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Size Effects on Flexural Behavior of Steel Fiber Reinforced Concrete with Industrial Wastes

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Abstract: Presently in India, about 960 million tonnes of solid waste is being generated annually as by-products during industrial, mining, municipal, agricultural and otherprocesses.Due to the rapid industrialization taking place globally, the problems generated are acute shortage of construction material and increasing in productivity of wastes.In present the most of design codes for concrete structures do not consider the effect of size.The flexural behavior of concrete is often different from its behavior under direct tension. The flexural strength has been varies for depend on the size of the beam. The size effect to be much weaker in three-point-bend beams than in four-point-bend beams (because the zone of maximum stress is much shorter in the former). The flexural strength of beam decreases as the size increases. The size effect on flexural strength to be determined. To identify increase the specimen size and decrease the flexural strength of concrete. This paper deals with an experimental study on size effects on flexural behavior of steel fiber reinforced concrete with industrial wastes. The flexural behavior of steel fiber concrete beam is investigated in this study.

Keywords: concrete materials, size effects, flexural strength, four point bending, three point bending.

I. INTRODUCTION

A. General

Concrete is most widely used construction material in the world due to its ability to get cast in any form and shape. It also replaces old construction materials

such as brick and stone masonry. The strength and durability of concrete can be changed by making appropriate changes in its ingredients like cemetitious material,

aggregate and water and by adding some special ingredients.Thus the manufacture of cement liberates large amount of carbon dioxide which mixed up in the atmosphere causing hazardous to the environment, thus to reduce the usage of cement in the concrete and to reduce the liberation of carbon-di-oxide into the atmosphere the cement is partially replaced with the industrial waste. There are so many industrial wastes such as Ground Granulated Blast Furnace Slag, Meta kaolin, Rice husk ash, Bottom ash, Silica Fume and many. These industrial wastes are partially replaced with cement and treated whole as a cement material and used in the concrete. The weakness can be removed by inclusion of fibers in the mixture.

In general, the change of a structural property when the size of a structure changes is known as a size effect. In other words, if geometrically similar specimens do not behave similarly for different sizes, this is called a size effect. Size effects occur in concrete in any loading conditions. Tensile strength is a parameter it is very difficult to determine. The accurate measurement of tensile strength of concrete is not easy. The tensile strength measurement is depends on the test method used. i.e., direct test method and indirect test method. The bending test is easy to perform when compared to the direct tension test. This paper presents on size effects on the flexural behavior of steel fiber reinforced concrete with industrial waste. Three different sizes of the beam specimen used for this investigation. The replacementof cement by metakaolin and GGBS. The mix proportion is 5% and 10%. And also replacement of fine aggregate by copper slag & its mixing proportion is 20%, 40%, & 60%. The 3% of steel fiber is additionally added to the weight of cement. The steel fiber is added to the cement its increase the toughness and improve the strength. The metakaolin and GGBS also improve the durability and reduce the use cement. Copper slag also used for increase the density of concrete and provides good resistance to sulphate attack. The super plasticizers provide the lower permeability, and also reduce the water content. The specimens are filled by the M_{30}concrete. The curing period is 28 days. Finally the beam specimens are to be tested by three point bending and four point bending method.

B. Three point bending test

The beam specimens are casted and cured for 28 days. The specimens are placed on two supports that are 200 mm, 200mm, 300mm apart. It is supported on steel rollers which are again supported on steel plates. Loading is applied by using hydraulic jack. The jack is manually operated for loading and unloading. The load applied is measured by pre-calibrated proving ring of capacity 100 KN. In three point loading, the load is to be applied at the center that is exactly above the un notch position.

C. Four point bending test

The beam specimens are casted and cured for 28 days. The specimens are placed on two supports that are 200 mm, 200mm, 300mm apart. It is supported on steel rollers which are again supported on steel plates. Loading is applied by using hydraulic jack. The jack is manually operated for loading and unloading. The load applied is measured by pre-calibrated proving ring of capacity 100 KN. In four point loading, the load is to be applied at $1/4^{th}$ of the span length from the supports.

