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The Effect Of Seawater Use On Concrete Mixtures With Variations In Semen Water Factor

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Abstrak

The purpose in this study was to know the characteristic properties of fine aggregate materials and rough aggregates derived from Badene Village batauga sub-district as well as to know the strong press produced by concrete against seawater mixture with variations of cement water factor. In this study the material was mixed using laur water and fresh water with variations in cement water factor which is 0.45, 0.50, and 0.55. Testing is carried out at the age of concrete 3 days, 7 days and 28 days, using the dimensions of the slinder test object 15 cm x 30 cm. The total number of test objects is 54 pieces. The stronger the concrete press by using seawater as a concrete mixture can increase the strong press of concrete when compared to fresh water, as well as the smaller the value of the cement water factor used then the greater the strong value of the press. Strong press concrete with seawater mixture using cement water factor 0.55, 0.50, and 0.45 at age 28 days produce strong concrete presses respectively 15.82 MPa, 18.65 MPa, and 20.85 MPa, while strong concrete press with freshwater mixture using cement water factor 0.55, 0.50, and 0.45 at 28 days old produce strong concrete press 15.70 MPa respectively 18.40 MPa and 20.00 MPa. The results showed the influence of seawater use on concrete mixtures can increase the strength of the press compared to the use of concrete mixtures using fresh water.

Keywords: Concrete, Fine Aggregate (Sand), Rough Aggregate (Gravel), Seawater, Strong

1. Introduction

The use of concrete as construction material has long been known in Indonesia. One of the main ingredients which is used in building construction. Concrete is a kind of material formed by mixturing cement, fine aggregate, coarse aggregate, water and another variety of materials.

The important material needed to produce concreate is water. In the current phenomenon, the need of water as the main terms in making concreate has begun decrease, especially in big cities or in developed countries where clean water is prioritized only on primary needs. In the world of civil engineering, especially in developed countries, they thought about the challenges ahead of reducing the potential for clean water (fresh water) which can be used as a material for concrete mixtures, especially as infrastructure development is increasing along with the increasing use of clean water.

Morover, the data from United Nations and World Meteorological Organization predict that around 5 billion of people will lack clean water and even drinking water (Source: Conference on Our World in Concrete and Structure in Singapore). (Nobuaki Otsuki et al, 2011) also said that about 2025 half of humanity stay in areas that lack of clean water (fresh water).

Nowadays, majority people of Indonesia still fullfiled with the fresh water for their daily need, but another side islands still isolated from fresh water or have difficulty obtaining fresh water, so that the distillation process is carried out to obtain fresh water. To reduce this process, in terms of concrete construction, it is better to consider using sea water as the alternative material of concreate. Seawater contains a lot of salt, so it is important to know the effect of using seawater on the nature and performance of concrete.

2. Theory Of Literature

Definition of Concrete

Concrete is the mixture of Portland cement or other hydraulic cement, smooth aggregate, coarse aggregate and water, with or without additives that form solid mass (SNI-03-2847-2002). Along the time, concrete will be increasingly hardened and will reach the strength of the plan (F'c) at the age of 28 days.

There are related previous research among entitled "Strong Experimental studies concrete press against variation addition of sodium chloride (Nacl)" by (Sanjaya, 2013). The aim of the study was exploring the stongest press of concreate when influenced by the addition of sodium chloride (NaCl) and without the addition of sodium chloride (Normal concrete). Results of the research showed that strong test of concrete press, modulus of elasticity can be seen that the more age then the greater the solid. Concrete with the addition of sodium chloride (NaCl) 2% and 5% larger in weight than without the addition of sodium chloride (NaCl) and the larger the weight, the greater the modulus elasticity. Based on the previous result,

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in this study will be discussed about the effect using sea water against concrete mixture with a variation of FAS toward the strong value of concrete press to be produced.

In general, there are some advantages and disadvantages of concrete as followed :

A. Advantages of concrete
1) can be easily formed according to the needs of construction
2) able to accomodate heavy load
3) resistant to high temperatures
4) Low maintenance costs.

