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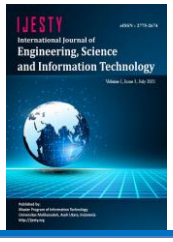

Analysis Of Use Sea Sand as A Fine Aggregate Replacement To Strong Press Concrete

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Abstract

Concrete is a composite building material made from a combination of aggregate and cement. The limitation of concrete material, in this case, is a fine aggregate (river sand). The utilization of sea sand as an alternative to fine aggregate in the manufacture of concrete is motivated by the availability of sea sand in nature in very large quantities. This study aims to determine the comparison and how much the compressive strength of concrete produced when using sea sand. The test was carried out when the specimens were 7, 14, and 28 days old with the specimens used in this study were concrete cylinders with a diameter of 15 cm and a height of 30 cm. The results showed that the use of sea sand as a substitute for fine aggregate showed an average compressive strength in 7 days of 18.86 MPa, an average compressive strength of 14 days of 25.52 MPa, an average compressive strength of 28 days of 29.00 MPa. Then for the average compressive strength value of the use of river sand in 7 days is 17.17 MPa, the average compressive strength of 14 days is 23.24 MPa, the average compressive strength of 28 days is 26.41 MPa.

Keywords: *Concrete, Compressive Strength, Sea Sand, Fine Aggregate.*

1. Introduction

Sea sand generally has the characteristics of fine and round granules, which are uniform and contain salts that are not beneficial for concrete, so many are advised not to be used in making concrete. Smooth and round granules and uniform gradation, can reduce adhesion and affect the strength and durability of concrete. However, people who live on the coast still use sea sand as one of the fine aggregates on concrete for reasons easy to obtain [1] [2].
Sea sand is a material used as a substitute for ordinary sand for a mixture of cement, fine or coarse aggregate and water, with the mixture when poured into a mold and then allowed to stand hard. By using sea sand, the most important thing is the compressive strength of the concrete [3]. Factors that influence the compressive strength of concrete consist of the quality of the material, cement water, aggregates, how to process it such as mixing, compaction, and age of the test. Concrete is a result of mixing cement, water, fine aggregate, and coarse aggregate. Aggregate is the most important concrete component, which functions as a filler in a concrete mixture [4] [5].
Looking at several kinds of natural materials that can be used for making concrete, substituting or mixing concrete making such as sea sand are often found in various regions, especially Indonesia. And to utilize sea sand which so far has not been much used so as a researcher wants to test how strong the compressive strength of concrete using sea sand.
This research is to provide information about the use of sea sand as a substitute for river sand and also to predict the strength of concrete, as well as new breakthroughs in the world of civil engineering that are still needed [6].

2. Literature Review

2.1. Concrete

Concrete (concrete) is the main construction material most widely used besides steel. Concrete is obtained by mixing cement, fine and coarse aggregates, and water by a certain ratio. If the mixture is mixed and poured into a mold and then left, a hardening process will occur. The hardening process occurs because of the continuous chemical reaction between water and cement [7] [8].

2.2. Sea Sand Instead of Fine Aggregate

Sea sand is sand taken from the shores of the beach, the shape of the grains are smooth and round due to friction with each other [9]. This sand is bad because it contains a lot of salt. This salt absorbs water content from the air and causes the sand to always be rather wet and cause volume expansion when used on buildings. However, sea sand can be used in concrete mixtures with special treatment, that is by washing it so that the salt content is reduced or lost. Quality characteristics of fine aggregate used as concrete structural components play

an important role in determining the quality characteristics of concrete structures produced because fine aggregates fill most of the concrete volume. Sea sand as one type of fine aggregate material has availability in large quantities [10].

