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Comparative Study on High Performance Concrete with Different Admixtures

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Abstract: *In recent years, an emerging technology termed high - performance concrete (HPC) has become popular in construction industry. For designing HPC, both supplementary cementing materials and super plasticizers are essential for the improvement of workability and mechanical properties. In this study five paper presented this experimental studies conducted on various grades of HPC mixes using different materials in various proportions, Overall this paper high lights the usage of partial replacement of cement by fly ash (FA),silica fume (SF), metakaoline (MK) and Ground Granulated Blast Slag (GGBS) to achieve high strength concrete mixes. From the experimental investigation the cubes and cylinders were tested for both compressive and tensile strength. It was found that by the partial replacement of cement with various admixtures and crushed sand by fine aggregate helped in improving the strength of the concrete substainally compared to normal mix concrete.*

Keywords: *Crushed sand, compressive strength, fly ash, GGBS, High performance concrete (HPC), metakaoline, silica fume, split tensile strength.*

I. INTRODUCTION

Concrete is a mixture of cement, fine aggregate, coarse aggregate and water, concrete plays a vital role in the development of infrastructure viz., buildings, industrial structures, bridges and highways etc., leading to utilization of large quantity of concrete. High performance concrete (HPC) is concrete meeting special combinations of performance and uniformity requirements that cannot be always achieved routinely by using conventional constituents and normal mixing. This leads to examine the admixtures to improve the performance of the concrete. These Special applications of high performance concrete (HPC cannot be achieved by Ordinary Portland Cement (OPC).It is achieved not only by reducing water cement ratio but also by replacement of cement with some mineral admixture like Silica fume, Ground granulated Blast Furnace Slag (GGBS), Metakaolin and Fly ash etc with chemical admixtures. In HPC, materials and admixtures are carefully selected and proportioned to form high early strengths, high ultimate strengths and high durability beyond conventional concrete. The admixtures like fly ash, silica fume, ground granulated blast furnace slag (GGBS), are added both for strength and durability and enhance its marketability as an environmentally friendly product. The proportion in which fundamental components are mixed, and the admixtures that are used, constitute the main difference between conventional concrete and HPC. This paper presents the study of various mixes (M_{35}, M_{60}, M_{70}, M_{80}, and M_{90}). The tests were conducted on concrete cubes and cylinders to study the compressive strength and split tensile strengths.

II. LITEREATURE REVIEW

Magudeaswaran.P, Eswaramoorthi.P, (2013). investigated the strength properties of silica fume and flyash in High performance concrete. This work primarily deals with the strength characteristics such as compressive and split tensile strength. the specimens were casted with M_{60} grade concrete with different replacement levels of cement. Mahesh Patel, Prof. P.S. Rao, (2013).the paper presented the study of characteristics of M_{35} conventional concrete by replacing the sand with crushed sand and cement with GGBS. the crushed sand can be used as alternative material for the fine aggregate. GGBS can be used as one of the alternative material for the cement. It was found that the partial replacement of cement with GGBS and sand with crushed sand helps in improving the strength of the concrete substantially compared to normal mix concrete.

Vijaya Sekhar Reddy.M, Ramana Reddy.I.V, (2013). The paper presents experimental studies conducted on HPC mix of M_{70} grade using mineral and chemical admixtures in various proportions. The main purpose of this investigation is to develop confidence among user agencies in India to use mineral and chemical admixtures in a desirable proportion in most of the construction works. Overall, the paper highlights the usage of admixtures to achieve high strength concrete mixes and from the experimental investigation it is clear that mineral admixtures contribute effectively a lot not only for achieving durability, also high strength.

Vijaya Sekhar Reddy.M., Dr. Ramana Reddy I.V. (2012), paper presented experimental studies conducted on two grades of HPC mixes of M_{80} and M_{90} using mineral and chemical admixtures in various proportions. The main purpose of this investigation was to develop confidence among user agencies in India to use mineral and chemical admixtures in a desirable proportion in most of the construction works.

III. EXPERIMENTAL PROGRAMME

The experimental programme was designed to compare the mechanical properties(compressive and tensile strength) of high performance concrete with various grades of concrete with different replacement levels of cement such as silica fume, fly ash, metakaoline, Ground Granulated Blast Slag were selected as 0-30 percent silica fume, 0-33percent fly ash, 10,13.23,15.13 percent metakaoline, 30-50% GGBS. Also replacement level of fine aggregate by crushed sand was selected as 0-30%.

