Concrete Asphalt Marshall Stability Using Concrete Objective Waste

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Abstract: The road is one of the most important infrastructures. The community needs it because the road functions to connect the source of production. Asphalt is an aggregate binding material in road pavement construction, which plays an important role in determining road pavement performance. Road Pavement, in general, uses materials that are still fairly common. This study uses a fine aggregate of crushed concrete specimens. The method used is an experiment on the addition of concrete test specimens with percentages of 10%, 20%, 30%, 40%, and 50%. Marshall method which is the basis for calculating the stability value and flow. the results of 5 Marshall test samples of asphalt concrete mix utilizing concrete waste obtained the characteristics of the average value of the study that all had met Highways' requirements at a VMA value of 18.22%, a value of 4.22 VIM.%, VFB value 75.04%, STABILITY value 4806 kg, FLOW value 3.24 mm, and Marshall Quotient (MQ) value 14958.1 kg / mm.

Keywords: Marshall Method, Laston, Concrete Test Wastes

INTRODUCTION

The road is a land transportation infrastructure, which is a supplementary building for traffic movement.(Hasan et al., 2020) in general, ways are below and above ground and water levels. (Government Regulation No. 34 of 2006 concerning Roads).(Syaifuddin dan Hasilani, 2013) The material to be used must meet the characteristics of flexibility, stability, durability, and water resistance.(Gunarto, 2019) Concrete Asphalt Layer is a cover for road pavement construction with structural value first developed in America by The Asphalt Institute under the name Asphalt Concrete (AC).(Borges Cabrera et al., 2017) According to the Public Works Department of Bina Marga, this mixture consists of continuous gradation aggregates with hard Asphalt, mixed, spread, and compacted in hot conditions at a specific temperature.(Widojoko & Purnamasari, 2012) The mixing temperature is determined based on the type of Asphalt to be used.(Ziari et al., 2019) Whereas what is meant by continuous gradation is a composition that shows an even distribution of grains ranging from the most significant size to the smallest size.(Dalhat et al., 2020) Asphalt concrete with continuous gradation mixture has a composition consisting of coarse Aggregate, Fine Aggregate, mineral filler (filler), and Asphalt (bitumen) as a binder.(Zhou et al., 2019) In general, the use of asphalt pavement composition is 4-10% based on the mixture's total weight. Natural Aggregate is one of the main elements of asphalt mixture, base lane, and subbase of highways, airports, walkways, and parking lots.(Nwakaire et al., 2020) It is also an equally important material for Portland cement concrete mixtures used in rigid pavement construction, buildings, industrial facilities, and land structures.(Arabani & Mirabdolazimi, 2011)

Aggregates and their fractions processed thus become essential industrial commodities for the construction sector. Natural aggregates are the main ingredient in a mixture of asphalt

concrete and cement Portland.(Gunarto & Candra, 2019) Concrete waste of test specimens derived from sample specs can be used in asphalt mixtures to eliminate potential problems arising from disposing of materials and saving natural aggregate resources.(Fanani et al., 2017) This study uses a revised standard Marshall design method to prepare specimens that meet the minimum size and aspect ratio requirements in uniaxial testing.(Utama, 2005) The use of recycled concrete aggregates in highway construction, i.e., as an aggregate of asphalt mixture or Portland cement mixture, is one way to reduce the need for natural Aggregate because of its considerable economic and environmental benefits.(Firdaus, 2010) Uniaxial testing of laboratory specimens is useful as a measure of the relevant mechanical properties of materials as specific geometric requirements.(Manjunath et al., 2014)

LITERATURE REVIEW

2.1. Asphalt

Asphalt or bitumen is a brown-black material that is viscoelastic. It will soften and melt if it gets enough heating and vice versa.(Lv et al., 2018) Mixing temperature is determined based on the type of Asphalt to be used. If asphalt concrete, the mixing temperature is generally between 145 ° C and 155 ° C, so hot Asphalt is called a concrete mixture.(Ahmedzade et al., 2007) This mixture is better known as a hot-mix.(Alenezi et al., 2018) The dominant properties of asphalt concrete are more desirable and will determine the type of asphalt concrete chosen.(Gupta & Bellary, 2018) It is vital when designing the sidewall thickness. Road classifications that serve light traffic must give preference to Asphalt concrete types with high durability and flexibility(Javilla et al., 2017). The initial optimum estimation of asphalt content estimates the optimal asphalt content, according to the data specifications of the trial results and errors and based on the mixing value.(Anwar, 2016)

2.2. Aggregate

Aggregate is the main component of a road pavement structure that is 90-95% aggregate based on the percentage of weight, or 75-85% aggregate based on volume.(Jitsangiam et al., 2013) Thus, the quality of the pavement specified by the aggregate properties and the aggregate yield of other ingredients. A total is a collective collection of mineral materials such as sand, gravel, and broken rock.

