Characteristic of Brick Produced

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Characteristic bricks produced of small industry in south Sulawesi

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ABSTRACT

This research aims to describe the characteristics of brick for small industrial production in South Sulawesi.Variables tested were visual test size, water absorption and compressive strength. This research was conducted at the Laboratory Materials Department of Civil Engineering and Planning Education Faculty of Engineering, Universitas Negeri Makassar. Samples taken at random as much as 150 bricks each industry group. Testing each variable of each 50 samples. Data analysis technique used is descriptive and statistical analysis. The visual test results showed that the most of the bricks do not meet the three requirements visually. High size bricks have irregularities of 6.88 mm and deviations thick of 29 mm while the size of the width of the bricks showed a deviation of 1.07 mm. The absorption test results show that of most of the samples of bricks showed absorption between 10% to 13.99% and meet the required value. The maximum value of bricks compressive strength of 0.8 MPa or do not meet the required compressive strength value. In general, the brick production of small industries in South Sulawesi are not eligible.

Key word : Bricks, Strength, Absorption

Introduction

Red brick are commonly used as wall for building of simple houses as well as on the structure of reinforced concrete buildings in Indonesia (Tanjung and Meidiawati, 2016). Many people in developing countries still depends on this brick industry. (Patra *et al.*, 2015). Its use as a wall supported by the price is relatively cheap, easy to obtain, have a high enough strength, weather resistant. (Amin, 2015).

Bricks are generally based clay has been used as building material. Since long time ago. It has provided human beings with a very useful building material. (Smeu *et al.*, 2014). Brick is a ceramic material mainly used in construction industry. The stages of production process of bricks includes digging the clay, preparing the clay,forming, combusting and distributing the bricks. In combusting stages, blocks are buning with high temperature (900-1200°C). (Tariq *et al.*, 2014).

In South Sulawesi, the production of bricks are mostly made in small industry. Conventional fabrication method using simple tools such as hoes and shovels. In addition, mold bricks are made in the traditional way characteristic differences cause production. This can be seen in a form that is not always the same, untidy and rough-textured.

Many brick-industry has remained mostly traditional system with no importance to enhancement or standardization of physical properties of the final product at all (Deboucha and Hashim, 2011). In Indonesia, standardization bricks stated in the Indonesian National Standard No. 15-2094-1991 discussing the quality of the bricks. Red rock solid covers the exterior, size, compressive strength, water absorption, and salinity. Visual of bricks should be shaped

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rectangular prism, has ribs elbows and sharp, flat fields and showed no cracks.

This research aim to give an overview of the exterior, size, compressive strength, and water absorption of bricks produced by small industries in South Sulawesi as well as determine the category of the bricks is based on the Indonesian National Standard No. 15-2094-1991.

Research Methods

This research is a descriptive and statistical. Bricks sampling was carried out at 15 small industry in South Sulawesi. Testing characteristics of the bricks made in Material Testing Laboratory Faculty of Engineering, Universitas Negeri Makassar. The variables of this research is characteristic brick which include: visual, size, compressive strength and water absorption. The population in this study are the bricks produced in fifteen brick industry in South Sulawesi. Sampling was done by the method of random sampling as many as 30 pieces in every industry, so the total sample of 450 pieces. Description of the amount of sample are presented in Table 1.

Table 1. Distribution of Sample

No	Investigating	Number of Sampel
1	Visual	150
2	Size	150
3	Strength	
4	Absorbtion	150
	Total	450

Data analysis technique used is descriptive analysis, which calculates the average value of the results of the test specimen for visual, size, compressive strength and water absorption then presented in tabular form to facilitate the calculation and analysis of data. The data has been analyzed, then consulted with the quality requirements of the bricks to do a breakdown by the Indonesian National Standard No. 15-2094-1991. To determine the relationship between water absorption and compressive strength used Spearman correlation analysis

Research Result

Visual Testing of Bricks

The number of bricks samples examined on a visual test about 150 pieces. Visual of bricks tested by the elbow and ribs sharpness, flatness field and a rift field. The elbow ribs measured using the results of the examination of the three bricks small industrial sources are presented in Table 2.