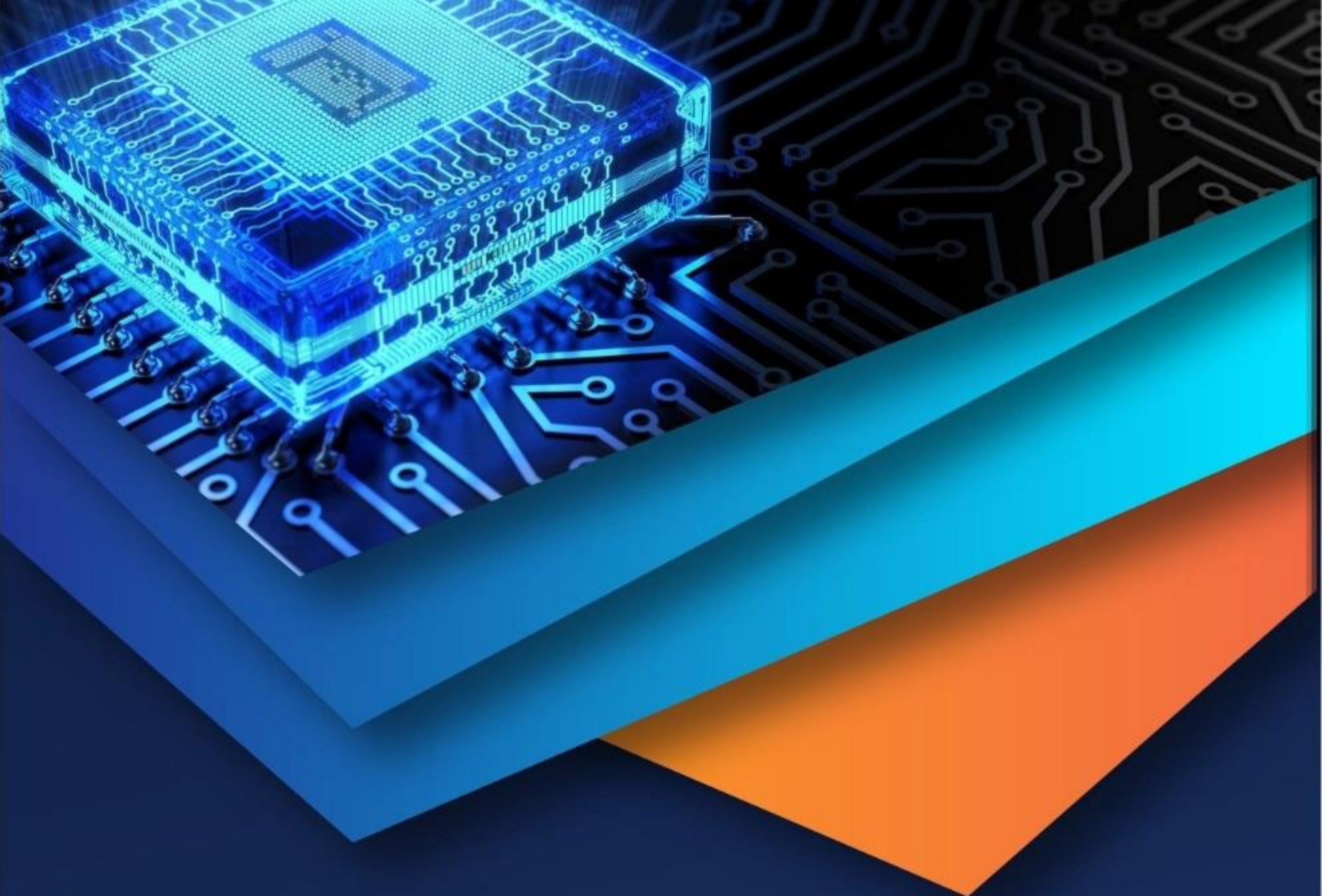
II. MOTIVATION OF THE STUDY

The many researchers have been completed in this title and proved positive results arerecorded. Overall view of studies as given below.