2.3. Rough Aggregate

The coarse aggregate fraction for the design is the Aggregate held by filter No. 8 (2.36 mm). It must be clean, hard, durable, and free of clays or other undesirable material.(Liu et al., 2018)

Table 1. Rough Aggregate Provisions for Asphalt Concrete Mixture

Checking type	Standard	Conditions max / min
Abrasion with Los Angeles machines	SNI 03-3407-1994	Maks. 12%
brasion with a Los Angeles machine	SNI 03-2417-1991	Maks. 40%
ggregate adhesiveness to bitumen	SNI 03-2439-1991	Min. 95%

Angularity	SNI 03-6887-2002	95/90(*)
Flat and Oblong Particles	SNI T-01-2005	Maks. 10%
Material escaped sieve No.200	SNI 03-4142-1996	Maks. 1%

SOURCES: ROUGH AGGREGATE TESTING

2.4. Fine Aggregate

Fine aggregates are aggregates that pass filter no. 8 (2.38 mm). (Candra et al., 2020) Fine aggregates consist of natural sand, artificial sand, slag sand, or a combination of these materials. Fine aggregates must be clean, dry, secure, and free of clays and materials which interfere and consist of granules with sharp angles and a gauze surface.(Loaiza & Colorado, 2018)

Table 2. Excellent Aggregate Provisions for Asphalt Concrete Mixture

Checking type	Standard	Conditions max / min
Sand equivalent value	SNI 03-4428-1997	Maks. 50%
Material escaped sieve No.200	SNI 03-4142-1996	Maks. 8%
Angularity	SNI 03-6877-2002	Maks. 45%

SOURCES: FINE AGGREGATE TESTING

2.5. Concrete Waste Test Objects

waste is a material from the production process that can no longer. While the concrete test object waste is a real sample that is no longer in use.(Gunarto & Candra, 2019)(Moropoulou et al., 2001) The Concrete debris used in this study came from the Civil Engineering Laboratory of Kadiri University

2.6. Marshall Testing

This Marshal test aims to determine the stability and stability of the asphalt mixture following SNI 06-2489-1991. Before being tested, the specimens were put in a water bath at 60 ± 1 ° C for 30 minutes.(Zhou et al., 2019) Then the samples are removed from the sink and placed in a Marshall testing machine for further testing.(Nwakaire et al., 2020)

METHOD

In this study, an experimental program finds the vulnerability of Asphalt concrete samples using concrete specimen waste as a fine aggregate using revised Marshall procedures.(Gyan & Univeristy, 2018) Aspect ratio. Laboratory mixtures are prepared on various gradations and asphalt content to determine the number of punch designs needed for the revised Marshall procedure.(Article & Donner, 2011) In the second phase, the specimen. After all the results of testing the physical properties of the material and by the specifications, then the planning of making test specimens and testing Marshall. The real experimental method True-Experimental Research in this study with experiments in the Civil Engineering laboratory Kadiri University

3.1 Tools used

The equipment used in this study are as follows:

1. A set of sieves to grade fine aggregates and coarse aggregates.

2. Asphalt/ductility test.

3. Los Angeles Aggregate/machine test tool (abrasion test)

4. Dryers are ovens.

5. Digital Scales

6. Specific gravity test equipment.

7. Marshall press.

8. Machine for printing cylindrical specimens with a diameter of 4 inches (10.16) with 3 inches (7.5).

9. Marshall automatic compactor.

10. Ejector

11. Water bath

3.2 Material Used

- *Rough aggregates/coral*

- *Fine aggregate/sand is.*

- *Filler / PC Cement*

- *Oil asphalt or bitumen*

- *Concrete Test Object Waste*

3.3 Research Phase

The research stages will be conducted from the beginning to the end, as explained as follows:

1. Preparation.
   For preparing the material, check the tools to be used—preparation of Materials such as Asphalt, Coarse Aggregate, Fine Aggregate, filler.
2. Material testing
   - Coarse Aggregate, Fine Aggregate, and filler
     Aggregate testing is needed as a filler in asphalt mixtures with gradation compositions following gradations used that meet existing specifications. Coarse and fine aggregates must filter analysis tested, specific gravity, absorption, and filler. The material used is limestone ash, with a level of use of 4% on each test object. The following are the standard provisions for aggregate inspection.
   - Asphalt.
     Asphalt testing by conducting penetration tests, softening points, Ductility, specific gravity, and weight loss

RESULTS AND DISCUSSION

4.1 Marshall's Electrical Test Results.

In this Marshall test there is a mixture of the addition of concrete specimen's waste as a fine aggregate with a percentage of 10%, 20%, 30%, 40%, 50%, the results of the Marshall test can be seen in Table 4.

