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REPLACEMENT OF CEMENT WITH FLY ASH AND STEEL FIBER IN RIGID PAVEMENT

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Abstract - *In India, major part of electricity is produced from thermal power plants. These thermal power plants use different types of fuels for combustion. During combustion of coal as a fuel in these thermal power plants, a by product namely fly ash is produced. Indian coal has highest ash content as compared to coal found in other countries. There are nearly 85 thermal power plants in India which uses coal as source for power generation and thus produces a large amount of fly ash. This fly ash is disposed in soil, which in turn causes a lot of environmental problems. To overcome this disposal of fly ash into the soil, it can be used in concrete by partially replacing with cement. Because the chemical composition of fly ash and cement is almost identical.*

The main objective of this report is to analyse the behavior of M20 grade concrete with mix design 1:1.48:2.74 and with 0.48 water cement ratio. Here cement was partially replaced by 10%, 20%, 30% of fly ash of F- class by weight. As concrete shows cracks abruptly when undergoing tension. So to overcome this problem and to enhance the flexural strength of concrete, steel fibers were used. The steel fiber of hook type in percentage of 0.5%, 1%, 1.5% were used to produce M20 grade concrete. Aspect ratio of steel was used as 50. Compression strength test, flexural strength test, split tensile test were performed according to guidelines of Bureau of Indian Standards. The tests were co related with results of normal concrete. Due to addition of steel fiber and fly ash Compressive strength, flexural strength, split tensile strength has increased due to pozzolonic action of fly ash and strong bond formation of steel fiber. The highest value of compressive strength and flexural strength was achieved, when cement was replaced by 10% of fly ash and with addition of 1.5 % of steel fiber. Split tensile strength achieves its highest value at 10% of flyash and 1 % of steel fiber. Due to addition of fly ash, workability starts increasing.

Key Words: fly ash ,steel fibre, bitumen

1.INTRODUCTION

The impact of crushed stone aggregates, extraction of the source that are formed in many parts of the country and has created a lot of problems in the environment. It included the loss of forests, noise, dust blasting, vibration and pollution hazards. In India 70% of electricity is generated from thermal power plants by using coal. From where fly ash is produced as a by product. Environmental threats include Air pollution, water pollution and particularly shortage of land for the dumping of that fly ash have taken place by using this coal. In India there is the worst condition for dumping coal. The outcome of Air that comes from coal and lignite that are used in power plants, as the result being light becomes airborne that causes health Problem. The important here is that when it reaches in the atmosphere it cause depletion of Ozone layer. Now to overcome from this problem the best choice is that , this waste material has to be used in other works. In India, there is problem of dumping area for dumping fly ash as majority of electricity is generated from thermal power stations. Full supply generation of fly ash is estimated to be 154 million tonnes in 2001 to 2012 . To work on this problem, although fly ash is used as landfills but now fly ash is used as replacement material for cement, also in pavements, base blocks etc. Fly ash can be used in large quantities in embankment fills and in replacement of aggregate. In India the artificial aggregates are not used widely, because of their high cost and easy availability of natural resources .Menakanda in 2008, found that fly ash aggregate produced by normal curing showed comparable result with the concrete produced by normal curing. In the investigation where the properties of fly ash aggregate which are produced by cold bounded technique and that are compared with natural gravels. As the concrete which is made out of these techniques is good idea to replace it with other materials. The effect of using fly ash in industrial buildings are somehow very1representative job as it will have a tremendous change in the universe. Fly ash can be used in different ways, as a partial replacement of cement in construction industry. As fly ash is light, it can be also used as lightweight course aggregate artificially. The method by which artificial aggregate is formed is known as polarization. The composition of fly ash concrete depends upon the different proportions of cement and formation of light weight concrete. It is so much influenced that it is using directly as concrete, in construction industry. The design and construction due to fly ash is very much economic as it reduce the weight of concrete and thus reduces the overall weight of the structure. Because the unit weight of normal concrete is much more than fly ash concrete. Concrete is very weak in tension. To overcome this tension reinforcement is used in concrete. But this reinforcement is confined to some place of structure. To

increase the overall tensile strength of concrete, steel fibers can be used.

1.1 LITERATURE REVIEW

Prahallada et al. (2013) This paper reviews that an attempt was made to study the properties of fiber reinforced concrete produced from waste plastic fiber and fly ash. Fly ash was added in different percentages like 0%, 5%, 10%, 15%, 20% and 25%. Plastic fiber was added in dry mix at19the rate of 0.5% by volume fraction. The concrete mix was designed for M30 grade. Ordinary Portland cement of 53 grade, natural river sand, locally available crushed aggregate of 10mm down size, portable water free from impurities and salts was used. 0.46 w/c ratio was adopted. Fly ash used was obtained from Harihara Polyfibers Plant (Kumarpatnam). All the samples were tested at 28days ofcuring. It was observed that impact strength, workability, tensile strength, flexural strength, compressive strength increased upto 10% addition of fly ash into it after 10% addition of fly ash all the strengths was decreased.

R.Vasudev et al. (2013) This research indicates that the variation of direct compressive strength for concrete cubes was found to be inconsistent with the increase in percentage of fibers. The splitting tensile strength was increased by 20-22% for concrete cylinder samples with 0.5% fiber content in M20 and M30 Grade concrete mixes. Much research on readily available fibers was conducted with an additional input of cost for the purchase of fibers. But these tests were thus a true example of sustainable development as the recycling of scraps from lathe shops is done to improve the behavior of concrete and also the cement content was partially replaced by fly ash in higher grade concrete.

