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Comparative Study of the Potential of Sorong City Sand and Tobelo Sand as Concrete Material

Muhammad Nur Fajar[1], Herlina Arifin[*2], Didik Setya Purwantoro[3], Achmad Rusdi[4], Darmawan Kafara[5]

[1,2,3,4,5] Civil Engineering, Universitas Muhammadiyah Sorong, 98416, Indonesia
[*]Corresponding author, e-mail: herlinaafn22@gmail.com

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ABSTRACT

The quality of the sand used for the concrete mixture can affect the compressive strength produced by the concrete. This study aims to determine the amount of compressive strength and modulus of elasticity of concrete with quarry sand material Km.14 Sorong City and sand quarry from other regions, namely Tobelo North Halmahera quarry sand. This study used an experimental method with a total of 18 selinder-shaped test objects consisting of 3 samples aged 7 days, 3 samples aged 14 days and 3 samples aged 28 days for each quarry Modulus of elasticity testing was only carried out on concrete aged 28 days. All material testing until the manufacture and tests of compressive strength and modulus of elasticity of cylindrical samples are carried out at the Civil Engineering Concrete Laboratory of the University of Muhammadiyah Sorong. From the results showed the average compressive strength produced between sand Km.14 of Sorong city and Tobelo sand was 8.78 Mpa: 11.13 Mpa for 7 days old, 10.66 Mpa: 12.83 Mpa for 14 days old and 11.23 Mpa: 13.78 Mpa for 28 days old. In addition, based on concrete strain testing, it can be seen that the higher the compressive strength or stress of the concrete, the higher the strain value.

Keywords: *Tobelo Sand, Sorong City Sand, Compressive Strength, Strain*

INTRODUCTION

In infrastructure development, concrete is one of the most famous building materials used such as in the construction of roads, bridges, buildings, dams, side channels, culverts, foundations and others. [7]. Concrete itself has a constituent material consisting of fine aggregate, coarse aggregate, cement and water [15], Each quality of each material becomes a factor in the quality of concrete. Although its function is only as a filler, but because of its large enough composition, this sand is also important in making concrete. The most influential property of sand on the strength of concrete is the hardness of the grains of sand and the maximum size of the concrete mixture that matches the signal. [5]-[6]

Sorong City as one of the developing cities in Indonesia is always carried out construction work where many of these works use concrete materials, so the city of Sorong requires a considerable supply of concrete constituent materials, in addition to utilizing local sand, construction actors often bring sand from outside the area with various factors, one of which is the quality of Sorong sand which is not good for high quality concrete because most quarries take from River sand, however, river sand that is often used in the manufacturing

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mixture needs to be further investigated to find out the mud content of the river sand whether the river sand to be used has a decent mud content in the reference regulations for concrete manufacturing mixtures [8]

For concrete quality reference, 2 tests are usually carried out, namely compressive strength testing and concrete strain testing. The compressive strength of fc' concrete is determined by a standard cylinder treated under standard laboratory conditions at a certain speed of immersion, at a lifespan of 28 days. In addition, based on PBI 1971 the value of fc' voltage reaches approximately 0.002 and will continue to decrease until the specimen is destroyed at a value of 0.003-0.005, and the initial slope of the curve will vary depending on the compressive strength value of the concrete. [14], [3]

This study then took two samples to be compared, namely local sand and sand from outside the area that are commonly used for concrete constituent materials for construction work in Sorong City, as was the case with previous research [10] conducted research on the aggregate comparison of 3 rivers in the Ogan Komering Ulu area. Cube samples aged 14 and 28 days to concrete compressive strength K 300 [9] about the comparative analysis of Sugiwaras River sand with Tanjung Raja River sand against K-300 concrete compressive strength. Which of the two studies compares the quality of sand from various kinds of river sand quarries that are usually used as construction materials

METHOD

The location of this research was carried out in the Laboratory of the Faculty of Engineering, especially the Laboratory of the Civil Engineering Study Program, University of Muhammadiyah Sorong (UNAMIN) and the research time began in May until it was completed. The method applied in this study is an experimental method, which is research that aims to investigate causal relationships between materials and compare the results.