Table 4. Results of Marshall Characteristics Test for All Parameters Taken Average

No	Test Objects Concrete	VMA %	VIM %	VFB %	Stability Kg	Flow mm	MQ Kg/mm
1	10%	17,79	3,21	71,49	3847	3,16	1208,4
2	20%	18,12	4,52	74,22	4262	3,23	1387,3
3	30%	18,37	5,27	76,72	4956	3,25	1390,5
4	40%	18,39	4,78	75,81	5438	3,29	1632,4
5	50%	18,47	3,36	76,78	5553	3,30	1672,1
Average		18,22	4,22	75,04	4806	3,24	14958,1
Specification		>15%	3-5%	>65 %	>800 kg	2-4 mm	min 250

SOURCES: MARSHALL TESTING RESULTS

From the results of testing the characteristics of the table the highest VMA value is found in the percentage of concrete waste mixture 50% with a value of 18.47% and the lowest value in the percentage of concrete specimens waste mixture 30% with a value of 17.79%, for the highest VIM value is in the percentage of concrete specimens waste mixture 30% with a value of 5.27% and the lowest value is in the percentage of concrete specimens waste mixture 10 %% with a value of 3.21%, for the highest VFB value, it is found in the percentage of the mixture of the concrete specimen waste 50% with a value of 79.78%, and the value is in the percentage of the concrete specimen mixture 10% with a value of 71.49%, for the highest stability value is found in the percentage of concrete test object waste mixture 50% with a stability value of 5555kg, and for the lowest value stability is in the percentage of concrete mixture test object waste 10% with a value of 3847 kg, for the highest flow value is the percentage of the mixture of concrete specimens waste 50% with a value of 3.24 and the lowest value is found in the percentage of the concrete specimens waste mixture 10%, with a value of 3.16mm, for the highest MQ value contained in the percentage of concrete specimens waste mixture 50% with the value of 1672.1 kg / mm and the lowest value was found in the percentage of the mixture of the waste of the concrete specimen 10% with a value of 1208.4 kg / mm.

4.2 Concrete Mixture at VMA Value

Based on the 2010 general specifications, Revision 3, Division 6 on Asphalt Pavement requires the highest VMA value in the percentage of demolished concrete specimens 50% with a value of 18.47% greater compared with more VMA values in the 10% concrete specimen waste

packaging of 17.79%. While the mixture of 20%, 30%, and 40% of each VMA value is 18.12%, 18.37%, and 18.39%.
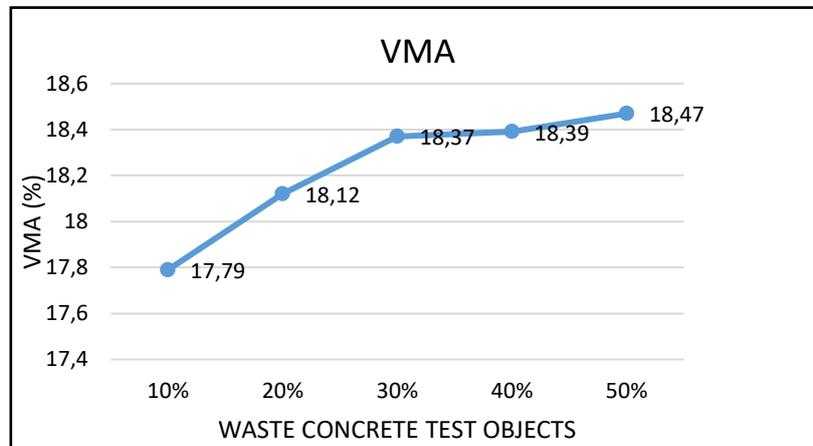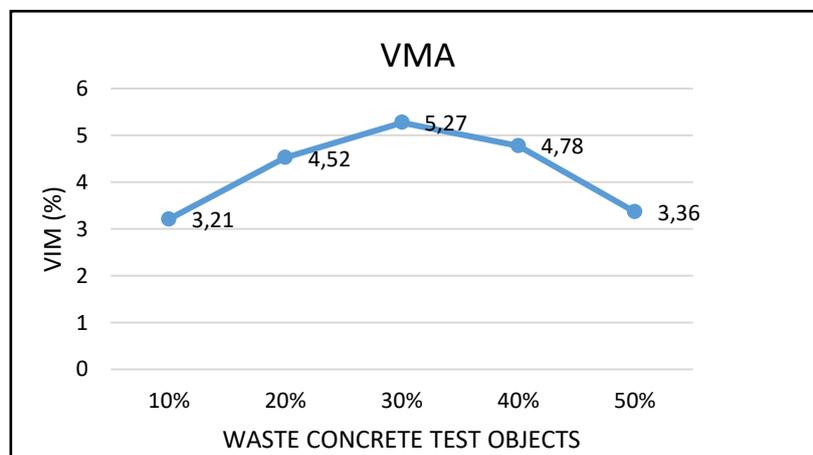

