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The Effect Of Abrasion's Value And Cbr Of Class A's Aggregate Foundation's Layer (LPA) On Bina Marga's 2018 Specification's Curves

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ABSTRACT : *This study aims to identify the abrasion's values from material sources that are common in South and Central Kalimantan. Analyzed the effects of abrasion's value against LPA gradation changes to their compaction. Analyzed the effects of abrasion against CBR. Analyzed gradation's value effect of LPA on CBR and analyzed the effect of the level of degradation of the Bina Marga's 2018 specifications. The materials used in this research are LPA from Martadah, Awang Bangkal, Kayangan Mountain at South Kalimantan and from Hampangen's LPA at Central Kalimantan, which has been compacted in according OMC (Optimum Moisture Content). standart. With varying gradations mix refers to the Bina Marga's 2018 specificatio. The method used in this research are abrasion test; sieve analysis before and after compaction; the atterbeg boundaries, before and after compaction and CBR laboratory's scale.*

Abrasion's value derived from four LPA's sources – Martadah's material got 39.32% with CBR's value on average by 58.49%, Awang Bangkal had 30.30% with CBR's value on average by 59.38%, Kayangan Mountain had 28.88% with the CBR's v value on average by 63.31% and Hampangen had 34.92% with CBR value on average by 87.78%. The results showed that abrasion's value varies with the time of testing. It is indicated as a result of the material's loading effects, pressure and temperature of the material, the water content as well as geological elements of the material. The abrasion value does not affect the change in the upper and lower limit specification curves after compaction, in the study it was found that the grain size (diameter) was the grain that influenced the change in the gradation curve after the compaction. The abrasion value affects the CBR value. To reach the optimum point CBR value that is close to specifications, the abrasion value must be in the range 28.88-34%.

The test results are obtained changes in aggregate grain behavior such as an increase in CBR values that have been modified gradations. Gradation before being modified has the highest CBR value at 10x strokes of 29.04%, while 30x strokes has the highest CBR value of 44.106% and at 65x strokes has a CBR value of 62.448%, while the CBR that has been modified has the highest CBR value at 10x hits at 33.079%, while 30x hits has a CBR value of 58.808% and for 65x hits has a CBR value of 66.159%. it shows the increase in CBR value before and after gradation modification. so it can be concluded gradation affects the CBR value. From all material sources, the highest degradation was in the LPA-Martadah sample with a degradation rate of 25.21% and the lowest degradation was in the LPA-Hampangen with a degradation rate of 11,885%.

KEYWORDS *Abrasion's value; specification's curve; CBR; degradation.*

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I. INTRODUCTION

Transportation has a very important role in the development of the construction, technology and industry in various regions of Indonesia, especially on the road infrastructure sector. Roads are of transportation's infrastructure that badly needed by the people. This conclusion based on the fact that the road is supporting various development sectors and simplify the connection from one region to another (Sulistyoati, 1994). In road construction, just rely on the soil is not sufficiently strong and resistant without significant deformation of the repeadly wheel's load, so that the necessary additional layer on top of the road, called the pavement's layer. Planning on road pavement's layer should be adjusted to the condition and function of the road it self, the types of pavement is divided into flexible pavement and rigid pavement (Sulistyoati, 1994).

According to Sukirman (2010), road's pavement composed by surface course layer, base course layer, subbase course layer and subgrade layer. Base course itself consists of Aggregate Base Class A (LPA) and Aggregate Base Class B (LPB). According to Sukirman (2010) LPA function as part of the pavement structure that secures the vertical force of the weight of the vehicle and spread to the layers beneath it, in this case the LPB and the subgrade layer.

According to Bina Marga (2018), class A aggregate's base consists of a combination of coarse aggregate fraction and fine aggregate fraction. Aggregate's fraction curve must not be allowed to out of the upper and lower limit's curve, as shown in Figure 1.1.

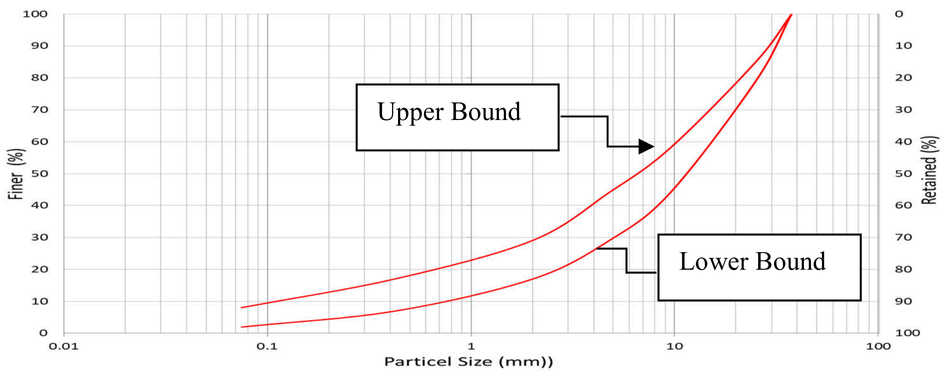

Fig.1. Upper and lower limit's gradation (Bina Marga, 2018)

Coarse aggregate fraction retained on a 4.75 mm sieve in Figure 1.1 consists of particles or pieces of stone which is hard and durable and meet the applicable requirements. While the fine aggregate fraction are particles of natural sand or finely crushed stone and other fine particles that passed a sieve of 4.75 mm and fulfill the requirements in accordance with the latest regulations in this case is Bina Marga's 2018 specifications as shown in Table 1.1.

Table 1.1 Properties of Aggregate Base LPA class, according to Bina Marga (2018).

Traits	General Specifications
Abrasion from Coarse aggregates (SNI 2417: 2008)	0 -40 %
Broken granules, restrained sieve 3/8 " (SNI 7619: 2012)	95/90 '
Liquid limit (SNI 1967: 2008)	0-25
Plasticity Index (SNI 1966: 2008)	0 - 6
The product of the Plasticity Index with % Passed Sifter No. 200	max. 25
Clumps of Clay and Granules are Easy to Break (SNI 03-4141-1996)	0 - 5 %
CBR laboratory (SNI 1744: 2012)	min. 90 %
Comparison of Sift Pass No. 200 and No. 40	max. 2/3

In this specification, it appears that the abrasion is one of the conditions that determine of coarse aggregate. Abrasion should be in the range between 0% to 40%. According to Bayhaqie (2018), in his study of *the effect of*

*variations in aggregate mixture LPA's class against permeability coefficient horizontal (k_h) which have been obtained from two different locations accidentally discovered that the gradation that has been designed to meet the requirements or is between upper and lower limit has been shifted out of specification's bounds, after aggregate's design compacted*as shown in Figure 2. that is shown gradation before compaction process and Figure.3. that is shown gradation after compaction process.

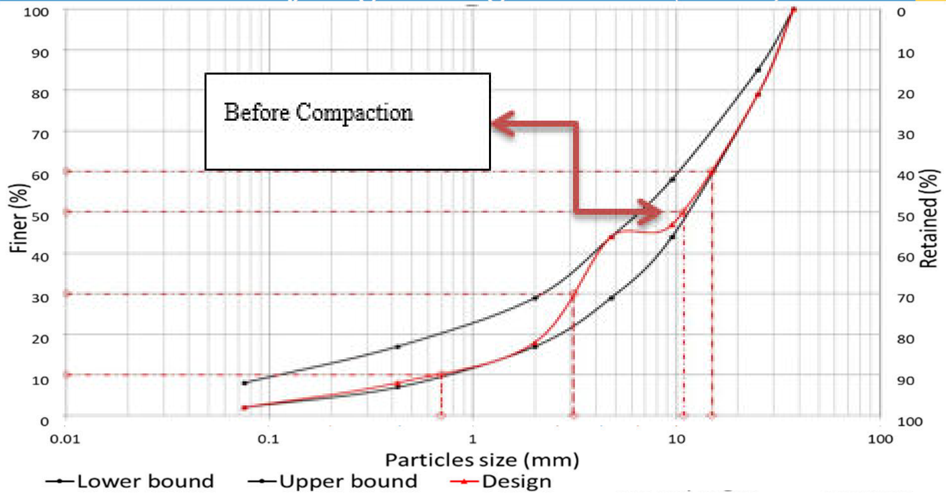

Fig.2. Gradient prior to compaction (Bayhaqie, 2018)