2.3. Concrete Compressive Strength

Concrete compressive strength is the magnitude of the broad unity load that causes the concrete test specimen to disintegrate when it is burdened with a certain compressive force, which is produced by a press machine [11]. Based on the compressive strength of concrete can be divided into several types which can be seen in Table 1

Table 1. Several types of concrete according to compressive strength

Concrete type	Compressive Strength (MPa)
Simple concrete	Up to 10 Mpa
Normal concrete	15-30 Mpa
Pre-tensioned concrete	30 -40 Mpa
Concrete high compressive strength	40 -80 Mpa
Concrete compressive strength is very high	> 80 Mpa

To calculate the compressive strength of concrete, a formula can be used:

$$fc' = \frac{P}{A} \quad \text{.....(1)}$$

Description:
fc ' = Compressive strength
P = maximum load (kg)
A = cross-sectional area of test specimens (cm^2)

3. Methods

The method used in this study is experimental, an experiment that aims to investigate the compressive strength of concrete by using sea sand instead of fine aggregate. The specimens made in this experiment were concrete cylinders with a diameter of 15 cm and a height of 30 cm. Compressive strength testing is performed after the concrete is 7, 21, and 28 days old.

4. Result and Discussion

4.1. Aggregate Test Results

1. SSD Fine Aggregate Specific Gravity
   In testing this fine aggregate specific gravity obtained data as follows:

Table 2. Testing the SSD Fine Aggregate Specific Gravity

Fine aggregate	Weight W (gram)	Volume ΔV (ml)	Specific gravity $= \frac{W}{\Delta V}$ (gram / ml)
River sand	100	74	1.35
	100	71	1,4
	100	69	1.45
	Average (gram / ml)		1,4
Sea sand	100	67	1.5
	100	71	1,4
	100	69	1.45
	Average (gram / ml)		1.45

2. Testing of Fine Aggregate Water Content
   In testing the fine aggregate moisture content obtained the following data:

Table 3. Testing of Fine Aggregate Water Content

Fine aggregate	Initial weight A (grams)	Dry Weight B (gram)	Water content $= \frac{A-B}{B}$ x 100 (%)
River sand	100	96.39	3,750
	100	97.23	2,850
	100	95.75	4,440
	Average (%)		3,680
Sea sand	100	97.80	2,250
	100	98.15	1,885
	100	98.50	1,520
	Average (%)		1,885

3. Testing of Fine Aggregate Mud Content
   In testing the fine aggregate sludge levels the following data were obtained:

Table 4. Testing of Fine Aggregate Mud Content

Fine aggregate	Weight of oven dry aggregate A (gram)	Weight of oven dry aggregate after washing B (gram)	Sludge levels $\frac{A-B}{B}$ x 100 (%)	Specification <5%
River sand	96.39	93.25	3,367	OK
	97.23	93.45	4,044	OK
	95.75	92.55	3,457	OK
	Average (%)		3,622	OK
Sea sand	97.80	95.50	2,408	OK
	98.15	96.75	1,447	OK
	98.50	96.70	1,861	OK
	Average (%)		1,905	OK

4. Gross Rough Aggregate SSD
   In this rough aggregate specific gravity test the following data are obtained:

Table 5. SSD Gross Aggregate Specific Gravity Testing

Rough aggregate	Weight W (gram)	Volume ΔV (ml)	Specific gravity $= \frac{W}{\Delta V}$ (gram / ml)
Gravel	100	83	1.20
	100	70	1.42
	100	70	1.42
	Average (gram / ml)		1.35

5. Rough Aggregate Moisture Test
   In testing the rough aggregate water content, the following data are obtained

Table 6. Testing of Coarse Aggregate Water Content

Rough aggregate	Initial weight A (grams)	Dry Weight B (gram)	Water content $= \frac{A-B}{B}$ x 100 (%)
Gravel	200	198	1.01
	200	195	2.56
	200	197	1.52
	Average (%)		1.70

6. Testing of Rough Aggregate Mud Content
   In testing this coarse mud aggregate content obtained data as follows:

Table 7. Testing of Rough Aggregate Mud Content

Rough Aggregate	Weight of oven dry aggregate A (gram)	Weight of oven dry aggregate after washing B (gram)	Sludge levels $\frac{A-B}{B}$ x 100 (%)	Specification <5%
Gravel	198	196.5	0.763	OK
	195	194	0.515	OK
	197	195	1,025	OK
	Average (%)		0.767	OK

