Previous Concrete Development

Rahmi Karolina[1], Syahrizal[1], M. A. P. Handana[1], M. Rizky Indrawan[1]
[1]*Department of Civil Engineering Universitas Sumatera Utara*

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Abstract: Based on the Meteorology, Climatology and Geophysics Agency (BMKG), the average rainfall in Indonesia is quite high, the high rainfall caused the number of inundation. One reason is the use of concrete as a pavement material in residential areas. The increased region areas covered by pavement with settlement construction as well as in urban areas can result in a shorter water gathering time, so the accumulation of collected rainwater exceeds the existing drainage capacity.Porous concrete is expected to be able to solve the problem of the shrinking land infiltration capacity and run – off magnitude, the magnitude of flood discharge and landslide.From the result of the research, the highest compressive strength on variation I (BP 0) is 13.29 MPa, and the lowest compressive strength in variation IV (BP 15) is 5.78 MPa. In the resistance test of Sodium Sulfate, the highest compressive strength in variation I (BP 0) is13.50 Mpa, and the lowest is in variation IV (BP 15) which is 5.07 MPa. In the infiltration rate test, the highest value on variation I (BP 0) is 3.71 x 10-3 mm / h, and the lowest value on variation V (BP 20) is 2.39 x 10-3 mm / h.

1 INTRODUCTION

1.1 Background

One of concrete usage is as a pavement material in residential areas. The increased region areas covered by pavement with settlement construction as well as in urban areas can result in a shorter water gathering time, so the accumulation of collected rainwater exceeds the existing drainage capacity.

The porous concrete is a simple form of lightweight concrete made by eliminating the use of fine aggregates. As a result of not using sand in porous concrete, air-filled cavities is created. Cavity levels range from 12% to 25%. This cavity resulted in a reduced density of the concrete as well as a reduced amount of area that needs to be covered by cement paste, thereby directly affecting the portion of cement in the mixture and able to save the construction cost.

The density of porous concrete depends on the gradation of the coarse aggregate used, usually the porous concrete density ranges from 60% -70% of the normal concrete density. The size of the coarse aggregate used is between 10-20 mm. Aggregates that can be used includes crushed stones, natural gravels, blast furnace slags and clinkers. Aggregates of crushed stones produce a higher compressive strength than when using natural gravels that tend to have rounded surfaces.

1.2 Research Purposes

The purpose of the author in this research for final task are as follows:

1. To know the amount of porous concrete mixing composition to get an optimum result.
2. To determine the compressive strength, infiltration, resistance to optimum sodium sulfate in each composition.

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Table 1: The proportion of concrete mixture every variation per m3.

Description	Cement (kg)	Sand (kg)	Water (kg)	Gravel (kg)	Master Euse 3029 (L)
Variation I (N)	300	0	121,3	1800	1,8
Variation II (A)	300	90	121,3	1710	1,8
Variation III (B)	300	180	121,3	1620	1,8
Variation IV (C)	300	270	121,3	1530	1,8
Variation V (D)	300	360	121,3	1440	1,8

2 METHOD

The method used in this research is an experimental study conducted at the Concrete Laboratory of Faculty of Engineering of Department of Civil Engineering of University of North Sumatra. Generally the sequence of the research phases includes: a. Provision of constituent materials for previous concrete materials, b.Examining of materials, c.Mix Design, d.Making of samples, e.Curing, f.Compressive strength test of 28 days of age, g.Infiltration test, h.Absorption test and i.Resistance to sodium sulphate test

2.1 Mix Design

A complete mix design calculation can be seen in the attachment. From the mix design results, it is obtained 1m³ concrete mixture proportion among others are as follows:

2.2 Visible Properties Test

Concrete bricks should have a flat surface, no cracks and defects, the corners and ribs are not easily brushed with the strength of fingers. All of these are examined with careful observation by arranging bricks on a flat surface as in the actual installation.

