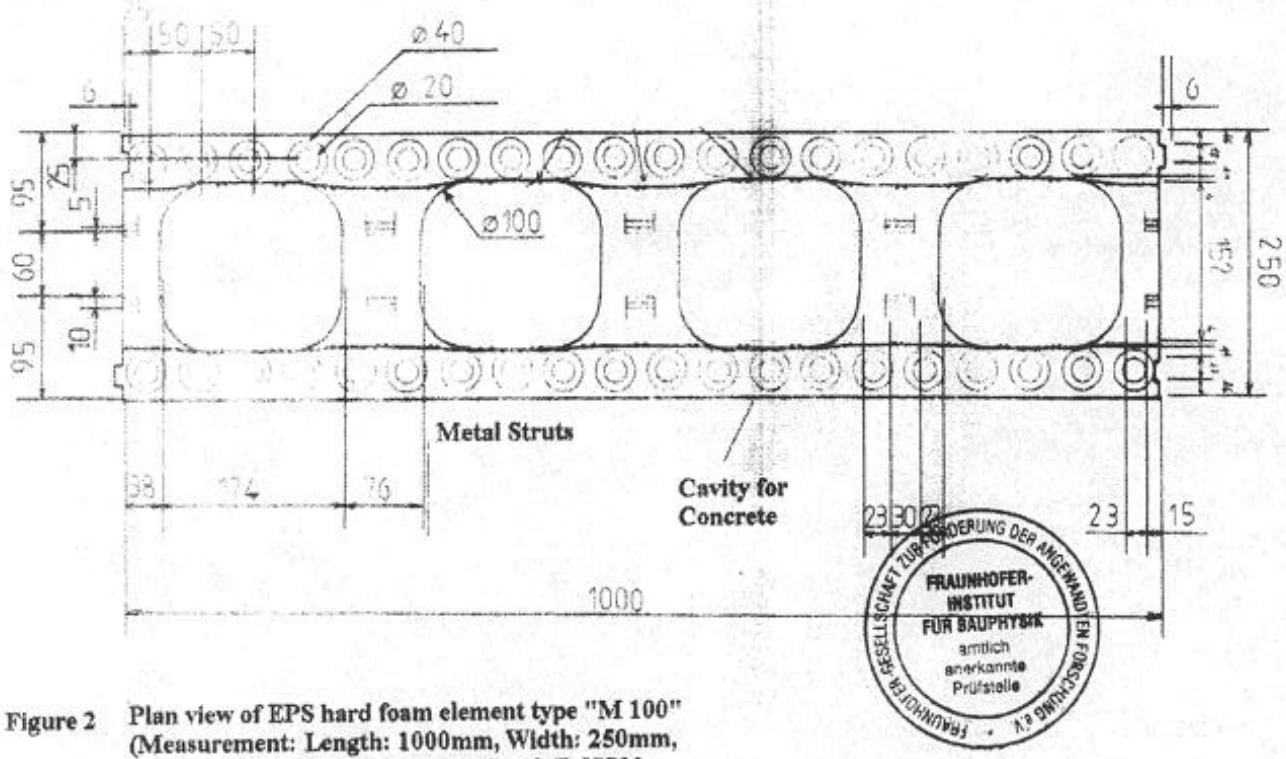


Figure 2 Plan view of EPS hard foam element type "M 100" (Measurement: Length: 1000mm, Width: 250mm, Heigth: 300mm) EUROMAC 2, S.ar.l, F-57730 Folschviller/France. Specification for layout of cavities for concrete and supporting metal struts. (Specification in mm, Applicant's drawing)