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Usage of Illite-kaolinitic Clay for Rammed Earth Manufacturing and Its Drying Rate

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Abstract. This submission concerns by unburned clay as a construction material. It briefly summarize basic reasons why to deal with an earth construction and its main goal is determine rammed earth drying speed. The speed of drying is crucial because it is only process with which unburned clay obtains its strength. A main part of the submission is dedicated to description of carried out experiments and their evaluation. There was one earth mixture tested from which two testing body sizes were manufactured by technology of ramming. The speed of drying was determined by measuring of moisture drop.

Introduction

An unburned clay was commonly used construction material of the past. However, with the boom of new modern construction materials, unburned clay was pushed out from the business, and therefore the necessary scientific research of unburned clay mechanical properties was never performed [1–3].

These days unburned clay returns to focus again generally for three reasons. First reason is reconstruction of already built clay buildings[4, 5]. Second, the unburned clay constructions are compatible with the principles of sustainable development [6, 7]. Third, unburned clay has a blessed impact on the internal micro-climate of the building and consequent improvement in the health of inhabitants [1, 8].

For proper unburned clay construction design it is necessary to employ construction methods that are properly based on scientific research. Such methods are not available nowadays. This article concerns especially with a method of unburned rammed earth test bodies manufacture and theirs drying speed. The manufacturing method is critical because it considerably influence properties of final product such as compressive strength, bending tensile strength,etc. [1, 9].

The drying speed of unburned clay is important because drying is the only process with witch unburned clay receive its strength. It is so necessary to know drying speed to be able to estimate the time that must pass from a manufacture to full construction load. [1, 7].

Manufacturing Method

An earth appropriate for building constructions consists from three elementary components: sand, clay and water. The clay fulfils a function of binder, the sand a function of filling agent and the water serves for activation of bonding properties of the clay and for good earth mixture processing.

An earth mixture for testing bodies manufacture was proposed. A sand to clay ratio was 80/20 and water to clay coefficient (water coefficient) was 0.37. The components were mixed and mechanically and manually kneaded until homogenous clay mixture was not obtained. The used clay was of illite-kaolinitic type.

The clay mixture was rammed to steel moulds and the testing bodies was created. It was totally manufactured 5 test bodies of size 4 x 4 x 16 cm and 12 testing bodies of size 2 x 2 x 10 cm (see Fig. 1). Ready-made testing bodies were right after unmoulding inserted into air-conditioned chamber (see Fig. 2). The environment properties in air-conditioned chamber were set to 20 °C and 50 % relative air humidity. Test bodies composition is stated in Table 1.

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Fig. 1 Manufacture of test bodies

Fig.2 Test bodies in an air-conditioned chamber

Table 1 Composition and quantity of test bodies

Size of test bodies [cm]	**Number of test bodies [ks]**	**Kind of clay**	**Sand/clay ratio [-]**	**Water clay ratio [-]**
4x4x16	5	illite-kaolinitic	80/20	0.37
2x2x10	12	illite-kaolinitic	80/20	0.37

Measured Results

Test bodies put into air conditioned chamber were periodically weighted and a drop of their moisture was observed. Average weight drop tested bodies in time is stated in Table 2.

The measured mass decrease was used for mass moisture content (see Table 3, Fig. 3) and mass moisture content to test body form coefficient (volume to surface ratio) (see Table 4 Fig. 4).

Table 2 Weight drop of tested bodies in time

Size of test bodies [cm]	**Date of measuring**						
	27.2.2017	**28.2.2017**	**1.3.2017**	**3.3.2017**	**7.3.2017**	**10.3.2017**	**14.3.2017**
4x4x16	603.4	567.9	566.6	565.7	565.5	565.5	565.4
2x2x10	90.2	84.3	84.1	83.5	83.5	83.4	83.3

Table 3 Moisture content

Size of test bodies [cm]	Date of measuring						
	27.2.2017	28.2.2017	1.3.2017	3.3.2017	7.3.2017	10.3.2017	14.3.2017
4x4x16	7.4	3.1	0.9	0.7	0.7	0.7	7.4
2x2x10	7.4	1.0	0.9	0.8	0.7	0.6	7.4