B. Disadvantage of concrete
1) Formed pattenly
2) Implemented with high accuracy
3) Weight
4) Loud reflector power

1. Concrete constituent Materials

In understanding the concrete behavior, it is necessary to know about the characteristics of each component.

A. Portland Cement

The name of Portland Cemen proposed by Joseph Aspidin in 1824. Portland Cement was made through several steps, making it very subtle and has both adhesive and cohesive properties. The cement is produced by burning together a mixture of Cacareus (which contains calcium carbonate or limestone) and Argilaceous (which contains alumina) with a certain comparison. Portland cement content consists of: lime, silica, alumina. These three basic ingredients are mixed and burned at 15500 C and become clinker which is then smoothed into powder. Usually added casts or potassium sulfate (CaSO4) between 2 – 4% as a time-ignition binding material.

B. Aggregate

The aggregate for concrete mixing materials is the fine aggregate (sand) and coarse aggregate (gravel). Both can be obtained naturally or artificial (manual). Aggregates are derived from natural deposits such as sand and natural gravel or excavations. Natural sand is more economical as a source of deposit. The two aggregate types are as follows::

1). Fine Aggregate (natural sand)

The fine aggregate is a filler in the form of sand. The size varies between filter sizes No. 4 to No. 100 (American Standard screening). The requirements on aggregate proportions with the ideal gradation recommended are found in the ASTM C 33/03 "Standard Spesification for ConcreteAggregates" standard. How to distinguish the most widely used aggregate type is based on the size of the grain. The aggregate that has a large grain size is called a rough aggregate, being a small aggregated aggregate called a subtle aggregate. In general, coarse aggregate is referred to as gravel, Kericak, ruptured stone, or suplit. As for the fine aggregates are referred to as sand, either as natural sand obtained from rivers or landmines, or from the breakdown of stones.

2 Coarse Àgregat (gravel, ruptured stone, or fragments of blast furnance)

According to ASTM C 33-03 and ASTM C 125-06, crude aggregate is aggregated with a grain size greater than 4.75 mm

Table 1. Fine Aggregate Ideal Sieve Gradation

Diameter of filter (mm)	The pass Persentage (%)	Ideal Gradation (%)
9,5 mm	100	100
4,75 mm	95 – 100	97,5
2,36 mm	80 – 100	90
1,18 mm	50 – 85	67,5
600 µm	25 – 60	42,5
300 µm	5 – 30	17,5
150 µm	0 – 10	5

(Source: ASTM C 33/ 03)

Table 2. Rough Aggregate Ideal Sieve Gradation

DIAMETER FILTER (MM)	THE PASS PERCENT AGE (%)	IDEAL GRADATION (%)
25,00	100	100
19,00	90 -100	95
12,50	-	-
9,50	20 – 55	37,5
4,75	0 – 10	5
2,36	0 – 5	2,5

(Source: ASTM C 33/ 03)

3). Sea Water

Seawater is a mixture of 96.5% pure water and 3.5% other materials such as salty material, dissolved gases, organic materials and undissolved particles. Sea water is more salty because it has an average salt content of 3.5%. It means that in 1 liter of sea water (1000 ml) contains 35 grams of salt. Salt content in each sea is different from its contents. The most bargaining sea is to the east of the Gulf of Finland and to the north of Bothania Bay, both part of the Baltic Sea. The most salty sea is the Red Sea.

Sea water has its salt levels because the earth is filled with mineral salts contained in rocks and soils. Almost all oceans have a constant individual salt ratio, for example in the Atlantic Ocean, the ion concentration among others 2.00% of chloride, 0.28% of sulphate, sodium. The conditiona regarding coarse aggregate is as follows:

A) must consist of hard and unporous items.

b) Coarse aggregate grains must be permanent, meant that it is not rupture or destroyed by the influence of the weather, such as the sun and rain.

c) should not contain substances that can damage the concrete, such as substances that are relatively alkaline.
D) should not contain mud more than 1%. If the moisture level exceeds 1%, the rough aggregate should be washed
1.11%, magnesium 014%, calcium 0.05%, and potassium 0.04%. Seawater contains also some dissolved CO2.

