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DETERMINATION OF THE GROUNDWATER RECHARGE COEFFICIENT OF THE UPPER CISADANE RIVER - CISADANE SUB-WATERSHED

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Abstrak. Recharge groundwater naturally manifested by curved shrinkage (recession curve) elementary streams (base flow) is a very important component of the flow stream produced by the inflow through the process of rainfall infiltration into percolation and finally donated to soil water deposits.This research aims to know the quantity of groundwater Coefficient Recharge tentative Natural Cisadane River Watershed with an area of 842.69 Km², where the magnitude of the suffixes can be used as the basis for the determination of soil water uptake in the region allow question-based environment that is sustainable, so that sustainable utilization/groundwater remain sustainable.In addition the value of the coefficient of the term can also be used to indirectly set the magnitude of the numerical groundwater in surrounding watershed in the process of regionalization.The most common watershed characteristics affecting large affixes which include variable rainfall, geology, soil infiltration rates, factor flow base, and land cover.The study was carried out to obtain the estimated average value of affix using Recessive Curves (curvilinear depreciation/recession curve) of the daily discharge data for the period 1980 – 2015 acquired from Water Resources R & D Center in Bandung. The average rainfall value is sought by the Isohyet method and then the value of the additive coefficient (Recharge Coefficien) can be determined, by dividing recharge value and rainfall avarage of the watershed area. The Value of the Recharge Coefficient (RC) obtained based on a calculation of 0.14 %. While based on the calculation of the benefits that occur in rock formations get the value of the Recharge Coefficient (RC) of: 742.11 x 106 m3/year. The amount of groundwater that can be released or flowed during the dry/dry season is: 172.70 x 106 m3/year, or about 98.27 %. The decline in the contribution of the suffixes in the Cisadane River Watershed can impact on the depletion of water sources during the dry season.Therefore, the need to management of water resources and integrated watershed conservation efforts and sustainable as a solution decrease the suffixes, so that quality, quantity, and continuity of water resources on a watershed Cisadane can awake.

Keywords: recharge; coefficient recharge; curve is recessive; Cisadane River watershed

I. INTRODUCTION

Concrete is a composite material between cement paste, aggregate and water. The strength of concrete is highly dependent on its constituent materials. In early 1990 in France, one of the new breakthroughs in the field of concrete material technology was reactive powder concrete introduced **[1]**. Reactive powder concrete has characteristics in the form of very high compressive strength, ductility and durability. This reactive powder concrete is classified as concrete with a compressive strength above 200 MPa as Ultra High Strength Concrete (UHSC) **[2]**. The purpose of the study was to determine the effect of bendrat fiber on compressive strength, splitting tensile strength and flexural strength in reactive powder concrete. The principle underlying the development of reactive powder concrete is to improve the homogeneity of the mixture, increase dry density by reducing water content and applying pressure to fresh concrete during setting time, improve microstructure with curing, and increase the ductility of the material **[3]**. Based on previous research, reactive powder concrete does not only consist of cement, coarse aggregate, fine aggregate and water, but also superplasticizer, silica fume and steel fiber or bendrat wire.

Fiber concrete is concrete that is made with fiber added to it, which aims to increase the tensile strength of the concrete so that it is resistant to tensile forces caused by climate, temperature and weather changes experienced by a large surface **[4]**. The effect of adding fiber to the concrete mix depends on the type of fiber from its size and shape, the fiber aspect ratio which is the ratio between the length and diameter of the fiber, and the fiber concentration if too much is added to the concrete mix it will tend to clump which will prevent even distribution throughout the concrete **[5]**.

Beams are known as flexible elements, namely structural elements that predominantly carry internal forces in the form of bending moments and shear. In the SNI-03-2847-2002 Regulation on Calculation of Concrete Structures for Buildings for planning beams that carry earthquake loads **[6]**.

