EXPERIMENTAL INVESTIGATION ON FUNCTIONALLY GRADED CONCRETE USING FLY ASH AND BAGASSE ASH BASED ON NEUTRAL AXIS

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ABSTRACT

Functionally Graded Concrete is Conceptual procedure by using a layer-by-layer technique with two different technological practices. It is now established that the concrete were performed to produce & analyse the behaviour of a concrete member with a FGC. The method for producing functionally graded concrete have a gradation compressive strength and stiffness throughout its depth. This paper discuss about the various literature reviews in which the functionally graded concrete have incorporated with the materials such as Fly ash, red mud, cylinder have been widely used in the study. This would help the readers such as civil engineers, architects, technical assistant for quickly.

Key words – fly ash ,bagasse ash,in neutral axis.

I. INTRODUCTION

Functionally graded concrete materials (FGCMs) would be constructed in multiple layers by incrementally varying the material properties.It increase the residual stress distribution, thermal resistance, and resistance to cracking and reduce the stress intensity factor, so it is a very promising material that requires research for further developments. This initially developed using metal materials for spacecraft applications, nowadays it is also studied for building elements such as beams, plates, and shells. Static and dynamic analyses of FGM structures have attracted various researchers in the last few decades. functionally graded beam (FGB) subjected to static transverse loads by supposing Young's modulus of the beam differs exponentially through the thickness.

1.1 FUNCTIONALLY GRADED CONCRETE :

For the sake of economy, strength and anti-corrosion FGC to be developed that having one layer of normal concrete and another of lean concrete. Represent the FGC graphical representation of Cross section And also increase the residual stress distribution, thermal resistance, and resistance to cracking and reduce the stress intensity factor, so it can be very promising material that requires research for further developments. Although FGM was initially developed using metal material for spacecraft applications, nowadays it is also studied for building elements such as beams, plates, and shells.

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II. SOURCE OF FUNCTIONALLY GRADED MATERIALS

- Fly ash.
- Bagasse ash
- Fibre reinforced concrete.
- Fibre-reinforced cement composite.
- Natural Fibre/Epoxy cylinder.

NEUTRAL AXIS :

The neutral axis is an axis in the cross section of a beam or shaft along which there are no longitudinal stresses or strain .if the section is symmetry isotropic and is not curved before a bend occur then the neutral axis is at the geometric centroid .

BAGASSE ASH :

Bagasse is the fibrous matter that remains after sugarcane or sorghum stalks are crushed to extract their juice.It is dry pulpy residue left after the extraction of juice fromsugar cane. Dry bagasse is burnt to produce steam.The steam is used to rotate turbines to produce power.Bagasse ash are also used for rebinding material for cement for adding concrete.

FLY ASH :

Fly ash is a by- product of coal-lined deem generating plants. Fly ash is a finely divided residue resulting hum the combustion of pulverized coal and transported by the flue gases of boilers fired by pulverized coal. Fly ash produced in large quantities in the country, as a waste product, from a number of thermal power stations and industrial plants using pulverized coal as fuel from boilers. Its availability is likely to increase with the increased industrialization in the country. The use of fly ash as a pozzolana and a line aggregate, also for other allied purposes in well established in a number of countries abroad. Seine recent investigations on Indian fly ash then suitability for various uses.Indigenous fly ashes for replacement of cement anti or use with lime, as It admixture for cement, concrete bituminous nurtures and as fine aggregate for mortal concrete have already been successfully tried out and greater attention is now being paid to fully exploit the potentialities of fly ash as a construction material.

Classification of Fly Ash :

ASTM – C 618-93 categorizes natural pozzlonas and fly ashes into the following two categories:

- **Class F Fly Ash**: The burning of harder, older anthracite and bituminous coal typically produces Class F fly ash. This fly ash is pozzolanic in nature, and contains less than 10% lime (CaO). The glassy silica and alumina of Class F fly ash requires a cementing agent, such as Portland cement, quicklime, or hydrated lime, with the presence of water in order to react and produce cementations compounds.

