Study of Fly Ash Mix on Strength Characteristic of Cement

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Abstract— **In this project our main objective is to study the influence of partial replacement of cement with Marble dust-Fly ash mix. It is investigated that it is able to use marble dust-fly ash mix as partial replacement of cement without compromising on strength & stability. We are also trying to find the percentage of Marble Dust-Fly Ash mix replaced in concrete that makes the strength of the concrete maximum. In the present investigation, a feasibility study is made to use Marble Dust-Fly Ash mix as partial replacement of cement in concrete. This Waste Marble Fly Ash mix is composed of 50% of waste marble dust and 50% of fly ash.**

Index Terms— **Keywords** : Cement, Dust-fly Ash mix, Concrete Mix.
Sub Area : Construction Technology & Management
Broad Area :Civil Engineering

I. INTRODUCTION

In this particular experiment, effect of partially replacing cement with marble dust-fly ash mix on properties of concrete is to be studied. The details of the experimental program carried out to achieve the objectives listed as follows. The main parameters investigated in this study were compressive strength, split tensile strength and flexural strength. The experimental program included the following:

- Testing properties of constituent materials
- Development of concrete mix of desired strength
- Casting of specimens
- Curing of specimens
- Workability
- Compressive strength test on marble dust-fly ash mix based concrete mix
- Split tensile strength test on marble dust-fly ash mix based concrete mix
- Flexural strength test on marble dust-fly ash mix based concrete mix

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II. MATERIALS

The concrete test specimens were casted using cement, coarse sand, coarse aggregate, fly ash, rice husk ash and water. The materials, in general, confirmed to the specification laid down by the relevant Indian Standard Codes. The characteristics of the materials were as follows:

III. CEMENT

Cement is a fine, grey powder that has cohesive and adhesive properties in the presence of water. Portland cement is hydraulic cement that hardens in water to form a water-resistant compound. These consist of two basic ingredients namely argillaceous and calcareous. This mixture is grounded, blended, fused in kiln at 1400^0C and a product clinker is obtained. The clinker is cooled and grounded to get cement. The different types of cement as classified by Bureau of Indian Standards (BIS) are ordinary Portland cement, pozzolana Portland cement, rapid hardening Portland cement, sulphate resisting Portland cement etc. The OPC is the basic Portland cement and is best suited for use in general concrete construction where there is no exposure to sulphates in the soil or in ground water. Cement is available in three different grades 33, 43 and 53 Grade Cement .43 grade of cement is the popular Brand of Cement which has low heat of hydration and provides long life strength of Concrete Structures. Ordinary Portland cement of grade- 43 conforming to Indian Standard IS: 8112- 1989 has been used in the present study. The results of the various tests on cement properties are given in Table 1.3

Ingredient	% content in cement
Silicon Dioxide (SiO2)	21.8
Aluminium Oxid (Al2O3)	4.8
Iron Oxide (Fe2O3)	3.8
Calcium Oxide (CaO)	63.3
Sulphur trioxide (SO3)	2.04
Magnesium Oxide (MgO)	2.5
Sodium Oxide (Na2O)	0.21

Table 1.2: Compound composition of Ordinary Portland Cement

Compound	% age by mass in cement
Tricalcium Silicate	25-50
Dicalcium Silicate	20-45
Tricalcium Aluminates	5-12
Tetra-calcium Alumino Ferrite	6-12

AGGREGATES

Aggregates are the important constituents in concrete. They give body to the concrete, reduce shrinkage and effect economy. Earlier, aggregates were considered as chemically inert materials but now it has been recognized that some of the aggregates are chemically active and certain aggregates exhibit chemical bond at the interface of aggregates and paste. The mere fact that the aggregates occupy 70-80 % of the volume of concrete, their effect on various characteristics of and properties of concrete is undoubtedly considerable. To know more about concrete, it is very essential that one should know more about the aggregates which constitute major volume in concrete. Generally aggregates can be classified as normal weight aggregates, light weight aggregates and heavy weight

Aggregates. Normal weight aggregates can be further classified as natural aggregates and artificial aggregates.

Aggregates can also be classified on the basis of the size of the aggregates as fine aggregates and coarse aggregates.

FINE AGGREGATES

Sand is an extremely useful and needy material in the construction work but its importance lies in its quality so while purchasing it one has to be very careful. Sand which is used in the construction purpose must be clean, free from waste stones and impurities. Usually natural sand is used as a fine aggregate at places and where there is no availability of natural sand then crushed stone can be used as fine aggregates. The sand used for the experimental works was pathankot quarry crushed sand which was locally procured and conformed to grading zone II. As per IS 383- 1970, sieve analysis of the fine aggregate was done in the laboratory. The sand has been first sieved through 4.75 mm sieve to remove any particle greater than 4.75 mm sieve and then sand was sieved through a 75 micron sieve to make it free from lumps of clay a foreign matter and was then thoroughly washed and air dried in the laboratory before being used for casting the concrete mix. Depending upon the particle size distribution IS 383- 1970 has divided fine aggregate in IV zones. Sand is generally composed of silica and gets deposited by the weathering action on sand stone. Sand is also classified as: Fine Sand (0.075 to 0.425 mm), Medium Sand (0.425 to 2 mm) and Coarse Sand (2.0 to4.75 mm). Different types of tests conducted on sand is specific gravity, water absorption and fineness modulus and there outcomes are given in table 1.2 .

