The Compressive Strength of Concrete Containing Additive as Cement Reducer

Andang Widjaja[1,*], Yogi Risdianto[1], Yhougha Arista M[2], Rofy Syakur M[1]

[1] *Universitas Negeri Surabaya*
[2]*Dynamix Ready Mix Concrete*
[*]*Corresponding author. email: andangwidjaja@unesa.ac.id*

ABSTRACT
This paper discussed about the compressive strength of cylinder normal concrete and concrete containing additive as cement reducer, cement, sand, aggregate and water. The composition of control concrete were add with additive material called cement reduction. The methods of mixed design based on Indonesian Standard SNI-03-2834-2000. Composition of control concrete was 1 cement (100%): 2.4 fine aggregates: 3.1 coarse aggregates: 0.54 water. There were 3 mixed concretes designed: 1) 0.6cement reducer (0.6% of cement weight) 100% cement 2.4 fine aggregates: 3 coarse aggregates: 0.52 water.; 2) cement reducer 0.8% of cement weight and 100% cement (mix 0.8); 3) cement reducer 1% of cement weight and 100% cement (mix 1.0.). Concrete specimens were cylindrical with diameter of 15 cm and height of 30 cm. The results showed that the rate of compressive strength of control concrete with 0% cement reduction on 28 days tested was 32 MPa or 100%. The rate of compressive strength of concrete with 0,6%; 0.8%; 1%; cement reduction was 99%, 109%, and 104%respectively. The rate of weight of control concrete was 12.69 kg or 100%. The rate of weight of modified mixed concrete were 101%, 102%, and 102%.

Keywords: *Additive Cement Reduction, Compressive Strength, Concrete.*

1. INTRODUCTION

The ASTM C494 showed that there were seven types of admixtures as follows: type A-Water-reducing admixtures, type B-Retarding admixtures, type C-Accelerating admixtures, type D-Water-reducing and retarding admixtures, type E-Water-reducing and accelerating admixtures, type F-Water-reducing, high range admixtures, and type G-Water-reducing, high range, and retarding admixtures. These chemical admixtures to be added to hydraulic-cement concrete mixtures for the purpose

The additive agent called cement reducer can be found in the market. Additives agent to reduce the amount of cement in the mix and increase the strength of the concrete [2].

Gandage, Abhijeet concluded that: admixtures are added to concrete to improve its fresh state and/or hardened state performance. Admixtures help in executing concreting operations in difficult conditions. Adopting admixtures in concrete manufacture improves its sustainability. Addition of admixture extends the service life of concrete due to improvement in its performance and quality. Use of accelerators help reduce setting time, superplasticizers aid in optimizing concrete mix design, reduce concrete porosity. Air entraining agents help improve durability of the concrete. However, it should be noted that admixtures are not the only factor that determine the performance of concrete. It is the concrete mix design, batching, placement and finishing along with ambient conditions that help in achieving long term maintenance free concrete [3].

Chemical admixtures are the ingredients in concrete other than hydraulic cement, water, and aggregate that are added to the mix immediately before or during mixing. There are a variety of chemical admixtures available for use in concrete mixtures to modify fresh and hardened concrete properties [4].

Rodrigo Antunes and Mang Tia concluded that the higher the concrete volume in construction, the more environmental benefit can be obtained by reducing cement content in concrete. A 25 % cement reduction in a concrete pavement led to a decrease of 80,000 tons in CO_2 emission, while a seaport construction displayed a decrease of 17,000 tons of CO_2. [5]

The use of limestone as an additive in portland cement can increase the concentration of CaO becomes more dominant and the compressive strength is lower. Need accuracy to calculate of the concentration ratio of the chemical components of raw material for clinker by considering the addition of limestone additive [6].

2. SLUMPT TEST, COMPRESSION STRENGTH TEST

Slump test is method of measuring consistency of concrete which can be done either in laboratory or at the site. It does not measure all factors contributing to workability, nor it is representative of the place ability of concrete. It also showed characteristic of concrete. The slump value was measured as the difference in height between the height of the cone slump apparatus and the average value of the height fresh concrete [7].

The compressive strength of the cylinder specimen calculated by dividing the maximum load carried by the specimen during the test by the average cross-sectional area of cylinder specimen [8].

3. METHOD

The composition of control concrete *fc*'30 was 1cement: 2.4 fine aggregate : 3.1 coarse aggregate: 0.54 water. Material proportion by weight in m^3 of concrete fc' 30 MPa was cement of 348 kg: fine aggregate of 831 kg: coarse aggregate b (ϕ10mm-20mm) of 697 kg; and coarse aggregate a (ϕ 5mm-10mm) of 376 kg; fine aggregate (<ϕ0.5mm) of 675 kg water of 180 kg. This composition was taken from Dynamix Ready Mix laboratory.

