COMPARISON OF PERCEPTION OF MASONS ON BRICK SITES AND CLAY PHYSICAL PROPERTIES AT SELECTED SITES IN MARAKWET WEST SUB COUNTY, KENYA

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ABSTRACT

Burnt clay bricks are the main building material for walls in Marakwet West Sub-County of Elgeiyo Marakwet County in Kenya. The study aimed at comparing some selected physical properties of clay with the perception of masons with a view of locating the best site for bricks in the Sub-County. The methodology involved interviewing masons to get their perceptions about a site they regarded as producing better bricks. In addition, laboratory measurements of sand, clay, silt, liquid limit and plastic index of clay samples from Chebiemit, Cheptongei and Kapsowar towns in the County were determined. Soil samples were taken at depths of 300mm, 600mm and 900mm in the three areas. Ranking of the perceptions and laboratory results were done to determine the best brick sites. A total of seventeen masons were interviewed. The best brick sites from perceptions of masons in order were as follows; Cheptongei came first, Chebiemit came second and Kapsowar came out last. Based on laboratory results the best sites in order are Chebiemit, Kapsowar and Cheptongei. Combining the two results and ranking them it was concluded that the best sites in order are Chebiemit, Cheptongei and lasty Kapsowar. Further research is needed on the chemical contents of the clay from the three sites.

Keywords: Brick, perception and laboratory results.

INTRODUCTION

The population of Kenya increased from 2.5 million in 1897 (KNBS, 2010) to 44.3 million in 2013 with the urban population being 25% (World Bank, 2015) and is expected to reach 50% by the year 2030 (GOK, 2007). The proportion of people with brick/block walls has also increased from 12% in 1989 to 17% in 2009 (KNBS, 2009). The population of Elgeyo-Marakwet increased from 284,494 in 1999 to 369, 998 in 2009 (CBS, 1999) meaning an increase of 3% per year.

Urbanization means more houses for people at affordable price and bricks can be used to construct affordable houses. Bricks made of clay are one of the building materials used in the world for construction as they are locally available (Ahmad *et al.*, 2008). Although brick manufacturing has been mechanized, brick making is still hand made in many parts of Africa including Elgeyo-Marakwet County in Kenya. This often results in production of bricks that are not uniform in physical properties.

In Marakwet West, a sub-county of Elgeyo Marakwet county, bricks are the main materials used to construct walls for houses in Kapsowar, Chebiemit, Cheptongei towns among other areas in the Sub-County. Alternatives to bricks in the area are bushstones and cement concrete blocks. However, the source of bushstones in Kamwosor is more than 40 kilometres away whereas cement concrete blocks are expensive owing to high poverty level of 45.9% in Kenya (World Bank, 2015).

LITERATURE REVIEW

A good brick must be hard, well burnt, sharp in shape and dimension, should not break easily when stuck against another brick or dropped from a height of about one metre and its compressive strength should be desirable (Gopi, 2009). Compressive strength can be determined correctly while the other properties are difficult to evaluate and hence open to perceptions by users like masons or architects as was observed by Baiden *et al*., (2014). Compressive strength depends on the clay composition and is reduced by high porosity in clay used to make the brick (Okunade, 2008).

Bricks are obtained from clay which contains three types of particles: sand, silt and clay. Mueller *et al*, (2008) recommended that the percentages of physical properties of clay be as follows: sand (20-45), silt (24-45), clay (20-35), liquid limit (25-38), and Plastic Index (7-16). Another standard IS: 2117-1991 recommends clay to be (20-30%), silt (20-35%) and sand (35-50%). So for any site for brick production there is need to determine the amounts of sand because too much sand results in breaking of bricks while too much clay results in cracking of green bricks (Mueller *et al.*, 2008).

Several studies on bricks have been done on bricks. Kumar *et al*, 2006 varied the amount of sand from 0-12% and found that higher percentages of sand resulted in higher compressive strength. A clay sample with clay minerals much lower than 0.02 mm, makes clay highly porous thus lowering the compressive strength and increases the water absorption of the brick (Hall and Djerbib, 2004). Fractures and moisture absorption in clay bricks was done by (Lertwattanaruk and Choksiriwana, 2010). Binici *et al.*, (2007) investigated on bricks and found that a house made of bricks is preferred because it cools the house during hot weather and insulates the house against heat loss during cold months. Kiptum *et al*., (2014) investigated on physical properties of clay used to make bricks in Nyagatare, Rwanda and found that recommended Plastic Index was found at depths greater than 500 mm below the ground surface. Environmental impacts of bricks have been investigated and shown that it requires high energy during firing process (Chusid *et al*., 2009). Therefore, there was need for research on bricks so that it sustainability is maintained by locating sites that produce durable bricks thus saving on energy and environment.

This research aimed at comparing some selected physical properties of clay with the perception of masons with a view of locating the best site for bricks in the sub-County.

METHODOLOGY

In this research two approaches were used: interview and laboratory. The interview questionnaire was administered to 17 masons during the construction of KeRRA camp at Cheptongei which attracted most masons from Kapsowar, Chebiemit and Cheptongei areas of Marakwet west Sub County. All the masons were asked to rank from 1 to 3 the brick sites Kapsowar, Chebiemit and Cheptongei. The ranking was based on the cracks in bricks, well burnt bricks, hard bricks and absorption of water by bricks.

