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Ratio of Compressive Strength to Split Tensile Strength of Sea Sand and Sea Water Concrete Using Propane Additive Concrete

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Abstract
The need for concrete materials in construction is increasing, especially in coastal areas that often require concrete with special characteristics to deal with maritime environmental conditions; one of the challenges in development in the region is the limited availability of fresh water, so the use of seawater as an alternative in mixing concrete is a potential choice. In addition, abundant sea sand is also considered an economical fine aggregate material. The purpose of this study was to determine the effect of additives on the ratio of compressive strength and splitting tensile strength of concrete using sand and seawater as basic materials. This research method uses an experimental research method, namely by comparing normal concrete with Additive concrete to find out how the compressive strength and splitting tensile strength of concrete are. The results of the study showed that the compressive strength and splitting tensile strength test of normal concrete with additives, the results of the concrete compressive strength test at the age of 7 days increased by 16.84 Mpa, the age of 14 days by 8.93 Mpa, while the age of 28 days increased to 6.28 Mpa. In the splitting tensile strength test, concrete also experienced an increase at the age of 28 days by 0.400 MPa of normal concrete with an average of 22.64 MPa. So it can be concluded that concrete using additives reaches the planned compressive strength and splitting tensile strength and is suitable for use.
Keywords: *compressive strength, split tensile strength, additives*

Abstrak

Kebutuhan akan material beton dalam konstruksi yang semakin meningkat terutama pada wilayah pesisir yang sering mmbutuhkan beton dengan karakteristik khusus untuk menghadapai kondidi lingkungan maritime;salah satu tantangan dalam pembangunan diwilayah tersebut adalah ketersediaan air tawar yang terbatas ,sehingga pemanfaatan air laut sebagai alternative dalam pencampuran beton menjadi pilihan yang potensial.Selain itu pasir laut juga yang melimpah dianggap sebagai material agregat halus yang ekonomis. Tujuan dari penelitian ini adalah mengetahui pengaruh bahan tambah terhadap rasio kuat tekan dan tarik belah beton yang menggunakan pasir dan air laut sebagai material dasar. Metode penelitian ini menggunakan metode penelitian eksperimental yaitu dengan membandingkan antara beton normal dengan beton Additive mengetahui bagaimana kuat tekan dan tarik belah beton.
Hasil penelitian menunjukkan bahwa pengujian kuat tekan dan tarik belah beton normal dengan bahan tambah , maka didapatkan hasil pengujian kuat tekan beton pada umur 7 hari mengalami peningkatan sebesar 16,84 Mpa,umur 14 hari sebesar 8,93 Mpa,sedangkan umur 28 hari meningkat menjadi 6,28 Mpa. pada pengujian kuat tarik belah beton juga mengalami peningkatan diumur 28 hari sebesar 0,400 mpabeton normal dengan rata-rata 22,64 MPa.. Maka dapat disimpulkan beton dengan menggunakan bahan tambah additive mencapai kuat tekan dan kuat tarik belah rencana dan layak digunakan.
Kata Kunci: *kuat tekan,kuat tarik belah,Bahan Tambah (Additive).*

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1. Introduction

Concrete is one of the most widely exploited building materials worldwide. In recent decades, the utilization of concrete has increased substantially, leading to an increase in the demand for raw materials, such as fresh water and river sand. The exploitation of important resources such as river sand has caused serious environmental problems. Great efforts have been made to find new, non-traditional materials and recycled waste materials to compensate for the shortage of natural fine aggregates. Researchers in the field of construction materials have focused on the utilization of alternatives to fine aggregates. [1]. The need for concrete materials in construction is increasing, especially in coastal areas that often require concrete with special characteristics to deal with maritime environmental conditions. One of the challenges in development in this area is the limited availability of fresh water, so the use of seawater as an alternative in mixing concrete is a potential choice. In addition, abundant sea sand is also considered an economical fine aggregate material, although its salt content often affects the resistance of concrete to corrosion and cracking. [2]