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Class C Fly Ash: Fly ash produced from the burning of younger lignite or sub bituminous coal, in addition to having pozzolanic properties, also has some self-cementing properties. In the presence of water, Class C fly ash will harden and gain strength over time. Class C fly ash generally contains more than 20% lime (CaO). Unlike Class F, self-cementing Class C fly ash does not require an activator. Alkali and sulfate (SO4) contents are generally higher in Class C fly ashes

Aim and scope of the project :

The aim of the present study is to carry out flexural strength of concrete mix with partial replacement of cement by red mud and fly ash. The compressive strength of concrete in turn depends upon the properties of its constituent materials viz, cement, fine aggregate, coarse aggregate, bagasse ash, fly ah etc., in the present investigation. Effort has been made to develop reinforced red mud concrete.

The scope of the present investigation can be summarized as follows:

1. To study the effect on workability, and strength properties of concrete mix with varying percentage of cement replacement by bagasse ash and fly ash.
2. To achieve 28 days characteristic compressive strength, tensile strength and load-deflection characteristics of 20 & 25 MPa. To find out optimum percentage of cement replacement by red mud for which the concrete yields superior mechanical properties.
3. To determine the flexural strength in functionally graded structural element.

Cement :

Cement is the binding material that is most commonly used in the concrete which binds all the ingredients into a compact mass. The Portland pozallana cement (PPC) of 53grade will be used as per IS 12269:1987. It is a fine powder produced by heating materials in a kiln to form a clinker, grinding the clinker and adding small amounts of other materials. Various type of Portland pozzlana cement are available with the most common being called Portland pozallana cement (PPC). The various properties such as fineness, specific gravity, standard consistency and setting time were found. The specific gravity of cement is observed .

Fine Aggregate :

The fine aggregate used in this project is natural river sand which has been washed and sieved to remove particles larger than 5mm. Fine aggregates passing through the minimum4.75mm sieve will be used. The specific gravity of fine aggregate used for concrete was determined and found .

COARSE AGGREGATE:

The coarse aggregate used are hard blue granite stones from quarries and a maximum of 20mm aggregates have been used for project work. The specific gravity of coarse aggregate used for concrete was determined and found .

III. LITERATURE REVIEW

Pankaj et al (2014) have studied that the Functionally Graded Materials are those in which the volume fraction of the two or more constituent materials is varied continuously as a function of position along certain dimension(s) of the structure. This paper presents a review of the developments in analysis of FGM beam type structures with an emphasis on the recent work published. Diverse areas relevant to various aspects of analysis of FGM beam type structures are reflected in this paper. Higher order shear deformation theory may be used to get precise results in case of thick beams. The study of dynamic stability of FGM beams considering material nonlinearity may be undertaken as a future work of research. Moreover, higher order stretching strain may be considered to include geometric nonlinearity. Experimental analysis of dynamic stability of functionally graded material beams may be taken as a future work in order to validate the used computational method and obtained theoretical results.

Satyanarayana et al (2015) have investigated the mechanical behaviour of functionally graded concrete (FGC) was studied. Generally, concrete used in the field suffers from lack of durability and homogeneity. Based on the experimental investigations carried out, the following conclusions are drawn. FGM cubes having interface at 50 % volume of specimen has approximately 12-15% more compressive strength compared to normal concrete and 4-5% more compressive strength compared to fly- ash concrete. The FGC with 30% replacement of fly ash gives more strength and economical.

Chandra Wahyu Purnomo (2012) has been investigated the effect of the activation method on the properties and adsorption behavior of bagasse fly ash-based activated carbon.Bagasse fly ash (BFA) has been intensively studied for activated carbon preparation. Several activation methods have been investigated, physical activation using steamand CO2, chemical activation using KOH, and one step combination method between chemical and CO2 physical activation (physiochemical activation). Using coarse BFA particles as the precursor, it was observed that steam activation mainly enhances mesopores, while CO2 and KOH activation develops particularly the micropores inside the carbon matrix.