T.Sama et al. (2014) showed that the compressive strength, flexural strength and split tensile strength increases with increase in steel fiber content .In the research fly ash has a very good effect on compressive strength. The maximum strength has been achieved at 2% steel fiber and 30% fly ash.

Adanagouda et al. (2015) This shows that 10% fly ash can be taken as Optimum dosage, which can be used as a partial replacement to cement for giving maximum possible compressive strength at any age for composite fibers (steel and polypropylene) reinforced high performance concrete. Addition of composite fibers (steel and polypropylene) improves the tension stiffening effect considerably and this increase the bond stress of reinforced bars in composite fiber reinforced20concrete than in plane concrete. From experimental results it has been observed that at 28days of 1.25% composite fiber of polypropylene volume with 10% fly ash concrete the increase in compressive strength is 26.61%, split tensile strength is 13.00% and flexural strength is 9.73% over plane concrete without fiber. Steel fibers reduce the settlement, plastic, water permeability and shrinkage.

S.P.Shetty et al. (2015) The incorporation of increasing amount of fly ash leads to reduction in shrinkage strain in SCC.This decrease in shrinkage seems to have a linear reduction as the replacement level increases. When 80% of fly ash is replaced with cement, shrinkage reduced to two-third of the nominal mix. Class C fly ash causes greater shrinkage than class F fly ash because class F fly ash has lower Al2O3 content than class C fly ash. It is possible to control shrinkage of high volume fly ash SCC by reducing the dosage of super plasticizer and varying water to binder ratio. Although there is slow gain of early age strength of high volume fly ash SCC but there is high development of latter age strength and hence Target strength can be achieved. Some researchers proved 50% fly ash replacement is the optimum replacement in achieving higher strength. There is reduction in autogenous shrinkage as the fly ash content in SCC increased which is due to the less heat of hydration of cement.

1.1METHODOLOGY

1.2COMPRESSION TEST

This test indicates the compressive strength of the structure. For compression test, cubes of size 150x150x150 mm were used.

5.1.1 Preparation of Mould

For making cubes, the moulds should be made up of steel or cast iron. Moulds of cast iron with inner surface parallel to each other and machine faced were used. The mould that were used have a metal base plate with a right surface to support the mould. The mould was free of dust and other foreign materials and was oiled on the inner surface to prevent the sticking of mortar.

Batching, Mixixing & Casting

These operations must have to do with proper care**.**

The concrete that were used for making cubes was prepared by hand mixing on a well waterproof platform.

Also fine and coarse aggregates were mixed on platform. The cement ,fly ash and steel fibers were mixed dry to give uniform colour.

After that water was added and all the ingrediants were mixed with mix proportion M20 thoroughly.

Different mixtures were formed in varying quantities of fly ash, cement and steel fibers.

The mould were filled with mixtures in three different layers. Each layer was rammed at least 25

2. OBJECTIVE

To analysis the behaviour of flyash and steel fiber concrete properties i.e compressive strength, flexural strength,tensile strength and workability by performing following tests

- Workability test with slump cone.
- Flexural Strength test on universal testing machine.
- Compressive Strength test on universal testing machine.
- Split Tensile Strength test on universal testing machine.

3. TESTING

- The cubes were taken out from the curing tanks and were transferred to the laboratory by wrapping in gunny bags. The compression test was performed on universal testing machine
- The cubes were placed in between the plates of machine and load 140kg/cm2/min was transferred till the spicemen shows failure.

The compressive strength was then calculated by this formula

Compressive Strength (MPa) = Failure Load/Cross Sectional Area

- It is evident clear that compressive strength increases upto 24.6 MPa for 7 days by replacing cement by 10% fly ash and adding 1.5% of steel fiber.After increasing the quantity of fly ash ,the compressive strength starts decreasing .

SPLIT TENSILE STRENGTH TEST

As concrete is very weak in tension. So to increase this tensile strength, steel fiber is added to concrete. For finding out split tensile strength of concrete, cylinders of size 300 mm length and 100 mm diameter were casted. The moulds were first cleaned and were oiled inside to get rid from sticking of concrete on walls. The prepared mixture is filled in cylindrical mould in five layers and is tempared very well. Few moulds were casted with different percentage of fly ash, cement and steel fiber with mix design M20.After 24 hours, demoulding is started and cylinders of concrete are dipped in curing tanks. These cylinders are then tested and the failure load is determined and noted down on universal testing machine.

FLEXURAL STRENGTH TEST

To determine the flexural strength, beam specimens of size 150x150x700 mm were cast with different composition of fly ash, cement aggregates and steel fiber with mix design of M20.

4. CONCLUSIONS

It has number of advantages, but also has many issues that is not solved yet. There are many problems that can involved in uniform dispersal of fiber and consistent characteristics. It should have a precise configuration as compared to normal concrete. While steel fiber is not added in sufficient quantity, the desired improvement can not be obtained. But the quality of fiber decreases the workability of the concrete. So special types of techniques are used for concrete mixture. If the proper techniques are not used, finishing problem can occur with the fiber coming out of concrete.

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