The fine aggregate comes from Pasirian, Lumajang district. Coarse aggregate from Jeladri, Pasuruan district. Sand testing were done to get specific gravity, grain gradation, absorption value.

Size of sieve were 3/8"=9.5mm; #4=4.75mm; #8=2.36mm; #16=1.18mm; #30=0.60mm; #50=0.30mm; #100=0.15mm; #200=0.075mm. The gradation of fine aggregate showed at grading zona 2.

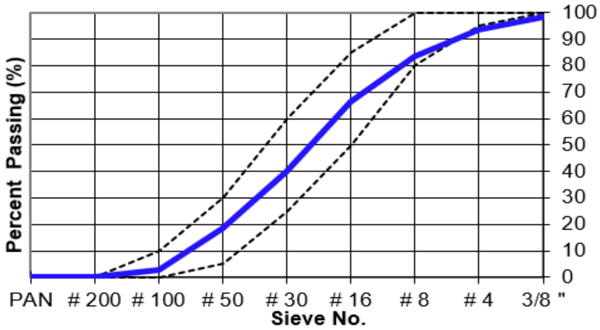

Figure 1. Gradation of fine aggregate

Size of sieve were 1,5"=37,5mm; 1"=25mm;3/4"=19mm; 1/2"=12.5mm; #4=4.75mm; #8=2.36mm; #16=1.18mm; #30=0.60mm; #50=0.30mm; #100=0.15mm; #200=0.075mm.

Gradation of coarse aggregate at the figure below.

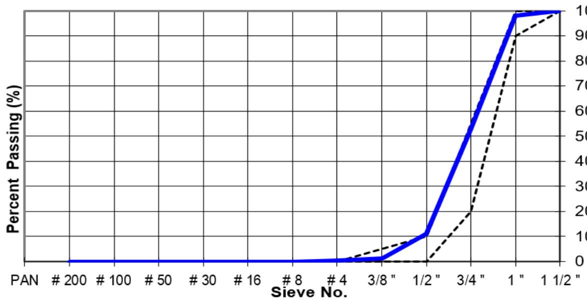

Figure 2. Gradation of coarse aggregate

Table 1. Proportion material (weight of kg/m^3)

Material	1	2	3	4
% Additive agent of cement weight	0	0.6	0.8	1.0
Cement, *kg*	348	348	348	348
Coarse Aggr b	697	697	697	697
Coarse Aggr a	376	376	376	376
Fine Aggr., *kg*	834	834	834	834
Water, *l*	185	185	185	185
Add agent, *l*	0	2.04	2.72	3.40

Sequence of mixing material was starting by putting the coarse aggregate into the drum of concrete mixer machine, then the fine aggregate, cement, water and additive agent CCR.

The concrete mixing was done by electric machine. The drum type of mixing machine classified as tilting drum, with a revolving star of blades for more efficient. The mixer drum revolves about 25 radians per minute. The surface of drums should be in wet condition.

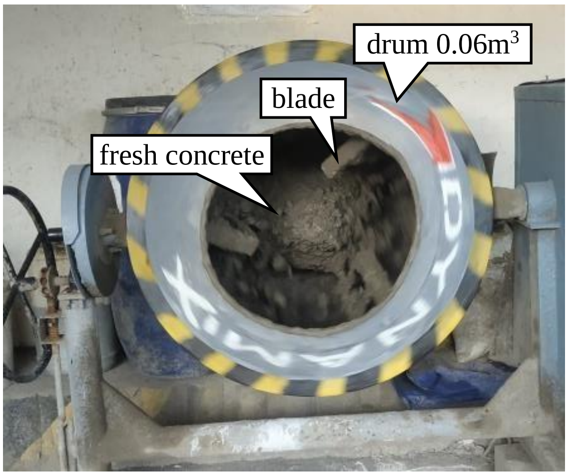

Figure 3. Electric Mixing Machine

Cylinder specimen dimension were 30cm in height, and diameter of 15cm. There were 36 cylinders were cured in water for curing age 28 days, without controlling pH. The temperature was 25º±2ºC.

4. RESULT AND DISCUSSION

The rate of 3 slump test of the control concrete mix was 9.7cm. The range of the slump for fresh concrete containing cement reduction was 8cm to 10 cm. The values rate of slump test were 9.2cm, 7.5cm, and 8cm, respectively. Concrete type number 1 for control concrete, 2 for concrete mix with 0.6% cement reduction, 3 for concrete mix with 0.8% cement reduction, and 4 for concrete mix with 1.0% cement reduction.