Concrete additive Propan has become one of the most researched additives due to its ability to increase the compressive strength and splitting tensile strength of concrete. The addition of this additive can improve the cement hydration process and increase the compactness of the concrete structure, which ultimately increases the strength and resistance of concrete to the maritime environment. According to several studies, the use of additives in seawater-based concrete can strengthen the bonds between cement particles and reduce the negative effects of salt on sand and seawater. [3]. This study aims to examine the effect of concrete additive Propan on the ratio of compressive strength and splitting tensile strength of concrete using sand and seawater as basic materials. Through this study, it is expected to provide alternative solutions in utilizing local natural resources in the coastal area of Lumpue, Pare-Pare City, by improving the quality and strength of concrete through the use of additives.

2. Material and Methods

Types of research

The type of research used in this study is quantitative research which is a research method that requires a lot of use of numbers, starting from data collection, interpretation of the data, and the appearance of the results accompanied by images, tables, or graphs. Then the research data is analyzed according to laboratory testing procedures. This research method uses an experimental research method, namely by comparing the compressive strength of concrete and the splitting tensile strength of concrete. [4]. [5]

Place and Time of Research

The place of the test object manufacturing, maintenance, and testing was carried out in the Civil Engineering laboratory of the Faculty of Engineering, Muhammadiyah University of Parepare and the research period was carried out for 3 months starting from October to December 2024..

Data collection technique

1) Primary data Data obtained through experiments at the Civil Engineering Structure and Materials Laboratory, Muhammadiyah University of Parepare. This study focuses on Additive Concrete which will be used as an additional material. The number of samples needed for each variation a: [6]
   a. Normal Concrete 12 pieces
   b. Concrete using Concrete additive Propan 12 pieces

Table 1 . Normal Concrete Sample Quantity

No.	Type of testing	Concreteage(days) 7	14	28
1	compressive strength	3	3	3
2	splitting tensile strength	-	-	3
	Amount			12

Table 2 . Concrete using Concrete additive Propan Sample Quantity

No.	Type of testing	Concreteage(days) 7	14	28
1	compressive strength	3	3	3
2	splitting tensile strength	-	-	3
	Amount			12

a. Aggregate specific gravity check

The following are the calculations used to determine the specific gravity of aggregate:

1. *Bulk Specify Gravity* $= \frac{Bk}{(Bj-Ba)}$ .... (2)
2. SSD specific gravity $= \frac{Bk}{(Bj-Ba)}$ .... (3)
3. Apparent specific gravity $= \frac{Bk}{(Bk-Ba)}$ .... (4)
4. Absorption $= \frac{(Bj-Bk)}{Bk} x\ 100\ \%$ .... (5)

Where :
Bk = Oven dry test object weight (grams)
Bj = Weight of saturated surface dry test object (grams)
Ba = Weight of dry surface test object saturated in water (grams)

b. Estimated aggregate content

To determine the weight of coarse aggregate used, you can use the following formula:

$$W = V\ x\ SSD \text{..........................} (6)$$

Where :
W = Coarse aggregate weight
V = Coarse aggregate volume
SSD = Surface specific gravity of coarse aggregate

c. *Data analysis techniques*

The data analysis technique used in this study uses descriptive parametric analysis. The concrete compressive strength test data is obtained from the division of the maximum load of the test object by the cross-sectional area of the test object, then the data will be presented in the form of a table or graph. The steps taken are as follows: [7]

1. Weigh the weight of the test object before testing is carried out.
2. Place the test object on the Universal Testing Machine.
3. Turn on the Universal Testing Machine and the test object will experience an additional load so that the compressive strength indicated by the manometer can be read.
4. The test object will crack if the load given has reached the maximum limit of the load that the test object can withstand. When it cracks, the manometer needle will stop at the maximum point that the test object can withstand.