COARSE AGGREGATES

Aggregates most of which retained on 4.75-mm IS sieve known as coarse aggregates. The various types of coarse aggregates described as:

- Uncrushed gravel or sand which results from natural disintegration of rock.
- Crushed gravel or sand when it results from crushing of gravel or hard stone.
- Partially crushed gravel or stone when it is a product of the blending of above two

The graded coarse aggregate is described by its nominal size i.e. 10mm,16 mm, 20 mm and40 mm. Crushed stone aggregates with nominal size 20 mm and 10 mm in the proportion of 50:50 were used throughout the experimental study. The coarse aggregates have to be washed to remove dust and dirt to surface dry condition. The properties of coarse aggregates such as specific gravity, bulk density and fineness modulus were determined and are given in table 3.3, 3.4, 3.5 and 3.6.

MARBLE DUST-FLY ASH MIX

In this experiment mixture of marble dust powder and fly ash has been used as a partial replacement material for cement concrete. This was made up of 50% of marble dust and 50% of fly ash. These both particles have different particle size and different specific gravity. So, after mix these material in same proportion a different material is formed whose particle size and specific gravity is different.

WATER

Water is an important ingredient in concrete and the best part is that it is least expensive. To produce the desired properties of concrete water chemically reacts with cement (hydration). The water used in this experimental work was portable water as supplied in concrete lab of our college. Water used for making and curing was clean and free from harmful impurities like oil, alkali, acids, salts, organic substances that may be deleterious to concrete. Portable water is the most suitable for making mix and curing.

ADMIXTURE

The material used other than cement, sand, aggregate and water in the concrete mix to impart some special property to the mix in its fresh and hardened stages. The addition of admixture improves the strength, hardness, workability, etc. Admixture used in this experiment is super plasticizer which reduces the amount of water to be used earlier.

CEMENT CONCRETE & MIXED DESIGN

The basic engineering material used in most of the civil engineering structures is Concrete. Its popularity as main building material in construction is because of, its economy of use, good durability and it can easily manufactured at site. The ability to mould it into any shape and size, because of its plasticity in fresh stage and its hardening to achieve strength, is particularly useful.

Like other civil engineering materials concrete mix needs to be designed for properties like strength, workability, durability and cohesion. Concrete mix design is that science which decides the relative proportions of ingredients of concrete, to achieve the desired properties in the most economical way.

Due to advent of high-rise buildings and pre-stressed concrete, use of higher grades of concrete is becoming more and more common. Even revised IS: 456-2000 code advocates the use of higher grade of concrete for exposure to more severe conditions, for durability considerations. With advent of new generation admixtures, it is possible to achieve high workability levels with higher grade of concrete economically. Use of mineral admixtures like fly ash, silica fume, meta kaolin and slag has revolutionized the concrete technology by increasing strength and durability of concrete by many folds.

However, it should be borne in mind that mix design when adopted at site should be implemented with proper understanding and with necessary precautions.

WHAT IS MIX DESIGN

Concrete is an extremely versatile in nature, because it can be designed for strength ranging from M10 to M l00 and workability ranging from 0 mm slump to 150 mm slump. In all the cases basic ingredients of concrete are same, but it is their relative proportioning that makes the difference. Basic Ingredients of Concrete are: -

Cement - It is the binding material in concrete.
Water- It produces the heat of hydration when mixed with cement and also makes concrete workable.
Coarse Aggregate - It provides the required density in concrete and increases its volume.
Fine Aggregate – when mixed with cement forms a thin paste used for grouting.

Admixture - They enhance certain properties of concrete e.g. gain of strength, workability, setting properties, imperviousness etc. and to enhance these properties concrete needs to be designed for certain properties in the plastic stage as well as in the hardened stage.

Desired properties from concrete in plastic stage: -

- Workability
- Cohesiveness
- Initial set retardation

ADVANTAGES OF MIX DESIGN

Mix design aims to achieve good quality concrete at site in an economical way. Some of the qualities that a concrete should possess are as follows:

Quality concrete:

1. Better strength.
2. Better imperviousness and durability.
3. Dense and homogeneous

IL Economy:

While preparing a mix design one should always keep in mind that mix should be economical. It is possible to save up 20% of cement for M-25 grade of concrete with the help of

concrete design mix. In fact with higher the grade of concrete we can do more savings.
Best use of available materials: some it is not possible to get transported what is required at site , so the best way is to use the available material at site ,but the condition is that the material should meet the IS recommendations. This can help us to save transportation costs from longer distances.

Other properties: Design mix can help us to achieve form finishes, to attain high early strengths for early de- shuttering of concrete, concrete with better flexural strengths, concrete with pump ability and concrete with lower densities

CONCRETE MIX DESIGN FOR M-25 WITH ORDINARY PORTLAND CEMENT (OPC) USING IS 10262 METHODS

STIPULATIONS FOR PROPORTIONING:

1. Grade Designation : M25
2. Type of Cement : OPC 43 grade confirming to IS 8112
3. Maximum Nominal Size of Aggregates : 20 mm
4. Minimum cement content : 300 kg/ m3
5. Maximum w/c ratio : 0.50
6. Workability : 0.90 C.F
7. Exposure condition : Moderate
8. Method of Concrete Placing : HandDegree of Supervision : Good
9. Maximum Cement Content : 540 kg/ m3

CONCLUSIONS

The partial replacement of cement with industrial waste has gained importance due to requirement of more durable construction and safety of environment in future. This research was conducted with the purpose of discovering marble dust- fly ash mix as a superior material for partial replacement of cement. Based on study and various experimental results, the following conclusion has been drawn from this investigation:-

1. Investigation shows that we can use marble dust-fly ash mix as a partial replacement material for cement in concrete.
2. We can replace cement with marble dust-fly ash mix from 0%-7.5% and the maximum percentage of replacement that we can done with marble dust- fly ash mix is 7.5%.
3. The increase in compressive strength of 27.24% is due to pozzolanic activity of fly ash and also due to pozzolanic activity and cementious property of marble dust.

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