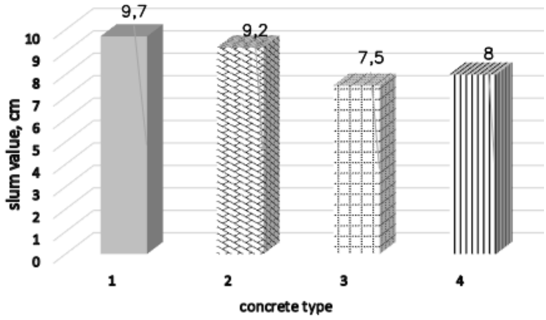

Figure 4. Slump of concrete

Slump test were carried out at the laboratory for measure all factors contributing to workability, nor it is representative of the place ability of concrete.

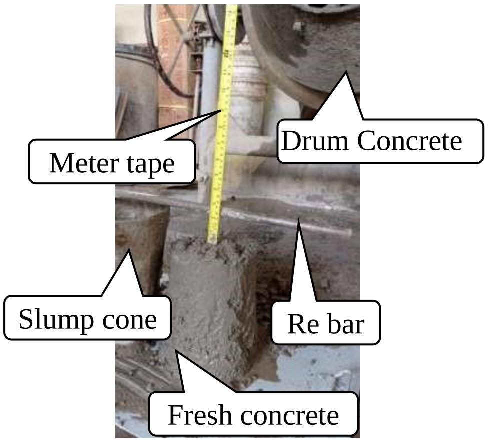

Figure 4. Slump test measurement of concrete containing 1.0% cement reduction

The weight of cylinder specimen concrete control without cement reducer 12.69 kg. The others concrete cylinder with cement reduction 0,6%, 0,8%, and 1,0% were 12.86kg, 12.956 kg, and 12.99 kg, respectively. All concrete cylinder have the same weight, its about 12 to 13kg.

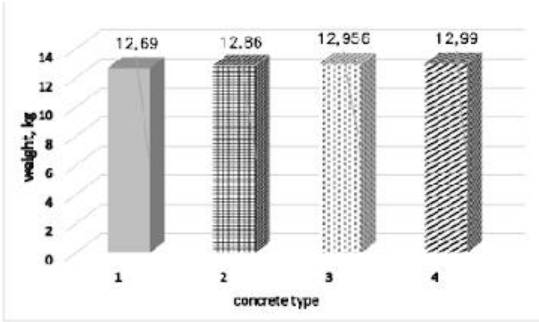

Figure 5. Weight of cylinder specimen

The result test of rates compressive strength was 32 MPa, 31,59 MPa, 34,77 MPa, and 33,18MPa. Note: **1** for normal concrete, **2** for concrete containing 0.6% cement reduction, **3** for concrete containing 0.8% cement reduction, and **4** for concrete containing 1.0% cement reduction.

The rate of compressive strength of the control concrete mix was 32 MPa. The rate of compressive strength of the concrete mix with 0.6% cement reduction mix was decrease 0.01%. Then, the rate of compressive strength of the concrete mix with 0.8% cement reduction mix was increase 1.09%. The rate of compressive strength of the concrete mix with 1.0% cement reduction mix was lower than compressive strength of the concrete mix with 0.8% cement reduction or 1.04% greater than the control one.

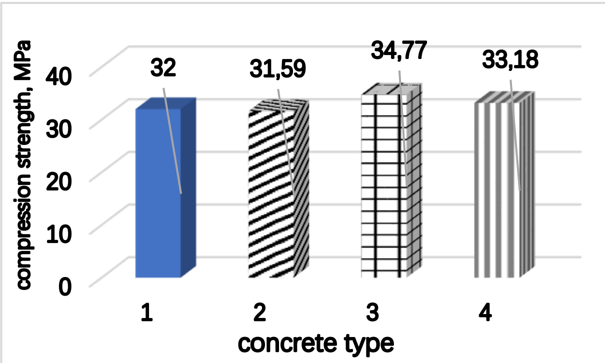

Figure 6. Compressive strength

5. CONCLUSION

The rate of compressive strength of the concrete mix without cement reduction mix was 1.09% lower than the compressive strength of the concrete mix with 0.8% cement reduction.

The compressive strength of the concrete mix without cement reduction and concrete mix with cement reduction were almost same. The standard deviation was 1,6 MPa.

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