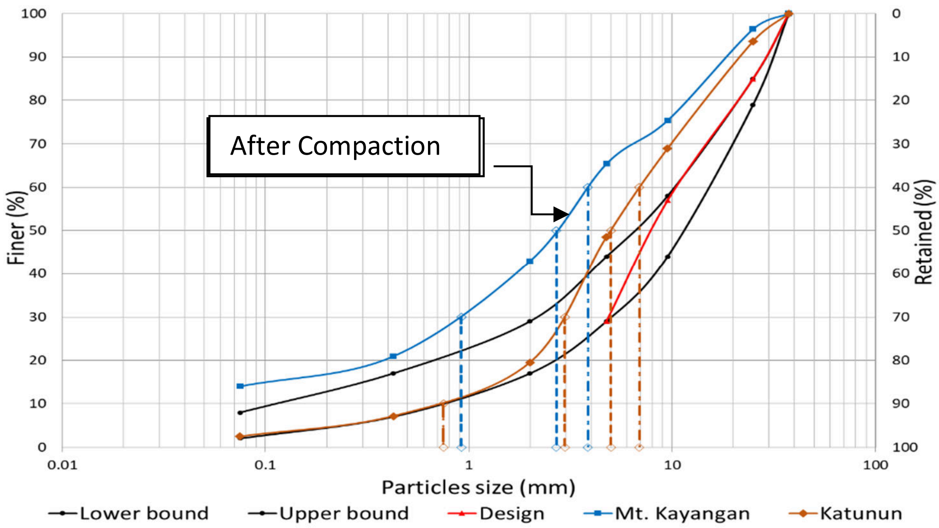

Fig.3. Gradation after compaction (Bayhaqie, 2018)

Figure 3, shows the phenomenon of the friction, this happens after the proctor compaction test, the data changes as a result of the outbreak of the granules thus becoming ineligible with upper and lower limit specification curve. This is shown in Figure 3. Kayangan Mountain's gradation curve looks shifted further in the draft than the Mount Katunun's gradation curve. This is possible because of the the shifted range towards a gradation design is affected by the abrasion value.

Based on the conditions above, we have to do kind of research that focuses on to effects of the abrasion value resulted to the changes of Bina Marga's 2018 specifications curve. This research is expected to contribute benefit both to academic and practitioner.

II. LITERATURE INTERVIEW

According to Bina Marga (2018), aggregate base (LPA) consists of a combination of coarse aggregate fractions and fine aggregate fractions. Coarse aggregate fraction retained on a 4.75 mm sieve must consist of particles or pieces of stone is hard and durable that meet the requirements. While the fine aggregate fraction are particles of natural sand or finely crushed stone and other fine particles that passed a sieve of 4.75 mm and meet the requirements in accordance with the specifications of Bina Marga at 2018. LPA serves as the foundation for the pavement on it and serves as a water-conducting layer / layer drainage. So that there are no puddles on the road base course. As for the grain size are matched to the table 2.1. which are gradation of aggregate base according to Bina Marga at 2018.

Table 2.1. Gradation of Aggregate Base (Bina Marga, 2018)

Sieve Size		Percen Finer %		
ASTM	(mm)	Class A	Class B	Class S
2"	50	-	100	-
1½"	37,5	100	88 – 95	100
1"	25,0	79 – 85	70 – 85	77 – 89
3/8"	9,50	44 – 58	30 – 65	41 – 66
No. 4	4,75	29 – 44	25 – 55	26 – 54
No. 10	2,0	17 – 30	15 – 40	15 – 42
No. 40	0,425	7 – 17	8 – 20	7 – 26
No. 200	0,075	2 – 8	2 – 8	4 – 16

Table 2.2. The properties of Aggregate Base (Bina Marga, 2018)

The properties	Class A	Class B	Class S
Abrasion from Rough Aggregates (SNI 2417: 2008)	0 - 40%	0 - 40%	0 - 40%
Broken granules, restrained sieve 3/8 "(SNI 7619: 2012)	95/90 [1)]	55/50 [2)]	55/50 [2)]
Liquid Limits (SNI 1967: 2008)	0-25	0 - 35	0 - 35
Plasticity Index (SNI 1966: 2008)	0 - 6	0-10	4-15
The product times the Plasticity Index with% Passed Ayakan No. 200	Max.25	-	-
Clays of Clays and Easy-to-Break Grains (SNI 03-4141-1996)	0 - 5%	0 - 5%	0 - 5%
CBR submersion (SNI 1744: 2012)	Min.90%	Min.60%	Min.50%
Comparison of percent escaped sifter No. 200 and No.40	Max.2 / 3	Max.2 / 3	Max.2 / 3

According to Sukirman (2003), aggregate may be degraded, the gradation changes due to rupture of a grain aggregate. Aggregate destruction can be caused by a mechanical process, such as the forces that occur during the process of implementation of the pavement (hoarding, overlay and compaction), services for traffic load and the chemical processes such as the influence of moisture, heat, and temperature changes throughout the day.

According Bayhaqie (2018), the solidification process or used to know with compaction process carried out on samples of the granules resulting in rupture of aggregates. This can be proved by a sieve analysis test after the compaction process had completed. As for the changes in grain size can be seen in changes in the shape and position of the two types of LPA grading curve for each type of design gradation. In research conducted sieve analysis test conducted on samples after compaction LPA – Kayangan and LPA - Katunun. The grading curve design (initially) that still meet the specifications shown in Figure 4.

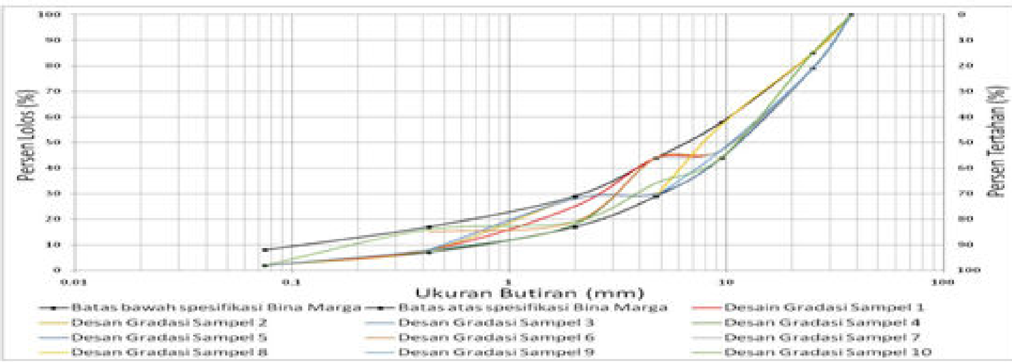

Fig.4. LPA grading curve design still meets the specifications (Bayhaqie, 2018)

The LPA gradation curve changes before and after the compaction can be seen in Figure 4.

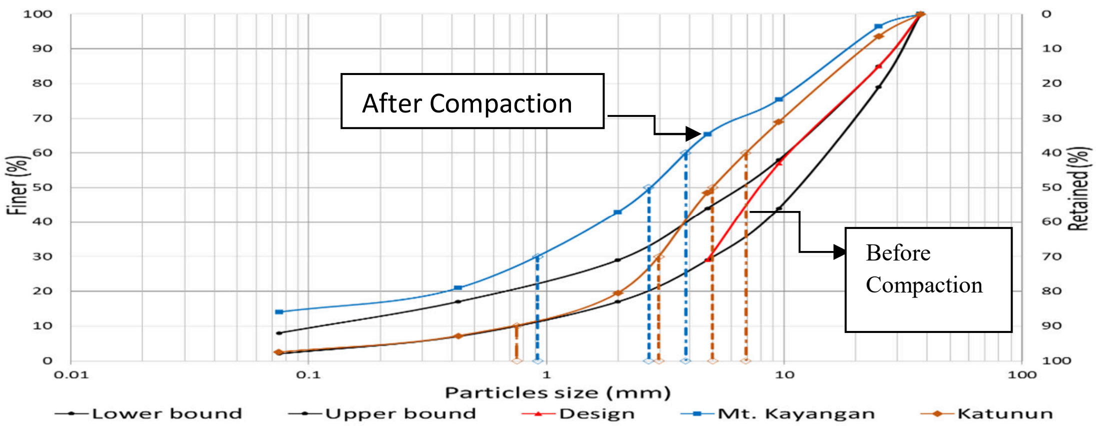

Fig.5. Gradation before and after compaction (Bayhaqie, 2018)

When seen in the displacement curve position, the two types of material in all types of mix turned out to be outside of the upper limit of the specifications provided. This resulted in actual gradation is not in accordance with the gradation design. Samples LPA - Kayangan tend to stray further the shift to the left when compared with samples LPA - Katunun. This means that the sample LPA - Kayangan changing grain size becomes smaller when compared to LPA - Katunun. This indicates the sample is LPA - Kayangan more wear. Parameter matching illustrates the wear rate of the aggregate abrasion value. If seen, there are significant wear of aggregate with grain size changes (due to compaction).