4.2. Concrete Test Results

1. Compressive Strength Test Results
   In compressive strength testing at the age of 3-day test specimens obtained the following data:

Table 8. Compressive Strength Test Results

No	Test Objects	Age day	Force Press (kN)		Compressive Strength (N / mm2)	
			River Sand	Sea Sand	River Sand	Sea Sand
1	I	3	200	190	11.32	10.75
2	II	3	185	205	10.47	11.60
3	III	3	175	220	9.90	12.45

2. Concrete Age Conversion Data Results
   The results of compressive strength testing on the age of the test object 3 days later carried out the conversion of the concrete age to get the compressive strength data based on the variation in age to be achieved. Conversion data sought is in the form of 7-day, 14-day, and 28-day test specimens. From the conversion results we get the following data:

Table 9. Test Object Conversion Results 3 Days to 7 Days

No	Test Objects	Age day	Force Press (kN)		Compressive Strength (N / mm2)	
			River Sand	Sea Sand	River Sand	Sea Sand
1	I	7	325	309	18.39	17.49
2	II	7	301	333	17.01	18.84
3	III	7	284	358	16.09	20.26

Table 10. Test Object Conversion Results 3 Days to 14 Days

No	Test Objects	Age day	Force Press (kN)		Compressive Strength (N / mm2)	
			River Sand	Sea Sand	River Sand	Sea Sand
1	I	14	440	418	24.90	23.65
2	II	14	407	451	23.03	25.52
3	III	14	385	484	21.79	27.39

Table 11. Test Object Conversion Results 3 Days to 28 Days

No	Test Objects	Age day	Force Press (kN)		Compressive Strength (N / mm2)	
			River Sand	Sea Sand	River Sand	Sea Sand
1	I	28	500	475	28.29	26.88
2	II	28	463	513	26.17	29.00
3	III	28	438	550	24.76	31.12

3. Results of Average Compressive Strength by Age

From the compressive strength results that have been obtained, the average compressive strength of each age is as follows:

Table 12. Results of Average Compressive Strength by Age

No	Age day	Average Compressive Strength (N / mm2)	
		River Sand	Sea Sand
1	7	17.17	18.86
2	14	23.24	25.52
3	28	26.41	29.00

4.3. Discussion

1. Comparison of Concrete Compressive Strength

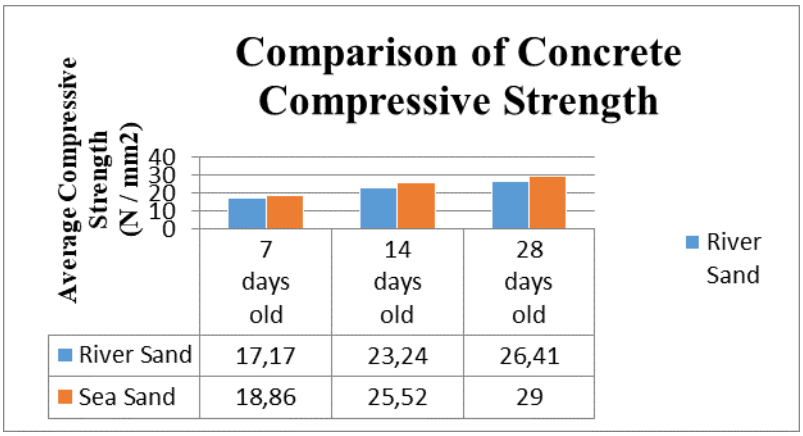

Fig 1. Comparison of Concrete Compressive Strength

Concrete compressive strength testing is done to see whether the concrete has a strength that meets planned requirements. In concrete cylinders using river sand at the age of 7 days, the average compressive strength of concrete is 17.17 MPa, age of 14 days the average compressive strength of concrete is 23.24 MPa and the age of 28 the average compressive strength of concrete is 26.41 MPa. Concrete cylinders using sea sand at the age of 7 days the average compressive strength of concrete was 18.86 MPa, age of 14 days the average compressive strength of concrete was 25.52 Mpa, and the age of 28 days the compressive strength of concrete was 29.00 MPa.