Table 2. Visual Characteritic of Bricks

Characteristic	Qualified		
	Samples	Number	Percentage
Angel and sharp	150	82	54,67
Flatness	150	106	70,67
Crack	150	120	80,00

Based on table 1 it appears that most of the bricks do not have sharp elbows and ribs. Brick ribs that are not indicated by the elbow angle is not appropriate. Medium sharp ribs that are not caused by cracks in the ribs. Field surface is generally flat and did not show cracks.

Analysis of visual test for all three characteristics is done through an assessment that is a value of 1 for the sample to be eligible and a value of 0 if it does not qualify. Samples qualified him third visual properties demonstrate the value 3, while a value of 2 is a sample that only meet two requirements. A value of 1 is shown on samples that meet the visual requirements. The results of visual analysis presented there Table 3.

Table 3. Visual test of Brick

Skor	Sample	Percentage
1	83	55,33
2	20	13,33
3	47	31,33
Total	150	100

Table 3 shows that there are 55.33% of the samples are scored 1, means only one characteristics is eligible. This illustrates that most of the samples only meet one of the three characteristics of the visual indicator. The analysis description above illustrates that based on the visual test results, brick production of small industries in South Sulawesi ineligible.

Size Testing of Bricks

Measurement of bricks made on the length, width and thickness. The measurement results for 150

7 mples showed average values. The measurement results are presented in Table 4.

Table 4. Dimension Average

Dimension	Quality Requirement M5-a (mm)	Average (mm)	Error (mm)
Length	190	194,34	-4,34
Width	90	88,93	1,07
Thickness	65	35,99	29,01

Based on Table 4 the average length of a brick is 194.34 mm and showing deviation of 4.34 mm. Width showed the difference of 1.07 mm was thick bricks have a very large difference is 29 mm.

Indonesian National Standard No. 15-2094-1991 also set the limit deviation value deviation of each sample was calculated by comparing the lot of quality requirements in the standard. The average value of the deviation measurement are presented in Table 5

Table 5. Deviation Size of Bricks

Size	Requirement M5-a (mm)	Average Deviation (mm)	Description
Length	2	6,88	Unqualified
Width	3	1,07	Qualified
Thickness	5	29	Unqualified

Based on Table 5 it appears that the size of the width iseligible, while the length and thickness are not eligible. Even deviations in thickness measurement showed a tremendous value. Furthermore, the calculation of the number of samples that do not eligible sizes presented in Table 6.

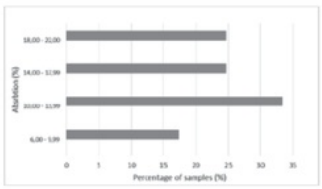
Table 6. Description of Unqualified Bricks

Size	Quality Requirement M5-a Class 20 (mm)	Unqualified	
		Number	Percentage
Length	2	82	54,66
Width	3	0	0
Thickness	5	100	100

Based on the analysis of the percentage of samples that do not eligible, then most of the samples did not meet quality requirements sized bricks arranged in the Indonesian National Standard No. 15-2094-1991.

Absorption Testing of Bricks

Water absorption is the ratio between the dry weight and wet weight. This value is an indicator of the quality of bricks. The higher the water absorption, the quality of the lower brick. However, as the ceramic material brick has pores so that the value of water absorption should be kept to a minimum. Statistical test results on the absorption of the bricks is presented in Figure 1.



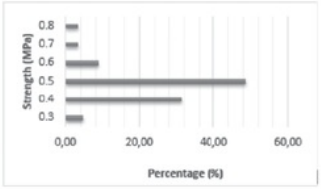
Statistic	Value
Maximum	21,90
Minimum	6,19
Standar Deviation	3,90
Average	14,24

Fig. 1. Statistic Description of absorbtion

Figure 1 shows that most of the samples of bricks showed absorption between 10% to 13.99%. Percentage samples with greater absorption of 14% amounting to 49.34%, or almost half of the total sample. The value of the sample standard deviation of 3.90 or brick has properties that are relatively the same. The maximum value of absorption of 21.90% or more lower than the standard maximum absorption is 22%.

