ARPN Journal of Engineering and Applied Sciences

ADDITIONAL BETONMIX TO INCREASE THE STRENGTH OF CONCRETE PRESS

Syaiful Syaiful
Department of Civil Engineering, Ibn Khaldun University, Bogor, Indonesia
E-Mail: syaiful@ft.uika-bogor.ac.id

ABSTRACT

Concrete for buildings, roads and bridges was very widely used in 2020. The development of concrete construction requires experts to improve the quality and workmanship of concrete in a modern, fast and strong way. Normal concrete without the treatment of any additives will make the quality and compressive strength of concrete around the standard standards. To answer this problem, the research objective is to add *Betonmix* additives to improve concrete performance and increase the compressive strength of concrete structurally. Normal compressive strength value of concrete at the age of 7 days is only 249.21 kg/cm^2. The compressive strength of normal concrete at 28 days is 260.75 kg/cm^2. The composition of the addition of the right additive will increase the compressive strength of the concrete as planned obtained addititve *Betonmix* addition composition of 0.20% at the age of 28 days concrete samples amounted to 300.26 kg/cm^2.

Keywords: additives, betonmix, gravel aggregate, normal concrete, sand aggregate.

1. INTRODUCTION

Normal concrete consists of a mixture of cement, sand, gravel and water as a mixture forming material. Normal concrete is usually used for simple buildings and non-rise buildings with minimal risk. Concrete is formed from the union of 4 components into a single unit in the desired mold form [1], [4], [26]. Concrete with perfect workmanship will get the desired compressive strength. Concrete strength is reduced because the strength of the concrete has decreased due to the quality of the constituent material and the presence of pores/cavities in the finished concrete [2-3], [5], [24-25]. The reduction of the cement water factor results in decreased porosity of the concrete and pores, so the viscosity of the concrete will also be reduced so that it is difficult to work on [6], [8-9]. Concrete is a composite material of several materials, the main material consisting of a mixture of cement, fine aggregate, coarse aggregate, water and other additives with a certain ratio, because concrete is a composite, the quality of concrete is very dependent on the quality of each forming material [10-11], [17]. Furthermore, the composition of concrete with additional can be decomposed such as: cement, sand aggregate, gravel aggregate + water and additives. Additional material is material other than concrete constituents (cement, sand aggregate, gravel aggregate and water) added to the concrete mix. Additional material added to concrete is intended to improve concrete performance [13], [15-16], [33]. The use of additional materials in concrete mixes has several advantages, namely: improving concrete workability, reducing the cost of concrete work, increasing the durability of concrete, increasing the compressive strength of concrete, increasing the life span of concrete, reducing shrinkage, making concrete more waterproof, porosity and water absorption [7], [12], [14], [21-22]. There are 3 (three) additional ingredients, namely chemical additives, mineral additives and other added ingredients. Additional ingredients used are mineral additives and have been widely available in the market with various compositions [18-20], [23]. Based on these recommendations, this research will reveal the findings of the latest mixture types that can determine the expected strength. Concrete compressive strength is the maximum compressive load that can be borne by the broad unity or compressive strength of concrete from a large number of test specimens, where the possibility of a compressive strength that is less than planned and limited to 5%. Concrete compressive strength measurements carried out in several measurements in accordance with the required concrete plan age [21], [25-26]. Furthermore, the requirements for fine aggregate pass the filter, the gross aggregate pass the filter, the cement water factor requirements in the figures used as planned are shown in Table-1, Table-2 and Figure-1 below [4], [26-27].

ARPN Journal of Engineering and Applied Sciences

Table-1. Boundaries of fine aggregate gradation zones.

Size filter (mm)	Percentage cummulative passes of filter			
	Grading zone 1	Grading zone 2	Grading zone 3	Grading zone 4
9.500	100	100	100	100
4.760	90-100	90-100	90-100	95-100
2.800	60-95	75-100	85-100	95-100
1.190	30-70	55-90	75-100	90-100
0.595	15-34	35-59	60-79	80-100
0.279	5-20	8-30	12-40	15-50
0.149	0-10	0-10	0-10	0-15

Table-2. Grading limits of coarse aggregate.

