Analysis of the compressive strength of concrete from brick wall waste as a concrete mixture

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ABSTRACT

Every building renovation or building reconstruction often occurs demolition of the wall. The demolition of this wall becomes construction waste therefore it is necessary to experiment with using wall waste to become a productive material. This research is an experiment in making concrete using wall waste. The wall waste used is in the form of rubble from the ruins of a red brick wall. The compression test method refers to the 1974:2011 SNI regulations on concrete. In this test, the focus is on the maximum compressive strength of concrete that can be produced in the sample. Each sample of the test object is divided into three groups, each group has three test objects. The first group is a sample of pure concrete, fine aggregate 100% concrete sand. The second group is a fine aggregate experimental concrete sample containing 25% wall waste, and the third group contains 50% wall waste. The test object is in the form of a concrete cylinder with a diameter of 150 mm and a height of 300 mm. Concrete testing is carried out at the age of 7 days, 14 days, and 28 days. The results of this study provide information that red brick wall waste can be recycled into concrete material so that it does not become construction waste. It is known that the compressive strength of concrete using additional wall waste as fine aggregate meets the requirements of structural concrete quality and can improve the quality of concrete. Furthermore, it is hoped that the wall waste can be reused as an added material to the concrete mixture in building construction activities or other construction using concrete.

Key word: wall waste; brickwork; modified concrete; structural concrete; concrete quality.

INTRODUCTION

Walls based on their function are an important component in the construction of simple and non-simple buildings (Frapanti, 2018). Every time you build a building, there is always a wall that generally functions as a room divider. The outer wall serves as a safety for residents to protect themselves from the weather, wild animals, bad people, and so on (Paikun & Maulana, 2020), (Paikun; Yusuf. M.I; Kurniawan; Amal. T.I, 2021) therefore the wall is a very important building component in a building.

Old buildings, whether houses, markets, shops, or buildings, are often rejuvenated (Aini, 2021), (Nahak, Bria, & Mauta, 2018). Some building rejuvenations are carried out in total or reconstruction, some are only renovated by replacing some components of the building (Rahmadaniyati, 2017). In addition to old buildings, renovation activities in a building are often carried out to adjust to the needs of the owner following building design trends or room needs (Rilatupa, 2020). Reconstruction activities are mostly carried out after a disaster, reconstruction activities will dismantle the entire building and replace it with a new one (Sunoko, 2017), while renovation activities usually dismantle some components of the building, including dismantling walls or walls (Kusumawardana, 2018). As a result of this demolition, it will cause debris that becomes waste, therefore solutions and innovations are needed to utilize the waste into productive materials.

Concrete referring to SNI 2847:2013 is a mixture between portland cement or other hydraulic cement, fine aggregate, coarse aggregate, and water, with or without additives that make up the solid mass (Firda & Fuad, 2020). According to SNI 02-6820-2002, fine aggregates are aggregates with a maximum grain size of 4.75 mm (Ningsih, 2018). As for the general requirements of fine aggregates according to SNI 03-6821-2002 consisting of sharp and hard grains, fine grains are eternal, that is, they are not broken or destroyed by the influence of weather (Bestarino, 2020). Concrete is a construction that is often used in the field of civil engineering (Rabbani, 2021). Almost every civil

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building structure, be it buildings, bridges, or water buildings, uses concrete materials (Irlan, Rintawati, & Paikun, 2020), (Hani, 2018).

Due to damage to buildings during earthquakes or other disasters, due to reconstruction, and building renovations cause a lot of wall waste (Paikun & Kurniawan, 2022), therefore experimental research on utilizing wall waste as additional materials in concrete making becomes important. This study aims to determine the compressive strength of concrete by utilizing wall waste into additional fine aggregates or concrete sand with the addition of 25% and 50% of wall waste about making K-250 quality concrete. After it is known that the compressive strength of concrete uses additional fine aggregates from wall waste, it is hoped that the results of this study can be used by the construction community to use wall waste as an addition to making concrete. The results of this study are also expected to provide solutions in handling construction waste specifically for brick wall waste and can be used by the community as an effort to provide special materials for additional materials in concrete.

