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Experimental and Theoretical Investigation on the Shear Behaviour of Steel Fibre Rinforced Concrete Beams

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ABSTRACT - The main objective of the paper is to investigate the strength of steel fibre reinforced concrete beam (SFRC) by using the universal testing machine (UTM). A set of beams were tested with different volumetric fractions. The addition of steel fibres provides the ultimate strength. The behaviour of steel fibre RC beams at the ultimate limit state (in shear) is provided. Following this, a detailed design is to incorporate in elucidate of material test results and evaluation of serviceability and strength provisions in reinforced concrete structures. The strengthening effect of fibres in the concrete achieves primarily due to the bridging effect of fibres at the crack interfaces.

KEY WORDS-Fibre reinforced concrete, steel fibres, shear strength, crack pattern.

I. INTRODUCTION

Concrete fails in the brittle manner and it has the low tensile strength. If the steel fibres are to the concrete, it can show the higher toughness under static loading, such as bending, tension and shear. The steel fibre improves the mechanical properties in the concrete, such as ductility and energy absorbing capacity. The main function of the steel fibres in the concrete is to transfer the stresses across the cracked section.

The addition of steel fibres improves the brittle manner of the concrete to the ductile manner. Addition of the fibres improves the ductile property, reduces the crack width in the concrete and reduces the spacing. Steel fibre in the concrete improves the shear strength of reinforced concrete beam and partially replaces the stirrups. The steel fibre has the ability to maintain the structural integrity and cohesiveness in the material.

The properties of fibres play an important role in determining the predominant mechanism of failure as well as on the macroscopic behaviour of the cracked FRC members. The effectiveness of steel fibre reinforced concrete improves the various mechanical properties of concrete depends on the fibre dosage, fibre aspect ratio, amount of longitudinal steel, tensile strength of fibres and concrete compressive strength. Therefore, an experimental test will be conducted to study the shear behaviour of steel fibre reinforced concrete beams.

II. OBJECTIVE

- The main objective is to study and examine the shear behaviour of the reinforced concrete beams with steel fibres.
- To examine the effect steel fibres of RC beams on ultimate load carrying capacity and failure pattern.
- Comparative study of the crack pattern and the crushing behaviour of the conventional beam and SFRC beams.

III. LITERATURE REVIEW

Beulah Gnana Ananthi, Jaffer Sathick and Abirami has done an experimental investigation on the shear behaviour of steel fibre reinforced concrete beams. They have made the comparison test between the conventional beams and the beams with steel fibre. Their result shows that the beam with steel fibres increased the compressive strength and the tensile strength. Finally, they have concluded that the usage of steel fibre increases the shear strength and helps in replacing the transverse stirrups in high strength concrete.

D.H. Lim and B.H. oh has investigated on the shear behaviour of SFRC beams. Comparative tests have been taken between the conventional beams and SFRC beams. Therefore they have concluded that the use of fibre reinforcement reduces the stirrups and satisfies the shear strength and ductility of the concrete.

Ali A. Hameed, Mohannad H. Al-Sherrawi has experimented on the influence of steel fibre on the shear strength of the concrete beams. The addition of steel fibres improve the ductility and the maximum deflection is increased. They have found out the shear strength is increased by 67.56% compared to the normal beam. This

experiment has concluded that the addition of steel fibre increased the shear capacity and energy absorption.

Tantary, Upadhyay Akhil, Prasad has done an experimental analysis on a series of reinforced concrete fibre beams loaded in shear. The beams with the steel fibres has increased the shear strength about 30% than the beams without steel fibre. They have concluded that , the addition of steel fibres increase the shear strength, ductility and provide effective crack mechanism.

Syed Mohsin, Abbas, Cotsovos has done a research on the shear behaviour of the steel fibre reinforced concrete beams. They have examined the shear behaviour of SFRC beams and conventional beams. The result has concluded that the steel fibre has the ability to enhance the shear capacity and the ductility.

Mansur,M. ASCE, K.C.G. Ong and Paramasivam has conducted the investigation on the shear strength of the fibrous concrete beams without stirrups. The addition of steel fibre changed the mode of failure from shear to failure. The shear failure in the beam decreases when the fibre is increased. This paper has concluded that the effect of steel fibres gives good predictions of the ultimate strength and mode of failure for beams with no shear reinforcement.

Jun Zhao, Jingchao Liang, Liusheng Chu and Fuqiang Shen has done a research on the shear behaviour of the steel fibre reinforced concrete beam with high strength reinforcement. The addition of fibres increases the stiffness of the beam, the ductile manner of the concrete and reduces the brittleness of the shear failure and width of the crack. The test results shows that the steel fibres increases the shear capacity of the beams with high strength reinforcement.

Yoon-Keum Kwak, Marc O. Eberhard, Woo-Suk Kim, Jubum Kim has experimented to test the shear strength of the steel fibre reinforced concrete beams without stirrups. The mode of failure had changed from shear to flexure, when the steel fibre volume is increased. The result has demonstrated that the ultimate strength is increased by increasing the fibre content and decreasing the shear span depth ratio and increasing the compressive strength.

