

Conversion of compressive strength of concrete cement using adhesive pozolan on age variation of concrete

¹I Wayan Intara*, ²I Wayan Sudiasa, ³I Made Jaya, ⁴I Wayan Dana Ardika

^{1,2,3,4} Civil Engineering Department, Politeknik Negeri Bali
^{1,2,3,4} Jln. Raya Kampus Bukit Jimbaran, Bali-Indonesia
email : intarajoist@yahoo.com (indicated by *)

Abstract. It is known that the adhesive to the concrete mix in general use cement types of PPC (pozzolan portland cement) and PCC (portland cement composite) of various cement brands marketed in Bali. The same was done by ready mix concrete fabric, they are also substituting cement with fly ash in the concrete mix a certain percentage of the sale. Material pozzolan as a cement substitute material include: fly ash, coverslag, spent catalis, stone powder, and portland cement pozzolan. From previous studies it is known that in ages early (before 28 days) concrete using pozzolan as a substitute for cement produces the compressive strength is lower than the concrete of the adhesive cement type I (Ordinary Portland Cement), an increase in compressive strength occurred after 28 days

Research conducted at the Laboratory of Materials Engineering Department of Civil Bali State Polytechnic using the test piece cylindrical with a size of 15x30 cm quantity of 20 pieces for each age concrete with compressive strength Designed 25 MPa, tested at the age of 3, 7, 14, 21, 28, 56, and 90 days following the PBI'71. Material aggregate from Karangasem district, ppc cement production of Gresik and pcc production of Tonasa. Value slump concrete mix according to the interval of 30mm-60mm. Concrete compressive strength designed is reached at the age of 56 days, with a value of 25.990 MPa for PCC and 25.961 MPa for PPC. Conversion Age and Compressive Strength Characteristics for cement adhesive PCC is 0.60, 0.67, 0.80, 0.88, 0.96, 1.00, and 1.33, and for PPC cement adhesive was 0.56, 0.65, 0.81, 0.86, 0.92, 1.00, and 1.23 according to the concrete in a row 3, 7, 14, 21, 28, 56, and 90 days.

Keywords: Concrete, Pozzolan Cement, Age of Concrete, Compressive Strength of Concrete

INTRODUCTION

In general, it is very difficult to get Portland type I (OPC) cement, which is currently available in PPC (portland pozzolan cement) and PCC (portland composite cement). This type of cement is currently used as an adhesive in a mixture of concrete. In the ready mix business there is also a tight competition, so to be able to exist they substitute cement with fly ash to get more competitive price. Problems arise in the field at the time of testing of cube and cylinder test objects, ie testing of concrete samples in various ages. Often obtained test data at age 3, 7, 14 that the compressive strength of concrete in accordance with the compressive strength of the plan even greater. However, on a 28-day sample test often results in a smaller value than the quality of the plan. To determine the value of compressive strength test at age less than 28 days converted with the coefficient of age and compressive strength dikatif of PBI 71. Cube test object used in PBI 71 comes from cement type I. The expected goal of this research is to get answers on the achievement of concrete compressive strength values in the variations in age for PCC and PPC cement. The value is to become a new reference in the construction industry which still uses the age conversion and concrete compressive strength value of type I cement adhesive.

METHODOLOGY

The implementation of the research is divided into several stages: preparation, manufacture of test specimens, specimen treatments, data collection and data analysis. Preparatory steps include the preparation of tools, inspection of materials including the making of the implementation schedule. Equipment used such as mixer, cylinder mold 30 mm x 150 mm, vibrating machine, place of care and press test equipment, examined feasibility of conducting research condition. Examination of the material concerning the examination of the characteristics of the basic materials used in the study such as specific gravity, unit weight, the design of fine aggregate gradation and coarse aggregate to be used in any mixture and others. Mixing of materials is done by Mixer machine by following the standard procedure. In this study aggregates before mixing were prepared under SSD conditions. The number of specimens prepared according to the age of the test and the number of specimens per test. Power measurements were performed at ages of 3, 7, 14, 21, 28, 56 and 90 days using each 20 (twenty) cylinders 30 mm x 150 mm for each type of cement and test life. Thus the required test material for each treatment is 140 (one hundred and forty) pieces, so the total of 30 mm x 150 mm total cylinders made entirely is 280 (two hundred and eighty) pieces. The printed test piece was left in the mold for 24 hours and then opened from the mold for further maintenance. Treatment is carried out by placing test specimens in a room protected from direct sunlight up to the time specified for testing: 3, 7, 14, 21, 28, 56 and 90 days. The test is done at the material laboratory of Civil Engineering Department of Bali State Polytechnic. The data collected are crushed loads for compressive strength. All of it was obtained from the test results of the cylindrical test object in accordance with the specified test age. Before testing the specimens were weighed and measured on the sides. From the information of compressive strength values, produced for each group of specimens and each subsequent age of testing is analyzed to obtain the age and strength relationship of concrete made with mixed adhesive of PCC and PPC and concrete with Cement Type I adhesive. For the purposes of drawing conclusions, a discussion involving both tested parameters and related theories is present in the literature. To facilitate an understanding of the discussion, the test results will be displayed in the form of tables and curves.

RESULT AND DISCUSSION

Concrete Test Results

A. The value of slump

The slump value test is intended to determine the degree of viscosity of the concrete mix which can further illustrate the workability of the concrete mixture. The slump test results obtained can be seen in the following table below.

Table 1 The value of concrete slumps

Mixture	Slump value (cm)						
	PCC3	PCC7	PCC15	PCC21	PCC28	PCC56	PCC90
I	4	3	3	5	3	3	3
	PPC3	PPC7	PCC14	PCC21	PCC28	PCC56	PCC90
II	3	3	3	3	6	3	5

From table 1 it can be seen that the slump value occurring is still within the required interval range of 30 mm - 60 mm, so mixing and molding of concrete can be continued.