Related Research

Unused lightweight brick waste is reused as an added material for concrete constituents which consists of two examinations, namely as a coarse aggregate with variations in the maximum size of the aggregate, namely 16 mm, 22.4 mm and 25 mm, while the second examination is a light brick waste as a substitute for cement with a mixture variation of 5%, 10% and 15% and binder weight. The concrete properties testing carried out consists of a slump test and compressive strength. The results showed that the coarse aggregates of lightweight brick waste with a maximum size variation of 16 mm obtained the highest compressive strength. Meanwhile, the use of light brick waste as a material to replace cement produces the highest compressive strength with a variation of 5% (Faizah, Widiyanto, Putri, Prayuda, & Firdausa, 2021).

Ceramic waste can be used as an alternative to fine aggregates on concrete mixtures. Ceramic waste as fine aggregates are varied with percentages of 0%, 3%, 6%, 9%, 12% and 15% of the total needs of fine aggregates, as well as adding fly ash. The higher the percentage of ceramic waste used, the absorption value of concrete increases, and the unit weight of concrete decreases as the percentage of ceramic waste increases. The percentage of ceramic waste mixture that has the highest compressive strength is 9%, and if it the >9% then the compressive strength of concrete will decrease. Ceramic waste can be used as an alternative to fine aggregates of a maximum of 9% (Karimah, Rusdianto, & Susanti, 2020).

The use of wall fragments as a substitute for part or all of the stone ash in worn-layer asphalt concrete with four types of wall fragments composition as a filling material, namely 100% wall fragments, 50% wall fragments and 50% stone ash, 25% wall fragments and 75% stone ash, and 100% stone ash. Wear-coated asphalt concrete (AC-WC) with 100% wall fragment content as a filling material, produced the largest VMA of 17.67%, resulting in the largest VIM of 6.26%. The worn-layer asphalt concrete (AC-WC) that produces the largest VFB is asphalt concrete with 100% stone ash content as a filling material, which is 74.00%. Worn-coated asphalt concrete (AC-WC) that produces the greatest stability is asphalt concrete with 25% wall fragment content and 75% stone ash content as a filling material, which is 1622.47 kg. The worn-out layer of asphalt concrete (AC-WC) that produces the largest melting is asphalt concrete with 50% wall fragment content and 50% stone ash content and 25% wall fragment content and 75% stone ash content as a filling material, which is 4.84 mm. The worn-layer asphalt concrete (AC-WC) that produces the largest Marshall Quotients is asphalt concrete with 100% wall fragment content as a filling material, which is 433.31 kg / mm (Tan & Sebastian, 2020).

Experiments on making asphalt using coal mine waste, namely resin, processed using used oil added ash from plant branches can produce asphalt with penetration between 170.02-170.60 dmm, mushy point between 56-57 C °, Ductility 14-15 cm, flash point 200-204 C °, burn point 210-216 C °, specific gravity 0.992-0.997 gr / cm3, bitumen attachment to rocks 99% (Paikun, S Rico, R Debby, S Cece, L Herlina, 2020), (Paikun, 2020).

Previous experimental research has successfully utilized waste into productive materials, such as lightweight bricks into coarse aggregate concrete materials and cement substitutes, ceramic waste for concrete mixtures, coal mine waste into asphalt, including the use of wall fragments as worn-out asphalt concrete. The similarity of this study with previous research is that they both use the experiential method, the difference is that this study utilizes brick wall waste as a substitute for fine aggregates or concrete sand in a certain percentage to produce concrete using the concrete compressive strength standard K-250, so it is hoped that by adding this wall waste can increase the compressive strength of concrete.

Theoretical Basis

Concrete is a mixture of portland cement or other hydraulic cement, fine aggregate, coarse aggregate, and water, with or without admixture (Nasional, 2013), (Indonesia, 2013). Concrete can be obtained from the mixing of fine and coarse aggregate materials, namely sand, stone, crushed stone, or other such materials, by adding enough cement adhesive materials, and water as auxiliary materials for chemical reactions during the process of hardening and concrete treatment. Fine and coarse aggregates, referred to as coarse stacking materials of the mixture, are the main components of concrete. The value of strength and durability of concrete is a function of many factors, including the comparative value of the mixture and the quality of the stacking material. Normal concrete is concrete that uses sand aggregate as fine aggregate and gravel as coarse aggregate and has a concrete specific gravity between 2200-2400kg/m^3 (Mulyono & Ir, 2004).