The chemical reaction of sea water to concrete is caused by the content of a number of dissolved salt ions. Salt content or salinity of seawater typically ranges from 3.5%. The exception of the seas or oceans. The underlying ions contained in seawater are generally sodium, magnesium, chloride, and sulfate. These ions can damage the construction of the seawater environment in various ways.

3. Concrete mixed planning (MIX DESIGN)

There are several methods for planning a concrete mixture, such as the decrease of SK SNI T-15-1990-03 with the book title "Ordinance of Fertilized Normal concrete mixture Plan". The steps in the calculation of concrete planning by method are as follows :

a. Determination of strong Concrete press

Determination of strong concrete press based on concrete strength at 28 days. The formula used in calculating strong press averages is as follows**:**

$$f'cr = f'c + 1{,}64s \qquad ...(1)$$

where:

f'cr = the average strong flat concrete (kg/cm²)
f' c = press strongest (kg/cm²)
s = standard deviation (kg/cm²)
m = margin (kg/cm)

b. Determination of standard deviation value (S)
Determination of the standard deviation value based on two things, they are as follows:

1) The quality control of concrete mixing implementation. The smaller the standard value of the deviation is better control of concrete mixing.

Table 3 The standard deviation of quality work (kg/cm²)

Work Volume		Work Quality		
Size	**Unit (M3)**	**Very good**	**good**	**acceptable**
less	< 1000	45< S ≤ 55	55< S ≤ 65	65< S ≤ 85
Average	1000 – 3000	35< S ≤ 45	45< S ≤ 55	55< S ≤ 75
More	> 3000	25< S ≤ 35	35< S ≤ 45	45< S ≤ 65

(source : Book of Technology concrete, pg.161)

2) The greater volume of work (m3) result in a small standard deviation..

Tabel 4. Deviasi Standar (MPa)

Work quality control level	S (MPa)
Satisfied	2.8
Very good	3.5
Good	4.2
Average	5.6
Poor	7.0
Less control	8.4

(Source : Book of Technology concrete, pg.169)

c. The type of aggregate setting
Types of gravel and sand are set, whether it is a natural aggregate (not broken down) or an aggregate of the type of stone rupture.

d. Finding the cement factor (FAS)

In this study used FAS 0.5 taken from the table 8.11 terms FAS (Concrete technology book, Hal 169) obtained based on the type of unboned concrete, because on the graph obtained the value of a large water factor is 0.7 which is feared that will make a mixture of liquid or dilute concrete. The FAS used can be seen in table 5.

Table 5.the terms of FAS

Kind of concrete	Environment conition	FAS Maks
concrete reinforced custom	Light	0.65
	average	0.55
	heavy	0.45
Pra-tegang	Light	0.65
	average	0.55
	heavy	0.45
Unreinforced	Light	0.70
	average	0.60
	heavy	0.50

(Source : Book of Technology concrete,, pg.169)

e. Determination of Slump Value

Determination of slump based on concrete usage for certain types of construction see table 6, for this study the determination of slump is the use of concrete for the foundation construction type of the palm is not boned, and underground structures.

Table 6. Slump value assignment

No	The use of concrete	Maks	Min
1	wall, plat foundation, and telapak tulang foundation	12,5	5
2	telapak tidak bertulang foundation ,kaison, and underground structure	9	2,5

3	Plate, balok, coulumn, and wall	15	7,5
4	Paving	7,5	5,2
5	Mass concreting	7,5	2,5

(Source : PBI,1971)

f. Determination of Free Moisture Value

Table 7. Determination of Free Moisture Value

gravel size Maks. (mm)	gravel size	Slump (mm)			
		0-10	10-30	30-60	60-100
10	Alami	150	180	205	225
	Batu Pecah	180	205	230	250
20	Alami	135	160	180	195
	Batu Pecah	170	190	210	225
40	Alami	115	140	160	175
	Batu Pecah	155	175	190	205

