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BEHAVIOR AND STRENGTH OF RC DEEP BEAMS USING HIGH PERFORMANCE CONCRETE- A LITERATURE REVIEW

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Abstract: In this study, structural behavior of RC deep beams with various approaches. Deep beams are classified as span to depth ratio varying from1.5 to 2.5. The paper presents the literature survey of study of deep beams under different loading conditions, using HSSC, steel fiber etc. The general trend is load deflection characteristics and modes of failure are studied.

Keywords: RC Deep Beams, Shear Strength, High Performance Concrete, fly ash, admixtures.

I. INTRODUCTION

RC deep beams have many useful applications in buildings, bridges structures such as transfer girders, wall footings, foundation pile caps, floor diaphragms, bunkers, tanks etc. Particularly the use of deep beams at lower levels in tall buildings for both residential and commercial purposes. A beam is considered as deep if the depth of beam is large in relation to span of beam. Acc. to IS 456-2000 a beam is considered as a deep beam when the ratio of effective span to overall depth L/D is less than 2.0 for simply supported member and 2.5 for continuous member. The investigation of their behaviour is a subject of considerable interest in RC structure researches. The behaviour of deep beam depends on its properties of materials and strength characteristics. Concrete plays a vital role in the development of deep beam and other structural elements.

However, most of the current design codes were developed using experimental results based on NSC; therefore existing codes limits the maximum concrete strength based on it. These limitations reflect the lack of research development rather than the inability of the material to perform its capacity. Thus adequate investigation of its behavior in structural members is highly desirable. It is well known that concrete is weak in tension and strong in compression. Therefore, its primary purpose in a reinforced concrete structural member is to sustain compressive forces, while steel reinforcement is used to sustain tensile forces. As concrete is used to sustain compressive forces, it is essential that its strength and characteristics are determined. In this regard, one of the main parameter that needs to be investigated is the use of high performance concrete in deep beam.

A. SCOPE AND OBJECTIVE

Shear strength of deep beams depends on various parameters like compressive strength of concrete, shear reinforcement, shear span to depth ratio etc. Many reports published over the past decades presents to increase the strength by using HSC or different fibers but the fibers are costly and not availability. If high performance concrete is used, it would provide the required workability, durability and strength necessary for the structures.

II. LITERATURE REVIEW

Several research efforts have been made to understand the strength and behavior of deep beams. The study on deep beams has been an interesting topic by varying parameters. However some studies have been reported on the investigators recently which are summarized in table 1

Table 1 Review of literature

Author, Title of Paper, name of Journal	Description	Outcomes
S. P. Sangeetha, P.S Joanna, Flexural Behavior of Reinforced Concrete Beams with Partial Replacement of GGBS, American Journal of Engineering Research (AJER)	This paper focuses on the structural behavior of reinforced concrete beam with Ground Granulated Blast furnace Slag (GGBS).It is an inexpensive replacement of Ordinary Portland Cement (OPC) used in concrete, and it improves fresh and hardened properties of concrete	The structural behavior of Reinforced concrete beams with GGBS resembled the typical behavior of reinforced cement concrete beams and there is increase in load carrying capacity of GGBS beams with age. Hence results of this investigation suggest that concrete with 40% GGBS replacement for cement could be used for RC beams.
Uday Naik, Sunil Kute, Span-to-depth ratio effect on shear strength of steel fiber-reinforced high-strength concrete deep beams using ANN model, International Journal of Advanced Structural Engineering 2013	The paper predicts the shear strength of high-strength steel fiber-reinforced concrete deep beams.	The results of variation in span-to depth ratio show decrease in shear strength for different influencing factors like fiber content, fiber aspect ratio, longitudinal steel, depth of beam, and shear span. This also shows that the size effect is predominant in decreasing the shear strength.
H S Kim, Structural Behaviors of Deep RC Beams under Combined Axial and Bending Force	This paper presents experimental studies of deep reinforced concrete (RC) beam behaviors under combined axial and bending loads. In order to investigate the effect of axial loads on the structural behaviors of the deep RC beams, specimens are prepared to have different shear span-to-depth ratios. From the experiments, load-deflection relationships, and strains of steel bar and concrete are observed.	When the shear span-to-depth ratio decreases with increased axial load, the deep beam is failed due to concrete crushing before shear failure is occurred. These experimental results indicate that early failure of the beam is occurred due to concrete crushing when the deep beam is under axial load with relatively small shear span-to-depth ratio.
Md M sazaad, Study of behaviour of reinforced concrete deep beam under two points loading and the effect of shear reinforcement, Conference on OUR WORLD IN CONCRETE & STRUCTURES	The paper presents the study of behavior of reinforced concrete deep beam under two-points loading and the effect of shear reinforcement. The influence of variation of web reinforcement spacing on the shear strength of deep R.C. beam is investigated. The general trend in crack pattern, the load deflection characteristics and the mode of failure of deep R.C. Beam under two-points loading are also investigated.	From the investigation that under two-point loading diagonal cracks are the first crack to be developed in relatively deeper beams and flexural cracks are the first crack to be developed in the shallower beams. Different web reinforcement arrangements have no appreciable effect on the formation of initial diagonal cracks in the deep beam.