Aggregates are granular materials, for example sand, gravel, crushed stone and incandescent furnace crust that are used together with a binding medium to form a concrete or hydraulic cement mortar SNI 03 - 2847 - 2002 (Nasional, 2002), (Masdiana et al., 2021). Fine aggregates are natural sands as a result of the natural disintegration of rocks or sand produced by the stone-breaking industry and have the largest grain size of 4.75 mm (Number 4). Provisions regarding coarse aggregates according to the standard SK-SNI S-04-1989-F. Coarse Aggregate Coarse aggregate is an aggregate with a grain size greater than 4.75 mm. Provisions regarding coarse aggregates according to the standard SK-SNI S04-1989-F (Rezi, 2018).

The cement commonly used is Portland cement. Portland cement is a hydraulic cement produced by grinding portland cement slag, especially consisting of calcium silicate which is hydrolyzed and ground together with additional materials in the form of one or more crystalline forms of calcium sulfate compounds and can be supplemented with other additives (SNI 15-2049-2004) (Indonesia, 2004).

Water is needed in the manufacture of concrete to trigger the chemical process of cement, wet the aggregate, and provide ease in concrete work. Drinking water can generally be used as a concrete mixture. Water-containing compounds, which are polluted with salt, oil, sugar, or other chemicals, when used in concrete mixtures will degrade the quality of concrete, and may even change the properties of the concrete produced (Tri, 2004). The water used in the concrete manufacturing process if it is too little will cause the concrete to be difficult to work with, but if the water used is too much, the strength of the concrete will decrease and shrinkage occurs when the concrete hardens (Yuhesti, 2014).

Based on the basics of this theory, the experimental research on the analysis of compressive strength of concrete using the addition of a fine aggregate mixture of brick wall waste grains has a clear theoretical reference and is feasible to do.

RESEARCH METHODS

This research uses an experimental qualitative method, which is an experiment to make concrete using cement, gravel, and sand where the sand will be partially replaced using waste of smoothed brick wall walls, with reference to concrete quality K-250. To achieve success in this research, it starts with the stages of literature study, provision of tools and materials, material processing, material testing, manufacture of test objects, slump testing, and testing of the compressive strength of concrete at the age of 7 days, 14 days, and 28 days. In summary, this research activity is summarized in Figure 1.

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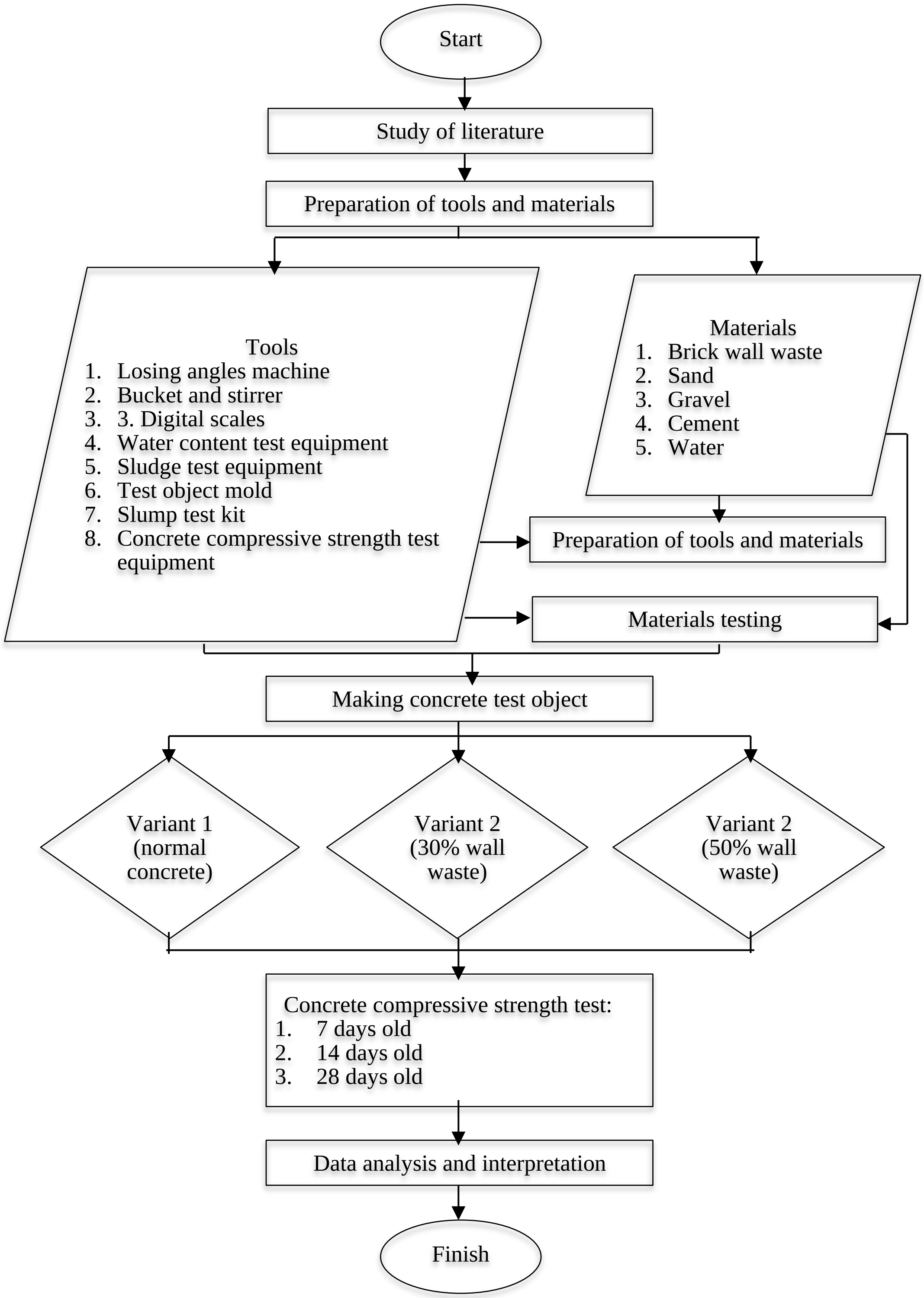

