OPTIMUM FIBRE CONTENT FOR TENSILE STRENGTH OF FIBRE REINFORCED MICRO-CONCRETE

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ABSTRACT
Fibre reinforced concrete is one of the most promising construction techniques and repairing materials of modern times. Polyester fibre is, by far, the front runner in the field of reinforcing fibres from long ago. On the other hand, micro-concrete technology is a new trend where the size of coarse aggregate is reduced significantly without compromising the strength of concrete. Here along with strength, workability is ensured using chemical admixture (Super plasticizer). In micro-concrete, polyester fibre is mainly used for increasing its tensile strength. So in this research, it was aimed to determine the optimum fibre content at which micro-concrete will hold sufficient tensile strength without deteriorating other major properties. So in this research fibre content was varied from 0.1to 0.5% by volume and it was found for the addition of polyester fibre compressive strength increases upto 43 percent and splitting tensile strengths increases upto 30 percent with respect to control.

Keywords: Micro-concrete; polyester fibre; optimum content

INTRODUCTION
Micro-concrete technology is a new trend where the size of coarse aggregate is reduced significantly without compromising the strength of concrete. Now a days it is mainly used for retrofitting purposes for its various inherent characteristics (pattanaik, 2009; Lakshmanan et al., 2006). As the size of coarse aggregate is kept smaller than usual size, it can be pumped easily to the desired height. Not only that, it requires less compaction than conventional concrete and it is also easy to handle. The main advantage of using this concrete is its capability of using in congested area where the spacing of reinforcement is kept small for different purposes (Habert & Roussel, 2009). On the other hand for retrofitting purpose, tensile strength of concrete is also considered as an important property of concrete for different application. For example, for retrofitting measures of beam-column joints where sufficient shear reinforcement has not been provided, the tensile strength of concrete may help to make it ductile. Increasing tensile strength of concrete using fibres is a popular technique from long ago. In this research the tensile strength of micro-concrete will be tested using different content of Polyester fibre. Then the optimum dose of fibre will be determined at which concrete would hold sufficient tensile strength without deteriorating other properties like compressive strength and slump.

METHODOLOGY
At first micro-concrete mixture with proportion Cement: CA: FA=1:1:1.5) was prepared for casting at least thirty 4 inch x 8 inch concrete cylinder. In this research 5mm downgraded crushed stone was used as coarse aggregate. Superplasticizer (Master Gelenium) was added 6ml/kg of cement to get desire workability. Then the mixture was equally divided into six groups and then Polyester fibre was added at different proportion on volume basis of total concrete (0.1%, 0.2%, 0.3%, 0.4%, 0.5%) to different groups (Hossain, 2015). One group was kept without fibre and it was used as control mix for the comparison with other groups.

Fig. 1: Recron-3S polymer modified fibre.

Table 1: Properties of Recron-3S fibres.

Properties	Recron 3S
Type	Polyester
Cross section	Modified triangular
Form	Monofilament (Micro)
Specefic gravity	1.36
Tensile strength (MPa)	578
Modulous of elasticity (MPa)	17240
Length (mm)	12±1, 18±1
Equivalent diameter (mm)	0.0375
Aspect ratio	320 and 480

Before casting in the mould, concrete will be tested from each group for their slump according to ASTM C143 and the change of slump with different content of Polyester fibre will be measured. After 24 hours the moulds will be removed and the cylinders will be kept in water tub for 28 days curing. After 28 days curing from each group three cylinders will be tested for their compressive strength according to ASTM C39/C39M, three cylinders will be tested for tensile strength ASTM C496/496M. Thus "The percentage of optimum fibre content" will be determined for steel and Synthetic fibre at which micro-concrete would hold sufficient tensile strength without deteriorating other properties.

Table 2: Properties of Coarse aggregate and Fine Aggregate

Basic Property	Coarse aggregate	Shylet sand
Unit Weight	1584.9 kg/m^3	1554.30 kg/m^3
Specific Gravity	2.804	2.709
Absorption capacity	2.95%	2.67%
Fineness modulous	4.95	2.92

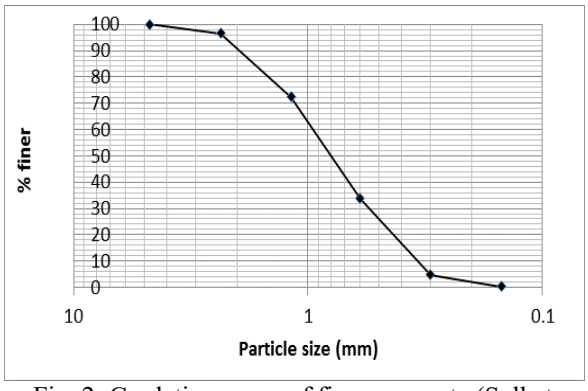

Fig. 2: Gradation curve of fine aggregate (Sylhet sand)

