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RESEARCH ARTICLE OPEN ACCESS

MIXING AND PROPORTIONING OF HIGH STRENGTH CONCRETE

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Abstract:

This paper presents design of admixture concrete. High strength of concrete is used in highway pavements, airport, bridge, concrete sleeper and dam, etc. High strength of concrete is obtained by mixing of cement, fine aggregate, coarse aggregate, water and admixture. In many type of cement, elephant cement (Portland cement Type I) is used in this paper. Fine aggregate is obtained from Than Lwin River and coarse aggregate is obtained from Barbu Mountain (Kyaikmayaw) Township, Mon State. Water cement ratio of 0.26 is used in this design. Admixture (MIGHTY 150 S) is used in this design. Design of structural mix proportions are calculated by ACI method. The mixture size of coarse aggregate of 20 mm (3/4″) is used. The limit of slump value for this study is 1 in-3 in. Admixture dosages 1%, 1.2% and 1.4% are used in this proportion. Compressive strengths are tested for 3 days, 7 days and 28 days. The compressive strength with admixture 1% is 8136.76 psi, with admixture 1.2% is 9053.58 psi and with admixture 1.4% is 8118.93 psi at 28 days. The concrete strength is sustained within high strength concrete range because compressive strength has over 6000 psi to 9000 psi.

Keywords- admixture concrete, fine aggregate, coarse aggregate, water cement ratio, compressive strength

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I. INTRODUCTION

High strength of concrete is used in highway pavement, airport, bridge and dam. High strength concrete is high performance concrete. High strength concrete is obtained by mixing of cement, sand, aggregate, admixture and water in required proportion. High strength concrete has a compressive strength greater than 55 MPa having water cement ratio (w/c0 rating from 0.35 to 0.3 or even less. Due to low w/c ratio it requires super plasticizer to achieve required workability.

Admixtures are the materials other than three basic ingredients of cement concrete-cement, aggregate and water-added to the concrete mix before or during mixing to improve certain of its hydrations in fresh or hardened state. The functions of admixtures are to accelerate the initial set of concrete, i.e. to speed up the rate of development of strength at early ages, retard the initial set, increase the strength of concrete, improve workability, reduce heat of evoluation, increase durability of concrete-resistance capillary flow of water and to make it impermeable, increase the penetration and pumpability of concrete, reduce segration in grouts.

II. INVESTIGATION OF MATERIALS USED FOR HIGH STRENGTH CONCRETE

The ingredients of high strength concrete are: cement, fine aggregate, coarse aggregate and water. Admixtures may be used to enhance some properties of the concrete.

A. Cement

Cement acts as a binder element in concrete. In this research Elephant cement (Portland Cement Type I). This cement used in the general concrete construction when there is no exposure to sulphate in the soil or in the ground water.

From test result, initial setting time 103 min and final setting time 255 min, specific gravity of the cement 3.07.

B. Fine Aggregate

Aggregate passing through 4.75 mm sieve are defined as fine. They may be natural sand deposited by rivers, crushed stone sand-obtained by crushing stones and crushed gravel san. The smallest size of fine aggregate (sand) is 0.06 mm.

Specific gravity of fine aggregate is 2.46. Water absorption by fine aggregate is 15.46% and moisture content is 7.22%. From sieve analysis of fine aggregate, fineness modulus of fine aggregate is 2.617.

C. Coarse Aggregate

Aggregate retained on 4.75 mm sieve are identified as coarse. They are obtained by natural disintegration or artificial crushing of rocks. From the result, specific gravity of coarse aggregate is 2.71. Water absorption is 0.04% and moisture content 1.03%. For high strength concretes, 10 to 20 mm size of aggregate used. In this paper, size of aggregate 20 mm only used.

D. Water

In concrete, the single most significant influence on most or all of the properties is the amount of water used in the mix. Water used in the preparation of concrete should be free from dirt and organic matters. In concrete mix design, the quantity of water is decided on the basic of water ratio which is taken according to the desired level of workability and strength.

E. Admixture

Admixture are used enhance some properties like strength, durability, workability, to increase or decrease setting times. Admixture may be organic or inorganic in composition but their chemical character. In this test, Type F high-range. Water reducing or superplasticizing (MIGHTY 150 S) is used.

F. Superplasticizer

Superplasticizer are admixture which are water reducing but significantly are distinctly more than the water-reducing admixture. The use of superplasticizer was found to increase the strength of concrete at a constant water-cement ratio. The effects of superplasticizer are very important in mix design with proportioning and mixing of concrete. In this test, dosage rate of superplasticizer are used 1%, 1.2% and 1.4% with water cement ratio is 0.33.

III. HIGHT STRENGTH CONCRETE MIX DESIGN

Mix design is a process of selecting suitable ingredient materials of concrete mix to achieve good quality concrete at site economically. Different design mix methods help us to arrive the trial mix that will give us required strength, workability, cohesion etc. In this study the chosen mix design method in American Concrete Institute Method ACI 211.1-91. ACI recommends a relationship between compressive strength and w/c ratio. Water demands for aggregate sizea are summarizes in relation to the concrete workability (consistence) required. This leads to an estimate of cement content and aggregate content from an assumed concrete plastic density. The rounded bulk volume for the coarse aggregate is estimated from giving the fineness modulus of the fine aggregate and the coarse aggregate calculated. The designed proportions are shown in the Table 1.