2.3 Size Test

The concrete brick must have a minimum nominal thickness of 60 mm with a tolerance of + 8%. This test is performed using a capillary pipe or the like with a precision of 0.1 mm. Thick measurements is done on three different places and the average score is taken. Tests conducted on 10 pieces of samples.

2.4 Concrete Compressive Strength Test

The test is done on 28 daysof age concrete for each concrete variation of 10 pieces. Compressive strength test of concrete is done by using electric

compress machine with 2000 KN capacity.The compressive strength of a concrete sample is calculated by the formula:

$$f'c = \frac{P}{A} \quad (1)$$

where: f'c = Compressive strength (kg/cm^2)
P = Compressive load (kg)
A = Surface area of sample (cm^2)

2.5 Resistance to Sodium Sulphate Test

The test is done on concrete that soaked in sodium sulfate solvent for each concrete variation of 3 pieces. Compressive strength test of concrete is done

by using electric compress machine with 2000 KN capacity.

The compressive strength of a concrete sample is calculated by the formula:

$$f'c = \frac{P}{A}$$

Where: f'c = Compressive strength (kg/cm^2)
P = Compressive load (kg)
A = Surface area of sample (cm^2)

2.6 Absorbtion Test

Five samples in a good state is soaked in water until saturated (24 hours), weighed in a wet state. Then dried in the dryer kitchen for approximately 24 hours, at a temperature of about 105°C until the weight on the twice weighing differ less than 0.2% of the preceding weighing.

Water absorption is calculated as follows

$$Water\ absorption = \frac{A-B}{B} \times 100 \quad (2)$$

Where :
A = wet concrete weight
B = dry concrete weight

2.7 Infiltration Test

This infiltration test is to determine the water content that passes from the surface of concrete with mm / hour units. The tool used is a ring with a size of 12 inches, the ring is affixed to the surface of the concrete with an adhesive tool so that the water will not flow out from the bottom side of the ring. Based on ASTM C 1701 / C the formula used is as follows:

$$I = \frac{KM}{D^2 t} \quad (3)$$

Where:
I = Infiltration rate (mm/jam)
M = Water weight(kg)
D = Inner ring diameter (12 inchi/ 30,5 mm)
t = the time it takes to pass water from the top of the ring to the bottom of the surface
K = constants (4,583666 x 10^3 untuk SI atau 1,26870 untuk inch-pound)

3 RESULTS AND DISCUSSION

3.1 Visible Properties

Figure 1: Visual Test. a. Side view, b. Front view, c. Top view.

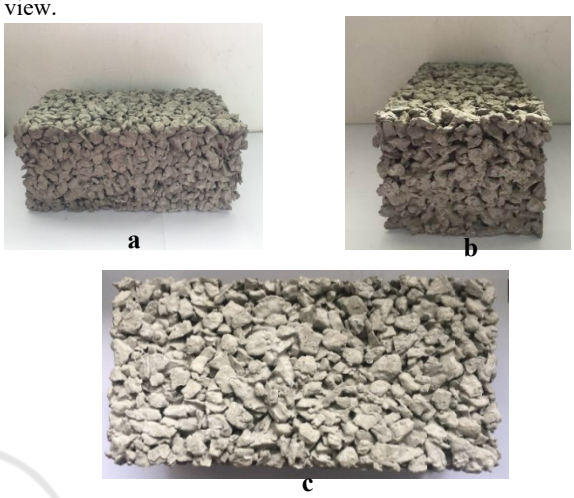

Table 2: From the examination of paving block visible properties, obtained data as follows:

Description	Paving Block				
	0 % sand	5 % sand	10 % sand	15 % sand	20 % sand
1.Sector					
a.Flatness	Flat	Flat	Flat	Flat	Flat
b.Rift	No	No	No	No	No
c.Fineness	Fine	Fine	Fine	Fine	Fine
2.Ribs					
a.Right-angledness	Right-angled	Right-angled	Right-angled	Right-angled	Right-angled
b.Sharpness	Sharp	Sharp	Sharp	Sharp	Sharp
c.Strength	Strong	Strong	Strong	Strong	Strong