Figure 1: Research location and Sorong sand Quarry

Figure 2: Location of Mamauya Tobelo Sand Quarry

2.1 Materials and Test Equipment

The materials used in making concrete are as follows:

- Portland cement type I from the production of Tonasa PCC cement weighing 50 kg
- Coarse Aggregate / Crushed Stone 1-2 cm obtained from PT. PII Saoka
- Fine Aggregate/Sand obtained from quarry km.14 of Sorong city and quarry of Mamuya

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Tobelo North Halmahera
- Water from clean water installations of the Civil Engineering Laboratory, Faculty of Engineering, University of Muhammadiyah Sorong.

The Test Equipment used are as follows: One Set Sieve (Sieve), Scale, Measuring Cup, Stopwath, Picnometer, Oven, Mixed Bowl and spoon, Alloy Mold, Ruler / meter, Pipette, conical mold, Molen machine, Compressing testing Machine, exstensometer, Shovel, Bucket, Iron Pound, One set of abrams.

2.2 Research Phase

The stages of implementing the complete research include:
- Phase I: includes the Preparatory stage, namely the study of literature and all materials and equipment needed in the research process.
- Phase II: includes testing of the materials used, in this case testing only on Coarse Aggregate (crushed stone 1-2 cm) and fine aggregate (sand) consisting of SSD sand inspection, Sieve Analysis, Aggregate Absorption Rate Examination, Aggregate Sludge Content Inspection, Volume Weight Examination, Specific Gravity Examination and Stone Abrasion Examination and located at the Civil Engineering Laboratory of Muhammadiyah University Sorong.
- Phase III: includes the calculation of mix design based on SNI 03-2834-2000
- Phase IV: includes Determination of Concrete Mortar Mixture, Concrete Mortar Making, Slump Inspection, Casting into Selinder molds, as well as maintenance and testing for 7, 14 and 28 days of life.
- Stage V: Includes data analysis from test results to obtain conclusions from the variables studied.

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RESULTS AND DISCUSSION

From several tests that have been carried out at the Concrete Technology Laboratory, Faculty of Engineering, University of Muhammadiyah Sorong. can be obtained the test results of coarse aggregate, fine aggregate, formula mix design, manufacture of test specimens, to test specimen press testing. The test results are as follows:

Tabel 1: Material Testing Results

Items	Fine Aggregates (KM 14 Sorong City)	Fine Aggregates (Tobelo)	Coarse Aggregate (PII Saoka)
Kadar Lumpur dalam pasir (%)	8,90	6,07	5,49
Modulus Halus Butir	3,35	2,61	7,84
Berat Isi (gr/Cm^3)	1,48	1,42	1,34
Berat Jenis (SSD)	2,46	2,53	2,92
Penyerapan Air (%)	4,64	1,09	2,25

3.1. Fine Modulus of Granules

Finnes modulus or commonly abbreviated as MHB is an index used to measure the fineness or roughness of aggregate grains. SNI 03-2834-2000, MHB value is based on filter analysis testing, here are the test results of filter analysis:

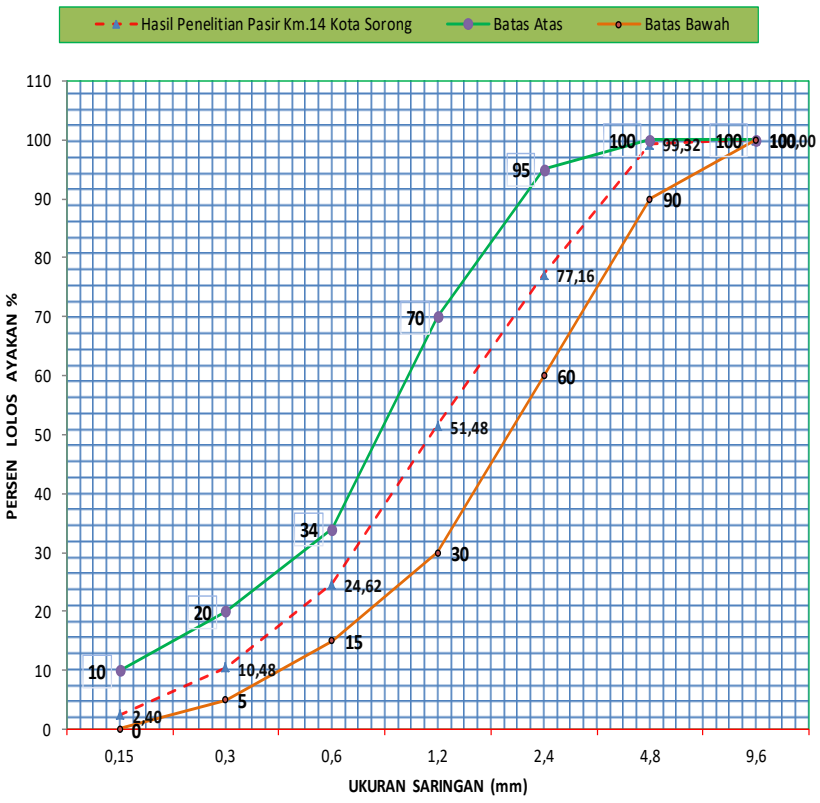

Figure 3: KM Sand Grain Distribution Curve. 14 Sorong City

From figure 3 can be seen the test results of Sand Km.14 Sorong City is classified as gradation area 1 (coarse sand) with a fine grain modulus of 3.35.

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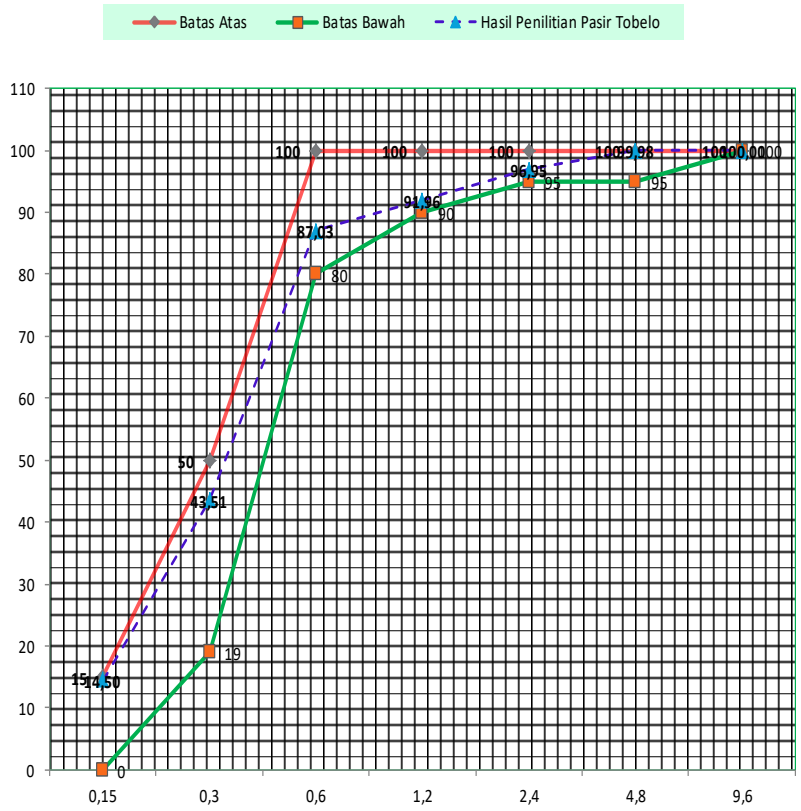

Figure 4: Tobelo Sand Grain Distribution Curve

From figure 4 can be seen the test results of Tobelo sand classified as gradation area 4 (rather fine sand) with a fine grain modulus of 2.61.

3.2. Proportion of Mixture based on SNI 03-2834-2000

KM. 14 Sorong City

From the calculation of the proportion of mixture (Job Mix Design) and according to ssd, the theoretical concrete mixture arrangement for each m3 is obtained as follows:

- Semen Portland = 394,23 kg /m^3
- Water = 205 kg /m^3
- Fine Aggregate = 994,82 kg /m^3
- Coarse Aggregate = 753,55 kg/ m^3

Tobelo

Dari perhitungan proporsi campuran pada lampiran 1 Sesuai ssd didapat susunan campuran beton teorotis untuk tiap m3 sebagai berikut :

- Semen Portland = 394,23 kg /m^3
- Water = 205 kg /m^3
- Fine Aggregate = 573,41 kg /m^3
- Coarse Aggregate = 1258,56 kg/ m^3

3.3. Concrete Compressive Strength Test Results

The compressive strength value of concrete is obtained by imposing a certain compressive force on the surface of the concrete area so that the concrete specimen is cracked or destroyed using a press machine [11]. The results of the calculation of compressive strength of concrete

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can be seen in the table below