Strength Testing of Bricks

Compressive strength is the main indicator of quality bricks. By default, the compressive strength of minimum average of 30 bricks is 1.5 N/mm2 (1.5 MPa). Compressive strength test results for a sample of 150 pieces is presented in Figure 2.



Statistic	Value
Maximum	0,80 MPa
Minimum	0,30 Mpa
Standar Deviation	0,09 Mpa
Average	0,48 Mpa

Fig. 2. Statistic Description of brick strength

Figure 2 shows that most of the brick has compressive strength of 0.5 MPa and only 2%, showing strong press 0.8MPa. Even most of the bricks showed a very low compressive strength with a

Table 7. Correlation of strength vs absorbtion

			Strength	Absorbtion
Spearman's rho	Strength	Correlation Coefficient	1.000	-.079
		Sig. (2-tailed)	.	.335
		N	150	150
	Absorbtion	Correlation Coefficient	-.079	1.000
		Sig. (2-tailed)	.335	.
		N	150	150

third of the value of the minimum limit. Percentage of bricks that had such powers only around 15% of the overall sample. Standard deviation value of 0.09 indicates that the sample rocks have relatively equal strength. The maximum value of 0.8 MPa strength indicates that all the bricks are not eligible strengths.

Correlation between water absorption and compressive strength of bricks

The correlation between the level of absorption of bricks with compressive strength were analyzed by Spearman correlation analysis can be seen in Table 7.

Results of the analysis showed that the significance value of 0.335 or greater than the value of 0.5. This illustrates that there is no significant correlation between the strength with absorption. Correlation coefficient of -0.079 indicates low correlation value or smaller than 0.5. Negative sign (-) indicates the opposite relationship, or if high-strength brick then absorption is low and vice versa.

Discussion

Bricks characteristics indicate that the visual test, test size and compressive strength test are not eligible. While test results showed that the absorption of the bricks eligible. When compared with standard bricks according to ASTM C62-89a, 1990 which requires maximum absorption value of 17% (Deboucha and Hashim, 2011), the small brick industry results eligible. The process of making bricks and skilled manual labor led to poor quality of bricks produced.

Manual work processes using molds wooden board with a connection rib nails. Consequently, elbow mold inaccurate, so that the bricks produced is also not the elbow.Furthermore, low surface flatness caused by the use of uneven mold board and the appointment process and natural drying in the open air, allowing non-uniform shrinkage occurs so that the surface of the brick arched. Brick ribs that are not sharp because of the way of charging the batter into the mold is not solid on the whole batch or in the corners of the mold is not filled with good.

Size bricks which are not in accordance with the size of the bricks on the Indonesian National Standard due to ignorance of labors to a standard size. Similarly, the knowledge of the condition of the power that is not understood by the labor so that the process of compaction bricks and burning are not controlled.

The negative correlation between the absorption of bricks and power associated with the content of air bricks. High absorption indicating high air cavity inside. The cavity is an indication of the low density of the bricks that leads to lower compressive strength. Based on the description, the brick-making in small industry in South Sulawesi quality control should be done by the government (Ministry of Industry). The control begins on the mold accurate, rigorous treatment process as well as a perfect combustion process. Labor skills should be improved so that the brick industry has good quality and high selling value.

Conclusion

The test results showed that most of the visual bricks do not meet the three requirements visually. A total of 55% of the samples only fulfill one requirement and there are only 31% of the samples that meet three requirements. The test results show that neither of bricks qualified size. High size bricks have irregularities and deviations of 6.88 mm thick by 29 mm while the size of the width of the bricks showed a deviation of 1.07 mm. The test results show that the absorption of most of the samples of bricks showed absorption between 10% to 13.99% and meet the required value. The maximum value of bricks compressive strength of 0.8 MPa or do not meet the required compressive strength value. In

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