Han Aylie et al (2015) have studied on bamboo as a naturally graded material was conducted, finding that the bamboo fibres had a radial fibre distribution outward through the thickness of the section. This graded section influenced the response to tensile, torsion and flexural stress positively. The load carrying capacity of FGC flexural beams was investigated by means of finite element mode. A combination of two different concrete strengths shows significant changes in the stiffness and ultimate load of the FGC beams. A method for producing functionally graded concrete (FGC) having a gradation in compressive strength and stiffness throughout the depth of a member was developed. The flexural member, through optimising of material use while improving the serviceability of the member.

Jeffery Roesler et al (2006) have studied an alternative approach is to design distinct layers within the concrete pavement surface which have specific functions thus achieving higher performance at a lower cost. The objective of this research was to address the structural benefits of functionally graded concrete materials (FGCM) for rigid pavements by testing and modelling the fracture behaviour of different combinations of layered plain and synthetic fibre-reinforced concrete materials. The application of functionally graded (or layered) concrete materials (FGCM) for rigid pavement has shown promising results based on fracture testing. Here concrete specimens that used fibres showed an improved softening behaviour over plain concrete. The compressive and split-tensile strengths of mixture were measured.

Bahurudeen et al (2014) has been studied by functionally graded concrete of sugarcane bagasse ash based Portland pozzolana cement and evaluation of compatibility with Superplasticizers. Sugarcane bagasse ash is a by-product from sugar industries and can be supplementary cementitious material in concrete. The development of new cementitious blends with processed sample of sugarcane bagasse ash is described in this paper.Utilization of various supplementary cementitious materials significantly influences fresh and hardened properties of concrete.Interaction of pozzolanic material with cement and chemical admixtures produces diverse effects in the fresh properties of blended cement concrete.Development of sugarcane bagasse ash based Portland pozzolana cement is reported.

MIX DESIGN :

The experiments were carried out for optimising the maximum strength. In this paper discussing about the two grade of concrete using M20&M 25 based on the neutral axis .in this topic two materials are added like fly ash & bagasse ash.5%,10%,15%,20%, of fly ash & bagasse ash were adding in the one cube with different ratio.for every cube fly ash 0.104gm,cement 1.804kg,fine aggregate 5.86kg,coarse aggregate kg,water 0.805ml .

Test result and curing details :

Before testing the member was checked dimensionally, and a detailed visual inspection made with all information carefully recorded. The load was increased incrementally up to the calculated working load, with loads and deflections recorded at each stage. Loads will then normally be increased again in similar increments up to failure, with LVDT replaced by a suitably mounted scale as failure approaches. This is necessary to avoid damage to LVDT, and although accuracy is reduced, the deflections at this stage will usually be large and easily measured from a distance.To essential that precise deflection readings are taken up to collapse.

The concrete specimen must be cured before they are tested. Unless required for test at 24 hours, the cube, prisms and beams should be placed immediately after demoulding in the curing tank or mist room. The curing temperature of the water in the curing tank should be maintained at 25-40°C. If curing is in a mist room, the relative humidity should be maintained at no less than 95%. Curing should be continued possible up to the time of testing. In order to protect adequate circulation of water, adequate space should be provided between the cubes, and between the cubes and the side of the curing tank.

IV. COMPRESSIVE TEST RESULT:

Compressive Strength Using bagasse ash and Fly Ash :

Compression test according to IS:516 (1959) was carried out on the 150x150x150 mm cubes were tested for the compressive strength of concrete. The concrete with fly ash and bagasse ash is placed in the concrete cubes at a distance of 25 mm, 50mm and 75 mm from the bottom of the cubes. Remaining 125mm, 100 mm and 75mm were conventional concrete. The compressive strength for respective proportion of fly ash and red mud are calculated.