Size filter (mm)	Percentage cummulative passes of filter	
	Grading zone 1	Grading zone 2
37.500	95-100	100
19.000	30-70	95-100
9.500	10-35	25-55
4.760	0-5	0-10

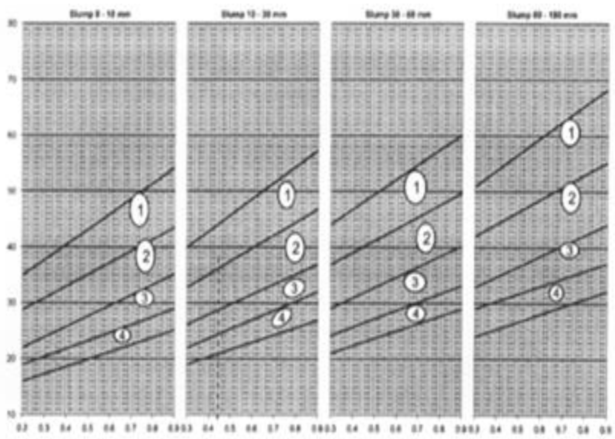

Figure-1. Requirements for cement water factors in numbers.

After the concrete has been printed according to the plan, it is necessary to take care of the test object that has been finished, so that the concrete reaches maximum maintenance. Care is taken so that the hydration process takes place naturally and without any outside interference such as being stepped on, moved or crushed by other materials to the age as planned. The treatment intended to obtain high compressive strength of concrete is also expected to improve the quality of concrete, impermeable, wear resistant and stability of the planned structural dimensions [6], [19]. Likewise in concrete works that support infrastructure facilities for roads, bridges and other high-quality buildings made of concrete for smooth motor vehicle traffic [20], [29], [31]. This study uses a new discovery by combining two methods, namely (1) chemical additives, namely type A water reducing additives which reduce the mixing water needed to produce concrete with a certain consistency. Water-Reducing Admixture is used, for example, by not reducing cement content and slump value to produce concrete with a low ratio of cement water. Or by not changing the cement content used with a fixed cement water factor, the resulting slump value can be higher. This is meant by changing the cement content but not changing the fas and slump. In the first case reducing fas indirectly increases the compressive strength, because in many cases low fas increases the compressive strength of concrete. In the second case, the high value of the slump obtained will facilitate the placing of the mortar or the timing of the mortar can be slowed down. In the third case it is intended to reduce costs due to the use of small cement. (2) other added ingredients of type b are concrete without slump, ie concrete which has a slump of 1 inch (25.4) or less, shortly after mixing. The choice of added material depends on the properties of the desired concrete, such as its plasticity, binding time and strength achievement, liquid freeze effect, strength and price of the concrete [7], [21], [32]. As chemical additives used concrete mix products, which are products made in the construction field have 3 functions, namely: improving the quality of concrete, making casting easy and speeding hardening [5], [28], [31], [34]. This product is found in the market with a pattern that is very easy to work on as shown in Figure-2 below.

ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

Figure-2. Additive products used.

The research objective is to obtain a fixed slump value by adding additive substances to increase the compressive strength of concrete.

2. METHODS

Using the British Mix Design Method or DoE/Department of Environment method. The following outlines the steps of the DoE method of work, namely, (1) determine the strength of the concrete plan. (2) determine the type of cement used. Conducted at the Laboratory of Civil Engineering, Department of Civil Engineering, Ibn Khaldun University, Bogor. KH. Sholeh Iskandar Rd. KM. 2 Kedungbadak Tanah Sareal Bogor, West Java, INDONESIA, 16161. The following research method is displayed in the form of a flowchart in Figure-3 below.

