A Laboratory Assessment on Concrete Mix Design by using Fly Ash as Bonding Agent

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Abstract— The interfacial transition zone, generally the weakest link of the chain, is considered as the strength-limiting phase in concrete. In freshly compacted concrete, water films from around the large aggregate particles. Fly Ash use as a bonding layer between two layers of concrete about 5mm thick for the grade of M30, and M35. A comparison test was carried out in between control mix and fly ash in powder form and in paste forms with two different profiles such as horizontal and rectangular in cubes of 15x15x15cm. For each grade and for each profile 9 numbers of cubes were casted. Compressive strength tests were carried out after the curing of 7, 14 and 28 days. In present research work, fly ash used as bonding agent as it's useful in reduction of interfacial transition zone in the concrete.

Key words: Concrete, Fly Ash, Bonding Agent, Mix Design, Interfacial Transition Zone

I. INTRODUCTION

Concrete mix design is that the science of deciding relative proportions of ingredients of concrete, to realize the specified properties within the most economical manner. With advent of high rise buildings and pre-stressed concrete, use of upper grades of concrete is changing into additional common. Even the revised IS 456-2000 & IS 10262-2009 advocate's use of upper grade of concrete for additional severe conditions of exposure, for durability issues. With advent of recent generation admixtures, it's possible to achieve higher grades of concrete with high workability levels economically. Uses of mineral admixture like ash have revolutionized the concrete technology by increasing strength and sturdiness of concrete by several folds.

Mix style of concrete changing into additional relevant within the higher than mentioned situation. However, it ought to be borne in mind that blend style once adopted at web site ought to be enforced with correct understanding and with necessary precaution. the method of choosing appropriate ingredients of concrete and decisive their relative amounts with the target of manufacturing a concrete of the specified strength, sturdiness and workability as economical as potential, is termed the concrete combine style. The proportioning of ingredient of concrete is ruled by the specified performance of concrete in two states, specifically the plastic and also the hardened states. If the plastic concrete isn't possible, it cannot be properly placed and compacted. The property of workability, therefore, becomes of significant importance. The compressive strength of hardened concrete that is generally considered to be an index of its different properties, depends upon several factors, e.g. quality and amount of cement, water and aggregates; batching and combination ; compaction and natural action. the price of concrete is created of the price of materials, plant and labour. The variations within the price of materials arise from the actual fact that the cement is many times pricey than the mixture, so the aim is to provide as lean a mixture as potential. From technical purpose of read the wealthy mixes could result in high shrinkage and cracking within the structural concrete, and to evolution of high heat of association in mass concrete which can cause cracking.

The actual price of concrete is expounded to the price of materials needed for manufacturing a minimum mean strength called characteristic strength that's such that by the designer of the structure. this relies on the quality control adds to the value of concrete. The extent of quality control is often an economic compromise, and depends on the size and type of job. The cost of labour depends on the workability of mix, e.g., a concrete mix of inadequate workability may result in a high cost of labour to obtain a degree of compaction with available equipment.

A. Characterization of cement

It is well known that the cement not only binds the individual ingredients together but also fills up the voids in between sand and aggregates to form a compact mass. Though, it contributes only about 20% to the total volume of the concrete mix, its role is very much vital as it is the only ingredient of concrete whose properties are scientifically controlled and the variation in its quantity significantly affects the strength and durability properties of the concrete mix. The cement characterization tests are performed on the cement that is used in the present investigation with regard to physical properties, particle size analysis, chemical and mineralogical characteristics. The cement is carefully stored throughout the course of the present investigation in order to avoid any deterioration in its properties due to the contact with the atmospheric moisture.

B. Fly Ash

Fly ash is used as a cementitious material drawn from burning of coal in high temperature. There are two types of Fly ash such as

- ASTM class F
- ASTM class C

Cementitious material used in this experimental programmed was low calcium Fly ash (ASTM type F). Since the ASTM class F contains calcium of about 5% by mass, whereas class C contains more than 5% of calcium which tends to change in micro structure of concrete and properties of concrete. Fly ash (Class-F) was obtained from Mettur Thermal Power Plant (MTTP). The specific gravity and Finesses modulus (passing through 45 µm) of Fly Ash was 2.3 and 7.86. The chemical composition for cementitious material is shown in Table 3.1.

1) Characterization of Fly ash

The characterization tests are performed on the fly ash that is utilized in the present study. The various tests comprise of particle size analysis, chemical characterization, mineralogical characterization and the TGA.