III. RESEARCH METHODS

The research was carried out in several stages. As for the beginning stages of the determination of the research topic and then go into the preparation stage. During the preparation stage to do a literature study of references in accordance with the purposes of research and conduct an inventory of the location of the quarry (LPA material resources) are selected based on the value of abrasion that have met the 2018 Bina Marga's specifications. The next stage which is done after the preparation stage, is the stage of the field. Field stage, including making test specimens from several locations were selected based on the value of abrasion which has been obtained from the testing that has been done by some previous researchers. From the results of the abrasion test the chosen location for the material with abrasion values that differ enough away that LPA-Martadah by 26%, LPA- Awang Bangkal with abrasion value amounted to 18.59%, and LPA - Kayangan by 38.65%. If the field phase has been implemented, the next step is the laboratory stage.

Laboratory stage includes an inventory of tools and checking tools. The tool is a set of sets of sieve analysis test tools, atterbeg test tools, tools for test compaction and CBR. Having ascertained all the tools available and ready for use to the next step to the checks stage and laboratorium's test. The test stage requirements and laboratory testing of the test specimen is consist of granular aggregate analysis test, while the tests are examinations of abrasion of coarse aggregate, grain inspection restrained broken sieve 3 / 8 ", the examination of the liquid limit, plasticity index checks with% passes a sieve no. 200, inspection blobs clays and friable grains, as well as comparisons percent passes inspection sieve no. 200 and no. 40.

After checking the requirements and testing of the test object based on the table Specifications of Highways in 2018 completed, before performing the test CBR perform the drying process with an oven and do sieving, which ended with a check gradation after solidified, and then proceed with the examination of the CBR in order to get the CBR value of each the location of the material. After all the testing is done, the analysis results are plotted into the strainer after compaction curve upper and lower limit at Bina Marga specification making it look if there are changes in the curve before and after the compaction.

After all stages complete, perform the data validation process. Validation is done on one source of material for testing abrasion, limit atterbeg, as well as testing CBR back and analyze the effect of the relationship with the Bina Marga's 2018 curve specification which include: identifying the abrasion value of each source material that is commonly used in South Kalimantan and Kalimantan Central as a source of reference in the collection of values abrasion that commonly used, to analyze the effect of abrasion value to changes in gradation LPA after the compaction, to analyze the effect of abrasion value of the CBR, gained influence gradation LPA to the value of CBR and gain influence the rate of degradation of the Bina Marga's 2018 techincal specification.

Figure 6. shows the gradation draft LPA prior to the test proctor compaction process, the image can be seen that the curve is such that it meets the upper and lower limit Bina Marga's gradation curve. The curve

consists of 3 samples. 1 sample was designed to be right between the upper and lower limit curves of Bina Marga which are denoted by the sample design Type 1, one sample was designed to be closer to the lower limit curve of Bina Marga which are denoted by the design of Type 2 and the final design was designed to be closer to the upper limit of the curve of Bina Marga that type 3 is denoted by design.

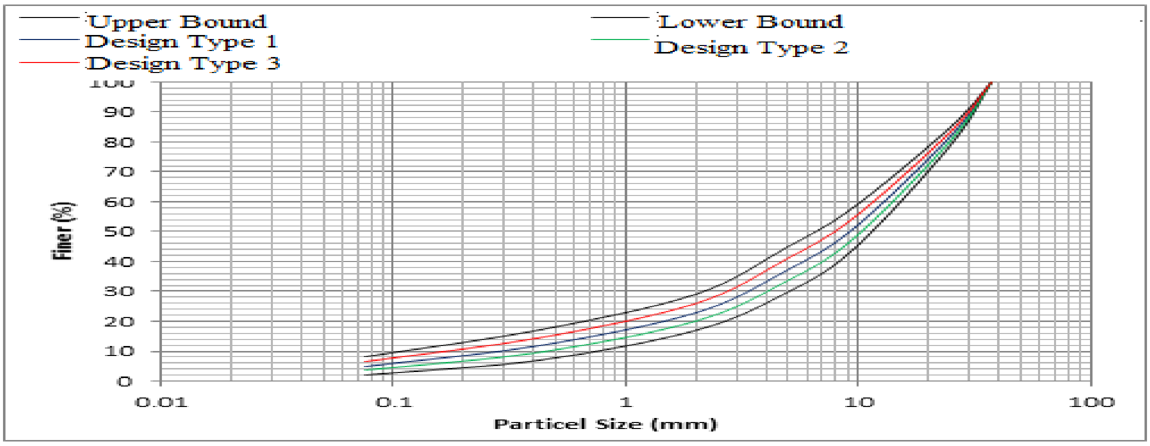

Fig.6. LPA designs a gradation curve

IV. DISCUSS

4.1. Examination of the requirements of the test specimen

Table 4.1 Abrasion Test Results of Coarse aggregate LPA Awang Bangkal, Martadah, Kayangan Mountain and Hampangen (SNI 2417: 2008).

No Ayakan.			LPA Awang Bangkal	LPA Martadah	LPA Gn. Kayangan	LPA Hampangen
Pass	Tertahan					
1½"	1"		1250 gr	1250 gr	1250 gr	1250 gr
1"	¾"		1250 gr	1250 gr	1250 gr	1250 gr
¾"	1/2"		1250 gr	1250 gr	1250 gr	1250 gr
1/2"	3/8"		1250 gr	1250 gr	1250 gr	1250 gr
Nomor Bola Baja			12	12	12	12
Nomor Putaran			500	500	500	500
Berat Sampel		(gr)	5000	5000	5000	5000
Berat Tertahan Sampel Pada Ayakan No. 12		(gr)	3485	3034	3556	3254
Nilai Abrasi		(%)	30.3	39.32	28.88	34.92
Spesifikasi		(%)	0 - 40	0 - 40	0 - 40	0-40
Keterangan			Memenuhi	Memenuhi	Memenuhi	Memenuhi

4.2. Analysis Results

Abrasion Value Classification

From the results of the early literature abrasion values obtained by study of literature that is Martadah around of 26%, Awang Bangkal around of 18.59%, Kayangan Mountain around of 38.65% and Hampangen around of 30%. However, after the abrasion test with the same material on the LPA obtained a new abrasion values and undergo significant changes and yet still be eligible in the Bina Marga's 2018 specification. For abrasion value difference results from the reference and test results can be seen in Table 4.2.

Table 4.2. Differences abrasion value

LPA	ABRASION Reference (%)	examination (%)
LPA-Martadah	26	39.32
LPA-Awang Bangkal	18:59	30.3
LPA-Gn.Kayangan	38.65	28.88
LPA-Hampangen	30	34.92

From the test values obtained abrasion change and not keep it indicated due to the effect of age on aggregate, the composition of aggregate (element geology and mineral), the influence of temperature and pressure, the method of taking the aggregate, and the influence of water in the pores of the aggregate but each LPA these still qualify in accordance with the table table 1.1 General Bina MArga's 2018 Specifications.

4.2. Gradation Curve Analysis After Compaction

Gradation Curve Design

Figure 7. shows the gradation draft LPA prior to the test proctor compaction process, the image can be seen that the curve is such that it meets the upper limit and lower limit gradation curve Highways. The curve consists of 3 sampels.