(source :Book Technology concrete, pg:188)

g. Cement quantity Calculation

The rate or amount of cement can be calculated as follows :

$$\text{Level of concrete} = \frac{\text{Fas}}{\text{Free moisture content}}$$

h. Combined weight Determination

The combined weight is a combination of both the weight of the fine aggregate and the rough aggregate with the percentage of the aggregate mixture. The weight of the combined type can be calculated by formula:

$$Bjgab = \frac{(xa)}{100} * Bjxa + \frac{(xb)}{100} * Bjxb \quad ...(3)$$

where:

Bjgab = Aggregate combined type weight
Xa = % fine aggregate
Xb = % coarse aggrerate
Bjxa = weight of Sand SSD specific type
Bjxa = weight of Sand SSD glaze type

i. Determination of fresh concrete weight

Fresh concrete weights can be determined using graphs based on combined weight data and the need for stirring water for each cubic meter.

j. Correction of concrete mixture for implementation

Correction of concrete mixture for this implementation can use the following formula:

1) Sand field weight

$$BLp = \frac{BSSDP}{(1 + Rp) * (1 - Wp)} \quad ...(4)$$

where:

BSSDP = weight of sand (kg/m³)
Rp = Absorbsi of sand (%)
Wp = water level of sand (%)

2) The weight of gravel (BLk)

$$BLp = \frac{BSSDK}{(1 + Rk) * (1 - Wk)} \quad ...(5)$$

where:

BSSDP = weight of sand (kg/m³)
Rk = Absorbsi of sand (%)
Wp = water level of sand (%)

3) Heavy field Krikil

BLk= Wa + (BSSDp – BLp) + (BSSDk – BLk)... (6)

Where:

Wa = Free Moisture Content (kg/m³)

4. Strong Concrete Press

Strong concrete press is the magnitude of the wide unity burden that causes concrete test objects to be destroyed when saddled with a particular press force, produced by the Press machine (SNI 03-1974-1990). Concrete press force testing is carried out using a press machine. The maximum load mass will read in tonnes. Test objects are placed on the field of Machine press in a centric. The load is done slowly until the concrete is destroyed.

Strong concrete press of each test object can be calculated by

Formula:

$$f'c = P / A \quad ...(7)$$

Where:

f' c = Strong concrete press of each test object (kg/cm²).
P = heavy Maksimum (Kg).
A = Concrete press area or surface area (cm²).

The standard deviation is determined based on the level of implementation of the field. The better the quality of equipment, supervision and implementation of the standard deviation is increasingly small, and vice versa. This standard deviation further affects in the calculation of looking for strong value press averages.

Standard deviation can be calculated with formula:

$$S = \sqrt{\frac{\Sigma (f'c - f'cm}{n - 1}} \quad ...(8)$$

As for calculating the concrete press force characteristic:

$$f'ck = f'cm - (k \times s) \quad ...(9)$$

where :

f' cm = Strong press concrete of each test object (kg/cm²).
f' ck = Strong press concrete characteristics (kg/cm²).

n =Number of test objects.
S = Standard deviation
K = 1,64.

The shape and size of the test objects strongly affect the strong press of the resulting concrete. The standard form of test objects according to Indonesian national standard is cylinder diameter 150 mm and height 300 mm, but if for some reason can not make cylinder, then it can be used a side cube 150 mm. When used a 150 mm side cube, the test result strong should be multiplied by the correction factor of 0.83.

3. METODOLOGY OF RESEARCH

Research overview

The initial step of the study was the selection of research locations, i.e. determining the aggregate producing areas that would be sampled in this study. The effect of the use of sea water to concrete mixture with the aggregate that will be sampled in this research is for the fine aggregate (sand) and the rough Agrekat (gravel) from the subdistrict Batauga. Concrete mixing with sea water is often done by people who are in isolated location with clean water (fresh water), especially the islands, but not yet based on the certainty about how much quality of concrete produced from the influence of sea water usage to the concrete mixture.

