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STRENGTH STUDIES OF PAVEMENTS WITH FLY ASH AND STEEL FIBER AS REPLACING CEMENT

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Abstract - *In India, a considerable part of electricity is produced from thermal power shops. These thermal power shops use different types of energies for combustion. During combustion of coal as a energy in these thermal power shops, a by- product videlicet fly ash is produced. Indian coal has the loftiest ash content as compared to coal set up in different countries. There are nearly 85 thermal power shops in India which use coal as a source for power generation and therefore produce a large quantum of cover ash. This cover ash is disposed of in soil, which in turn causes a lot of environmental problems. To overcome this disposal of cover ash into the soil, it can be used in concrete by incompletely replacing it with cement. Because the chemical composition of cover ash and cement is nearly same.*

The main ideal of this paper is to assay the geste of M20 grade concrete with blend design 11.482.74 and with0.48 water cement rate. Then cement was incompletely replaced by 10, 20, 30 of cover ash of F- class by weight. As concrete shows cracks suddenly when witnessing pressure. So to overcome this problem and to enhance the flexural strength of concrete, sword fibres were used. The sword fibres of hook type in chance of0.5, 1,1.5 were used to produce M20 grade concrete.

1.INTRODUCTION

The impact of crushed gravestone summations, birth of the source that are formed in numerous corridor of the country and has created a lot of problems in the terrain [1-4]. It included the loss of timbers, noise, dust firing, vibration and pollution dangers. In India 70 of electricity is generated from thermal power shops by using coal. From where fly ash is produced as a by product. Environmental pitfalls include Air pollution, water pollution and particularly deficit of land for the jilting of that fly ash have taken place by using this coal. In India there's the worst condition for jilting coal. The outgrowth of Air that comes from coal and lignite that are used in power shops, as the result being light becomes airborne that causes healthp Problem [5]. The important then's that when it reaches in the atmosphere it beget reduction of Ozone subcaste. Now to overcome from this challenge the stylish choice is that, this waste material has to be used in other workshop [7].

In India, there's a problem of jilting areas for jilting cover ash as the maturity of electricity is generated from thermal power stations. Full force generation of cover ash is estimated to be 154 million tonnes in 2001 to 2012 [13].To work on this problem, although cover ash is used as tips, now fly ash is used as a relief material for cement, also in pavements, base blocks etc[8]. Fly ash can be used in large amounts in dam fills and in relief of total. In India the artificial summations aren't used extensively, because of their high cost and easy vacuity of natural coffers [11-15].

Menakanda in 2008, set up that cover ash total produced by normal curing showed similar results with the concrete produced by normal curing. In the disquisition where the parcels of cover ash total which are produced by cold bounded fashion and that are compared with natural gravels [16]. As the concrete which is made out of these ways is a good idea to replace it with other accoutrements . The effect of using cover ash in artificial structures is ever a veritably representative job as it'll have a tremendous change in the macrocosm [18- 19]. Fly ash can be used in different ways, as a partial relief of cement in the construction assiduity. As cover ash is light, it can be also used as featherlight coarse total instinctively [21]. The system by which artificial total is formed is known as polarization [3].

The composition of cover ash concrete depends upon the different proportions of cement and conformation of light weight concrete. It's so important told that it's used directly as concrete, in the construction assiduity[6]. The design and construction due to cover ash is veritably important profitable as it reduce the weight of concrete and therefore reduces the overall weight of the structure. Because the unit weight of normal concrete is much further than fly ash concrete [7]

Concrete is veritably weak in pressure [11] To conquer this pressure underpinning is used in concrete. But this underpinning is confined to some place of structure(16). To increase the overall tensile strength of concrete, sword filaments can be used.

1.1 OBJECTIVES

In the growing world, the raw material sources used in the product of cement are fine and non renewable and have to safe guard it for unborn generations[10]The

mineral cocktails are desolate products of artificial processes, whose disposal is a great concern. Ash which is produced from thermal power shops is one similar waste abundantly available in different corridor of the country. To overcome this problem, flyash has to either recycled or is used as it's in construction processes.

To analysis the geste of flyash and sword fiber concrete parcelsi.e compressive strength, flexural strength, tensile strength and plasticity by performing following tests

- Plasticity test with depression cone.
- Flexural Strength test on universal testing machine,
- Compressive Strength test on universal testing machine.
- Split Tensile Strength test on universal testing machin

1.2 LITERATURE REVIEW

Shah (1987) reported that many of the current applications of fiber reinforced concrete involve the use of fibers ranging around 1 % by volume of concrete. Recently, it has been possible to incorporate relatively large volumes (ranging up to 15%) of steel, glass, and synthetic fibers in concrete.[19] With such a large volume of fibers in concrete it was reported that the fibers may substantially increase the tensile strength of concrete.