C.E. Chalioris, E.F. Sfiri has experimentally investigated the shear performance of the steel fibrous concrete beams subjected to monotonic and cyclic loading. The beams with the steel fibres increased the compressive and tensile strength than that of the beams without fibres. The test results showed that, the fibrous beam improved the shear performances and increased the shear strength, ultimate deflections and energy absorption.

Thomas H.K. Wang, Woosuk Kim, Yoon-Keun Kwak and Sung-Gul Hong has tested the shear strength of the lightweight concrete beams without web reinforcement. They made the comparison test between the normal weight concrete beams and light weight concrete beams. The test results showed that, the lightweight concrete beams increased the compressive strength , tensile strength and stiffness of the steel fibre. They have concluded that the addition of steel fibres has improved the resistance to structural damage, shear capacities and ductility in lightweight concrete.

B.H. Oh, D.H. Lim, S.W. Yoo, E.S. Kim had made the experimental test on the shear behaviour and shear analysis of reinforced concrete beams containing steel fibres. The compression strength and the flexural strength has been increased by 25% and 55% when the fibre is added. The test results concluded that the beams with steel fibre can reduce the amount of stirrups needed and increased the both strength and ductility and it also increased the cracking shear strength.

A.M. Shende, A.M. Pande, M. Gulfam Pathan has experimented to test on the shear strength of the M-40 grade concrete. In this paper, they have been tested the compressive strength, flexural strength and split tensile strength. The beams which were undergone the test has showed the result of increased flexural strength and compressive strength with the increased fibre content. In this research paper, the author has concluded that specimens with increased fibre content had the high ultimate strength when compared with the other specimens.

Tian Sing Ng, Stephen J. Foster, Ali Amin has done an experiment to test the shear behaviour of geo-polymer concrete beams with steel fibres. For this investigation they have used the hooked end steel fibre. It was observed that, the shear crack has occurred in the beams without steel fibres and the beams failed in the brittle manner. The beams with the steel fibre had only finer cracks and failed due to diagonal cracks. The ultimate strength and cracking behaviour is increased when the fibre concentration is increased.

Nguyen-Minh, M. Rovnak and T. Tran-Quoc had dealt with the behaviour and capacity of steel fibre reinforced concrete flat slabs under punching shear. It was observed that the slabs without the steel fibres failed in brittle manner and the slabs with the steel fibre had failed in ductile mode. This paper showed the results as, the usage of steel fibres increased the punching shear

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resistance and it also increased the stiffness and ductility of the concrete.

Yining DING, Fasheng ZHANG, Torgal Fernado, Yulin ZHANG has done a research on the influence of steel fibre on the shear strength of the self-consolidating concrete beams. They have used the monotonic loading to test the ultimate load bearing capacity of the beams. The beams with no steel fibres failed due to brittle failure with low ultimate load carrying capacity. The addition of steel fibre had strong effect on failure pattern which transformed the brittle shear failure into ductile failure pattern. With this, the authors have concluded that the combined use of the steel fibre and stirrups shows the great effect on the shear load carrying capacity and energy absorption.

Daniel, Fernanda, Romildo, Moacir Alexandre has analysed the shear behaviour of the steel fibre reinforced concrete beams. The beams were tested to determine the ultimate load carrying capacity. It was noted that the beams with increased fibre content has increased the tensile strength and the flexural strength. It also noted that the steel fibre has increased the ductility and ultimate shear strength. This research has concluded that the addition of steel fibres has the highest shear and flexural strength than the beams without steel fibres.

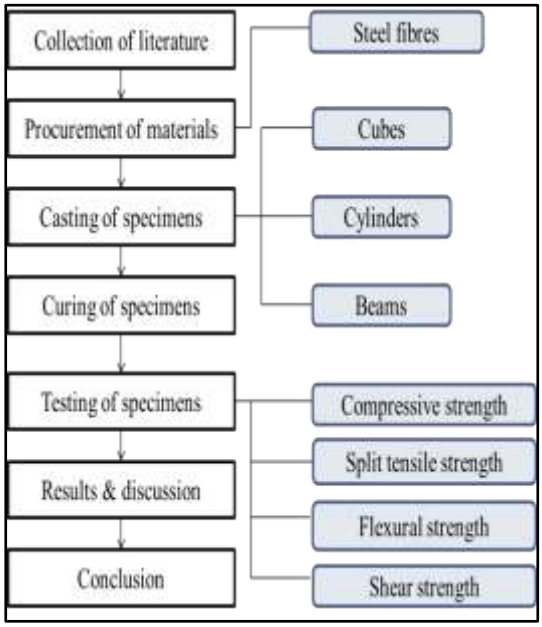
K.S. Elliot, C.H. Peaston, K.A. Paine has done a research on the shear behaviour of steel fibre reinforced prestressed concrete beams. In this they have been used two types of steel fibre were used, hooked end and amorphous metal fibre. The addition of the hooked end steel fibre has increased the compressive strength. The addition of the steel fibres has increased the shear capacity by 43% to 52% than the other beams. The maximum tensile strength was increased by 50% that that of the beams without fibres. The addition steel fibre to the concrete decreases the cracking width and increases the ductility of the concrete. The research paper has concluded that, when the steel fibre is added to the concrete, it had increased the compressive strength, flexural strength and the shear strength of the concrete.