Location and research time

A strong research on concrete press is conducted on the civil engineering of Universitas Dayanu Ikhsanuddin (UNIDAYAN), which is located on Jalan Dayanu Ikhsanuddin Baubau. The research began to be conducted on 11 June 2016 until completion.

Data Collection Techniques

Sampling for fine aggregate (sand) and coarse aggregate (gravel) is performed directly in the area or sand mining areas. This is done so that the samples taken are directly sourced from the location. The sample is then inserted into one place (sample sack) for the inspection of characteristic data and mix design. Location of fine aggregate material retrieval (sand) and gross aggregate (gravel) of times in subdistrict Batauga.

Research implementation

Methods of implementation of research are as follows: (a) Aggregate characteristics inspection, (b) Concrete inspection, (c)Treatment of test items

4. RESULTS OF RESEARCH AND DISCUSSION

Characteristics of fine aggregate Material

Test result characteristics of the results of the examination of the characteristic aggregate sand village of Burukene Batauga subdistrict which can be seen in the following table 8:

Table 8. Results of Examination of The Properties of Fine Aggregate sand Of Burukene Kec Village. Batauga.

No	Type of control	Result of control Desa Burukene	item
1	Weight Type:		
	Weight Type Bulk	2,60	--
	Weight Type SSD	2,39	--
	Weight Type Semu	2,26	--
	Absorption	5,68	%
2	Weight of free term	1,49	gr/cm^3
3	Weight of solid term	1,33	gr/cm^3
4	Level of mud	4,59	%
5	Level of water	2,24	%

Source: result of data analysis

Table 9. Fine Aggregate Sieve Analysis Results

No filter	Material 1500 Gram			
	Average of Weight Held(gr)	% weighy held	% comula tive	% Komulat if pass
1	0,00	0,00	0,00	100,00
¾	0,00	0,00	0,00	100,00
½	0,00	0,00	0,00	100,00
3/8	0,00	0,00	0,00	100,00
□	80,00	5,33	5,33	94,67
□	330,00	22,00	27,33	72,67
□□	335,00	22,33	49,67	50,00
□□	350,00	23,33	73,00	27,00
□□	215,00	14,33	87,33	12,67
100	30,00	2,00	89,33	10,67
Pan	160,00	10,67	100,0	0,00

Source: result of data analysis

Based on the specification above, the results of the analysis of the fine aggregate (sand) sieve in Burukene village are included in gradation or rough sand areas.

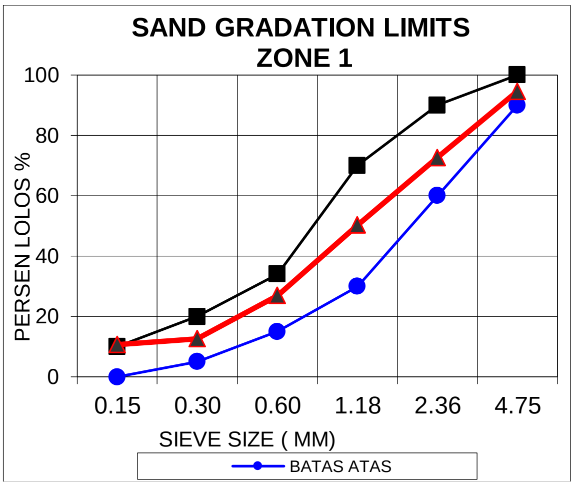

figure 1. Sand gradation limits

Characteristics of rough aggregate Material

Crude Aggregate examination results used in this study can be seen in the following table:

Table 10. Results of Rough Aggregate Properties Examination in Desa Burukene

No	Type of control	Result of control Desa Burukene	item
1	Weight Type:		
	Weight Type Bulk	2,53	--
	Weight Type SSD	2,47	--
	Weight Type Semu	2,43	--
	Absorption	1,63	%
2	Weight of free term	1,57	gr/cm^3
3	Berat Isi Padat	1,68	gr/cm^3
4	Level of water	0,7	%
5	Level of mud	0,19	%

