International Research Journal of Engineering, IT & Scientific Research
Available online at https://sloap.org/journals/index.php/irjeis/
Vol. 8 No. 5, September 2022, pages: 159-166
ISSN: 2454-2261
https://doi.org/10.21744/irjeis.v8n5.2158

Concrete Characteristics Using Aggregate from Nanga Jemah Village, Kapuas Hulu District for Rabat Beton Road

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Article history:

Submitted: 18 May 2022
Revised: 9 June 2022
Accepted: 27 July 2022

Keywords:

aggregate;
beton;
compressive strength;
rabat beton road;
split tensile strength;

Abstract

The use of concrete for various building constructions has been widely used, both as a building structure and also for transportation purposes, especially for concrete roads. Nanga Jemah Village is one of the villages located in Boyan District, Kapuas Hulu Regency which has potential in the field of building materials. The use of aggregates originating from Nanga Jemah has often been done, but until now no one has investigated this type of aggregate as a concrete-forming material, especially for the manufacture of concrete rebate roads. The aggregates used in this study are aggregates derived from Nanga Jemah, both fine aggregates and coarse aggregates by comparing the use of commonly used materials. The purpose and objective of this research are to develop the potential of the area in the form of materials originating from the village of Nanga Jemah so that they can be used as concrete-forming materials, especially for the construction of the Rabat Beton road. This study uses a mixed composition, namely sand and crushed stone from Nanga Jemah, sand from the Jemah area and crushed stone which is commonly used, crushed stone from Nanga Jemah and sand which is commonly used and as a comparison is a mixture of aggregates commonly used. The specimens were made cylindrical with a diameter of 15 cm and a height of 30 cm, while the age of concrete was 3 days, 7 days, and 28 days with a strength of 30 MPa. From the results of the study, it was found that from the results of the fine aggregate test, the silt content of the sand from Nanga Jemah was 1.58% smaller than the requirements of SNI-2461-2002, which was a maximum of 5%, while the wear value of the stone from Nanga Jemah was 18.06. % smaller than the maximum requirement of SNI-2417-2008 of 40%. For the value of the compressive strength of concrete according to the requirements of PdT-14-2003, the concrete rebate road must have a minimum compressive strength of 16 MPa, while the results of testing the compressive strength of concrete at the age of 28 days using aggregate from Nanga Jemah yield a value of 12.8569 MPa. For testing the split tensile strength of concrete according to PdT-14-2003, the value of the split tensile strength of concrete has a minimum value of 2.19 MPa, while the results of testing using aggregate from Nanga Jemah at the age of 28 days show 4,9515 MPa.

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1 Introduction

Developments in the field of construction are inseparable from the use of concrete as one part of building construction. Concrete construction is more in demand because it is relatively strong, easy to form, and more economical when compared to construction that uses steel or wood (Tanyildizi & Coskun, 2008; Parra et al., 2011; Behnood et al., 2015). In concrete construction work, especially for road rabat concrete is widely used as an environmental road because it is easy to work and easy to maintain (Akbaş & Iyisan, 2021; Sukirman, 1999; Sukirman, 2003), Concrete consists of fine aggregate, coarse aggregate, cement, and water requires planning and implementation of work following standards. which has been determined. The use of aggregate as a concrete filler is very dominant almost 60 - 80 % in the ratio of the concrete volume consists of aggregate, if the use of aggregate from other areas outside the work site certainly requires more expensive transportation costs than if using aggregate from the work site itself (Albertini et al., 1997; Aschuri et al., 2016; Bazaz et al., 2006; Qisthi & Kushari, 2019; Cihackova et al., 2015; Dony et al., 2013). Nanga Jemah village located in Tanjung Boyan Subdistrict, Kapuas Hulu Regency is located in the hills, so the potential as a place of natural resources in the form of aggregate, both sand as fine aggregate and broken rock as coarse aggregate, but the aggregate has never been tested as a mixture concrete (Ajagbe et al., 2012; Morel et al., 2007). To increase the potential of natural resources in the form of aggregates as a concrete mixture and to overcome the cost of using aggregates if using aggregates from other areas, then used aggregates from the village of Nanga Jemah special as a concrete mixture (Evangelista & de Brito, 2010; Fan et al., 2015; Kekanović et al., 2014; Khoso et al., 2018; Korkiala-Tanttu et al., 2017).