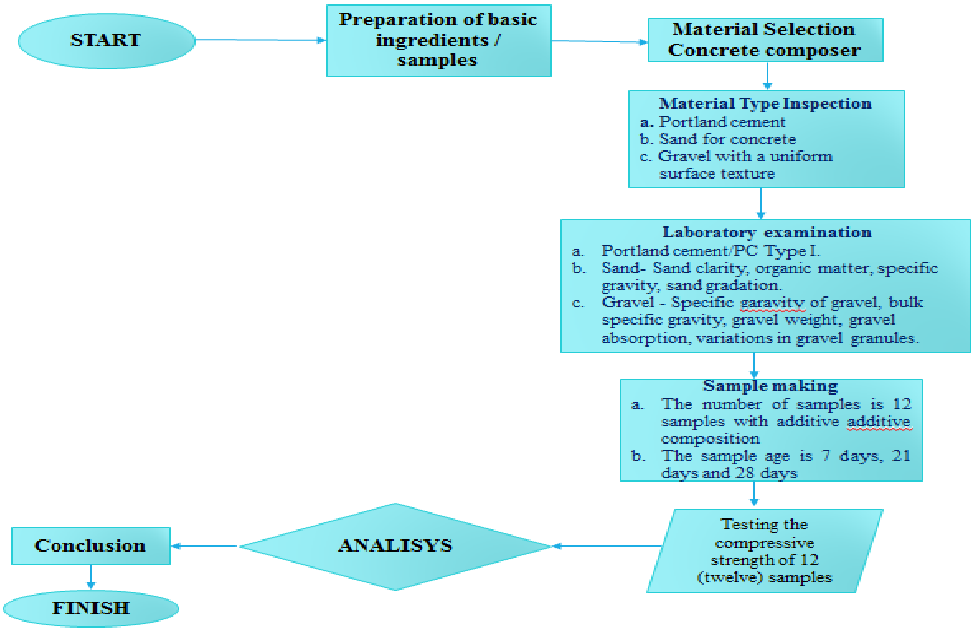

Figure-3. Chart of research flow diagrams.

3. RESULTS AND DISCUSSIONS

3.1 Research Result

The results of the grading of concrete sand gradation from *Leuwiliang* Bogor District through a sieve analysis, the sand used is included in zone 2 aggregate. Next shown in Figure-4 below.

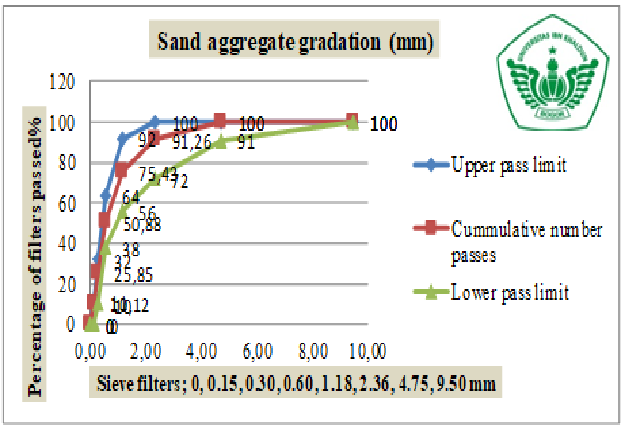

Figure-4. Graph of sand gradation through a sieve.

VOL. 16, NO. 15, AUGUST 2021 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

The results of the gravel gradation test used are included in the 20 mm sieve slip granules, and are shown in Figure-5 below.

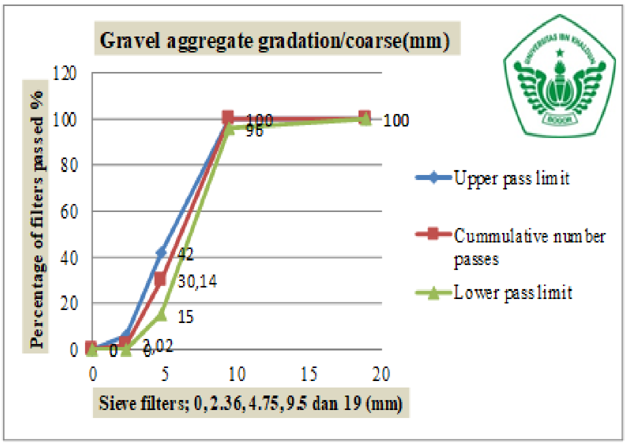

Figure-5. Gravel gradation chart that filter passes the 20 mm.

Next, the results of the measurement of gravel density are shown in Table-3 below.

Table-3. Results of gravel density measurements.

Type of measurement	Unit	Measurement results
Dry weight (BJ)	gr	5.000,0
Heavy in water (BA)	gr	3.141,7
Oven dry weight (BK)	gr	4.762,4

Based on Table-3 above, it can be calculated bulk density, surface dry density, apparent density, and specific gravity for water absorption.