B. Strong Press Concrete Characteristics

Calculation of compressive strength using Pres 2.1 and 2.2. Strong Press Mean (R_m) is the sum of compressive strength of the test object divided by the number of specimens (20

pieces). The concrete characteristic strength of the concrete (f_c) is calculated by equation 2.3 as described in the calculations using simple statistical analysis, according to the formula in PBI'71. The compressive strength value of the concrete characteristics for each treatment of the adhesive for each test age is shown in Table 2.

C. Age Conversion Rate and Strong Concrete Press

After obtaining the result of strength value, press the concrete characteristic for each cement, then inserted in the concrete compressive strength recapitulation table in the variation of age (3, 7, 21, 28, 56, and 90 days), then calculated age conversion rate against concrete compressive strength age 56 days, shown in table 2 and figure 1.

Table 2 Conversion Rate of Age and Strong Concrete Press

Umur	Kode Benda Uji	KUAT	ANGKA
		TEKAN	KONVERSI
		MPa	UMUR
PORTLAND COMPOSITE CEMENT			PCC
3	PCC3	15,691	0,60
7	PCC7	17,318	0,67
14	PCC14	20,914	0,80
21	PCC21	22,815	0,88
28	PCC28	24,846	0,96
56	PCC56	25,990	1,00
90	PCC90	34,466	1,33
POZOLAN PORTLAND CEMENT			PPC
3	PPC3	14,533	0,56
7	PPC7	16,912	0,65
14	PPC14	21,052	0,81
21	PPC21	22,382	0,86
28	PPC28	23,906	0,92
56	PPC56	25,961	1,00
90	PPC90	32,038	1,23

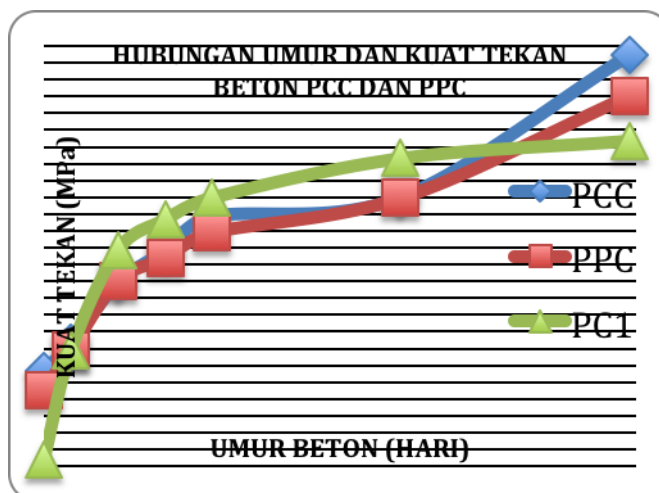


Figure 1 Age and Strength Press Concrete

From table 2 and Figure 1 can be seen some of the concrete behavior of PCC and PPC as follows:

- At the age of 3, 7, 14, 21, 28, and 56 days the compressive strength values achieved by PCC and PPC concrete are close to the same, in the graph also almost coinciding with the red and blue lines.
- Stronger characteristic of the plan was achieved at age 56 days with 25,990 MPa and 25,961 MPa values for PCC and PPC concrete. This value is greater than the value of

- compressive strength of the targeted plan of the calculation of job mix design is 25 MPa.
- c. At the age of 90 days the value of compressive strength of PCC concrete characteristics of 34.466 MPa greater than 8% of the value of compressive strength of PPC concrete characteristics of 32.038 MPa.
 - d. When compared to compressive strength values of PC1 concrete characteristics it is seen that the compressive strength of PCC and PPC concrete characteristics at age 3 and 7 days is greater than PC1 concrete by about 30%. However, at the age of 14, 21, 28, and 56 days of concrete PCC and PPC produce a compressive strength smaller than PC1 concrete. Increased compressive strength of PCC and PPC characteristic concrete is high after 56 days to 90 days. This is also seen in Figure 5.3 the green color curve is above the red and blue color curves.
 - e. From table 5.6 it can be seen that when using age conversion of compressive strength of PC1 concrete characteristic then at age 3 and 7 days will be produced compressive strength of PCC and PPC concrete characteristics higher than compressive strength of concrete plan (25 MPa). But at the ages of 14, 21, and 28 days yield a lower compressive strength characteristic than the compressive strength of the plan. This is the answer to the field practitioner's question as to why at the early age of the test specimen they tested yielded a compressive strength higher than the compressive strength required in the planning.

CONCLUSIONS

From the above data can be concluded several things as follows:

- a. The material of sand and gravel concrete formers meets the applicable requirements; sand enter zone 2 mud content below 5%, gravel gradation max 20 mm, mud content below 12%.
- b. The slump value of the concrete mixture is obtained in a range that meets the requirements of 30 mm-60 mm
- c. Strong targeted target characteristics achieved at age 56 days, for both types of concrete; PCC with 25,990 MPa and PPC of 25,961 Mpa
- d. Age Conversion Rate and Strong Press The characteristics for PCC cement adhesive are 0.60, 0.67, 0.80, 0.88, 0.96, 1.00, and 1.33 according to age 3, 7, 14, 21, 28, 56, and 90 days
- e. Age Conversion Rate and Strong Press The characteristics for PPC cement adhesives are 0.56, 0.65, 0.81, 0.86, 0.92, 1.00, and 1.23 by age 3, 7, 14, 21, 28, 56, and 90 days

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