C. Literature Review

1) Influence of the surface transition zone on properties of concrete

The surface transition zone, typically the weakest link of the chain, is taken into account because the strength-limiting introduce concrete. It's as a result of the presence of the surface transition zone that concrete fails at a significantly lower stress level than the strength of either of the 2 main elements. as a result of it doesn't take terribly high energy levels to increase the cracks already existing within the surface transition zone, even at fifty p.c of the final word strength, higher progressive strains is also obtained per unit of applied stress. This explains the development that the elements of concrete (i.e., combination and hydrous cement paste or mortar) typically stay elastic till fracture in an exceedingly uniaxial compression take a look at, whereas concrete itself shows dead behavior. At stress levels over regarding seventy p.c of the final word strength, the strain concentrations at massive voids within the mortar matrix become massive enough to initiate cracking. With increasing stress, the matrix cracks bit by bit unfold till they be part of the cracks originating from the surface transition zone. Once the crack system becomes continuous, the fabric ruptures. Sizable energy is required for the formation and extension of matrix cracks below a compressive load.

Xie Ping etal (1991) were concluded that "Structural features of the transition zone between granular aggregate and portland cement paste were studied. Two types of aggregates were used, quartz and limestone. The transition zones square measure structurally characterised by a parameter named as "interfacial excess conductance" supported electrical physical phenomenon ways. The experimental results indicate that the transition zone between quartz particles and hydraulic cement paste is often less dense than bulk paste, notwithstanding the mixture size, which the thickness of this transition zone decreases with the decreasing of the mixture size. a similar general options occur for the transition zone between larger sedimentary rock particles and hydraulic cement paste. A transition zone denser than bulk paste happens, however, for a lot of smaller sedimentary rock particles due probably to chemical interaction between the sedimentary rock particles and hydraulic cement paste."

Gengying Li etal (2001) were concluded that "The weak transitions zone between new and old concrete controls many properties of repaired concrete. The transition zone between aggregates and cement pastes of normal concrete has been studied by a number of researchers. But to this point, there's very little info on the market regarding the surface zone between new and recent concrete. The bond strength was conjointly investigated. The take a look at results show that the binder may be a very important issue that affects the morphology (size and shape), geology and also the microstructure of the transition zone in repaired concrete."

Guangjing Xiong etal (2002) were concluded that "An attempt to modify the repair ITZ by introducing fly ash into a primer between concrete substrate and repair materials has been made. A comparison test was carried out for five different interfaces. The test result showed that the fly ash modified concrete made the microstructure of the repair interface zone more dense and uniform."

Grade	compressive strength N/mm²
M30	32.58
M35	36.29

Table 1: Compressive strength of control mix

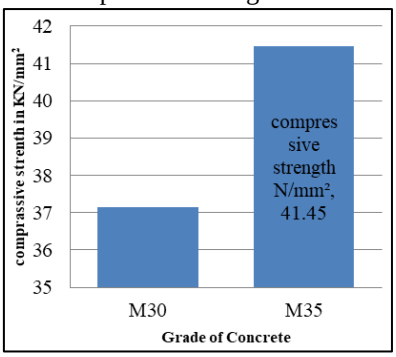

Fig. 1: Compressive strength of control mix

Grade	compressive strength N/mm²
M30	37.15
M35	41.45

Table 2: Compressive strength of fly ash in powder form

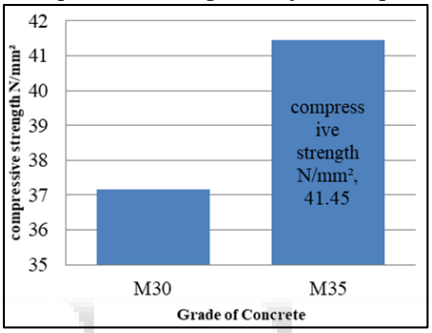

Fig. 2: Compressive strength of fly ash in paste form

Grade	compressive strength N/mm²
M30	36
M35	40.48

Table 3: Compressive strength of fly ash in paste form

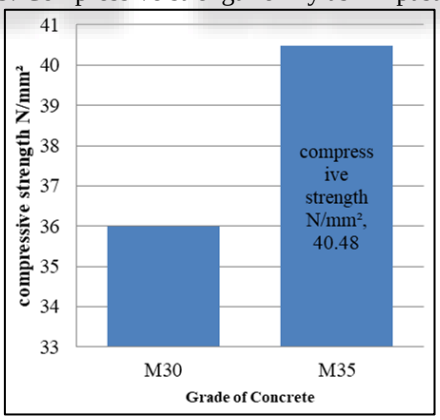

Fig. 3: Compressive strength of fly ash in paste form

D. Discussion

The interfacial transition zone, generally the weakest link of the chain, is considered as the strength-limiting phase in concrete. In freshly compacted concrete, water films from around the large aggregate particles. While using the fly ash in powder form, fly ash absorbed the water which is present in between cement paste and aggregate. Therefore, interfacial transition zone reduce. While using the fly ash in paste form, fly ash absorbed the water but in less quantity as compared to fly ash in powder form. It also reduces the interfacial transition zone in concrete.

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