Tabel 2: Compressive Strength Results of KM Sand Concrete. 14 Sorong City

No Sampel	Slump (Cm)	Age of Concrete	P (kN)	Compressive Strength (Mpa)	Average
1A	9.9	7	150	8.49	8.78
1B	10.3	7	145	8.21	
1C	9	7	175	9.62	
2A	9.9	14	195	11.04	10.66
2B	10.3	14	195	11.04	
2C	9	14	175	9.91	
3A	9.9	28	195	11.04	11.23
3B	10.3	28	210	11.89	
3C	9	28	190	10.76	

From table 2 it can be seen that the compressive strength of KM sand. 14 Sorong City experienced an increase in each increase in the compressive strength value, but the maximum compressive strength value of KM sand. 14 Sorong City has a fairly low value of 11.23 MPa, this is because the mud content of the sand used has a fairly high water content.

Tabel 3: Compressive Strength Results of Tobelo Sand Concrete

No Sampel	Slump (Cm)	Age of Concrete	P (kN)	Compressive Strength (Mpa)	Average
1A	8	7	175	9.91	11.13
1B	12	7	245	13.87	
1C	9	7	170	9.62	
2A	8	14	230	13.02	12.83
2B	12	14	230	13.02	
2C	9	14	220	12.46	
3A	8	28	230	13.02	13.78
3B	12	28	245	13.87	
3C	9	28	255	14.44	

From table 3 it can be seen that the compressive strength of Tobelo sand has increased in each increase from the compressive strength value, but the maximum compressive strength value of KM sand. 14 Sorong City has a fairly low value of 13.78 MPa, this is because the

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mud content of the sand used has a mud content that exceeds the allowable requirement of 5% [4].

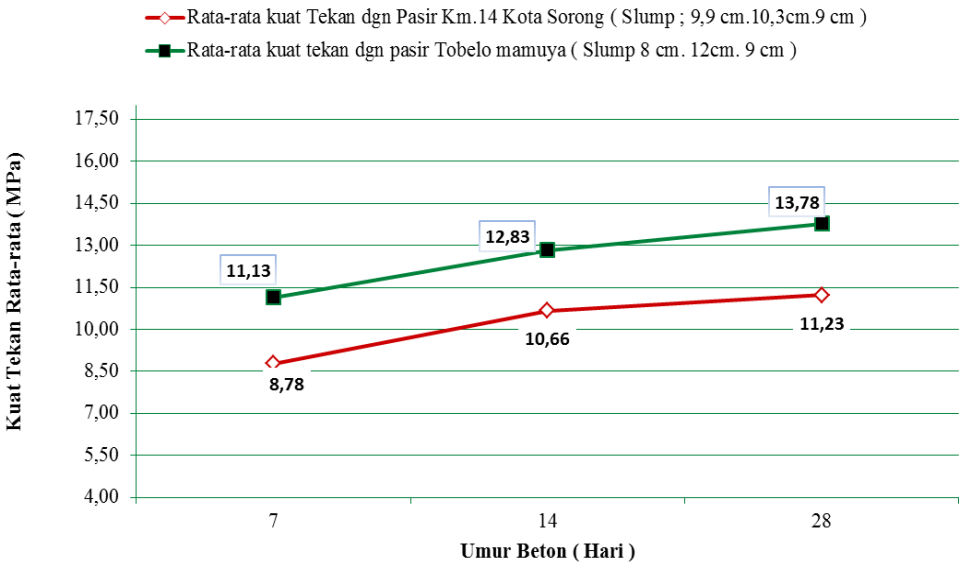

Figure 5: The results of the comparison of the average compressive strength of concrete with quarry sand km.14 sorong city and quarry sand Tobelo mamuya.

From figure 5 shows that concrete with Tobelo sand quarry material on average has better compressive strength compared to sand material Km.14 Sorong City. This is due to the mud content of KM sand. 14 higher compared to Tobelo sand. However, the compressive strength value of these two samples is also still in the category of low quality concrete because both sands have mud content above 5% [4] from these results, it can be concluded that the mud content has a significant influence on compressive strength [1],[12] .