Bulk density $= \dfrac{BK}{BJ - BA}$

$= \dfrac{4.762,4}{5.000,0 - 3.141,7}$

$= 2.563\ \text{gr/cm}^3$

Dry surface specific (SSD) $= \dfrac{BJ}{BJ - BA}$

$= \dfrac{5.000,0}{4.762,4 - 3.141,7}$

$= 2.690\ \text{gr/cm}^3$

Pseudo specific gravity $= \dfrac{BK}{BK - BA}$

$= \dfrac{4.762,4}{4.762,4 - 3.141,7}$

$= 2.938\ \text{gr/cm}^3$

Specific gravity of water absorption $= \dfrac{BJ - BK}{BA} \times 100\ \%$

$= \dfrac{5.000,0 - 4.762,4}{3.141,7} \times 100\ \%$

$= 0.075\ \%$

The measurement of coarse gravel aggregate wear a maximum of 20 mm and the wear of broken stones is shown in Table-4 below.

Table-4. Results of gravel wear measurements.

No	Type of measurement	Unit	Measurement results
1	Weight of the initial test object (A)	gr	5.000.0
2	The weight of the test specimen is retained by filter no. 12 after the Los Angeless/LA machine (B)	gr	3.532,4

Based on the table above, the degree of wear can be calculated.

Degree of wear $= \dfrac{A - B}{B} \times 100\%$

$= \dfrac{5.000,0 - 3.532,4}{3.532,4} \times 100\ \%$

$= 0.41\ \%$

The method of checking portland cement, fine aggregate, coarse aggregate and water uses the British Mix Design Method or DoE (Departement of Environment) method. The amount of concrete mixture needs and correction factors as below.

- Portland Cement Type I = 474 kg in a ratio of 1.00
- Water = 179 kg with a ratio of 0.30
- Sand = 617 kg in a ratio of 1.27
- Gravel = 1.118 kg with a ratio of 2.30

The results of the calculation of volume weight by comparison then carried out seven stages for the stirring stage, in one stirring stage for 12 samples are:

Mixed volume = 12 x (0.15 m x 0.15 m x 0.15 m)
= 0.0405 m^3

Furthermore, the needs of each sample are needed in one stirring stage as follows:

a) For the needs of concrete samples without using additional materials with a concrete age of 7 days, 21 days and 28 days are:

- Portland cement type I = (474 x 0.0405) = 19.197 kg/m^3
- Water = (179 x 0.0405) = 7.249 kg/m^3
- Sand = (617 x 0.0405) = 24.988 kg/m^3
- Gravel = (1118 x 0.0405)= 45.279 kg/m^3

VOL. 16, NO. 15, AUGUST 2021 ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

www.arpnjournals.com

b) Furthermore, the sample requirements using concretemix additives for a mixture of 0.16% at the age of 7 days, 21 days and 28 days are:

- Portland cement type I = (474 x 0.0405) = 19.197 kg/m^3
- Water = (179 x 0.0405) = 7.249 kg/m^3
- Sand = (617 x 0.0405) = 24.988 kg/m^3
- Gravel = (1118 x 0.0405)= 45.279 kg/m^3
- Concrete material *Betonmix* 0.16% = 19.197 x 0.16% = 0,03 kg/m^3 = 30.715 gr/m^3

c) Furthermore, the sample needs using concretemix additives for a mixture of 0.20% at the age of 7 days, 21 days and 28 days are:

- Portland cement type I = (474 x 0.0405) = 19.197 kg/m^3
- Water = (179 x 0.0405) = 7.249 kg/m^3
- Sand = (617 x 0.0405) = 24.988 kg/m^3
- Gravel = (1118 x 0.0405)= 45.279 kg/m^3
- Concrete material *Betonmix* 0.20% = 19.197 x 0,20% = 0.04 kg/m^3 = 38.394 gr/m^3

d) For the needs of concrete samples with concrete additives the content of 0.41% at the age of 7 days, 21 days and 28 days, as follows:

- Portland cement type I = (474 x 0.0405) = 19.197 kg/m^3
- Water = (179 x 0.0405) = 7.249 kg/m^3
- Sand = (617 x 0.0405) = 24.988 kg/m^3
- Gravel = (1118 x 0.0405)= 45.279 kg/m^3
- Concrete material *Betonmix* 0.41% = 19.197 x 0.41% = 0.07 kg/m^3 = 78.707 gr/m^3

3.2 The Results of Measurements of Concrete Compressive Strength Values

The following shows results of the comparison of normal concrete compressive strength values, with the addition of additives concentration of 0.16%, 0.20% and 0.41% at the age of the sample 7 days in Figure-6 below.