Al-Tayyib et al. (1990) reported that adding polypropylene fibers (0.2% by volume of concrete) to concrete mixes increses the properties of both fresh and hardened concretes. It was reported that polypropylene fiber reinforcement has no noticeable effect in retarding corrosion of reinforcing steel in concrete[22].

Ezeldin et al. (1991) The primary variables of this study are: rapid-set cementing materials; (b) fiber type; and (c) fiber content. Three commercially available rapid-set materials were investigated in the experiments. The findings showed that steel fibers can be successfully mixed with rapid set materials up to a quantity of 75 lb/cu yd (45 kg/m3) and reported that the mechanical properties depend on the fiber shape, aspect ratio and its content.[27]

Saluja et al. (1992) carried the experiments on steel fiber concrete to find out compressive strength and concluded that steel fibers are effective in increasing the compressive strength up to 1.0 percent fiber content,beyond which the increase is not much effective.[8,9]

Ashour et al. (1993) expressed that eight high-strength concrete beams with different fiber contents and shear span-depth ratios were examined to study the influence of fiber addition at ultimate load, crack propagation, flexural rigidity and ductility. It was reported that the addition of steel fibers enhanced the strength. A semi-empirical equation was proposed to estimate the effective moment of inertia of simply supported high-strength fiber reinforced concrete beams and concluded that the estimated deflections using this equation agree well with the experimental values. At ultimate conditions, the length of the plastic hinge developed was found to be proportional to the fiber content.[23]

Balaguru et al. (1993) examined the workability and the behaviour under compression, splitting tension, flexure and shear strength of fiber reinforced high strength semi light weight concrete. Silica fume and water-reducing admixtures were used to obtain the high strength.The results showed that the silica fume can be successfully used to obtain high strength. The brittleness of silica fume concrete can be overcome by using steel fibers[12].

Banthia et al. (1994) examined the Bond-slip characteristics for three deformed steel fibers bonded in concrete with different strengths. Fibers were aligned at 0, 15, 30, 45, and 60 degree with respect to the loading direction and complete load-versus-slip curves were obtained.[22] It was found that the bond-slip characteristics of fibers aligned with respect to the loading direction were significantly superior to those for inclined fibers.

Nataraja et al. (1999) [9]reported the variation in impact resistance of steel fiber-reinforced concrete and plain concrete determined from a drop weight test by statistical approach. It was reported that the goodness-of-fit test indicated poor fitness of the impact resistance and suggested that more number of specimens required a reliable measure of the impact strength for goodness of fit [22].

Vidivelli et al. (2010) .The mix was designed for 1:1.66:3.61. The workability was maintained at 40-60mm. The w/c ratio was varied from 0.48 to 0.39 Various tests like compressive, flexural and split tensile strength were carried out at the ages of 28, 45, 60, 90 and 180 days. It was observed that compressive flexural and tensile strength increased at 10% and 20% replacement of fly ash at all the ages of curing like 28, 45, 60, 90 and 180 days and reduction was observed at 30% and 40% replacement of fly ash at the ages of curing like 28, 45, 60, 90 and 180 days compared to conventional concrete.[11]

S.R. Mohan et al. (2011) Based on their experimental test, it has been found that fly ash can serve as a good substitute for cement in reasonable proportions by volume and whatever deficiencies that may result can be

easily overcome by use of steel fibers. Properties of the resulting composites show better performance than plain concrete both in terms of mechanical and structural strengths. An ideal choice would be 15% fly ash with 0.15% fiber gives an increase of 5% to 31 % increase in cube strength at the end of seven days and 12% to 55% at the end of 28 days[10]. Similar enhancements in tensile strength and modulus of rupture are observed making these composites an efficient material over concrete with the use of local materials and technology. In general steel fiber composites show better performance upto 20% fly ash and 0.3% fiber content. Optimum could be 0.15% fiber content at 10 or 15% fly ash giving a range of 12 to 54.82 % increase[10].

Baboo et al. (2012) This paper reveals Workability was low when super plasticizer was added workability becomes medium till 10% of plastic content[16]. Compressive strength decreased when super plasticizer was not used. Compressive strength increased when super plasticizer was used till 10% of plastic flakes at 15% there was a reduction. As the percentage of waste plastic flake increased, flexural strength decreased[16].

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.[26]

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 reinforced concrete than in plane concrete..[15]

S.P.Shetty et al. (2015) The incorporation of an 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. 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.

2. MATERIALS AND DISCUSSION

AGGREGATES

Aggregates constitute about 70% of total concrete. So the properties of aggregates mainly predominate the properties of concrete.The aggregates are normally divided into two categories, namely fine and coarse aggregates having size of less than 4.75 mm are grouped as fine aggregates,while as aggregates having size of more than 4.75 mm are grouped in coarse aggregates.Fine aggregate normally consists of natural, crushed, or manufactured sand.[19] Coarse aggregates can be made of natural gravel or crushed stone. In the present study the sand confirm to zone II as per Indian standards.