Table 3: From the examination of paving block, obtained data as follows

No	Variation	Type	Right Side Thickness	Left Side Thickness	Middle Side Thickness	Average Thickness
1	0 % sand		8,183	8,185	8,205	8,191
2	5 % sand		8,157	8,104	8,102	8,121
3	10% sand		8,193	8,026	8,157	8,125
4	15% sand		8,117	8,092	8,112	8,107
5	20% sand		8,193	8,026	8,157	8,125

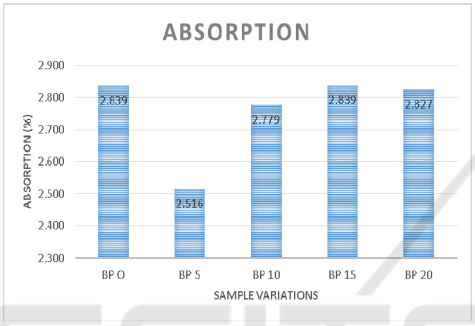

Figure 2: Graph of Paving Block Absorption.

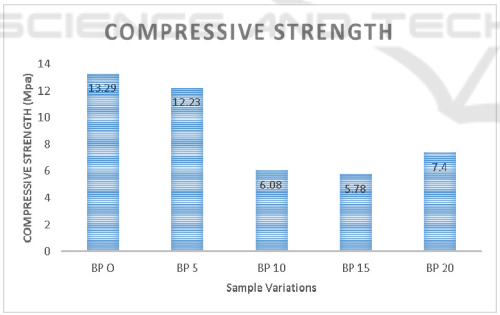

Figure 3: Graph of Paving Block Compressive.

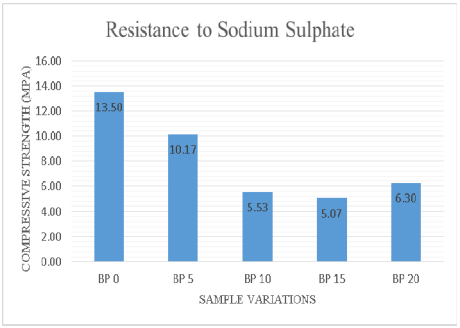

Figure 4: Graph of Resistance to Sodium Sulphat.

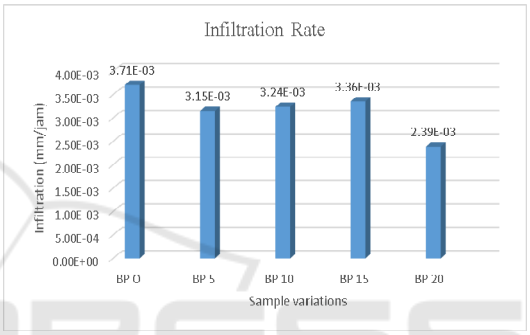

Figure 5: Graph of Infiltration Rate.

Based on the figures behind it is obtained that on Figure 2 the highest absorption value is on BP variation and the lowest is on BP 5 variation, on Figure 3 the highest compressive strength is on BP variation and the lowest is on BP 15 variation, on Figure 4 the highest resistance to sodium sulfate is on BP variation and the lowest is on BP 15 variation, on Figure 5 the highest infiltration is on BP variation and the lowest is on BP 20 variation.

4 CONCLUSIONS

From the research results, analysis, and discussion that have been implemented, it can be concluded as follows:

1. In the mixture, the amount of water, cement, and master Euse are determined as parameters to compare the compressive strength, absorption, resistance to Sodium Sulfate and infiltration rate.
2. Based on the test results, it can be concluded that the optimum variation is on variation I (BP 0) because it has the highest compressive strength and a large infiltration. For variation

I (BP 0) compressive strength is 13.29 MPa, resistance to Sodium Sulfate of 13.50 MPa, and infiltration rate of 3.71 x 10-3 mm / h.