Source: result of data analysis

Table 11. Rough Aggregate Sieve Analysis Results

No. filter	Material 2400 Gram			
	Weight Held (Gr)	Held pecentage (%)	held%	pass%
1 1/2"	0,00	0,00	0,00	100,00
1"	30,00	1,25	1,25	98,75
3/4"	815,00	33,96	35,21	64,79
1/2"	950,00	39,58	74,79	25,21
3/8"	335,00	13,96	88,75	11,25
4	200,00	8,33	97,08	2,92
8	45,00	1,88	98,96	1,04
16	0,00	0,00	98,96	1,04
30	5,00	0,21	99,17	0,83
50	5,00	0,21	99,38	0,63
PAN	15,00	0,63	100.00	0.00

Source: result of data analysis

Based on the above specifications, the results of analysis analysis of Rough Aggregate (Gravel) of Burukena Village are included in the Aggregate Standard Gradation area with a maximum granules of 40mm.

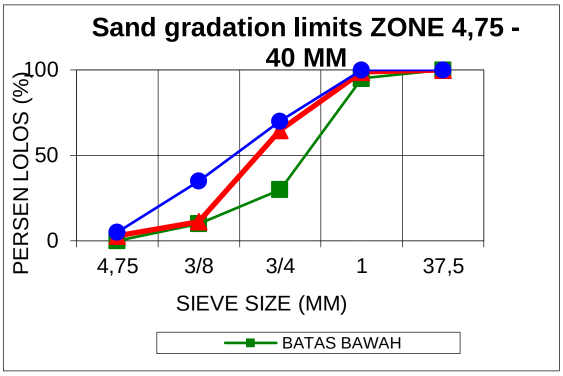

figure 2. Gravel gradation limits

Water

The water used in the Laboratory is PDAM water and seawater that comes from the lakeba kel beach area. Sulaa Kec. Betoambari Baubau City.

Cement

The cement used in this study is cement that is commonly used for concrete construction and widely available in the market which is the type of cement produced by Tonasa cement plant.

Aggregate Composition Examination Results from Aggregate Rusteristic Test Results

From the comparison of the design of the composition of the mixture obtained the proportion of materials for concrete 28, 44% fine aggregate and 71.56% rough aggregate, the percentage of rough aggregate usage is more dominant than fine aggregate. In the arrangement of concrete filler elements, rough aggregate becomes the main filler material, while fine aggregate serves more as pore filler.

The Plan of Mix Design

Table 12. Mix design planning for composition 28.44/71.56 on FAS 0.45.

Concrete item	weight/M^3 concrete (kg)	RATIO of CEMENT QUANTITY	WEIGHT FOR 1 SAMPLE (kg)	WEIGHT FOR 9 SAMPLES (kg)
water	210,92	0,51	1,12	12,30
cement	411,11	1,00	2,18	23,97
sand	458,21	1,11	2,43	26,72
gravel	1180,27	2,87	6,26	68,83

Source: result of data analysis

Tabel 13. Mix design planning for composition 28.44/71.56 on FAS 0.50.

Concrete item	weight/M^3 concrete (kg)	RATIO of CEMENT QUANTITY	WEIGHT FOR 1 SAMPLE (kg)	WEIGHT FOR 9 SAMPLES (kg)
water	211,56	0,57	1,12	12,34
cement	370,00	1,00	1,92	21,58
sand	469,52	1,27	2,49	27,38
gravel	1209,42	3,27	6,41	70,53

Source: result of data analys

Table 14. Mix design planning for composition 28.44/71.56 on FAS 0.55.