FIGURE 4.2. VMA VALUE GRAPH

4.3 Concrete Mixture at VIM Value

Based on the 2010 Bina Marga general specifications, Revision 3, Division 6 on Asphalt Pavement requires that the VIM value in the Asphalt concrete mix specimen waste 30%, must be higher than 5.27 % of the VIM value of percentage10% of waste valued at 3.21%. Whereas the mixture of 20%, 40%, and 50% of each VIM value was 4.52%, 4.78%, and 3.36%.

FIGURE 4.3. VIM VALUE GRAPH

4.4 Concrete Mixture at VFB Value

Based on the 2010 General Specifications, Revision 3, Division 6 on Asphalt Pavement. The volumetric test results of asphalt mixture using a mixture of concrete specimens as fine Aggregate as a binder in the form of VFB parameters showed values of 71.49%, 74.22%, 76.72%, 75.81%, 76.78%, for each - each has a mixed percentage of 10%, 20%, 30%, 40%, and 50% and all the mixtures meet the 2010 general specifications, revision 3, division 6 regarding Asphalt Pavement
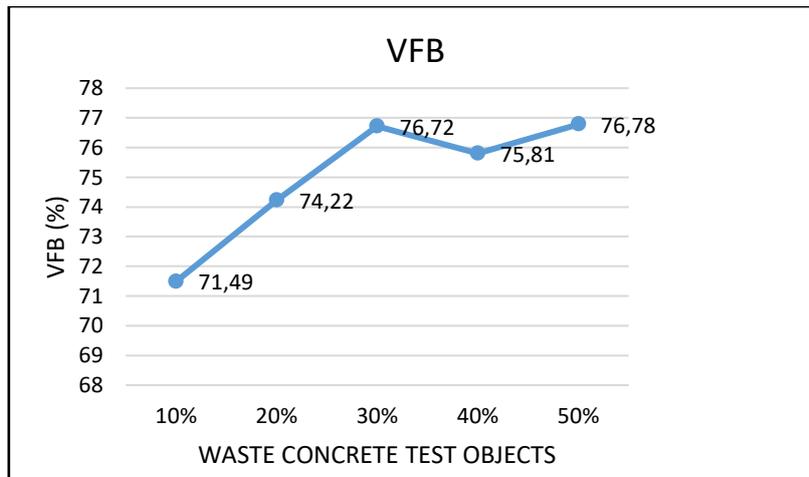
FIGURE 4.4. VFB VALUE GRAPH

4.5   Concrete Mixture At STABILITY

The test results' stability value almost meets the specifications of Bina Marga, Revision 3, 2010.The highest stability value in the mixture of 50% Concrete Waste is 5,553 kg. The lowest stability value is in 10% of concrete specimen waste with a stability value of 3847 kg. And all levels of the mixture meet the 2010 general specifications, revision 3, division 6 on Asphalt Pavement
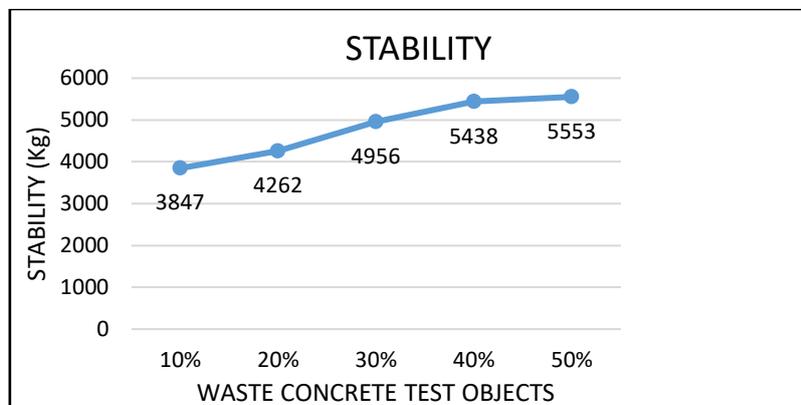