Figure 1. Flow chart

Materials

Concrete-making experiments using brick wall waste as an add-on to the concrete mixture, made 3 variants with mixed composition as described in Table 1.

Table 1. Variants of the composition of concrete addition of wall waste

Variant	Cement	Gravel	Sand	Wall waste
Variant 1	384 kg	1026 kg	692 kg	-
Variant 2	384 kg	1026 kg	519 kg	173 kg
Variant 3	384 kg	1026 kg	346 kg	346 kg

Variant 1 is normal concrete with a cement composition of 384 kg, coarse aggregate (gravel) 1026 kg, and fine aggregate (sand) of 692 kg. Variant 2 is experimental concrete with a composition of 384 kg of cement, 1026 kg of coarse aggregate (gravel), and 692 kg of fine aggregate consisting of 75% sand and 25% waste of pulverized brick walls. Variant 3 is experimental concrete with a cement composition of 384 kg, coarse aggregate (gravel) 1026 kg, and fine aggregate of 692 kg consisting of 50% sand, and 50% smoothed brick wall waste.

Of the three compositions of the concrete mixture material, slump testing was then carried out which aimed to determine the viscosity of the concrete mortar. Slump testing is carried out on fresh concrete, which is a concrete mixture that has just been stirred and is still plastic and has not yet occurred to binding. Test method of a concrete slump on portland cement based on SNI 03-1972-1990 and PBBI 1971 (Muldiyanto, 2018). Then the compressive strength test of concrete was carried out with the hypothesis that the greater the addition of brick wall waste, the higher the compressive strength of the concrete. From each composition of the concrete mixture will be made 9 specimens each.

Methods

This research is experimental method research that aims to determine the compressive strength of concrete using a mixture of brick wall waste. In this experiment will compare the normal concrete mixture K-250 with experimental concrete using additional red brick wall waste as a fine aggregate of 25% and an additional 50%. Next, analyze the compressive strength of concrete to find out which mixture composition has a higher compressive strength of concrete.