3. Based on the discussion, it can be concluded that previous concrete without using sand has a larger copressive strength when compared to using sand. Variation II (BP 5) compressive strength is 12.23 MPa, variation III (BP 10) is 6.08 MPa, Variation IV (BP 15) is 5.78 MPa, and variation V (BP 20) is 7.4 MPa.
4. For the results of the resistance of Sodium Sulphate test, Variation II (BP 5) compressive strength is 10.17 MPa, variation III (BP 10) is 5.53 MPa, variation IV (BP 15) is 5.07 MPa, and variation V (BP 20) is 6.30 MPa.
5. For the infiltration rate test, it is obtained that Variation II (BP 5) is 3.15 x 10-3, variation III (BP 10) is 3.24 x 10-3, variation IV (BP 15) is 3.36 x 10-3, and variation V (BP 20) is 2.39 x 10-3.

5 SUGGESTIONS

After seeing the research results and realize the possibility of deficiencies in this research, the authors can provide suggestions as follows:

1. Further research is needed to be done with different dosage variations and combined with other types of chemical admixture.
2. For further research, it needs to be done for different materials and different gradations.
3. In the process of porous concrete casting, it is necessary to notice the water content because if the cement water factor is less or more, it will greatly affect the spreading of pores.

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REFERENCES

ANNUAL BOOK of ASTM STANDARDS.(1991).*Concrete and Aggregate*

FIE, PASCE, CEng FICE, BEng MEng, and R. N. Swamy. "Concrete Technology and Design, New Concrete Material." (1983).

Fintel, Mark. "Buku Pegangan tentang Teknik Beton." *Cetakan Pertama. Jakarta: PT Pradanya Paramita* (1987).

Ginting, A. (2016). Kuat Tekan dan Porositas Beton Porous Dengan Bahan Pengisi Styrofoam. *Jurnal Teknik Sipil*, *11*(2).

Handana, M. A. P., Karolina, R., & Syahputra, E. (2018, March). Previous concrete as one of the technology to overcome the puddle. In *IOP Conference Series: Earth and Environmental Science* (Vol. 126, No. 1, p. 012041). IOP Publishing.

Hanta, L., & Makmur, A. STUDI EKSPERIMENTAL PENGARUH BENTUK AGREGAT TERHADAP NILAI POROSITAS DALAM CAMPURAN BETON BERPORI PADA APLIKASI JALUR PEJALAN KAKI.

Karolina, Z. R. (2017). KAJIAN PENDAHULUAN BETON LOLOS AIR (POROUS CONCRETE) DENGAN PENAMBAHAN MASTERROC HCA10. *Jurnal Teknik Sipil USU*, *6*(1).

Nevile M A . 1977. "*Properties of Concrete".* The Englsih Language Book Society Pitman Publishing

Nugraha, Paul. "Antoni." *Teknologi Beton* (2007)

Prabowo, D. A. (2014). Desain Beton Berpori Untuk Perkerasan Jalan Yang Ramah Lingkungan (Porous Concrete Pavement Design For Environmentally Friendly Pavement).

Puja, A., and P. Rachmat. "Pengendalian mutu beton sesuai SNI, ACI dan ASTM." (2010).

Shetty, M. S. "Concrete technology." *S. chand & company LTD* (2005): 420-453.

Sugianto, K. J. R. (2002). Banjir, Beberapa Penyebab dan metode pengendaliannya dalam perspektif Lingkungan.

Yap, S. P., Chen, P. Z. C., Goh, Y., Ibrahim, H. A., Mo, K. H., & Yuen, C. W. (2018). Characterization of pervious concrete with blended natural aggregate and recycled concrete aggregates. *Journal of Cleaner Production*, *181*, 155-165.

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