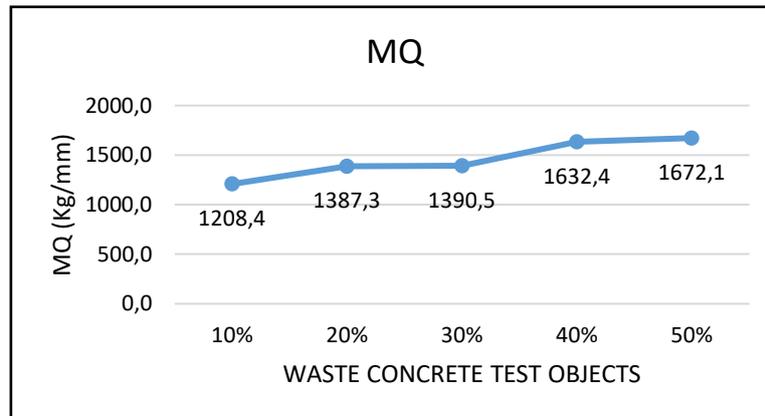**FIGURE 4.5.** STABILITY VALUE GRAPH

4.6   Concrete Mixture at FLOW Value

Based on the flow values obtained already meet the specifications set by Bina Marga, which is 2 mm to 4 mm. The flow value in the concrete mixture waste mixture is 10%, 20%, 30%, 40%, and the highest flow value in the 50% tile mix is 3.30 mm. In comparison, the lowest flow value in the mixture of the test object waste 10% concrete, with a value of 3.16mm.
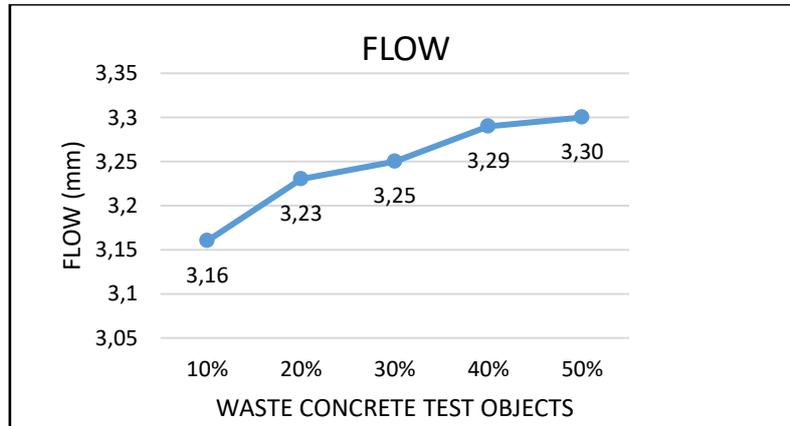
FIGURE 4.6. FLOW VALUE GRAPH

4.7 Concrete Mixture at MQ Value

Based on the MQ test results, the lowest MQ value is in the mixture of concrete specimens at a 10% percentage of 1208.4 kg / mm. The highest MQ value in the mixture of concrete specimens with 50% percentage of 1672.1 kg / mm, and the respective percentages of 20%, 30%, and 40% are 1387.3 kg / mm, 1390.5 kg / mm, and 1632.4 kg / mm. The low MQ value in the percentage of 10% of concrete specimens waste.

FIGURE 4.7. MQ VALUE GRAPH

CONCLUSIONS

the use of five samples of concrete waste with an average rating below 10%, 20%, 30%, 40%, 50% by Marshall method shows VIM, VMA, VFB, Stability Value, Flow, and MQ meet the requirements of Bina Marga:

1. Average VIM value: 4.22%
2. Average VMA value: 18.22%
3. Average VFB value: 75.04%
4. Average Stability Value: 4806 kg
5. Average Flow Value: 3.24 mm
6. Average MQ value: 14958.1 kg / mm

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