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Literature Review for Experimental Behavior of Concrete under Compression Load with Steel Fiber and Ferro-Cement Partial Add Of Cement

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Abstract: *In this thesis the study performance of concrete under compression with steel fiber and Ferro-cement partial add of cement, It has been Studied that the relative under Compression load partial adding of steel fiber and Ferro-cement appear that the ratio are designed for target strength and result in increased Stress-strain value.*

Keywords: *cement, Ferro cement, sand, steel fibre, etc.*

I. INTRODUCTION

Concrete is a man-made construction materials which is most commonly used in construction work in the world. It is obtained by mixing of water, cement, fine aggregate, coarse aggregate and some minerals admixtures in necessary proportion are known as concrete. The hardened concrete can be worked as an artificial stone in which the voids of coarse are filled by the fine aggregates and cement. The hardening of concrete is caused by chemical reaction between cement, water, and reaction for a long time and hardening of concrete strong with the age. The properties of concrete depend on the quantity and proportion of the ingredients used in the mix and the control exercised in formwork and curing.

Concrete is the boon to construction, as it has various direct and indirect advantages concrete has many inherent advantages such as:

- A. High resistance and weathering action
- B. Availability of ingredients at reasonable cost
- C. High compressive strength
- D. Mould ability to any shape leading to architectural finishes
- E. Aesthetic appearance. Therefore it widely used in construction It has some disadvantages they are
- F. Low tensile strength
- G. Poor ductility
- H. More brittleness
- I. High W/C ratio

A Concrete with reinforcement fails suddenly when subject to earthquake and nuclear blast etc. This problem can be avoided if the critical sections are able to undergo large plastic deformation and be in a position to absorb large of strain energy.

Section composed with high strength steel and higher steel ratios fail suddenly without yielding of tension steel, provision of compression reinforcement helps to some extent. But the design becomes most uneconomical

The improvement in ductility of concrete allows economical use of high strength steel, higher cement ratio and avoids sudden failure and also the moment curvature characteristics of reinforced concrete section can be brought nearer to that of a steel section and the analysis of intermediate concrete structures get simplified. The concrete with improved ductility is more efficient building material.

The structural which are designed for seismic resistant demands high ductility. Therefore the ductility of concrete is being improved by confining it in steel binders, as ties in compression member and as stirrups in beams at present. In the structures which are statically indeterminate the critical section, at which first hinge forms are incidentally also the section having maximum shear force. The stirrup reinforcement, which is provided. Moreover, use of sophisticated arrangement of closely spaced stirrups in confinement columns not only creates plane of weakness between core and the concrete and interrupts the continuity but also adds the problem of steel congestion.

Therefore it may not be possible to sufficiently the structure by providing the laterals ties alone but it would be useful if a supplementary or indirect confinement, in addition to laterals, can be devised. Several investigations have revealed that incorporation of discontinuous, discrete and uniformly spread fibers in concrete increases tensile strength ductility, impact, toughness, flexural and fatigue resistance.

The conclusion highlighted that fibers can give some confinement, such type of concrete is termed as Confined fiber Reinforced Concrete (CFRC). When we use fibers in large volumes it has tendency to ball. Therefore limitation to the quantity of indirect confinement offered by steel also. This Limitation confinement necessity the requirement of additional confinement can be provided in the form of Ferro cement shell. Such concrete can be termed as Confined Ferro Reinforced Concrete (CFRC). The present present investigation is an attempt to study the strain characteristics of CFRC.

II. LITERATURE REVIEW

A. *P Sangeetha¹ and R. Sumathi²2010 [2]*

Fiber – Wrapping using Fiber – Reinforced Plastic (FRP) shells is one of effective methods, significantly enhances the strength and ductility of concrete columns. The paper reports the behavior of the GFRP wrapped concrete columns under uniaxial compression. The cross section of the concrete columns considered in the work is circular with diameter of 150mm and height 300mm. The Parameters that are varied in the investigation are wrapping shell materials, (which includes GFRP Materials Surface Mat(SM), Chopped Strand Mat (CSM) and Woven Roving Mat (WRM)), Number of Plies (1Ply and 3plies) and Period of Curing (7 & 28 Days). Results from a series of the experimental study were reported and discussed. The study on small – scale specimens showed that confinement increased the strength of the concrete columns loaded axially.