From each of the compositions of the concrete mixture will be made test objects of 9 test objects each, with a cylindrical shape of 15 cm in diameter, and a height of 30 cm. Each specimen from each composition of the concrete mixture will be tested 3 samples at 7 days of concrete age, 3 samples at 14 days of age, and 3 samples at 28 days of age, so that all 27 specimens will be made. Manufacture of cylinder-shaped test objects with a diameter of 15 cm with a cylinder height of 30 cm. The volume of 1 piece of cylindrical sample can be calculated using the equation $t.\ \pi.\ r^2$ (National, 2000). So that each test object has a volume of 0.00530 m^3. method of making test objects refers to SNI DT 91-0008-2007 (Setiyaningsih, 2013) provided that the basis of the aggregate mixture as described in Table 2.

Table 2. The basic composition of the concrete mixture

Materials	Volume
Cement	384 Kg
Sand	692 Kg
Gravel	1039 Kg
Water	215 Liter

Stirring the test object using a waterproof, clean, moist metal container, such as a steel pan or bowl, stirred using a blunt shovel with the following:

1. Stir cement, sand, and additional materials of insoluble wall waste powder in water, without adding water until everything is thoroughly mixed.
2. Add coarse aggregate and stir all the mixture without adding water until the coarse aggregate is uniformly dispersed throughout the mortar.
3. Add water, and stir the mixture until the concrete appears uniform and has the desired consistency.

Data Analysis

The material used consists of coarse aggregate in the form of gravel, fine aggregate in the form of concrete sand, and brick wall waste granules, portland cement packaging 50 kg of the Semen Gresik brand, the water used in this test concrete mixture come from PAM which is available in the testing laboratory environment.

Fine aggregate in the form of sand obtained from TB building materials. According to SNI 03 – 2847 – 2002, that fine aggregate is an aggregate that has a maximum grain size of 5.00 mm (Prasetya, Hernadi, & Nugroho, 2021). Coarse aggregate in the form of crushed stone refers to SNI 1969:2008 is in the form of crushed stone obtained from the stone breaking industry and has a grain size between 4.75 mm (Number 4) to 40 mm (Number 1 1/2 inch) (Rahmawati & Oetomo, 2020). Portland cement used based on SNI 15-2049-2004 is a hydraulic cement produced by grinding cement slag, mainly consisting of hydraulic calcium silicate and milled together with additives in the form of one or more crystalline forms of calcium sulfate compounds. (Citrasari, Pratiwi, Hariyanto, & Octavia, 2019). Wall waste as an additive to the fine aggregate used comes from the rest of the demolition of one of the houses in a residential environment located in the Cisaat district. This wall waste was smoothed using Los Angeles machines.

Concrete testing in this study refers to SNI regulation 031974-1990 concerning the method of measuring concrete compressive strength using a Digital Compression Machine, which is a digital concrete compressive testing machine that has kilo newton (KN) units. Where the compressive strength of concrete can be calculated using the equation P / A (kg/cm^2) (Permatasari, 2019).

P = maximum load (kg)
A = the cross-sectional area of the test object (cm^2).

RESULT AND DISCUSSION

Material Needs Analysis of Test Objects

Analysis of material needs for the manufacture of test objects for concrete K - 250 refers to the standard SNI DT 91-0008-2007, the standard of concrete mixture K - 250 / M^3 is as in Table 3.

Table 3. The basic composition of the concrete mixture K-250/M^3

Materials	Volume
Cement	384 kg
Sand	692 kg
Gravel	1039 kg
Water	215 liter
W / c ratio	0.58

It is known that the volume/m^3 of concrete uses 1400 kg of sand, and 1800 kg of gravel, so the manufacture of concrete/m^3 requires 0.49 m^3 of sand, and 0.58 m^3 of gravel, with a W/C ratio of 0.58.

The concrete test object can be a cube or a cylinder. In this study, the test object used a cylinder with a diameter of 15 cm and a height of 30 cm, with a volume of 0.0053 m^3, so that the material requirement for each test object was the conversion of the need for 1 m^3 of concrete into one unit of test object. The material requirements of one unit of the test object are described in Table 4.

Table 4. Requirement of concrete material 1 unit of the test object

Materials	Volume
Cement	2.04 kg
Sand	3.67 kg
Gravel	5.51 kg
Water	1.14 liter

It is known that the material requirements for one test object are as described in Table 4, and the number of cylindrical concrete specimens in this study were 27 samples, where each component of the concrete mixture was made of 3 specimens, for testing at ages 7, 14, and 28 days. With the number of 27 concrete test objects in this study, material needs can be known as explained in Table 5.

