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MECHANICAL PROPERTIES OF CONCRETE WITH FLY ASH AND MANUFACTURED SAND

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Abstract—Day by day construction sector is undergoing a huge development, for developing a country there should be proper infrastructure to provide all the facilities. Concrete is most important part of the building structure. Cement is the expensive constituent of concrete and also it emits co_2 gas to environment which creates a bad impact on environment. Therefore it is necessary to replace it with suitable alternative. We used fly ash as alternative to cement in 30% as replacement .An alkali activator NaOH is used.

On the other hand second expensive material in the concrete is natural sand, there also some issues regarding sand mafia and scarcity of natural sand due to limited sources as per need. Best alternative to natural sand is crush sand. A study is conducted on 100% replacement of natural sand by crush sand.

Keywords—concrete; NaOH; fly ash;crush sand; scarcity of natural sand.

I. INTRODUCTION

Conventional concrete is mixture of cement, sand and aggregate. The use of fly ash leads to a reduction in early strength of concrete but there is an increase in long term strength .The concurrent use of the two byproducts will lead to economic and environmental benefits. The standard mix with 100% crush sand has exhibited much higher compressive strength Crush sand is made by crushing the natural rock in desired shape and desired size. It is free from organic impurities.

Fly ash is also known as pulverized fuel ash which is byproduct of thermal power stations. Dirk India pvt.ltd was the source of fly ash used in these experimental study. Pozzocrete P63 was used in this study. It has class f which has low calcium content (less than 7% limes).

Crush sand is used as alternative to the river sand. A study is conducted on 100% replacement of river sand by crush sand and various tests such as compressive strength, flexural strength and split tensile tests are carried out. The molds of size 150mmx150mmx150mm are used for compression test; 100mmx100mmx500mm was used for flexure test and 150 mm dia cylinders of height 300mm was used for split tensile strength. 3 days, 7 days, 28 days tests are taken on the specimens.

LITERATURE REVIEW

Dr. A.S. Wayal et.al in (2013) conducted a study on effect of M. sand on durability properties of concrete. From the test results, it is observed that with increasing proportion of manufactured sand the penetration of water into concrete decreases. The results of rapid chloride penetration test shows high permeability for the mix proportion of 100% natural sand while 50% NS and 50% MS has moderate permeability and 100% manufactured sand has low permeability. Results show that river sand can be fully replaced by manufactured sand. That proportioning the concrete mix for type of job in hand is an essential part of any quality assurance

Palash ashok khanorkar et.al in (2016) studied the replacement of conventional sand by artificial sand in concrete. They prepared the mix design for 35 Mpa grade of concrete. In this they have replaced 50 percent and 100 percent natural sand by artificial sand. They have replaced 10 percent of cement by fly ash along with 0.93 percent dosage of super plasticizer by weight of total cementatious material.

Crush sand mixes are gives better results of strength as compare to only natural sand concrete strength

Dr.Uma et.al in(2015) conduct study on strength and durability studies on concrete with fly ash and artificial sand..

The suitability of replacing the 30% of fly ash and 50% of artificial sand for a concrete of grade M35..They have conclude that combine mix reduces its compressive strength by 6.68N/mm^2at the age of 7 days, 1.09N/mm^2at the age of 28 days and 0.91N/mm^2at the age of 56 days.

M.kataria et.al conducts a study on An experimental study on using manufactured sand in concrete. Fine aggregate is an essential component of concrete. In this study, the compressive strength and workability of concrete are studied. While natural river sand is replaced by M. sand. They have conclude that workability of concrete decreases with increase in percentage replacement of river sand by M.sand facilitate better strength. 100%replacement of river sand can be used in concrete.

A. chandana Jyothi et.al in (2015) conduct a study on Performance of Concrete with Partial replacement of cement by fly ash and Natural Sand by Artificial sand. An attempt has been made to examine the suitability of replacing the 30% of fly ash and 50% of artificial sand for a concrete of grade M35.

They have concluded that the strength for combine mix increase gradually as the time of curing period increases. The percentage strength loss gradually increases as the number of days immersion of cubes in acid increases. The results obtained for combined mix are almost equal to that of conventional mix.