3. Results and Discussion

Aggregate Test Results

Aggregate testing based on SNI (Indonesian National Standard) is carried out on coarse aggregates and fine aggregates. The recapitulation results of each test are shown in the table below. [8]

a. Coarse Aggregate .[9]

Table 3. Summary of coarse aggregate test results

(Source: Data Processing Results, 2024)

NO.	AGGREGATE CHARACTERISTICS	INTERVALS	OBSERVATION RESULTS		AVERAGE VALUE	DESCRIPTION
			I	II		
1	Mud Content	Maks 1 %	1,1%	0,90%	1,00%	Meets
2	Wear	Maks 50%	10,9%	10,8%	10,9%	Meets
3	Water Content	0,5% - 2%	1,32%	2,56%	1,94%	Meets
4	Volume Weight					
	a. Loose condition	1,6 - 1,9 kg/liter	1,80	1,85	1,83	Meets
	b. Solid condition	1,6 - 1,9 kg/liter	2,00	1,95	1,97	Meets
5	Absorption	Maks 4%	2,46%	1,01%	1,73%	Meets
6	Specific gravity					
	a. Sg Real	1,6 - 3,3	3,11	3,11	3,11	Meets
	b. Sg Dry basis	1,6 - 3,3	2,89	2,89	2,89	Meets
	c. Sg. Surface dry	1,6 - 3,3	2,96	2,96	2,96	Meets
7	Finenes Modulus	6,0- 8,0	7,67	7,40	7,54	Meets

b. Fine aggregate .[10]

Table 4 .Fine aggregate test results summary
(Source: Data Processing Results, 2024)

NO.	AGGREGATE CHARACTERISTICS	INTERVALS	OBSERVATION RESULTS		AVERAGE VALUE	DESCRIPTION
			I	II		
1	Mud Content	Maks 5 %	4,2%	3,6%	3,90%	Meets
2	Organic Content	<No.3	NO.1	NO.1	1	Meets
3	Water Content	2% - 5%	3,09%	3,95%	3,52%	Meets
4	Volume Weight					
	a. Loose condition	1,4 - 1,9 kg/liter	1,38	1,51	1,45	Meets
	b. Solid condition	1,4 - 1,9 kg/liter	1,89	1,90	1,89	Meets
5	Absorption	0,2%-2 %	1,01%	1,83%	1,42%	Meets
6	Specific gravity					
	a. Sg Real	1,6 - 3,3	2,25	2,38	2,32	Meets
	b. Sg Dry basis	1,6 - 3,3	2,20	2,28	2,24	Meets
	c. Sg. Surface dry	1,6 - 3,3	2,22	2,33	2,27	Meets
7	Finenes Modulus	1,50-3,80	3,31	3,28	3,29	Meets

c. Concrete Mix Design

Concrete mix planning is calculated using the SNI 7656:2012 method with the following data results [6].:

Table 5. Material Requirements for Making Concrete Cylinder Test Objects
(Source: Data Processing Results, 2024)

	individual cubic concrete needs		requirement per concrete cylinder		9 cylinder requirement	
weight of cement	411,78	kg	2,51	kg	22,59	kg
weight of sand	633,61	kg	3,86	kg	34,77	kg
weight of gravel	1101,61	kg	6,72	kg	60,44	kg
weight of water	203,00	kg	1,24	kg	11,14	kg

Correction of Water Content

Testing of water content on materials is carried out before the mixing process for water content testing can be seen in SNI 03-1971-19990. [11]

For example, the water content obtained:

Coarse Aggregate = 1.94%

Fine Aggregate = 3.52%

So the weight of the adjustment mass based on water content is:

Coarse Aggregate (Wet) = 1.94% x 1101.61 = 21.378 kg

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Fine Aggregate (Wet) = 3.52% x 633.610 = 22.312 kg

The absorbed water does not become part of the mixing water and must be removed from the adjustment in the added water, then:

Water given Coarse aggregate = 1.42% x 1101.61 = 15.660 kg

Water given Fine aggregate = 2.25% x 633.610 = 14.256 kg

Thus the water requirement is as follows:

203.0 – 43.6 90 + 29.916 = 189.225 kg

So the estimate for 1 m3 of concrete is as follows:

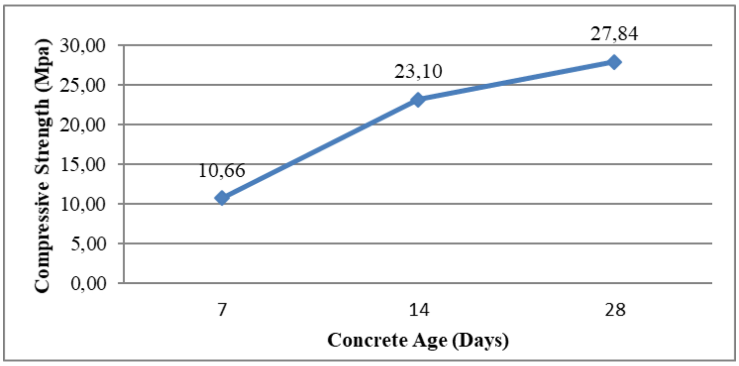
Water (added) = 189.225 kg

d. Compressive strength. [12]

Based on the research results, the average compressive strength of ordinary concrete measured after 7, 14, and 28 days is as follows:

1. Normal Concrete

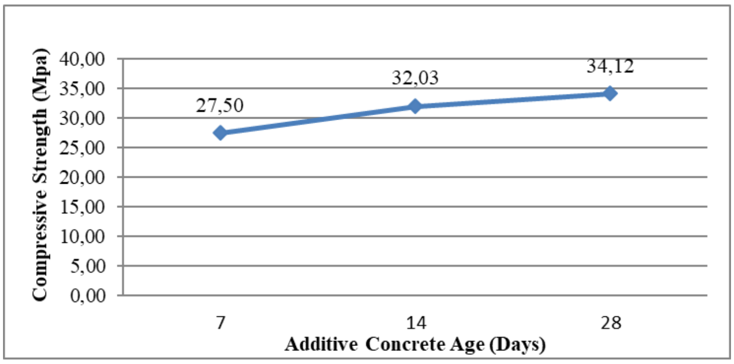
Figure 1. Normal concrete compressive strength test graph
(Source: Data Processing Results, 2024)



In the graph above, it can be explained that normal concrete experiences an increase in compressive strength from 7 days to 14 days of 12.44 MPa, while from 14 days to 28 days, the compressive strength increases by 4.74 MPa.

2. Concrete Additives

Figure 2 Additive concrete compressive strength test graph
(Source: Data Processing Results, 2024)



In the graph above, it can be explained that normal concrete experiences an increase in compressive strength from 7 days to 14 days of 4.53 MPa, while from 14 days to 28 days, the compressive strength increases by 2.09 MPa.

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e. Splitting tensile strength. [13]

1. Normal Concrete

Figure 3. Normal concrete tensile strength test chart
(Source: Data Processing Results, 2024)

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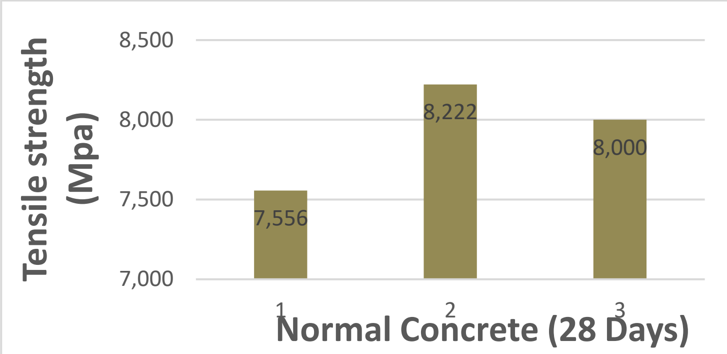
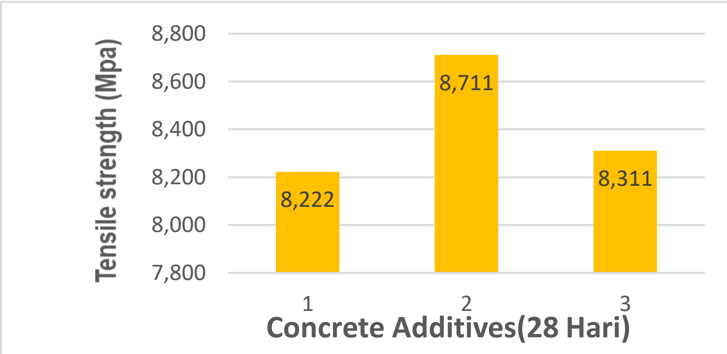