B. *Shabans Salik K¹, Athira M. M.², Lalna S.S³, Prasum C.⁴, Rafeekha K.⁵ Rajimol K. R⁶, Safna A. M⁷ 2015 [3]*

This paper evaluates the performance of short concrete compression members strengthened with coir rope wrapping, under axial compression. From the study on small-scale specimens, it has been seen that the coir rope wrapped specimen exhibit significant increase in strength, as compared to control specimen, due to the confinement by rope wrapping. The tests were carried out with ropes of different diameters 0.6cm, 1cm and 1.4cm at spacing of 0.0h, 0.1h, 0.2h and 0.3h, where h is the height of the specimen. Maximum improvement was obtained for wrapping with coir rope of diameter 1.4 cm at 0.0h spacing. The strength was found to be increased with increase in diameter of rope and decreased with increase in spacing. The costs for unit improvement with various wrapping were worked out and the method was found to be very cost-effective. As the weight of coir rope is negligibly small, it has practically no impact on footing design.

C. *A.R. Rahai¹, P.Sadeghian² and M.R. Ehsani³2008 [4]*

This paper presents the results of experimental studies about concrete cylinders confined with high-strength carbon fiber reinforced polymer (CFRP) composites. Forty small scale specimens (150×300 mm) were subjected to uniaxial compression up to failure and stress-strain behaviors were recorded. The various parameters such as wrap thickness and fiber orientation were considered. Different wrap thicknesses (1, 2, 3, and 4 layers), fiber orientation of 0o, 90o, ±45o and combinations of them were investigated. The results demonstrated significant enhancement in the compressive strength, stiffness, and ductility of the CFRP-wrapped concrete cylinders as compared to unconfined concrete cylinders.

D. *Katsuki Takiguchi¹ And Abdullah²2000 [5]*

Investigation by many researchers have indicated that by providing external confinement at plastic region or over the entire reinforced columns, the strength and ductility can be enhanced. In this paper, a strengthening method using circular ferrocement jacket to improve the confinement of a substandard column was investigated and compared with control specimens and different strengthening methods. Five 1:6 scale model square columns were constructed and have been tested under constant axial load while simultaneously being subjected to cyclic lateral load. The loading system used in this experiment displaced the tested columns in a double bending. Two columns were tested as control specimens; one column was strengthened with circular Ferro cement jacket and were compared with those of other two identical square RC columns strengthened circularly with steel plate and carbon fiber. The control specimens suffered shear failure and significant degradation of strength during testing whereas the strengthened columns showed ductile flexural response and higher strength. The test results indicate that circular Ferro cement jacket can be an effective alternative material to strengthen reinforced concrete column with in adequate shear resistance.

E. Hanaa I El Sayad¹ and Aiman A. Shaheen² 2011 [6]

The aim of this investigation is firstly to evaluate the different methods used for confining the reinforced concrete (R.C) columns either internally or externally. Secondly, the effect of overheating on the performance of confining methods is studied using the computer program “ANSYS 5.4”. Beside the traditional transverse steel ties, the internal confinement was satisfied by steel fibers or a cage of xpaned metal mesh inside the ties, while external confinement was achieved by wrapping the studied columns with Ferro cement layers or GFRP sheets. Six R. C columns were prepared, namely, the control column reinforced traditionally with transverse ties only, two columns containing 1% and 2% steel fibers, one column reinforced additionally with a cage of expanded metal mesh, two columns wrapped with either Ferro-cement laminates or glass fiber reinforced plastics (GFRP). The columns were tested under axial loads to evaluate the effect of the different confining methods on the ultimate capacity and ductility. It was found that adding 2% steel fibers or reinforcing the column with a cage of expanded metal mesh inside the ties gave almost similar results (26% increase in the ultimate capacity compared with that of the control column). Despite that the ultimate capacity of the column wrapped with GFRP was the highest among the studied columns (37% increase in the ultimate capacity), its ductility was the lowest. The parametric study using ANSYS 5.4 showed that the R.C columns containing steel fibers were less affected by fire than the other columns. It was also found that the ultimate capacity of R.C columns wrapped with GFRP was reduced by fire to a high degree (approximately 53% reduction in the ultimate capacity).