2 Materials and Methods

This research will be conducted for 6 months. Testing was performed at the Pontianak State Polytechnic Civil Engineering Laboratory. Research methods are arranged in such a way as to facilitate the implementation of research so that it runs more appropriately, effectively, and efficiently (Hariyani, 2009; Mc Nei & Kang, 2013; Ministry of Public Works, 2007; Mindeguia et al., 2012; Papayianni & Anastasiou, 2012). The steps taken are: (1) Collection of Research Materials Coarse and fine aggregates come from Nanga Jemah Village Coarse aggregates and aggregates come from the Market (2) Aggregate Inspection According to the testing procedure as shown in the table below

Table 1
Aggregate testing standards

NO	Inspection	Inspection standard	Unit
A	Coarse Aggregate		
1	Grades	SNI 03-1968-1990	
2	Abrasion	SNI 03-2417-1991	%
3	Weight Type	SNI 03-1969-1990	
4	Water Content	(SNI 03-1971-1990)	
5	Weight Content	(SNI-03-4804-1998)	
B	Fine Aggregate		
1	Grades	SNI 03-1968-1990	%
2	Weight Type	SNI 03-1970-1990	
3	Water Content	(SNI 03-1971-1990)	
4	Weight Content	(SNI-03-4804-1998)	

a) Making a Mixed
Design The design of the test object consists of 4 variations, namely: (a) Using sand and broken stone from Nanga Jemah (b) Using sand from Nanga Jemah and broken stone from the market (c) Using sand from the market and broken stone from Nanga Jemah and (d) Using sand and broken stone from the market, The whole plan uses concrete strength of 30 MPa (Pirmohammad et al., 2015; Rétrospective, (n.d.); Riedel et al., 2008; Silva et al., 2014)

b) Making a test object
Based on the 4 variations, then made a test object in the shape of a cylinder with a diameter of 15 cm and a height of 30 cm with a range of 30 MPa for test objects aged 3 days, 7 days, and 14 days.

c) Examination of Concrete Characteristics
After making the test object with 4 formulas and the same mixture and with the same concrete strength, then test the compressive strength of the concrete and the tensile strength of the concrete (Silva et al., 2014; Strzałkowski, & Garbalińska, 2020; Tjokrodimuljo, 1996; Toklu & Yazıcıoğlu, 2020).

d) Furthermore, from the results obtained from the above characteristic values, the analysis of the concrete mix for Rabat Beton road was performed.

3 Results and Discussions

The results of fine aggregate testing can be seen in Table 2 below:

Table 2
Results of fine aggregate

No.	Testing	Nanga Jemah	Market
1	Water Content (%)	2,6776	0,357
2	Weight Type and Absorption		
	Weight Type Bulk	2,467	2,5079
	Weight Type SSD	2,5205	2,5270
	Weight Type Apparent	2,6069	2,5567
	Absorption	2,1824	0,7600
3	Content Weight	1,4574	1,6207
4	Sludge levels (%)	1,58	1,12

While from the Coarse aggregate test can be seen in Table 3 below:

Table 3
Coarse aggregate

No.	Testing	Nanga Jemah	Market
1	Water Content (%)	2,2401	0,5207
2	Weight Type and Absorption		
	Weight Type Bulk	2,3507	2,6638
	Weight Type SSD	2,3808	2,6817
	Weight Type Apparent	2,4238	2,7123
	Absorption	1,2912	0,667
3	Content Weight	1,5022	1,4586
4	Abrasion (%)	18,06	14,06

The results of the Concrete Compressive Strength Test are obtained in Table 4 below