Dr . S . Elavenil et al conduct a study on manufactured sand. They have concluded plan. This can be done

effectively with proper understanding of properties of constituent material of concrete. It is important to consider the gradation recommended by ASTM for fine aggregate .The bulk specific gravity (BSG) and absorption capacity are the physical properties that are required to make the calculation of a mix design and can also be used to evaluate the consistency of a sources of material . The effect on the use of manufactured sand on early age and long term volumetric properties, such as shrinkage and creep respectively, are not available and should be studied.

II. MATERIALS USED

A. Cement :

OPC 53 grade ACC concrete plus cement was used . it is greyish colored powder. It has specific gravity of 2.7 . It has fineness 1.6 %.standard consistency was 30%.

B. Fly Ash :

fly ash of class f was used for the study .pozzocrete P63 was used which has more fineness than the P10 and P60 grade pozzocrete. It has less than 7% lime content in it .it is coal combustion product. Fineness of fly ash was 1.4 %

C. Natural Sand:

The river sand used in these study was locally available river sand. The specific gravity of river sand was 2.28. the fineness modulus of river sand was 3.42. Silt content was 2% .water absorption of 3% was observed.

D. Crush Sand:

The crush sand from Ghospuri stone crushing plant was used. The specific gravity was 2.74.The fineness modulus was3.32.No organic impurities are observed. The crush sand was well graded. The silt content was 2 %. Water absorption was 1.02%. It has cubical shape. It conforms to grading zone II.

E. Coarse Aggregate:

Coarse aggregate used in the study were20 mm and 12.5mm nominal sizes and were tested as per Indian standard specification IS:383-1970.Its specific gravity was 2.72,water absorption was 0.13% and fineness modulus was 3.12.

F. NaOH:

An alkali activator NaOH was used in concrete of 0.3 M. Sodium Hydroxide in flake form was used in this experimental work. In order to make sodium hydroxide solution sodium hydroxide flakes were dissolved in potable water.

G. water:

Potable water was used in concrete.

III. DETAILS OF MIX :

The M20 grade of concrete is used for the present experimental study. The mix proportion used was 1:1.5:3. The water cement ratio adopted was 0.45. Maximum nominal size of aggregate is 20 mm conforming to zone II.

IV. TESTS CONDUCTED:

A. compressive strength test :

The compression test was carried out on 150mm x150mmx150mm specimens. The specimens used are as per IS 10086:1982. These specimens are tested by compression testing machine after 3 days,7 days ,28 days curing. Load should be applied gradually. Load at the failure divided by the area of specimen gives the compressive strength of concrete. At least 3 specimens should be tested for each days tests. The test should be taken at room temperature. The compressive strength of concrete was tested on the compression testing machine. Compressive strength of specimen is calculated as

$$P= L/A$$

Where,

P= Compressive strength of concrete.

L= Load at failure of specimen.

A= Total area of specimen.

B. Split tensile strength test:

The split tensile strength was carried out on150mmx300mm size cylinder on compression testing machine at 28 days. The specimens used are as per IS 10086:1982.As per IS 456 :2000 the split tensile strength of concrete is 0.7fck .the split tensile strength is calculated by the following formula :

$$T =2P/\pi DL$$

Where,

P-load applied up to failure.

D- Diameter of cylindrical specimen.

L- Length of cylindrical specimen.

C.Flexural strength test:

The flexural strength is expressed as modulus of rupture .the specimens of size 100mmx100mmx500mm was used for the flexural strength test. The flexural test is carried out as per IS 516:1959. The test is carried out on universal testing machine.

Flexural strength is measure of an unreinforced beam resist in bending. Flexural tests are extremely sensitive to specimen preparation; curing and handling .it is calculated as follows:

$$F_r=7.5 \sqrt{F_c'}$$

Where,

F_r = modulus of rupture.

F_c'=compressive strength of concrete.

V .CONCLUSION:

- When 100% river sand is replaced by crush sand then strength was increased than the conventional concrete at 3 days and 7 days test results.
- The 100% crush sand mix has 3 days strength which was nearly equal to 7days strength of conventional concrete.
- It is observed that when 30% cement was replaced by fly ash and 0.3 M NaOH solution was used, then the results was equal to the conventional mix.
- The mix in which river sand is replaced by 100% crush sand gives higher strength than the conventional mix at 28 days .

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