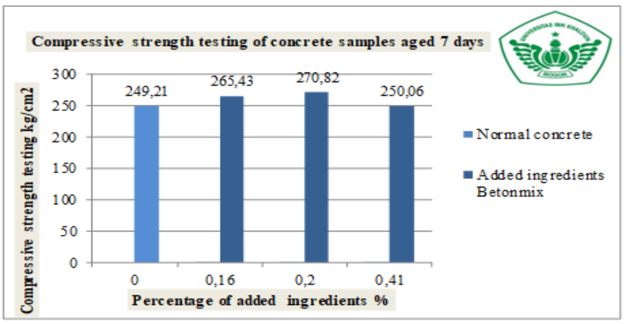

Figure-6. Comparison of compressive strength values of samples aged 7 days.

Furthermore, the results of the comparison of the normal compressive strength values are displayed, with the addition of additives concentration of 0.16%, 0.20% and 0.41% at the age of the sample 21 days in Figure-7 below.

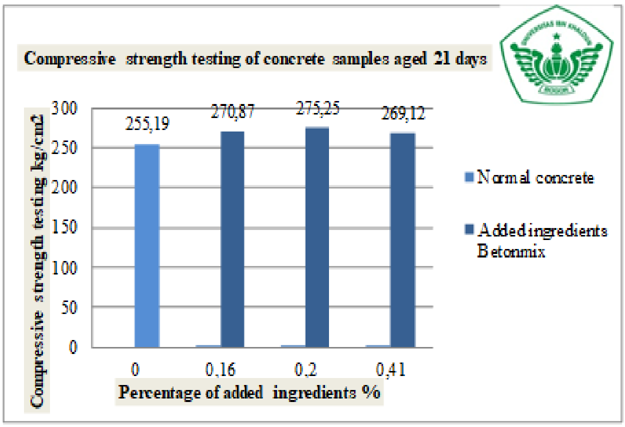

Figure-7. Comparison of the compressive strength value of concrete samples aged 21 days.

The figure below shows results of the comparison of normal concrete compressive strength values, with the addition of additives concentration of 0.16%, 0.20% and 0.41% at the age of 28 days in Figure-8 below.

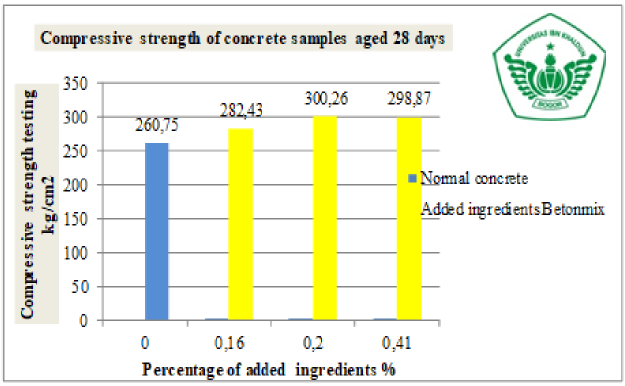

Figure-8. Comparison of concrete compressive strength values of samples aged 28 days.

4. DISCUSSIONS

The discussion using the same method determined the value of the cement water factor of 0.39 so that a small slump value would increase the compressive strength of concrete. The principle is that the smaller the slump value in the concrete mixture, the level of workability will also decrease, meaning that the more reduction in water in the concrete mixture, the compressive strength of concrete will increase. Conversely the smaller the value of the cement water factor will reduce the value of slump and the level of workability, it will affect the process of working on a concrete mixture. The results obtained are as follows: normal concrete compressive strength of 7, 21 days and 28 days is 249.21 kg/cm^2, 255.19 kg/cm^2 and 260.75 kg/cm^2. The composition of 0.16% of *Betonmix* in the order of compressive strength of normal concrete age 7, 21 days and 28 days is 265.43 kg/cm^2, 270.87 kg/cm^2 and 282.43

ISSN 1819-6608
ARPN Journal of Engineering and Applied Sciences

kg/cm^2. Furthermore, for additional materials 0.20% *Betonmix*, respectively, the normal concrete compressive strength of 7 days, 21 days and 28 days is 270.82 kg/cm^2, 275.25 kg/cm^2 and 300.26 kg/cm^2. And finally the composition of additives 0.41% of *Betonmix* in a compressive strength of normal concrete age 7 days, 21 days and 28 days is 250.06 kg/cm^2, 269.12 kg/cm^2 and 298.87 kg/cm^2.