Table 4
Concrete Pressure Strength Test Results

No	Variation	Manufacturing Date	3 days (MPa)	7 days (MPa)	28 days (MPa)
1	Pasir Nanga Jemah Batu Nanga Jemah	7 April	12,1335	19,0166	12,8569
2	Pasir Nanga Jemah Batu Pasaran	8 April	16,9765	13,8714	25,4987
3	Sand His Stonenga Jemah	9 July	24,9461	20,0178	26,4322
4	Sand Market Stone Market	12 July	30,2725	30,1271	32,1265

The results of the Split Pressure Test can be seen in the table below:

Table 5
The Results Split Pressure Test

No.	Variation	Manufacturing Date	3 days (MPa)	7 days (MPa)	28 days (MPa)
1	Pasir Nanga Jemah Batu Nanga Jemah	7 April	3,1180	6,3702	4,9515
2	Pasir Nanga Jemah Batu Pasaran	8 April	8,2336	7, 6894	5,5683
3	Market Sand Nanga Jemah Stone	July 9	6,1257	5,4325	6,8642
4	Market Sand Stone	July 12	7,1075	8,4949	7,1018

Discussion

Nanga contains more mud content which is as much as 1.58 % compared to the mud content of the market which is 1.12 %. Meanwhile, from the rough aggregate testing, the abrasion value of the stone is greater, namely 18.06 %, while from the market it is 14.06 %.

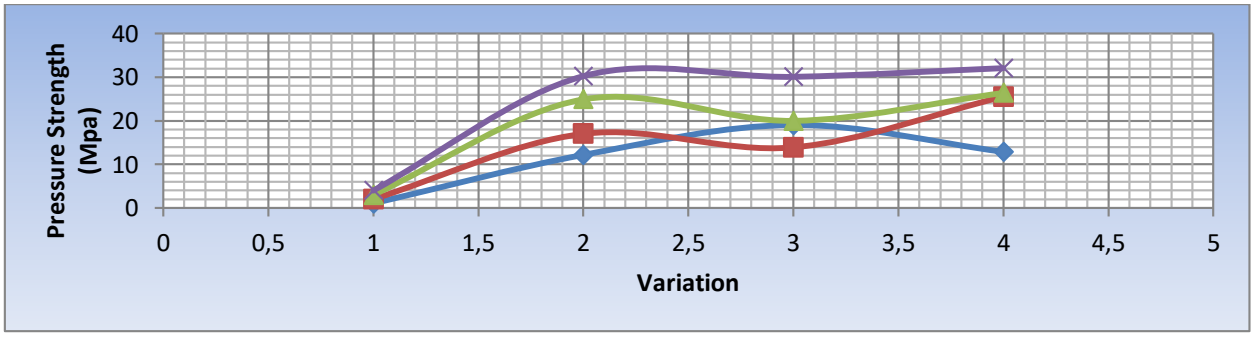

Figure 1. Pressure Strength Between Variations

In Figure 1, the relationship between variations is seen, which shows the compressive strength and age of concrete from the figure above. The maximum compressive strength is 26.4322 MPa for variation 3 for 28 days while the minimum compressive strength is found in variation 1 for 3 days of age with a compressive force of 12.1335 MPa[28,29,30].

