Proceedings of Narotama International Conference on Civil Engineering 2015
ISBN : 978-602-72437-2-9

The Usage of Crushed Stone Waste as an Alternative of Sand Material for Paving Block Mixture

Dwi Deshariyanto[a]*, Mohammad Harun[a]

[a] *Civil Engineering Department, Wiraraja University, Sumenep, Indonesia*

Abstract

The high price of paving block in SumenepRegency is influenced by the unavailability of sand in this area. Ascrushed stone waste is available, it can be used as an alternative material for paving block mixture. This article aims to explore the quality of the paving block with different kind of aggregates, especially with crushed stone waste as an alternative of sand. Experimental method is employed in this study. The result of the paving block testing is analyzed with F-Test in order to know the level of significance whereas regression analysis is applied to know the influence of crushed stone waste use and to analyze the paving block according to SNI 03-061-196 of paving block. The estimation result of Variance testing and Regression testing indicates that there is a difference of compression strength and abrassion resistance in the adding of white stone waste as filler in the mixture of paving block mixture and there is no difference of abbrasion resistance in the adding of white stone waste as filler in the mixture of paving block mixture. The criteria of quality paving block used as a testing material are a) the smooth surface is visually noticed which means there is no crack nor defect to be found, some corner or rib parts are easily to be fixed with hands. b) it equally has a measure of 6.08 cm so that the paving block used is to meet the quality standard of paving block.c) based on the physical nature, paving block according to SNI 03-0691-196 does not meet the quality standard of abrasion resistance dan water absorption

Peer-review under responsibility of organizing committee of The NarotamaInternational Conference on Civil Engineering 2015 (NICCE-2015).

Keywords : waste, substitute material, paving block

1. Introduction

Sumenep Regency is located at the eastern end of Madura Island; it also includes 126 scattered islands located between 113 ° 32'54 "-116 ° 16'48" East Longitude and between 4 ° 55'-7 ° 24 'South latitude, with total area of 1.146,93 Km2 (54.79 %) and total area of its islands 946.53 Km2 (45.21 %) (BPS, 2010). Sumenep Regency, geologically, has limestones hills from sedimentary rock with various minerals such as: phosphates, limestone, calcite / rock star, gypsum, quartz sand, dolomite, kaolin clay and stone. These abundant natural mineral resources can be explored for developing its region in Sumenep Regency

Paving block is often used as one of the road pavement materials because its materials can absorb water and be produced in various sizes, shapes and colors. The paving blocks for road pavement in Sumenep Regency are taken from other places such as Surabaya and Mojokerto because the quality of paving blocks in other places is better than the local paving blocks. Several attempts to produce paving block locally have been made but failed because the cost to produce the same quality is higher than that of other places. Since the cost of local production is higher than the other places, the price of local paving block is higher than that of other places as well

The high price of local paving block is influenced by the unavailability of fine aggregate (sand) in Sumenep Regency. The sand is only available from other places such as Mojokerto, Situbondo, Pasuruan, etc. In order to increase income per capita in Sumenep Regency, local natural resources

* Corresponding author. Tel.: +62–813-3048-0481 Fax: +62-031-593-1213.
E-mail address: ucha_ibran@yahoo.com

should be extensively used. Severalapplications of the local materials such as: using limestone as filler material for wall and chrushed stone as concrete aggregate. The crushed stone waste is used only for fine plaster to coat the wall surfaces. Since the crushed stone can be used as fine plaster, it is possible to be used as fine aggregate for paving block mixture materials. A further research needs to be conducted in order to get the high quality and economic paving block from the local materials.

This research is intended to produce a new local product that complies with national standard and potentially increases the local economic. This research focuses on the identification of the best combination of paving block mixtures with several tests (i.e. compression strength, abrasion resistance, and absorption tests) of 5 samples.

2. Research Methodology

The researchers made a laboratory experiment by producing the paving block which was later tested for its compression strength, abrasion resistance, and absorption. Further, the result was analyzed to know the effect of crushed stone waste use for paving block as a substitute material of sand in Sumenep Regency.