5. CONCLUSIONS

If the concrete is planned normally without using the addition of compressive strength, then the duration of adding concrete periodically only increases by 4.425%. The optimal addition of *Betonmix* additives occurs at the age of 28 days of concrete at 0.20%. Furthermore, the recommended compressive strength of concrete is at the age of 7 days, amounting to 270.82 kg/cm^2, so that at the age of 21 days the compressive strength of concrete is 275.25 kg/cm^2 and at the age of 28 days the compressive strength of concrete reaches the optimum value of 300.26 kg/cm^2. This means that the increase in the compressive strength of concrete is harmonized with the addition of *Betonmix* additives proportionally. The addition of these additives should not be given too much and too little or too much, must be in accordance with the doses that have been tested in the laboratory. The test results in the laboratory showed that the performance of the sample concrete increased significantly at 0.20% composition, recommended under these conditions.

REFERENCES

[1] Amalia. 2009. Studi Eksperimental Perilaku Mekanik Beton Normal Dengan Substitusi Limbah Debu Pengolahan Baja (Dry Dust Collector). Program Magister Teknik Sipil, Pasca Sarj, 56. (Indonesian).

[2] Badan Standardisasi Nasional. 2013. Persyaratan Beton Struktural untuk Bangunan Gedung. Bandung: Badan Standardisasi Indonesia, 1–265. (Indonesian).

[3] Badan Standardisasi Nasional. 2016. SNI 8140: 2016 Persyaratan beton struktural untuk rumah tinggal. 58. (Indonesian).

[4] Betaubun P. & Hairulla. 2018. Compressive strength and tensile tests for concrete made from local materials from Toftof, Eligobel District. International Journal of Civil Engineering and Technology. 9(8): 574-579.

[5] BSN. 2019. SNI 03-2847:2019 Persyaratan Beton Struktural Untuk Bangunan Gedung Dan Penjelasan Sebagai Revisi Dari Standar Nasional Indonesia 2847 : 2013. Badan Standarisasi Nasional, 8. (Indonesian).

[6] Chen H., Qian C., Liang C. & Kang W. 2018. An approach for predicting the compressive strength of cement-based materials exposed to sulfate attack. PLoS ONE, 13(1): 1-17. https://doi.org/10.1371/journal.pone.0191370

[7] Curb C., Median C. R., Slab F., Compendium C. M., & Materials, C. (2017). TS 1350 September 2017 Amendment to OPSS. MUNI 1350 (Nov 2014) - Material Specification for Concrete - Materials and Production. 1350(September).

[8] Dvorkin L. I. 2020. The influence of polyfunctional modifier additives on properties of cement-ash fine-grained concrete. Magazine of Civil Engineering, 93(1): 121-133. https://doi.org/10.18720/MCE.93.10

[9] Ekinci C. E. & Kelesoglu O. 2014. A study on occupancy and compressive strength of concrete with produced injection method. Advances in Materials Science and Engineering, 2014. https://doi.org/10.1155/2014/241613

[10] Elvira Y. 2016. IJTI Case study on use area parking at new market city shopping center Bogor Syaiful, Yena Elvira Case Study on use area parking at new market city shopping center Bogor. IJTI (International Journal of Transportation and Infrastructure.

[11] Ervianto M., Saleh F. & Prayuda H. 2016. Kuat Tekan Beton Mutu Tinggi Menggunakan Bahan Tambah Abut Terbang (Fly Ash) Dan Zat Adiktif (Bestmittel). Sinergi, 20(3): 199. https://doi.org/10.22441/sinergi.2016.3.005 (Indonesian).

[12] Febrigiano G., Wallah L. S. E., Tanudjaja H. & Imbar, S. E. J. 2013. Pengaruh Kecepatan Pembebanan Dan Dimensi Benda Uji Terhadap Kuat Tekan Beton. Jurnal Sipil Statik, 1(3): 145-152. (Indonesian).

