Department of Building Engineering

EXERCISE NR 1

Determining the dimensions of ceramic wall elements,
selected laboratory tests
and preparation of the product for strength testing

Instructions from the lab:
" Building engineering and building materials"

1. Introduction

The PN -EN 771-1 standard distinguishes two groups of masonry elements in terms of protection against external factors:

- element **P** is a ceramic masonry element with a low gross density in a dry state for use in a protected wall;
- element **U** is a ceramic masonry element for unprotected walls and a ceramic masonry element with a high gross dry density for use in protected walls.

A protected wall means a wall that is protected against water penetration.

1.1. Checking dimensions (according to PN-EN 772-16)

LENGTH (l_u), WIDTH (w_u) and HEIGHT (h_u) should be specified by:

- two measurements taken near the edge of each sample at the position shown in Figure 1.0,
- one measurement approximately in the centre of each sample in the position as in Figure 1.1. if it results from the requirements of EN 771-1, i.e. if at least two nominal dimensions of the element are not greater than 250 mm, 125 mmand 100 mm.

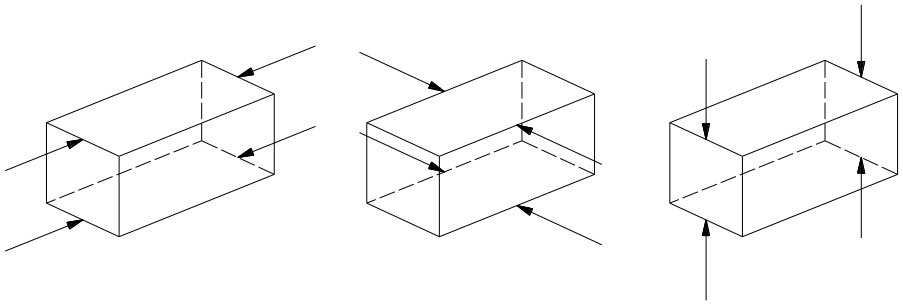

Fig. 1.0. Measurement locations when two measurements are taken

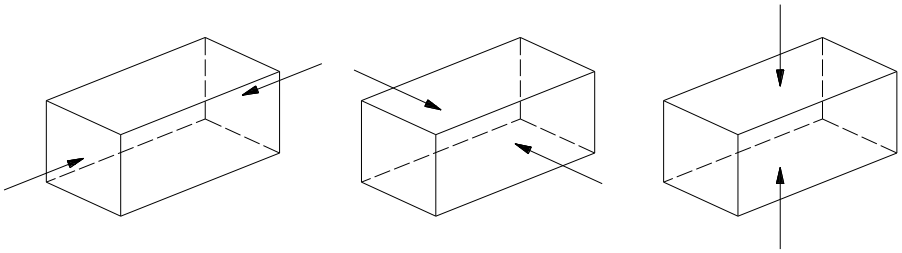

Fig. 1.1. Measurement locations when performing a single measurement

- four measurements at the corners of the specimen, in the case of specimens with irregular surfaces (keyways and tongues, grip holes, etc.), without taking into account these projections, as shown in Figure 1.2.

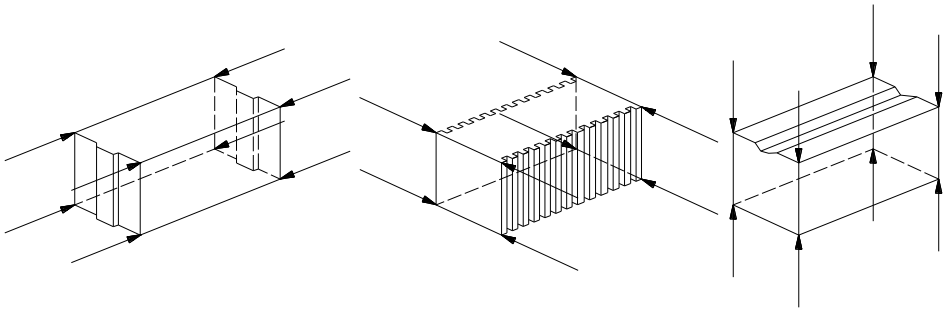

Fig. 1.2. Measurement locations for samples with irregular surfaces

When taking two measurements, the length (l_u), width (w_u) and height (h_u) should be calculated as the arithmetic mean of the two measurements to the nearest 0,2 mmor 0.5 mm.