The research applied the Experimental Method of (CRS) Complete Random Scheme for 5 combinations. The compression strength test of paving block was repeated for 10 samples while the abrasive resistance test was repeated for 3 samples. The absorption test was repeated for 5 samples. The test was carried out as follows:

1) Control*(A),* mixture proportion1PC : 6PS : 0LBP *(crushed stone waste 0 %).*

2) Testing 1*(B),* mixture proportion1PC : 4,8PS : 1,2LBP *(crushed stone waste 20 %).*

3) Testing 2 *(C),*mixture proportion1PC : 3,6PS : 2,4LBP *(crushed stone waste 40 %).*

4) Testing 3*(D),* mixture proportion 1PC : 2,4PS : 3,6LBP *(crushed stone waste 60 %).*

5) Testing 4 *(E),* mixture proportion 1PC : 1,2PS : 4,8LBP *(crushed stone waste 80 %).*

The production of the paving block was made based on the mixture proportion and the factor of water for cement was 0.4. The testing of materials on cement and water was visually completed. In the meantime, the testing of materials on sand and crushed stone waste was made to figure out its density, absorption, sieve analysis, and water content. The paving block was tested to figure out its visual characteristics, size, compression resistance, abrasion resistance, and also its water absorption. The standard ofpaving block testwas SNI 03-0691-196 of paving block.The data of paving block test result was analyzed using Variance completely Randomized Design with F testing to identify the level of significance. The Regression analysis was used to find out the influence of crushed stone waste (as the sand substitute material in the paving block mixture) on the compression strength, absorption, abrasion resistance and paving block classification analysis.

3. Discussion

The results of laboratorium tests, based on visual inspection on water quality, show that the water used in the paving block factory is clean and odorless. On the cement inspection, the cement and its package are dry and in a good condition.

The tests for water density and absoption are undertaken with ASTM C136 – 76 standard. The results of density test is 2.70, and water absorption test is 3.92 % with fine modulus of 4.39, also water content of 39.25 %.The results of density test is 2.75, and water absorption test is 4.33 % with fine modulus of 5.92, also water content of 37.49 %.

The results of compression test for paving block can be seen at Table 3.1, while the water absorption and the abrasion tests can be seen at Table 3.2 and Table 3.3 respectively.

ISBN : 978-602-72437-2-9

Tabel 3.1. The Results of Compression Test for Paving Block

NO	A (Crushed Stone Waste 0 %)	B (Crushed Stone Waste 20 %)	C (Crushed Stone Waste 40 %)	D (Crushed Stone Waste 60 %)	E (Crushed Stone Waste 80 %)
1	82.28	119.68	169.55	194.48	122.17
2	97.24	99.73	159.57	191.99	149.60
3	79.79	112.20	164.56	269.28	129.65
4	119.68	104.72	149.60	147.11	164.56
5	122.17	92.25	174.53	137.13	134.64
6	124.67	122.17	169.55	134.64	114.69
7	127.16	154.59	172.04	152.09	119.68
8	114.69	142.12	157.08	147.11	112.20
9	119.68	122.17	147.11	144.61	104.72
10	127.16	127.16	144.61	124.67	137.13
Average	**111.45**	**119.68**	**160.82**	**164.31**	**128.90**

Tabel 3.2. The Results of Water AbsorptionTest for Paving Block

NO	A (Crushed Stone Waste 0 %)	B (Crushed Stone Waste 20 %)	C (Crushed Stone Waste 40 %)	D (Crushed Stone Waste 60 %)	E (Crushed Stone Waste 80 %)
1	16.983	13.249	10.021	12.723	14.506
2	15.244	12.049	10.644	8.025	10.328
3	14.494	12.661	10.884	12.884	10.561
4	13.433	13.676	11.493	10.576	11.495
5	14.991	12.607	11.256	10.800	12.316
Average	**15.029**	**12.849**	**10.859**	**11.002**	**11.841**

Tabel 3.3. The Results of Abbrasion Test for Paving Block

NO	A (Crushed Stone Waste 0 %)	B (Crushed Stone Waste 20 %)	C (Crushed Stone Waste 40 %)	D (Crushed Stone Waste 60 %)	E (Crushed Stone Waste 80 %)
1	0.520	2.592	1.067	0.595	0.865
2	0.761	1.902	1.182	0.787	0.643
3	1.159	1.248	0.691	0.685	0.637
Average	0.813	1.914	0.980	0.689	0.715

4.1 Compression Strength Test

Tests of between – subjects effects (due to the influence of the treatment) describe the total overall influence between the treatment of 6325.975 and flat – align the influence between the treatment of 6325.975. While within the group effect (error or variation of unsystematic data) describes the total influence in treatment 44278.815 and flat – average influence in treatment 922.475. The F value taken from the analysis is 6.858 and F value from table is 4.043, so F analysis > F table, then Ho

denied. This means that there is a strong distinction between the treatments of the press in adding the white stones as waste material filler (filler) on the paving block mixtures.