[13] Jahami A., Temsah Y., Khatib J., Baalbaki O., Darwiche M. & Chaaban S. 2020. Impact behavior of rehabilitated post-tensioned slabs previously damaged by impact loading. Magazine of Civil Engineering, 93(1): 134–146. https://doi.org/10.18720/MCE.93.11

[14] Kadri E. H., Aggoun S., Kenai S. & Kaci A. 2012. The compressive strength of high-performance concrete and ultrahigh-performance. Advances in Materials Science and Engineering, 2012. https://doi.org/10.1155/2012/361857

[15] Karaburc S. N., Yildizel S. A. & Calis G. C. 2020. Evaluation of the basalt fiber reinforced pumice lightweight concrete. Magazine of Civil Engineering, 94(2): 81-92. https://doi.org/10.18720/MCE.94.7

[16] Kashevarova G. G. & Tonkov Y. L. 2020. Technical diagnostics of reinforced concrete structures using intelligent systems. Magazine of Civil Engineering, 93(1), 13–26. https://doi.org/10.18720/MCE.93.2

[17] Laksono B. 2017. Experiment of early age concrete with fly -ash using high-strength design engineering faculty.

[18] Madhusudhan Reddy M., Sony B., Praveen Goud U., Raja Sekhara Reddy K. & Asadi S. S. 2020. An experimental analysis for evaluation of compressive strength of concrete cube by using foundry sand, silica fume and metakaolin as an admixture. International Journal of Scientific and Technology Research, 9(1), 1217–1220.

[19] Mohammed D., Tobeia S., Mohammed F. & Hasan S. 2018. Compressive strength improvement for recycled concrete aggregate. MATEC Web of Conferences, 162, 4-7. https://doi.org/10.1051/matecconf/201816202018

[20] Mubarak M., Rulhendri R. & Syaiful S. 2020. Perencanaan peningkatan perkerasan jalan beton pada ruas jalan babakan tengah kabupaten bogor. astonjadro, 9(1): 1. https://doi.org/10.32832/astonjadro.v9i1.2694 (Indonesian).

[21] Of I. T. Y. 2009. TS 1350 November 2009. November.

[22] Prakash M., Manikandan S., Surenther I., Aswin Kumar, M. N., Ilakkiya S. & Menaka D. 2019. Speculation of compressive strength of concrete in real-time. International Journal of Recent Technology and Engineering. 7(6): 988-992.

[23] Prayuda H. & Saleh F. 2019. Kuat tekan beton awal tinggi dengan variasi penambahan superplasticizer dan silica fume high early age concrete compressive strength with. 36-43.

[24] SNI 03-2824. 2000. Tata cara pembuatan rencana campuran beton normal. Badan Standar Nasional Indonesia Standardisasi Nasional, 1-34. (Indonesian).

[25] SNI 2493. 2011. Tata Cara Pembuatan dan Perawatan Benda Uji Beton di Laboratorium. Standar Nasional Indonesia, 23. www.bsn.go.id (Indonesian).

[26] SNI1974-2011. 2011. Cara Uji Kuat Tekan Beton dengan Benda Uji Silinder. Badan Standardisasi Nasional Indonesia, 20. (Indonesian).

[27] Syaiful, S. 2020. Analysis on the addition of fiber the strong bending mixed concrete. 15(6). www.arpnjournals.com

[28] Syaiful S. & Hariyadi D. 2019. Case study on sustainable T-Jungtion Cibinong city mall (CCM) in Bogor Indonesia. 14(17). www.arpnjournals.com

[29] Syaiful S. & Lasmana L. 2020. A study on level of railway road damage with sustainable PCI method. 15(8). www.arpnjournals.com

[30] Syaiful S. & Pratama Y. 2019. Sustainable studies about general public transport performance in the city of Bogor. 14(18). www.arpnjournals.com

[31] Triyanto T., Syaiful S. & Rulhendri R. 2020. Evaluasi tingkat kerusakan jalan pada lapis permukaan ruas jalan tegar beriman kabupaten Bogor. Astonjadro, 8(2): 70. https://doi.org/10.32832/astonjadro.v8i2.2628 (Indonesian).

[32] Usanova K. & Barabanshchikov Y. G. 2020. Magazine of Civil Engineering Cold-bonded fly ash aggregate concrete. 2020, 95(3): 104-118. https://doi.org/10.18720/MCE.95.10

[33] Vdovin E. A. & Stroganov V. F. 2020. Properties of cement-bound mixes depending on technological factors. Magazine of Civil Engineering, 93(1): 147-155. https://doi.org/10.18720/MCE.93.12

[34] Yanti G., Zainuri Z. & Megasari S. W. 2019. Peningkatan Kuat Tekan dan Kuat Lentur Beton Dengan Variasi Penambahan Serat Daun Nanas. Teknik, 40(1): 71. https://doi.org/10.14710/teknik.v40i1.23390. (Indonesian).