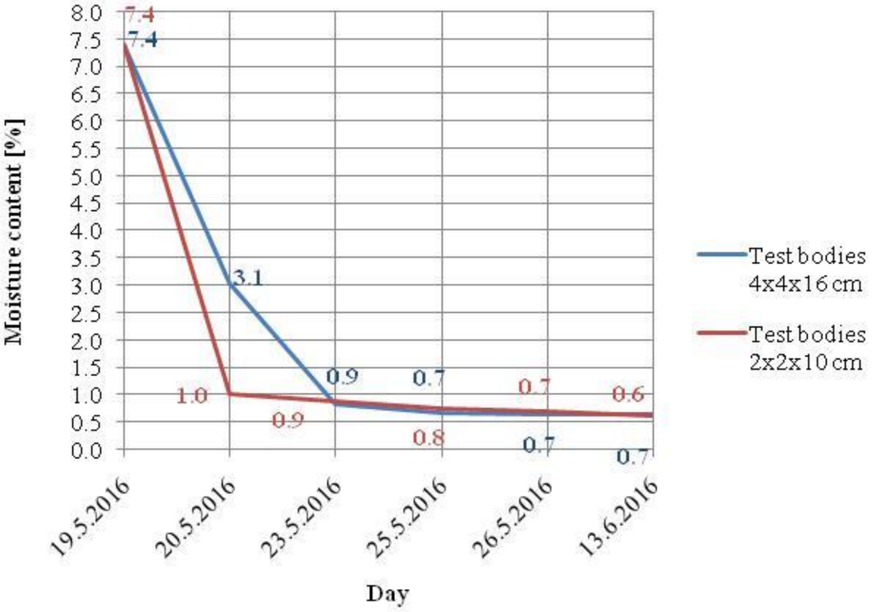

Fig. 3 Moisture content

Table 4 **Moisture content and form coefficient ratio**

Size of test bodies [cm]	Date of moisture content and form coefficient ratio measure						
	27.2.2017	28.2.2017	1.3.2017	3.3.2017	7.3.2017	10.3.2017	14.3.2017
4x4x16	8.3	3.4	1.0	0.8	0.7	0.7	8.3
2x2x10	16.3	2.2	1.9	1.7	1.5	1.3	16.3

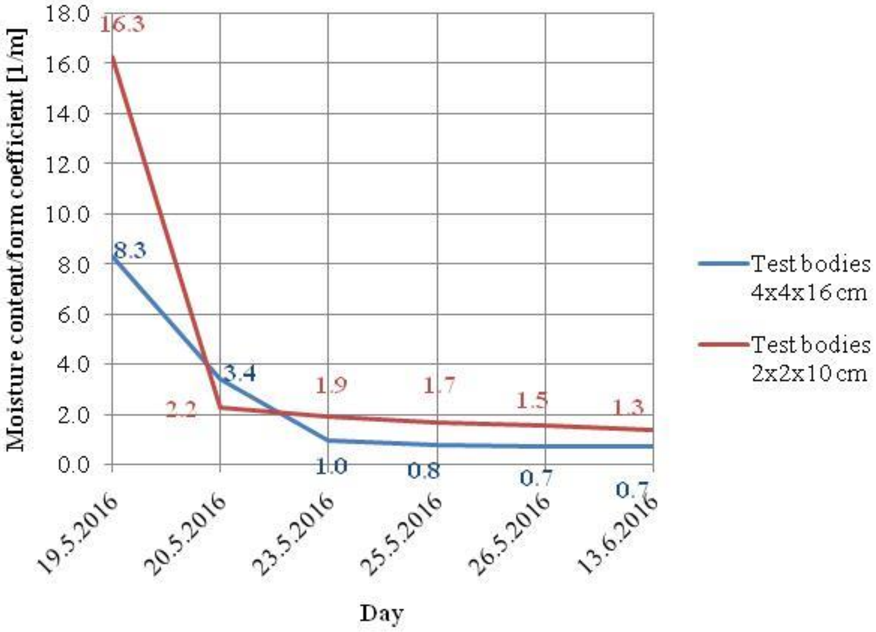

Fig. 4 Moisture content and form coefficient ratio

Conclusion

We can establish that the drying speed is dependent on ratio of total body volume and body surface. The tested bodies'mass moisture content unified after two day from a manufacture.

We consider as appropriate to measure speed of drying with a use of the form coefficient. However, for proper assessing of speed of drying it is necessary carry out described measurement on another test bodies of other sizes (other value of form coefficient) and measure drop of test bodies' weight in shorter time intervals particularly in first days after manufacture. Proper interval for the measurement just after manufacture is about 1 hour. That experiment we plan to carry out in following months.

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