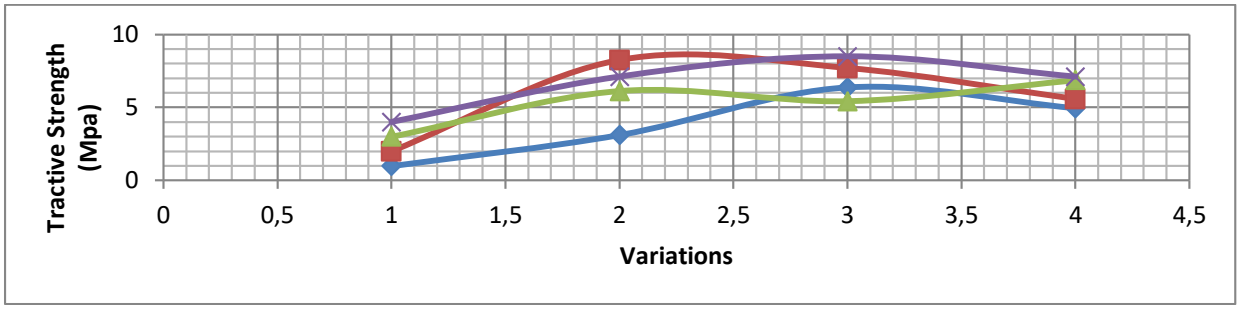

Figure 2. Tractive Strength Between Variations

From figure 2, we can see the relationship between variations, which shows the tensile strength and age of concrete from the picture above. The maximum tensile strength is 8.2336 MPa for variation 2 for 3 days while the minimum compressive strength is at variation 1 for 3 days of age with a compressive force of 3,118 MPa (Strzałkowski, & Garbalińska, 2020; Tjokrodimuljo, 1996; Toklu & Yazıcıoğlu, 2020; Zaharieva et al., 2004)
Application on Concrete Rebate road

No.	Type	Test result	Requirement
1	Fine aggregate mud content (%)	1.58	<5% (SNI-2461-2002)
2	Coarse aggregate wear (%)	18.06	<40% (SNI-2417- 2008)
3	Concrete (MPa)	12,8569	> 16 (PdT-14-2003)
4	Strength (MPa)	4,5915	> 2,19 (PdT-14-2003)

From the test results of fine aggregates obtained mud sand from Nanga Jemah is 1.58 % smaller than the requirements of SNI-2461-2002 which is a maximum of 5 %, while the wear value on rocks from Nanga Jemah is 18.06 % smaller than the maximum requirements of SNI-2417-2008 which is 40 %. The value of concrete compressive strength according to the requirements of PdT-14-2003 concrete rebate road must have a minimum compressive strength of 16 MPa while the test results of concrete compressive strength at the age of 28 days using aggregate from Nanga Jemah produced a value of 12,8569 MPa. For the tensile strength test of concrete according to PdT-14-2003, the tensile strength value of concrete has a minimum value of 2.19 MPa while the test results using aggregate from Nanga Jemah at the age of 28 days showed a result of 4,9515 Mpa (Toklu & Yazıcıoğlu, 2020; Zaharieva et al., 2004; Zhang et al., 2018; Zhao et al., 2015; Nurkertamanda et al., 2017)

4 Conclusion

1. Sand from Nanga Jemah contains more mud compared to sand in the market where the value of the results of the mud content test is as much as 1.58 % compared to the mud content of the market which is 1.12 %. From the results of fine aggregate testing, the content of sand mud from Nanga Jemah is 1.58 % smaller than the requirements of SNI-2461-2002, which is a maximum of 5 %
2. Stone from Nanga Jemah has a lower wear level value than stone from the market, which is 18.06 % compared to the wear value of the market which is 14.06 %, but the stone from Nanga Jemah meets the requirements of 18.06 % smaller than the maximum requirements of SNI-2417-2008 of 40 %.
3. The use of fine and coarse aggregates from Nanga Jemah will result in a maximum reduction of concrete compressive strength of 59.98 % and a minimum of 36.88 %. For the value of compressive strength of concrete according to the requirements of PdT-14-2003 concrete rebate road must have a minimum compressive strength of 16 MPa while from the test results of compressive strength of concrete at the age of 28 days using aggregate from Nanga Jemah produced a value of 12,8569 MPa, so it does not meet the requirements.
4. The use of fine and coarse aggregates from Nanga Jemah will result in a maximum decrease in concrete tensile strength of 56.13 % and the smallest of 25.01 %. For testing the tensile strength of concrete according to PdT-14-2003, the tensile strength of concrete has a minimum value of 2.19 MPa while the test results using aggregate

from Nanga Jemah at the age of 28 days showed a result of 4.9515 Mpa so it can meet the requirements for rabat beton road

Conflict of interest statement
The authors declared that they have no competing interests.

Statement of authorship
The authors have a responsibility for the conception and design of the study. The authors have approved the final article.

Acknowledgements
We are grateful to two anonymous reviewers for their valuable comments on the earlier version of this paper.

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