J. Basic. Appl. Sci. Res., 6(6)44-48, 2016
© 2016, TextRoad Publication

ISSN 2090-4304
Journal of Basic and Applied Scientific Research
www.textroad.com

Mix Design of Third Quality Structure Concrete Using Local Material of Merauke Regency and Import Sand of Palu Regency

Philipus Betaubun

Study Program of Civil Engineering, University of Musamus, Merauke, Indonesia

Received: March 6, 2016
Accepted: May 19,, 2016

ABSTRACT

Concrete would be as the composition and supporting unsure on building structure. If the concrete is good quality, it can hold the building load such as dead load which is as the concrete load itself as well as life load which is one of loads that is used in making concrete is sand. In Merauke Regency, there are some local sand mining and import sand. This research intends to investigate the characteristic of concrete by mixing the local and import sand. The research is conducted in laboratory of Civil Engineering, University of Masamus-Merauke. The methodology consists of design by using DoE method. The composition using in this research is 70% import sand (Palu) and 30% local sand; 80% import sand and 20% local sand, normal local sand and normal import sand. The research uses 20 cubes with the dimension of 15x15x15 cm as the samples. Result shows that the compressive strength on the composition of 70% Palu sand and 30% local sand is 21.80 Mpa; the composition of 80% Palu sand and 20% local sand is 29.54 Mpa; and the composition of local sand, normal concrete 16.57 Mpa; and Palu sand is 30.56 Mpa. The production is more than planned compressive strength such as more than K-225.

KEYWORDS: building structure, characteristic, local and Palu sand

INTRODUCTION

Merauke Regency is as boundary regency of Indonesia Republic which is restricted with the country of Papua New Guinea. The condition of topography in Merauke Regency generally is as shore, plain land, and swam. Most of local sand material in Merauke Regency is along shore. Concrete is as the composition and supporting unsure of building structure. Good quality of concrete would be able to hold big building load and the building is standing strongly it is supported by good structure. However, good structure can create the fitness and safety for the inhabittant who live in the building. However, concrete is used for the construction such as building, road, bridge, airport, reservoir, quay-wall, dam, etc. Sand in mErauke regency generally cannot fulfill the strength which is hoped if it is used as the mix material of concrete structure. In previous research, there is produced the concrete with the standard of K-225 and it is originally used quary local sand (Bokem sand) and the result is reaching the planned strength, but in the field work there is more found the mixture on two kinds of sand which is as the sand that is taken from some location in Merauke and then it is mixed with the import sand so it has not known how big the strength if the two kinds of sands to be mixed.

Research of Maruba [1] concluded that the evaluation by mixing Merauke Bokem sand with the composition of concrete as follow: 370 kg of cement; 724 kf of soft agregate; 424 kg of rough agregate 1-2 (gravel); 765 kg of rough agregat of rough agregate 2-4 (gravel); and 205.42 kg of water or the comparison of 1 : 1.96 : 3.18 produced the compressive strength of concrete as fc' = 226.76 kg/cm^2 or 227 kg/cm^2. Research of Maturbons Patrisius [2] presented that based on the analysis of mix design for fc' of 125 Mpa with the comparison of mix for concrete whipping as 1 pc : 1.9 pc : 3.4 kr produced the compressive strength of 11.4 Mpa, so it does not reach the planned strength of K 125 or fc' of 12.5 Mpa, and it is caused by Urumb sand has more content of snail which is easy crumbly and rarefaction, and the composition of agregate is out of condition [3]. Research of Pamutta Dina Limbong [4] concluded that the characteristic of three kinds of cement are in condition of each evaluation, the proportion of mix as 1 : 2.16 : 3.58 and the compressive strength for 28 days for Gresik cement PPC is 226.42 kgf/cm^2; Tonasa OPC is 217.61 kgf/cm^2; and Tonasa cement PPC is 173.88 kgf/cm^2.

Based on the description as above, it is nacessary to make structure concrete design with third class quality by using local sand (Merauke) and Palu sand (Center Sulawesi). Concrete mix material is using local sand which will be mixed with import sand from Palu, rough agregate, portland cement typw I, and media of water which is able to accept the compressive strength by using the method of DoE (Department of Environment) with the planned mix proportion as follow: 70% of Palu sand and 30% of local sand; 80% Palu and 20% local sand for reaching the structure concrete of third class quality. However, it can be concluded the two kins of sand are feasible or not if there are mixed and it can be used or not for light construction or can be used on heavy construction due to the third class quality of concrete such as for the structure of foundation, plaster of wall or cast of floor. The design as above is hoped can decrease the building cost which is expensive

***Corresponding Author:** Phililipus Betaubun, Study {ropgram of Civil Engineering, University of Musamus, Meraukje, Indonesia. Email: mrphilbet@gmail.com

enougg mainly the cost of infra-structure development in Merauke city becomes as more economic. It is needed to be carried out research in laboaratory.