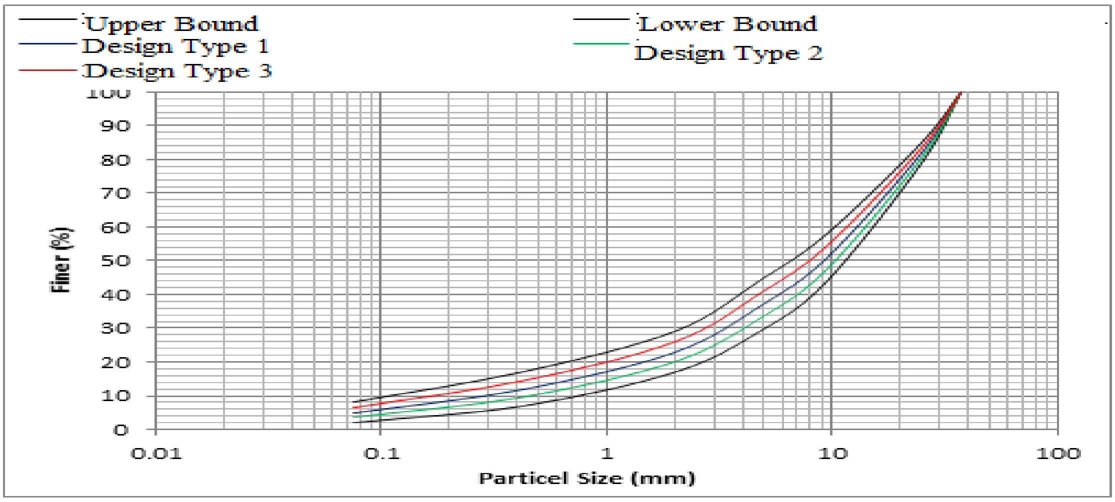

Fig.7. Gradation's drafts before compacting

Gradation curves After Compaction

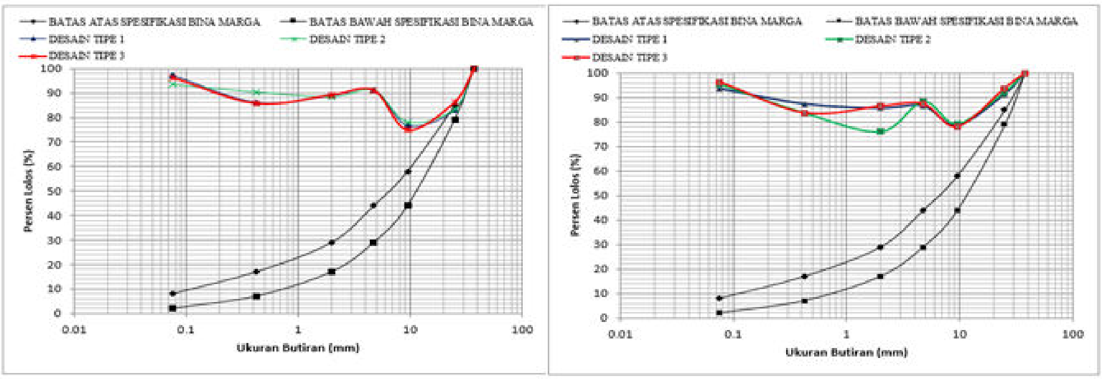

Fig.8. After compaction Left: Gradient Martadah, Right: Gradient Awang Bangkal

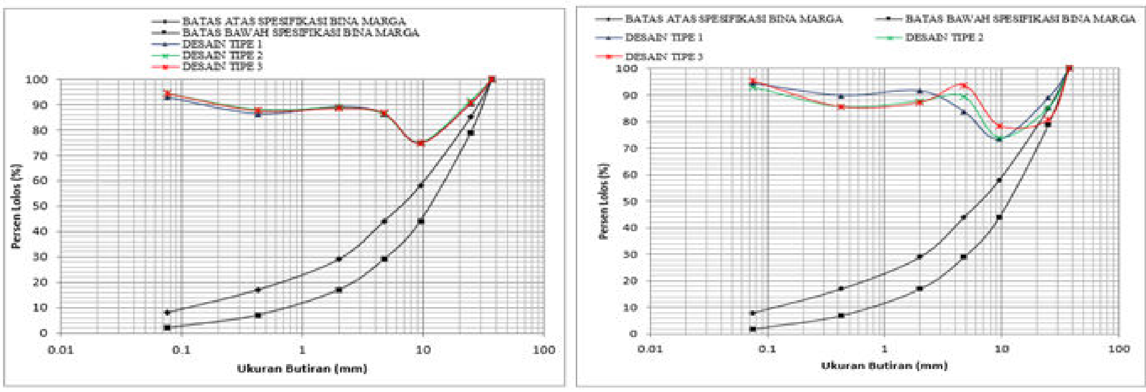

Fig.9. after compaction Left: Gradient Gn. Kayangan, Right: Gradient Hampangen

Figure 8 sd 9 is the result of sieving on each source material that LPA- Kayangan, Awang Bangkal and Hampangen after compaction by design Type 1, 2 and 3, where the figures show a curve to be altered by pamadatan process. Curves that initially meets the curve of the upper limit and lower limit after the compaction process is much eased curve upper limit and lower limit so that after compaction can be seen the results of sieve analysis which already does not meet the specifications it is caused by the rupture of the grains of the aggregate result of the compaction process.

Gradation curves Combined After Compaction

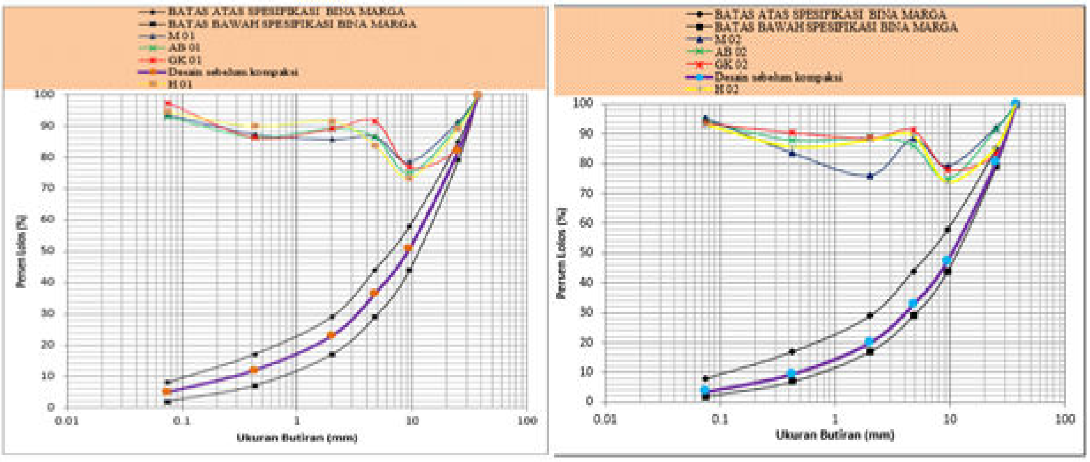

Fig.10. Combined gradations before and after compaction Left: Gradient Tipe1, Right: Gradient Type

