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SHOCK RESISTANCE AND FLEXIBILITY OF STEEL SHAVING FIBER REINFORCED CONCRETE

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1. INTRODUCTION

The purpose of reinforcing cement-bound materials is partly to improve the mechanical properties and partly to obtain a material with reliable properties, particularly when subjected to tensile or impact loads. Plain concrete in tension exhibits a low ultimate stress-strain characteristic and is considered unreliable because microcracks develop quickly into disastrous crevices. Applying steel fiber to reinforce plain concrete produce an improved stress-strain relationship and high flexural toughness. Therefore, when the steel shaving fiber reinforced concrete (FRC) as a cheaper kind of fibers which is obtained from assembly halls was used in laboratory and practical fields, the results showed, excellent resistance against impact effects and cracking phenomenon. And cracking taken the form of microcracks instead of one large disastrous crevice.

2. EXPERIMENTAL PROCESS

Type of concrete which usually uses in concrete pipes or blocks in the reason of using slippery-mould and immediate de-moulding have low water-cement ratio (W/C) and without any workability. Thus such as those products are brittleness. Any shock effects in transportation or careless handling and existence of microcracks due to dry shrinkage are led to all of a sudden failure or disastrous crevices. Therefore in order to eliminate all phenomenon and increase shock resistance, high flexibility, and better resistance against crack growth and propagation, adding steel shaving fiber to concrete of above products were investigated, Fig. 1. The behavior of steel shaving FRC in flexural test under static and impact loading by using 35x15x5 cm beams showed good results comparing with plain concrete Fig. 3 and Fig. 4.

Toughness as the amount of energy necessary to deform a component is an important factor for non-traditional steel reinforced concrete products which is very low for plain concrete. In the reason of absence of impact toughness test method, flexural toughness under static loading by using 45x15x15 cm beams were investigated and steel shaving FRC showed excellent result Fig. 5.

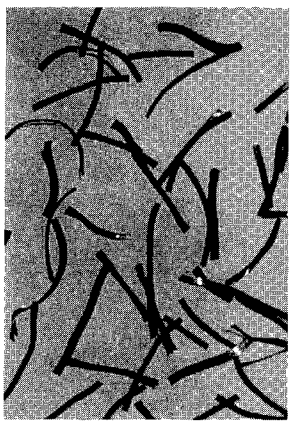

Fig. 1 : Steel shaving fibers

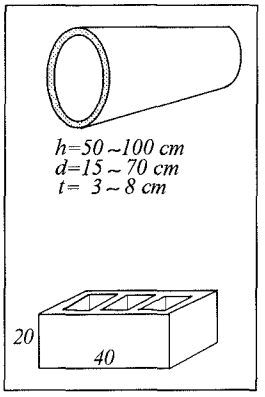

Fig. 2 : Concrete pipes & blocks

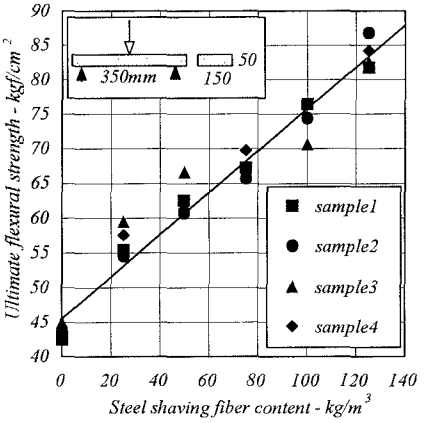

Fig. 3 : Flexural strength

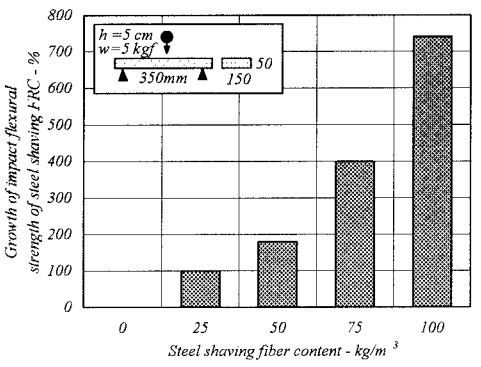

Fig. 4 : Flexural impact strength

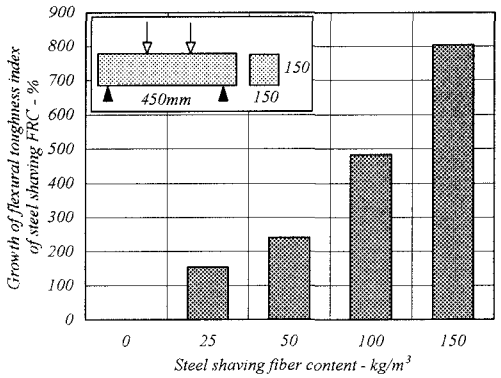

Fig 5 : Flexural toughness index

The size of dry shrinkage cracks were reduced by 260% comparing with plain concrete due to using of steel shaving FRC, Fig. 6. In a such cases fibers are more effective than conventional reinforcement. Because, they are very closely spaced at controlling cracking of the matrix.

Main purpose in using steel shaving FRC were two important factors. The first, steel shaving FRC increases the strength of the composite by transferring loads and stresses across the cracked matrix. The second, and more importantly, fibers increase the toughness of FRC by providing energy absorption mechanisms related to the debonding and pull-out processes of fibers bridging the cracks. By applying experimental results in practical applications in concrete pipes and blocks manufacture workshops by using 50 kg/m^3 steel shaving fiber in more than 90% of products below results after inspection were observed:

-Decreases local damage due to increases shock resistance

-Elimination of all of a sudden failure in transportation cases

-Elimination of crack's propagation in tension zone of concrete pipes subjected to earth pressure due to increasing tensile strength and flexibility.

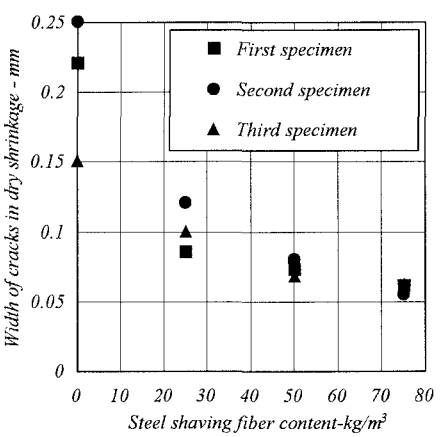

Fig. 6: Size of dry shrinkage cracks

3. CONCLUSION

Experimental and observations of applying steel shaving fiber as recycle material and cheaper one comparing to similar and industrial steel fibers showed below results:

1. Impact resistance of steel shaving FRC by using 100 kg/m^3 comparing to plain concrete about 700% was increased.

2. Flexural toughness of steel shaving FRC as the amount of energy absorption factor in static loading by using 150 kg/m^3 steel shaving fiber more than 800% was increased.

3. Practical inspection and observation of applied steel shaving FRC in concrete pipes and blocks showed more than 90% of damage phenomenon like cracking, all of a sudden failure, crack due to dry shrinkage, local damages in curing, storing and transportation cases were decreased.

4. Because of using mallet or compressing methods for compacting concrete, there was not any difficulties in mixing of steel shaving fiber with low W/C ratio mixtures and with low workability.