Proportion limits the effect of mixture of red brick stone on concrete strength

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Abstract. The proportion of concrete material affects the strength of concrete. The innovation of a mixture of waste red bricks can be used in concrete. The research method used experiments in the laboratory with normal concrete compressive strength compared to the composition of the mixture of red brick waste in the proportion of 25% and 50% based on SNI. The research objective was to find out the limits of the proportion of the design strength of normal K-200 concrete and by adding red brick waste as a fine aggregate substitute. The results of the use test with 25% and 50% of red brick waste are able to achieve the strength of the plan with reference to a normal concrete comparison so that the material is feasible as a substitute material. The addition of 50% waste is able to reach K-200 but compared to an additional 25%, there is a decrease in strength at 7 days at 16.7%, age 14 days by 20%, and age 24 days at 36.8%. Recommendation for the limit of the proportion of adding red brick waste to 25%.

1. Introduction
Concrete is part of the buildings that we encounter in the development process such as buildings, roads, bridges, and infrastructure buildings in general. Development cannot be separated from the achievement of concrete quality and is measured based on the compressive strength of concrete [1,2], which is the ability of hard concrete to resist compressive forces in each unit of the concrete surface area [3]. In order to achieve the desired strength, the proportion of mixed materials which consists of aggregate, cement, and water is needed to meet the requirements [4,5]. Some of the results of research on the use of aggregate can be replaced with other materials[6-8], including waste red brick to make use of waste material around our environment [9-11].

Red bricks made from the soil with or without a mixture of other materials are burned at a temperature of 900°-1000°C using the burning material of rice husk ash included in pozzolanic material because it contains more than 70% silica [12,13]. Silica will react with cement and water to form calcium silicate hydrate which functions as an adhesive, it will affect the strength of the concrete [14-16].

The purpose of the study was to assess how far the compressive strength of waste bricks as a substitute for the main ingredients of sand in concrete mixtures carried out in the laboratory. The purpose of the research was to determine the difference in K-200 concrete compressive strength in normal concrete and mixed concrete with red brick waste with a proportion of 25% and 50%.
2. Methods
The research method used is a literature study to get an understanding of the nature of concrete using red brick waste and conducting experimental studies in the laboratory. The research carried out the method through experiments by physically examining all the ingredients of the concrete mixture and the red brick powder material as a substitute for some fine-grained ingredients. The concrete mixture material to be used is examined first so that the material used has the required quality. The research flow charts can be seen in the figure 1.

![Research flow chart](image)

Material checks are focused on a mixture of fine aggregate concrete, coarse aggregate, and water. Testing on fine aggregate includes sieving to obtain a distribution of the number of percentages of fine aggregate granules according to the standards of SNI 03-1968-1990 [17,18], specific gravity and absorption to obtain a false type weight, saturated bulk density, dry surface saturated density, and the amount of absorption according to SNI 03-1969-1990 standard [19], determines the number of loose and solid contents according to SNI 03-4804-1998 [20], levels of organic matter according to SNI 2816-
2014 regarding the method of testing organic matter in fine aggregate for concrete [21], the amount of material contained in the aggregate through sieve No.200 by washing method based on SNI 02-2816-1992, water content by drying based on the reference of SNI 03-1971-1990.

Coarse aggregate inspection includes sieving analysis of the distribution of the quantity or number of granular percentages in accordance with SNI 03-1968-1990, specific gravity and aggregate absorption based on SNI 03-1969-1990, the number of loose and solid contents of coarse aggregate based on SNI 03-4804-1998, the amount of material contained in coarse aggregates passed filter No.1" held in filter No.4" by washing and comparing the weight of the material through the filter No.6 to the original weight according to SNI 03-2816-1992, checking the moisture content by drying in accordance with the requirements of SNI 03-1972-1990.

Examination of waste red bricks to determine the properties and content of substances in waste red bricks. The design of concrete mixtures in determining the mix composition of concrete mixtures uses SNI 03-2834-2000 [22]. Normal and design concrete mixture design with a substitute for a fine aggregate of red brick waste (25% and 50%) on the concrete quality of K-200. Compression strength requirements are based on the results of the compressive strength of the cube with a size of 15x15x15 cm [23]. The concrete strength plan is based on the relationship between compressive strength and cement water factor [24]. Mixed proportions include compressive strength of the average plan, selection of cement water factor, slump test, maximum aggregate grain size, free water content, fine aggregate gradation composition, aggregate relative density, mixture proportion, and correction of a concrete mixture.

The specification of additives for red brick waste is by making K-200 concrete for the design of the site mix, making samples by reducing 25% of sand from the site mix replaced with 25% waste filtered red brick by passing filter No. 100, and making samples reduce 50% of sand from the site mix was replaced with 50% of filtered red brick waste by passing the cover of 100.

3. Result

3.1. Material testing results
Tests of materials that have been done consist of examining the aggregate average volume weight of solid conditions (1.65 kg / ltr) and loose conditions (1.31 kg / ltr). Coarse aggregate (5.7%) moisture content and fine aggregate (13.1%). On coarse aggregates, apparent specific gravity (2.54), bulk specific gravity conditions of the SSD (2.40), bulk specific gravity dry conditions (2.31) are obtained. Apparent fine aggregate specific gravity (1.60), dry bulk specific gravity conditions (1.48), bulk specific gravity conditions of the SSD (1.56).

The percentage of coarse aggregate water absorption (3.82%) exceeding 3% indicates that the SSD aggregate sample holds a considerable amount of water content. The percentage of water absorption in fine aggregates is 5%.