Table 5. Requirements for concrete materials 27 test objects

Materials	Volume
Cement	54.95 kg
Sand	99.03 kg
Gravel	148.68 kg
Water	30.77 liter

Analysis of material requirements as described in Table 5, aims to provide information to the public and researchers that to conduct experiments on concrete test objects, it is necessary to prepare a number of these materials.

Test Object

The procedure for making test specimens is to select the portion of the concrete mixture used in the test for molding of the specimen in such a way that it represents the actual comparison and conditions, when the concrete is not being stirred or a test sample is taken, cover it to avoid evaporation. Print the test object as close as possible to the storage area for the first 24 hours. If it is not possible to print the specimen near the storage area as soon as possible after leveling, place the mold on a rigid surface, free from vibration and other disturbances. Avoid collisions or scratches on the surface of the test object when transferring the test object to the storage area. To avoid evaporation of water from unhardened concrete, cover the specimen immediately after finishing work, preferably with a non-absorbent and non-reactive slab or a strong, durable, water-resistant plastic sheet. Description of the manufacture of the test object as described in Figure 2.

Figure 2. Concrete test objects

Opening of the test object from the mold as simulated in Figure 2, opened after 24 hours + 8 hours.

Concrete Compressive Strength Analysis

The volume of a cylindrical specimen with a diameter of 15 cm and a height of 30 cm is 0.0053 m^3. Before testing the compressive strength of concrete, the test object is first weighed to determine the tendency of the weight of the test object. Weighing simulation of the test object as described in Figure 3.

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Figure 3. Weighing of test object

All test objects are weighed as simulated in Figure 3. Each variant of the composition of the concrete mixture is made 9 test objects. In this study, there were 3 variants of mixed composition so that there were as many as 27 test objects. The weight of the test objects of each variant is described in Table 6.

Table 6. Weight of the test object for each variant

Concrete variant	Composition of concrete mix	Average test object weight
Variant 1	Normal concrete: cement 2.04 kg, sand 3.67 kg, gravel 5.51 kg, water 1.14 liters	11.915 Kg
Variant 2	Experimental concrete: cement 2.04 kg, sand 2.57 kg, wall waste granules 1.10 kg, gravel 5.51 kg, water 1.14 liters	11.985 kg
Variant 3	Experimental concrete: cement 2.04 kg, sand 1.83 kg, wall waste granules 1.83 kg, gravel 5.51 kg, water 1.14 liters	12.030 kg

The results of the concrete weight test of the test object have a difference in the weight of the concrete as described in Table 6. It can be concluded that the greater the addition of the mixture of wall waste granules, the weight of the concrete increases.

After testing the weight of the concrete then the compressive strength test of the concrete is carried out. At the test preparation stage, the test object must be treated as follows:

- Taking the test object from the soaking tub
- Clean the dirt that sticks with a wet cloth
- Coating the top and bottom surfaces of the test object with sulfur mortar (capping) in the following manner; 1) melt the sulfur mortar in a melting pot whose inner walls have been lightly coated with grease, 2) place the test object perpendicular to the mold, 3) lift the test object out of the mold and allow it to air.

After the test object is ready, the test procedure can be started with the following steps:

- Placing the test object on the press machine centrically.
- Running the press machine with an additional load of between 2 to 4 kg/cm^2 per second.
- Carry out loading until the test object is destroyed.

- Record the maximum load that occurs during the examination of the test object.
- Documenting the form of damage to the test object.
- Record the state of the test object.
- Calculating the compressive strength of concrete, i.e. the magnitude of the load unit area.

Testing the compressive strength of concrete using a tool as simulated in Figure 4.

Figure 4. Concrete compressive strength test simulation

The procedure for testing the compressive strength of concrete was carried out on all samples of the test object as described and illustrated in Figure 4. The compressive strength test of concrete was carried out at the age of 7 days, 14 days, and 28 days. The compressive strength of concrete at the age of 7 days from variants 1-3 as presented in Table 7.