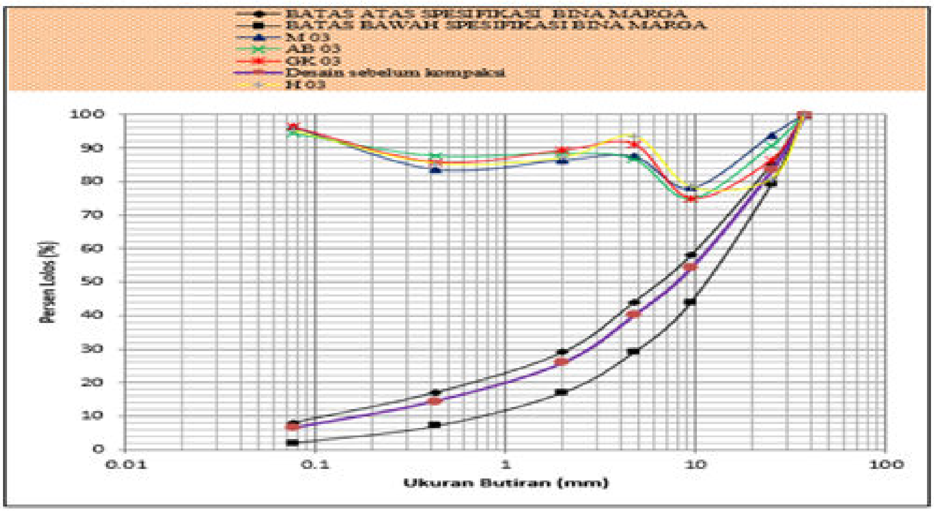

Fig.11. Combined gradations before and after compaction Left: Gradient Type 3

Figure 10 sd 11 shows the change curve first before compacting and after compacting by each source material is divided into each design type. The curve shows all the source material to do the compaction process on all type of changes that are relatively the same, or it can be said percent qualify (percent loss of granules) each change relatively equal between the four sources of material, both of LPA-Martadah which has abrasion value 39.32 %, Kayangan which has a value of 28.88% abrasion, Awang Bangkal which has a value of 30.30% and Hampangen abrasion which has a value of 34.92% abrasion.

Table 4.3. Recapitulation ratio percent gradation restrained design with actual gradation gradation Martadah LPA- design early and gradation after compaction

Sebelum pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel 3 tertahan (Kg)	Setelah pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel3 tertahan (Kg)
1 1/2 "	0	0	0	1 1/2 "	0	0	0
1"	3.6	3.9	3.3	1"	1.725	1.561	1.25
3/8"	6.2	6.6	5.8	3/8"	4.273	4.136	4.38
No. 4	2.9	2.95	2.85	No. 4	2.676	2.325	2.517
No. 10	2.7	2.55	2.85	No. 10	2.86	4.767	2.71
No. 40	2.2	2.1	2.3	No. 40	2.528	3.272	3.265
No. 200	1.4	1.2	1.6	No. 200	1.29	0.928	0.735
Pan	1	0.7	1.3	Pan	0.164	0.172	0.101

Table 4.4. Recapitulation ratio percent gradation restrained design with actual gradation gradation LPA-design Awang Bangkal first and gradation after compaction

Sebelum pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel 3 tertahan (Kg)	Setelah pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel3 tertahan (Kg)
1 1/2 "	0	0	0	1 1/2 "	0	0	0
1"	3.6	3.9	3.3	1"	1.94	1.686	1.889
3/8"	6.2	6.6	5.8	3/8"	5.007	5.032	5.041
No. 4	2.9	2.95	2.85	No. 4	2.731	2.783	2.683
No. 10	2.7	2.55	2.85	No. 10	2.17	2.257	2.307
No. 40	2.2	2.1	2.3	No. 40	2.728	2.416	2.488
No. 200	1.4	1.2	1.6	No. 200	1.42	1.131	1.138
Pan	1	0.7	1.3	Pan	0.237	0.103	0.095

Table 4.5. Recapitulation ratio percent gradation restrained design with actual gradation gradation LPA-design Gn. Kayangan first and gradation after compaction

Sebelum pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel 3 tertahan (Kg)	Setelah pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel3 tertahan (Kg)
1 1/2 "	0	0	0	1 1/2 "	0	0	0
1"	3.6	3.9	3.3	1"	3.39	3.357	2.731
3/8"	6.2	6.6	5.8	3/8"	4.615	4.399	5.03
No. 4	2.9	2.95	2.85	No. 4	1.704	1.779	1.798
No. 10	2.7	2.55	2.85	No. 10	2.184	2.324	2.152
No. 40	2.2	2.1	2.3	No. 40	2.747	1.929	2.86
No. 200	1.4	1.2	1.6	No. 200	0.525	1.29	0.736
Pan	1	0.7	1.3	Pan	0.031	0.145	0.026

Table 4.6. Recapitulation ratio percent gradation restrained design with actual gradation gradation Hampangen LPA- design early and gradation after compaction

Sebelum pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel 3 tertahan (Kg)	Setelah pemadatan Nomor ayakan	Sampel 1 tertahan (Kg)	Sampel 2 tertahan (Kg)	Sampel3 tertahan (Kg)
1 1/2 "	0	0	0	1 1/2 "	0	0	0
1"	3.6	3.9	3.3	1"	2.195	2.938	3.849
3/8"	6.2	6.6	5.8	3/8"	5.314	5.219	4.329
No. 4	2.9	2.95	2.85	No. 4	3.257	2.122	1.287
No. 10	2.7	2.55	2.85	No. 10	1.695	2.442	2.569
No. 40	2.2	2.1	2.3	No. 40	2.035	2.89	2.91
No. 200	1.4	1.2	1.6	No. 200	1.12	1.422	0.95
Pan	1	0.7	1.3	Pan	0.395	0.59	0.515

Effect of Abrasion Value with Percent Passed
Type 1

To determine the effect of changes in the value of abrasion against the curve can be seen in the curve with the percent abrasion value comparison escapes in Figure

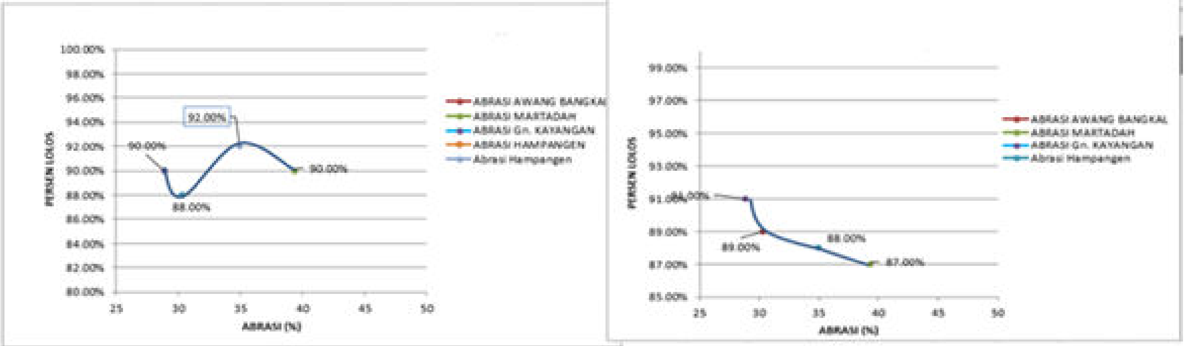

Fig.12. Combined gradations before and after compaction Left: gradation D10, Right: gradation D30

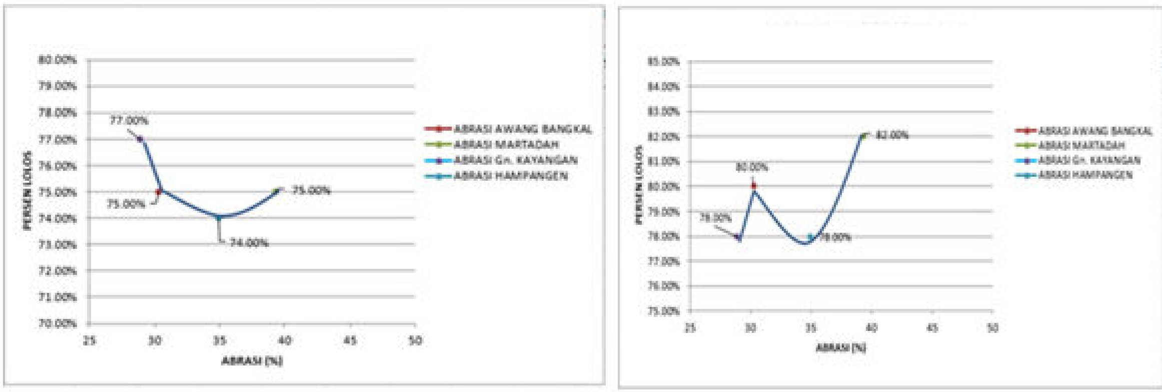

Fig.13. Combined gradations before and after compaction Left: gradation D50, Right: gradation D60

