COMPARATIVE ANALYSIS OF CONCRETE MIXED DESIGN

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ABSTRACT:
Concrete mix design is the process of selecting appropriate concrete ingredients and calculating their relative proportions with the goal of generating concrete with a minimum set of attributes, namely workability, strength, and durability, as economically as feasible. It should be clarified that it is typically impossible to determine mix proportions precisely using a table or computer data. The major goal of the study was to build an M25 concrete mix and determine the compressive strength utilising various mix design methodologies, including the DOE technique, the ACI method, the IS10262-1982 method, and the IS10262-2009 method. We draw the conclusion that the DOE methods utilised in the first four ways use the least amount of cement possible while still providing concrete with the desired compressive strength. Because of the vastly different qualities of the constituent elements, designing a concrete mix is not an easy task. The process of choosing the proper ratios of cement, fine aggregate, coarse aggregate, water, and any admixtures necessary to meet the demands of compressive strength, workability, and durability is known as mix design. According to the definitions given above, designing serves two purposes. The primary goal is to meet the basic requirements for strength and durability. The second goal is to produce concrete as cheaply as possible. The fundamental tenet of mix design is that the water cement ratio controls the compressive strength of workable concrete. Another most convenient relationship applicable to normal concretes is that for a given type, shape, size and grading of aggregates, the amount of water determines its workability. However, there are various other factors which affect the properties of concrete

INTRODUCTION

The hard, chemically inert, particle material known as aggregate is bonded by cement and water to form concrete, a material used in building construction that holds a unique place among modern construction materials. Because design mixes are specific to regional climate, local materials, and exposure, there are a number of methodologies that have been created for designing concrete mixes that are not universal. The performance criteria ought to serve as the foundation for developing the new-generation mix design approach. The minimal cement content and concrete strength produced from the proposed concrete mix should not be viewed as the primary factors determining whether a concrete mix is suitable for an area with extreme environmental conditions. The mix design Approaches for harsh environments should include the needs for quality and durability in a cost-effective way. For the concrete coherent mix, the strength and relative proportion of the ingredients should be taken into account. The fineness modulus method, ACI mix design technique, and DOE method are three common concrete mix design methods that are discussed in this paper from a qualitative and cost-effective point of view. The study makes it evident that the mix design methodologies' fundamental design parameters for quality and cost-effectiveness need considerable change. The durability indicators, in terms of denseness indicator, i.e., mix density and fine aggregate- to-total aggregate ratio, quality indicator, i.e., total aggregate-to-cement and fine aggregate-to-cement ratio, and other cementing material/mineral admixtures in addition to minimum cement content are suggested for severe environment. It is anticipated that with detailed experimental investigation on various suggested design factors focusing more on local challenges, present study will pave the way for the development of performance-based extreme environment design mix principles.

The process of selecting suitable ingredients of concrete and determining their relative amounts with an objective of producing a concrete of required strength, durability, and workability as economically as possible is termed as concrete mix design. Here we are doing concrete mix design of M25 grade by adding various types of admixtures and get more strength as well as it’s become economical mix design as far as cost is concern.

I. RELATED WORK

This is the simplest test and the one that is used the most frequently for on-site testing. It is mentioned in ASTM C 184-83 and 430-83 and can be utilised in a lab. Correctly weigh 100g of cement and place it in an IS sieve no. 9. (90 microns). Use a figer to break up the air-set lumps in the sample. For a total of 15 minutes, continuously sieve the sample with a circular and vertical motion. Weigh the debris that is still on the sieve.

MATERIALS USED

Cement

SAGAR 53grade cement ordinary Portland cement, ppc cement is used for casting the elements. The following test are conducted

- Fineness test
- Standard consistency test
- Initial setting time test
- Final setting time test
- Specific gravity test
- Compressive strength test

Fine aggregate:

In this investigation fine aggregate is a naturaly available sand and it is free from dirt, dust and any organic matter. The fine aggregate used for the project was obtained from Krishna river.

The following tests were conducted on the sand:

i. Sieve analysis.
ii. Bulking of sand by volume method.
iii. Specific gravity test.