In the graph above, it can be explained that in normal concrete there is an increase from sample A to sample B of 0.666 Mpa, while from sample B to sample C there is a decrease of 0.222 Mpa..

2. Concrete Additives

Figure 4. Concrete tensile strength test graph Additive
(Source: Data Processing Results, 2024)

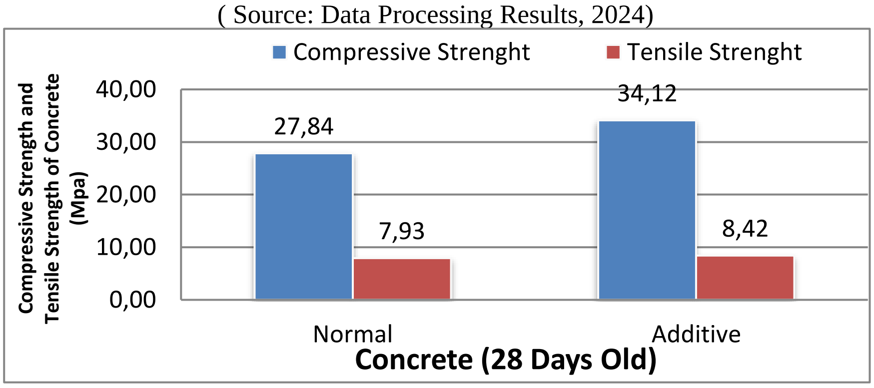


In the graph above, it can be explained that in normal concrete there is an increase from sample A to sample B of 0.491 Mpa, while from sample B to sample C there is a decrease of 0.4 Mpa.

f. Combined Compressive Strength & Splitting Tensile Strength of Concrete

After conducting the process of testing the compressive strength and splitting tensile strength of concrete, the next step is to combine the compressive strength and splitting tensile strength of concrete. The results of the compressive strength and splitting tensile strength tests of normal concrete and Additive concrete with a curing age of 28 days are as follows: [14]

Figure 5. Combined graph of compressive and tensile strength testing of Normal and Additive concrete
(Source: Data Processing Results, 2024)



Based on the analysis results, Panca Lautang District, Watang Pulu District, Baranti District, Panca Rijang District, Kulo District, Maritengngae District, Dua Pitue District and Pitu Riawa District have fulfilled the mobility aspect of the road network, and Tellu Limpoe District, Watang Sidenreng District and Pitu Riase District have not fulfilled the mobility aspect.

4. Conclusion

From the research results discussed above, the following conclusions can be drawn:

From the research that has been done, the effect of sand and sea water on the compressive and splitting tensile strength of concrete on cylindrical test objects has a low value, this is because sand and sea water contain salts that are not suitable for concrete. However, in concrete that uses Concrete Additive Propan, the compressive and splitting tensile strength values will increase. This is thanks to the presence of Concrete Additive Propan which can improve the quality of concrete.

5. Acknowledgment
The authors would like to thank colleagues from the University of Muhammadiyah Parepare Indonesia who have provided insights and expertise that have greatly assisted this research, although they may not agree with all the interpretations/conclusions in this paper.

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