MATERIALS AND METHODS

Material and location of research

The basic material which is used in making sample of cube consists of cement, sand, gravel, water, and the load source that is used is cement Tonassa PPC. Fresh water is from University of Musamus, local sand is from Waninggap Nanggo village (Merauke), and the import sand and gravel is from Palu (Center Sulawesi).

Sample is formed as cube with the dimension of 15 cm x 15 cm x 15 cm with some comparison proportion as follow: 70% of Palu sand : 30% of Waninggap Nanggo sand; 80% of Palu sand : 20% of Waninggap Nanggo sand; Palu sand normal and Waninggap Nanggo sand normal, Each of composition consists of 20 sample cubes. Research method uses the experiment one by trial and error for knowing the treatment on research object. Evaluation of sample uses the method of SNI 03-1974-1990. However, for designing of concrete mix is used the method of DoE (Department of Environment). This research conducted in the laboratory of Civil Engineering University of Musamus on June until August 2015.

Evaluation of concrete slump

To know the workability of concrete mix and the homogenity of water using, there are some tools which was used as follow: iron cone tube (Abraham tube); reference tool with the diametre of 16 mm and the length of 60 cm; mistar; and steel plat. The objective of this evaluation is ;to obtain the number of concrete slump. The evaluation is carried out to the fresh concrete that represented the concrete mix for using in the work of concrete mix design and concrete quality controlling on the concreting development.

Concrete slump is as the viscocity of plasticity and cohesive from fresh concrete. The first step in this laboratory research is watering it. Then, entering the whipping of Abram's cone into three layers with the same width which every layer is pounded for 25 times spreaded. After that, the highest side of cone is spreaded and let it during 30 minutes, while the concrete whipping which is dropped at surrounded cone has to be cleaned. After 30 seconds, the printed samples are slowly taking up normally. Then the printed samples is putting back and put them on the samples side. After that, measuring the distance of concrete whipping level down or mortar due to the beginning height. However, it produced the viscocity or consistency of concrete whipping.

Evaluation of unit-weight of concrete

This activity intends to evaluate the unit weight of fresh concrete and the quantity of cement per-m^3 concrete. This evaluation intends to produce the accurate number of concrete unit-weight. This activity is carried out for fresh concrete which represents mix of concrete as follow: 1) the quantity of concrete for a unit cement; 2) it is as the design of concrete mix; and 3) it is as the control of concrete quality. However, unit weight of concrete is as the unit weight of fresh concrete per-unit volume.

Method of making and maintenance sample

This method is as the standard in laboratory in making and maintenance concrete sample. This activity is hoped to obtain sample in laboratory that is suitable with the condition. This method includes making sample in laboratory until the proportional evaluation that is suitable with the plan. Accuracy of material monitoring and evaluation condition is necessary and it is conditional for the compacted concrete by .vibrating and penetrating. The steps of implementation is are as follow:

1. Balance of each material due to the analysis
2. Mixing and whipping the whole material of concrete maker by using machine
3. Measuring of slump test after whipping quickly
4. Printing the sample by standard print which is made from steel with the cube dimension of 15cm x 15cm x 15cm
5. Compaction with the machines of vibrating and penetrating.
6. Printing.

After the implementation of concrete printing into cube printer then it has to be carried out the maintenance. The maintenance is as follow:

1. After printing it is carried out the covering by using the material which is easy to absorb water such as gunny bag
2. Sample can be released from the printer after 20 hours and may not more than 48 hours after printing.
3. Sample is soaked in water which has the temperature of 23 + 2^0c starting from the releasing of printing until the evaluation is carried out.

Room for saving the sample has to be free from the vibration mainly on the first 48 hours after saving it.

Compressive strength of concrete

Design of concrete compressive strength is as the ability design of concrete for accepting the pressure load until the concrete reaches the breaking point for obtaining concrete quality which is hoped. Therefore it is needed concrete mix .design. This condition is suitable with the technical and economic condition. Technical conditions is conditional in strength but mix design is also conditional in economy due to the price of cement is more expensive than the other aggregate. Therefore the usage of cement on design has to be as less as possible and the other aggregate is as more as possible and it does certainly not ignore the conditional strength. Then the workability on concrete work is defined as the ease to be carried out, poured, and vibrated.