Vengatachalapathy, ilangovan. R, a study on steel fibre reinforced concrete deep beams with and without Openings, international journal of civil and structural engineering	This study deals with the behavior and ultimate strength of steel fiber reinforced concrete deep beams with and without openings in web subjected to two-point loading.	Web openings may be provided in the compression zone of the beams and fiber content of 0.75% by volume may be added to improve the e strength of the structure.
Venu malagavelli, high performance concrete With GGBS and robo sand, international journal of engineering science and technology	The present paper focuses on investigating characteristics of M30 concrete with partial replacement of cement with Ground Granulated Blast furnace Slag (GGBS) and sand with the ROBO sand (crusher dust). The cubes and cylinders are tested for both compressive and tensile strengths. It is found that by the partial replacement of cement with GGBS and sand with ROBO sand helped in improving the strength of the concrete substantially compared to normal mix concrete.	Compressive strength of concrete can be improved by using admixtures.
Mr. Sabale Vishal Dhondiram and Miss. Borgave Manali Deepak, Experimental Study On High Performance Concrete, International Journal of Electronics, Communication& Soft Computing Science and Engineering	This paper generalizes the results of study on silica fume based high-performance concrete. The attempt has been made to compare, the 7 days and 28 days compressive strength, splitting tensile strength and flexural strength of concrete by using silica fume with the normal concrete of M60 grade with maintaining the water cement ratio 0.3.	Cement replacement up to 10% with silica fume leads to increase in compressive strength, splitting tensile strength and flexural strength, for both M60grade.
B.R. Niranjan, S.S.Patil, Analysis of RC Deep beam by finite element method, International Journal of Modern Engineering Research (IJMER)	The analytical study of reinforced concrete simply supported deep beams subjected to two point loads was carried out using finite element method to study the behavior of deep beam by considering flexural stress, flexural strain, and shear stress variations at different sections for various effective lengths to depth ratio and compared with Euler Bernoulli Theory.	Flexural strain and stress of deep beams is not linear is confirmed. The flexural steel requirements inversely proportionally to the Effective span to Depth Ratio of deep beam.

III. ANALYSIS

As mentioned above literature it has been observed that few experiment have been carried out to date to investigate the behavior of RC beam under different loading condition and using different materials, such as steel fiber, HSSC etc. As a result the RC deep beams exhibited reduced ductility and workability. The behavior of deep beam is very complex and then is still no agreement on role of size effect and materials in shear strength due to lack of information

Several parameters affect the strength of RC deep beams which include span to depth ratio, concrete strength, and amount of reinforcement. Thus it is necessary to investigate the behavior of deep beam using high performance concrete.

High Performance Concrete (HPC) is the latest development in concrete. It has become more popular these days and is being used in many prestigious projects. Mineral admixtures such as fly ash, rice husk ash, metakaolin, silica fume etc. are more commonly used in the development of HPC mixes. Addition of such materials has indicated the improvements in the strength and durability properties of concrete.

IV. EXPECTED OUTCOMES

The overall performance of HPC used in deep beam by varying proportions to improve the strength and behavior of RC deep beam.

V. FURTHER SCOPE

- The experimental investigation may be carried out using HPC with different aspect ratio.
- Different opening in beams may be fixed with HPC

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