Stress-Strain Behavior of Fiber Concrete, In this case, assuming perfect adhesion between the concrete and the reinforcing steel, the reinforcement will experience the same deformation as the concrete **[7]**. The magnitude of the stress that occurs at this level is directly proportional to the existing strain. If the load continues to be added, the tensile strength of the concrete will be reached and cracks in the concrete will appear so that the stress-strain relationship will also increase and is no longer directly proportional **[8]**. When approaching

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the limit load, the stress is no longer a straight line with the strain so that the design method uses the inelastic behavior of the material. Fiber concrete is a mixture of concrete added with fiber **[9]**. The addition of fiber will result in an increase in the flexural strength of the concrete so that the fibrous concrete will become more flexible. The initial stress-strain relationship is linear, but in fibrous concrete the stress-strain relationship is not exactly the same as concrete without fiber. As can be seen in Figure 1, fiber concrete has more ductile properties.

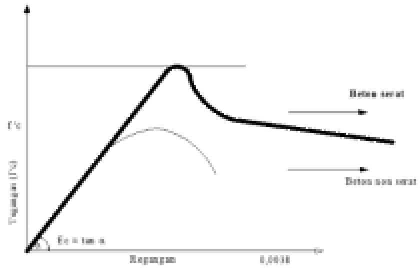

Figure 1. Stress-Strain Graph of Fiber-Reinforced Concrete

II. RESEARCH METHODS

The data analysis technique used by the researcher is the independent variable with 0% and 0.5% bendrat fiber (concrete treatment method by soaking in plain water), the dependent variable (flexural strength value) and the controlling variable (water cement factor, concrete age, type of cement, aggregate and method of making test objects) **[10]**.

The use of test objects in this study were concrete cube test objects, concrete cylinders and reinforced concrete beam test objects. Concrete cubes measuring 5 x 5 x 5 cm and concrete cylinders measuring 10 x 20 cm were used for compressive/compressive strength tests. For splitting tensile tests using 10 x 20 cm concrete cylinders, and flexural tests using 4 x 6 x 60 cm concrete beams, reinforced concrete beams measuring 5 x 9 x 140 cm with 10 mm diameter plain steel reinforcement. Testing of Test Objects: Compressive Strength Test, Compressive strength test based on ASTM C39-94 **[11]** standards. Splitting Tensile Strength Test, Determining tensile strength in concrete. Flexural Strength Test, Flexural strength is the ability of a concrete block placed on two supports to withstand a force perpendicular to the axis of the test object, which is given to it until the test object breaks and is expressed in Mega Pascal (MPa) force per unit area. Steel Tensile Test (Coupon Test) **[12]**

III. RESULTS AND DISCUSSION

The test specimens are made referring to SNI-03-2847- 2002 Procedures for Calculating Concrete Structures for Buildings. After the beam test specimen is ready for testing, place the test specimen that has been measured, weighed and marked on the support in the right place with the top of the test specimen. During the test, observations were made on the behavior of the test specimen, especially on the form of deformation, the occurrence of melting, buckling events and collapse models that cause a decrease in the structure's ability to withstand loads. In the articles that have been published on reactive powder concrete, there are various types of mixture compositions, but in the implementation in the laboratory, this composition is then developed to obtain the optimum composition. This study uses the composition of the mix design using the Pan-Mixer at PT. Wika Beton (Pio, 2015).

Table 1. Mix Design using the Pan-Mixer at PT. Wika Beton

No	Material	Berat (Kg)	%
1	Semen	950	100
2	*Silica fume* (sika fume)	95	10
3	Pasir kuarsa #50	950	100
4	Pasir kuarsa #200	95	10
5	Superplasticizer (Viscocrete 10)	20.9	2
6	Sika *fiber*	0.6	0.000256
7	Air	229.9	22

From the composition above, the research was carried out by replacing sika fiber with bendrat fiber and adding a percentage of water from 22% to 32%. Mixing using mini mixer in Civil Engineering laboratory UNPAK Bogor using cube mold measuring 5 cm x 5 cm x 5 cm, cylinder mold diameter 10 cm x 20 cm, reinforced beam measuring 5 cm x 9 cm x 140 cm and beam measuring 4 cm x 6 cm x 60 cm.

The composition of the mix design carried out for the compressive strength test and splitting tensile strength test using 2 types of Tiga Roda cement.