The good component of concrete mix will produce high concrete compressive strength but if the implementation does not well controlled, it may be produced more unavailable concrete due to the design. The manner of preparing it will determine the concrete quality. The implementation in the field includes the preparation, measuring, mixing, pouring or placing, vibrating, finishing, curing.

Concrete

Concrete is as the mix of soft aggregate (sand) and rough aggregate (gravel, breaking stone) with cement that is united by water in a certain comparison. Concrete is also defined as building material of construction which the characteristic can be determined first by carrying out the accurate design and controlling to the selected material. Then the materials are mixed together. Because of cement hydrate by water, the mix will be stoniest and has the hardness and strength which can be used for any objectives.

Concrete strength

Compressive strength is as one of the main concrete performances. Compressive strength is as concrete ability for being able to accept force per-unit number area [5]. The value of concrete strength by carrying out the test of concrete strength due to the cylindroid or cube sample on the age of 28 days which is loaded by pressure force until reaching the maximal load. Maximal load is obtained from the test by using the tool of compression testing machine.

Concrete compressive strength is adding due to the additional of concrete age. The velocity of adding the concrete strength is very influenced by some factors such as water, cement, and temperature of maintenance is more and more increasing the concrete strength. Increasing rate of concrete pressure is fast in the beginning but more and more become slower. There are some factors that influence the concrete strength such as cement-water factor, characteristic of aggregate, and the proportional of cement and type of cement that is used.

The characteristic of concrete

The characteristic of concrete is for getting the hoped quality due to the conditional construction and building age. The characteristic of concrete are strength, volume-weight, modulus of elasticity, hardness degradation, and water density, climate holding, chemical material, etc.

Mix design of concrete

The main objective to study the characteristic of concrete is for mix design such as the selection of suitable materials of concrete and to determine the proportion of each material for producing economic concrete with well quality [6]. This research is conducted by using the method of DoR (Department of Environment). Design by using DoE method is used as the standard of design by General Work Department in Indonesia and it is published in standard book of SNI T-15-1990. DoE method is the simplest method by producing the accurate product such as the usage of simple tables and graphics. The steps of DoE method is as follow: to determine the mean design of compressive strength. (f'c), factor of cement-water, value of slump, size of maximum aggregate, free water content, proportion of aggregate, volume-weight of united aggregate, and to analyse the proportion of design concrete mix which is as the mix with the quality class III with the cube sample of 15 cm x 15 cm x 15 cm.

Compressive strength of concrete

The method is as the standard in testing for determining compressive strength of concrete with the cube sample of 15 cm x 15 cm x 15cm which is made and curing in laboratory as well as in field by the design compressive strength of 28 days. This test intends to obtain the value of compressive strength due to the right steps. The test is conducted to the fresh concrete that represents concrete mix and the result can be used in the works of concrete mix design and concrete quality control on concreting implementation. Compressive strength of concrete is as load volume per-unit area number that causes the concrete sample is damaged if it is loaded by certain compressive force> the formula of concrete compressive strength is as follow:

$$f'cr = \frac{\sum_{i=1}^{n} f'ck}{n} \quad (1)$$

$$Sd = \sqrt{\frac{\sum_{i=1}^{n}(f'ck - f'c)^2}{n-1}} \quad (2)$$

$$f'c = f'cr - k\,x\,Sd \quad (3)$$

Note:
f'cr = mean design of compressive strength
f'ck = compressive strength of each sample
sd = deviation standard
n = number of sample
K = constant with the error of 5%, k = 1.64

Density

Density also gives influence to the factor of cement-water because the whipping strength or mixing will affect the compaction. If the mix too watery it will be difficult to be compacted and on it has to be evaluated the viscosity of the fresh concrete by slump test. The density of concrete will be good if the hydrate process is completed and it will be influenced by the maintenance during the violence is happened. Concrete violence will reach until 100% on the concrete age of 28 days. Compressive strength of concrete can also be influenced by type of cement, the strength or violence of aggregate, factor od cement-water (FAS), gradation of aggregate, shape of aggregate, condition of aggregate surface, curing, and concrete compaction.

Classification of concrete

In the rule of Indonesian Concrete, concrete strength is classified into three classes such as the first class of concrete is as the concrete for non-structural work and for the implementation is needed special expert. The second class of concrete is for general structural work and the implementation is needed enough expert and it is carried out under the leader of experts. Second class of concrete is classified into the standard quality of B1, K125, K175, and K225. On the quality of B1, the quality control is only limited on the material quality, but on the compressive strength is not conditioned on control. The third class of concrete is as the concrete for structural works which is used the concrete with the concrete quality over the K-225. The implementation is needed special expertise and it has to be carried out by the leader of experts.