Coarse aggregate:

In this investigation hard broken granite aggregate is used. The size aggregate is various from12 mm to 20 mm. The source of aggregates is from gunthapalli village

Applications:

In order to reduce the cost of cement, lower the heat of hydration, increase workability, lessen the impact of aggregate reactivity, achieve necessary long-term strength levels, and for environmental reasons, fly ash is typically used to concrete mixtures. Certain applications in construction can make use of fly-ash modified concrete. Because fly ash produces enhanced strength at late ages that cannot be attained with more Portland cement, ash is frequently utilised in the manufacturing of high strength concrete. This is because the addition of ash may lower the water demand without a loss in workability. [Popovics199Ob] Additionally, fly ash is frequently utilised in the creation of roller-compacted concrete (RCC). Fly ash can be applied in two different ways here: rich concretes with low ash concentrations, or lean concretes with high ash contents. [AC1 1987c] In RCC, the paste content must be kept high enough to assure compaction; fly ash does this. Because the performances of a given fly ash vary inherently and with different cements, trial mixes are recommended for the prediction of the performance of fly ash concrete mixtures.

PROPOSED METHODOLOGY

Test Methods:

Test and sampling methods for fly ash are outlined in ASTM and RILEM report the methodology for various fly ash tests.

The following fly ash tests are discussed in detail:

- Moisture content,
- Loss on ignition,
- Silicon oxide content,

- Alumina oxide content,
- Calcium oxide content,
- Chloride content,
- Free calcium oxide content,
- Total alkali oxides content,
- Particle density determination (by Pycnometer bottle and Le-Chatlier Flask methods),
- Fineness determination (by dry sieving, wet sieving, Blaine air permeability and laser methods)

The following tests for fly ash cement pastes, mortars, or concretes are outlined:

1. Soundness (expansion test),
2. water requirement (expressed as water content of test specimen divided by water content of control specimen to achieve equal specified consistencies)
3. Preparation and curing of specimens, determination of compressive strength (28 days).

Proportioning:

A reasonable concept is to pre estimate the relative amount of fly ash to be used in the mixture, and then follow a proportioning technique similar to that used in proportioning concretes made with Portland cement or blended cement. Methods for the pre estimation of the optimum amount of fly ash are available. [Popovics 1982b] It is possible to design a fly ash concrete of comparable strength to standard concrete at any age. However, factors such as curing condition sensitivity, sensitivity to particular cement, etc., must be considered.

The interaction between fly ash and other admixtures and by-products in concrete must be studied. In general, there are four classes, other than air entraining admixtures, of concrete admixtures that are used along with fly ash: accelerators, retarders, water reducers, and super plasticizers. Results show that all types of accelerators are effective in the presence of fly ash. However, they do not completely compensate for the slow rate of strength gain that results with ash substitution. Similarly, fly ash does not seem to consistently affect the performance of water reducing admixtures or super plasticizers. In the case of super plasticizers however, some test results show that their effectiveness may be reduced by the presence of fly ash. The simultaneous use of fly ash and other mineral admixtures was investigated. It was found that fly ash and condensed silica fume or fly ash and ground slag can be used together in concrete. When used with a modest amount of silica fume, the early strength of the fly ash concrete improved considerably. In addition, the later strength also improved dramatically. However, the use of silica fume increases the water requirement of a mix, and this has to be accounted for.

MIXED DESIGN WORKING AND PROCEDURE:

Nominal mix – M35

Step-1 :targret mean strength fm = fck +1.65 * S

= 35 + 1.65 * 5

= 43.25 N/mm^2

Step -2 :water cement ratio Water cement ratio = 0.35 **Step-3:** water content :

Max water content = 186

For 20mm aggregate = (25-50mm) Workability = 100mm

Water content = [186+6/100*186] Therefore water content = 197ltrs **Step-4 :**calcutaion of cement content

W/c ratio = 0.35

Cement content = water content / W/c ratio

= 197 / 0.35

Therefore cement = 562.85

Step -5 :volume of fine aggregate

V = [w+c / s_c +1/p*f_a / s/a]*1/1000

0.98 =[197+562.85/3.40+1/0.35*f_a/2.75]*1/100

Fine aggregate =594.301 kgs

Step – 6 :volume of coarse aggregate C_a =1-p/p*f_a*S_{ca}/S_{fa}

C.A = 1003.365 kgs
Therefore mix design
C: F.A.:C.A=562.85:594.301:1003.365
=562.85/562.85 = 1
Cement =1
Fine aggregate =594.301/562.85=1.055 Coarse aggregate=1003.365/562.85=1.782 Therfore mix design be C:F.A:C.A = 1:1.055 : 1.782
By some similar changes the mix can be changed for the 20mm aggregate and also for flyash .