Table 7. The average compressive strength of 3 concrete variants aged 7 days

Variant	Mass of Test Object Kg	Area Press Cm^2	Press Style		Concrete Cylinder Fc' Mpa
			KN	N	
Variant 1	11.92	17671.50	252.17	252166.67	14.27
Variant 2	11.99	17671.50	266.30	266300.00	15.07
Variant 3	12.03	17671.50	268.40	268400.00	15.19

The concrete compressive strength of 3 variants of mixed composition at the age of 7 days meets the concrete quality standard K-250 as shown in Table 7. Normal concrete variant 1 at the age of 7 days has a concrete compressive strength of 14.27 MPa. The compressive strength of the concrete variant 2 with the addition of 25% fine aggregate of brick wall waste at the age of 7 days experienced an increase in quality of 5.61%, while variant 3 concrete with the addition of 50% fine aggregate of brick wall waste experienced an increase in concrete quality of 6.45%.

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Testing the compressive strength of concrete at the age of 14 days from 3 variants of the composition of the concrete mixture with the procedure as simulated in Figure 4, described in Table 8.

Table 8. Average compressive strength of 3 concrete variants aged 14 days

Variant	Mass of Test Object Kg	Area Press Cm^2	Press Style		Concrete Cylinder Fc' Mpa
			KN	N	
Variant 1	11.92	17671.50	256.67	256650.00	14.52
Variant 2	11.99	17671.50	267.10	267066.67	15.11
Variant 3	12.03	17671.50	287.93	287900.00	16.29

The compressive strength of normal concrete at the age of 14 days experienced an increase in quality from the age of 7 days by 1.78%, while the concrete for variant 2 increased by 0.29%, and variant 3 increased by 7.26%. This is shown by the results of the compressive strength test of 7-day-old concrete in Table 7 and compared with the compressive strength of 14-day-old concrete in Table 8.

The last test is testing the compressive strength of concrete at the age of mature concrete, namely at the age of 28 days. The test results are presented in Table 9.

Table 9. The average compressive strength of 3 variants of concrete aged 28 days

Variant	Mass of Test Object Kg	Area Press Cm^2	Press Style		Concrete Cylinder Fc' Mpa	Mutu Beton Silinder	
			KN	N		Fc'	K
Variant 1	11.92	17671.50	261.13	261133.33	14.78	22.74	264.50
Variant 2	11.99	17671.50	267.83	172495.43	15.16	23.32	277.43
Variant 3	12.03	17671.50	307.40	307400.00	17.40	26.76	322.43

Concrete experiments using Mix Design SNI DT 91-0008-2007 concrete quality K-250 which is the reference for concrete experiments in this study based on the test results meet the requirements. Normal concrete quality variant 1 at a maximum age of 28 days has a concrete compressive strength (fc) of 22.74 MPa, equivalent to K-264 > K-250. Variant 2 has a concrete compressive strength (fc) of 23.32 Mpa equivalent to K-277 > K-250. Variant 3 has a concrete compressive strength (fc) of 26.76 equivalent to K-322 > K-250.

The compressive strength of concrete at a maximum age of 28 days when compared to normal concrete without an additional fine aggregate of brick wall waste, with each variant experiencing an increase in concrete quality. Concrete with an additional mixture of fine aggregate grains of brick wall waste 30% has an increase in quality of 4.89%, while the addition of 50% fine aggregate grains of brick wall waste can increase the quality of concrete by 21.90%. Thus it can be stated that brick wall waste can be used as a mixture of fine aggregate in concrete mixtures and significantly improve the quality of concrete. Thus it can be stated that brick wall waste can be used as a mixture of fine aggregate in concrete mixtures and significantly improve the quality of concrete.

CONCLUSION

This research has resulted in a solution to utilize waste brick walls into productive materials as additional material for fine aggregate or sand in a concrete mix. Based on the experimental results and has been through testing, it can be seen that brick wall waste can be processed into grains of sand. These wall waste sand grains can then be used as additives for fine aggregate in concrete mixtures. Concrete with the addition of fine aggregate grains of brick wall waste based on the results of laboratory tests, and the results of the compressive strength test of concrete, is declared to be able to improve the quality of concrete. The greater the use of additional brick wall waste granules in the fine aggregate of the concrete mixture can significantly improve the quality of the concrete. Based on the results of this study, it is expected to carry out the management of brick wall waste into fine aggregate grains as additional material in the concrete mixture. With the wall waste treatment, it is hoped that it will open up new business opportunities for the community. Further research needs to identify the characteristics of the granular material of brick wall waste because the experimental results in this study are stated to be able to improve the quality of concrete.

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