3.4. Stress - Strain Relationship of Concrete

From compressive strength testing and strain testing will then be processed to further see the effect of concrete compressive strength value on concrete strain, here is the stress – strain relationship curve of KM sand. 14 Sorong City and Tobelo sand:

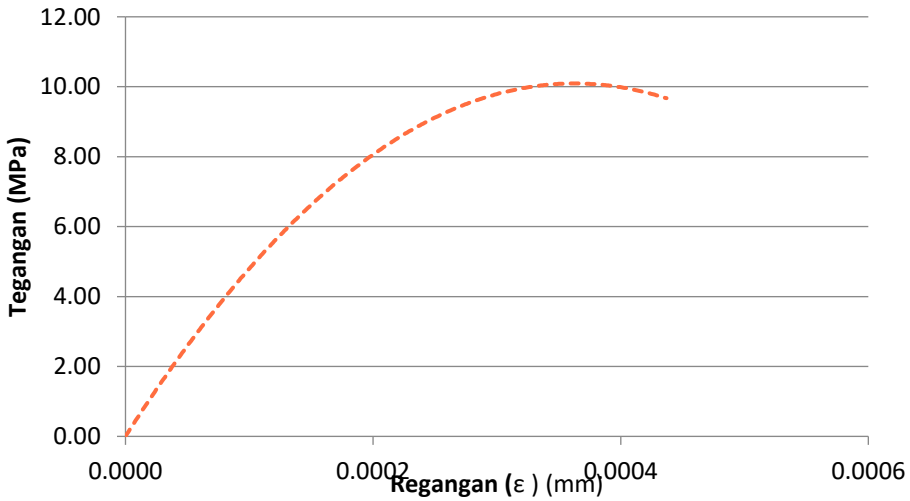

Figure 6: Sand strain stress curve KM. 14 Sorong City

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From figure 6 it can be seen that the strain value of concrete will continue to rise in line with the increasing stress of the concrete. And the strain increase will start low when the concrete collapses.

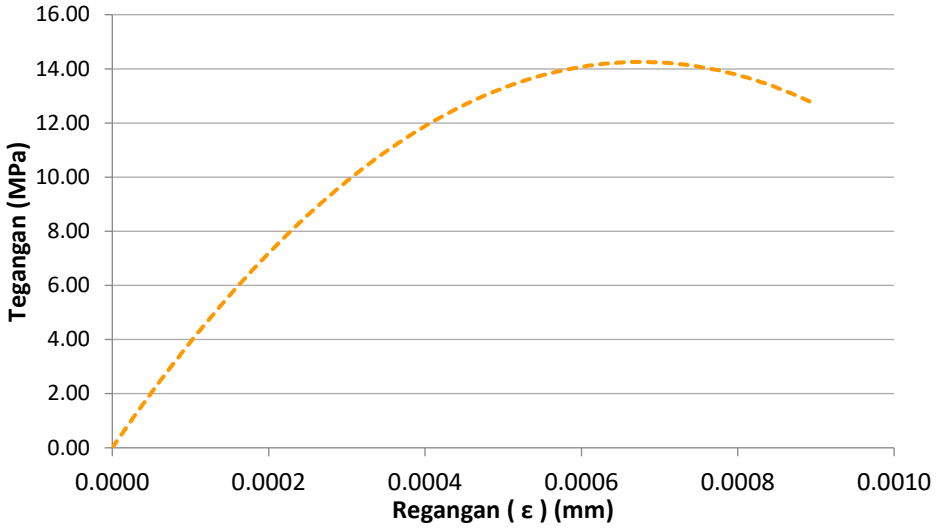

Figure 7: Tobelo Sand Strain Stress Curve

From figure 7 it can be seen that the strain value of concrete will continue to rise in line with the increasing stress of the concrete. And the strain increase will start low when the concrete collapses.

From figure 6 and figure 7, it can be seen that the higher the compressive strength or stress of the concrete, the strain value will also be higher, this is because the higher the quality of concrete, the better the ability to dormate.

CONCLUSION

From the results of compressive strength test research for all ages of concrete, it shows that the compressive strength of concrete using Mamuya Tobelo quarry sand is still higher than the compressive strength of concrete using quarry sand km.14 Sorong City, but overall the compressive strength results with two different types of sand materials all have low concrete quality. The factors that can affect the non-achievement of concrete quality according to plan are: this study uses normal conditions of materials from the field that still have high mud levels above 5%, namely sand km 14 Sorong City with a mud content of 8.90%, tobelo mamuya sand of 6.09% and crushed stone 1/2 PII Saoka of 5.49%. In addition, based on concrete strain testing, it can be seen that the higher the compressive strength or stress of the concrete, the strain value will also be higher, this is because the higher the quality of concrete, the better the ability to dormate.

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