

## Effect of Combination Magnetic Aggregates and Steel Fiber on Improving of Mechanical Characteristics of High weight Concrete

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### 1-Introduction

The special concretes are those materials with un-normal characteristics and production process. Steel fibers used in concrete can prevent the crack progressing, and the concrete strengths can be increased, and the fracture mechanism will be positively changed. The steel fiber is effective in increasing flexural and tensile strength with different length to diameter ratio. Many aggregates such as barite, hematite, magnetite, and steel particles or SBR industrial recycles particles are used for the production of heavy concrete.

### 2-Experimental Program

In this paper, the effects of combination and application of steel fibers and heavyweight magnetite aggregates with two different water to cement ratios on fresh and hardened concrete properties were experimentally investigated. Three different amount were considered for replacing magnetite ( $Fe_3O_4$ ) with regular aggregate: 0%, 50%, and 100% and 0.52 and 0.4 water-cement ratios. Also, three different steel fiber ratios (in term of concrete volume) equal 1, 1.5, and 2 % from Italian DUROCEM Company (shown in Figure 1) were added to fresh concrete. Totally 24 concrete design mix with 300 specimens including cubic, cylindrical, and beam for compressive, tensile, flexural, and shear strengths, shown in Figure 2, were used. Therefore mechanical properties of special concrete with magnetic heavyweight aggregates and steel fibers aggregates were investigated.



Fig. 1. Steel fiber used in this research

**Test Setup and Instrumentation.** Loading of compressive specimens was done according to BS1881 and ASTM-C39 Standards. Also, the tensile strength of split specimens was measured based on ASTM-C496 Standard with  $f_t = \frac{2P_{max}}{\pi.D.L}$ . The shear strength tests are done with

specimens with dimensions 400x 150x38 mm according to set-up shown in Figure 3.



Fig. 2. Test specimens

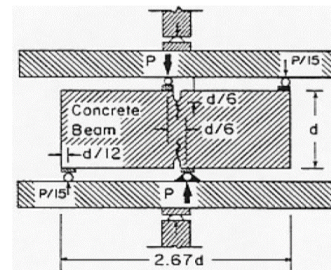


Fig. 3. Shear strength test set-up

### 3- Conclusions

The test results indicated that density and special weight of hardened concrete were not sensitive to w/c ratio, but the steel fiber ratio particularly containing 2% fiber was more effective to increase these amounts up to 44.87%. The results given in Figure 4 showed that the compressive strengths of specimens with 0.52 and 0.4 w/c ratios and fibers volume more than 1.5% were increased up to 78 and 147%, respectively.

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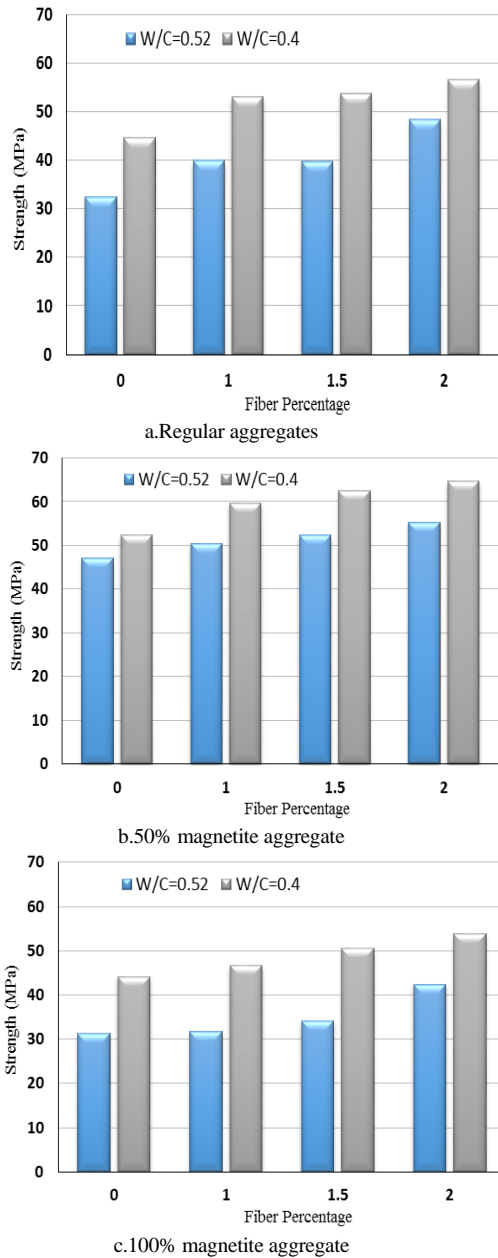


Fig. 4. Compressive strength in term of the kind of aggregate and fiber percentage

Both fiber and magnetite aggregate percentages were effective on amount of tensile splitting strengths, shown in Figure 5. The tensile strengths were increased up to 65, 120, 181 and 223% in specimens with 0, 1, 1.5 and 2% fibers.

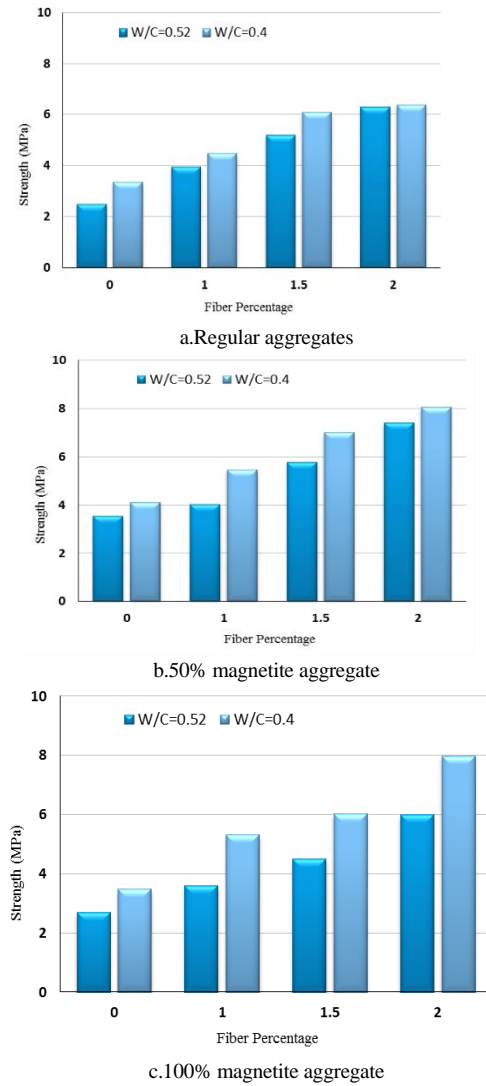


Fig. 5. Tensile strength in term of the kind of aggregate and fiber percentage

Moreover, the test results indicated that more increasing equal 8% in shear strength happened in specimen with half magnetite aggregate and 1.5% fiber and w/c equal 0.52. The specimen without fiber had 18% increasing and specimens with 1 and 2% fiber had 38 and 70% increasing. Specimens with 100% magnetite had the same results in increasing tensile strengths from 52 up to 80%.