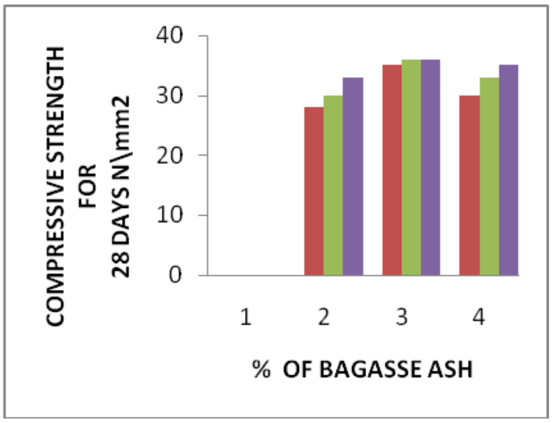

Fig 1.Compressive strength result for 28days bagasse ash

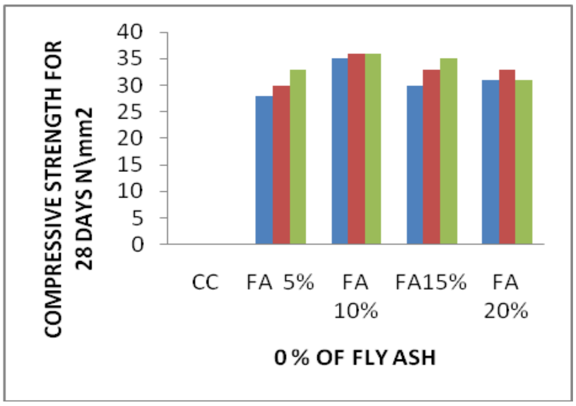

Fig 2.Compressive strength result for 28days fly ash

FLEXURAL STRENGTH FOR PRISM :

The flexural strength for the entire specimen was same. After the curing period of 28 days was over, the prism as washed and its surface was cleaned for clear visibility of cracks. The most commonly used load arrangement for testing of prism will consist of two-point loading. The load will normally be concentrated at a suitable shorter distance from a support.

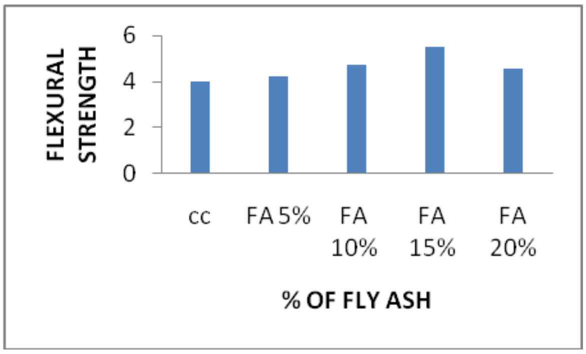

Fig 1.Flexural strength result for 28days fly ash

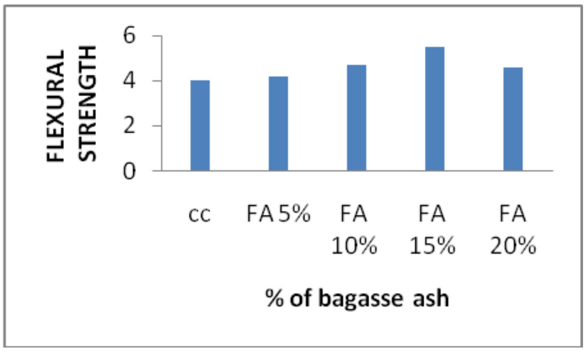

Fig 2. Flexural strength result for 28days bagasse ash.

V. CONCLUSION :

- The general objective of this research was to compare the fresh and mechanical properties of functionally graded concrete beam with bagasse ash and fly ash concrete.
- The bond strength FGC beam is optimum at 50mm depth.
- It has been determined that the FGC concrete having interface at the bottom and fly ash,bagasse ash concrete formed by replacement of 10% of cement by bagasse ash and fly ash is having better result as compare to conventional concrete.
- From the experimental result, when bagasse ash is replaced for cement as 10% in lean concrete which is placed at 50 mm, had obtain more strength than the conventional concrete.
- From the experimental result, bagasse ash when Fly ash is replaced for cement as 10% in lean concrete which is placed at 50 mm, had obtain more strength than the conventional concrete.

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