F. PSangeetha 2006 [7]

Fiber wrapping or encasement of columns with fiber-reinforced plastic (FRP) sheets significantly enhances strength and ductility of concrete. To investigate the behavior of concrete columns confined by fiber reinforced polymer (FRP) sheets under uniaxial compression, analytical models were solved using Finite Element Method (FEM) against published experimental data. Cross sections of concrete columns in analysis are categorized into circular, square and rectangular sections. Finite Element Analysis (FEA) can effectively simulate the behavior of concrete columns confined by FRP sheets when the proper numerical model is adopted. Results from a series of the analysis on small-scale specimens showed that confinement increase strength (20-25) and ductility of concrete columns loaded axially. ANSYS (version 6.0) offers a series of very robust nonlinear capabilities for designs and analyses.

G. Emdad K. Z. Balanji¹, M. Neaz Sheikh² Muhammad N.s. Hadi³ 2016 [8]

The strength and ductility of high strength concrete columns improve with the addition of steel fiber. This paper reports the behavior of circular High Strength Concrete (HSC) columns reinforced with Hybrid Steel Fibers (HSF) under different loading conditions. In this study, HSF consisted of a combination of macro steel fibers and micro steel fibers. A total of eight circular specimens of 205 mm diameter and 800 mm height were cast and tested. All specimens were reinforced with same amount of steel reinforcements. The specimens were divided into two groups of four specimens. Group RC (reference group) contained no steel fibers. Group HSF (hybrid steel fibers) contained 2.5% by volume of HSF. From each group one specimen was tested under concentric loading, one under 25 mm eccentric loading, one under 50 mm eccentric loading, and one under four-point loading. The results showed that the specimens reinforced with HSF achieved higher strength and ductility compared to RC specimens under different loading conditions. It was also observed that the presence of HSF delayed the spalling of the concrete cover

H. Azadeh Parvin¹ and David Brighton² 2014 [9]

In recent years, the repair of unstrengthened and damaged reinforced concrete member by external bonding such as ferrocement laminate is increasing which demands need of investigations on behavior of ferrocement confinements. Significant amount of work has been carried out on confinement of column with ferrocement laminates considering change in parameter such as types of meshes with different sizes, concrete grade, height of column, etc. In this study, use of ferrocement as an external confinement to concrete specimen is investigated with reference to layers of confinement and orientation of meshes. The effectiveness of confinement is achieved by comparing the behavior of confined specimen with that of unconfined specimen.

I. Shankarkumar V¹, Arun K², Dhivya P³, Mahesh Kumar M⁴, Suresh Babu R⁵ 2010 [10]

Invention of new methods in strengthening concrete is under work for decades. On the track of such invention Fiber Reinforced Composite materials plays a significant role. The main function of fiber reinforcement is to carry the load along its length and also to provide stiffness and strength in one direction. FRP thus alters the compressive strength, tensile strength and flexural strength of concrete to a good extent and hence it imprints as a good solution for strengthening concrete. FRP materials can be externally

bonded or wrapped to the existing structure; hence they can also be used for rehabilitation works. There are three major types of fiber reinforced polymers used in construction works. They are Glass fiber reinforced polymer (GFRP), Carbon fiber reinforced polymer (CFRP) and Aramid fiber reinforced polymer (AFRP). In the present investigation the effect of GFRP on M25 and M50 concrete mix is studied at two cases. First, Effect of GFRP on the compressive and flexural strength of M25 and M50 concrete mix with respect to number of layers, and secondly Effect of GFRP on compressive strength M25 and M50 concrete mix with respect to number of layers at 2000C temperature which is termed as durability studies.