For the method where one measurement is taken, the length (l_u), width (w_u) and height (h_u) should be reported to the nearest 0,2 mmor 0.5 mm.

The difference for all dimensions between the declared value and the average value determined based on the measurements of the tested sample should not be greater than one of the following declared categories. The calculated value should be rounded to 1.0 mm:

T1: $\pm 0{,}40\sqrt{\text{the nominal dimension}}$ mm or 3 mm - the higher value is assumed;

T1+: $\pm 0{,}40\sqrt{\text{the nominal dimension}}$ mm or 3 mm for length or width – the higher value is assumed and

$\pm 0{,}05\sqrt{\text{the nominal dimension}}$ mm or 1 mm for height – the higher value is assumed;

T2: $\pm 0{,}25\sqrt{\text{the nominal dimension}}$ mm or 2 mm - the higher value is assumed;

T2+: $\pm 0{,}25\sqrt{\text{the nominal dimension}}$ mm or 2 mm for length or width – the higher value is assumed and

$\pm 0{,}05\sqrt{\text{the nominal dimension}}$ mm or 1 mm for height, the higher value is assumed.

THE THICKNESS OF THE EXTERNAL AND INTERIOR WALLS should be measured at three separate points so that the measured values are representative of the minimum thickness of the internal and external walls being measured. The accuracy of the measurements should be 0,2 mm.

The average thickness of the outer and inner walls of each sample should be calculated to an accuracy of 0,2 mm.

The thickness of the outer and inner walls of the test sample shall be calculated as the average of the values determined for the individual samples and the result shall be reported to the nearest 0.5 mm.

THE DEPTH OF HOLES that do not pass through the masonry unit must be measured in two different positions and the result determined to an accuracy of 0,5 mm.

The average depth of holes should be calculated to an accuracy of 0,5 mm.

Calculate the depth of holes in the test sample as the average of the values calculated for the individual samples. The accuracy should be 1 mm.

1.2. Laboratory tests

MASS TEST is performed on air-dry or dried samples.

Testing of air-dry samples should be carried out by weighing the products with an accuracy of 5 g. Dry samples should be previously kept for 6 h in a dryer at a temperature of 105-110 ÷°C. Weighing should be performed with an accuracy of 0.1 g of sample mass.

The test result should be considered positive if the arithmetic mean of the results obtained for the individual pieces of tested products in the required number complies with the requirements of the subject standard.

GROSS DRY DENSITY TEST (according to PN-EN 772-13) consists in determining the ratio of mass to gross volume after drying the element to a constant mass.

The dry mass shall be dried to constant mass at a temperature of 105 °C ±± 5 °C and the mass $m_{dry,u}$ shall be recorded .

Gross volume in dry condition is calculated by subtracting from the dimensions of length, width and height of the element the volume of holes, cavities, recesses or indentations intended for

filling with mortar. Measurements can be made using any method, but with the accuracy of measurement specified in the EN 772-16 standard.

Gross density in dry state [kg/m ^{3}] is calculated from the formula:

$$\rho_{g,u} = \frac{m_{dry,u}}{V_{g,u}} \times 10^6 \quad (1.1)$$

The gross dry density should be calculated for each sample - whole element, with an accuracy of:

- up to 5 kg/m ^{3} for density up to 1000 kg/m ^{3};
- up to 10 kg/m ^{3} for densities above 1000 kg/m ^{3}.

Calculate the average gross dry density of the test sample .