The size dependence of flexuralproperties of cement mortar and concrete beam. The failure location of all concrete beams is at the mid span. The flexural strength of both cement mortar and concrete decreases with the specimen size increases (Jikai Zhou et al.,).Xudong chen et al.,expressed that the beam theory the stress distribution in three point bending can be assumed to vary linearly through the thickness. In four point bending in which the stress varies linearly through the height of specimens. The direct tensile strength is lower than the flexural strength.Wei-Ting Linhas expressed that the fiber has also been added in the fiber cementitious materials to improve concrete properties, particularly tensile strength, surface abrasion resistance and energy absorbing capacity.Strain at peak stress increases with an increase in concrete strength. For the concrete with higher strength, the ascending part of the stress–strain curve is more linear than for the lower strength concrete. These are investigated by Chen X et al., Xudong chen et al., expressed that the results are the peak stresses increase with an increase in the strain rate. The failure location of all concrete beams was at the midspan and no effect of strain rate was observed. The splitting tensile strength of concrete is more sensitive to an increasing the strain rate than flexural and tensile strength. All concrete beamsare failure at mid span. The failure occurs at low reversible energy.These are expressed by (Shengxing et al).Man H K, has expressed that the size effect can be approximated with a Weibull model, where the main parameter, the Weibull modulus, depends on theconcrete composition. The effect is larger for larger specimen sizes.Del viso J R has identified that the post peak behavior depends on the specimen shape. Large specimens resist less in terms of stress than the smaller ones. The crack pattern observed after the test is sensitive to the shape of the specimen. The strain at peak load increases also as size decreases.Selim pul showedhas Super plasticizer is added to the certain ratio 1% or 2% of binder. The proposed method for measuring direct tensile strength minimized the eccentricity during loading. Flexural strength increases more than the uniaxial tensile strength and split tensile strength.Ghaemmaghami Ahas expressed that series of tests was carried out based on the size effect due to a number of geometrically similar notched specimens of various sizes. This indicates that the high specific fracture energy of dam concrete is the result of the nature, size and properties of its aggregate.Delsye et al.,has expressed that Utilizing OPS in concrete production not only solves the problem of disposing this solid waste but also helps conserve natural resources. Vertical flexural cracks were observed in the constant-moment region.Miroslavvorechovsky et al.,expressed that increasing specimen size there is an increased probability at weak spot in high stress regions. Weakened layer results in reduction of strength of small specimens. Zdenek P et al.expressed that the existing flexural strength data better than the classical, statistical weibull theory. The energy release rate which depends on the entire stress field in the structure. The size effect on the flexural strength of laminates appears to be primarily energetic rather than statistical. The tensile strength is varying with the dimension of the specimen. The specimen size increases with decreasing the nominal tensile strength. The nominal stress measured at the maximum load (Carpinteri A et al.,) Bazant Z Phasdetermined thatthe modulus of rupture depends on the beam size or on the magnitude of the strain gradient at the surface.It depends only on the ratio of the boundary layer thickness to the beamdepth.Nallathambi P et al.,expressed that deflection is measured adjacent to the notch at the mid span. Increasing the elastic modulus with increasing the aggregate size.The critical energy release rate increased with increasing depth to span ratio but decreased with increasing notch depth.Bazant Z.Phas proved that the potential energy release caused by fracture depends on the length of the crack band and the area of the crack band. Size effects on strength, such as the dependence of the bending strength on the depth of a beam.Tanigawa Y has expressed that the size effect in the concrete strength is related to the ratio of the diameter of the specimen to that of aggregate. The size effect on the strength of concrete is also affected by the mechanical heterogeneity of the concrete system depending on the relative mechanical properties of mortar mix and aggregate. It is observed that the strength decreases with increasing the volume of specimen.

III. CONCLUSION

The modulus of rupture of concrete, which characterizes the bending strength of unreinforced beams, is known to depend on the beam size). A through knowledge of this size effects is therefore needed to be able to translate the experimental numbers to values that can be applied in engineering practice. The use above industrial wastes is to reduce environmental pollution. The flexural strength is determined by the four point bending and three point bending method. To compare the test result and draw the load deflection curve for both test. To identify the size effect for various notch less specimen. To identify the size effect on the strength of concrete is also affected by the mechanical heterogeneity system. The flexural strength formula is varied for different size of the beam. So to make the empirical relation. It is used for calculating the size effect and to check the beam size increase with decrease the flexural strength.



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