J. Md. Mozaffar Masud¹ and Arum Kumar² 2013 [11]

The present study investigates the effect of confinement using ferrocement as wrapping material on the circular RC columns under concentric loading condition. Methods: Experimental studies were carried out on the confining effect using external confinement technique with one layer and two layers of GI wire mesh under concentrically loaded condition. All columns were tested by uniform concentric compressive load from top with a hydraulic compression testing machine of capacity 1000KN. Findings: Most of the researches have done on confining effect of either long column or short column (slenderness ratio more than 3). This paper demonstrates the confining effect on short column having slenderness ratio is less than 3, such a column is called pedestal. Pedestal is a form of short column which is used as a base support for steel structure, statue or vase. To protect the column of steel structure from corrosion that is in direct contact of soil, pedestal is provided. During earthquake such a structure can collapse or even cracks can develop. Hence, Ferro cement structures are highly ductile and energy dissipating material that can undergoes large deformations without collapsing during earthquakes. Even the deformed structures can be strengthened at very low cost after deformation. Steel jacketing has proved to be an effective measure for strengthening or retrofitting and has been widely used in practice, but the engineering community is currently looking for alternatives. Applications/Improvements: Material like Ferro cement is oldest, cost effective method emerges an alternative solution for strengthening of reinforced concrete column. External confinement or encasing of column with Ferrocement enhances the strength and ductility of concrete column.

K. Vikram Singh Thakur¹, Vikas Khatuja², Sumanth Reddy³, K.V. Ratn Sai⁴, and Dr. P.Rathish Kumar⁵ 2016 [12]

In this paper, stress-strain diagrams for self-compacting concrete confined with ferrocement shell in addition to lateral tie confinement is presented, based on the experimental results of 102 cylinders of diameter 150mm and height 300 mm tested under axial compression. Increase in the strength and strain of concrete confined with ferrocement shell and lateral tie confinement is found to be linear. A constitutive relation is proposed for the first time for confined SCC to enable the engineers to apply the same for the designing such elements.

L. Prof.Y.B.I. Shaheen¹, Dr. M. Hassanen² 2012 [13]

This paper presents a proposed method of producing new circular reinforced concrete columns reinforced with various types of reinforcing materials. The experimental program includes casting and testing up to failure sixteen circular columns having the same dimensions of 72 mm in diameter and 1m long were tested under concentric compression loadings. The experimental program comprises five designations series. The main variables are the type of reinforcing materials metallic or non metallic, the number of layers; volume fraction of reinforcement, specific surface area of reinforcing materials, incorporating of bamboo in the core of the test specimens. The main objectives are to evaluate the effectiveness of employing three types of FRP with different technical methods of strengthening concrete columns. To make comparative study between strengthening concrete columns and concrete columns reinforced with welded steel meshes, fiber glass meshes, polypropylene meshes, and bamboo with meshes. The results of an experimental investigation to examine the effectiveness of these produced columns are reported and discussed including strength, deformation, cracking, ductility and energy absorption properties of the test specimens. Specimens strengthened with FRP, Aramid emphasized more effective and efficient more than hydride materials. High ductility and energy absorption properties could be obtained of Ferrocement columns. New reinforced concrete Columns were developed with high strength, crack resistance, high ductility and energy absorption properties. High ductility and energy absorption properties could be obtained of Ferro cement columns.

M. V M Shinde¹, J P Bhusari 2016 [14]

In recent years, the repair of unstrengthened and damaged reinforced concrete member by external bonding such as fibrocement laminate is increasing which demands need of investigations on behavior of Ferro cement confinements. Significant amount of work has been carried out on confinement of column with Ferro cement laminates considering change in parameter such as types of meshes with different sizes, concrete grade, height of column, etc. In this study, use of Ferro cement as an external

confinement to concrete specimen is investigated with reference to layers of confinement and orientation of meshes. The effectiveness of confinement is achieved by comparing the behavior of confined specimen with that of unconfined specimen. The experimental program consists of testing 30 specimens under uniaxial compression. Cylindrical specimen of 120mm dia. and 600 mm height were used. Results show that the confinement of cylindrical specimen can improve the ultimate strength with single and double layer of mesh compared to unconfined specimen. Ultimate compressive strength increases with the change in orientation of square mesh from 90° to 45°.

III. CONCLUSION

- A. On the basis of test result, we can suggest that stress-strain property of the concrete can further be improved by mixing some other types of mineral admixture like 'Blast-furnace Slag (BFS), Fly ash (FA), Rice Husk ash (RHA)' as future work.
- B. On the basis of result obtain from current work a study is also suggested for Flexural strength and Split Tensile strength related properties in future.
- C. On the basis of result obtain from current work a study is also suggested for Bond strength by Pull out test related properties in Future.
- D. The confinement of the reinforcement in column with fibers has improved stress-strain behavior compared to plane concrete.
- E. The confinement of Ferro cement shell with fibers has improved the stress strain behavior of the concrete

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