TABLE 1: Mix Proportion

Mix Proportion			
Cement	Find Aggregate (Sand)	Coarse Aggregate (Chipping)	Water
571 kg/m^3	594 kg/m^3	1040 kg/m^3	150 kg/m^3
1	1.04	1.82	0.26

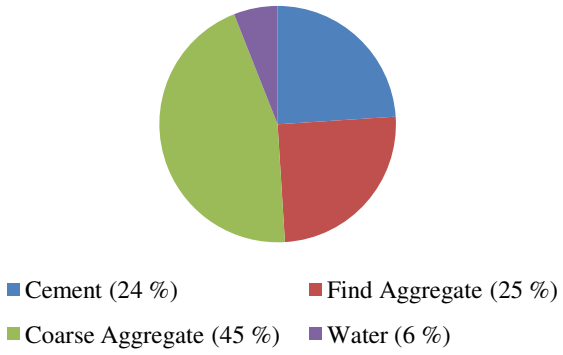

Figure 1: Typical Distribution of Materials in Concrete

IV. STRENGTH TESTS OF HIGH STRENGTH CONCRETE

Compressive strength or compression strength is the capacity of material or structure to with sand loads endings to reduce size. Water cement ratio is 0.26 and coarse aggregate contents are used 20 mm in this test. Admixture dosage of 1%, 1.2% and 1.4% are used. The compressive strength for 3 days, 7 days and 28 days are tested. Compressive strength of concrete is usually found by testing cubes. The test results of compressive strength are cube strength. According to, the expression of converting the strength of cubes into equivalent cylinder strength. According to ACI code, fcu cube=fcy/0.83.

Figure 2: Compression of Concrete Cube Specimen after Compressing

V. RESULT AND DISCUSSIONS

The compressive strength of hardened concrete is considered one of the most important properties and is often used as an index of the overall quality of concrete. From test results, compression of test results for different admixture dosage as shown in Tables and Figure.

TABLE 2: Average Compression Strength of Concrete for Admixture Dosage 1%

Age of Strength		3 days	7 days	28 days
No. of Cubes		3	3	3
Cube Strength (psi)	Cube 1	4953.20	5421.75	7842.89
	Cube 2	5270.75	4460.20	7927.96
	Cube 3	5278.00	5148.95	8639.42
Average strength		5167.32	4950.30	8136.76

TABLE 3: Average Compression Strength of Concrete for Admixture Dosage 1.2%

Age of Strength		3 days	7 days	28 days
No. of Cubes		3	3	3
Cube Strength (psi)	Cube 1	5473.45	4932.90	9093.11
	Cube 2	5283.05	5989.95	8816.64
	Cube 3	5779.70	5438.95	9251.00
Average strength		5602.07	5453.93	9053.58

TABLE 4: Average Compression Strength of Concrete for Admixture Dosage 1.4%

Age of Strength		3 days	7 days	28 days
No. of Cubes		3	3	3
Cube Strength (psi)	Cube 1	5034.40	5469.40	8167.69
	Cube 2	5017.00	5128.65	8276.60
	Cube 3	4906.80	4892.30	7912.49
Average strength		4986.07	5163.45	8118.93

TABLE 5: Average Compression Strength of Plain Concrete

Age of Strength		3 days	7 days	28 days
No. of Cubes		3	3	3
Cube Strength (psi)	Cube 1	4574.75	5179.40	7786.33
	Cube 2	4381.90	5179.40	7883.31
	Cube 3	4516.75	4932.90	7891.49
Average strength		4491.13	5097.23	7815.37

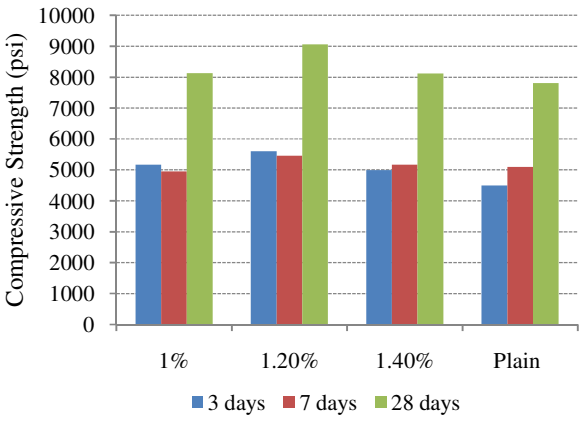

Figure 3: Results Comparison of Compressive Strength

VI. CONCLUSIONS

From this result, the following facts can be concluded.

(1) At the same water-cement ratio, sand content, aggregate content, the compressive strength of admixture dosage with 1.2% is the highest compressive strength than with 1% and 1.4%.

(2) Therefore, the compressive strength of admixture dosage 1.2% gives the best result at 28 days for this study among different admixture dosage.

(3) In the concrete mix with the maximum aggregate size of 3/4" and admixture dosage of 1.2%, the concrete strengths are within high strength concrete strength range. So, this mix design results prove the title of "High Strength Concrete".

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