Type 2

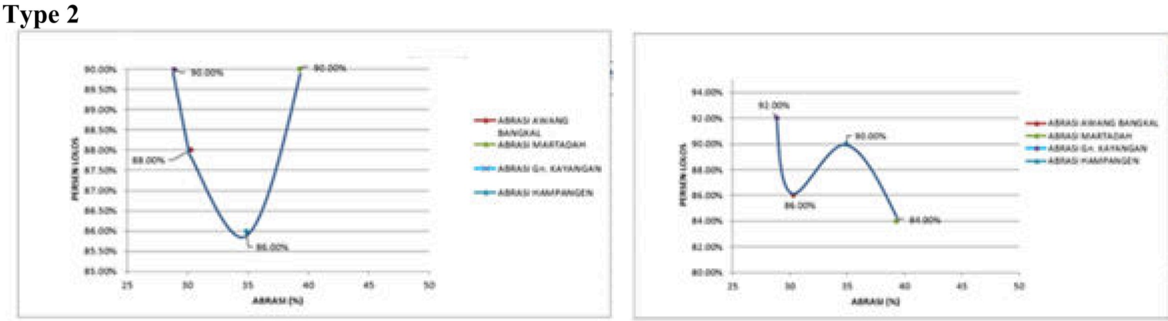

Fig.13. Combined gradation's curve, before and after compaction Left: gradation D10, Right: gradation D30

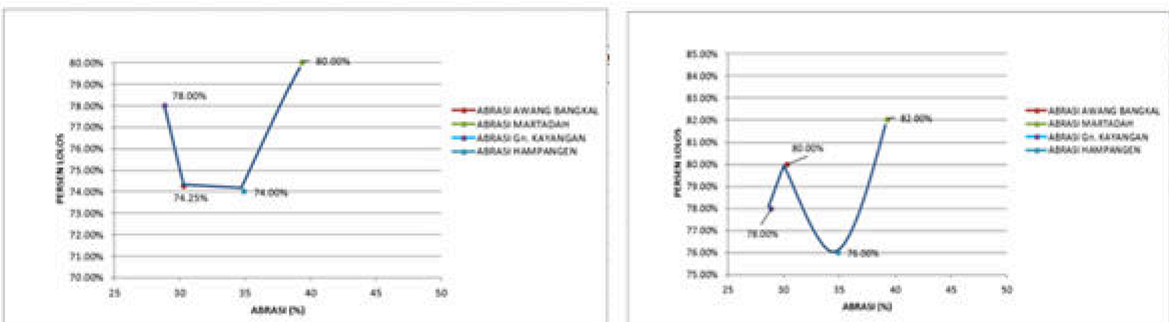

Fig.14. Combined gradation's curve before and after compaction Left: gradation D50, Right: gradation D60

Type 3

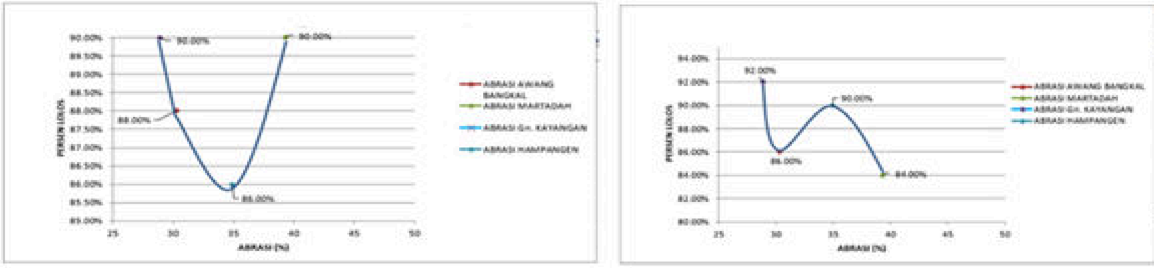

Fig.13. Combined gradation's curve, before and after compaction Left: gradation D10, Right: gradation D30

Fig.14. Combined gradation's curve before and after compaction Left: gradation D50, Right: gradation D60

After repeated the research and focusing to particularly on abrasion and percent of qualify after compaction by curve comparison of abrasion and percent of qualify in Figure 16 to 20, the results are not linear which had showed to a statement on the journal Bayhaqie, 2018 on the Influence of Variation of Mixed Aggregate Class A (LPA) against the Horizontal Permeability coefficient (K_h), the results of the analysis showed changes that occurred specifications curve is not affected by abrasion value of each source material. So do a re-analysis of the factors affected to the specification's curve that may occur either by analyzing the effect of aggregate's diameter of each source material.

Curve Ratio Before and After Compacting Design Type 1

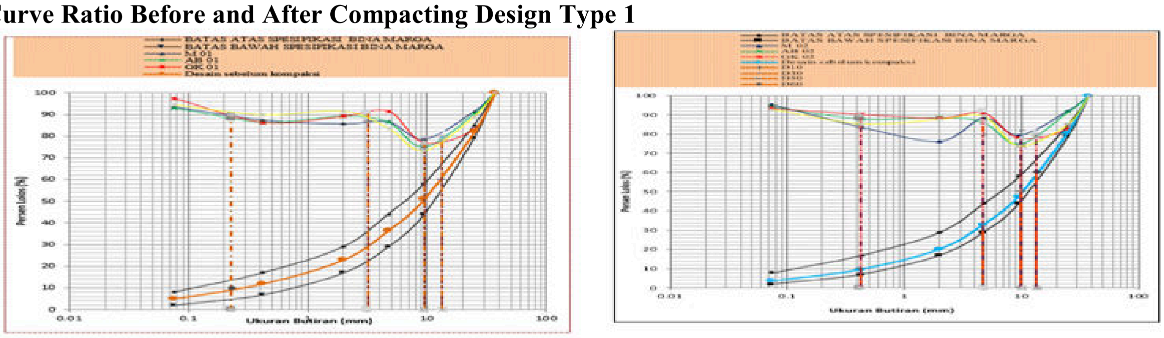

Fig.16. Combined gradations before and after compaction Left: Gradient Type 1, Type 2 gradation Right

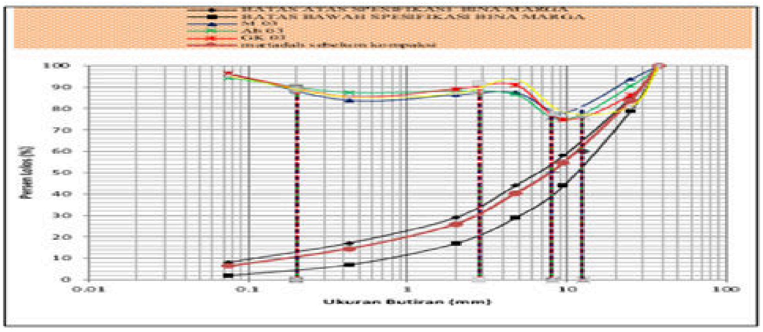

Fig.17. Combined gradations before and after compaction Gradient Type 3

Effect of Diameter Against Aggregate Curve Design

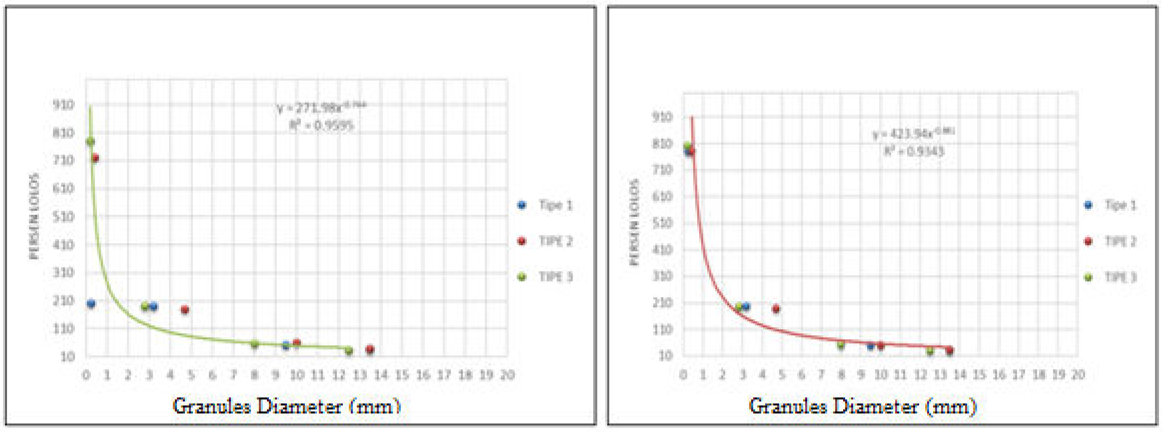

Fig.18. Curve percent qualify for D10, D30, D50, D60 Left: LPA-Martadah, Right: LPA-Awang Bangkal