Based on the determined gross density, an element group (P, U) must be assigned.

COMPRESSIVE STRENGTH TEST (according to PN-EN 772-1) consists in applying a uniformly distributed load and increasing it uniformly until the destruction of the sample, which is placed centrally on the compression plate of the testing machine.

Sample preparation

Before performing the test, the surface of the samples should be prepared appropriately. Any keys and/or protrusions should be removed from the surface of the tested elements. The surfaces of the samples, the whole element or samples cut from a larger element, to which the load is applied, should be flat (tolerance 0,1 mmfor each 100 mm) and such that the upper surface lies between two planes parallel to the base surface (the permissible deviation from parallelism is not greater than 1 mmfrom each other on each 100 mm). If the surfaces do not meet the above requirements, they should be prepared by:

a) **Grinding** - Samples should be ground until flatness and parallelism as described above are achieved. Holes, recesses, depressions, internal or external recesses should be left unaltered. Grinding should not be performed if:
- the grinding process will significantly increase the contact area of the tested surfaces - then it is necessary to level out with mortar;
- the height of the samples that remains after they have been placed is less than 40 mmor the height to width ratio is less than 0.4 – then a composite sample should be prepared, consisting of samples placed one on top of the other without using any mortar, binding material or separating layers between them.

b) **Levelling with mortar** – cement mortar with a compressive strength of no less than the expected compressive strength of the masonry element or 30 N/mm2 (assuming the lower value) is used. Surfaces intended for levelling samples with high water absorption values should be moistened before preparation. The levelled glass or stainless steel plate should be coated with a layer of anti-adhesive oil or covered with a sheet of thin paper or plastic foil to prevent the mortar from sticking to the plate. On the prepared plate, apply a layer of mortar approximately 5 mm, approximately 25 mmlonger and approximately 10 mmwider than the element. Lay the element and press one of the laying surfaces to the mortar layer so that the vertical axis of the sample is perpendicular to the surface of the plate. Check that the mortar layer protrudes at least 3 mmabove the entire surface. Do not fill with mortar those recesses that are intended to be filled with mortar during bricklaying. Remove unnecessary mortar from all sides of the element.

The mortar sample should be covered with a damp cloth and kept moist until the mortar has hardened sufficiently. If, after the mortar has hardened, there is no damage, lack of compaction, lack of adhesion to the masonry unit and/or cracks, then a second layer of mortar should be applied

in the same manner as the first, using materials taken from the same batch of cement and sand and using the same mixing proportions.

Mortar-levelled samples should be stored under moisture-retaining bags or in a climatic chamber with a relative humidity greater than 90% for a period sufficient for the mortar to achieve minimum strength.

Masonry units with recesses, the net loaded area of which is greater than 35% of the area of the laying surface, shall be tested without removing or filling the recesses. In cases where this area is less than or equal to 35% of the gross area, the recesses shall be filled with the same mortar as that intended for levelling.

Before testing, samples should be seasoned in a manner appropriate for each type of product. Seasoning methods include:

- seasoning to an air-dry state ;
- seasoning to a constant mass state;
- seasoning to 6% moisture;
- seasoning by immersion in water.

LP…. -Group ……/team …… Date……..……

1. ……

2. ……

3. ……

4. ……

Exercise 1

TESTS OF SELECTED WALL ELEMENTS

DETERMINATION OF DIMENSIONS AND GROSS DENSITY

Name of element:…… Dimensions of element.....……

Size	Measurement values		Average value	Deviations dimensions	Standard dimensional tolerances			
					T2+	T2	T1+	T1
Length l_u, mm								
Width in $_u$, mm								
Height h_u, mm								
Wall thickness external, mm				-	-			
Wall thickness internal, mm				-	-			

Size	Value
Dry sample weight, g	$m_{dry,u}$ =
Gross volume, mm^3	$V_{g,u}$ =
Gross density dry, kg/m^3	ρ_g =
Element Group	

PRODUCT EVALUATION:

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