IV. MATERIALS

All the materials which will be used for the tests, are confirmed to the authorized specifications and standards. In order to investigate the effect of steel fibre on the shear strength, the concrete beams cast by using the materials such as,

- Cement
- Coarse aggregate
- Fine aggregate
- Steel fibre

V. METHODOLOGY



VI. CONCLUSION

In this paper, I have referred many research papers regarding the shear behaviour of Steel Fibre Reinforced Concrete beams (SFRC). The aim of this research is to compare the shear strength between the conventional beams and the steel fibre reinforced concrete beams. The experimental investigation will be done and the results will be calculated in phase-II by referring the above mentioned research papers.

REFERENCES

[1]. G. BEULAH GNANA ANANTHI, A. JAFFER SATHICK, M. ABIRAMI, "Experimental investigation on shear behaviour of fibre reinforced concrete beams using steel fibres", Vol:12, No:6, 2018.

[2]. ALI A. HAMEED, MOHANNAD H. AL-SHERRAWI, "Influence of steel fibre on the shear strength of a concrete beam", Vol.4, No.7, July 2018.

[3]. THOMAS H.K. KANG, WOOSUK KIM, YOON-KEUN KWAK, AND SUNG-GUL HONG, "Shear testing of steel fibre reinforced lightweight concrete beams without web reinforcement", ACI Structural Journal, Title no. 108-S52.

[4]. A. MEDA, F. MINELLI, G.A. PLIZZARI AND P.RIVA, "Shear behaviour of steel fibre reinforced concrete beams, (April 2005)343-351.

[5]. L. NGUYEN-MINH, M. ROVNAK, T. TRAN-OUOC, AND K. NGUYEN-KIM,

"Punching shear resistance of steel fibre reinforced concrete slabs", Procedia Engineering 14 (2011) 1830-1837.

[6]. YINING DING, FASHENG ZHANG, TORGAL FERNANDO AND YULIN ZHANG, "Shear behaviour of steel fibre reinforced self-consolidating concrete beams based on the modified compression field theory".

[7]. K.S. ELLIOTT, C.H. PEASTON AND K.A. PAINE, "Experimental and theoretical investigation of the shear resistance of steel fibre reinforced prestressed concrete X-beams- Part I: Experimental work", Vol.35, November 2002, pp 519-527.

[8]. JUN ZHAO, JINGCHAO LIANG, LIUSHENG CHU AND FUQIANG SHEN, "Experimental study on the shear behaviour of steel fibre reinforced concrete beams with high-strength reinforcement, Published: 11 September 2018.

[9]. A.M. SHENDE, A.M. PANDE, M. GULFAM PATHAN, "Experimental study on steel fibre reinforced concrete for M-40 grade", (IRJES), Volume 1, Issue1 (Sep 2012), PP. 043-048.

[10]. DANIEL DE LIMA ARAUJO, FERNANDA GABRIELLE TIBURCIO NUNES, ROMILDO DIAS TOLEDO FILHO AND MOACIR ALEXANDRE SOUZA DE ANDRADE, "Shear strength of steel fibre reinforced concrete beams", July-Sept, 2014.

[11]. M.A. MANSUR, M. ASCE, K.C.G.ONG, AND P. PARAMASIVAM, "Shear strength of fibrous concrete beams without stirrups", Published on July 18, 1985.

[12]. YOON-KEUN KWAK, MARC O EBERHARD, WOO-SUK KIM, AND JUBUM KIM, "Shear strength of steel fibre reinforced concrete beams without stirrups", ACI Structural Journal Title no. 99-S55, V.99,No. 4, July-August 2002.

[13]. C.E. CHALIORIS, E.F. SFIRI, "Shear performance of steel fibrous concrete beams", Procedia Engineering 14 (2011) 2064-2068.

[14]. TIAN SING NG, ALI AMIN, STEPHEN J. FOSTER, "The behaviour of steel-fibre reinforced geopolymer concrete beams in shear", Volume 65, Issue 5.

[15]. D.H. LIM, B.H. OH, "Experimental and theoretical on the shear of steel fibre reinforced concrete beams", Published on March 24, 1998.

[16]. TANTRAY. M.A., UPADHYAY AKHIL, PRASAD.J, "Influence of steel fibres on the shear strength of concrete", Volume 1, No.1, October 2012.

[17]. S. SYED MOHSIN, A. ABBAS, D. COTSOVOS, "Shear behaviour of steel fibre reinforced concrete beams", Published on 12th-13th June 2012.

[18]. B.H. OH, D.H. LIM, S.W. YOO AND E.S. KIM, "Shear behaviour and shear analysis of reinforced concrete beams containing steel fibres", Magazine of concrete research, 1998, 50, No. 4, Dec., 283-291.