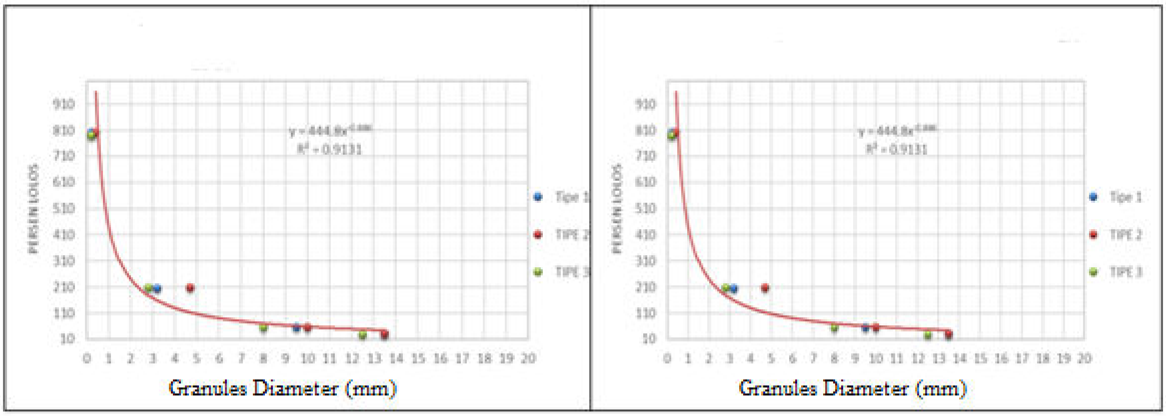

Fig.19. Curve percent qualify for D10, D30, D50, D60 Left: LPA-Gn. Kayangan, Right: LPA-Hampangen

From the curve comparison diameter with percent escapes obtained a conclusion that the size of diameterlah can be factors that cause changes in the curve General Specifications upper limit and a lower limit that can be evidenced by the smaller diameter of aggregates each passing granules and the larger the diameter of the granules percent escapes fewer and fewer. To see the relationship diameter of each source material with percent escapes can be seen in Figure 20.

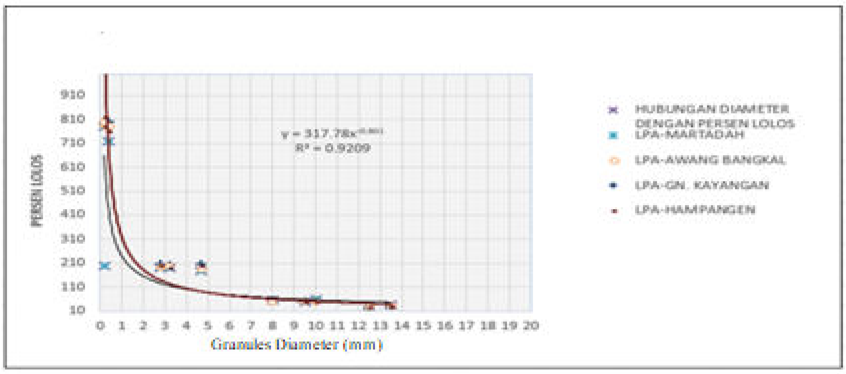

Fig.20. composite curve relationship and percent diameter escape

Effect of Abrasion value of the 95% Marinade Dried Volume CBR

Table 4. 7 Value abrasion and CBR value when dry volume weight of 95%

locations	sample 1	sample 2	sample 3	CBR average	Abrasion (%)
Martadah	47.98%	57.67%	69.83%	58.49%	39.32
Awang Bangkal	76.48%	56.05%	45.60%	59.38%	30.3
Gn. Heaven	59.85%	59.38%	70.70%	63.31%	28.88
Hampangen	90.25%	83.60%	80.50%	84.78%	34.92

In Table 4.7 shows the value of abrasion and CBR values that have been averaged. The tables show a high abrasion values have CBR value smaller than the source material that has a smaller abrasion value, but the source material that has a value abrasion Hampangen 34.92% shows a relatively increased value of CBR. So the results of these calculations be made to a range of numbers to determine optimum conditions CBR value. To determine the optimum value range CBR current dry conditions 95% and a maximum dry CBR can be seen in Figure 21.

Table 4.8 Value abrasion and CBR value when the maximum dry volume weight

locations	sample 1	sample 2	sample 3	CBR average	Abrasion (%)
Martadah	50.50%	60.70%	73.50%	61.57%	39.32%
Awang Bangkal	80.50%	59.00%	48.00%	62.50%	30.30%
Gn. Heaven	63.00%	62.50%	80.10%	68.53%	28.88%
Hampangen	95.00%	88.00%	76.48%	86.49%	34.92%

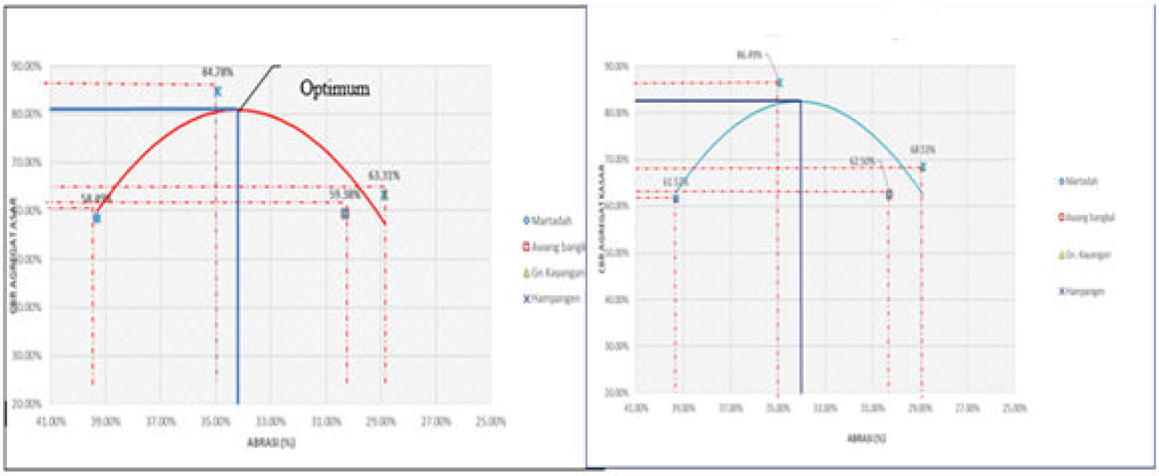

Figure 4.21. Curve abrasion comparison with CBR, Right: Dry 95%, Left: Maximum Dry

Dry CBR value ratio of 95% and a maximum dry:

$$\text{CBR Ratio} = \frac{\text{Smallest CBR Dry 95\% Value}}{\text{Smallest CBR Dry Value}}$$

$$= \frac{58.49\%}{61.57\%}$$

$$= 0.94\% = 1\%$$

Based on the calculation above, can be concluded that the value of the abrasion effect on the value of CBR also found the ratio of the value of CBR, the CBR value of dry 95% and the CBR dried to a maximum of 0.94, which means the value of CBR dry 95% is 0.95 times greater than the value of CBR when the maximum dry. From the comparison obtained showed that to plan the pavement thickness by using dry CBR maximum value, must use 0.95 times to the CBR dry conditions 95% value and to achieve the optimum point CBR value approaching the specifications we need, abrasion values are in the range of 28.88-34%

Gradient influence on the value of CBR

To get the effect of the increase in the value of CBR gradation can be seen in Figure 22. The curve shows the gradation for abrasion test in original condition and gradation on the conditions to be modified draft. Figure 22. a comparison gradation curve and the value of CBR. In these curves are designed in four types of gradation which aims to determine the effect of the gradation value of the increase in value of CBR. The first curve is a curve using the original gradation CBR test occurs after a relatively steady increase in the number of strokes. Unlike the three types of variation gradations do the design, look at the draft design gradation curve increased significantly compared to the original gradation or early.