Concrete item	weight/M^3 concrete (kg)	RATIO of CEMENT QUANTITY	WEIGHT FOR 1 SAMPLE (kg))	WEIGHT FOR 9 SAMPLES (kg))
water	212,08	0,63	1,12	12,37
cement	336,36	1,00	1,78	19,62
sand	478,78	1,42	2,54	27,92
gravel	1233,27	3,67	6,54	71,92

Source: result of data analysis

The result of Strong Press Test

The test results performed on the test object are obtained strong press average concrete at each test age based on aggregate comparison composition:

Table 15. Strong Test Results Press Average on fresh water

No	Description	Strong Press (Kg/cm2)		
		FAS 0,45	**FAS 0,50**	**FAS 0,55**
1	Age 3 days	81,00	77,30	65,00
2	Age 7 days	122,70	107,90	99,40
3	Age 28 days	200,00	184,00	157,00

Source: result of data analysis

Table 16. Strong Test Results Press Average on seawater

No	escription	Strong Press (Kg/cm2)		
		FAS 0,45	**FAS 0,50**	**FAS 0,55**
1	age 3 days	90,8	85,9	69,9
2	age 7 days	132,5	111,6	103
3	Age 28 days	208,5	186,5	158,2

Source: result of data analysis

Figure 3. Graph of strong comparison of press using seawater and fresh water at the age of 28 days

From the chart above can be seen a strong increase in concrete press mixed by using higher sea water strong press when compared to freshwater concrete. In the seawater mix concrete sample, firmly press the concrete with each FAS 0.45, 0.50, 0.55 at the age of 3 days of 90.8 Kg/Cm2, 85.9 Kg/Cm2, 69.9 Kg/Cm2, 7 days old at 132.5 Kg/Cm2, 111.6 Kg/Cm2, 103.0 Kg/Cm2, and 28 days old at 208.5 Kg/Cm2, 186.5 Kg/Cm2, 158.2 Kg/Cm^2. While in freshwater mixed concrete samples, strong press concrete with each FAS 0.45, 0.50, 0.55 at the age of 3 days amounting to 81.0 Kg/Cm2, 77.3 Kg/Cm2, 65.0 Kg/Cm2, age 7 days at 122.7 Kg/Cm2, 107.9 Kg/Cm2, 99.4 Kg/Cm2, and 28 days life of 200.0 Kg/Cm2, 184.0 Kg/Cm2, 157.0 Kg/Cm2. Based on strong press results on the chart above the effect of seawater use on concrete mixture can increase press strength compared to the use of concrete mixture by using fresh water.

5. CONCLUSION

Based on the results of research on the Laboratory of Structure and Construction of Civil Engineering Faculty of Engineering Universitas Dayanu Ikhsanuddin Baubau, the authors can draw conclusions that the results of testing the characteristics of fine aggregates and rough aggregates obtained through the results of examination of the material of the origin of Badene Village batauga sub-district - each type of examination there is included in the standard but some are not included in the required inspection standards. E.g. sand sludge content 4.59 %, sand water content 2.24%, loose sand volume weight 1.33 and solid condition 1.49, real sand type weight 2.60, dry base sand type weight 2.26, surface dry sand type weight 2.39, modulus smoothness 4.32 and absorption 5.68%. While gravel sludge content is 0.19%, gravel moisture content is 0.70%, gravel volume weight is loose condition 1.57, solid condition volume weight 1.68, absorption 1.63%, real type weight of gravel 2.53, dry base gravel type weight 2.43, surface dry gravel type weight 2.47 and modulus roughness 6.94.

From the results of the test strong press concrete produced by using seawater as a mixture of concrete can increase the strong press of concrete when compared to fresh water, as well as the smaller the value of cement water factor used then a large amount of strong press value. Strong press concrete with seawater mixture using cement water factor 0.55, 0.50, and 0.45 at the age of 28 days produce strong concrete presses respectively is 15.82 MPa, 18.65 MPa, and 20.85 MPa, while strong concrete press with freshwater mixture using cement water factor 0.55, 0.50, and 0.45 at 28 days old produce strong concrete press is 15.70 MPa respectively , 18.40 MPa and 20.00 MPa.

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