T test shows, that t calculation > t table (2.619 > 2.012), then Ho is accepted. It means that there is significant influence between compression tests (Variable Y) and crushed stone waste as additional paving block filler (Variable X)

4.2 Abrasion Resistance Test

Tests of between – subjects effects (due to the influence of the treatment) describe the total overall influence between the treatment amounted to 0.606 and the average influence of the treatment amounted to 0.606. While within group effect (error or variation of unsystematic data) describes the total influence in treatment 3.828 and the average influence of the treatment is 0.294. The F value of the analysis is 2.059 and F table is4.667, so F analysis>F table, then Ho denied. This means that there is a difference among the water absorption treatment waste in adding a white stone as filler material (filler) on the mix paving block.

T test stated that t calculate > t table yaitu-1.452< 2.179 then Ho rejected means that there is significant influence between water absorption (variable Y) and the addition of waste of crsushed stone as fillers paving block (variable X)

4.3 Penyerapan Air Paving Beton

Tests of between – subjects effects (due to the influence of the treatment) describe the total overall influence between the treatment amounted to 33.804 and the average influence of the treatment amounted to 33.804. While within group effect (error or variation of unsystematic data) describes the total influence in treatment 61.336 and the average influence of the treatment is 2.667. The F value of the analysis is 12.676 and F table is 4.279, so F analysis>F table, then Ho denied. This means that there is a difference among the water absorption treatment waste in adding a white stone as filler material (filler) on the mix paving block.

T test stated that t calculate > t table yaitu-3.560 < 2.074 then Ho rejected means that there is significant influence between water absorption (variable Y) and the addition of waste of crsushed stone as fillers paving block (variable X).

4.4 Kualitas Paving Block

Assessment of the quality of the paving block is used as test objects namely a) nature looks from all the treatments have a flat surface, there are no cracks – cracked and deformed, the corners and her ribs there is some easy tidied by using fingers, b) the size of all the treatments have thick flat – of 6.08 cm, thus paving block is used as a noun qualified research quality test paving block , c) physical properties of the terms of paving block according to SNI 03-0691-1996 did not meet the requirements for resistance to wear and moisture absorption

4. Conclusion

The result of Variance test analysis and regression test indicated that there was a difference of compression strength when limestone waste was added as filler in the paving block mixture and there was no difference of abrasive resistance when limestone waste as filler was added in the paving block mixture.

The result of Variance test analysis and regression test shows that there was a difference of absorption tests when limestone waste was added as filler in the paving block mixture. The paving block quality for all samples can be assessed through three factors: 1) the visible factor such as flat surface, unavailability of hairy crack, easy to smoothen the corner; 2) the uniform factor, the average thickness is 6.08 cm that complies with the quality standard; 3) the physic factors such as compliance

ISBN : 978-602-72437-2-9

on Indonesia Standard SNI 03-069-1996 for absorption dan abrasive resistance, however, the sample failed to pass the standard.

5. Reference

[1] Ali Ansori. (2010). BalokPelatBetonBertulang. Yogyakarta, GrahaIlmu

[2] Ami Asparini. (2006), BatuPutihdariRengel – TubansebagaiBahanAlternatifAgregatCampuran HRS. JurnalAplikasi : Volume 1, Nomor 1, Agustus 2006

[3] BadanPusatStatistik. (2010). KabupatenSumenepdalamAngka 2010. Sumenep, BPS KabupatenSumenep.

[4] BadanStandarisasi Nasional. (1996). SNI 03 - 0691 – 1996, 1996 tentang Bata Beton. Jakarta, BadanStandarisasi Nasional.

[5] DepartemenPekerjaanUmum. (1990). SNI-T-15-1990-03 tentangSyarat-SyaratBahanBangunan. Bandung, YayasanLembagaPendidikanMasalahBangunan, DepartemenPekerjaanUmum.

[6] Edward G. Nawy, Tavio, Benny Kusuma. (2010). BetonBertulang. Surabaya, ITS Press.

[7] Imam Ghozali. (2008). DessainPenelitianEksperimental. Semarang, BadanPenerbitUniversitasDipenogoro.

[8] SuharsimiArikunto. (2006). ProsedurPenelitianSuatuPendekatanPraktik. Jakarta, PT. RinekaCipta.

[9] Tjokrodimuljo K. (1996). TeknologiBeton. Yogyakarta, Naviri.

This page is intentionally left blank