Fine aggregate filter analysis with a percentage of cumulative retained percentage (01.2%) and fine aggregate fineness modulus (5.012). Testing of coarse aggregate passing filter No.100 is held in filter No.200 taken from the results of 5 kg coarse aggregate test practice, fine aggregate fineness modulus shows aggregate amount stored in PAN container, coarse aggregate passing filter No.1 "held in filter No.4 "II from the results of the 5 kg coarse aggregate practice test and show that the comparison of the results of the practice carried out with the ASTM C33-90 requirement limits.

The fine aggregate sludge level was found to be 2 ml of mud height and 68 ml of fine aggregate (sand) and sludge content of 2.85%. Examination of levels of organic matter in fine aggregates shows color no. 4.

3.2. Concrete test results
The results of K-200 compressive strength test on normal concrete and concrete with a mixture of red brick waste at 25% and 50% carried out on each of the 3 test objects, can be seen in Tables 1, 2 and 3.
Testing of concrete with 25% of red brick waste at the age of 7 days did not meet K-200 (200 kg / cm²) indicated that the red brick factor was not completely dry. At the age of 14 days, it has exceeded K-200, indicated that red bricks are dry so that the properties of the waste are perfectly mixed with sand and cement so that satisfactory results are obtained. At the age of 28 days, it exceeds the K-200 by 410 kg / cm², the results are not much different from the results of the concrete with compacting so that the formation of cavities is as minimal as possible.

Testing of concrete with 50% of red brick waste at the age of 7 days does not meet the K-200 value (200 kg / cm²), this is indicated in the concrete there is still a large cavity. At the age of 14 days, it meets the K-200. At the age of 28 days, it has reached K-200.

Based on the test results of the average compressive strength at the age of 28 days in the composition of the red brick waste (25% and 50%) and normal concrete obtained the value of K-200 is fulfilled, but

| Table 1. Value of average compressive strength of k-200 normal concrete press strength test. |
|-----------------|-----------------|-----------------|-----------------|
| Age (day) | Test Object | Test Object Weight (Kg) | Press Strength (KN) | Average Compressive Strength (KN) |
| 7       | 1            | 7.50             | 180              | 170             |
| 2       |              | 7.40             | 200              |                 |
| 3       |              | 7.88             | 170              |                 |
| 14      | 1            | 7.80             | 90               |                 |
| 2       |              | 7.16             | 200              | 200             |
| 3       |              | 7.93             | 400              |                 |
| 28      | 1            | 7.74             | 420              |                 |
| 2       |              | 7.79             | 420              | 420             |
| 3       |              | 7.78             | 400              |                 |

Table 2. Strength value of concrete press mixed 25% of red brick waste.

| Age (day) | Test Object | Test Object Weight (Kg) | Press Strength (KN) | Average Compressive Strength (KN) |
|-----------|-------------|-------------------------|---------------------|----------------------------------|
| 7         | 1           | 7.36                    | 120                 | 120                              |
| 2         |              | 7.40                    | 180                 |                                  |
| 3         |              | 7.41                    | 20                  |                                  |
| 14        | 1           | 7.15                    | 300                 |                                  |
| 2         |              | 7.45                    | 300                 | 300                              |
| 3         |              | 7.90                    | 340                 |                                  |
| 28        | 1           | 7.49                    | 410                 |                                  |
| 2         |              | 7.59                    | 380                 | 380                              |
| 3         |              | 7.54                    | 400                 |                                  |

Table 3. Strong value of 50% mixed concrete press in red brick waste

| Age (day) | Test Object | Test Object Weight (Kg) | Press Strength (KN) | Average Compressive Strength (KN) |
|-----------|-------------|-------------------------|---------------------|----------------------------------|
| 7         | 1           | 6.86                    | 100                 | 100                              |
| 2         |              | 6.51                    | 130                 |                                  |
| 3         |              | 7.11                    | 90                  |                                  |
| 14        | 1           | 7.40                    | 170                 |                                  |
| 2         |              | 7.10                    | 280                 | 240                              |
| 3         |              | 7.33                    | 240                 |                                  |
| 28        | 1           | 7.30                    | 240                 |                                  |
| 2         |              | 7.41                    | 260                 | 240                              |
| 3         |              | 7.33                    | 220                 |                                  |

Based on the test results of the average compressive strength at the age of 28 days in the composition of the red brick waste (25% and 50%) and normal concrete obtained the value of K-200 is fulfilled, but
when compared to the age of 28 days the approaching value is 25%. Concrete with a composition of 50% is produced below the average of a mixture of 25% but still above the concrete strength of K-200. With the composition of the red brick waste from the compressive strength test obtained values exceeding the K-200 quality, the use of the red brick waste is suitable to be used as a substitute for fine aggregate mixture in concrete with a composition of 25% and 50% waste red brick. The test results of the 50% mixture decreased with a mixture of the age of 28 days in a mixture of 25%, which was above the average of 300 kg / cm². This is indicated because in the composition of red bricks it is known to have clay properties so that if too much composition causes possible degradation of quality.

4. Conclusion
Additional materials for red brick waste show results that are in accordance with the K-200 specimen as a comparison, therefore a mixture of waste red brick is suitable to be used as an alternative material to substitute for fine aggregate/sand. From the results of the additives of the red brick waste material (25% and 50%), the results are above the average of 200 kg / cm². The maximum limit for the use of red brick waste in proportion does not exceed or enough 25% of the sand substitute mixture, because with 50% there is a decrease in quality. The selection of sand to be more precise so that when mixing sand with red brick waste powder can minimize the occurrence of excessive bubbles which can lead to pores so that the effect on the compressive strength of the concrete becomes not optimal.

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