The test data shows that the strength of concrete made using sea sand has an average compressive strength that is relatively higher than that of concrete made using river sand.

Based on the compressive strength of concrete can be divided into several types:

Table 13. Some Types of Concrete According to its compressive strength

Concrete type	Compressive Strength (MPa)
Simple concrete	Up to 10 Mpa
Normal concrete	15-30 Mpa
Pre-tensioned concrete	30 -40 Mpa
Concrete high compressive strength	40 -80 Mpa
Concrete compressive strength is very high	> 80 Mpa

From the results of the concrete compressive strength test, the strength of the concrete ranges between 17-29 MPa. Judging from the table above, the concrete can be used for normal types of concrete.

2. Concrete Quality

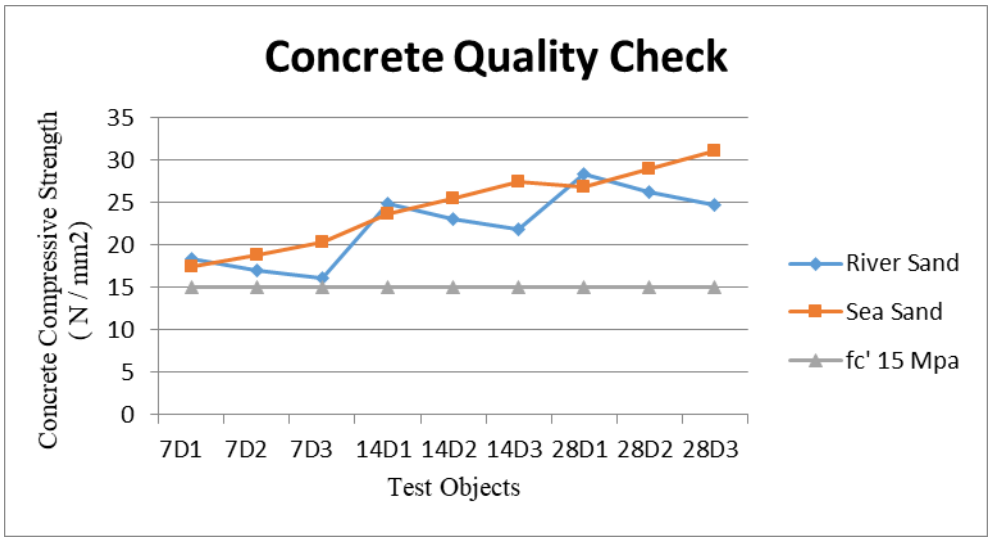

Fig 2. Concrete Quality Check

From the graph above, the quality of concrete is considered to meet the requirements (quality is achieved). The value of the compressive strength test results is based on variations in the age of 7 days, 14 days, and 28 days consisting of 3 specimens each, not less than the compressive strength of concrete required, namely fc '15 Mpa.

5. Conclusion

Based on the results of research and discussion on the use of sea sand as a substitute for fine aggregate against concrete compressive strength as well as a comparison of concrete compressive strength using sea sand and river sand can be drawn several conclusions as follows:

1. Sea sand can be used as a smooth aggregate substitute because the sea sand has a smooth and rounded texture which is great for concrete constituent materials. For a strong value of its own pace is greater than the use of river sand with a mixture of the same concrete quality.
2. The data value of the test results showed that the strength of concrete made by using sea sand has strong press averages which are relatively higher than in concrete made by using river sand.
3. The ratio of strong press concrete by using river sand at 7 days is 17.17 Mpa, 14 days at 23.24 Mpa, and age 28 for 26.41 MPa. While the strong value of concrete press by using sea sand at 7 days of 18.86 Mpa, 14 day age of 25.52 Mpa, and 28 day age of 29.00 MPa.

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