Table 2. Mix Design With 0% Bendrat Fiber

No	Material	Berat (kg)	%
1	Semen tipe II	19.5	100
2	*Silica fume* (sika fume)	1.95	10
3	Pasir kuarsa #50	19.5	100
4	Pasir kuarsa #200	1.95	10
5	Superplasticizer (Viscocrete 3270)	0.39	2
6	Serat bendrat	0	0
7	Air	6.5	32

Table 3. Mix Design With 0% Bendrat Fiber

No	Material	Berat (Kg)	%
1	Semen tipe I	8	100
2	*Silica fume* (sika fume)	0.8	10
3	Pasir kuarsa #50	8	100
4	Pasir kuarsa #200	0.8	10
5	Superplasticizer (Viscocrete 3270)	0.16	2
6	Serat bendrat	0	0
7	Air	2.56	32

Evaluation of the test results was carried out using the results of experimental tests. The evaluation was carried out to assess the acceptability criteria of all test objects as part of the structural system that withstands earthquake loads. The evaluation was carried out by involving several aspects as follows a. Crack Pattern, b. Initial Stiffness, c. Stiffness degradation, d. Ductility,

Testing of Test Object Material, In this study, the aggregate used was Bangka quartz sand processed by PT. Karunia Hosana, Bekasi. The use of quartz as an aggregate can strengthen the surface between the aggregate and the paste, so that concrete destruction does not occur on the surface. Even if it does occur, it requires high energy so that very high concrete quality is achieved. The cement used in this study is type II and type I cement with the Tiga Roda trademark. The hydration heat of type II cement is lower when compared to type I. The specific gravity of type II and type I cement is 3.15 gr/cm3 which meets the ASTM C150-92 standard. The silica fume used in this study is produced by PT. Sika Indonesia, with the sika fume trademark.

Making and Testing Test Objects. After testing some of the materials to be used, preparing the concrete mixer (mini mixer), test object molds and materials and preparing the mixture with a certain composition, the next stage is to carry out the mix design procedure. Curing for 5 x 5 x 5 cm cubes was done with regular water curing for 7, 14, 21 and 28 days compression test while for 10 x 20 cm cylinders for 7, 14, 28 days compression test with regular water treatment. For cylinder splitting tensile strength and beam flexural strength testing at 28 days with regular water treatment.

Concrete Compressive Strength. The results of the cube compressive strength study can be seen in the graph of the relationship between age and compressive strength in Figure 3.

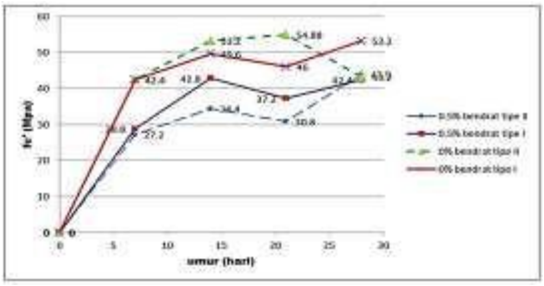

Figure 3. Graph of the Relationship between Age and Concrete Compressive Strength

In the results of the cylinder compressive strength for Tiga Roda cement type II at the age of 28 days with 0% and 0.5% bendrat fiber, the concrete quality increased and Tiga Roda cement type I with 0% and 0.5% bendrat fiber, the concrete quality decreased as seen in Figure 4.

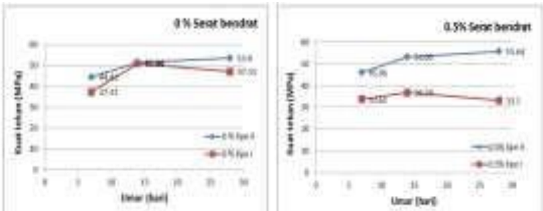

Figure 4. Graph of the Relationship Between Age and Concrete Compressive Strength

Splitting Tensile Strength of Concrete The results of the splitting tensile strength of concrete at the age of 28 days can be seen in Figure 5. Based on the results of the splitting tensile test, Tiga Roda type II cement with the addition of 0.5% bendrate fiber in the concrete experienced an increase in the splitting tensile strength value, and Tiga Roda type I cement with 0.5% bendratin concrete experienced a decrease in the splitting tensile strength value.