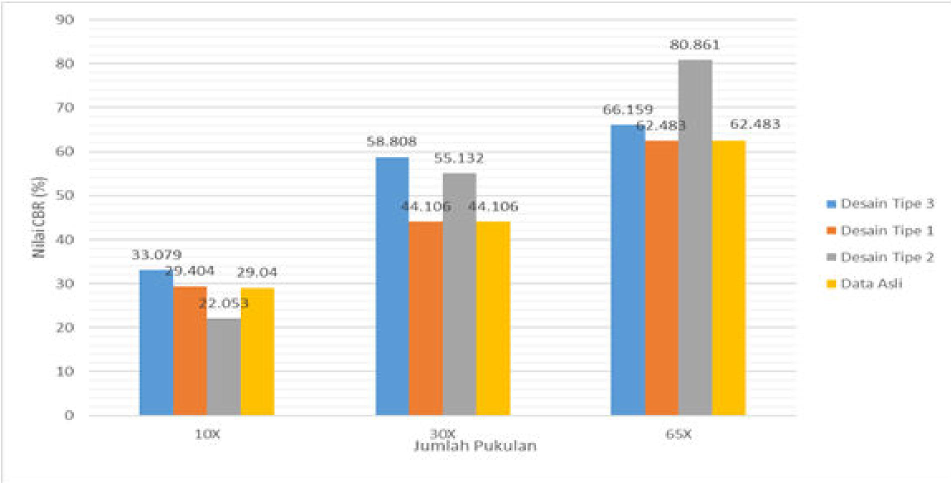

Figure 22. curve gradation ratio and CBR

With different gradations in each type of design seen on the curve also varies resulted in an increase to the increase in the value of CBR. Increasing the value of the highest CBR occur in the design of Type 2 when the number of blows to 65x with CBR value of 80 861% near specifications with a diameter smaller than the gradation on the design of Type 1 and Type 3. It can be concluded that the gradation affects the increase in the value of CBR. Altough it needs to be done to raisde the gradation design of the CBR value in order to meet the specifications.

The level of degradation of the curve

The level of degradation that occurs as a result of the outbreak of the grain caused by the compaction process resulting in the loss or destruction of certain grains of the material. Source material that has the highest rate of degradation indicates the aggregate on the source material has the strength withstand minor collisions so that it can be categorized as a type of aggregate that is not good to be a top pavement construction. While a good aggregate tends to have a small degree of degradation so that the aggregate is classed as a good material to be used as pavement construction. Value loss due to degradation of the details can be seen in Table 4.9 sd 4.13.

Table 4.9 Value grain loss due to compaction in LPA- Martadah

number sieve	sample 1 restrained (Kg)	sample 2 restrained (Kg)	sample 3 restrained (Kg)
1 1/2 "	0	0	0
1 "	1,875	2,339	-2.95
3/8 "	1,927	2,464	-16.1
No. 4	0224	0625	-9735
No. 10	-0.16	-2217	-10.7
No. 40	-0328	-1172	-14 025
No. 200	0:11	0272	-2075
pan	0836	0528	0795
% Degradation	22:42	14 195	25.21

Table 4.11 Values grain loss due to compaction in LPA- Awang Bangkal

number sieve	sample 1 restrained (Kg)	sample 2 restrained (Kg)	sampel3 restrained (Kg)
1 1/2 "	0	0	0
1 "	1.66	2214	-6145
3/8 "	1,193	1,568	-19 405
No. 4	0169	0167	-10 565
No. 10	0:53	0293	-8685
No. 40	-0528	-0316	-10.14
No. 200	-0.02	0069	-4.09
pan	0763	0597	0825
% Degradation	18,835	22.96	21 795

Table 4.12 Values grain loss due to compaction in LPA- Kayangan Mountain

number sieve	sample 1 restrained (Kg)	sample 2 restrained (Kg)	Sampel3 restrained (Kg)
1 1/2 "	0	0	0
1 "	0:21	0543	-10 355
3/8 "	1,585	2,201	-19.35
No. 4	1,196	1,171	-6.14
No. 10	0516	0226	-7.91
No. 40	-0547	0171	-12
No. 200	0875	-0.09	-2.08
pan	0969	0555	1:17
% Degradation	24.02	23 885	23 335

Table 4.13 Values grain loss due to compaction in the LPA-Hampangen

number sieve	sample 1 restrained (Kg)	20 %	sample 2 restrained (Kg)	sampel3 restrained (Kg)
1 1/2 "	0	0	0	0
1 "	1,405	7,025	0962	-15 945
3/8 "	0886	4:43	1,381	-15 845
No. 4	-0357	-1785	0828	-3585
No. 10	1,005	5025	0108	-9995
No. 40	0165	0825	-0.79	-12.25
No. 200	0:28	1.4	-0222	-3.15
pan	0605	3,025	0:11	-1275
% Degradation	19 945	19 945	11 885	17 955

The fourth source of material obtained from the rate of degradation is greatest in samples LPA-Martadah degradation rates of 25.21% on the design of the Type 3 and the lowest degradation are on the LPA-Hampangen degradation rates amounting to 11.885% in Type 3. So the best material to be used for pavement construction on the top of the fourth base course material source is LPA-Hampangen.

V. CONCLUSION

From this research to be tested against 12 types of LPA mixture of four sources of material that is Martadah, Awang Bangkal, Gn. Heaven and Hampangen obtained some conclusions include:

1. Value abrasion test results LPA-Martadah by 39.32%, LPA-Awang Bangkal amounted to 30.30%, LPA-Kayangan amounted to 28.88% and the LPA-Hampangen amounted to 34.92%. The research found a picture that abrasion value obtained from each source material obtained varying results in each test abrasion, it is indicated because of the influence of load time, test methods, pressure and material temperature, moisture content, and elements of geological materials.
2. Abrasion value does not influence the change curve specification upper limit and lower limit after compaction, the research found that the grain size (diameter) butiranlah affecting grading curve changes after compaction. The influence of the form of the outbreak of the granules have a smaller diameter into finer grains, occurs accretion stone dust and sand and gravel on the LPA after solidified as a result of the comminution process that occurs in small diameter grain size. So that the pores are filled by granules. So the actual gradation is no longer appropriate to the gradation of the design.
3. Based on the above calculation can be concluded that the value of the abrasion effect on the value of CBR also found the ratio of the value of CBR, the CBR value of dry 95% and the CBR dried to a maximum of 0.94, which means the value of CBR dry 95% is 0.95 times greater than the value of CBR when the maximum dry. From the comparison obtained showed that to plan the pavement thickness by using dry CBR maximum value, must use 0.95 times the value of CBR dry conditions 95% and to achieve the optimum point CBR value approaching specifications, abrasion value should be in the range of 28.88-34%.
4. From the test results in getting the behavioral changes granular aggregates such as an increase in the value of CBR in gradation draft when the number of blows to 65 times with CBR value of 80 861% compared with the CBR value obtained when using the original data or without modification of gradation which has a gradation current highest number of strokes 65 times amounted to 62 483%. It can be concluded gradation affect the value of CBR.
5. Of all the sources of material degradation tersebesar be obtained on the sample LPA-Martadah degradation rates of 25.21% on the design of the Type 3 and the lowest degradation are on the LPA-Hampangen degradation rates amounting to 11 885% in Type 3 design.

SUGGESTION

As for suggestions that can be given for further research are:

1. It is expected that no further research about the relationship abrasion value and CBR based minerals and trace elements of geological materials.
2. It is expected that no further research with a focus on rock classification test based on mechanical and chemical tests.
3. We recommend that you do a review of the specifications of Highways 2018 Division 5 of LPA testing, because the study found several improper SNI peruntuntukan in testing, such as CBR marinade SNI, SNI atterbeg limit and sieving after compaction so that it can be used as appropriate.

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