FLY ASH

Fy ash is a by-product produced from the combustion of coal in an electrical generation station. Fly ash is a natural pozzolan, which means that it is a “siliceous or siliceous-and-aluminous material” that chemically reacts with calcium hydroxide or free lime (CH) that has evolved during reaction of cement and water to form composites having cementitous properties.[21]

STEEL FIBER

Steel fibres are formed from low carbon content iron .The inclusion of fiber especially steel fibers in concrete significantly enhances the flexural strength, ductility and toughness. Because of its non-flexibility it gives more strength. The most important thing describing a fiber is its aspect ratio. Aspect ratio is the length of fiber divided by an equivalent diameter of fiber, where equivalent is the diameter of the circle with an area equal to the cross sectional area of fiber. The Steel fiber that have been used in this project were having aspect ratio of 50 with cylindrical hooked geometry. The typical diameter of fibres lies in the range of 0.25-0.75 mm.l Length of these fibres is 30 mm and the diameter of steel fibre used is 0.6 . Density of steel fibre is 7900 kg/cum.[21-24]

It was observed that with different percentage variations of steel fibres, the compressive strength values increased at all curing ages, but with cement replacement with fly ash, the values decreased with respect to the control mix. The increase in compressive strength with steel fibres was due to the bonding of fibres into the concrete, which resists the development of cracks [13]. However, the strength decreased with the replacement of fly ash because of the slow pozzolanic reaction compared to cement . But at later ages, the strength increased with the variation of steel fibres and replacement of cement with fly ash which is comparable to the control mix.

Advantages

The primary advantages are as follows

- It can improve the ductility of concrete, that is it makes it cracks resistance.
- Tensile strength can be improved by traditional rebars in a particular direction.
- Steel fibers are used for multi direction reinforcement.
- It required less labour.
- Construction time is less required.

By the use of steel fibre,the mechanical properties of concrete, that material toughness in tension and durability, can be improved.

PROPERTIES OF CONCRETE IMPROVED BY STEEL FIBER

1. Flexural strength:-Its strength increases upto 3 more times than conventional concrete.
2. Fatigue strength :- 1 ½ times more increase in fatigue resistance.
3. Impact resistance:- Higher resistance , that causes damage in heavy impact.
4. Permeability:- It is less porous.
5. Abrasion resistance:- It is more effective against abrasion and spalling.
6. Shrinkage:- Cracks can be eliminated.
7. Corrosion :- It affects the material but is limited in certain areas.

3. CONCLUSIONS

Based on above papers the conclusions are drawn that with the variation of steel fibres the strength properties such as compressive strength, split tensile strength, and flexural strength increased at all curing ages. But with the inclusion of fly ash, the strength values decreased and showed a similar trend. The values of durability properties such as water absorption and porosity decreased due to the denseness of the concrete mix.

The compressive strength of concrete increases as the percentage of replacement of cement is increased upto 20% in addition with steel fibre 2% further replacement there is decrease in strength of concrete.

The compressive strength of concrete increases as the percentage of replacement of cement is increased upto 20% in addition with coconut fibre 1% further replacement there is decrease in strength of concrete.

The compressive strength obtained for 28 days containing fly ash 20% and steel fiber 2% is found to be 30.011N/mm2 which is about 7.80% than the compressive strength 27.67N/mm2 obtained for 28 days containing fly ash 20% and coconut fiber 1%.

The split tensile strength obtained for 28 days containing fly ash 20% and steel fiber 2% is found to be 3.15 N/mm2 which is about 8.57% more than the split tensile strength 2.88 N/mm2 obtained for 28 days containing fly ash 20% and coconut fiber 1%.

The flexural strength obtained for 28 days containing fly ash 20% and steel fiber 2% is found to be 5.16 N/mm2 which is about 23.97% more than the CVC. The flexural strength obtained for 28 days containing fly ash 20% and coconut fiber 1% is found to be 4.8N/mm2 which is about 13.29% more than the CVC.

FUTURE SCOPE

Hydration property cement with SAP and fly ash replacement to know how hydration is affected by these two materials. Also the shrinkage and other durable properties are recommended to study since it is self-curing and fly ash added.

- In this study the steel fibre content is fixed as 0.03% by volume of concrete it can be studied in future by varying its percentage upto 0.1% in which earlier researches done for conventional concrete.
- In this study no super plasticizers used even it is M40 grade because to obtain virgin results, it is also recommended to study with super plasticizers.
- From this work it can be observed that for higher percentage of replacement of fly ash (40% and 50%) the strength result considerably low and in future it is recommended to make use of some alkaline activators and also using class C fly ash which may increase strength and pave a pathway to develop the Geopolymer concrete, the eco-friendly and sustainable

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