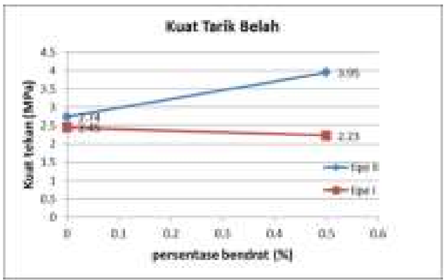

Figure 5. Graph of Ridge Percentage of Bendrate with Concrete Compressive Strength

Flexural Strength of Concrete The results of calculating the flexural strength of concrete at the age of 28 days can be seen in table 5 and table 6. Based on the values in tables 5 and 6, the flexural tensile strength for bendrat fiber is 0.5% with 1 concentrated load decreases while with 2 concentrated loads the tensile strength increases. For reinforced concrete beams, the flexural tensile strength also increases with the addition of 0.5% bendrat fiber.

Table 5. Results of Flexural Tensile Strength of Reactive Powder Concrete at 28 Days

Dimensi 4 x 6 x 60 cm					
1 Beban Terpusat			2 Beban Terpusat		
Serat Bendrat	Beban (kN)	Kuat Lentur (MPa)	Serat Bendrat	Beban (kN)	Kuat Lentur (MPa)
0%	1	6.25	0%	2	15.62
0.50%	2	12.5	0.50%	3	23.44

Table 6. Flexural Tensile Strength Results of Reinforced Concrete at 28 Days

Dimensi 5 x 9 x 140 cm			
Serat Bendrat	Berat (kg)	Beban (kN)	Kuat lentur (MPa)
0%	14.28	10	56.92
0.50%	14.67	11	61.93

Concrete Crack Pattern. Crack observation was conducted during the loading process. The collapse pattern of concrete with the addition of bendrat fiber in the concrete compressive strength test, splitting tensile strength and shear strength of concrete showed that the bendrat fiber was able to hold the concrete test object from being directly destroyed

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during the test. When the test object was dismantled after the test, the bendrat fiber was still attached to one side of the concrete and the fiber. The collapse that occurred in the fiber concrete was caused by the release of the bond between the fiber and the concrete, not because the fiber broke due to the loading during the test. This can indicate that adding bendrat fiber to the concrete mixture can minimize direct collapse of the concrete or can reduce the brittle nature of the bendrat concrete so that it does not crack.

Figure 6. Cylinder Test Object

For beam structure cracks have a vertical or diagonal pattern, in addition there is also a hairline crack pattern. In the test of fiber concrete beams, the crack that occurred was in the middle part which began with a hairline crack at the bottom which then spread to the top forming a straight line.

Figure 7. Concrete Crack Pattern With Bendrat Fiber

The crack pattern in reinforced concrete that occurs due to vertical loading on the concrete beam, at small loads cracks have not yet occurred because the concrete and steel together withstand the forces where the compressive force is resisted by the concrete and the tensile force is resisted by the concrete and the reinforcing steel. At moderate loads, the tensile strength of the concrete is exceeded and the concrete experiences hairline cracks, at that time the reinforcing steel will take over bearing all the tensile forces that arise and the concrete cannot transmit the tensile force across the cracked area. At the ultimate load, where the concrete strength limit capacity is exceeded and the steel reinforcement reaches yield, the beam is destroyed as indicated by very wide cracks and very large deflections. Flexural Analysis of Reinforced Concrete Beams. The model used for the analysis is a rectangular beam in the form of reinforced concrete with tensile reinforcement.

IV. CONCLUSION

Based on the results of the tests and data analysis that have been carried out, several conclusions can be drawn as follows The addition of additional chemical materials (superplasticizer) visconcrete 3270 of 2% of the weight of cement in the concrete mixture and the addition of fiber in the form of straight wires do not have a significant effect on workability. For the results of splitting tensile strength with fiber using type II cement of 3.95 MPa and type I cement of 2.23 MPa. The results of concrete flexure at 1 concentrated load of 12.5 MPa and at 2 concentrated loads of 23.44 MPa. The results of reinforced concrete flexure in the test were 61.93 MPa. The collapse that occurred in the 4 x 6 x 60 cm beam was a flexural collapse, while in the 5 x 9 x 140 cm beam it was a diagonal tensile collapse.

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