RESULTS AND DISCUSSION

Test result of soft aggregate

Test result of soft aggregate (sand) such as local sand as well as import sand is presented as in Table 1.below.

Table 1 Test result of soft aggregate

No	Item of test	Result (sand)		Standard of soft aggregate
		Paluk	Waninggap	
1.	Water content %	2.74	2.39	
2.	Mud content %	2.85	1.29	5 (maximum)
3.	Organic	Color of bright tea clear	Color of bright tea color	Color is not more than color standard
4.	Volume-weight SSD	2.46	2.57	
5.	Absorbing %	2,56	1.17	20 (maximum)
6.	Gradation	Zone 2	Zone 4	Zone 1, 2, 3, 4

Test result of rough aggregate

Test result of rough aggregate is presented as in Table 2 below

Table 2 Test result of rough aggregate

No.	Item of test	Result	Standard of rough aggregate
1.	Water content %	0.51	
2	Mud content %	0.47	1 (maximum)
4.	Volume-weight	2.61	2.3 – 2.6
5.	Absorbing %	0.74	5
6.	Gradation	Zone 3	Zone 1, 2, 3, 4

Result of mix design

Based on the test of material characteristic that is used for concrete mix by using DoE method, it is obtained the proportion of mix as in Table 3.

Table 3 Conclusion of design result

No	Type of mix material	Composition of 1 M^3 agregate concrete SSD	Composition of 1 M^3 concrete corrected aggregate water content	M^3 concrete corrected aggregate water content
1.	Portland cement, kg	325	325	1
2.	Water, liter	185	173.21	0.53
3.	Soft agregate, kg	884.38	885.97	2.73
4.	Riugh agregate, kg	997	994.71	3.06
Total		2375	2053.89	7.32

	Cement	Soft agregate	Rought agregate	water	Total
Propostion of mix	1	2.73	3.06	0.53	7.32

Test result of compressive strength

Based on the test result of concrete compressive strength, the comparison proportion is 70% of Palu sand : 30% of local sand; 80% of Palu sand : 20% of local sand; normal of Palu sand : normal of local sand for each sample and the result is presented as in Table 4.

Table 4 Result of compressive strength for each proportion

Test	Result (proportion of mix)			
	Normal (import)	Normal (local)	70 : 30 %	80 : 20 %
Characteristic compressive strength (f'c) (Mpa)	30.56	16.57	21.80	29.54

Based on the test of third class quality structure concrete design as in Figure 1 below, the result is 80% of Palu sand: 20% of local sand is 29.54 Mps; the comparison on 70% of Palu sand: 30% of local sand is 21.80 Mpa; for normal of local sand is 16.57 Mpa' and for normal of import sand is 30.56 Mpa. Based on the test result, the compressive strength on the mix of local sand and Palu sand can produce structure concrete quality of third class with the value of compressive strength: fc' = 29.54 Mpa for the comparison on 80% of Palu sand: 20% of local sand.

CONCLUSION

Based on the result of study and discussion of third class quality structure concrete, it can be concluded as follow:

1. The maximum composition of compressive strength is 80% of Palu sand: 20% of local sand. Proportion of mix composition is 6.5 kg of soft aggregate (13.6 kg of Palu sand and 3.4 kg of local sand), 19 kg of rough aggregate, and 3.3 kg of water; so the proportion of concrete mix ia !: 2.73: 3.06.
2. Compressive strength on mix concrete of Waninggap Nanggap sand and Palu sand can produce the third class structure concrete mix with the value of compressive strength: fc' = 29.54 Mpa for the composition on 80% of Palu sand: 20% of local sand.

REFERENCES

1. Maruba, 2008. *Design Kuat Tekan Beton K-225 Berdasarkan Perbandingan Berat Menggunakan Pasir Lokal Merauke,* Universitas Musamus, Merauke.
2. Maturbons Patrisius, 2005. *Mix Design dan Uji Kuat Tekan Beton Pasir Lokal dari Urumb Kabupaten Merauke,* Sekolah Tinggi Teknologi Merauke.
3. Persyaratan Bangunan Indonesia, 1971. *Persyaratan Agregat Halus.*
4. Pamuttu Dina Limbong, 2012. *Kuat Tekan Beton Pasir Lokal Dengan Menggunakan Beberapa Merk Semen,* Universitas Musamus, Merauke.
5. Mulyono Tri, 2004. *Teknologi Beton,* Penerbit Andi, Yogyakarta
6. Nugraha Paul dan Antoni, 2007. *Teknologi Beton*, Penerbit Andi, Surabaya