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Experimental Investigation on High Strength Steel Fiber Concrete

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ABSTRACT –
Concrete is one of the most used materials has been widely studied on its behavior, strength, etc. Concrete characteristic could be observed from the cracks that are commonly found in concrete Micro crack is one of the types of the concrete cracks. The appearance mortar aggregate interface is caused by the inherent weakness of plain concrete. The weakness can be micro cracks in the reduced by randomly spreading micro reinforcement into the mixture. This study investigate the effects on the use of steel fiber on the strength of concrete with planned characteristic compressive strength of 60 MPa. Mix Design on this study referred to ACI 211 4R-08 and 4 (four) varieties of the concrete mixture is used. The varieties in the mixture will be determine by steel fiber content on the mixture. The mechanical properties to be tested in this study are compressive test, split tensile test, shear test and flexural test were conducted. Result data obtained has been analyzed and compared with a control specimen which is concrete with 0% steel fiber. The specimen planned characteristic compressive strength is not achieved. The largest compressive strength obtained from this test is 56.38 MPa obtained from concrete with a 2% steel fiber mixture. However, result data clearly shows percentage increases in compressive strength, split tensile strength, shear strength and flexural strength due to the increases of the used steel fiber on concrete, while the ductility effect start occurred on the use of 2% steel fiber.
Keywords: *Concrete, Fiber, material, micro cracks, shear strength*

I. INTRODUCTION

The steel fiber reinforced concrete has steadily increased during the last 25 years. Substantial developments have taken place in the reinforced concrete. The current application of steel fiber reinforced concrete include highway and airfield pavements, hydraulic structures, tunnel linings etc. Specially, in the area of structural elements. A number of researchers are evaluating the possibility of using steel-fiber reinforced concrete for structural applications. Strength and ductility are the important factors to be considered in the design of seismic resistant reinforced concrete structures. Under seismic condition, the structure may be subjected to large deformations.

The addition of steel-fibers significantly improves many of the engineering properties of mortar and concrete, particularly impact strength and toughness. Flexural strength, fatigue strength, tensile strength and the ability to resist cracking and spalling are also enhanced. To design and analyze structures using steel fiber reinforced concrete for compression, the stress strain behavior of the material in compression is needed. While the compressive strength is used for the strength calculation of the structural components, the stress strain curve is needed to evaluate the toughness of the material for consideration of ductility.

The shape of the uniaxial stress strain curve is strongly ejected by the testing conditions such as stiff ness of the testing machine, size and shape of the specimen, loading rate etc. and concrete characteristics such as water/cement ratio, aggregate type, type of fiber, etc. However careful attention was given at all stages to avoid variations in the casting, testing and in instrumentation. The toughness ratio graph can be given as the variation of toughness ratio with strength and aspect ratio for different fiber content may be gives as below in Variation of toughness ratio with strength and aspect ratio for different fiber content

II. REVIEW STUDY:

Nataraja et al [1] has presented about Stress strain curves for steel-fiber reinforced concrete under compression. Steel-ber reinforced concrete is increasingly being used day by day as a structural material The complete stress strain curve of the material in compression is needed for the analysis and design of structures. In

this experimental investigation, an attempt has been made to generate the complete stres strain curve experimentally for steel fiber reinforced concrete for compressive strength ranging from 30 to 50 MPa. Round crimped fibers with three volume fractions of 0.5%, 0,75% and 1.0% (39, 59, and 73 kg/m3) and for two aspect ratios of 55 and 82 are considered.

Allasghar et al [2] has proposed about Seismic behaviour of concrete moment frame reinforced with GFRP bars. In this research, four types of concrete moment frame were designed with. glass fiber reinforced polymer (GFRP) bars according to ACI 440.1R-15 and the seismic behavior wa assessed using pushover analysis. The frames were three and five stories with two and three bays. A computer code was developed to calculate the amount of fiber reinforced polymer bars in beams of the frames. In order to evaluate nonlinear behavior in plastic hinge regions, sections of beams and colum were analyzed on the basis of moment-curvature diagram and also P-M interaction curve for columna

Chun et.al [3] has presented about Hybrid effect of macro and micro steel fibers on the pallet and tensile behaviors of ultra-high-performance concrete. This study aims to investigate the effectif hybrid use of macro and micro steel fibers on the pullout and tensile behaviors of ultra-hip performance concrete (UHPC). The pullout behaviors of multiple aligned fibers embedded in UHIC were also compared with the tensile behaviors of UHP-HFRC to analyze their correlations.

Wang etal [4] has presented about Compressive behaviour of hybrid double-skin tubular columna with ultra-high performance fiber reinforced concrete. This study presents the results of an experimental program on the compressive behavior of hybrid fiber reinforced polymer (F)-concrete steel double skin tubular columns (DSTCs) with ultra-high performance fiber-reinforced concrete (UHPFRC). In

total 40 specimens, including 32 hybrid DSTCs and eight FRP confined solid concrete (FCSC) specimens veere prepared and tested under axial compression

Kamil et al [5] has presented about Numerical analysis of asially loaded rectangular concrete filled steel tubular short columns at elevated temperatures. Elevated temperatures significantly reduce the local buckling strengths of steel tubes and the ultimate strengths of rectangular concrete filled steel tubular (CPST) columns exposed to fire. No fiber-based models have been developed that include local buckling effects on the fire-mistance of rectangular CFST columns.

Afroughsabet et,al [6] has presented about The influence of expansive cement on the mechanical physical, and micro structural properties of hybrid-fiber-reinforced concrete. This work reports the properties of hybrid-fiber-reinforced concrete (H_{gamma}*FRC) made with expansive (Ty*p_{C}*K) cement. Combinations of metallic and non-metallic fibers at total fiber volume fraction of 1% were studied. The effectiveness of double hooked-end (DHE) steel fibers in concrete containing expansive cement is investigated for the first time in this study. The mechanical, physical, and microstructural properties of concretes have been assessed.

Wang et al[7] has presented about Axial compressive behaviour of reactive powder concrete- filled circular steel tube stub columns. Reactive powder concrete (RPC) is strength concrete that has a relatively high brittleness. However, its ductility can be enhanced by type of ultra-high enclosure in a steel tube. This paper presents an experimental study of the axial compressive behavior of RPC-filled circular steel tube stub columns.

Rizkiani et al [5] has proposed about Experimental Study On High Strength Steel-Fiber Concrete. Concrete as one of the most used materials has been widely studied on its behavior, strength, etc. Concrete characteristic could be observed from the cracks that are commonly found in concrete. Micro crack is one of the types of the concrete cracks. The appearance of micro cracks in the mortar aggregate interface is caused by the inherent weakness of plain concretie.

Hung et al \{theta\} has presented about Tension-stiffening effect in steel-reinforced UHPC composites: Constitutive model and effects of steel fibers, loading patterns, and rebar sizes. The tensile performance of steel-reinforced concrete members is closely associated with the bond interaction between concrete and the embedded rebar. Ultra-high performance concrete (UHPC) is a rapidly emerging concrete material that has an ultra-high compressive strength and bond strength.

III. CONCLUSION

Based on the above experimental study, following conclusions can be drawn regarding the compression behavior of steel fiber reinforced concrete. Addition of crimped steel-fibers to concrete increases the toughness considerably. The increase in toughness is directly proportional to the reinforcing index. Increase in toughness is marginally higher for lower grade of concrete compared to higher grade of concrete. A marginal increase in compressive strength, strain at peak stress is also observed. This increase is directly proportional to the reinforcing index.

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