Clay used in this study were obtained from three locations: Chebiemit, Cheptongei and Kapsowar areas in Marakwet West Sub-County of Elgeyo Marakwet County. Masons were interviewed in the area on the properties of bricks from the three sites. Samples were picked at depths of 300 mm, 600 mm and 900 mm in all the sites. Tests were done on sand, silt, clay, liquid limit and volumetric shrinkage according to ASTM D4318 (ASTM, 2006).

RESULTS AND DISCUSSION

Results from interviewing masons

Table 4.1 Ranking by respondent

Area	Respondents																		
Chebiemiet	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	Total	
Many cracks	2	2	1	3	1	1	1	2	3	2	2	3	2	3	3	3	2	36	
Well burnt	3	3	2	3	3	3	3	2	2	3	2	2	2	2	2	2	2	41	
Hard	2	3	2	3	3	3	3	3	2	2	3	2	2	2	2	2	3	42	
Absorbs water	2	2	2	3	3	3	3	1	1	2	1	1	1	1	1	1	1	29	
Correct dimension	2	3	2	3	3	3	3	2	2	2	2	2	2	2	2	2	2	39	
Cheptongei																			
Many cracks	3	3	3	1	3	3	3	1	1	1	1	1	1	1	1	1	1	29	
Well burnt	1	1	1	1	1	1	1	1	1	2	1	1	1	2	2	1	1	20	
Hard	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	1	17	
Absorbs water	3	3	1	1	1	3	1	2	2	3	2	2	2	3	3	2	2	36	
Correct dimension	1	1	1	1	1	1	1	1	2	1	1	1	1	1	1	1	1	18	
Kapsowar																			
Many cracks	1	1	1	2	2	2	2	3	2	3	3	2	3	3	2	2	3	37	
Well burnt	2	2	3	2	2	2	2	3	3	1	3	3	3	1	1	3	3	39	
Hard	3	2	3	2	2	2	2	2	3	2	2	3	3	2	2	3	2	40	
Absorbs water	1	1	3	2	2	2	2	3	3	1	3	3	3	2	2	3	3	39	
Correct dimension	3	1	3	2	2	2	2	3	3	3	3	3	3	3	3	3	3	45	

Table 4.2 Summary of the results

	Chebiemit	Cheptongei	Kapsowar
Many cracks	2	1	3
Well burnt	3	1	2
Hard	3	1	2
Absorb water	1	2	3
Dimensionally correct	2	1	3

The respondents reported that Cheptongei brick was leading in the number of cracks, it was well burnt, hard and correct dimensionally. Chebiemit brick absorbs more water than the rest. It can be seen that best brick came from Cheptongei, then Chebiemit and lastly Kapsowar.

Laboratory results

Table 4.3 Atterberg's Limits and texture of soil at different depths

Source	Depth mm	Atterberg Limits				% of sand	% of silt	% of clay	
		Liquid limit	Plastic limit	Plastic Index	Linear shrinkage				
Chebiemit	300	30.5	22.7	7.8	5	0	47	53	
	600	28.3	19.2	9.1	6.4	0	44	64	
	900	28.6	20.9	7.7	5.7	70	29	1	
Cheptongei	300	44.8	31.8	13.0	6.7	86	9	5	
	600	42.3	29.8	12.5	7.2	95	3	2	
	900	49.8	37.5	12.3	7.9	80	14	6	
Kapsowar	300	41.8	28.4	13.4	8.6	0	26	74	
	600	45.2	32.8	12.4	7.9	59	31	10	
	900	48.5	28.1	20.4	7.9	71	26	3	

Chebiemit had plastic index of less than 10 while Cheptongei and Kapsowar had values higher than ten at three depths. Chebiemit has no sand in the first 600 mm. Cheptongein had higher content of sand followed by Kapsowar. Cheptongei soil has less silt and clay. Kapsawor had higher level of clay at 300 mm depth.

From Table 4.1, all clay from the three sites do not meet the criteria for sand content. Some areas like Cheptongei had too much sand while other areas like Chebiemit had less sand. The clay sample that met liquid limit, plastic index and silt contents were from Chebiemit at depths of 600 mm and 900 mm. The clay from Kapsowar met Plastic Index and silt content only. The soil samples from Cheptongei met plastic index. Therefore if the best site is the one that met most of the criteria then the first in the rank is Chebiemit, then Kapsowar and lastly Cheptongei.

The ranking for Chebiemit were (2, 1), for Cheptongei (1, 3) and for Kapsowar (3, 2). The values in the bracket are for respondents' perception ranking and laboratory ranking, respectively. Based on the perceptions of the masons and the laboratory results it can be seen that the bests sites in order are Chebiemit, Cheptongei and lastly Kapsowar.

CONCLUSIONS

The interviewed respondent ranked Cheptongei as the best brick site while the laboratory results showed that the best brick site was Chebiemit. Combination of the two outputs showed that the best site are Chebiemit, Cheptongei and Kapsowar in that order.

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