1. **Nominal mix of M35**

Using 10mm coarse aggregate
Step -1 target mean strength : Fm = fck + 1.65 *s
=43.25
Step – 2 :water cement ratio
0.40
Step -3 :water content
Max water content taken =186 ltrs
Step-4 :cement content
Cement content = water content / w/c ratio
=186/0.4
=0.4
Therefore cementcontent =465kg/m^3
Step -5 :volume of fine aggregate $V=[W+C/S_C +1/P * f_a/S_{fa}]*1/1000$
$0.98 = [186 +465/3.40 +1/0.35 *f_a/2.75]*1/1000$
Therefore Fine aggregate =632.580kg
Step-6 :volume of C.A Ca=1-p/p*fa*Sca/Sfa Ca =1068.005kg
Cement= 465/465=1 Fine aggregate = 1.360 Coarse aggregate =2.296
Therefore C:F.A:C.A=1 :1.360 :2.296
Similarly mix design using 10% flyash is given below C:F.A:C.A=1 :1.360 :2.296
Cement = 18 * 10/100 =1.8
=18-1.8
CEMENT = 16.2 kgs =8.1kgs FLYASH=1.8kgs =0.9kg F.A=24.48kg = 12.24 kg C.A=41.328 = 20.664
Cement = 9.6-0.96
Cement = 8.64 Flyash = 0.96kgF.A=13.056kg C.A=22.0416kg

PROCEDURE

(I) After the designated curing period, removes the specimen from the water, and wipe off any excess moisture.
(II) Round the specimen's dimension to the closest 0.2m.
(III) Wipe the testing machine's bearing surface.
(IV) Set up the machine so that the load is applied to the cube cast's opposing sides before inserting the specimen.
(V) Position the specimen so that it is centered on the machine's base plate.
(VI) Gently turn the movable part by hand so that it touches the specimen's top surface.
(VII) Continue applying the stress at a rate of 140 kg per cubic centimeter per minute until the specimen breaks.

EXPERIMENTAL RESULTS

Result

Test results on cement

S.NO	TEST NAME	RESULT
1	sieve test	8 %

2	standard consistency	29 %		
3	Initial setting time	52 min		
4	Final setting time	480 min		
5	Specific gravity test	3.15		
6	Compressive strength	3 days N/mm^2	7 days N/mm^2	28 days N/mm^2
		22.12	30.12	44.23

Test result on fine aggregate

S.NO	TEST NAME	RESULT
1	Sieve analysis	Zone lll
2	Bulking of sand by volume method	12.5%
3	Specific gravity test	2.51
4	Relative density	45% (medium dense)

Test result on coarse aggregate:

S.NO	TEST NAME	RESULT
1	Fineness modulus	7.5
2	Specific gravity	2.83
3	Water absorption	2.1%
4	Crushing strength	22.43%
5	Impact test	28.12%

II. CONCLUSIONS

- Fly ash is introduced in various amounts, including 0 percent, 10 percent, 20 percent, 30 percent, and 40 percent.
- For 43 grade cement with M30 mix, the strength can be raised by adding up to 30% of fly ash, while the strength can be decreased by adding 40% of fly ash.
- The test results demonstrate that adding 30 percent fly ash to cement increased strength to its maximum level after 28 days, however at a slower rate than when compared to ordinary Portland cement concrete (OPCC) in the early days.
- When compared to regular concrete, the split tensile strength increased by 20.14 percent, while the compressive strength increased by 27.12 percent.
- Fly ash is used as an additive, which significantly lowers the cost of building.

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