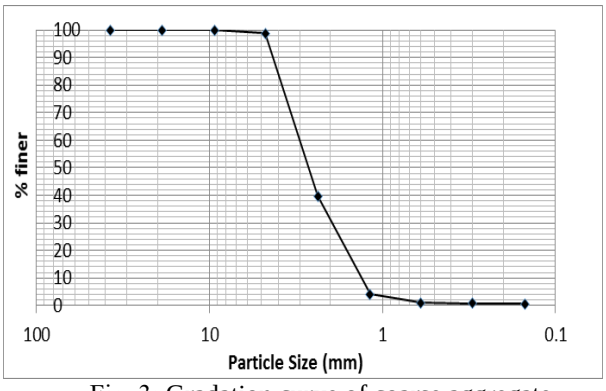

Fig. 3: Gradation curve of coarse aggregate (crushed stone)

RESULTS AND DISCUSSIONS

The graphical representation of the results of concrete cylinder found from concrete testing laboratory is given below. In the figure PFRMC means Polyester Fibre Reinforced Micro concrete.

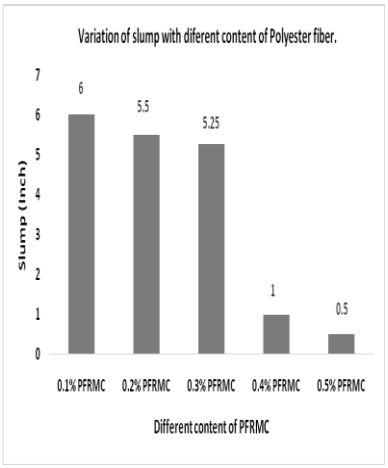

Fig. 4: Slump Vs. fibre content

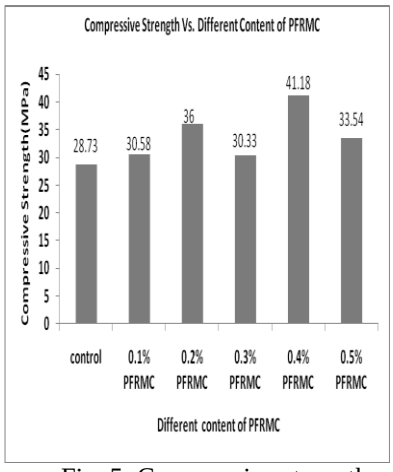

Fig. 5: Compressive strength Vs. Fibre content

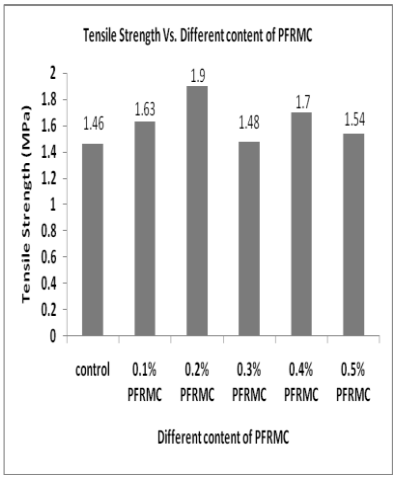

Fig. 6: Tensile strength Vs. fibre content

It was found with the increases of Polyester fibre content the value of slump decreases and after 0.3% Polyester fibre content the amount of concrete slump reduces significantly. Though this property can be improved by using admixture (Superplasticizer) but it can be said fibre content has influence on slump of concrete. On the other hand fibre content and attributes do not have direct influence on compressive strength properties of fibre reinforced concrete but the extent of this effect depend largely on preferential orientation of the fibres which is impracticable to control in such case. In this case for Polyester fibre it was found for different content of fibre the increase of compressive strength don't follow a regular pattern. The maximum increase of compressive strength was 43 percent with respect to control and was found at 0.4 percent Polyester fibre content. On the other hand it was found for different content of polyester fibre the maximum increase of tensile strength is 30.14 percent for 0.2 percent polyester fibre content and at this content the increase of compressive strength was 25.3 percent.

CONCLUSIONS

- From the graphical presentation, it is easily noticed that 0.2% polyester fibre content is the optimum content at which micro concrete will hold sufficient tensile strength along with compressive strength and slump.
- Though at 0.4% fibre content concrete shows more compressive strength but considering slump and tensile strength it was not defined as optimum fibre content.

ACKNOWLEDGMENTS

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