The concrete cube specimen size of 150 mm size, cylinder specimen of size 150 mm diameter and 300 mm height were used as test specimens to determine the compressive strength of concrete and Split tensile strength of concrete. The test results were compared with individual percentage replacements and combinations of admixtures for five grades of concrete (M_{35}, M_{60} M_{70}, M_{80}, M_{90}) during the curing period 28 days. Results of compressive strength and split tensile strength for M_{35}, $M_{60,}$ M_{70}, M_{80}, M_{90} were shown in Fig.1 and Fig. 2 respectively.

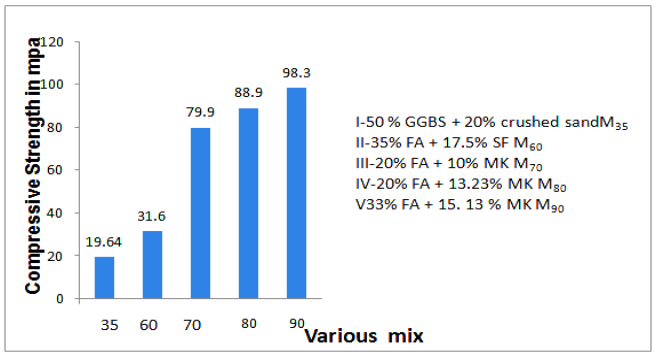

Fig. 1 Compressive Strength of various mixes

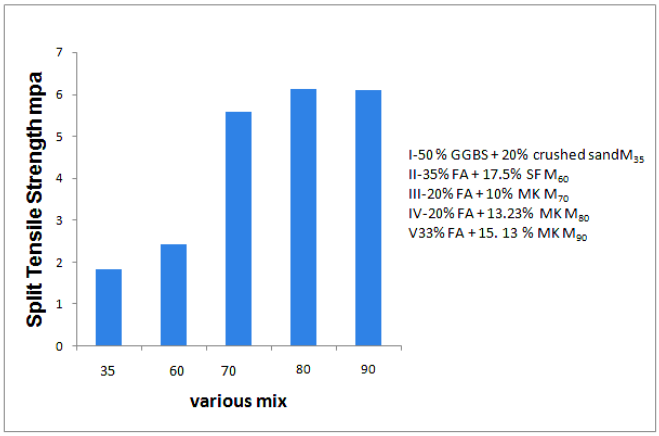

Fig. 2 Split Tensile Strength of Various mixes

IV. CONCLUSIONS

According to the test results, it can be conclude that M_{35}, M_{60}, M_{70}, M_{80}, M_{90} grade of concrete can be produced by partial replacement of cement by fly ash, silica fume, metakaoline and GGBS. Also replacement of fine aggregate by crushed sand. The strength of the concrete is increased by using admixtures.

1. The maximum compressive strength achieved in M_{35} grade of concrete is 11.2Mpa compressive strength for 50% replacement of cement by GGBS and 6.3Mpa split tensile strength for 20% replacement of fine aggregate by crushed sand.

2. The M_{60} grade of concrete in compressive strength is 61.5Mpa for the replacement of cement by 10%FA and 5% Silica fume and also the split tensile strength is 3.60Mpa for the replacement of cement by 15%FA and 7.5% SF mix.
3. The maximum compressive strength achieved in M_{70} grade concrete is 79.9Mpa with the replacement of 20% Flyash and 10% Metakaoline and split tensile strength is 5.58 Mpa.
4. The maximum compressive strength and split tensile strength achieved in M_{80} grade of concrete is 88.9Mpa and 6.12Mpa with replacement of 20%FA and 13.23%MK.
5. The maximum compressive strength and split tensile strength achieved in M_{90} grade of concrete is 98.3Mpa and 6.10Mpa with replacement of 33% FA and 15.23%MK.

Overall the five grades of concrete can be produced by maximum compressive strength is achieved in M_{90} grade is 98.3Mpa for 33% FA and 15.13% MK. the maximum split tensile strength is achieved in M_{80} grade is 6.12Mpa for 20%FA and 13.23% MK.

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